

Chapter 5 Construction schedule and Construction Cost Approximation

5.1 Electrical Design

The fundamental concept for calculating the substation cost of Gulshan underground substation and Kawran Bazar underground substation, which have been selected as suitable sites for UGSS based on Chapter 3, is as follows.

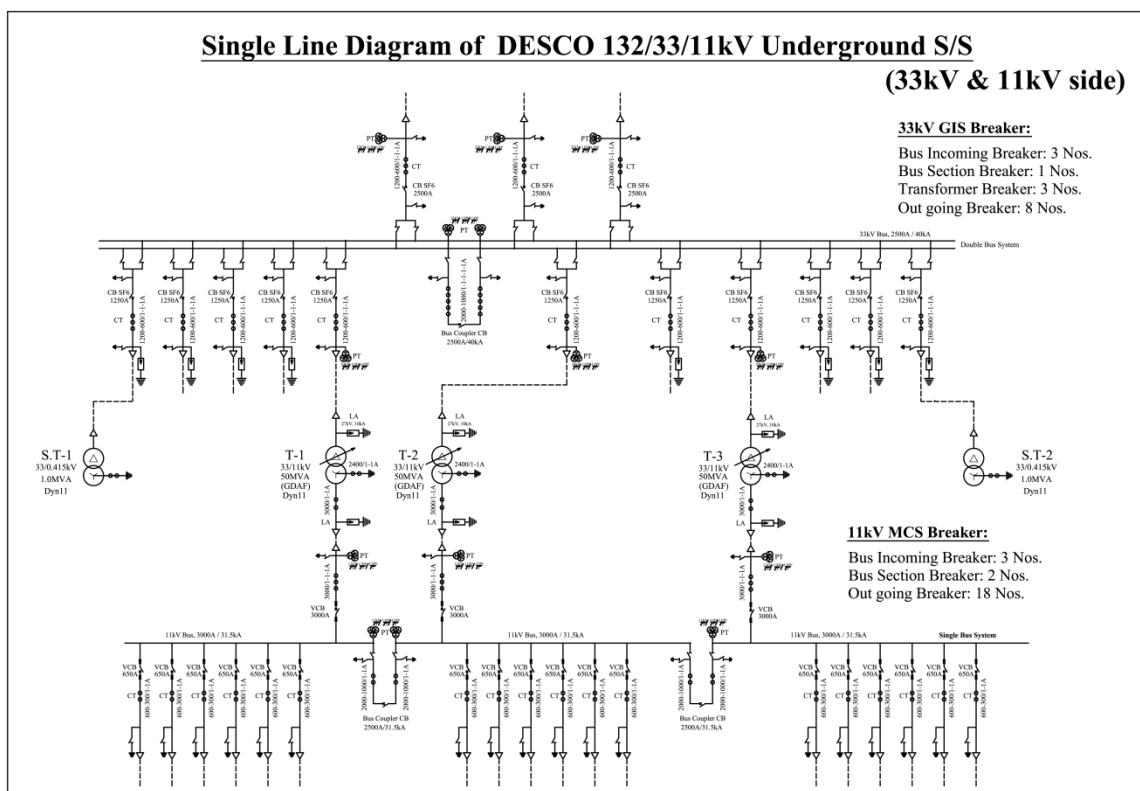
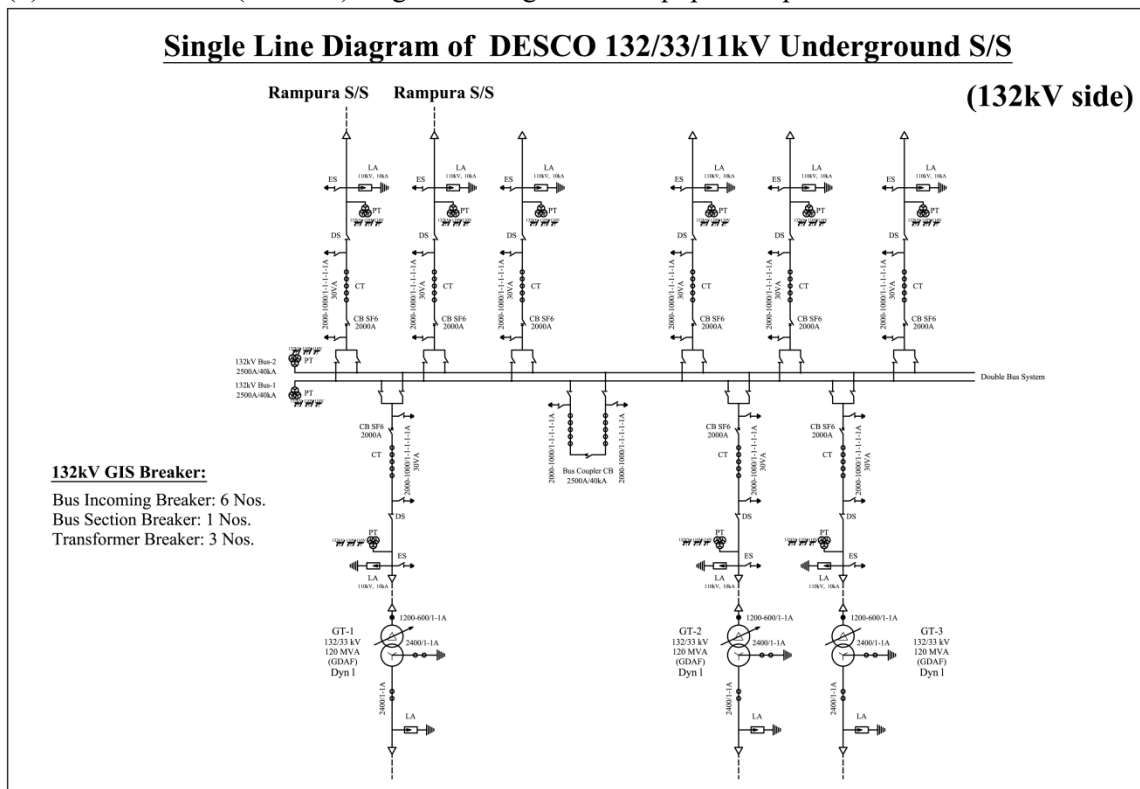
According to the single line diagram of standard specifications from DESCO and DPDC's interviews, the substation equipment and construction cost considered the following points. To reduce the fire hazard risk for the entire building by improving disaster prevention capability, a Japan-Technology Gas Insulated Transformer is installed. Moreover 2-winding transformers, 132/33kV (120MVA), 33/11kV (50MVA) are introduced because only 1 company has been confirmed to be able to supply 3-winding transformers. 3-winding also needs separated grounding transformers, so there is no great reduction in the substation area, and changing the winding type would impact existing substations in the power network from the point of view of earth fault current protection and phase angle. According to interviews with Japanese manufacturers, if the rated short current is 63kA for 132kV GIS switchgear, it will employ the upper grade voltage equipment and will become costly. Thus, a rated short current value of 50kA is employed for this survey through discussion with DESCO. 40kA is used for DPDC, the same as existing ones. 33kV and 11kV switchgears have the same number of feeders as existing ones.

Depending on the confirmed power system plan for both substations, incoming feeders in Kawran Bazar substation will be planned to enable them to get power from two source substations within a few years after the completion of the UGSS, around the same time as Kamrangichar substation operation commencement. Gulshan substation has also been planned to be able to get power from the new 230kV substation after the connection to PGCB's substation. 6 feeders on 132kV GIS will be installed at the time of commencing substation operation for future plans, to avoid duplicating CB expansion work despite the fact that both substations are planned to have an incoming feeder from 1 source substation. In this regard, the scope of 132kV switchgear expansion work at Gulshan's source substation is for 2 incoming feeders at Rumpura substation, and that of Kawran Bazar is for 3 incoming feeders at Dhanmaondi substation at the time of UGSS operation commencement.

In consideration of station power supply for the substation and building equipment required in a UGSS, the station transformers are specified as 33/0.415kV 1,000kVA×2. (Capacity of existing station transformer is 200~500kVA as standard.) Additionally, 11/0.415kV 1,000kVA×1 station transformer for Kawran Bazar substation's upper building is also considered.

The fundamental concept for calculation of the substation cost with the above mentioned specifications is as follows.

(1) Gulshan UGSS (DESCO) single line diagram and equipment specifications



(Source: JICA Survey Team)

Table 5-1 132/33/11kV Gulshan UGSS single line diagram

Table 5-1 132/33/11kV Gulshan UGSS equipment specifications

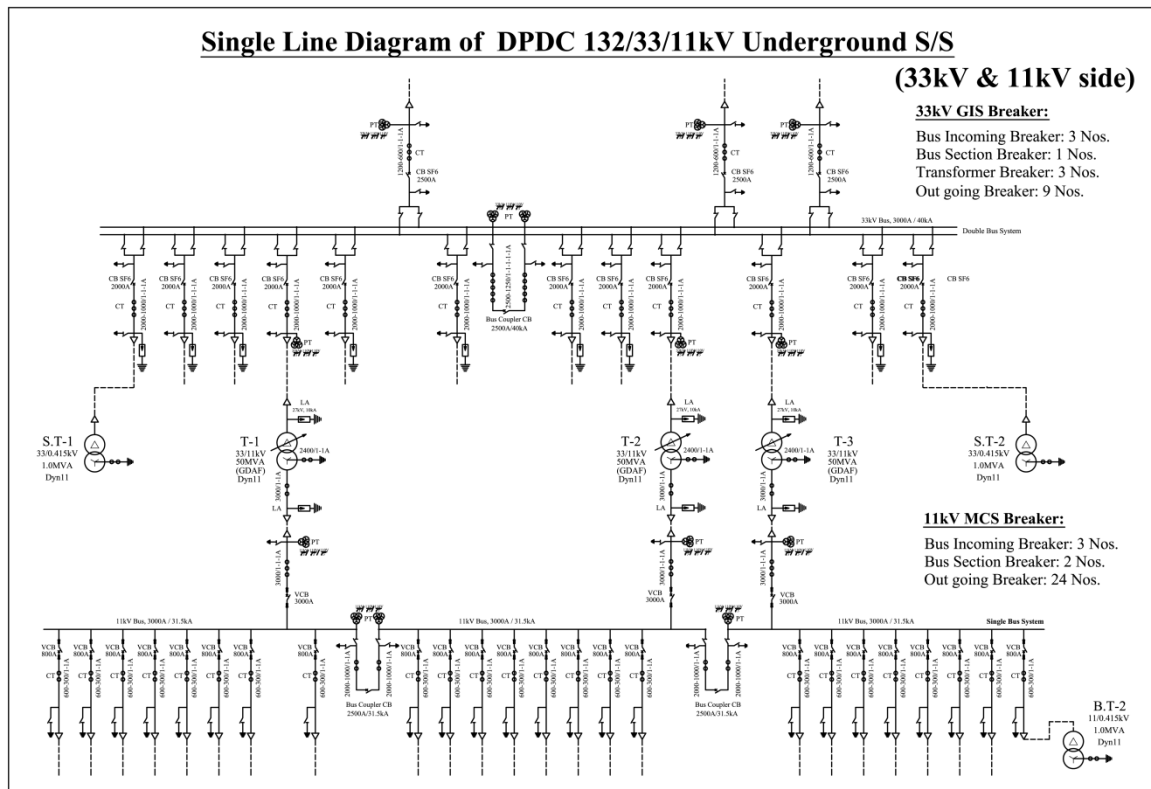
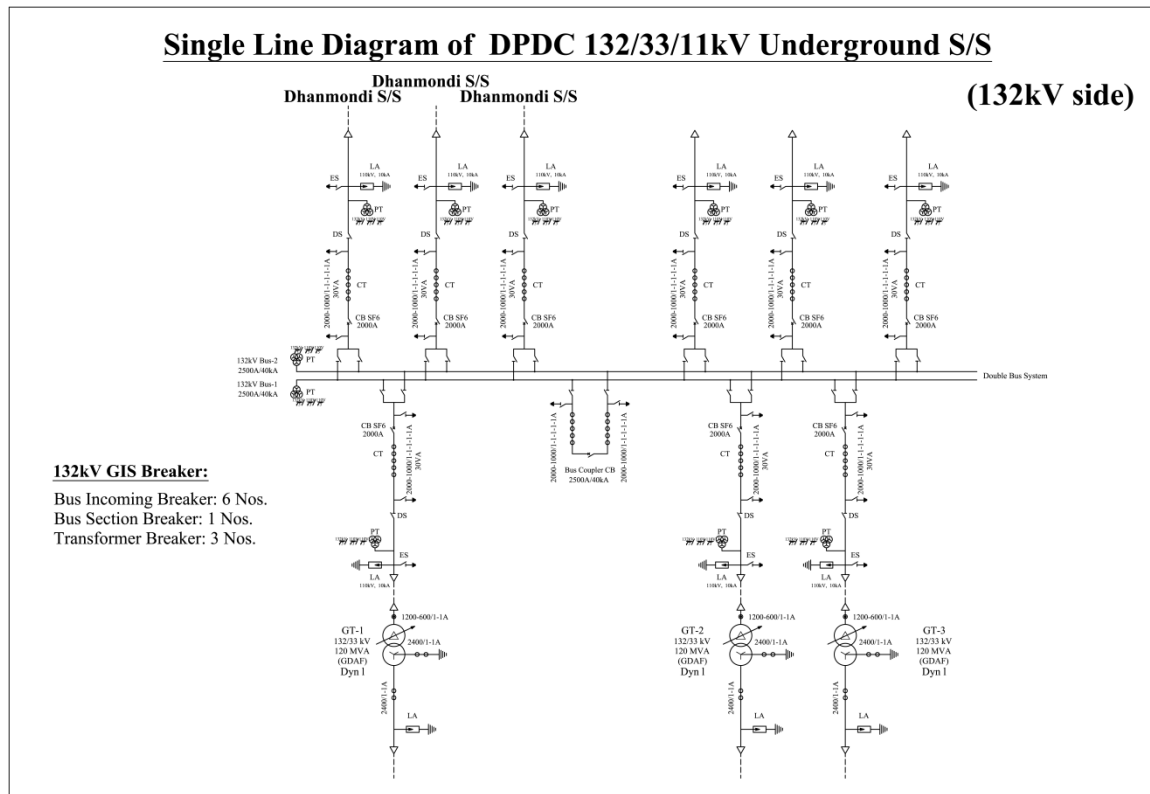
Description		Rated	Quantity
132kV GIS Double Bus	Incoming feeder Inc. line VT	145kV 2,000A / 50kA 3s	5 (2+3 spare)
	Tr feeder Inc. line VT	145kV 2,000A / 50kA 3s	3
	Bus VT		2
	Bus Coupler	145kV 2,500A / 50kA 3s	1
132/33kV Power Tr.		132/33kV 80 /120MVA with on-load tap. Dyn11	3
33/11kV Power Tr.		33/11kV 20/28MVA with on-load tap. Dyn11	3
33/0.4kV Station Tr.		33/0.4kV min. 200kVA*(Existing) * Depending on power consumption for UGS	2 * (Existing)
Description		Rated	Quantity
33kV GIS Double Bus	In com.Tr feeder	36kV 2,500A / 40kA 3s	3
	Tr feeder	36kV 1,250A / 40kA 3s	3
	Outgoing feeder	36kV 1,250A / 40kA 3s	8
	Bus VT		2
	Line VT		3
	Bus Coupler	36kV 2,500A / 40kA 3s	1
11kV MCSWG Single Bus	In com.Tr feeder	12kV 2,000A / 31.5kA 3s	3
	Outgoing feeder	12kV 630A / 31.5kA 3s	18
	Bus VT		3
	Line VT		3
	Bus Coupler	12kV 3,000A / 31.5kA 3s	2

(Source: JICA Survey Team)

** As discussed with DESCO, the rated short current is specified as 50kA.

(Because the rated 63 kA in DESCO's bidding specification is not based on their master plan and employing the upper voltage specification will lead to higher cost.)

(2) Kawran Bazar UGSS (DPDC) single line diagram and equipment specifications



(Source: JICA Survey Team)

Figure 5-1 132/33/11kV Kawran Bazar UGSS single line diagram

Table 5-2 132/33/11kV Kawran Bazar UGSS equipment specifications

Description		Rated	Quantity
132kV GIS Double Bus	Incoming feeder Inc. line VT	145kV 2,000A / 40kA 3s	6 (3+3 spare)
	Tr feeder Inc. line VT	145kV 2,000A / 40kA 3s	3
	Bus VT		2
	Bus Coupler	145kV 2,500A / 40kA 3s	1
132/33kV Power Tr.		132/33kV 120MVA (GDAF) with on-load tap. Dyn11	3
33/11kV Power Tr.		33/11kV 50MVA (GDAF) with on-load tap. Dyn11	3
33/0.4kV Station Tr.		33/0.4kV 1,000kVA* *Depending on power consumption for UGS	2
11/0.4kV Building Tr.		11/0.4kV 1,000kVA* *Depending on power consumption for Building	1
33kV GIS Double Bus	In com.Tr feeder Inc. line VT	36kV 2,500A / 40kA 3s	3
	Tr feeder Inc. line VT	36kV 1,250A / 40kA 3s	3
	Outgoing feeder	36kV 1,250A / 40kA 3s	9
	Bus VT	$33/\sqrt{3} / 0.11/\sqrt{3} / 0.11/\sqrt{3}$	2
	Bus Coupler	36kV 2,500A / 40kA 3s	1

Description		Rated	Quantity
11kV MCSWG Single Bus	In com.Tr feeder Inc. line VT	12kV 3,000A / 31.5kA 3s	3
	Outgoing feeder	12kV 800A / 31.5kA 3s	24
	Bus VT	$11/\sqrt{3} / 0.11/\sqrt{3} / 0.11/\sqrt{3}$	3
	Bus Sectionalizer	12kV 2,500A / 31.5kA 3s	2

(Source: JICA Survey Team)

(3) Fundamental concept for estimation of substation cost

The estimation for UGSS equipment and construction cost is as follows.

- The UGSS cost is calculated according to the above single line diagram and equipment specifications.
- Cost records for main equipment such as transformer, GIS, metal-clad switchgear, power cable and relay panels etc. are referred to from the breakdown of outdoor substation construction costs in recent years, according to DPDC and DESCO.
- Domestic transportation fees, device installation fees, spare parts, etc. are calculated from cost records by DPDC and DESCO.
- Reference cost for main transformer (gas insulated) and 50kA rated short current of 132kV GIS from domestic manufacturer are estimated.
- Design, fabrication, test and marine transportation fees are estimated in the Foreign portion. Domestic transportation, installation fees and spare parts, etc. are estimated in the Local portion.
- Estimated cost is in JPY, and the exchange rate is as follows

1USD = 108.2 JPY, 1BDT = 1.38 JPY

Table 5-3 132/33/11kV Gulshan UGSS cost (except for civil and building work)

Schedule No.	Description	Design, manufacture, factory testing, carrying and handling up to the site		Installation and Other Services
		Eq. Price Foreign (JPY)	Local Transp. Local (JPY)	Local (JPY)
1	Electrical equipment works	3,396,428,000	67,004,000	216,805,000
	Total	3,396,428,000		283,809,000
				3,680,237,000

(Source: JICA Survey Team)

Table 5-4 Source substation of 132/33/11kV Gulshan 132kV switchgear expansion work cost

Schedule No.	Description	Design, manufacture, factory testing, carrying and handling up to the site		Installation and Other Services
		Eq. Price Foreign (JPY)	Local Transp. Local (JPY)	Local (JPY)
1	Electrical equipment works	111,357,000	2,228,000	6,578,000
2	Civil & Building works			9,400,000
Total		111,357,000	2,228,000	15,978,000
				18,206,000
				129,563,000

(Source: JICA Survey Team)

Table 5-5 132/33/11kV Kawran Bazar UGSS cost (except for civil and building work)

Schedule No.	Description	Design, manufacture, factory testing, carrying and handling up to the site		Installation and Other Services
		Eq. Price Foreign (JPY)	Local Transp. Local (JPY)	Local (JPY)
1	Electrical equipment works	3,344,988,000	65,254,000	202,450,000
Total		3,344,988,000		267,704,000
				3,612,692,000

(Source: JICA Survey Team)

Table 5-6 Source substation of 132/33/11kV Kawran Bazar 132kV switchgear expansion work cost

Schedule No.	Description	Design, manufacture, factory testing, carrying and handling up to the site		Installation and Other Services
		Eq. Price Foreign (JPY)	Local Transp. Local (JPY)	Local (JPY)
1	Electrical equipment works	165,036,000	3,301,000	12,799,000
2	Civil & Building works			14,100,000
Total		165,036,000	3,301,000	26,899,000
				30,200,000
				195,236,000

(Source: JICA Survey Team)

5.2 T&D Facility Design

In this section, we describe the construction costs for T&D lines. The following table shows the number of T&D cables and construction costs for T&D cable. These data were obtained via site investigation.

Table 5-7 Number of T&D Cables

Voltage [kV]	Number of circuits [cct]	
	Gulshan	Kawran Bazar
132	2	3
33	9	9
11	18	18

Table 5-8 Construction Costs for T&D Cable

Voltage [kV]	Cable cost [BDT/km]	Installation cost [BDT/km]	Road cutting cost [BDT/m3]	
132 (3x1cx800 sqmm Cu)	48,000,000	11,265,616	5,500 (Dry season)	8,250 (Rainy season) May to Sep
33 (3x1cx500 sqmm Cu)	24,414,960	3,600,000		
11 (3cx300 sqmm Cu)	12,368,526	2,500,000		

The road cutting cost is a charge which is paid to the city cooperative. We estimate the construction cost for the underground transmission lines (132kV), their length being from UGSS to source substation. We also estimate the construction cost for the underground distribution lines (33, 11kV), their length being from UGSS to power pole (800m).

The following table shows the construction costs for the cable tunnel and lake crossing (Gulshan SS – Rampura SS). These are based on costs in Japan.

Table 5-9 Construction Costs for Tunnel and Lake Crossing

Tunnel Cost [USD/m]	Lake Crossing [USD/m]
3,250	3,900

5.3 Design of Earth and Structure Work (including Removal Work)

Schedule and costs for temporary earth work are calculated via the cycle times for each construction procedure under local conditions. Import and export of materials and equipment to/from the site are limited to during the night due to traffic congestion on neighboring roads. The cost of construction was calculated via, as far as possible, aggregating each item of work together with the anticipated risks by investigating market prices of materials and construction costs.

Estimated costs for the transformer substation under the ground are based on interviews with BTI about each construction item.

In addition, as a result of the interviews, we found that a few local unit prices for underground items were remarkably far from our assumptions, prorated via the ratio of underground and above-ground unit prices in similar Japanese cases. This is due to the difficulty of estimation with no proper local experience.

These unit prices are shown below.

5.4 Architectural Design (including removal of buildings)

Cost estimates for each item for the construction of the underground substation were calculated based on the outcomes of the interviews conducted with BTI. After the interviews, there were costs for underground construction which disproportionally differed from the expected costs. It is difficult to make proper calculations as local track records are scarce. Thus, compared with similar cases of actual costs recorded in Japan, the local cost estimation was drawn up based on the ratios of underground and above-ground unit prices. The calculated prices are shown in the following table.

Table 5-10 Unit Prices for Construction Costs

	RC		SRC	
	Unit Price (Taka/ft ²)	Unit Price (yen/m ²)	Unit Price (Taka/ft ²)	Unit Price (yen/m ²)
Underground	5,104	74,173	6,496	94,398
Above-ground	6,107	93,250	7,234	105,125

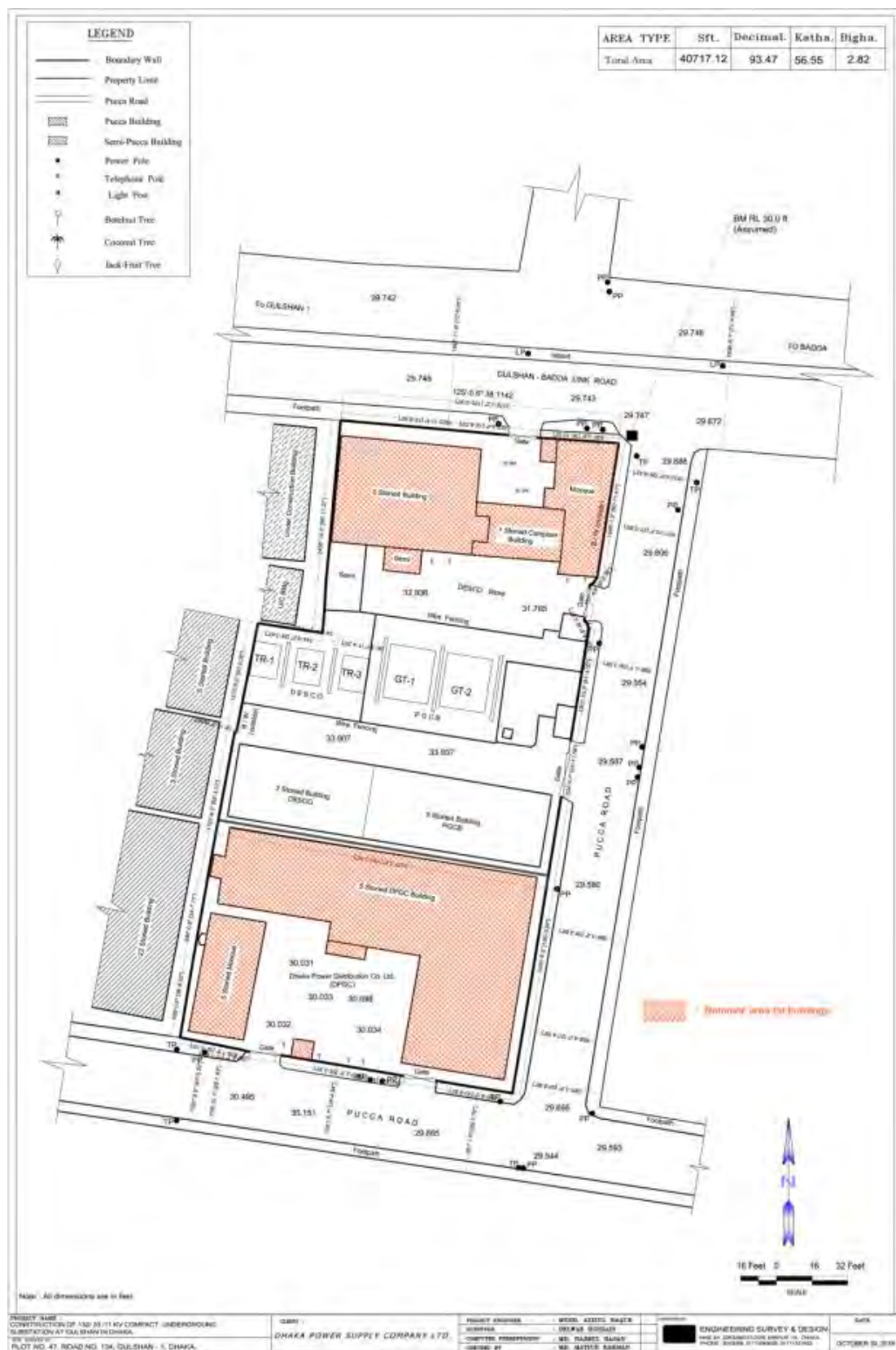
The estimated total costs for the ground section and the underground section for the two proposed sites are shown in the following table, based on unit prices in the previous table.

Table 5-11 Unit Prices for Construction Costs

Building data			Gulshan (F13+B4) (DPDC Building side area)		Kawranbazar (F13+B4) (Site expansion)	
			RC	SRC	RC	SRC
Ground section total floor space (nf)	Substation space		339.75	339.75	404.22	404.22
	service space		13,995.48	13,995.48	18,696.03	18,696.03
Underground total floor space (nf)			4,411	4,411	5,985	5,985
Ground section total cost	Substation space	(JPY)	31,681,719	35,716,237	37,693,552	42,493,649
		(MUSD)	0.299	0.337	0.356	0.401
	service space	(JPY)	1,305,079,790	1,471,275,572	1,743,406,507	1,965,421,139
		(MUSD)	12.330	13.900	16.471	18.568
Underground total cost	(JPY)		327,166,898	416,373,413	443,927,661	564,970,590
	(MUSD)		3.091	3.934	4.194	5.337
Substation buinding total cost	(JPY)		358,848,616	452,089,650	481,621,212	607,464,239
	(MUSD)		3.390	4.271	4.550	5.739

The removal costs for the Gulshan UGSS (DESCO) and Kawran Bazar UGSS (DPDC) projects, required to acquire the space for each UGSS construction, are estimated as follows. However, the estimation costs are calculated based on data for removal work in Japan; the building volumes can be confirmed by land survey drawings.

- The cost for building removal work is calculated based on records in Tokyo area
- The cost for existing substation removal work is calculated via records for substation removal work (10MVx3 Transformers, 3 units of GIS, 18 feeders' distribution switchgear, 660m2 total floor area for building)



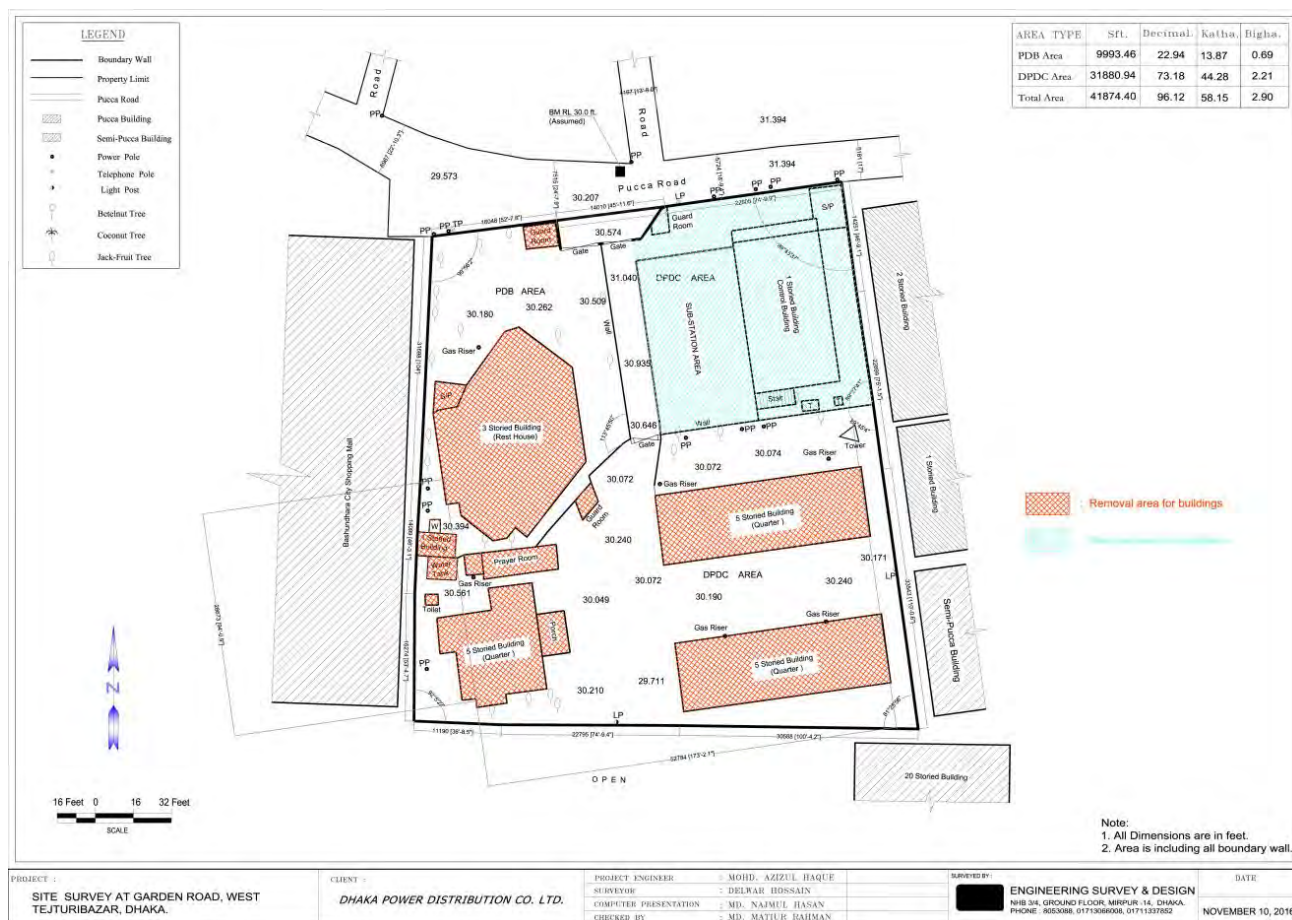


Figure 5-3 Kawaran Bazar UGSS removal work area

Table 5-12 UGSS removal work cost

Place	Target	Estimated cost
Gulshan UGSS		328,000,000
	DPDC building removal work	262,000,000
	DESCO building removal work	66,000,000
Kawaran Bazar UGSS		409,530,000
	DPDC building removal work	190,000,000
	Substaion removal work	152,530,000
	PDB building removal work	67,000,000

5.5 Project Implementation Schedule and Estimation of Project Cost

(1) Project Implementation Schedule

The project implementation schedule is expected to be as follows:

- L/A signing: June 2017
- Procurement of consultant: June 2017 – May 2018
- Detailed Design: June 2018 - June 2019
- Procurement for construction work: June 2019 - September 2020
- Construction of substations: September 2020 - September 2023
- Defect notification period: October 2023 - September 2024
- Project completion: September 2023
- Definition of project completion: Commencement of Substation Commercial Operation

Procurement of consultant assumes the QBS method and the period is expected to be 11 months. The QBS method is chosen because the process of construction for new substations without interrupting the operation of existing substations requires special safety measures. As an underground substation needs a sophisticated design with attention paid to the constraints of the site area, the detailed design period is assumed to be 13 months, a longer period than usual.

Table 5-13 Project Implementation Schedule

	2017				2018				2019				2020				2021				2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Signing of Loan Agreement																																
Selection of Consulting Firm																																
Detail Design																																
Selection of Contractors																																
Construction																																
Defect Notification Period																																

Source: JICA Survey Team

(2) Estimation of Project Cost

For the estimation of the project cost, the following conditions are assumed:

- Project cost consists of construction work for substations (Gulshan and Kawran Bazar), consulting services, physical contingency, price escalation, tax, interest during construction (IDC), and Front End Fee (FEF).
- The construction work for substations consists of substation equipment, transmission and distribution equipment, civil and construction work, and demolition. It does not include the construction cost for the superstructure.
- The scope of consulting services is mainly detailed design and construction supervision (for detailed information on consulting services, see Section 8.3).
- The date of the cost estimation is January 2017. The exchange rates are JPY 108.20/USD and JPY 1.38/BDT.
- Physical contingency is assumed at 5% of the base cost.
- Price escalation is 1.6% p.a. for foreign currency portion and 10.1% p.a. for local currency portion.
- Taxes and duties on import items are estimated at 56% (based on interviews at DESCO and DPDC). VAT is 6% for local currency portion of construction and equipment contracts and 15% of consulting services. Corporate income tax is 7% for construction and equipment contracts and 12% of consulting services.

- In the case that JICA finances the project with an ODA loan, construction work, consulting services, physical contingency, and price escalation are considered the eligible portion. IDC, FEF, and tax are regarded as the non-eligible portion.
- IDC is assumed at 0.7% p.a. for substation construction and 0.01% p.a. for consulting services.
- FEF is assumed at 0.2% of the loan amount.

Based on the above conditions, the detailed estimation of project cost is as follows:

Table 5-14 Estimation of Project Cost (Gulshan Substation)

Breakdown of Cost	Foreign Currency Portion (million JPY)			Local Currency Portion (million BDT)			Total (million JPY)		
	Total	JICA Portion	Others	Total	JICA Portion	Others	Total	JICA Portion	Others
Gulshan SS (Lot 1)	591	591	0	923	923	0	1,865	1,865	0
Gulshan SS (Lot 2)	4,462	4,462	0	539	539	0	5,206	5,206	0
Gulshan SS (Lot 3)	0	0	0	238	0	238	328	0	328
Dispute Board	18	18	0	0	0	0	18	18	0
Civil Works Sub Total	5,070	5,070	0	1,700	1,463	238	7,417	7,089	328
Price Escalation	393	393	0	925	845	80	1,669	1,559	110
Physical Contingency	272	272	0	131	115	16	453	431	22
Consulting Services	726	726	0	280	280	0	1,113	1,113	0
Land Acquisition	0	0	0	0	0	0	0	0	0
Administration Cost	0	0	0	154	0	154	212	0	212
VAT (Contractor & Consultant)	0	0	0	286	0	286	395	0	395
Import Tax	0	0	0	2,317	0	2,317	3,197	0	3,197
Corporate Tax	0	0	0	0	0	0	0	0	0
Income Tax (Contractor)	0	0	0	482	0	482	482	0	482
Income Tax (Consultant)	0	0	0	97	0	97	97	0	97
Interest during Construction	142	0	142	0	0	0	142	0	142
Front End Fee	20	0	20	0	0	0	20	0	20
Total	6,624	6,461	162	6,372	2,703	3,669	15,197	10,192	5,005

Source: JICA Survey Team

Table 5-15 Estimation of Project Cost (Kawran Bazar Substation)

Breakdown of Cost	Foreign Currency Portion (million JPY)			Local Currency Portion (million BDT)			Total (million JPY)		
	Total	JICA Portion	Others	Total	JICA Portion	Others	Total	JICA Portion	Others
Kawranbazar SS (Lot 1)	691	691	0	1,004	1,004	0	2,077	2,077	0
Kawranbazar SS (Lot 2)	4,370	4,370	0	428	428	0	4,961	4,961	0
Kawranbazar SS (Lot 3)	0	0	0	297	0	297	409	0	409
Dispute Board	18	18	0	0	0	0	18	18	0
Civil Works Sub Total	5,079	5,079	0	1,730	1,433	297	7,466	7,056	409
Price Escalation	393	393	0	992	818	174	1,761	1,521	240
Physical Contingency	272	272	0	136	112	24	460	427	32
Consulting Services	726	726	0	280	280	0	1,113	1,113	0
Land Acquisition	0	0	0	0	0	0	0	0	0
Administration Cost	0	0	0	156	0	156	215	0	215
VAT (Contractor & Consultant)	0	0	0	292	0	292	403	0	403
Import Tax	0	0	0	2,321	0	2,321	3,202	0	3,202
Corporate Tax	0	0	0	0	0	0	0	0	0
Income Tax (Contractor)	0	0	0	490	0	490	490	0	490
Income Tax (Consultant)	0	0	0	97	0	97	97	0	97
Interest during Construction	142	0	142	0	0	0	142	0	142
Front End Fee	20	0	20	0	0	0	20	0	20
Total	6,633	6,470	162	6,492	2,643	3,849	15,369	10,118	5,251

Source: JICA Survey Team

Chapter 6 Environmental and Social Considerations

6.1 Present Natural Environment and Social Conditions in Dhaka

Data and information collected through literature survey are presented in this section.

6.1.1 Physical Environment

The baseline condition of physical environment of the study area is given as follows.

6.1.1.1 Geology & Topography

Dhaka Division lies on the southern edge of a Pleistocene terrace, the Madhupur Tract and the Holocene floodplain deposits from the aquifers. Two geographical characteristics cover the city and surroundings: Madhupur Clay of the Pleistocene age and alluvial deposits of recent age. It is largely in one piece with seven small outliers.

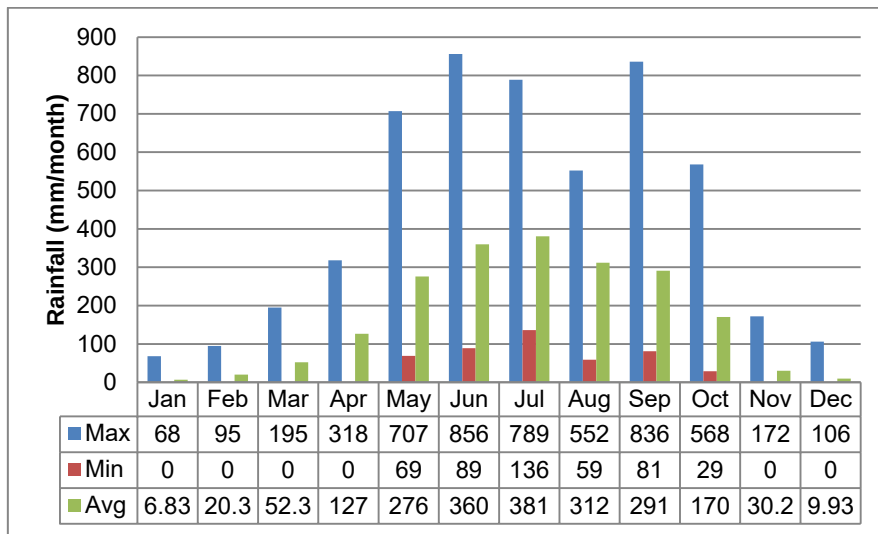
The Dupi Tila sands aquifer is the main source of water of the area. Madhupur Clay overlies the aquifer with a thickness of 8 to 45 m (avg. 10 m). The aquifer varies in thickness from 100 to 200 m (avg. 140 m). Ground water table lies at a depth of 15 to 20 m. Under the present condition, the peripheral rivers act as sources of recharge as the Dupi Tila sands are exposed along the riverbeds. Other sources of recharge are vertical percolation of rain and flood water, leakage from water bodies and the sewer system and seepage from the standing water bodies within the area.

The Pleistocene terrace of Dhaka is 1–10 m above the adjacent floodplains. The areas surrounding the city are mostly flat alluvial plain. The city is encircled by six rivers and canals. The Turag, Buriganga, and Dhaleswari rivers are located on the western side, while the Balu and Lakhya rivers are situated to the east. Tongi Khal, a manmade canal, connects the Turag and Balu rivers to complete the encirclement.

6.1.1.2 Meteorology

Rainfall

The following figure is obtained through the analysis of sixty years of rainfall data taken at the BMD Station of Dhaka from 1953 to 2013. It shows monthly maximum, minimum and average rainfall of Dhaka. The highest maximum monthly rainfall is recorded 856 mm. The average monthly rainfall is 136 mm. Less rainfall is observed from November to February.

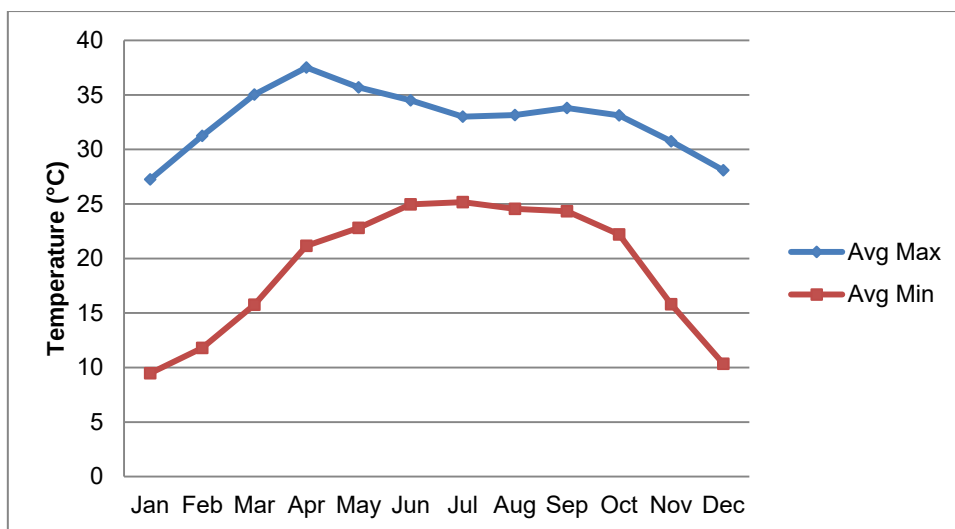


Source: Bangladesh Meteorological Department (BMD), Dhaka

Figure 6-1 **Monthly Rainfall of Dhaka BMD Station (1953-2013)**

Temperature

The following figure shows the average monthly maximum and minimum temperature at Dhaka BMD station from 1953 to 2013. It shows the highest maximum temperature in the month of April during pre-monsoon (March- May) period. From November to February lower temperature is recorded than the rest period. The highest maximum temperature is 37.5°C and the lowest is 9.5°C in the last 60 years.

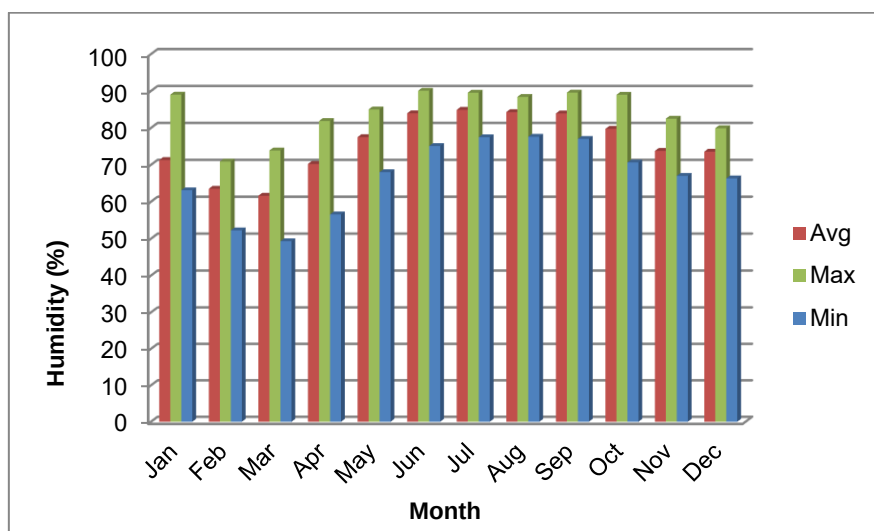


Source: Bangladesh Meteorological Department (BMD), Dhaka

Figure 6-2 **Monthly Temperature of Dhaka BMD Station (1953-2013)**

Humidity

The following figure shows sixty years' monthly relative maximum, minimum and average humidity of Dhaka BMD station (1953-2013). From June to September it is the most humid in the City where less humidity is observed from February to April.

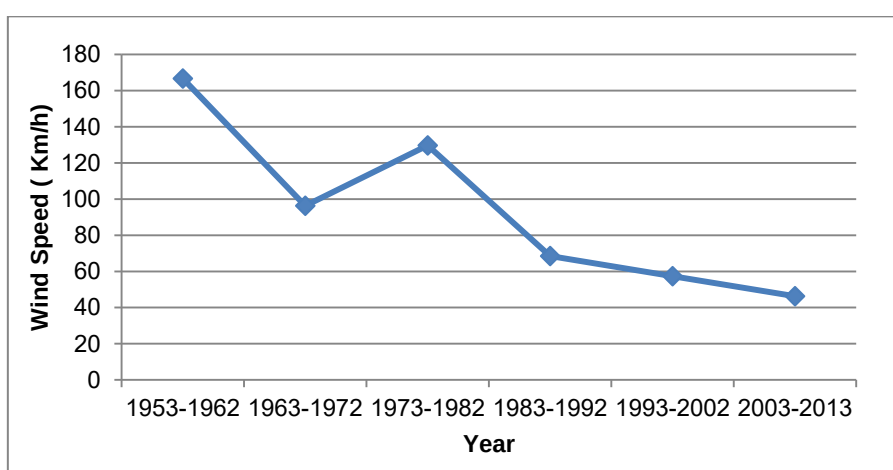


Source: Bangladesh Meteorological Department (BMD), Dhaka

Figure 6-3 Monthly Relative Humidity of Dhaka BMD Station (1953-2013)

Wind Speed

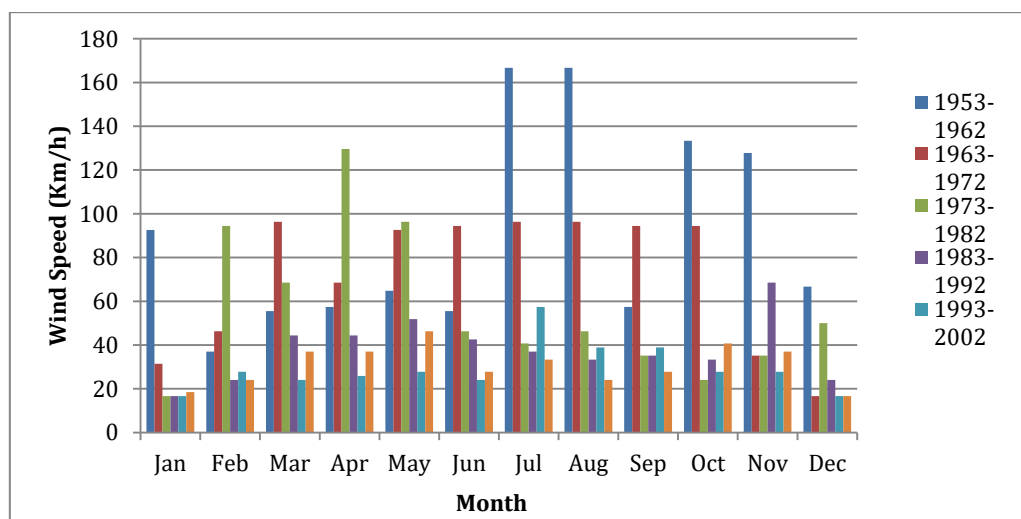
The wind speed data are collected from Dhaka BMD station. The sixty years (1953-2013) data of yearly maximum wind speed are analyzed and presented as maximum decadal wind speed in the figure below. The trend line shows negative slope which means high wind are not encountered in last three decades compared to the previous decades.



Source: Bangladesh Meteorological Department (BMD), Dhaka

Figure 6-4 Yearly Maximum Wind Speed of Dhaka BMD Station (1953-2013)

The monthly distribution of high winds over the years is shown in the following figure.



Source: Bangladesh Meteorological Department (BMD), Dhaka

Figure 6-5 Monthly Maximum Wind Speed of Dhaka BMD Station (1953-2013)

6.1.1.3 Ambient Air

The following table shows the air quality standards for Bangladesh and that of IFC.

Table 6-1 National Ambient Air Quality Standards for Bangladesh and IFC

Pollutant	Value for Bangladesh	Duration	IFC Standard
CO	10 mg/m ³ (9 ppm)	8 hours	N/A
	40 mg/m ³ (35 ppm)	1 hour	N/A
NO _x	100 µg/m ³ .(0.053 ppm)	Annual	40 µg/m ³
PM ₁₀	50 µg/m ³	Annual	70 µg/m ³
	150 µg/m ³	24 hours	150 µg/m ³
PM _{2.5}	15 µg/m ³	1 hour	35 µg/m ³
	65 µg/m ³	24 hours	75 µg/m ³
O ₃	235 µg/m ³ (0.12ppm)	1 hour	N/A
	157 µg/m ³ (0.08 ppm)	8 hours	160 µg/m ³
SO ₂	80 µg/m ³ (0.03 ppm)	Annual	N/A
	365 µg/m ³ (0.14 ppm)	24 hours	125 µg/m ³

Source: Environmental Conservation Rules 1997, IFC Standard

Note: CO, NO_x, PM, O₃ and SO₂ mean carbon oxygen, oxides of nitrogen, particulate matters, ozone and Sulphur dioxide respectively.

6.1.1.4 Ambient noise

The standard values for noise as per Environmental Quality Standards (EQS) of Bangladesh is shown in the following table.

Table 6-2 Standard value (dBa)

Category	Categories	Standard value (dBa)	
		Day	Night
A	Quiet places (hospitals, education institutions, etc.)	45	35
B	Areas which are used mainly for residential purposes	50	40
C	Areas which are used for residential and commercial purposes	60	50
D	Commercial	70	60
E	Industry	75	70

Source: Environmental Conservation Rules, 1997

6.1.1.5 Drainage

Drainage system of Dhaka is not adequate for preventing water logging at many places inside the city. With heavy rainfalls for a couple of hours, water logging occurs and it takes hours or even a few days to pass water through the existing drainage system. The drainage pattern of the study area is similar to urban drainage pattern. As open ground is scarce, infiltration and percolation are very low. Excess runoff is mostly carried by underground pipe network to the nearest khal or lakes. The storm drains are poorly maintained for which drainage congestion occurs in rainy season.

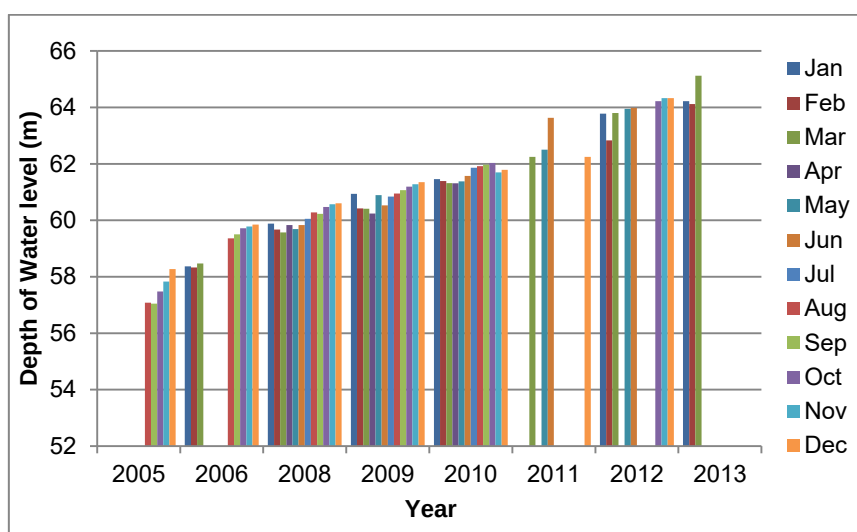
Bangladesh Water Development Board (BWDB) constructed a pumping station (capacity 22 m³/s) at the northwestern part (Goran Chadbari at the outfall of the Degun khal into the Turag River) of the city. There are also 65 small pumps with individual capacities of 0.142 cusec, installed temporarily by Dhaka-WASA to drain out storm water from various locations. Dhaka City Corporation also constructed and maintains at least 130-km long small diameter underground drains and around 1,200 km surface drain. They carry storm water to the main sewer lines.

6.1.1.6 Water Quality

1) Level of groundwater

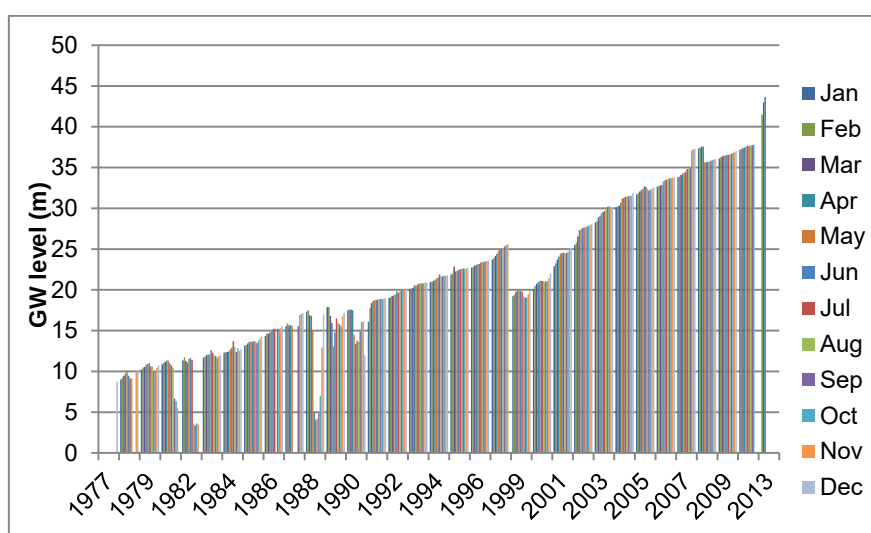
Groundwater has been used for water supply since the creation of the city, on which Dhaka city has been heavily dependent. There are total of 644 deep tube wells (2012-2013) in operation in Dhaka city area. The upper aquifers have already been existed and presently water table in the deeper aquifers declining considerably. Total water connection in Dhaka were 325,717 in 2012-2013 through a pipeline of 3,040 km. Impact of abstraction from deeper aquifer (>200m) is now being monitored.

The groundwater depth of Badda area in DESCO Area from 2005 to 2013 is shown in Figure 6-6. and that of Mohammadpur (DPDC Area) is plotted from 1977 to 2013 in Figure 6-7. The two figures both show the same trend of groundwater table: groundwater is now available at higher depth than the past.



Source: Bangladesh Agricultural Development Corporation (BADC)

Figure 6-6 Ground Water Depth of Badda (2005-2013)



Source: Bangladesh Agricultural Development Corporation (BADC)

Figure 6-7 Ground Water Depth of Mohammadpur (1977-2013)

2) Groundwater quality

Groundwater quality data of two locations in Dhaka are collected by BWDB as presented in Table 6-3.

Table 6-3 Ground water quality parameters

Parameters	Water quality		Unit	DPHE Standards
	Mohammadpur (137 m)	Motijheel (121 m)		
Bicarbonate	106.2	95.2	mg/l	-
Calcium	31.7	30.5	mg/l	75
Carbonate	3.7	1.6	mg/l	-
Chloride	23.9	10.2	mg/l	150-600
CO ₂	24.1	49.8	mg/l	-
EC	380.0	225.0	μS/cm	-
Fluoride	0.2	0.3	mg/l	1
Hardness	112.5	115.4	mg/l	200-500
Iron	0.5	6.2	mg/l	0.3-1.0
Magnesium	21.5	25.5	mg/l	30-35
Manganese	0.0	0.1	mg/l	0.1
Nitrate	3.5	1.1	mg/l	10
pH	7.0	7.2	-	-

Source: Bangladesh Water Development Board (BWDB)

6.1.1.7 Land Use

The gross area of DESCO circle is 23,440 ha, of which net cultivable area shares 3,473 ha (15% of gross area). That of DPDC area is 18,573 ha. Its net cultivable area occupies 2,277 ha, 12% out of its gross area. Detailed land use of the study areas are presented in the tables and maps below.

Table 6-4 Detailed Land Use of DESCO Study Area

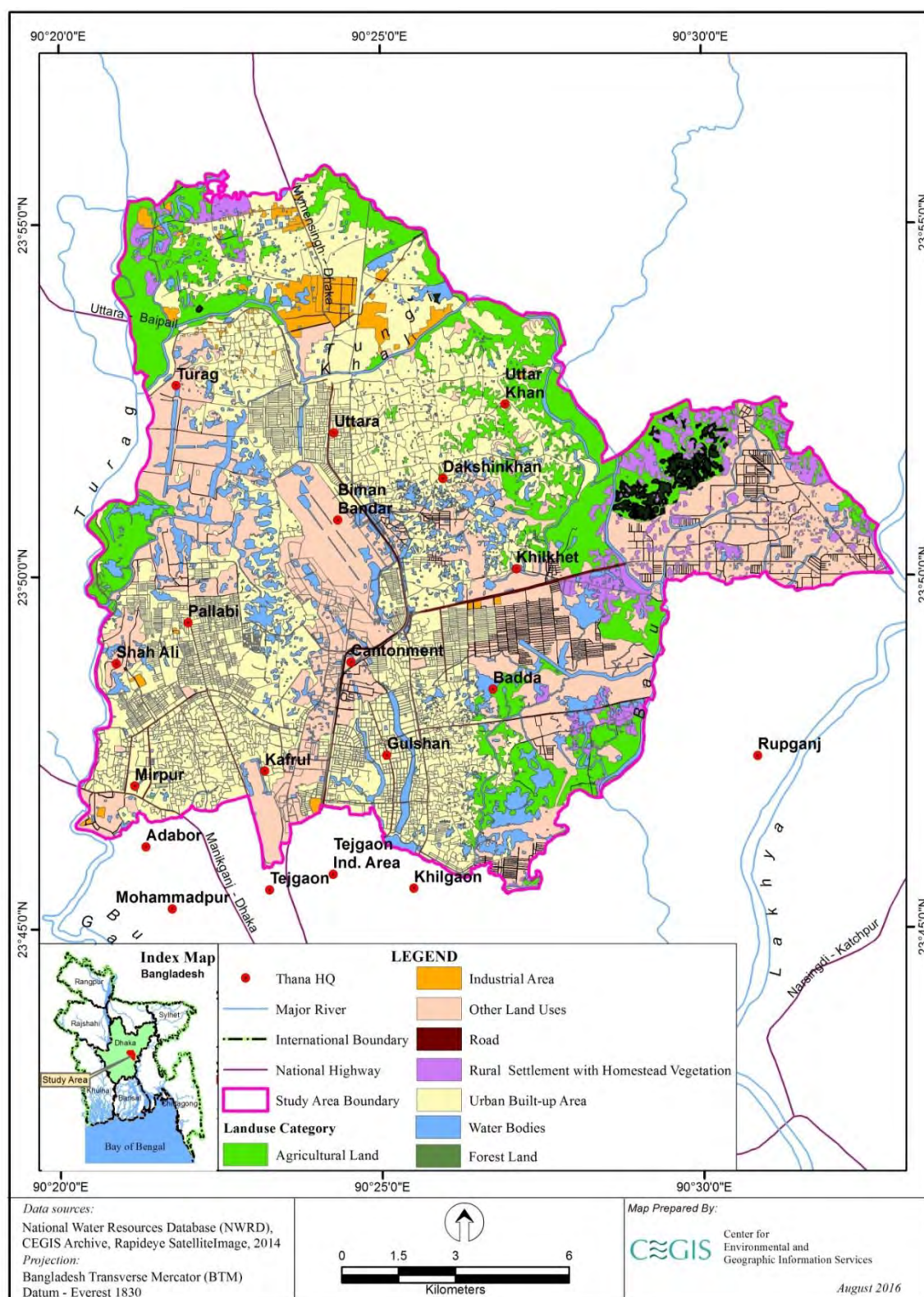
Land Use Class 1	Land Use Class 2	Area (ha)	%
Agricultural Land (NCA)	Agricultural Land (NCA)	3,473	15
Waterbodies	Beel	24	0
	Canal	281	1
	Ditch	1,336	6
	Seasonal Waterbody	47	0
	Lake	349	1
	Pond	233	1
	River	209	1
Rural Settlement with Homestead Vegetation	Rural Settlement with Homestead Vegetation	864	4
Road	Road	994	4
Other Land Use	Area under development	4,126	18
	Brick Field	13	
	Important Places	1,861	8
Urban Built-up Area	Urban Built-up Area	8,989	38
Industrial Area	Industrial Area	468	2
Forest Area	Forest Area	173	1
	Total	23,440	100

Source: Rapideye Satellite Image, 2014 and JICA Survey Team (CEGIS team field survey, August, 2016)

Table 6-5 Detailed Land Use of the DPDC Study Area

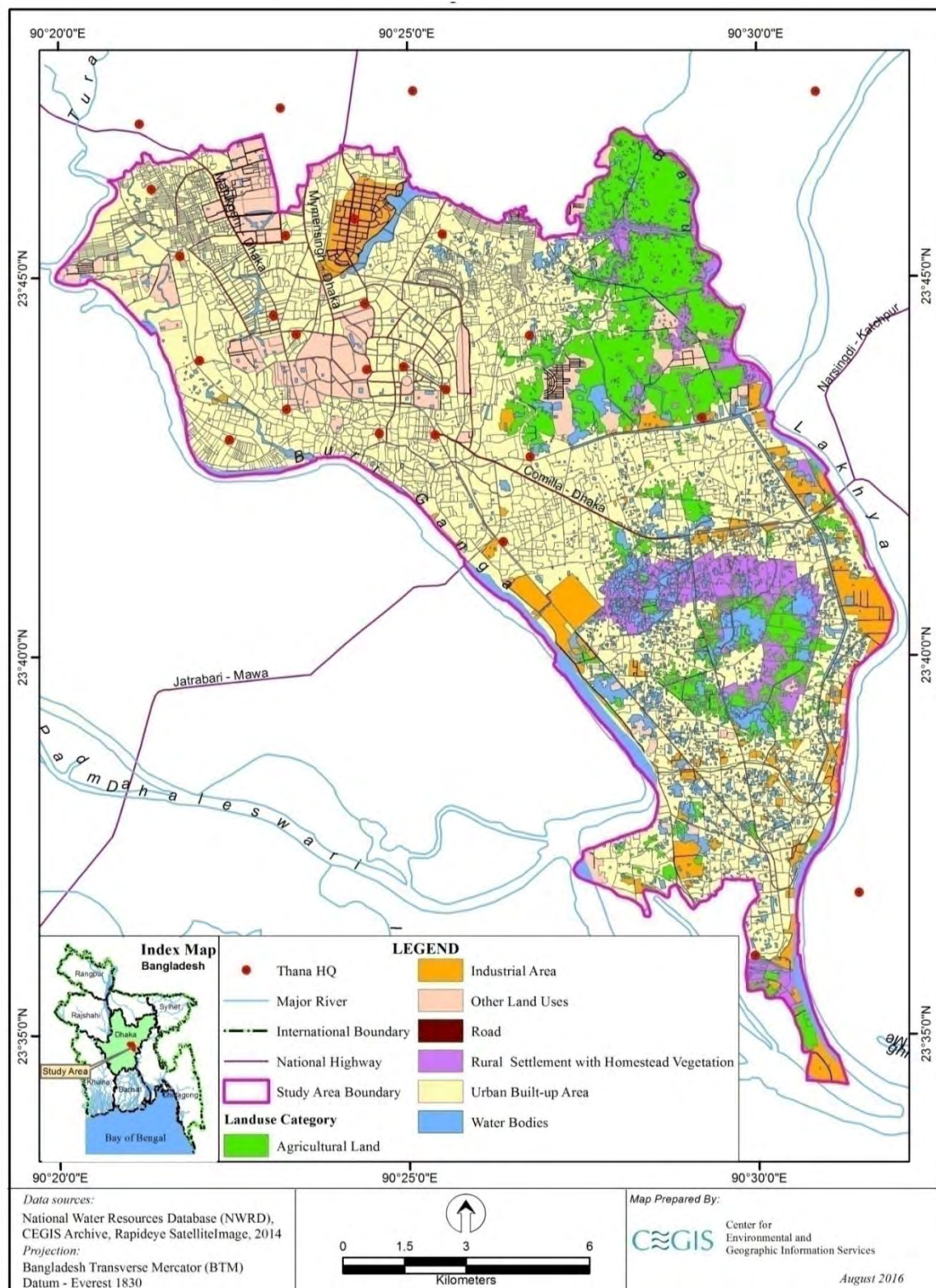
Land Use Class 1	Land Use Class 2	Area (ha)	(%)
Agricultural Land	Agricultural Land (Net Cultivable Area)	2,277	12
Waterbodies	Beel	11	0
	Canal	207	1
	Ditch	322	2
	Jheel	37	0
	Lake	96	1
	Marsh Land	488	3
	Pond	212	1
	Seasonal Water body	302	2
	River	363	2
Rural Settlement with Homestead Vegetation	Rural Settlement with Homestead Vegetation	911	5
Road	Road	1,033	6
Urban Built-up Area	Urban Built-up Area	9,795	53
Industrial Area	Industrial Area	1,146	6
Other Land Uses	Area Under Development	463	2
	Brick Field	63	0
	Important Places	848	5
	Total	18,573	100

Source: Rapideye Satellite Image, 2014 and JICA Survey Team (CEGIS team field survey, August, 2016)



Source: Center for Environment and Geographical Information Services (CEGIS)

Map 6-1: Land use map for the DESCO study area



Source: Center for Environment and Geographical Information Services (CEGIS)

Map 6-2: Land use map for the DPDC study area

6.1.1.8 Ecological description

1) DESCO area

The DESCO cover area is occupied with urban ecosystems including concrete structures, roads and lakes. The ecosystems are peril in nature due to continuous medication of land cover and consequential pressure of human interventions. There is an artificial wetland (Gulshan Lake) in the study area. According to the IUCN, the study area encompasses two bio-ecological zones, namely Madhupur Sal Tract and Brahmaputra-Jamuna Floodplain (Nishat.et al 2002). Due to massive urban development the major component of biological resources has been disturbed.

Ecosystems of this study area are broadly divided in two categories, i.e. a) terrestrial urban ecosystem and b) aquatic lagoon/lake ecosystem. These major categories are further divided with their sub categories.

Terrestrial urban Ecosystem

Flora of urban area

Inside the DESCO area, Flora of urban environment are mainly divided in two categories like “naturally grown” and “planted by human”. There is very few scope to grow flora by naturally as the study area have no untouched land. However, small grasses like *Cynodon dactylon*, *Cyperus rotundus* are grown naturally all the unpaved housing passages and roads islands and roadsides. Except this, the existing floral species are planted by human. Some where both side and the middle island of the roads of this city decorated with different types of plant species.



Source: JICA Survey Team (CEGIS)

Figure 6-8 Ornamental plants on the streets

Planted tree species are also observed at some parks and some residence areas. Most of the planted floral species are ornamental and shrubs.

The common plants observed in the study are Mahogoni (*Swietenia mahagoni*), Raintree (*Albizia saman*), Ipillpil

(*Mimosa glauca*), Jackfruit (*Artocarpus heterophyllus*), Weeping polyalthia (*Polyalthia longifolia*), Mango (*Mangifera indica*), Ear leaf Acacia (*Acacia auriculiformis*), Banana (*Musa sp.*), and etc. These plants contribute to the resting, sheltering and feeding needs of all the existing faunal communities.

b) Fauna of urban area

Birds occupy larger number of species than other urban faunal communities. House Crow (*Corvus splendens*), House Sparrow (*Passer domesticus*), Common Starling (*Sturnus vulgaris*), Barn Owl (*Tyto alba*), Jungle Mayna (*Acridotheres fuscus*), Blue Rock Pigeon (*Columba livia*), Asian Pied Starling (*Gracupica contra*), Red-vented Bulbul (*Pycnonotus cafer*), Black Drongo (*Dicrurus macrocercus*), Indian magpie Robin (*Copsychus saularis*) etc. are commonly observed. Local people report that, Common House Rat (*Rattus rattus*) and Small Indian Mongoose (*Herpestes*

auropunctatus) are the mammal's species often found at busy scrub area along the lake. House gecko (*Hemidactylus frenatus*), Keeled Grass Skink (*Eutropis macularia*) and Common Garden Lizard (*Calotes versicolor*) are the common reptiles of this study area. Among the Amphibian Common Toad (*Bufo bufo*) are usually noted at dump and cool places of parks, banks of Gulshan Lake and Hatir Jheel.

Aquatic lagoon/lake Ecosystems



Source: JICA Survey Team (CEGIS)

Figure 6-9 Wetland flora of the Gulshan Lake

This lake is polluted by solid wastes, discharged waste water and sewages etc. Floral diversity of this area is very poor. Alteration of lake water disfavored all types of normal hydrophytes succession and Water Hyacinth (*Eichhornia crassipes*) is the prime successor of this lake for having high concentration of sulphides. Among others, Alligator weed (*Alternanthera philoxiroides*), Chinese Spinach (*Ipomoea aquatica*), water primrose (*Ludwigia peploides*), etc. are the common associated floral species of the Gulshan Lake.

Fauna of the wetland

Deterioration of water quality in the above mentioned wetlands due to spillage of urban wastage have been adversely disfavours to dwell all types of water dependent animals. However, Common Kingfisher (*Alcedo atthis*), White-throated Kingfisher (*Halcyon smyrnensis*), Indian Pond Heron (*Ardeola grayii*) and Little Egrets (*Egretta gazerta*) occasionally follow Amphibians reptiles that are quite rare because of the deterioration of water quality. Skipper frog (*Euphlyctis cyanophlyctis*) and Stripes Keelback (*Xenochrophis vittatus*) are the common members of frogs and snakes respectively of this study area.

2) DPDC Area

The area has mainly urban ecosystems with terrestrial and aquatic environment. The DPDC coverage area falls under the two bio-ecological zones, namely the Brahmaputra-Jamuna floodplain and Madhpur salt tract, of which the project area is under only one bio-ecological zone, namely the Madhpur salt tract.

The study area occupies both terrestrial as well as aquatic ecosystems. Ecosystems of the area are divided into two major categories: i) Terrestrial ecosystem, and ii) Aquatic ecosystem. Each major category is further divided into sub-categories.

Gulshan Lake and adjoined HatirJheeli is the only wetlands present in the study area. Pollution of this lake has been a great threat for the existence of aquatic lives and other biodiversity. Gulshan Lake has been declared an Ecologically Critical Area (ECAs) in 2001 by DOE.

Flora of the wetland

Gulshan Lake is a manmade lake. The flora and fauna fairly vanished due to

Terrestrial ecosystem

Terrestrial ecosystems of the study area are mainly occupied by urban structures as well as concrete pavements. Major terrestrial ecological components of the study area are roadside trees and grasses, the sporadic homestead trees or ornamental plants and low population of wild animals.

Terrestrial Flora

All the study area is situated inside urban and semi-urban area. As a result, there is no forest patch or dense natural vegetation inside the study area. The urban area in most cases found as ornamental vegetation-rich instead of natural ecosystem. However, the semi-urban ecosystems have two components: like homestead, and roadside habitat where small to large fruit bearing plants, timber and medicinal plants are mainly observed. The rapid urbanization makes the ecosystem fragile. Most of the naturally grown plants have disappeared due to the expansion of residential area.

Terrestrial flora of the study area is mainly dominated with different types of ornamental plants. Fruit yielding trees like Mango (*Mangifera indica*), Areca nut (*Areca catechu*), Coconut (*Cocos nucifera*) are found some of the unpaved area between two buildings. Raintree (*Albizia saman*), and American mahogany (*Swietenia mahagoni*) are three common tree species which found along the roadsides. The species of undergrowth wild plants (herbs, shrubs, creepers) found are Apple of sodom (*Calotropis procera*), Vant (*Clerodendron viscosum*), Indian heliotrope (*Heliotropium indicum*) and Doab (*Cynodon dactylon*). Some plants also grow naturally in-between the planted plants and in the remaining bottom levels on either sides of the road which function as barrier of soil weathering. The small-sized herbs are also available and Vant (*Clerodendron viscosum*), Indian acalypha (*Acalypha indica*) and Doab (*Cynodon dactylon*) sporadically found everywhere in the area.

Terrestrial fauna

The urban ecosystems mostly are in a disturbed condition. The fauna are facing scarcity of shelter and protection due to human disturbance. The urban vegetation is no more considered as environment friendly. Existing plantation activities are done for decorative purposes that does not support the wildlife. Therefore, terrestrial fauna in this urban ecosystem are not diverse except some scavengers. Birds occupy larger number of species than other urban faunal communities. Crow (*Corvus splendens*), House Sparrow (*Passer domesticus*), Common Starling (*Sturnus vulgaris*), Barn Owl (*Tyto alba*), Jungle Mayna (*Acridotheres fuscus*), Asian Pied Starling (*Gracupica contra*), Red-vented Bulbul (*Pycnonotus cafer*), Black Drongo (*Dicrurus macrocercus*), Indian magpie Robin (*Copsychus saularis*) are commonly seen. House shrew (*Suncus murinus*), Common House Rat (*Rattus rattus*), Small Indian Mongoose (*Herpestes javanicus*) are mammals that have been found rarely along the building corridors and marsh area. House gecko (*Hemidactylus frenatus*), Keeled Grass Skink (*Eutropis carinata*) and Common Garden Lizard (*Calotes versicolor*) are reptiles commonly seen in the study area. Among the amphibian, Common Toad (*Bufo bufo*) is usually noted at dump and cool places such as parks and residence.

Aquatic ecosystem

The study area has no natural aquatic wetland and encompasses beside the manmade Hatirjheel Lake. This lake has no free floating or rooted floating plants. Wildlife occurrence is not referable except some water depended birds like little egrets and pond herons.

6.1.2 Socio-Economic condition

6.1.2.1 Demographic Features

1) Distribution of Household and Population

The following table illustrates demographic profile of the DESCO and DPDC covering area. Total population and ratio between male and female have been illustrated from the data obtained in the Population and Housing Census 2011.

DESCO Area is highly populated (4,468 persons/km²) in total area of 234,413,934 m² of entire Dhaka⁸. According to the Census 2011, there are 987,071 households in the area with 4,287,265 people (2,312,412 male and 1,974,853 female). The sex ratio⁹ of this area is 117 (117 are male and 100 are female).

The entire DPDC area covers two districts, namely Dhaka and Narayanganj. According to the Census 2011, total numbers of households in the DPDC covering area are 1,514,750. Total population is 6,727,320 (male: 3,719,217 and female: 3,008,103), and the sex ratio is 124. The average household size in the study area is similar to the national average of 4.4¹⁰.

Table 6-6 Demographic Profile of DESCO and DPDC Areas

Covering Area	Boundary	Household	Population			Sex Ratio
			Both	Male	Female	
DESCO	Dhaka, Gazipur and Narayanganj	987,071	4,287,265	2,312,412	1,974,853	117
DPDC	Dhaka, Narayanganj	1,514,750	6,727,320	3,719,217	3,008,103	124

Source: Population and Housing Census 2011

Note 1: DESCO extends its service in Badda, Biman Bandar, Cantonment, Dakshin Khan, Gulshan, Kafrul, Khilkhet, Mirpur, Pallabi, Rampura, Savar, Sher-e Bangla Nagar, Turag, Uttara, Uttara Khan Thanas of Dhaka District, Gazipur Sadar and Kaliganj Thanas of Gazipur District, and Rupganj of Narayanganj District. In total 48 Unions belong to 18 Thanas of three Districts.

Note 2: DPDC covers 111 Unions in 28 Thanas of two districts, namely Adabor, Bangshal, Chak Bazar, Dhanmondi, Gendaria, Hazaribagh, Jatrabari, Kadamtali, Kalabagan, Kamrangir Char, Khilgaon, Keraniganj, Kotwali, Lalbagh, Mohammadpur, Motijheel, New Market, Paltan, Ramna, Rampura, Sabujbagh, Shyampur, Sher-e Bangla Nagar, Sutrapur, Tejgaon, Tejgaon Ind. Area, and Demra of Dhaka District, and Narayanganj Sadar of Narayanganj District.

Note 3: Rampura and Sher-e Bangla Nagar Thanas are included in both DESCO and DPDC cover area, but the Unions covered in these two Thanas are different from each other.

2) Age Distribution

Among all age categories, middle-aged people are the most who live in the whole DESCO service area. The population from 15-59 consists of 63.0% of total population, out of which 50-59 shares most (25.5%) followed by 25-29 (11.2%), and 30-49 (10.8%).

⁸ National water resource database (NWRD), CEGIS archive.

⁹ Number of males per 100 females in a population, using the formula: Sex Ratio SR = M x 100 / F

¹⁰ Bangladesh Bureau of Statistics, 2012.

In DPDC Area, 30.1% of population are from 0 to 14. 65.3% are youth from 15 to 59 years old. and the rest 4.7% belong to those aged over 60 years old. Unlike DESCO area, most of the people belong to the age range of 20-49 among all age categories, and the biggest cluster of age category is 30-49 consists (26%).

6.1.2.2 Employment

1) Employment Status

Around 57.1% of the population aged over seven years old who do not attending schools in DESCO area are employed, of which 37.1% (238,077) are male and 20.0% (128,380) are female. 23.7% (152,303) of female are engaged in household work, 18.2% (116,834) of total population do not work (it includes children and physically challenged population). It is also found that around 0.5% (3,213) of total population including 0.3% (2,054) male and 0.2 % (1,159) female in the study area are looking for work. About 42.9% (275,407) of total population in the study area (including looking for work, household work and do not work) are dependent on the above economically active population.

Total populations in DPDC area are 7,200,942 of whom economically active population are 1,118,838 (aged over seven years old who do not attend schools). 632,533 (56.5%) of them are employed (male: 449,646, female: 182,887). 274,402 (24.5%) are engaged in household works most of whom are women (269,571). 206,507 (18.5%) of them are not engaged in any type of work and 5,396 (0.5%) people are looking for jobs.

Table 6-7 Employment Status of Economically Active Population

Status	Employed	Household work	Do not work	Looking for work	Total
DESCO Area					
Male	238,077	3,213	65,478	2,054	308,823
Female	128,380	152,303	51,356	1,159	333,823
Total	366,387	155,516	116,834	3,213	642,020
Percentage (%)	57.1	24.2	18.2	0.5	100.0
DPDC Area					
Male	449,646	4,831	92,986	3,523	550,986
Female	182,887	269,571	113,521	1,873	567,852
Total	632,533	274,402	206,507	5,396	1,118,838
Percentage (%)	56.5	24.5	18.5	0.5	100.0

Source: BBS, 2012

2) Occupation

It is found in the following table that people are mainly engaged in service oriented jobs both in DESCO and DPDC circles. The numbers of people engaged in service oriented jobs in DESCO service area are 277,652, which is more than half of the total population (422,009) of the same area. Service is the mainstay of the economy in DPDC area too. Most of the employed populations are engaged in the service sector (456,117 (72%)), 162,839 (26%) are engaged in industrial sector, and only 2% (13,577) are engaged in agricultural activities in DPDC area.

Table 6-8 Occupational Status in the Study Area

Sector	Agriculture	Industry	Service	Total
DESCO Area				
Male	20,392	65,307	183,515	269,214
Female	1,530	57,129	94,137	152,796
Total	21,921	122,436	277,652	422,009
Percentage (%)	5.2	29.0	65.8	100.0
DPDC Area				
Male	12,492	108,864	328,290	449,646
Female	1,085	53,975	127,827	182,887
Total	13,577	162,839	456,117	632,533
Percentage (%)	2.1	25.7	72.1	100.0

Source: Bangladesh Population and Housing Census, 2011

6.1.2.3 Quality of Life

1) Literacy

The average literacy rate¹¹ in the DESCO area is 72.3% which is higher than national (59.6%) literacy rate. It shows that the literacy rate of male (75.6%) is higher than national male literacy rate (54.1%) and same with female (67.8%) to the national label (49.4%).

That of DPDC area is 74%, of which male literacy rate is 76% and female literacy rate is 71%.

2) Housing Condition

In the DESCO area, overall housing condition is moderate. According to the Census 2011, 44% (443,082) households have pucca houses and 35% (361,525) have semi-pucca ones, whereas 18% (181,841) are kutcha and Jhupri.

In DPDC area, overall housing condition is satisfactory. Among total number of household of 1,621,393, 1,086,333 (67%) are found to live in pucca houses. Those who live in semi-pucca houses are 389,134 (24%) and kutcha houses are 113,498 (7%). Jhupri houses seen in DPDC area are 32,428 (2%).

3) Drinking Water

67% (646,611) of people collect drinking water from tap water supplied from Dhaka WASA lines in the DESCO Area. 30% (285,471) do so from tube wells and rest 3% (30,820) from other sources.

Tap water is the major source of drinking water in the whole DPDC area too. Total 1,345,756 (83%) households collect drinking water from tap. The ratio of tube well users shares 16%. 16,214 (1%) households of DPDC Area depend on other sources for drinking water.

Though arsenic is the concerning issue in Bangladesh, it is not a major issue in Dhaka.

4) Sanitation

¹¹ Literacy rate denotes ability to write a letter in any language. Literacy status assessment is made for population of 7 years and over.

About 90 % (912,723) households in the whole DESCO Area are reported to have sanitary toilet facilities, of which 52% (526,196) are water-sealed and 38 % (386,528) are non water-sealed. 9% households still have non-sanitary toilet facility, and the rest 1% (14,159) have no sanitation facility.

The sanitation facilities are found moderate in the DPDC area. 1,540,323 (95%) households use sanitary latrine, of whom 989,050 (61%) are with water-sealed. 551,274 (34%) with non water-sealed. and 81,070 (5%) has no sanitary latrine facilities.

5) Access to Electricity

According to the Bangladesh Population and Housing Census 2011, 95.1% households are under electricity coverage in the whole DESCO study area.

Electricity is good in coverage under the DPDC area too. 1,601,936 (98.8%) households are connected to electricity facilities. More electricity supply is required for rapid urbanization and growing industries.

6.2 TOR for Environmental and Social Field Survey

Based on the draft scoping results at Gulshan site and Kawranbazar site shown in the Chapter 3, the following table describes the survey objectives, survey items, methods and expected draft countermeasures for the primary data collection survey within and around the project area for both DESCO and DPDC.

As it is required in Bangladesh to develop both IEE and EIA for this particular project, environmental and social components likely to be impacted by the project interventions, and their impact degrees shall carefully examined and mitigation measures shall be developed.

Table 6-9 Survey TOR

Environmental Items	Survey Objectives		Survey Items	Survey Method	Expected Countermeasures (draft)
	DESCO	DESCO			
Environmental Pollution					
Air Quality	- Present ambient air conditions at the project site shall be identified. - Measures to avoid, or mitigate negative impacts shall be examined	- Relevant environmental standards - Meteorological Information - Current status of Ambient Atmosphere	- Obtain ambient air quality standards - Obtain meteorological data (temperatures, moisture, wind directions, wind speeds, etc.) from the nearby weather centers. - Measure primary data on ambient air conditions	Take preventive measures for air pollution	
Water Quality	- Present conditions of ambient water at the project site shall be identified. - Measures to avoid, or mitigate negative impacts shall be examined	- Relevant environmental standards - Current status of Water Quality	- Obtain water quality standards and effluent standards. - Obtain data on water quality	- Take preventive measures for water pollution - Satisfy effluent standards by installing wastewater treatment facility for temporary emission of domestic and other types of discharged water.	
Wastes	- The degree of impact caused by construction and domestic wastes shall be identified. - Measures to avoid, or mitigate negative impacts shall be examined	Relevant environmental standards	Obtain waste handling standards/ manuals/ guidelines.	Introduce a rule for disposal of industrial, domestic and hazardous wastes	
Soil Quality	- Present condition of soil shall be identified. - Measures to avoid, or mitigate negative impacts shall be examined	- Relevant environmental standards - Current status of groundwater	- Identify soil condition - Measure soil quality and any contamination.	- Develop soil contamination countermeasures - Examine other measures as required	
Noise and Vibration	- Present noise and vibration level at the project site shall be identified. - Measures to avoid, or mitigate negative impacts shall be examined	- Relevant environmental standards - Current status of noise and vibration	- Obtain noise level standards - Measure the noise levels	Take preventive measures for noise and vibration	

Environmental Items	Survey Objectives		Survey Items	Survey Method	Expected Countermeasures (draft)
	DESCO	DESCO			
Odor	• The degree of impact caused by domestic wastes shall be identified. • Measures to avoid, or mitigate negative impacts shall be examined		• Relevant environmental standards	• Obtain environmental standards for smell sources	• Take preventive measures for handling domestic wastes
Natural Environment					
Protected Areas	• The degree of impact likely to be caused by the construction work to the ECA shall be identified	N/A N/A	• Relevant environmental laws, regulations, and orders	• Identify the underground cable line route along the Gulshan Lake • Confirm the boundary of designated area	• Evaluate the diffusion of water pollutants to assess any potential environmental impact on the ECA • Take preventive measures
Ecosystem	• Measures to avoid, or mitigate negative impacts shall be examined				
Social Environment					
Land acquisition/ Resettlement	• The potential negative impacts caused by temporary requisition of ROW and surrounding area of UGSS shall be identified • Measures to avoid, or mitigate negative impacts shall be examined.		• Confirm who the affected people are (if any) and negative impacts caused by the project. • Confirm their assets • Identify their livelihood means	• Collect relevant laws and regulations, information on relevant cases • Conduct a household socioeconomic survey • Conduct a stakeholder meeting • Collect information on the employment and income in the affected area • Interview with the households	• Elaborate compensation and livelihood restoration measures (if required)
	N/A				
Deterioration of Local Economy such as Losses of Employment and Means of Livelihood	N/A	• The project affected people shall be identified on the Garden Road • Their present socioeconomic status shall be identified	Same as “land acquisition / resettlement” above.	Same as “land acquisition / resettlement” above.	Same as “land acquisition / resettlement” above.

Environmental Items	Survey Objectives		Survey Items	Survey Method	Expected Countermeasures (draft)
	DESCO	DESCO			
		Their tenure conditions shall be identified			
Land Use and Utilization of Local Resources	- The potential negative impacts caused by temporary requisition of ROW and surrounding area of UGSS shall be identified - Measures to avoid, or mitigate negative impacts shall be examined.		Same as “land acquisition / resettlement” above.	Same as “land acquisition / resettlement” above.	Same as “land acquisition / resettlement” above.
Disturbance to Existing Social Infrastructure and Services	- Present traffic situation throughout the cable line route and surrounding area of UGSS site shall be identified - The degree of impact caused to the traffic flow shall be analyzed.		- Measure traffic volumes - Identify kinds of vehicles	Conduct a traffic survey throughout the underground cable line route	Develop a schedule of vehicle operation during construction period
Misdistribution of Benefits and Compensation	N/A	Same as the above ‘local economy’	Same as “land acquisition / resettlement” above.	Same as “land acquisition / resettlement” above.	Same as “land acquisition / resettlement” above.
Local Conflicts of Interest	N/A	Same as the above ‘local economy’	Same as “land acquisition / resettlement” above.	Same as “land acquisition / resettlement” above.	Same as “land acquisition / resettlement” above.
Infectious Diseases	- Relevant domestic laws and regulations for labor health and safety shall be identified. - Actions taken by contractors shall be identified.		None	None	Develop a labor and hygiene plan.
Work Environment (Including Work Safety)	- Relevant domestic laws and regulations for labor health and safety shall be identified. - Actions taken by contractors shall be identified.		None	None	Develop a labor and hygiene plan
Accidents	- Relevant domestic laws and regulations for labor health and safety shall be identified. - Actions taken by contractors shall be identified.		None	None	Develop prevention and countermeasures against accidents

Source: JICA Survey Team

6.3 Results of Environmental and Social Field Survey in the Project Area

6.3.1 DESCO Circle

6.3.1.1 Air quality

The ambient air status of five parameters, i.e., PM, SPM, SO₂, and NO_x that represent the quality of pollution level, have been assessed at a location in the vicinity of DESCO Office at Gulshan-1 as presented in Table 6-10.

It is observed from the measurement that concentration of PM_{2.5} exceeds the Bangladesh Standard but within the range of IFC standard. The value of PM₁₀ is above DOE and IFC standard while that of SPM is two times higher than DOE standard. The other parameters, SO₂ and NO_x, are below both the standards. This depicts that the location of Gulshan UGSS is dusty as urban area and has low SO₂ and NO_x gases as residential and commercial area.

Table 6-10 Value of air quality parameters in the Project area (Gulshan-1 area)

No.	Sample Description	PM _{2.5}	PM ₁₀	SPM	SO ₂	NO _x
1	Method of Analysis	Gravimetric	Gravimetric	Gravimetric	Wet-Geake	Jacob and Hochheiser
2	Unit	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³
3	Test Duration (Minutes)	480	480	480	480	480
4	Bangladesh (DOE) Standard	65	150	200	365	100
5	IFC /World Bank Standard	75	150	NF	125	200
6	Concentration	70.5	218	453	25.5	27

Source: JICA Survey Team (CEGIS)

Note 1: The data were taken as of February, 2016.

Note 2: PM_{2.5}=Fine Particulate Matter, PM₁₀=Respirable Dust Content, SPM=Suspended Particulate Matter, NO_x=Oxides of Nitrogen, SO₂=Sulphur Dioxide.

6.3.1.2 Ambient noise

The noise level of the project location is presented in Table 6-11. Gulshan is in a residential and commercial area according to the area category defined in ECR 1997.

Table 6-11 Noise Level at Project Area

No.	Date and Time	Location	GPS Coordinate	Noise Level (dBA)	Area Type	Area Category
1	11/07/16 1:00 PM	DESCO, House-47, Road-134, Dhaka-1212	23°46'48.85"N 90°25'3.27"E	60	Residential and Commercial	C

Source: JICA Survey Team (CEGIS)

Note: The data was taken in the baseline study conducted in July, 2016.

6.3.1.3 Biological Environment

1) UGSS area

The proposed UGSS site is located in a built-up area where mere vegetation exists though all the area is covered by concrete structures. Only one big mango and two jackfruit trees exist here.

2) Underground cable route

The proposed underground cable route will pass under the roadsides where there are grasses and herbs such as *Cynodon dactylon*, *Cyperus rotundus*, *Croton sparsiflora*, *Euphorbia hirta*, *Mikania cordata* etc. that are grown naturally. In addition, the road's islands and passages are vegetated with different types of ornamental plants planted by the Dhaka City Corporation. As the project site is located in urban setup, low frequency of faunal species is observed in the route area. House Crow (*Corvus splendens*), House Sparrow (*Passer domesticus*), Common Starling (*Sturnus vulgaris*), Common Myna (*Acridotheres tristis*) etc. were seen during field visit along the underground cable route. All of them are roaming there for their feeding or resting purposes. There is no bird nest or other animal's permanent habitats exist along the cable route or even at the sub-station site.



Source: JICA Survey Team (CEGIS)

Figure 6-10 Selected project area

6.3.1.4 Land use

1) UGSS area

The following pictures show the road network condition at the proposed DESCO UGSS site and traffic condition of adjacent area. It is found that the proposed site at Gulshan-1 is highly recognized as huge and busy commercial area. The proposed location is very close to Mohakhali - Badda link road, along which people commute to their offices and attend various kinds of work since most of the corporate head offices are located adjacent to the proposed site. Huge traffic congestions are found there during and after office hour every day.



Eastern side of the project location

Source: JICA Survey Team (CEGIS)

Figure 6-11 No. 134 Road



Northern side of the project location

Source: JICA Survey Team (CEGIS)

Figure 6-12 Bir Uttam A K Khandoker Rd



Adjacent to the proposed substation site



Source: JICA Survey Team (CEGIS)

Figure 6-13 Traffic condition at Bir Uutam Rafiqul Islam Avenue A Road

2) Underground cable route

The final route for the underground transmission line is depicted in Map 6-3. Although the route has been chosen to avoid and minimize traffic congestion, it still has to pass some busy roads. The Gulshan Link Road, Hatirjheel Link Road and Bir Uttam Rafiqul Islam Avenue are the busiest roads along the route. For convenience of description the route has been divided into 6 subsections (A to G) in the map and Table 6-12. Presently there is no existing road in the C-D portion of the route.



Source: JICA Survey Team (CEGIS)

Map 6-3: Route of Underground Transmission line

Table 6-12 Road and Traffic details of the proposed route

Subsections	Road Name	Width	Length	Road Type	Traffic condition
SS-A	-	12'	50m	Rigid Pavement	Low traffic. Mostly used by PGCB.
A-B	Rd-3, Block-B, Aftabnagar	15'	316m	Mud Road	Low traffic. Few Pickup ,car, rickshaw and pedestrian
B-C	Rd-3, Block-B, Aftabnagar	12'	243m	Mud Road	Very Low traffic. Mostly rickshaw and pedestrians.
C-D	-	-	184m	No Road	Presently occupied by slum dwellers.
D-E	Bir Uttam Rafiqul Islam Ave	83'	25m	Flexible pavement Highway	Dense Traffic. Traffic congestion frequent.
E-F	Hatirjheel Link Rd	50'	364m	Flexible Pavement	Moderate Traffic. Traffic congestion less frequent.
F-G	Gulshan Lake side road	25'	930m	Flexible Pavement	Road not inaugurated for service. Pedestrian, few rickshaw and bike use this road.
G-H	Gulshan link road	52'	345m	Flexible Pavement	Dense Traffic.

Source: JICA Survey Team (CEGIS)

Some of those that feature the project area of DESCO underground cable line route are as follows:

- Hatirjheel-Begunbari Development Project

The project spreads over 302 acres- 46 acres of RAJUK's land, 34 acres of other government agencies, 81 acres of Wards' Court and 141 acres of private land for facilitating connectivity between the eastern and western parts of Dhaka.

Hatirjheel is located at the centre of the capital city. The place is surrounded by Tejgaon, Gulshan, Badda, Banasree, Niketon, Maghbazar and etc. It has made people living near these areas move much easier with the quality improvement of transportation system. Hatirjheel is now considered as one of the most common places for walking and running among urban people. Every day from very early in the morning and evening till late, this place becomes crowded with people.

The proposed UGSS at Gulshan-1 is quite adjacent to the Hatirjheel Development Project and the proposed transmission route will cross roads under the project.

- East West University campus

The permanent campus of East West University is located in Aftab Nagar, Rampura on the Progoti Sarani on 7.4 bighas of land. Total floor area of the nine-storied university complex is approximately 460,000 ft² with modern facilities. The campus area is crowded with students who come for their classes and other works. Various types of shooting are often held at this campus area especially for Romantic Bangla Natok as it is close to the Bangladesh Television. There are also people who live in the Zahirul Islam residential area nearby.



Source JICA Survey Team (CEGIS)

Figure 6-14 **Hatirjheel-Begunbari Project**



Source JICA Survey Team (CEGIS)

Figure 6-15 **East west university campus**

The proposed UGSS at Gulshan-1 will be connected with an underground cable route from the Rampura Substation of PGCB. It will cross between Bir Uttam Rafiqul Islam Avenue and Hatirjheel -Badda link road that are mostly busy with various kinds of vehicles like bus, private cars, and rickshaws. The following pictures show the road network condition of underground cable route network and traffic condition of route area.



Source: JICA Survey Team (CEGIS)

Figure 6-16 **Traffic condition at Hatijheel link road**



Source: JICA Survey Team (CEGIS)

Figure 6-17 **Traffic congestion at Bir Uttam Rafiqul Islam Avenue**

6.3.1.5 Demographic Features

The following table shows the distribution of household and population of the project area, two wards and a union of Badda and Gulshan Thana, 3,263 households consists of 13,358 people. Out of all population, 7,437 are male and 5,921 female.

Table 6-13 **Distribution of household and population of the project area**

Thana	Union	No of households	Population	Male	Female	Sex Ratio
Badda	Badda	1,135	4,690	2,592	2,098	124
Badda	Ward No. 21	1,818	7,350	4,130	3,220	128
Gulshan	Ward No. 19	310	1,319	716	603	119
Total		3,263	13,358	7,437	5,921	126

Source: Population and Housing Census 2011, Bangladesh Bureau of Statistics (BBS), 2012

Note: Project Area is presumed as 50-meter buffer area surrounding to the final cable route along with proposed underground substation.

6.3.1.6 Employment

- Labor Availability and Wage Rate

People of the project area are mainly involved in service and industry related activities. Beside this, less amount of people are involved in agriculture in the metropolitan area of Dhaka city.

Range of wage rate of the whole DESCO Area is presented in the table below. The study area consists of three districts, namely: Dhaka, Gazipur and Narayanganj. It is found that wage rate is almost same in every district but in Dhaka district wage rate is higher than other districts. Another noticeable fact is that women don't get equal wage rate till now. But the positive side is that both male and female are working together as it is beneficial for development which has been found during field work in the study area.

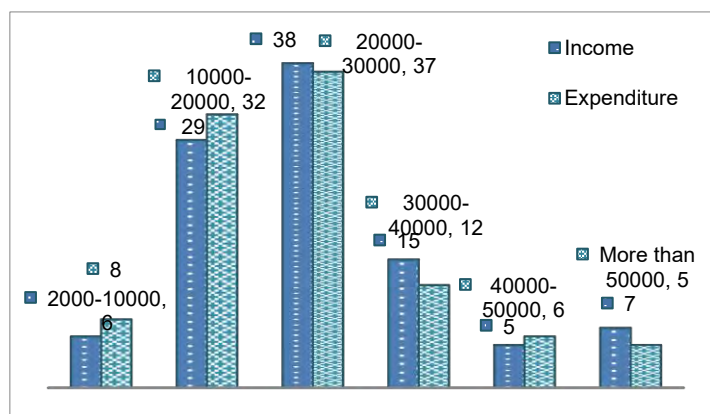
Table 6-14 Availability of Labor and Wage Rate

District	Type of Activities	Type of labor	Availability	Wage (Taka)	
				Max.	Mini.
Dhaka	Farming	Male	High	400	300
		Female	Medium	350	250
	Non farming	Male	High	500	350
		Female	Low	400	300
Gazipur	Farming	Male	High	350	300
		Female	Medium	300	250
	Non farming	Male	High	400-500	350
		Female	Low	400	300
Narayanganj	Farming	Male	High	300-350	200-250
		Female	Medium	300	200
	Non-Farming	Male	High	400	350
		Female	Low	300	250

Source: JICA Survey Team (CEGIS Field Survey 2016)

6.3.1.7 Household Income and Expenditure

The scenario of income and expenditure is presented in the following figure. In the DESCO Area, it is found from field data that the income and expenditure of most of the households range from Tk. 20,000 to Tk. 30,000 taka per month. The percentage of income and expenditure of more than Tk. 50,000 is moderate.



Source: JICA Survey Team (CEGIS Field Survey 2016)

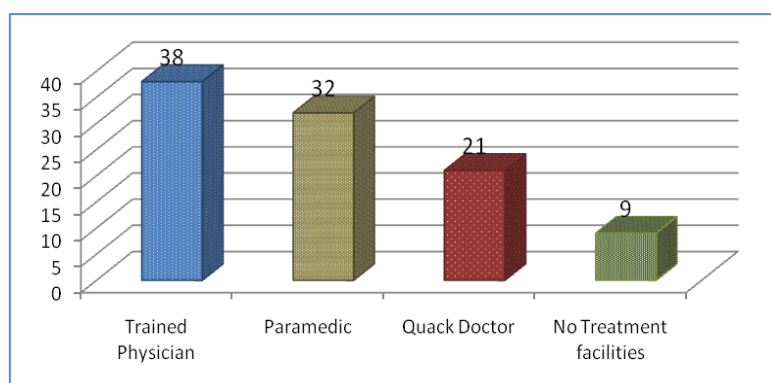
Figure 6-18 Distribution of Household by income and Expenditure

6.3.1.8 Quality of Life

1) Access to Health Facilities

The following figure shows the proportion of treatment facilities of the DESCO Area. 38% of people see trained physicians, and 32% of them go to paramedic physicians for medical services. On the other hand, people still have tendency to go to quack doctor (21%) for treatment, and

approximately 9% people who are not economically advantaged do not have access to medical facilities.



Source: JICA Survey Team (CEGIS Field Survey, 2016)

Figure 6-19 Percentage of treatment facility in the study area

2) Housing Condition

Land use data shows that project location is fully covered by settlement area, and most of their houses are pucca. It has been observed that Gulshan-1, the proposed site for the installation of UGSS, is very close to the urban road network. Pucca households are found adjacent to the proposed site, but most of which are used for commercial space. The following table identifies that project area consists of pucca households. There are total 81,133 households whose houses are pucca, 78,359 semi-pucca, 8,386 kutcha and 2,777 are Jhupri.

Table 6-15 Housing condition in the DESCO project area

Thana	Union	Pucca	Semi-pucca	Kutcha	Jhupri	Total
Badda	Badda	343	551	173	6	1,073
	Ward No. 21	80,654	77,794	8,075	2,768	169,291
Gulshan	Ward No. 19	136	15	137	2	290
Total		81,133	78,360	8,385	2,776	170,654
Percentage (%)		47.5	45.9	5.0	1.6	100.0

Source: Bangladesh Population and Housing Census, 2011

3) Drinking Water Facility

The following table presents the status of drinking water condition in the project area. It is found that 2,652 people use tap water whereas 311 get water from tube wells, and 95 from other sources. Field findings show that there is no salinity, and ground water quality is better than other regions. Dhaka-WASA plays the prominent role to supply water for the people of project area.

Table 6-16 Status of drinking water in the DESCO project area

Thana	Union /Ward	Tap	Tube-Well	Other	Total
Badda	Badda	883	186	5	1,074
	Ward No. 21	1,566	123	4	1,693
Gulshan	Ward No. 19	203	2	85	290
Total		2,652	311	94	3,057
Percentage (%)		86.8	10.2	3.1	100.0

Source: Bangladesh Population and Housing Census, 2011

4) Access to Electricity

According to the Bangladesh Population and Housing Census 2011, 98.9% coverage of electrification is found in the ROW of the underground cable line route areas, and 99.2% is found in the project location.

6.3.2 DPDC Area

6.3.2.1 Air quality

There is no data taken at Kawranbazar UGSS site and cable line route available. Instead of collecting primary data, secondary data obtained by the DOE at the continuous air monitoring stations (CAMS) are referred and analyzed as below.

Out of 11 different points of CAMS in Bangladesh, three monitoring stations are found within DPDC covering site as given in the following table.

Table 6-17 Air Monitoring station location of DOE in DPDC Cover Area

ID	Location	Monitoring Capacity
CAMS-1	Sangshad Bhaban	PM 10, PM 2.5, CO, NOx, SO2, O3 and HC concentration parameters
CAMS-2	Firmgate	PM 10, PM 2.5, CO, NOx, SO2, O3 and HC concentration parameters
CAMS-3	Darus-Salam	PM 10, PM 2.5, CO, NOx, SO2, O3 and HC concentration parameters

Source: Department of Environment

The air quality monitoring data of May 2016, and September 2016 is given in the tables below respectively.

It is evident from Table 6-18 that the average PM2.5 value is within both the standard limit of Bangladesh and IFC, and its recorded maximum value exceeds both. Maximum value of PM10 also varies from the standard and among the CAMs stations. The CO-8 hourly value exceeds the Bangladesh Standard at CAMS 2. The other detected level of the O3, SO2, NOx are within the standard value of Bangladesh.

Table 6-18 Monitored Air Quality at Dhaka May 2016

Parameter	Unit	CAMS-1			CAMS-2			CAMS-3		
		Ave	Max	Min	Ave	Max	Min	Ave	Max	Min
SO ₂ -24 hr	ppb	N/A	N/A	N/A	5.49	13.7	1.33	N/A	N/A	N/A
NO ₂ -24 hr	ppb	N/A	N/A	N/A	N/A	N/A	N/A	37.2	66.6	17.4
CO-1 hr	ppm	1.62	4.83	0.05	1.67	27.2	0.05	1.35	2.89	0.25
CO-8 hr	ppm	1.64	4.27	0.11	1.67	10.2	0.21	1.34	2.59	0.42
PM _{2.5}	µg/m ³	46.2	85.3	12.7	61.6	98.6	22.4	50.5	87.1	18.4
PM ₁₀	µg/m ³	N/A	N/A	N/A	92.3	179	38.2	100	161	34.0
O ₃ -1hr	ppb	N/A	N/A	N/A	N/A	N/A	N/A	5.50	38.1	0.37
O ₃ -8hr	ppb	N/A	N/A	N/A	N/A	N/A	N/A	5.39	23.0	0.69

Source: Air quality monitoring, DoE

From table 6-19, it is found that both SO₂, and NO₂ are within the standard value. PM_{2.5} and PM₁₀ are marginal compared to the IFC standard at the CAMPs stations. The value of obtained O₃-8hr is within the standard limit but the maximum value of O₃-1hr has exceeded the standard value of Bangladesh.

Table 6-19 Monitored Air Quality at Dhaka September, 2016

Parameter	Unit	CAMS-1			CAMS-2			CAMS-3		
		Ave	Max	Min	Ave	Max	Min	Ave	Max	Min
SO ₂ -24 hr	ppb	N/A	N/A	N/A	2.77	6.64	1.29	1.22	6.67	0.56
NO ₂ -24 hr	ppb	N/A	N/A	N/A	N/A	N/A	N/A	24.8	71.5	6.82
CO-1 hr	ppm	N/A	N/A	N/A	1.02	5.79	0.05	1.71	3.95	0.05
CO-8 hr	ppm	N/A	N/A	N/A	0	88	1.05	1.05	3.78	0.13
PM _{2.5}	µg/m ³	N/A	N/A	N/A	N/A	N/A	N/A	32.7	71.8	17.5
PM ₁₀	µg/m ³	N/A	N/A	N/A	N/A	N/A	N/A	62.6	123	35.8
O ₃ -1hr	ppb	N/A	N/A	N/A	N/A	N/A	N/A	2.11	16.0	0.43
O ₃ -8hr	ppb	N/A	N/A	N/A	N/A	N/A	N/A	2.12	7.76	0.78

Source: Air quality monitoring, DoE

Based on the above data and information, it is now presumed from the data and information obtained from the DOE that the DPDC service area could have air quality with marginal value of SO₂ and NO₂. On the other hand, there remains a possibility for the air parameters PM₁₀ and PM_{2.5} to exceed the standard level throughout the project site.

6.3.2.2 Ambient Noise

The noise levels of the project locations of Kawranbazar UGSS are presented in Table 6-20. The project area of Kawranbazar is roadside and just behind the Bashundhara City Shopping Mall and some high-rise commercial places. There are residential quarters of DPDC officers and their families within Kawranbazar site. The measured noise levels of Kawranbazar site are around the limit or exceeding the ECR standard value.

Table 6-20 Noise Level at Project Area

No.	Date and Time	Location	GPS Coordinate	Noise Level (dBA)	Area Type	Area Category
1	11/07/16 10:10 AM	Beside the area for proposed substation installation	23°45'03.9"N 90°23'29.0"E	59.5	Residential and Commercial	C
2	11/07/16 10:15 AM	In the proposed project location	23°45'03.5"N 90°23'30.8"E	60.2	Residential and Commercial	C
3	11/07/16 10:19 AM	In front of the existing substation	23°45'05.1"N 90°23'29.6"E	69.8	Residential and Commercial	C
4	11/07/16 10:30 AM	Beside the road of the substation construction	23°45'05.3"N 90°23'29.7"E	65.6	Residential and Commercial	C

Source: JICA Survey Team

Note: The data was taken in the baseline study conducted in July, 2016.

6.3.2.3 Biological Environment

1) Kawranbazar UGSS area

The selected proposed project area is situated inside urban area and contains only terrestrial ecosystem with terrestrial flora and fauna. The site is fully developed. Some insignificant numbers of wild herbs and shrubs are found during field visit. Among them, *Cynodondacylon* and *Cyperusrotundus* are common. About sixteen numbers of planted trees are also observed inside the substation boundary. Terrestrial fauna of this site is also negligible. Mole Rat



Source: JICA Survey Team (CEGIS)

Figure 6-20 Existing plants (Carambola, Guava, Tarotree) in the proposed site

(*Bandicotabengalensis*), Common House Rat (*Rattusrattus*), House Crow (*CorvusSplendens*), Large-billed crow (*Corvusmacrorhynchos*), the garden lizard (*Calotesversicolor*), Small Indian Mongoose (*Herpestesaupunctatus*) are commonly found in here. Table 6-21 provides species and numbers of the existing trees in the proposed area.

Table 6-21 List of existing plant species found in the proposed site

No.	English Name	Scientific Name	Numbers
1	Mango	<i>Mangiferaindica</i>	4
2	Neem	<i>Azadirachtaindica</i>	2
3	Carambola	<i>Averrhoecarambola</i>	4
4	Pomelo	<i>Citrus grandis</i>	1
5	Guava	<i>Psidiumguajava</i>	4
6	Jackfruit	<i>Artocarpusheterophyllus</i>	1

Source: JICA Survey Team (CEGIS Field visit, July 2016)

2) Underground cable route

The selected underground cable route is crossed among residential and commercial area. There is no natural vegetation; only roadside vegetation exists such as the Buddha tree (*Polyalthialongifolia*), Mango (*Mangifera indica*), Ironwood (*Mesuaferrea L*) and etc. Few number resident birds like House Crow (*CorvusSplendens*), Large-billed crow (*Corvusmacrorhynchos*), House Sparrow (*Passer domesticus*) etc., are observed there. A park named “Panthokunjo” exists around ten feet away from the selected cable route.



Source: JICA Survey Team (CEGIS)

Figure 6-21 View of Panthokunjo park beside the selected underground cable route



Source: JICA Survey Team (CEGIS)

Figure 6-22 View of roadside vegetation beside the selected underground cable route

6.3.2.4 Land Use

1) Kawranbazar UGSS area

The proposed UGSS is going to be built at Kawranbazar. The present condition of the starting point, Garden Road, is very narrow and congested in a dense commercial area where the Bashundhara City Shopping Complex is located next to the UGSS site. During office hours traffic jam is quite common.

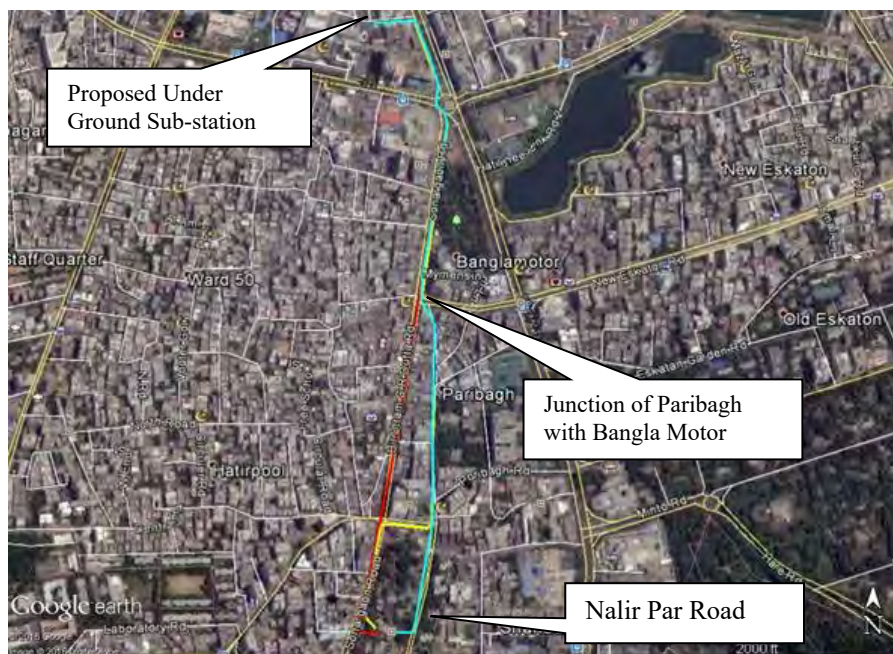


Source: JICA Survey Team (CEGIS)

Map 6-4: Location of Proposed 132/33 kV and 33/11 kV Compact UGSS

2) Underground cable route

The final route for the underground cable line is depicted in Map 6-5. The project area falls under Dhaka South City Corporation, highly commercial and residential area. The proposed 132 kV line will start from Dhanmondi substation of Shahbakh Thana and end at Kawranbazar UGSS. The roadway of the cable is Paribagh link road - Banglamotor point (Mor) - Sonargaon Road - Kawranbazar point (Mor) - Kazi Nazrul Islam Ave - Garden Road. The main road of Kawranbazar is one of the busiest roads in the city, and traffic jams there are in terrible situation.



Source: JICA Survey Team (CEGIS)

Map 6-5: Route of the Underground Cable



Paribagh Shah Shaheb Lane (Link Road)

Paribagh,
Rd

Sonargaon

Kawranbazar Mor

Source: JICA Survey Team (CEGIS)

Figure 6-23 Roadway scenario of the Project area

6.3.2.5 Demographic Features

The areas falling under the starting point (Shahbagh) to the ending point (Kawranbazar) are regarded as the project area¹². The project area covers three wards of three Thanas, Ward No. 57 under Shahbagh, Ward No. 39 under Tejgaon and Ward No. 50 under Kalabagan Thana. Data shows that 36% area of Ward No. 57, 7% of Ward No. 39 and only 2% of Ward No. 50 falls within the project area. The following table shows proportionate distribution of the project area in percentile in terms of Ward.

Table 6-22 Administrative Units within the Project area

District	Thana	Ward	Ratio of project area (%)
Dhaka	Shahbagh	Ward No. 57	36
	Tejgaon	Ward No. 39	7
	Kalabagan	Ward No. 50	2

Source: GIS Spatial Analysis, CEGIS

The exact location of the proposed UGSS falls under the Garden Road, Poschim Tejturi Bazar of Kawranbazar, Tejgaon. The project location is surrounded by high-rise commercial buildings. The Bashundhara Shopping Center is situated just beside the project boundary. The area is a commercial center, along which three DPDC quarters with 25 families and a structure used for prayer are founded within the site.

¹² The project area is presumed as 50-meter buffer area surrounding to the cable route along with the proposed underground substation.



Source: JICA Survey Team (CEGIS)

Figure 6-24 **Bashundhara Shopping Center
(behind the project location)**



Source: JICA Survey Team (CEGIS)

Figure 6-25 **Existing quarters
(inside the project boundary)**

According to the Population and Housing Census 2011, total population of the project area is 18,066, of whom 11,444 are male and 6,621 are female and number of total household is 2,487. The sex ratio of male and female of the project area is 173. It is found that in both study and project area the highest percentage of households comprises four persons in each.

Table 6-23 **Demographic information of the project area**

Ward	Household	Population			Sex Ratio
		Both	Male	Female	
Ward No. 57	1,380	12,065	7,869	4,196	188
Ward No. 39	854	4,751	2,852	1,900	150
Ward No. 50	253	1,250	724	526	138
Total	2,487	18,066	11,445	6,622	173

Source: Population and Housing Census 2011, Bangladesh Bureau of Statistics, 2012 and JICA Survey Team (CEGIS)

6.3.2.6 Employment

- Employment Status

In the project area, total number of economically active population is 1,634, out of whom 1,002 (61%) are employed (male: 610 (37%), female: 392 (24%)). Those who engage in household works is 351 (22%). 276 (17%) are not involved in any type of work, and no population is found who look for jobs.

People in the project area are mainly engaged in service oriented job. 874 (88%) people are engaged in service sector (male: 527(53%), female: 347 (35%)). In industrial activities, 109 (11%) people are engaged. People engaged in agricultural sector are small 18 (1%).

- Labor Availability and Wage Rate

Labor engagement in agricultural activities is not found in the surroundings of the project area. Male labor engagement is found more than that of female in non-farming and industrial activities. In terms of wage rate there some dissimilarity observed between male's and female's. Male labor can get more wages compared to female. In the surrounding area of the Kawranbazar project site, male and female labor involvement in industrial sector is high.

Table 6-24 Labor availability and wage rate in the project surrounding area

Location	Type of Activities	Type of labor	Availability	Wage (Taka)	
				Min.	Max.
Shahbagh	Farming	Male	Nil	0	0
		Female	Nil	0	0
	Non farming	Male	Medium	450	600
		Female	Very low	300	400
	Industrial labor*	Male	Medium	400	600
		Female	Low	300	500
Tejgaon	Farming	Male	Nil	0	0
		Female	Nil	0	0
	Non farming	Male	High	400	600
		Female	Medium	300	400
	Industrial labor*	Male	High	400	800
		Female	High	300	600
Kalabagan	Farming	Male	Nil	0	0
		Female	Nil	0	0
	Non farming	Male	High	300	600
		Female	Medium	250	450
	Industrial labor*	Male	Medium	400	800
		Female	Medium	300	500

Source: JICA Survey Team (CEGIS field visit, 2016)

6.3.2.7 Household Income and Expenditure

People of all classes (classes based on economic level) are found in the DPDC area. According to the field visit in 2016, it is found that majority of households have their income and expenditure between Tk.10,000 to Tk.50,000 per month.

Table 6-25 Distribution of income and expenditure by ranges

Range (Tk./month)	Distribution of Households (%)	
	Income level	Expenditure level
< 5,000	1	5
6,000 - 10,000	5	10
10,000 – 20,000	20	24
20,000 - 30,000	26	24
30,000 - 40,000	18	16
40,000-50,000	14	12
50,000-60,000	10	5
> 60,000	6	4
Total	100	100

Source: JICA Survey Team (CEGIS RRA, 2016)

6.3.2.8 Quality of life

1) Literacy

In the project area 14,499 (85%) people are literate, of which male are 9,639 (89%) and female are 4,859 (80%). Literacy rate in the project area is higher than the whole DPDC Area although there is no school or college found under the project area.

Table 6-26 Literacy rate in the Project Area

Ward	Both		Male		Female	
	Yes	No	Yes	No	Yes	No
Ward No. 57 (Part)	10,423	1,106	7,132	464	3,291	642
Ward No. 39 (Part)	3,149	1,181	1,943	689	1,206	492
Ward No. 50	927	214	564	105	363	109
Total	14,499	2,501	9,639	1,258	4,860	1,243
Percentage (%)	85.3	14.7	88.5	11.5	79.6	20.4

Source: BBS, 2012

2) Access to Health Facilities

Access to health services and facilities refer to availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability. Field data shows that almost every ward under the project area has one clinic/hospital. In case of primary treatment, people of this area are pleased about their local treatment services.



Source: JICA Survey Team (CEGIS)

Figure 6-26 Hospitals under the Project area

3) Housing Condition

In the project area, 2,084 (78%) households are pucca, while 477 (18%) are semi-pucca. There are 34 (1%) households with kutchha houses and 67 (3%) are reported to live in jhupri structures.



Source: JICA Survey Team (CEGIS)

Figure 6-27 Housing Pattern under the Project area

Table 6-27 Housing condition in the project area

Ward	Pucca	Semi-pucca	Kutcha	Jhupri	Total
Ward No. 57	1,240	211	17	10	1,478
Ward No. 39	619	224	14	56	913
Ward No. 50	225	42	3	1	271
Total	2,084	477	34	67	2,662
Percentage (%)	78.3	17.9	1.3	2.5	100.0

Source: BBS, 2012

4) Sanitation

Sanitation situation in the project area is as in the table below.

Table 6-28 Sanitation facilities in the area Project Area

Ward	Sanitary (water-sealed)	Sanitary (non water-sealed)	Non-sanitary	None	Total
Ward No. 57 (Part)	1,417	44	6	9	1,476
Ward No. 39 (Part)	237	617	52	8	914
Ward No. 50	225	45	2	0	272
Total	1,879	706	60	17	2,662
Percentage (%)	70.2	26.5	2.3	1.0	100.0

Source: BBS, 2012

5) Drinking Water

Tap water is the major source of drinking water in the whole project area. Total 2,543 (95%) households under the project area collect drinking water from tap water supplied from Dhaka WASA lines. Those who take water from tube wells are 92 (3.3%), and 26 (1%) depend on other sources. Under the UGSS project site DPDC has its own water pumps.

Table 6-29 Source of Drinking Water in the Project Area

Ward	Tap	Tube-Well	Other	Total
Ward No. 57 (Part)	1,461	6	9	1,476
Ward No. 39 (Part)	825	78	11	914
Ward No. 50	257	9	5	271
Total	2,543	93	25	2,661
Percentage (%)	95.6	3.5	1.0	100.0

Source: BBS, 2012



Tap Water supplied from Dhaka WASA lines

DPDC Own Water Pump

Source: JICA Survey Team (CEGIS)

Figure 6-28 Drinking water source under the UGSS Project site

6) Electricity facility

The electricity coverage of the whole project area is 98.9% in average. Under the project area, every household has electricity in Ward No. 5, 1,459 (98.8%) in Ward No. 57, and 897 (98.2%) in Ward No. 39.

6.4 Stakeholder Meeting

Stakeholder meeting (or public consultation) is mandatory for the IEE and EIA study according to the Guidelines of the DOE, and an option for the Environmental Category B projects according to the JICA Guidelines (April 2010).

During the consultation process, the project intervention for the proposed underground cable route and UGSS, findings of environmental and social survey, and anticipated environmental and social impacts were shared with local people to obtain their perceptions, views, and aspirations to the problems and solutions.

The main objectives for organizing public hearings as part of the environmental assessment were as follows:

- To provide a forum for the proponent to inform the community of the outcome of the environmental assessment of proposed undertakings;
- To verify the accuracy of the IEE findings in relation to the situation on the ground;
- To confirm that all the affected parties and stakeholders have been adequately consulted and have been part of the various decision-making processes;
- To offer the affected and interested parties, as well as other stakeholders, the opportunity to express their opinions on any issues considered outstanding; and
- To find solution for conflict resolution.

A participatory approach was taken for the meetings;

- To provide key Project information and create awareness among various stakeholders about project intervention
- To understand socio-economic, agricultural, hydrological, fisheries, and ecological issues were discussed in detail, including potential impacts of the interventions on the environmental and social parameters
- To get an overview on Institutional issues regarding people's opinions and suggestions freely.

6.4.1 DESCO Area

(1) Participants

Participants in the meetings with their ages, occupations are listed in the table below:

Table 6-30 Venue, Date and time of PCMs (DESCO)

Date	Time	Meeting place	Stakeholders	No of Attendance	Age distribution
11 Jul 2016	3:11 PM	DESCO sub-station, Gulshan-1	DESCO Officers	4	30s: 1, 40s: 1, 50s: 2
11 Aug 2016	11:30 AM	In front of NLDC Building, Aftab Nagar	Imam, Businessmen, Van driver, shopkeeper, students	16	10s: 3, 20s: 6, 30s: 2, 40s: 3, 50s: 1, 60s: 1
11 Aug 2016	1:00 PM	In front of East West University, Aftab Nagar			

Source: JICA Survey Team (CEGIS)

(2) Findings

People's concerns and suggested solutions were discussed in following table in terms of water resources, biota and ecosystem and socio-economic resources that would be affected due to the project intervention in pre-construction, construction and operation phases of the project.

Table 6-31 People's concerns and suggested solutions

Themes/Topics	Identified problems	Suggested Measures
Water Resources	There are residential buildings and a printing press along the A to D portion of the route (See Map 6-3). Trenching along the road will cause accessibility problems for vehicles.	Trenching to be done along south side of the road alignment as minimum buildings in this side.
Ecology	Low number of vegetation will be damage and local wildlife's movement may be disturbed.	Use low sound emitting machineries for construction and avoid works at night.
Socio-economic	- Traffic problem would create a hazardous situation during the construction of cable route. - Students movement and free will for movement will fall in problem during the construction phase of the project in both route and substation area. - During pre-construction phase, people would be affected by dust allergy due to demolition of building at the project location. - People health would fall at risks during construction phase in both substation and route area.	- To avoid traffic congestion and people's free movement it is better to do work at night when the roads are free. - Avoid construction work at the beginning of school and office hour. - Total area would be covered as precautionary measure to avoid dust allergy problems and accidental events during demolition of existing building at proposed substation site. - Proper safety measure would be taken at the route area during construction phase of the project.

Source: JICA Survey Team (CEGIS)

6.4.2 DPDC Area

6.4.2.1 Participants

Participants in the meetings with their ages, occupations are listed in the table below:

Table 6-32 Venue, Date and time of PCMs (DPDC)

Date	Time	Meeting place	Stakeholders	No of Attendance	Age distribution
11 Jul 2016	11:45 AM	DPDC Office, Kawranbazar	Sub. Assistant Engineer	1	40s: 1
21 Jul 2016	11:00 AM	DPDC Office, Bidyut Bhaban, 1 Abdul Gani Road	Superintending Engineer, Executive Engineer and Assistant Engineer	3	20s: 1, 40s: 1, 50s: 1
14 Aug 2016	1:00 PM	In front of Pantho Kunjo Park, Kawranbazar	Van driver, housewives, rickshaw driver, security guards, shopkeepers, and businessmen	13	20s: 1, 30s: 6, 40s: 4, 50s: 2

Source: JICA Survey Team (CEGIS)

6.4.2.2 Findings

People's concerns and suggested solutions were discussed in following table in terms of water resources, biota and ecosystem and socio-economic resources that would be affected due to the project intervention in pre-construction, construction and operation phases of the project. People of study area showed their positive attitude towards the project, but they also suggested that during construction period of underground cable line, responsible authority should take proper care to control any kind of communication interruption.

Table 6-33 People's concerns and suggested solutions

Themes/Topics	Identified problems	Suggested Measures
Water Resources	- The Paribag junction road is very narrow and condition is very bad. Waste dumping along the road reduces effective width of it. Trenching along the road will create severe problem to pedestrians as well as to the vehicles. - The Kawranbazar bypass road is also narrow and will cause similar problem while trenching along the road.	- The dumped wastes are to be removed prior to the commencement of the UG TL trenching work. - The excavated debris /soils to be placed such that less disturbance are created for pedestrians and vehicles.
Ecology	Existing wild herbs, shrubs and tree (name mention ecology baseline report) are destroyed in proposed underground SS for site preparation.	Create opportunity for tree plantation after construction work at Kawranbazar (Proposed SS) site
Socio-economic	- During the construction stage of underground cable serious traffic problem will be taken place. - During construction period there will be risk at accident of all local people and operators	- Effective traffic control should be initialized. - Extra caution should be taken during construction work at site. - Pictorial Safety signs should be placed at hazardous places. - Ensure Construction during night for avoiding jam. - Inaugurate new bypass road. - Construction work should be started after completion of Mouchak - Malibagh flyover, as traffic congestion goes beyond tolerance level. - Proper security in project area, law enforcing agency should be involved properly. - A neutral monitoring agency should be engaged for monitoring the construction activities. - Construct a foot over bridge in Kawranbazar –Panthopath road, as it is very risky for general people and road accident is very frequent here.

Source: JICA Survey Team (CEGIS)

6.5 Environmental Evaluation

This Paragraph describes the results of predictions and evaluations of the major environmental impact items for the proposed UGSS and underground transmission cable lines.

These predictions and impact evaluations have been made studying mitigation measures for avoiding or mitigating impacts with respect to various forms of environmental items.

6.5.1 Impact Analysis of DESCO Project

The results of the environmental impact assessment are summarized in the following tables for Gulshan UGSS and the planned underground cable line route. There is no item evaluated as “A” (significant positive/negative impact is expected).

Table 6-34 Results of Environmental and Social Evaluation (DESCO)

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
1. Pollution Control	1	Air pollution	B-	D	B-	D	Pre-Construction / Construction phase: Air quality is expected to worsen at the work site and in the surrounding area due to airborne pollutants and dust from the demolition work, removal of debris and construction work. Machinery and vehicles will generate exhaust gas too. The impact however will be temporary and limited to only the surrounding area. Operation phase: Impacts from air pollution are not expected.
	2	Water pollution	B-	D	B-	D	Pre-Construction / Construction phase: There will be wastewater from construction machinery, drainage from vehicle cleaning, muddy water and oil runoff from surface runoff during rainfall, and other water. The wastewater discharge however will be temporary, and they will be collected into Dhaka-WASA's drainage and sewage system to the Salidabad Treatment Plant through the edge of the Hatirjheel Lake and discharged into the Balu the River. Operation phase: Wastewater discharged from the substation will be directly collected into D-WASA's drainage and sewage system so that no water pollution is anticipated.
	3	Waste	B-	B-	B-	D	Pre-Construction / Construction phase: Huge amount of construction wastes will be generated from demolition works and construction activities which may be hazardous to the surrounding area. These wastes should be disposed of safely. Generation of domestic waste from workers is also anticipated. Operation phase: General waste is expected from the buildings in the site. But they will be collected by Dhaka City Corporation regularly so that no harm is anticipated.
	4	Soil Pollution	B-	D	B-	D	Pre-Construction / Construction phase: There could be soil pollution from workers' domestic wastewater, wastewater runoff containing oil from construction machinery or vehicles, and waste. Operation phase: There will be no hazardous waste produced from the project facilities and will not pollute the soil.

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
	5	Noise and Vibration	B-	B+	B-	B+	Pre-Construction / Construction phase: Severe noise and vibration is anticipated from the demolition work, construction work, transportation of vehicles and construction machinery. Operation phase: The existing facilities will be replaced with underground ones and no noise or vibration will be felt on the surface.
	6	Ground Subsidence	D	D	D	D	Pre-Operation / Construction phase: The soil condition is well according to the findings in the boring test. Construction with boring, excavation or pile work will not impact the ground stratum. Operation phase: Impacts to topography and geology are not expected as there is no case of soil fall reported on the existing facilities' site.
	7	Stability of surrounding structures	-	-	B-	D	Pre-Operation phase: There is no impact anticipated. Construction phase: Soil excavation work may cause foundation failure and displacement of the surrounding structures. Architectural and geotechnical investigations of the soil and adjacent buildings' foundations should be monitored. Operation phase: There is no impact anticipated.
	8	Offensive Odors	B-	D	B-	D	Pre-Operation / Construction phase: Domestic waste from workers could produce offensive odors, and it may cause problems to the dwellers and passers-by. Operation phase: No negative impact is anticipated as there is no problem with the current drainage system / waste treatment system.
	9	Sediment	D	D	D	D	Pre-Operation / Construction phase: No sediment will be produced. Operation phase: Given the low chances of sediment runoff into the Gulshan Lake during operation, it is unlikely that sediment deposits could impact the bank material of the lake.
2. Natural Environment	1	Protected Areas	B-	D	D	D	Pre-Operation phase: No specific impact is predicted. Construction phase: The project site has no protected areas, historic or cultural heritage sites, tourist areas, or any natural forests. Potential impact was anticipated to the Gulshan Lake, which is designated by DOE as an Environmental Critical Area (ECA), as underground cable will be installed across and along it. However it turned out in the technical design that there will be no direct / indirect harm anticipated to it as the route will not cross or enter into the lake. Moreover, wastewater generated in the construction phase will be collected and directly connected to Dhaka-WASA's drainage and sewage system. Operation phase: The site has no protected areas, historic or cultural heritage sites, tourist areas, or any natural forests so that no impact is anticipated.
	2	Ecosystem	B-	D	D	D	Pre-Operation phase: No specific impact is predicted. Construction phase: The site has been already levelled and the surrounding area is well developed as both residential and commercial areas. Impacts to the ecosystem are not expected as no rare species have been reported.

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
							Although underground cable will be installed across and along the Gulshan Lake, it tuned out in the technical design that there would be no direct / indirect harm to urban ecosystems anticipated as the route will not cross or enter into the lake. Operation phase: The site and its surrounding are well developed as residential as well as commercial area where no rare species have been reported. Impacts to the surrounding ecosystem are thus not expected by the facility operation.
	3	Hydrology	D	D	D	D	Wastewater collected at the site will be treated and will not impact the hydrology.
	4	Topography and Geology	D	D	D	D	Pre-Construction / Construction phase: Geographical strength is secured at the site, and no data has reported that there is soft ground at the site that may cause soil fall. No impact is thus anticipated on the topography and geology. Operation phases: Impacts to topography and geology are not expected as there is no case of soil fall reported on the existing facilities' site.
3. Social Environment	1	Land Acquisition and Resettlement	B-	D	D	D	Pre-construction phase: The existing substation facilities will be replaced within the present site, which will cause no involuntary resettlement. Construction phase: Temporary requisition of ROW of the underground cable line route will occur, but the impact will remain temporary. As it turned out in the technical design that the route would be laid along the public road and no permanent land acquisition or resettlement would occur. Operation phases: No land acquisition or resettlement is expected after the operation starts.
	2	Right of Way	-	-	B-	D	Construction phase: Temporary requisition such as restriction to access to the surrounding area and traffic block may be forced due to the installation of underground cable. Operation phases: There is no impact anticipated.
	3	Disturbance to Poor People	D	D	D	D	There is no poor settlement reported in the surrounding area.
	4	Disturbance to Ethnic Minority Groups and Indigenous People	D	D	D	D	No ethnic minorities and indigenous people have been found in the surrounding area.
	5	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	B+	B+	B+	B+	Pre-Construction / Construction phases: No adverse impacts to the livelihoods of residents in the site area. It is expected that job opportunities will be available at the demolition / construction site and there is a chance of local employment. Operation phase: No adverse impacts to the livelihoods of residents in the site area. It is expected as an indirect positive impact that their employers will be benefited from stabler power supply.
	6	Land Use and Utilization of Local Resources	B-	D	B-	D	Construction phase: Land use will not change, and no severe impact on local resource usage anticipated. Temporary requisition such as restriction to access to the surrounding area and traffic block may be forced due to the installation of underground cable.

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
							Operation Phase: Land use will not change and there will be no severe impact on local resource usage anticipated.
	7	Disturbance to Water Usage, Water Rights, etc.	D	D	D	D	It is expected that there will be no impact on water use.
	8	Disturbance to the Existing Social Infrastructure and Services	B-	B+	B-	B+	Pre-Construction phase: There will need rearrangement, relocation and removal of existing utilities' facilities (electric lines, gas facilities, water supply and sewage, telecom cables and satellite communication etc.), which may cause service interruption at UGSS site and its surrounding area. But the impact will remain temporary. Construction phase: Installation of underground transmission line will be along the road way, which will hamper regular traffic flows in the ROW. Hatirjheel Lake, roads and buildings will be affected due to project intervention. Movements of vehicles will be restricted that would hinder people's movement. But the impact will remain temporary. Road shall be blocked (if necessary) during night time and such transportation will be conducted accordingly. Transportation of construction materials may induce additional traffic. The transportation of heavy equipment for UGSS will use special vehicle that requires at least 10m wide road to turn. Special traffic control and route adjustment shall be required. Operation phase: Social infrastructures and services could be improved by the improvement of power supply.
	9	Social capital and Local Institutions such as Decision-making Institutions	D	B+	D	B+	Pre-construction / Construction phase: The project is not expected to negatively impact social capital, local decision-making bodies or other social institutions. Operation phase: The project is expected to positively impact social capital, local decision-making bodies and other social institutions for better power supply.
	10	Misdistribution of Benefits and Compensation	D	D	D	D	No parties have been found to receive any special benefits or damages from the project.
	11	Local Conflicts of Interest	D	D	D	D	No local conflicts are expected as this project replaces public facilities with new ones in the given site.
	12	Cultural Heritage	D	D	D	D	The project is not expected to have any direct impact on cultural heritage as there is no item of cultural heritage in the site.
	13	Landscape	D	D	D	D	No impacts will be caused by fences installed during construction period on views and urban landscape as this project replaces public facilities with new ones in the given site at the center of capital.
	14	Gender	D	D	D	D	The project is not expected to have any negative impact on gender relations.
	15	Children's Rights	D	D	D	D	The project is not expected to have any negative impact on gender relations.
	16	Infectious Diseases	B-	D	B-	D	Construction phase: Cough or allergy could be caused by the dust produced during the construction work. Cold infection and/or other

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
4. Others							infections communicated by mosquitoes or other intermediaries could spread among workers. Operation phase: Hygienic environment will not become worse compared with the existing facilities' operation which is to be replaced in the project.
	17	Work Conditions (Including Work Safety)	B-	B+	B-	B+	Construction phase: Workers' health could be impacted by the construction work. Dust could impact respiratory organs and eyes, noises could impact hearing and high temperatures and humidity could be a factor affecting workers' health during hot season. Operation phase: Workers' health could be improved compared with the present situation due to the operation of advanced facilities with better working environment.
	1	Accidents	B-	B-	B-	B-	Construction phase: As the traffic volume in the surrounding area is currently heavy, increase in traffic accidents on and out of the construction site, fire, falling or electrocution, work accidents and sickness can occur. Increase in traffic volume will be caused by the transportation of construction materials and workers. Operation phase: Occupational accidents, fire, electrical accidents, traffic accidents, sickness, and secondary disasters from underdeveloped rescue systems may occur.
	2	Cross-boundary Impact and Climate Change	D	D	D	D	No transboundary environmental impacts are expected. There may be possible air pollution such as dust in the construction work, but its impacts will stay very limited and do no harm to the climate.

Source: JICA Survey Team

Note: A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)

D: No impact is expected.

6.5.2 Impact Analysis of DPDC Project

The results of the environmental impact assessment are summarized in the following tables for Kawranbazar UGSS and the planned underground cable line route.

Table 6-35 Results of Environmental and Social Evaluation (DPDC)

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
1. Pollution	1	Air pollution	B-	D	B-	D	Pre-Construction / Construction phase: Air quality is expected to worsen at the work site and in the surrounding area due to airborne pollutants and dust from the demolition work, removal of debris and construction work. Machinery and vehicles will generate exhaust gas too.

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
							The impact however will be temporary and limited to only the surrounding area. Operation phase: Impacts from air pollution are not expected.
	2	Water pollution	B-	D	B-	D	Pre-Construction / Construction phase: There will be wastewater from construction machinery, drainage from vehicle cleaning, muddy water and oil runoff from surface runoff during rainfall, and other water. The wastewater discharge however will be temporary, and they will be collected into Dhaka-WASA's drainage and sewage system. Operation phase: Wastewater discharged from the substation will be directly collected into D-WASA's drainage and sewage system so that no water pollution is anticipated.
	3	Waste	B-	B-	B-	D	Pre-Construction / Construction phase: Huge amount of construction wastes will be generated from demolition works and construction activities which may be hazardous to the surrounding area. These wastes should be disposed of safely. Generation of domestic waste from workers is also anticipated. Operation phase: General waste is expected from the buildings in the site. But they will be collected by Dhaka City Corporation regularly so that no harm is anticipated.
	4	Soil Pollution	B-	D	B-	D	Pre-Construction / Construction phase: There could be soil pollution from workers' domestic wastewater, wastewater runoff containing oil from construction machinery or vehicles, and waste. Operation phase: There will be no hazardous waste produced from the project facilities and will not pollute the soil.
	5	Noise and Vibration	B-	B+	B-	B+	Pre-Construction / Construction phase: Severe noise and vibration is anticipated from the demolition work, construction work, transportation of vehicles and construction machinery. Operation phase: The existing facilities will be replaced with underground ones and no noise or vibration will be felt on the surface.
	6	Ground Subsidence	D	D	D	D	Pre-Operation / Construction phase: The soil condition is well according to the findings in the boring test. Construction with boring, excavation or pile work will not impact the ground stratum. Operation phase: Impacts to topography and geology are not expected as there is no case of soil fall reported on the existing facilities' site.
	7	Stability of surrounding structures	-	-	B-	D	Pre-Operation phase: There is no impact anticipated. Construction phase: Soil excavation work may cause foundation failure and displacement of the surrounding structures. Architectural and geotechnical investigations of the soil and adjacent buildings' foundations should be monitored. Operation phase: There is no impact anticipated.
	8	Offensive Odors	B-	D	B-	D	Pre-Operation / Construction phase: Domestic waste from workers could produce offensive odors, and it may cause problems to the dwellers and passers-by. Operation phase:

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
2. Natural Environment							No negative impact is anticipated as there is no problem with the current drainage system / waste treatment system.
	9	Sediment	D	D	D	D	Pre-Operation / Construction phase: No sediment will be produced. Operation phase: Given the low chances of sediment runoff during operation, it is unlikely that sediment deposits could impact the bank material.
	1	Protected Areas	D	D	D	D	The project site has no protected areas, historic or cultural heritage sites, tourist areas, or any natural forests. No specific impact is thus predicted.
	2	Ecosystem	D	D	D	D	The site has been already levelled for residential quarters and substation facilities, and the surrounding area is well developed as a commercial area. Impacts to the ecosystem are not expected as no rare species have been reported.
	3	Hydrology	D	D	D	D	The existing water drainage system is in a good condition and there will be no impact to the hydrology as wastewater collected at the site will be well treated.
3. Social Environment	4	Topography and Geology	D	D	D	D	Pre-Construction / Construction phase: Geographical strength is secured at the site, and no data has reported that there is soft ground at the site that may cause soil fall. No impact is thus anticipated on the topography and geology. Operation phases: Impacts to topography and geology are not expected as there is no case of soil fall reported on the existing facilities' site.
	1	Land Acquisition and Resettlement	C-	D	D	D	Pre-construction phase: The existing substation facilities will be replaced within the present site, which will cause no involuntary resettlement. Road clearance in front of substation site was predicted to cause not only requisition of road area from the people who run street shops there, but land acquisition who built their houses on their private land next to the road. It turned out in the social survey that no permanent land acquisition or resettlement will occur as a result of layout design examination. On the other hand, temporary requisition of shops and stands on the Garden Road in front of the substation site will occur and 10 street shops will be temporary relocated during pre-construction and construction phases. . Construction phase: Temporary requisition of ROW of the underground cable line route will occur, but the impact will remain temporary. As it turned out in the technical design that the route would be laid along the public road and no permanent land acquisition or resettlement would occur. Operation phases: No land acquisition or resettlement is expected after the operation starts.
	2	Right of Way	-	-	B-	D	Pre-Construction / Construction phase: Temporary requisition of shops and stands on the Garden Road in front of the substation site will occur and 10 households will be temporary relocated during pre-construction and construction phases. Temporary requisition such as restriction to access to the surrounding area and traffic block may be forced due to the installation of underground cable. Operation phases: There is no impact anticipated.
	3	Disturbance to Poor People	D	D	D	D	There is no poor settlement reported in the surrounding area.

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
	4	Disturbance to Ethnic Minority Groups and Indigenous People	D	D	D	D	No ethnic minorities and indigenous people have been found in the surrounding area.
	5	Deterioration of Local Economy such as Losses of Employment and Livelihood Means	C-	B+	B-/B+	B+	Pre-Construction / Construction phases: It was predicted in the scoping drafts that local market might be affected which lies on the Garden Road in front of the substation site, and that adverse impacts to the livelihoods of people who run street shops and who built their houses in the surrounding area might occur. It turned out in the social survey that no permanent land acquisition or resettlement will occur as a result of layout design examination. On the other hand, temporary requisition of shops and stands on the Garden Road in front of the substation site will occur and 10 street shops will be temporary relocated during pre-construction and construction phases. . It is expected that job opportunities will be available at the demolition / construction site and there is a chance of local employment. Operation phase: No adverse impacts to the livelihoods of residents in the site area. It is expected as an indirect positive impact that their employers will be benefited from stabler power supply.
	6	Land Use and Utilization of Local Resources	B-	D	B-	D	Construction phase: Land use will not change, and no severe impact on local resource usage anticipated. However, road clearance in front of substation site was predicted to cause not only requisition of road area from the people who run street shops there, but land acquisition who built their houses on their private land next to the road. It turned out in the social survey that no permanent land acquisition or resettlement will occur as a result of layout design examination. On the other hand, temporary requisition of shops and stands on the Garden Road in front of the substation site will occur and 10 street shops will be temporary relocated during pre-construction and construction phases. Temporary requisition such as restriction to access to the surrounding area and traffic block may be forced due to the installation of underground cable. Operation Phase: Land use will not change and there will be no severe impact on local resource usage anticipated.
	7	Disturbance to Water Usage, Water Rights, etc.	D	D	D	D	It is expected that there will be no impact on water use.
	8	Disturbance to the Existing Social Infrastructure and Services	B-	B+	B-	B+	Pre-Construction phase: There will need rearrangement, relocation and removal of existing utilities' facilities (electric lines, gas facilities, water supply and sewage, telecom cables and satellite communication etc.), which may cause service interruption at UGSS site and its surrounding area. But the impact will remain temporary. Construction phase: Installation of underground transmission line will be along the road way, which will hamper regular traffic flows in the ROW. Movements of vehicles will be restricted that would hinder people's movement. But the impact will remain

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
							temporary. Road shall be blocked (if necessary) during night time and such transportation will be conducted accordingly. Transportation of construction materials may induce additional traffic. The transportation of heavy equipment for UGSS will use special vehicle that requires at least 10m wide road to turn. Special traffic control and route adjustment shall be required. Operation phase: Social infrastructures and services could be improved by the improvement of power supply.
	9	Social capital and Local Institutions such as Decision-making Institutions	D	B+	D	B+	Pre-construction / Construction phase: The project is not expected to negatively impact social capital, local decision-making bodies or other social institutions. Operation phase: The project is expected to positively impact social capital, local decision-making bodies and other social institutions for better power supply.
	10	Misdistribution of Benefits and Compensation	C-	D	D	D	Pre-Construction / Construction phase: It was predicted in the scoping results that the livelihoods of local merchants might be affected due to the project implementation. The socioeconomic status and tenure condition of the project affected people has been identified in the social survey and no party has been found to receive any special benefits or damages from the project inappropriately. Operation phase: No party has been found to receive any special benefits or damages from the project.
	11	Local Conflicts of Interest	C-	D	D	D	Pre-Construction / Construction phase: It was predicted in the scoping draft that local conflicts of interest might occur among people who occupy the Garden Road for running their street shops and those who build their houses on their private land due to the road clearance in front of substation. It has turned out in the social survey that no permanent land acquisition or resettlement occur. Temporary requisition of street shops will occur until the project completion, but there found no local conflicts of interest anticipated in the stakeholder meeting hosted by DPDC. Operation phase: No local conflicts are expected as this project replaces public facilities with new ones in the given site.
	12	Cultural Heritage	D	D	D	D	The project is not expected to have any direct impact on cultural heritage as there is no item of cultural heritage in the site.
	13	Landscape	D	D	D	D	No impacts will be caused by fences installed during construction period on views and urban landscape as this project replaces public facilities with new ones in the given site at the center of capital.
	14	Gender	D	D	D	D	The project is not expected to have any negative impact on gender relations.
	15	Children's Rights	D	D	D	D	The project is not expected to have any negative impact on gender relations.
	16	Infectious Diseases	B-	D	B-	D	Construction phase: Cough or allergy could be caused by the dust produced during the construction work. Cold infection and/or other infections communicated by mosquitoes or other intermediaries could spread among workers. Operation phase:

Item	No.	Impact	Evaluation based on scoping drafts		Evaluation based on survey results		Results
			Pre- / construction Phase	Operation Phase	Pre- / construction Phase	Operation Phase	
4. Others							Hygienic environment will not become worse compared with the existing facilities' operation which is to be replaced in the project.
	17	Work Conditions (Including Work Safety)	B-	B+	B-	B+	Construction phase: Workers' health could be impacted by the construction work. Dust could impact respiratory organs and eyes, noises could impact hearing and high temperatures and humidity could be a factor affecting workers' health during hot season. Operation phase: Workers' health could be improved compared with the present situation due to the operation of advanced facilities with better working environment.
	1	Accidents	B-	B-	B-	B-	Construction phase: As the traffic volume in the surrounding area is currently heavy, increase in traffic accidents on and out of the construction site, fire, falling or electrocution, work accidents and sickness can occur. Increase in traffic volume will be caused by the transportation of construction materials and workers. Operation phase: Occupational accidents, fire, electrical accidents, traffic accidents, sickness, and secondary disasters from underdeveloped rescue systems may occur.
	2	Cross-boundary Impact and Climate Change	D	D	D	D	No transboundary environmental impacts are expected. There may be possible air pollution such as dust in the construction work, but its impacts will stay very limited and do no harm to the climate.

Source: JICA Survey Team

Note: A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (Further examination is needed, and the impact may be clarified as the study progresses.)

D: No impact is expected.

6.6 Mitigation Measures and Required Budget

The major environmental impacts, mitigation measures, responsible organizations, and budget required to be spent for each environmental item during pre-construction, construction and operation phases for the project are listed in the Environmental Management Plan (EMP) as shown as Table 6-32 for DESCO and Table 6-33 for DPDC.

6.7 Environmental Monitoring Plan

The environmental components to be monitored are those positively or negatively affected, or expected to be affected, by the project implementation. An Environmental Monitoring Plan (EMoP) have been drafted based on EMP in order to provide measurement tools and methods for the said items during pre-construction, construction and operation activities. The purposes of creating an EMP are to confirm that mitigation measures shall reduce any negative impacts on the environment to allowable levels during the construction and operation phase; set up an organization that is responsible for the implementation of monitoring the plan, and; perform appropriate monitoring during the construction and operation phase.

They are shown in Table 6-34 and Table 6-35. The environmental components that will be monitored are those positively or negatively affected, or expected to be affected.

Table 6-36 Environmental Management Plan (DESCO)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Pre-construction Period (Demolition of existing buildings, removal, land preparation, distribution line reconfiguration)									
1	Air Pollution (demolition and removal work)	- Dust in substation site from demolition works of the existing buildings - Exhaust gas from machinery and vehicles used for carrying debris and other wastes	-Ambient Air Quality Standard	-Prevention of dust dispersion and air pollution in the surrounding area	Particulate matter reduction: - spray water on access roads and construction site, especially in the dry season - Enclosure around buildings to be demolished - Using cover sheet on trucks for the transportation of soil -Periodic maintenance and management of all construction machinery and vehicles	- Demolition and removal Site	- Demolition and removal work phase	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO
2	Water Pollution (demolition and removal work)	-Runoff water from construction area -Domestic waste water of workers -Spillage due to inattention and deliberate dumping of wastes	- Wastewater standards	- Prevention of water pollution in the surrounding construction area	-Covering demolition site to minimize rainwater mixed with demolition wastes. Settling tank for excessive construction sludge & waste water - Install proper drainage to DWASA drainage -Prepare septic tanks facilities for workers - Ban on illegal dumping of wastes	-Demolition and removal Site	-Demolition and removal work phase	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO
3	Waste (demolition and removal work)	-Construction waste from construction work -Domestic waste from workers -Hazardous demolition waste such as asbestos..	-Waste Management Rule of the DOE	-Prevention of inappropriate waste disposal	-Conduct separate waste collection and promote recycling and reuse - Appropriate disposal of non-recyclable waste according to rules of Dhaka City Corporation	- Demolition and removal Site , and temporary living quarters for workers	- Demolition and removal work phase	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					-Hazardous waste should be treated under the related regulations				
4	Soil Pollution (demolition and removal work)	-Runoff water from construction area -Domestic waste water of workers -Spillage oil from construction machinery and vehicles used for construction equipment	- Soil Quality standards	- Prevention of soil pollution in the surrounding construction area	- Preventing soil loss by stabilizing any slopes of the construction area with concrete, as necessary based on geological survey -Install proper drainage to DWASA drainage for treatment to prevent soil pollution -Prepare septic tanks facilities for workers; -Spillage oil should be trapped in construction area for treatment	-Demolition and removal Site	-Demolition and removal work phase	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO
5	Noise and vibration (demolition and removal work)	- Noise and vibration by machinery used in demolition works - Noise by vehicles used for removing debris and other wastes, and moving workers	- Noise level standards	-Reduction of noise level from demolition works	- Optimizing construction schedule - Perform demolition works during night time (between 9 PM and 6 AM) -Using low-noise/ low vibration equipment, as much as possible - Limit truck speed	-Demolition and removal Site	-Demolition and removal work phase	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO
6	Existing Social Infrastructure and Services	UG substation site and its adjacent roads	-	- Consideration for services provided through the existing utility facilities (e.g. gas, water supply, telecom.)	-Rearrangement, relocation, and removal of existing utilities' facility to avoid service interruption. -Payment for shifting cost of existing facilities	-UG sub-station site and adjacent road	-Pre-construction phase	Implementation: DESCO: power facility Titas Gas (gas facility), WASA (water supply and sewage), BTCL (telecom cable), Dish authority (satellite communication)	DESCO

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
7	Land Use (Land requisition and traffic congestion)	- Possible access restriction and traffic increase	Temporary requisition such as restriction of access to the surrounding area and traffic blocking may be necessary during the demolition work	- Consideration for footpath, side road crossing etc. - To minimize disturbances of the surrounding area	- Prior public notice of demolition work and its schedule	Gulshan UG SS site	- During demolition work	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO
8	Working Environment (including Occupational Safety)	Labor accidents during demolition and removal of existing facility)	- Handling heavy loads - Electric shocks	- Prevention measures against labor accidents, accidents, and health problems	- Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment - Use facilities and equipment that protects against electric shocks	- Demolition and removal Site	- Demolition and removal work phase	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO
Construction period									
1	Air Pollution	- Dust in substation site as well as ROW of Transmission line sites - Exhaust gas from construction machinery and vehicles used for mobilization of equipments - Air pollution arising from incineration of construction materials	- Ambient Air Quality Standard	- Prevention of air pollution in the surrounding construction area	- spray water on access roads and construction site, especially in the dry season - Using cover sheet on trucks for the transportation of soil - Periodic maintenance and management of all construction machinery and vehicles	- construction area	- During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor
2	Water Pollution	- Runoff water from construction area - Domestic waste water of workers - Spillage due to inattention and	- Wastewater standards	- Prevention of water pollution in the surrounding construction area	- Install proper drainage to DWASA drainage - Prepare septic tanks facilities for workers - Ban on illegal dumping of wastes	- Construction area	- During construction phase	Implementation: Contractor Supervisor: DESCO and its Engineering Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		deliberate dumping of wastes							
3	Waste	-Construction waste from construction work -Domestic waste from workers -Hazardous waste such as dry batteries, etc.	-Waste Management Rule of the DOE	-Prevention of inappropriate waste disposal	-Conduct separate waste collection and promote recycling and reuse - Appropriate disposal of non-recyclable waste according to rules of Dhaka City Corporation -Hazardous waste should be treated under the related regulations	-Construction area specially in labor shed	-During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor
4	Soil Pollution	-Runoff water from construction area -Domestic waste water of workers -Spillage oil from construction machinery and vehicles used for construction equipment	- Soil standards	- Prevention of soil pollution in the surrounding construction area	- Preventing soil loss by stabilizing any slopes of the construction area with concrete, as necessary based on geological survey -Install proper drainage to DWASA drainage for treatment to prevent soil pollution -Prepare septic tanks facilities for workers; -Spillage oil should be trapped in construction area for treatment	- Construction area	- During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor
5	Noise and vibration	- Noise and vibration caused by construction machinery - Noise by vehicles used for mobilization of equipment and workers	- Noise level standards	-Reduction of noise level from construction activities	- Optimizing construction schedule - Perform construction work during night time (between 9 PM and 6 AM), especially piling work -Using low-noise/ low vibration equipment, as much as possible - Limit truck speed	-Construction area	-During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
6	Offensive Odors	-Domestic waste from workers	-Waste Management rule	-Prevention of offensive odors	Prepare septic tanks facilities for workers	-Labor shed	-During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor
7	Stability of surrounding structures	soil excavation	--	Safety of surrounding structures against foundation failure and displacement	Through architectural and geotechnical investigations of the soil and adjacent building foundation	Construction area and its proximity	During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor
8	Protected Areas	Part of UGTL's ROW that touches the border of ecologically critical area's boundary.	Ecological Critical Area	To avoid adverse impact on the protect ECA	Properly care during cable line digging that no mud /soil should not polluted further the Gulshan Lake -Covering worksite to minimize waste water. - Install settling tanks for excessive construction sludge & waste water	UGTL's ROW along Gulshan Lake	-During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor
9	Land Use	- Access restriction of the construction site on the transmission line's ROW	Temporary requisition such as restriction of access to the surrounding area and traffic blocking may be necessary	- Consideration for footpath, side road crossing etc. -To minimize disturbances of the surrounding area	- Acquisition of land usage clearance and relevant regulatory actions approved by Dhaka Metropolitan Police (DMP) and Dhaka City Corporation - Prior public notice of construction schedule - Road shall be blocked during night time, and road cutting may done at less busy period i.e. mid night - While excavation work is in progress, proper site coverage shall be done by temporary fence in order not to do harm to passers-by or car traffics.	Along ROW of UG line and Gulshan UG SS site	-During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
10	Infectious Diseases	- Temporary influx of migrant laborers from outside Dhaka during construction may increase risk of infection	-----	- Consideration of sanitation of local residents	- Establish medical center and implementation of periodic medical check-ups for Labor shed - Provide necessary education and trainings for worker's healthcare	- Construction area	- During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor
11	Working Environment (including Occupational Safety)	Labor accidents	- Handling heavy loads - Working at heights - Electric shocks	- Prevention measures against labor accidents, accidents, and health problems	- Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment - Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads - Keep lifting devices well maintained and perform maintenance checks as appropriate during the construction period - Use facilities and equipment that protects against electric shocks	- Construction area	-During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor
12	Accidents	Traffic accidents and labor accidents due to use of heavy machinery use	Traffic accidents due to land traffic and accident due to heavy machinery use	Prevention of traffic accidents and prevention of accident heavy machinery use	-Traffic accidents due to heavy traffic and equipment - Observation of traffic regulations, installation of traffic signs and education on safe driving - Training safe operation of vehicles	Sub-station construction area and underground transmission line's UG ROW area	- During construction phase	Implementation: Contractor Supervisor: DESCO and its ES Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Operation Period (Operation and maintenance of newly built underground substation, UG transmission lines, and reconfigured distribution lines)									
1	Working Environment (including Occupational Safety)	Labor accidents in distribution switching Labor accidents in Operation and maintenance activities	- Handling heavy loads (e.g. Power cables) - Oxygen deficiency - Electric shocks (power cables, equipment operation)	- Prevention measures against labor accidents, accidents, and health problems	- Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment - Proper maintenance for lifting equipment & tools, and conduct of safety checks prior to work. - Use facilities and equipment that protects against electric shocks	- Worksites for distribution line reconfiguration - UGSS and ROW	- Distribution line reconfiguration phase - During the operation and maintenance work	Implementation: DESCO	DESCO

Source: JICA Survey Team

Table 6-37 Environmental Management Plan (DPDC)

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
Pre-construction Period (Demolition of existing buildings, removal, land preparation, distribution line reconfiguration)									
1	Air Pollution (demolition and removal work)	- Dust in substation site from demolition works of the existing buildings - Exhaust gas from machinery and vehicles used for carrying debris and other wastes	-Ambient Air Quality Standard	-Prevention of dust dispersion and air pollution in the surrounding area	Particulate matter reduction: -water spray on access roads and construction site, especially in the dry season Enclosure around buildings to be demolished - Using cover sheet on trucks for the transportation of soil 2) Gas Reduction -Periodic maintenance and management of all construction machinery and vehicles	-Demolition and removal Site	-Demolition and removal work phase	Implementation: Contractor hired by DPDC Supervisor: DPDC	DPDC
2	Water Pollution (demolition and removal work)	-Runoff water from construction area -Domestic waste water of workers -Spillage due to inattention and deliberate dumping of wastes	- Wastewater standards	- Prevention of water pollution in the surrounding construction area	-Covering demolition site to minimize rainwater mixed with demolition wastes. Settling tank for excessive construction sludge & waste water - Install proper drainage to DWASA drainage -Prepare septic tanks facilities for workers - Ban on illegal dumping of wastes	-Demolition and removal Site	-Demolition and removal work phase	Implementation: Contractor hired by DPDC Supervisor: DPDC	DPDC

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
3	Waste (demolition and removal work)	-Construction waste from construction work -Domestic waste from workers -Hazardous demolition waste such as asbestos.	-Waste Management Rule of the DOE	-Prevention of inappropriate waste disposal	-Conduct separate waste collection and promote recycling and reuse - Appropriate disposal of non-recyclable waste according to rules of Dhaka City Corporation -Hazardous waste should be treated under the related regulations	-Demolition and removal Site , and temporary living quarters for workers	-Demolition and removal work phase	Implementation: Contractor hired by DPDC Supervisor: DPDC	DPDC
4	Soil Pollution (demolition and removal work)	-Runoff water from construction area -Domestic waste water of workers -Spillage oil from construction machinery and vehicles used for construction equipments	- Soil standards	- Prevention of soil pollution in the surrounding construction area	- Preventing soil loss by stabilizing any slopes of the construction area with concrete, as necessary based on geological survey -Install proper drainage to DWASA drainage for treatment to prevent soil pollution -Prepare septic tanks facilities for workers; -Spillage oil should be trapped in construction area for treatment	-Demolition and removal Site	-Demolition and removal work phase	Implementation: Contractor hired by DPDC Supervisor: DPDC	DPDC
5	Noise and vibration (demolition and removal work)	- Noise and vibration by machinery used in demolition works - Noise by vehicles used for removing debris and other wastes, and moving workers	- Noise level standards	-Reduction of noise level from demolition works	-Optimizing construction schedule - Perform demolition works during night time (between 9 PM and 6 AM) -Using low-noise/ low vibration equipment, as much as possible - Limit truck speed	-Demolition and removal Site	-Demolition and removal work phase	Implementation: Contractor hired by DPDC Supervisor: DPDC	DPDC
6	Temporary requisition of surrounding area of substation site	- Access restriction to the demolition site - limited access to adjacent roads	-JICA Guidelines for Environmental and Social Considerations (2010)	- Consideration for the owners of neighboring facilities and residents	- Proper demolition work plan and machinery arrangement to mitigate adverse	-UGSS's adjacent roads for project site	-Pre- construction phase	Implementation: DPDC	DPDC

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
				- Compensation for affected facilities - Consideration for livelihood activities	impacts on neighboring facilities				
7	Existing Social Infrastructure and Services	UG Sub-station Area and its adjacent roads, Underground transmission line's ROW.	-	- Compensation for existing utility facilities (e.g. gas, water supply, telecom.)	-Re-arrangement, relocation, and removal of existing utilities' facility to avoid service interruption. - Compensate / shifting fees for existing facilities	-UG sub-station site and adjacent roads and underground transmission line's ROW.	-Pre- construction phase	Implementation:D PDC: power facility Titas Gas (gas facility), WASA (water supply and sewage), BTCL (telecom cable), Dish authority (satellite communication)	DPDC
8	Working Environment (including Occupational Safety)	Labor accidents during demolition and removal of existing facility)	- Handling heavy loads - Electric shocks	-Prevention measures against labor accidents, accidents, and health problems	- Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment - Use facilities and equipment that protects against electric shocks	-Demolition and removal Site	-Demolition and removal work phase	Implementation: Contractor hired by DPDC Supervisor: DPDC	DPDC
		Labor accidents during distribution reconfiguration				- Worksites for Distribution line reconfiguration	-Distribution line reconfiguration phase	Implementation:D PDC	DPDC
Construction period									
1	Air Pollution	-Dust in substation site as well as ROW of Transmission line sites -Exhaust gas from construction machinery and vehicles used for mobilization of equipment	-Ambient Air Quality Standard	-Prevention of air pollution in the surrounding construction area	- spray water on access roads and construction site, especially in the dry season - Using cover sheet on trucks for the transportation of soil -Periodic maintenance and management of all construction machinery and vehicles	- Construction area	-During construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
		-Air pollution arising from incineration of construction materials							
2	Water Pollution	-Runoff water from construction area -Domestic waste water of workers -Spillage due to inattention and deliberate dumping of wastes	- Wastewater standards	- Prevention of water pollution in the surrounding construction area	-Install proper drainage to DWASA drainage -Prepare septic tanks facilities for workers - Ban on illegal dumping of wastes	- Construction area	- During construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor
3	Waste	-Construction waste from construction work -Domestic waste from workers -Hazardous waste such as dry batteries, etc.	-Waste Management Rule from DOE	-Prevention of inappropriate waste disposal	-Conduct separate waste collection and promote recycling and reuse - Appropriate disposal of non-recyclable waste according to rules of the City Corporation, Dhaka -Hazardous waste should be treated under the related regulations	-Construction area specially in labor shed	-During construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor
4	Soil Pollution	-Runoff water from construction area -Domestic waste water of workers -Spillage oil from construction machinery and vehicles used for construction equipment	-Soil standards	- Prevention of soil pollution in the surrounding construction area	-Preventing soil loss by stabilizing any slopes of the construction area with concrete, as necessary based on geological survey -Install proper drainage to DWASA drainage for treatment to prevent soil pollution -Prepare septic tanks facilities for workers;	- Construction area	-During construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					-Spillage oil should be trapped in construction area for treatment				
5	Noise and vibration	Noise and vibration caused by construction machinery as well as by vehicles used for mobilization of equipment and workers	- Noise level standards	-Reduction of noise level from construction activities	-Optimizing construction schedule - Perform construction work during night time (between 9 PM and 6 AM), especially piling work -Using low-noise/ low vibration equipment, as much as possible - Limit truck speed	-Construction area	-During construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor
6	Offensive Odors	-Domestic waste from workers	-Waste Management rule	-Prevention of offensive odors	Prepare septic tanks facilities for workers	-Labor shed	-During construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor
7	Stability of surrounding structures	soil excavation	--	Safety of surrounding structures against foundation failure and displacement	Through architectural and geotechnical investigations of the soil and adjacent buildings' foundations	Construction site and its proximity	During construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor
8	Local Economy such as employment, livelihood, etc.	-Temporary loss of employment - Changes in the traditional land usage patterns and utilization of local resources	- Employment status of local residents	- Recover and improve local residents' socioeconomic status	- Provide job opportunities to local residents when applicable	- Dwellers along the approach road and UG SS	-Construction phase	Implementation: Contractor Supervisor: DPDC	Expenses included in contract cost by Contractor
9	Land Use (Land requisition and Traffic Congestion)	- Access restriction of the construction site on the transmission line's ROW	Temporary requisition such as restriction of access to the surrounding area and traffic	- Consideration for footpath, side road crossing etc. -To minimize disturbances of the surrounding area	- Acquisition of land usage clearance and relevant regulatory actions approved by Dhaka Metropolitan Police (DMP) and	Along ROW of UG line and Kawranbazar UG SS site	-Construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
			blocking may be necessary		Dhaka City Corporation (DCC) - Prior public notice of construction work - Road shall be blocked at night time, and road cutting may done at less busy period i.e. mid night - While excavation work is in progress, proper site coverage shall be done by temporary fence in order not to do harm to passers-by or car traffics.				
10	Infectious Diseases	- Temporary influx of migrant laborers from outside Dhaka during construction may increase risk of infection	-----	- Consideration of sanitation of local residents	- Establish medical center and implementation of periodic medical check-ups for Labor shed - Provide necessary education and trainings for worker's healthcare	- Construction area	- During construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor
11	Working Environment (including Occupational Safety)	Labor accidents	-Handling heavy loads -Electric shocks	-Prevention measures against labor accidents, accidents, and health problems	- Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment - Inspect and ensure that any lifting devices, such as cranes, are appropriate for expected loads - Keep lifting devices well maintained and perform maintenance checks as appropriate	- Construction area	-Construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor

No	Potential Impact to be Managed	Sources of Potential Impact	Standard of Impact	Objectives	Management Effort	Management Location	Period of Management	Management Institution	Cost
					during the construction period - Use facilities and equipment that protects against electric shocks				
12	Accidents	Traffic accidents	Traffic accidents due to land traffic	Prevention of traffic accidents	-Traffic accidents due to heavy traffic and equipment - Observation of traffic regulations, installation of traffic signs and education on safe driving - Training safe operation of vehicles	Sub-station construction area and underground transmission line's ROW	- During construction phase	Implementation: Contractor Supervisor: DPDC and its ES Consultant	Expenses included in contract cost by Contractor
Operation Period (Operation and maintenance of newly built underground substation, UG transmission lines, and reconfigured distribution lines)									
1	Working Environment (including Occupational Safety)	Labor accidents in distribution switching	-Handling heavy loads (e.g. Power cables) - Oxygen deficiency - Electric shocks (power cables, equipment operation)	- Prevention measures against labor accidents, accidents, and health problems	- Prepare a manual for labor accident prevention including safety education and training - Provide workers with appropriate protective equipment - Proper maintenance for lifting equipment & tools, and conduct of safety checks prior to work. - Use facilities and equipment that protects against electric shocks	- Worksites for Distribution line reconfiguration	- Distribution line reconfiguration phase	Implementation: DPDC	DPDC
		Labor accidents in Operation and maintenance activities				- Operation and maintenance in UGSS and UGTL's ROW	- During the operation and maintenance work	Implementation: DPDC	

Source: JICA Survey Team

Table 6-38 Environmental Monitoring Plan (DESCO)

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
Pre-Construction(Demolition of existing buildings, removal, land preparation, distribution line reconfiguration)									
1	Air Quality (demolition and removal work)	-Dust resulting from demolition works -Exhaust gas from construction machinery and vehicles used for mobilization of equipment	PM10 Ambient Air Quality Standard SO2, NO2	- Obtain Baseline data - Evaluation of effect of the mitigation measures towards air pollution	Collecting samples and analyzing at a lab.	- Demolition and removal Site	1.Once before demolition work 2.Every month for the first two months 3.Adjusted frequency based on the 1&2 results for proper monitoring	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO
2	Water Quality (demolition and removal work)	-Runoff water from construction site -Domestic waste water of workers -Spillage due to inattention and deliberate dumping of wastes -Leakage of oil and chemical materials from construction activity	PH, Oil, Wastewater standards	Evaluation of effect of the mitigation measures towards water pollution	Collecting samples and analyzing at a lab	- Demolition and removal Site	1.Once before demolition work 2.Every month for the first two months 3.Adjusted frequency based on the 1&2 results for proper monitoring	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO
3	Waste (demolition and removal work)	-Construction waste from construction work -Domestic waste from workers -Hazardous waste such as dry batteries, etc.	- Waste Management Rules	- Evaluation of effect of the mitigation measures for waste	-Record of kinds and quantity of waste, and the disposal method	- Demolition and removal Site - Labor dormitory	-Continuous records	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO
4	Soil Pollution (demolition and removal work)	-Runoff water from construction area -Domestic waste water of workers -Spillage oil from construction machinery and vehicles used for construction equipment	Soil Quality standard	Evaluation of effect of the mitigation measures towards water pollution	Collecting samples and analyzing at a lab	- Demolition and removal Site	1.Once before demolition work 2.Once after the completion of demolition and removal work	Implementation: Contractor hired by DESCO Supervisor: DESCO	DESCO

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
Construction Phase									
1	Air Quality	-Dust resulting from construction work -Exhaust gas from construction machinery and vehicles used for mobilization of equipment	PM10 Ambient Air Quality Standard SO2,NO2	Evaluation of effect of the mitigation measures towards air pollution	Collecting samples and analyzing at a lab.	UG SS site at Gulshan	1.Once before construction work 2.Every month for the first two months 3.Adjusted frequency based on the 1&2 results for proper monitoring	Implementation: Contractor: Supervisor: DESCO&ES Consultant	Expenses included in contract cost by Contractor
2	Water Quality	-Runoff water from construction site -Domestic waste water from workers -Improper disposal of waste	PH, Oil, Coliforms, Wastewater standards	Evaluation of effect of the mitigation measures towards water pollution	Collecting sewage samples and analyzing at a lab	UG SS site at Gulshan	Once every three months	Implementation: Contractor: Supervisor: DESCO&ES Consultant	Expenses included in contract cost by Contractor
					Collecting groundwater samples and analyzing at a lab		Once every six months		
3	Waste	-Construction waste from construction work -Domestic waste from workers -Hazardous waste such as dry batteries, etc.	- Waste Management Rules	- Evaluation of effect of the mitigation measures for waste	-Record of kinds and quantity of waste, and the disposal method	-UGSS site at Gulshan	-Continuous records	Implementation: Contractor: Supervisor: DESCO&ES Consultant	Expenses included in contract cost by Contractor
4	Soil Pollution	-Runoff water from construction area -Domestic waste water of workers -Spillage oil from construction machinery and vehicles used for construction equipment	Soil Quality standard	Evaluation of effect of the mitigation measures towards water pollution	Collecting samples and analyzing at a lab	UG SS site at Gulshan	Once before construction work	Implementation: Contractor: Supervisor: DESCO&ES Consultant	Expenses included in contract cost by Contractor

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
5	Noise and Vibration	-Noise and vibration caused by construction machinery -Noise caused by vehicles used for mobilization of equipment and workers	Noise level standards	Evaluation of effect of the mitigation measures towards noise level	Measurement using noise level meter	UG SS site at Gulshan	1.Once before construction work 2.Once every three month 3.Proper monitoring for the potential work , which may influence to public by noise and vibration	Implementation: Contractor: Supervisor: DESCO&ES Consultant	Expenses included in contract cost by Contractor
6	Offensive Odors	-Domestic waste from workers	-Waste Management rule	Evaluation of effect of the mitigation measures towards offensive odors	Spot visiting and FGDs with concern stakeholders	UG SS site at Gulshan	Continuous records	Implementation: Contractor: Supervisor: DESCO&ES Consultant	Expenses included in contract cost by Contractor
7	Stability of Surrounding structure	Soil excavation work	- Building condition - Inclination condition - Subsidence condition	Evaluation of influence for surrounding structure	-Confirmation of the each condition based on construction progress -Record on the each condition	Surrounding structure of UG SS site at Gulshan	1.Once before excavation work 2.Once after excavation work 3.Once after UGSS construction work	Implementation: Contractor: Supervisor: DESCO&ES Consultant	Expenses included in contract cost by Contractor
8	Protected Areas	ROW of Proposed underground TL	Ecological Critical Area	To protect Gulshan Lake	Spot visiting and FGDs with concern stakeholders	UGTL's ROW along Gulshan Lake	During construction phase	Implementation: DESCO	-DESCO
9	Land Use	Road block /cutting due to implementation of s ROW	Temporary requisition such as restriction of access to the surrounding area and traffic blocking may be necessary	- Consideration for footpath, side road crossing etc.. - Consideration of local residents' feelings	- Interviewing affected people	- ROW of UG TL	During construction phase	Implementation: Contractor: Supervisor: DESCO&ES Consultant	Expenses included in contract cost by Contractor
10	Infectious disease	- deterioration of labor health	-health condition	-Monitor the health condition	-Medical check-ups	-Contractor's office	-Twice a year	Implementation: Contractor:	Expenses included

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
		- Spreads of infectious diseases						Supervisor: DESCO&ES Consultant	in contract cost by Contract or
11	Work Environment (Including Work Safety)	- Labor accidents	- Handling heavy loads - Working at heights - Electric shocks	- Evaluation of effect of the work safety plan	- Record of accidents	- Contractor's office	- Once a year	Implementation: Contractor: Supervisor: DESCO&ES Consultant	Expenses included in contract cost by Contract or
12	Accidents	- Traffic accidents	- Land traffic	- Evaluation of effect of traffic schedule	- Record of accidents	- Contractor's office	- Once a year	Implementation: Contractor: Supervisor: DESCO&ES Consultant	Expenses included in contract cost by Contract or.
Operation Period (Distribution line reconfiguration and O&M for UGSS and UG cables)									
1	Work Environment (Including Work Safety)	Labor accidents in distribution switching	- Handling heavy loads - Oxygen deficiency - Electric shocks	- Evaluation of effect of the work safety plan	- Record of accidents	- DESCO's office	- Once a year	DESCO	DESCO
		Labor accidents in Operation and maintenance activities							

Source: JICA Survey Team

Table 6-39 Environmental Monitoring Plan (DPDC)

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
Pre-Construction(Demolition of existing buildings, removal, land preparation, distribution line reconfiguration)									
1	Air Quality (demolition and removal work)	-Dust resulting from demolition works -Exhaust gas from construction machinery and vehicles used for mobilization of equipment	PM10 Ambient Air Quality Standard SO2, NO2	- Obtain Baseline data - Evaluation of effect of the mitigation measures towards air pollution	Collecting samples and analyzing at a lab.	- Within the existing substation site	1.Once before demolition work 2.Every month for the first two months 3.Adjusted frequency based on the 1&2 results for proper monitoring	Implementation: Contractor hired by DPDC Supervisor: DPDC	DPDC
2	Water Quality (demolition and removal work)	-Runoff water from construction site -Domestic waste water of workers -Spillage due to inattention and deliberate dumping of wastes -Leakage of oil and chemical materials from construction activity	PH, Oil, Wastewater standards	Evaluation of effect of the mitigation measures towards water pollution	Collecting samples and analyzing at a lab	- Demolition and removal Site	1.Once before demolition work 2.Every month for the first two months 3.Adjusted frequency based on the 1&2 results for proper monitoring	Implementation: Contractor hired by DPDC Supervisor: DPDC	DPDC
3	Waste (demolition and removal work)	-Construction waste from construction work -Domestic waste from workers -Hazardous waste such as dry batteries, etc.	- Waste Management Rules	- Evaluation of effect of the mitigation measures for waste	-Record of kinds and quantity of waste, and the disposal method	- Demolition and removal Site - Labor dormitory	-Continuous records	Implementation: Contractor hired by DPDC Supervisor: DPDC	DPDC
4	Soil Pollution (demolition and removal work)	-Runoff water from construction area -Domestic waste water of workers -Spillage oil from construction machinery and vehicles used for construction equipment	Soil Quality standard	Evaluation of effect of the mitigation measures towards water pollution	Collecting samples and analyzing at a lab	Kawranbazar UG SS site	-Once before demolition work -Once after demolition work	Implementation: Contractor hired by DPDC Supervisor: DPDC	DPDC

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
Construction Phase									
1	Air Quality	-Dust resulting from construction work -Exhaust gas from construction machinery and vehicles used for mobilization of equipment	PM10 Ambient Air Quality Standard SO2,NO2	Evaluation of effect of the mitigation measures towards air pollution	Collecting samples and analyzing at a lab.	Kawranbazar UG SS site	1.Once before construction work 2.Every month for the first two months 3.Adjusted frequency based on the 1&2 results for proper monitoring	Implementation: Contractor Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor
2	Water Quality	-Runoff water from construction site -Domestic waste water from workers -Improper disposal of waste	PH, Oil, Coliforms, Wastewater standards	Evaluation of effect of the mitigation measures towards water pollution	Collecting sewage samples and analyzing at a lab	Kawranbazar UG SS site	Once every three months	Implementation: Contractor Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor
					Collecting underground water samples and analyzing at a lab		Once every six months		
3	Waste	-Construction waste from construction work -Domestic waste from workers -Hazardous waste such as dry batteries, etc.	- Waste Management Rules	- Evaluation of effect of the mitigation measures for waste	-Record of kinds and quantity of waste, and the disposal method	-Construction area at Kawranbazar	-Continuous records	Implementation: Contractor Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor
4	Soil Pollution	-Runoff water from construction area -Domestic waste water of workers -Spillage oil from construction machinery and vehicles used for construction equipment	Soil Quality standard	Evaluation of effect of the mitigation measures towards water pollution	Collecting samples and analyzing at a lab	Kawranbazar UG SS site	Once before construction work	Implementation: Contractor Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor
5	Noise and Vibration	-Noise and vibration caused by construction machinery	Noise level standards	Evaluation of effect of the mitigation	Measurement using noise level meter	UG SS site at Kawranbazar	1.Once before construction work	Implementation: Contractor	Expenses included in

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
		-Noise caused by vehicles used for mobilization of equipment and workers		measures towards noise level			2.Once every three month 3.Proper monitoring for the potential work , which may influence to public by noise and vibration	Supervisor: DPDC/ES Consultant	contract cost by Contractor
6	Offensive Odors	-Domestic waste from workers	-Waste Management rule	Evaluation of effect of the mitigation measures towards offensive odors	Spot visiting and FGDs with concern stakeholders	UG SS sites at Kawranbazar	Continuous records	Implementation: Contractor Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor
7	Stability of Surrounding structure	Soil excavation work	- Building condition - Inclination condition - Subsidence condition	Evaluation of influence for surrounding structure	-Confirmation of the each condition based on construction progress -Record on the each condition	Surrounding structure of UG SS site at Kawranbazar	1.Once before excavation work 2.Once after excavation work 3.Once after UGSS construction work	Implementation: Contractor Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor
8	Local Economy such as employment, livelihood, etc.	- Deterioration of local socioeconomic status due to the temporary loss of approach road - Changing the traditional land usage patterns and utilization of local resources	-Employment of local livelihood	- Confirmation of affected peoples' socioeconomic situation	-Employment record - Interviewing affected people	-Surrounding UGSS site	During construction phase	Implementation: Contractor Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor
9	Land Use	Road block /cutting due to implementation of Kawranbazar UG SS as well as ROW	Temporary requisition such as restriction of access to the surrounding area and traffic blocking may be necessary	- Consideration for footpath, side road crossing etc. - Consideration of local residents' feelings	- Interviewing affected people	- ROW of UG TL	During construction phase	Implementation: DPDC Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor

No	Significant Impact to be Monitored	Source of Significant Impact	Monitored Parameter	Purpose of the Monitoring	Monitoring Method			Responsible Organization	Cost
					Method of Collecting and Analyzing Data	Location	Duration and Frequency		
10	Infectious disease	- deterioration of labor health - Spreads of infectious diseases	-health condition	-Monitor the health condition	-Medical check-ups	-Contractor's office	-Twice a year	Implementation: Contractor Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor
11	Work Environment (Including Work Safety)	- Labor accidents	- Handling heavy loads - Working at heights - Electric shocks	- Evaluation of effect of the work safety plan	- Record of accidents	- Contractor's office	- Once a year	Implementation: Contractor Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor
12	Accidents	- Traffic accidents	- Land traffic	- Evaluation of effect of traffic schedule	- Record of accidents	- Contractor's office	- Once a year	Implementation: Contractor Supervisor: DPDC/ES Consultant	Expenses included in contract cost by Contractor.
Operation Period (Distribution line reconfiguration and O&M for UGSS and UG cables)									
1	Work Environment (Including Work Safety)	Labor accidents in distribution switching	- Handling heavy loads - Working at heights - Electric shocks	- Evaluation of effect of the work safety plan	- Record of accidents	- Contractor's office	- Once a year	DPDC	DPDC
		Labor accidents in Operation and maintenance activities							

Source: JICA Survey Team

6.8 Implementation Mechanism

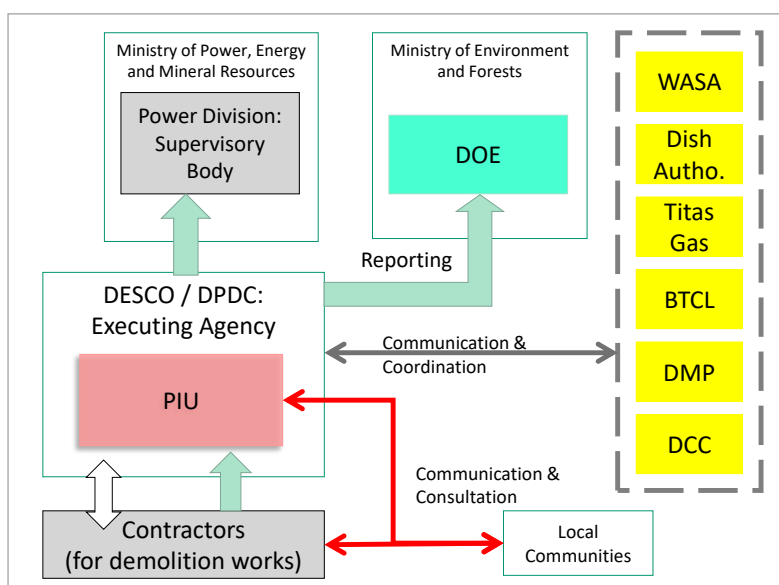
6.8.1 Pre-Construction Stage

The Project Implementation Unit (PIU) of DESCO/DPDC, shall take care for all pre-construction activities and the contractor will take all the necessary mitigation measures.

When demolition work of the existing buildings and removal of debris are conducted, in which a large inflow of workers and vehicles is predicted, the PIU shall inform the surrounding community of the content and schedule of such activity and mitigation measures, and obtain local people's opinions and change the mitigation measures as appropriate.

The PIU shall hold explanation sessions with the local people and submit reports to the DOE and communicate with relevant organizations for utility coordination.

The following figure describes the implementation mechanism of the environmental management and monitoring implementation structure with reporting flow.



Source: JICA Survey Team

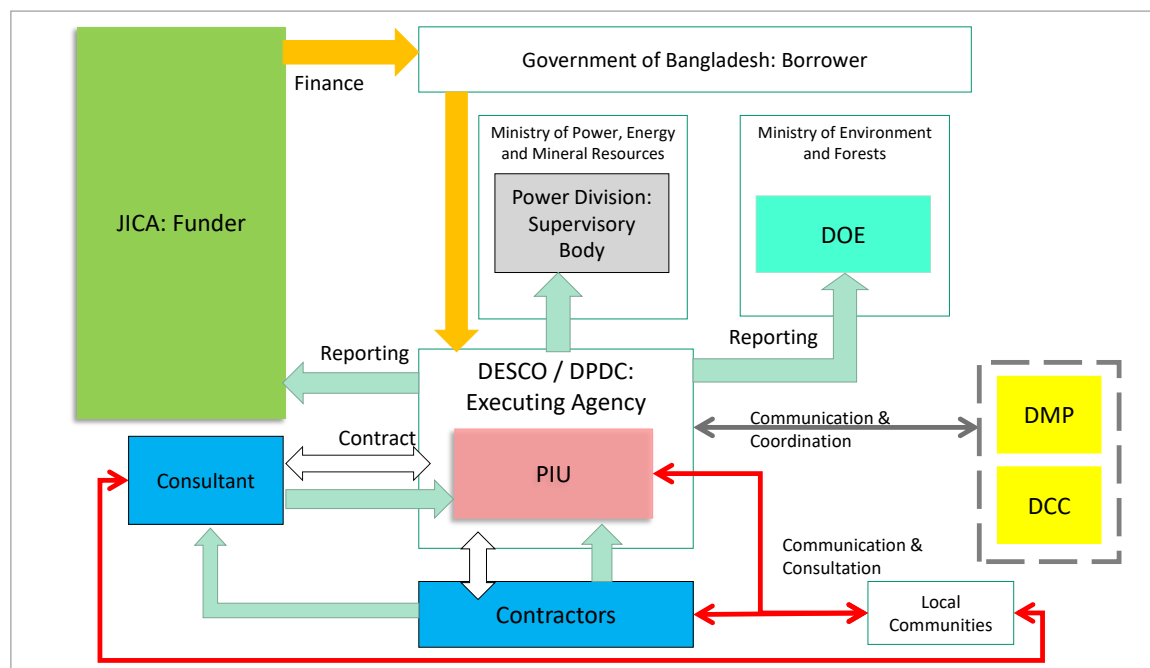
Figure 6-29 Implementation Mechanism at Pre-Construction Phase

6.8.2 Construction Stage

During construction work, in which a large inflow of workers and vehicles is predicted, the PIU shall inform the surrounding community of the content and schedule of such activity and mitigation measures, and obtain local people's opinions and change the mitigation measures as appropriate. The PIU shall handle all construction activities with the Consultant, and the contractor will take necessary mitigation measures.

The PIU shall hold explanation sessions with local people and submit reports to the DOE, JICA and other relevant organizations about the implementation status of the environmental management and monitoring.

The following figure describes the environmental management and monitoring implementation structure with the reporting flow during construction phase.



Source: JICA Survey Team

Figure 6-30 Implementation Mechanism at Construction Phase

6.8.3 Operation Stage

DESCO/DPDC shall handle operation and maintenance. They shall give a prior notice to the surrounding community on the plan and schedule of on-site maintenance work that may affect them. They shall submit reports to the DOE as required, and communicate with relevant organizations for utility coordination. They hold explanation sessions with the local community when required too.

6.9 Approvals from DOE

The Project is categorized as Red Category according to the Environmental Conservation Rules 1997, which requires an IEE and a comprehensive EIA. The proposed project to be implemented by DESCO and DPDC will require strict compliance with laws, rules and regulations pertinent to the environment in this regard.

Based on the UGSS sites and alignments of underground transmission cable line routes, investigations on soil conditions, natural environment survey, socioeconomic survey and traffic survey were carried out from June 2016 to February 2017. The IEE reports were compiled and

submitted to the DOE in November 2016, for which the DOE provided its approval in February 2017. The official letters are attached in the Chapter 10.

6.10 Action Plan for Social Assistance to the Affected People at DPDC Site

6.10.1 Results of Social Survey in November 2016

The Garden Road (approach road in front of underground substation) is built on a khas / government land. Numerous numbers of structures and shops are built on both sides of the road. Certain numbers of people have set up their floating businesses through possessing some portion of the road without an official permission.

6.10.1.1 Demographical Features of Surveyed Households

The census and asset inventory survey was conducted in November 2016¹³, targeting fifteen owners of street shops and stands who would be likely affected by the road clearance associated to the project implementation.

They are all males and household heads of 70 people in total. 51.4% including all fifteen owners are males and the rest 48.6% are female as shown in the table below.

Table 6-40 Surveyed Households

Demography	No of Surveyed Households	Total Affected Population			Average numbers of people per household
		Male	Female	Total	
Number	15	36	34	70	4.67
Percentage	-	51.4%	48.6%	100.0%	-

Source: Census and IoL survey, CEGIS, 2016

6.10.1.2 Asset Inventory

Household heads of these fifteen households were involved in different types of business.

Out of fifteen shops, cakes, cobbler, eggs, bananas, tea, betel leaves and cigarettes are sold at ten kutcha (non-permanent structures) one box based shops located in the south edge of the Garden Road. They placed tents for preventing rain on their roofs.

The rest five built permanent structures made of concrete located on the north side of the road to run restaurants, a bkash (mobile banking) shop and coffee shop. They extended some portions on the road by stands and tables that are movable.

Table 6-41 Structures and Business of Surveyed Households

Type of Structures	Wall material	Roof material	Type of Shops	Total
Kutcha (temporary material, mostly bamboo)	open	Tent	Cake Shop	2
			Cobbler	1
			Egg and banana Shop	4
			Tea, Paan (Betel leaf) and Cigarette Shop	3

¹³ The survey was conducted on the Garden Road in front of DPDC Office, Kawranbazar on 29 and 30 November 2016.

Type of Structures	Wall material	Roof material	Type of Shops	Total
Pucca (permanent)	brick	Tent + CI sheet	Bkash, Flexi Load Shop (Pre-paid Mobile recharge shop)	1
			Coffee Shop	1
			Restaurant	3
Total				15

Source: Census and IoL survey, CEGIS, 2016

6.10.1.3 Income Levels of Surveyed Households

The monthly incomes of the fifteen households are presented in the table below. The fifteen shop owners are the single income earners of each household. Those with pucca (permanent) structures have better socioeconomic conditions compared to those with kutcha ones.

Table 6-42 Monthly income of the affected people

Range of income (Tk.)	Number of Household		Percentage
	Those with kutcha structures (to be relocated)	Those with pucca structures (not required to move)	
< 10,000)	0		0
10,000 and over (<15,000)	4	1	33.3%
15,000 and over (<20,000)	5	1	40.0%
20,000 and over (<25,000)	1	3	26.7%
Total	10	5	100.0%

Source: Census and IoL survey, CEGIS, 2016

6.10.2 Anticipated Impact caused by the Project and Affected People

6.10.2.1 Land Acquisition

No permanent acquisition of private land is anticipated.

6.10.2.2 Loss of Livelihood Means

Temporary requisition of government road ('Garden Road) will require ten street shoppers to remove their kutcha assets and be away from the current shop spaces on the Garden Road from October 2019 (when the road clearance is expected to start) to Sep 2024 (when the distribution line switching is expected to be over). In this respect, they are regarded as the project affected people.

On the other hand, the rest five engaged in restaurants, bkash (mobile banking) and coffee shop business will be required to move their extended portions into their permanent structures, which will not cost them. The construction work is planned during night time (from mid-night till early morning), which will not make them lose their income either. They are not regarded as the project affected people.

6.10.3 Record of Local Consultation

6.10.3.1 Facts of Public Consultation Meeting

DPDC conducted a local consultation meeting with the affected people on site. All fifteen of them were present. Center for Environmental and Geographic Information Services, CEGIS, one of the local associates of JICA Survey Team, supported DPDC on behalf of JICA Survey Team. The overall objective of the consultations was to disclose the brief description of the project and to gather stakeholder's perception about the project activities.

Table 6-43 Venue, Date and Time of Informal/Formal Consultation Meeting

Meeting place	Types of Consultations	Date	Time	Number of Attendance
DPDC Sub-station Area and DPDC Campus, Kawranbazar	PCM with PAPs	26 Jan 2017	11:00 AM	15

Source: Census and IoL survey, CEGIS, 2016



Source: JICA Survey Team (CEGIS)

Figure 6-31 Formal Consultation Meeting within DPDC Complex, Kawranbazar

6.10.3.2 Findings

- The PAPs were already well aware of the proposed project intervention, since they were informed of it by CEGIS social team during the social survey in November 2016.
- All the affected people to be likely displaced showed no objection to the proposed project.
- They stated they would get prepared to leave the place at any time, without creating any disturbance to the UGSS construction work, before its commencement.



Source: JICA Survey Team (CEGIS)

Figure 6-32 Positive View of the PAPs on the Proposed Project Implementation

- They also mentioned that the project would bring immense benefit to both local people and in general all people of the country through smooth electric supply.
- Some of them expressed a desire for reasonable lump-sum amount of compensation for shifting their established business from there which help them manage the situation easily.
- The business they run in the area is their family's only source of income. They actually had been engaged in the business for the last 7 to 8 years.
- They wanted some sort of assurance from DPDC that after completion of construction work that they would be permitted to reestablish their business in the same place.

6.10.4 Social Assistance Framework and Scope of Compensation

6.10.4.1 Social Assistance Framework

DPDC decided not to declare a cut-off date for fixing the project affected people at the timing of social survey for the following reasons:

- The spaces for the fifteen street shops and stands have been fixed for years.
It has given a highly probable implication that there would be no more space available for an influx of illegal occupants for the sake of compensation.
- The Garden Road is a busy street where numerous numbers of people pass every day.
It has given a highly probable implication that the situation will not allow more people to occupy the road space.
- The demolition work of the existing buildings are planned to start in January 2020.
The road must be cleared three months prior to the commencement of demolition work.
DPDC finds it no problem to allow them to continue their business until then.
- DPDC fully understands the requirements of JICA Guidelines for Environmental and Social Considerations (April 2010).
The demands of the affected people are not mandatory to be fulfilled in the context of Bangladesh as they have no legal ownership. However, their demands do not create any pressure for DPDC. DPDC understands the requirement to compensate / support people whose means of livelihood will be hindered or lost.

Table 6-44 Social Assistance Framework

Type of Loss	Entitled Persons (EP)	No of EP	Entitlements (Compensation Package)	Responsible Organizations
Loss of venues for their street shops	Illegal occupants on the government road	10 HHs	Moving Cost (both ways)	Implementation: Contractor
			Compensation for asset investment (two times)	Supervision & Monitoring: DPDC
			One time assistance for start-up (worth 3 months income)	

Source: JICA Survey Team

6.10.4.2 Compensation and Payment Procedure

Compensation should be given to the affected people by the project. The entitled households are the ten households who will lose the venue for their livelihood means. Their shifting cost and

investing cost for the new street shops shall also be paid. And one time assistance shall be considered. The payment shall be done prior to their relocation.

6.10.4.3 Cost and Financial Sources

The total cost for compensation is estimated as Tk. 1.2 million. The estimation has taken price escalation into consideration at 10.1% annum.

Table 6-45 Compensation Cost (Estimation)

Item	Amount (BDT) (Base year*3)	Estimation of Required Cost (BDT)		TOTAL (A)+(B)
		(A) When relocation*4	(B) When return*5	
1 Moving Cost	5,000	6,673	10,796	17,469
2 Compensation for asset investment*1	108,000	210,872	341,158	552,030
3 One time assistance for start-up*2	460,500	614,599	-	614,599
TOTAL (BDT)		832,144	351,954	1,184,098
Equivalent to JPY (@1.38)		-	-	1,634,055

Source: JICA Survey Team

Note 1: The figure on the base year for “asset investment” (Tk. 108,000) is equivalent to the total amount of the ten affected households’ asset investments that was identified in the social survey at the end of November 2016.

Note 2: The figure on the base year for “one time assistance for start-up” (Tk. 460,500) is worth total amount of the ten households’ three months’ income that was also identified in the said social survey.

Note 3: Base year is the end of 2016. Price escalation is estimated as 10.1%.

Note 4: Timing of relocation is no later than the end of 2019. Moving cost, asset investment cost and the amount of one time assistance are estimated with 3 years’ price escalation taken into consideration.

Note 5: Timing of return to the same place is around the end of 2024. Moving cost and asset investment cost are estimated with 8 years’ price escalation taken into consideration.

6.10.4.4 Implementation Procedures and Schedule

According to the project implementation plan, demolition work of existing structures will commence in January 2020 for six months. The road clearance will take three months prior to it in the last three months of 2019. It is also assumed that it will take another three months for updating the profile of the project affected people, re-estimating the compensation package (cost for their shifting, reinvestment and one time assistance for start-up their business), and completing payment.

The contractor will implement the compensation process supervised and monitored by DPDC.

Table 6-46 Implementation Schedule of Compensation

No.	Activities	2019				2020				2021				2022				2023				2024			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Compensation																									
1	Updates PAP list																								
2	Declare a cut-off date																								
3	Give identify card to the PAPs (that help ensure priorities to their return to the same place)																								
4	Establish a compensation distribution committee at PIU																								
5	Deploy a grievance redress officer on site and establish a committee headed by Project Director																								
6	Make payments to the PAPs																								
Requisition of road in front of Kawranbazar SS																									
7	Clear the road																								
Project Implementation																									
Demolition work, construction work and dist. line switch																									
Operation phase																									
Return of the affected people to the same place (option for them to choose)																									

Source: JICA Survey Team

6.10.4.5 Grievance Redress Mechanism

An officer in charge of environment / social issues will be allocated at the project site for any grievances on temporary requisition of road and relocation of street shops and other assistance. The purpose of deployment of the officer is to promptly address concerns and complaints using a process that is accessible and transparent to the PAPs on the ground level.

A Grievance Redress Committee will be formed in the PIU headed by the Project Director. GRC can be comprised of the following members whose standing is neutral and independent:

- Project Director
- A grievance redress officer
- Local NGO
- Chairman of Union Parishad
- Representatives from the Project Affected Persons (PAPs)
- Local intellectuals
- A representative from JICA Bangladesh Office

6.10.4.6 Monitoring

Reporting, including redress functions, monitoring and evaluation will be implemented by the PIU. The implementation mechanism of social monitoring is same as the environmental monitoring system.

An internal monitoring shall be conducted by DPDC to evaluate the whole process.

6.11 Others

Screening form, monitoring form and environmental checklist, and the DOE official letters for IEE approval are attached in the Chapter 10.

Chapter 7 Financial and Economic Analysis for the Project

7.1 The Scope of the Project to be Evaluated

This project consists of 132/33/11 kV underground substations at Gulshan and Kawran Bazar, 132 kV transmission lines, 33 kV and 11 kV distribution lines, and superstructures on the underground substation sites. The project sites for the underground substations are the site currently used by DESCO, DPDC, and PGCB at Gulshan and the one currently used by DPDC and BPDB at Kawran Bazar. Although the superstructures are not eligible for an ODA loan, IRR is calculated for the superstructures due to their impact on the financial and economic feasibility of this project. For both the Gulshan and the Kawran Bazar substations, FIRR and EIRR are calculated for the whole project, superstructure, and underground substation separately. Although the assumptions in Section 3.9 are used as much as possible for FIRR, this section also reflects the changes caused mainly by the expansion of the substation sites.

7.2 Assumptions for Financial and Economic Analysis

For conducting the financial and economic analysis, the following assumptions are made:

Table 7-1 List of Assumptions for Financial and Economic Analysis

	Gulshan (DESCO)	Kawran Bazar (DPDC)
Maximum Receiving Capacity	240MVA	Same as left
Power Factor	0.90	0.90
Load Factor	0.58	0.57
Distribution/Transmission Loss	8.37%	9.41%
Unit Price of Power Purchase	BDT 5.63/kWh	BDT 5.56/kWh
Unit Price of Power Sales	BDT 6.91/kWh	BDT 6.90/kWh
WTP of Electricity	BDT 7.77/kWh	BDT 7.76/kWh
Rentable Ratio	75%	Same as left
Rentable Area	9,075 m ²	12,128 m ²
Monthly Rent (2016)	BDT 1,194/m ²	BDT 805/m ²
WTP of Monthly Rent (2016)	BDT 1,337/m ²	BDT 820/m ²
O&M Cost (UGSS)	1% of construction p.a.	Same as left
Service Cost (superstructure)	2,910 BDT/m ² p.a.	Same as left
Major Repair (superstructure)	3% of construction / 20 years	Same as left
Project Life	50 years after construction	Same as left
Standard Conversion Factor	0.82	Same as left
Exchange Rate	JPY 105.85/USD BDT 78.41/USD	Same as left

7.3 Calculation of FIRR

7.3.1 Financial Benefit

As in Section 3.4, the financial benefits of this project cover four areas: (1) an increase in distribution revenue, (2) an increase in revenue due to lower distribution loss, (3) rent revenue from real estate business utilizing the superstructures, and (4) a reduction in rent payments via internal use. The commencement of commercial operation is October 2023 for the underground substations and January 2026 for the superstructures in line with the revised implementation schedule.

The unit price of power purchases is estimated by using the data in the FY 2014/2015 financial statements of DESCO and DPDC (the same assumption as in Section 3.4). In addition, the growth rate of power demand uses the same assumption as in Section 3.4 (Gulshan at 12% p.a. and Kawran Bazar at 12% p.a. from 2016 to 2021 and at 10% p.a. after 2021). Given that DPDC's investment in transmission and distribution equipment is progressing, the power factor at Kawran Bazar is assumed to improve to 0.9. The reduction in power distribution loss was estimated at 1.2 GWh per year (the same assumption as in Section 3.9).

For both Gulshan and Kawran Bazar, the superstructures have 13 floors, out of which 11 floors (except for 2 floors for indoor parking space) are utilized for commercial purposes or internal use. In order to be consistent with the latest plan for floor usage, the control center of the substation is located on an underground floor.

On rent revenue and a reduction in rent payments, the same regression models as in Section 3.9 (estimation model for rent and that for an increase in rent) are used. The monthly rent is BDT 110.9/sq. ft. (BDT 1,194/m²) at Gulshan and BDT 74.8/sq. ft. (BDT 805/m²) at Kawran Bazar.

7.3.2 Financial Cost

The capital expenditure consists of (1) civil work, (2) construction work, (3) equipment and materials, (4) demolition, and (5) consulting services. The costs of civil work, construction work, equipment and materials, and consulting services are based on latest information on site areas and review of assumptions. Physical contingency is assumed at 5% of capital expenditure including taxes.

The estimation of electricity purchases is based on the FY 2014/2015 financial statements of DESCO and DPDC (the same assumption as in Section 3.9). O&M expenses for the underground substations (1% of capital expenditure), service cost of superstructures (actual cost in 2016 in Dhaka) and large-scale repairs (3% of construction cost) are based on the same assumptions in Section 3.9.

This section assumes corporate income tax (25% of profit before tax for DESCO, 35% for DPDC). On the estimation of capital expenditure, taxes and duties on import items are estimated at 56%. Additionally, VAT is 6% for the local currency portion of construction and equipment contracts and 15% of consulting services, and corporate income tax is 7% for construction and equipment contracts and 12% of consulting services.

7.3.3 Hurdle Rate/Discount Rate

The project is financially feasible when investment return surpasses WACC. For this reason, WACC is employed as the hurdle rate of the financial analysis. Given that the underground substation accounts for approximately 90% of the capex, it is not appropriate to set the hurdle rate to 10% (real interest rate) or higher.

For the calculation of FIRR, cash flow reflects corporate income tax. WACC also reflects a reduction in the cost of debt due to payment of corporate income tax consistent with the above assumption on cash flow. The cost of debt rests on the on-lending rate from the Bangladesh government to the executing agencies. The cost of equity reflects interview results (DESCO: 20% for superstructure and 15% for UGSS, DPDC: 17% for superstructure and 12% for UGSS) and the weighted average is calculated by using the capex amounts for the superstructure and UGSS. Since both financial benefit and financial cost are on a real basis, both cost of equity and cost of debt are adjusted from nominal to real rates. The assumptions for WACC are as follows:

Table 7-2 Assumptions for WACC

	Debt	Equity
Financing Cost (%)	4%	DESCO: 15.5% DPDC: 12.7%
Currency	Japanese Yen	Bangladesh Taka
Inflation Rate (CPI, 2015)	0.2%	6.1%

Source: JICA Survey Team, IMF “International Financial Statistics Yearbook 2015”

7.3.4 FIRR and NPV

Based on the above assumptions, FIRR for each substation is as follows (see the Appendix section for the data table for the calculation of FIRR):

Gulshan substation: FIRR is 6.30% for the whole project, 10.03% for the superstructure, and 5.74% for the underground substation. All of the FIRR exceeds WACC (5.25%). The Gulshan substation is considered financially feasible.

Kawran Bazar substation: FIRR is 4.80% for the whole project, 6.28% for the superstructure, and 4.53% for the underground substation. All of the FIRR exceeds WACC (4.00%). The Kawran Bazar substation is also considered financially feasible.

Table 7-3 FIRR and NPV for the Project

	Gulshan (DESCO)	Kawran Bazar (DPDC)
FIRR (Whole)	6.30%	4.80%
FIRR (Superstructure)	10.03%	6.28%
FIRR (UGSS)	5.74%	4.53%
NPV (Whole)	17.91 US mil.	17.57 US mil.
NPV (Superstructure)	10.91 US mil.	7.79 US mil.
NPV (UGSS)	7.00 US mil.	9.78 US mil.
WACC	5.25%	4.00%

(Source: JICA Survey Team)

7.3.5 Sensitivity Analysis for FIRR

This section evaluates financial feasibility in the cases when a major change occurs in key variables of the project. The sensitivity analysis assumes that changes in two key variables, (1) revenue and (2) capital expenditure, negatively affect FIRR.

In the case when revenue drops by 10%, FIRR becomes smaller than WACC at both the Gulshan and the Kawran Bazar substations. In the case when revenue drops by 20%, FIRR cannot be calculated because neither substation has a positive cash flow in any year. In the case when capital expenditure is increased by 10%, both the Gulshan and the Kawran Bazar substations can maintain FIRR above WACC. In the case when the capital investment is increased by 20%, the FIRR of the Gulshan substation is still above WACC but that of the Kawran Bazar substation falls slightly below WACC. From the above results, it is obvious that revenue has a significant influence on the feasibility of the project and, thus, electricity tariffs and real estate market conditions are key risk factors in terms of finance.

Table 7-4 Sensitivity Analysis for FIRR

		Gulshan (DESCO)	Kawran Bazar (DPDC)
Revenue	0%	6.30%	4.80%
	-10%	-0.83%	-1.74%
	-20%	N/A	N/A
Capital Expenditure	0%	6.30%	4.80%
	+10%	5.77%	4.36%
	+20%	5.32%	3.98%

Source: JICA Survey Team

7.4 Calculation of EIRR

7.4.1 Economic Benefits

The economic benefits of this project are (1) benefit caused by an increase in power distribution, (2) benefit caused by a reduction in distribution loss, and (3) benefit associated with the use of the superstructure. The commencement dates of commercial operation for the underground substations and the superstructure are based on the same assumptions on which FIRR relies.

On (1) benefit caused by an increase in power distribution, the estimation of the benefit is based on multiplying the power distribution by Willingness-to-Pay (WTP). On (2) benefit caused by a reduction in distribution loss, the estimation of the benefit is based on multiplying the reduction of power loss by WTP. The estimation of WTP uses the following formula¹⁴:

$$WTP = WTP_LB + PE (WTP_UB - WTP_LB)$$

WTP_LB: Lower bound of WTP (actual unit price of electricity in FY2014/15)

WTP_UB: Upper bound of WTP (BPDB's unit price of rental power in FY2014/15)

PE: Price elasticity (ADB's estimation for the Asia region, 0.43)

For estimating the upper bound and lower bound of WTP, it is a relatively reliable method to use the actual payment of electricity. For the lower bound of WTP, the actual unit price of electricity which customers paid to DESCO or DPDC is used. For the upper bound of WTP, the actual unit price of the rental power paid by BPDB is considered a proxy of customers' expense when they generate electricity via a captive power plant. The price elasticity is the one utilized for ADB's SASEC Second Bangladesh-India Electrical Grid Interconnection Project. As a result of the calculation, WTP is estimated at BDT 7.77 /kWh for DESCO and at BDT 7.76 /kWh for DPDC.

On (3) benefit associated with the use of the superstructure, the estimation of the economic benefit is based on multiplying the rentable area of the superstructure by Willingness-to-Pay (WTP). Tenants in buildings near the project sites (Gulshan - 27 samples and Kawran Bazar - 29 samples) were asked the question "How much would you expect to pay for the same size of office space adjacent to Gulshan Circle 1/Bashundhara City Shopping Centre if you needed to move to that location?". A weighted average of their indicated prices was calculated by using the office areas of the respondents. As a result, WTP is estimated at BDT 124.19/sq. ft./month (BDT 1,337/m²/month) in Gulshan and at BDT 76.15 /sq. ft./month (BDT 820/m²/month) in Kawran Bazar.

¹⁴ JBIC (2002) "A manual on IRR calculation for ODA loan projects", JBIC (2007) "THE STUDY ON BHERAMARA COMBINED CYCLE POWER STATION IN BANGLADESH"

7.4.2 Economic Cost

Based on an on-going project of the executing agency, Standard Conversion Factor, which is applied to the local currency portion, is assumed at 0.82. Capital expenditure uses the same assumptions on the project scope and physical contingency in FIRR but taxes (import duties, corporate income tax and VAT) were excluded. In addition, economic cost does not include corporate income tax paid by DESCO and DPDC, which are included in the financial cost.

O&M expenditure for the underground substations, service costs and major repairs for the superstructures use the same assumptions as in the financial cost. The estimated cost of electricity purchase is BPDB's generation cost in FY 2014/15, a proxy of average power generation cost in the power supply system of Bangladesh, plus the wheeling charges actually paid by DESCO and DPDC.

7.4.3 Hurdle Rate/Discount Rate

When the Bangladesh government approves a Development Project Proposal, a social discount rate is assumed at 15% on a real basis. Therefore, the interest rate is considered the hurdle rate/discount rate for this project.

7.4.4 EIRR and NPV

Based on the above assumptions, EIRR for each substation is as follows (see the Appendix section for the data table for the calculation of EIRR):

Gulshan substation: EIRR is 38.35% for the whole project, 16.22% for the superstructure, and 39.90% for the underground substation. All of the EIRR exceeds the social discount rate (15%) set by the Bangladesh government. The Gulshan substation is considered economically feasible

Kawran Bazar substation: EIRR is 27.99% for the whole project, 10.62% for the superstructure, and 29.60% for the underground substation. EIRR of the whole project and that of the underground substations exceed the social discount rate (15%) set by the Bangladesh government and, thus, the whole project and the underground substation are economically feasible. Although EIRR of the superstructure is lower than the aforementioned hurdle rate, it surpasses the lower limit (10%) which multilateral development banks generally impose. Therefore, the superstructure is not considered an investment with unacceptably low feasibility in terms of economics.

Table 7-5 EIRR and NPV for the Project

	Gulshan (DESCO)	Kawran Bazar (DPDC)
EIRR (Whole)	38.35%	27.99%
EIRR (Superstructure)	16.22%	10.62%
EIRR (UGSS)	39.90%	29.60%
NPV (Whole)	106.48 US mil.	65.61 US mil.
NPV (Superstructure)	0.48 US mil.	-2.08 US mil.
NPV (UGSS)	106.00 US mil.	67.69 US mil.
Social Discount Rate	15%	15%

Source: JICA Survey Team

7.4.5 Sensitivity Analysis for EIRR

This section evaluates financial feasibility in the cases when a major change occurs in key variables of the project. The sensitivity analysis assumes that changes in two key variables, (1) economic benefit, and (2) capital expenditure, negatively affect EIRR.

In either of the cases when the economic benefit drops by 10% or by 20%, EIRR exceeds the hurdle rate of 15% for both the Gulshan and the Kawran Bazar substations. In either of the cases when the capital expenditure increases by 10% or by 20%, EIRR exceeds the hurdle rate for both the Gulshan and the Kawran Bazar substations. The increase in capital expenditure has a milder impact on EIRR than the reduction in economic benefit does. In all cases, EIRR exceeds the hurdle rate and this shows that the economic feasibility of this project is robust.

Table 7-6 Sensitivity Analysis for EIRR

		Gulshan (DESCO)	Kawran Bazar (DPDC)
Economic Benefit	0%	38.35%	27.99%
	-10%	33.77%	24.73%
	-20%	28.62%	21.10%
Capital Expenditure	0%	38.35%	27.99%
	+10%	36.05%	26.36%
	+20%	34.03%	24.93%

Source: JICA Survey Team

7.5 Financial Analysis of Executing Agencies

7.5.1 Financial Analysis of DESCO

Based on the financial statements of the past three fiscal years, Debt-to-Equity Ratio has been less than 1 time and the current ratio is always more than two times. The pre-tax profit fluctuates due to the electricity tariff revision and so does Interest Coverage Ratio (ICR). Nevertheless, ICR is currently more than two times and this suggests DESCO earns enough profit to pay the interest expenses. Since DESCO has a healthy balance sheet, it is concluded that the company is financially stable in both the short term and long term.

Table 7-7 Financial Statement Analysis for DESCO

(Unit: Bangladesh Taka)

Income Statement - Important Items			
	FY2013/14	FY2014/15	FY2015/16
Sales	24,993,544,643	27,965,629,581	31,980,488,152
Operating Income	-404,551,778	982,508,188	-59,211,825
Interest Expenses	-320,223,260	-332,517,660	-341,524,780
Net Profit before Tax	926,545,854	1,990,459,182	600,584,561
Net Profit after Tax	668,638,320	1,634,872,109	446,181,845
Balance Sheet - Important Items			
	FY2013/14	FY2014/15	FY2015/16
Non-current Assets	12,547,692,108	13,077,369,673	16,632,707,653
Current Assets	22,858,480,949	25,465,786,914	28,096,500,621
Total Assets	35,406,173,057	38,543,156,587	44,729,208,274
Capital & Reserve	11,296,252,581	12,933,033,214	14,724,191,733
Long-term Liabilities	14,598,934,710	14,587,572,342	18,397,062,237

Current Liabilities	9,510,985,767	11,022,551,032	11,607,954,305
Interest-bearing Debt	9,030,620,214	8,133,297,866	11,291,546,312
Liabilities	24,109,920,477	25,610,123,374	30,005,016,542
Financial Ratio			
	FY2013/14	FY2014/15	FY2015/16
Debt-to-Equity Ratio	0.80	0.63	0.77
Current Ratio	2.40	2.31	2.42
Interest Coverage Ratio (EBIT/Interest Expenses)	3.89	6.99	2.76

Source: DESCO, JICA Survey Team

7.5.2 Financial Analysis of DPDC

The financial statements of the past three fiscal years show the shareholder's fund was quite small in FY 2013/14 but then increased. Low retail electricity tariffs resulted in a decrease of the shareholder's fund and it increased due to the positive operating margin caused by tariff revisions after FY 2014/15. Debt-to-Equity Ratio is improving, though the ratio is still above two times. The current ratio has been around two times, and this suggests that DPDC's financial stability is not an issue in the short-term.

Table 7-8 Financial Statement Analysis for DPDC

(Unit: Bangladesh Taka)

Income Statement - Important Items			
	FY2013/14	FY2014/15	FY2015/16
Operating Revenue	42,579,707,545	47,111,609,006	52,965,542,215
Operating Margin	-671,050,841	1,471,159,295	70,724,876
Financial Expenses	-934,135,740	-154,052,613	-94,329,260
Net Earnings before Tax	-102,614,178	2,802,498,917	1,324,896,716
Net Earnings after Tax	-234,861,018	2,656,707,914	999,011,716
Balance Sheet - Important Items			
	FY2013/14	FY2014/15	FY2015/16
Non-current Assets	38,011,726,604	38,574,848,230	44,798,091,265
Current Assets	33,753,309,649	40,739,492,081	42,987,307,279
Total Assets	71,765,036,253	79,314,340,311	87,785,398,544
Shareholder's Fund	26,480,196	2,340,976,694	12,103,921,554
Long-term Funds	55,559,739,543	53,963,940,108	53,270,729,242
Current Liabilities	16,178,816,514	23,009,423,509	22,410,747,747
Interest-bearing Debt	25,882,197,711	26,203,493,044	25,918,382,762
Liabilities	71,738,556,057	76,973,363,617	75,681,476,989
Financial Ratio			
	FY2013/14	FY2014/15	FY2015/16
Debt-to-Equity Ratio	977.42	11.19	2.14
Current Ratio	2.09	1.77	1.92
Interest Coverage Ratio	0.89	19.19	15.05

Source: DPDC, JICA Survey Team

Chapter 8 Operation and Maintenance after Project Completion

8.1 Monitoring and Evaluation after Project Completion

8.1.1 Project Objectives

The objective of this project is to supply enough electricity to meet an increase of power demand in the project areas via the construction of underground substations in the Dhaka urban area, thereby contributing to economic activities in the project areas, stable power supply in the Dhaka metropolitan area, and improvement of public welfare. In most projects funded by ODA loan, output refers to the infrastructure constructed by the project. While outcome is considered the immediate effects derived from operation of the infrastructure, impact is regarded as the long-term or secondary effects. This framework can be applied to this project as follows:

Output: construction of underground substations in the Dhaka urban area

Outcome: to supply enough electricity to meet an increase of demand in the project areas

Impact: economic activities in the project areas, stable power supply in the Dhaka metropolitan area, and improvement of public welfare

In consideration of the above outline, the following evaluation information should be obtained for assessing the attainment of project objectives in ex-post evaluation:

Output: Status of underground substations at project completion

Outcome: Attainment of targets for Operation and Effect Indicators, Status of Qualitative Effects

Impact: Status of Qualitative Effects, Before/After analysis of reference indicators

The detailed logic model for this project is as follows:

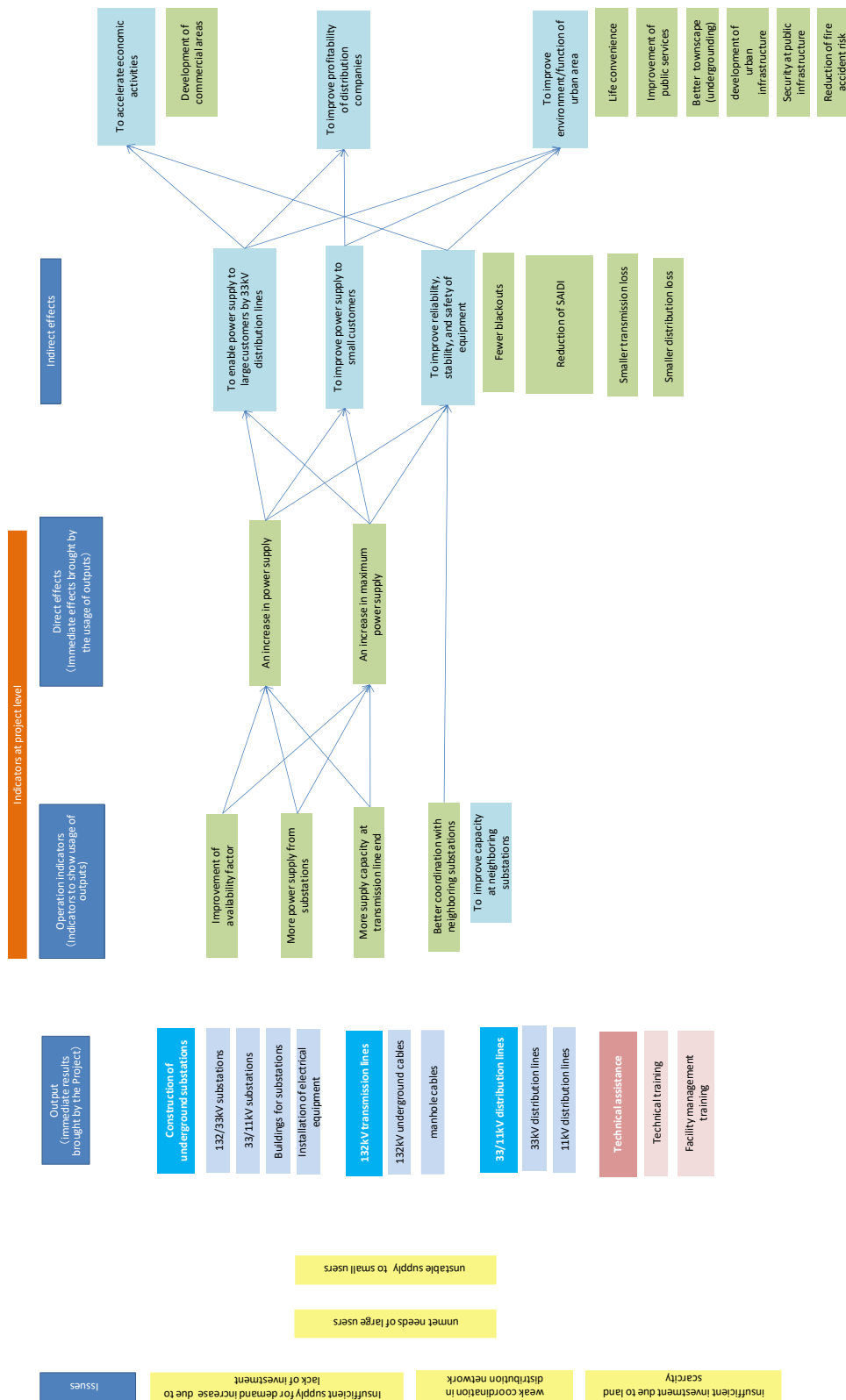


Figure 8-1 Logic Model

8.1.2 Operation and Effect Indicators

Operation and Effect Indicators are chosen for the assessment of quantitative effects after completion of the project. For an ODA loan project, an ex-post evaluation is conducted two years after project completion. In the ex-post evaluation, effectiveness of the project is assessed via the attainment of targets set for Operation and Effect Indicators. Since this project is expected to be completed in 2023, targets for Operation and Effect Indicators are considered attainable in 2025.

For fair judgment of the evaluation, it is desirable to select operation and effect indicators which directly reflect the operational situation of the infrastructure built by the project and, at the same time, are not affected by factors other than the project. As data collection is a cumbersome task, it is unsustainable to establish a data collection scheme for numerous indicators solely for the purpose of monitoring the project's effects. For this reason, selecting several indicators which can be collected routinely in O&M activities at the substations is appropriate. In consideration of the above arguments, appropriate operation and effect indicators are as follows:

Table 8-1 Operation and Effect Indicators

Indicators	Actual (2016)	Target (2025)	Note
Availability Factor (DESCO Gulshan Substation)	0.86	0.61	Maximum Demand (MW) / (Rated Capacity (MVA) x Power Factor)
Availability Factor (DPDC Kawran Bazar Substation)	0.89	0.32	Same as above
Annual Electricity Supply (DESCO Gulshan Substation)	254.6GWh	1,005.6GWh	Measured at the substation
Annual Electricity Supply (DPDC Kawran Bazar Substation)	145.8GWh	513.1GWh	Same as above
Bank Capacity (DESCO Gulshan Substation)	0 MVA	288 MVA	Target: Rated Capacity x 0.8
Bank Capacity (DPDC Kawran Bazar Substation)	0 MVA	288 MVA	Same as above

Source: DESCO, DPDC, JICA Study Team

8.1.3 Qualitative Effects

In addition to the realization of targets for operation and effect indicators, the ex-post evaluation of ODA loan projects assesses the incidence of qualitative effects. The Project is expected to produce the following qualitative effects:

Coordination with neighboring substations: The expansion of transformer capacity via this project will make coordination with neighboring substations easier and the power transmission network is expected to be enhanced. It will be easier to supply electricity to affected areas via the underground substations when accidents occur or when construction is ongoing at neighboring substations. As a result, stability of the power supply over a wider area beyond the project areas is expected.

Stable power supply for households: Distribution companies give priority to large customers. Due to the insufficient capacity of the existing transformers, the supply of electricity to small users such as ordinary households is currently unstable. As the increase of transformer capacity will reduce the availability factor, it is expected that the frequency of blackouts will be reduced among households in the project areas.

Stimulus to service industry: In the project areas, due to the insufficient capacity of transformers, it is difficult to supply to new large customers. Since the project areas are the most prosperous downtown area and the high-end office district in Dhaka, the expansion of transformer capacity will enable power supply to new large customers (such as shopping centers, hotels, and large office buildings). Acceleration of economic activities is expected in the project areas along with development of commercial facilities.

Promotion of urban infrastructure development: This project is to construct the first underground substations in Bangladesh, and these underground substations are expected to be a model case for urban infrastructure development with land restrictions. In the urban policy, more efficient use of underutilized areas is a high-priority task in the Dhaka metropolitan area. This project is expected to trigger a conversion from outdoor substations to underground substations. If this project contributes to the installation of underground transmission and distribution lines, it also contributes to the improvement of the urban landscape.

Improvement of security in substation facilities: Outdoor substations or unclosed indoor substations, which are common in Bangladesh, are easy to access from the outside. However, underground substations are not easily entered from the outside. After terrorist attacks occurred at Gulshan in July 2016, counterterrorism at important facilities became quite important. This project is considered to be a model case for improving the security of substation equipment.

Better living conditions in the project areas: The stabilization of the electricity supply is expected to contribute to (1) convenience of life for ordinary households (reduction of domestic work via the use of home appliances, sanitary preservation of food using refrigerators, utilization of information devices such as TV and PCs) and (2) smooth provision of public services (uninterrupted work at hospitals, schools, and government offices).

8.1.4 Reference Indicators

Reference Indicators which can be obtained for assessment of impact are mentioned below. The data are available from operational data in DESCO or DPDC. It is difficult to set targets for these indicators because of the assumption that this project catalytically accelerates the capacity enhancement of substations in neighboring areas. Since the indicators are affected by factors other than this project, before/after analysis requires precautions at the time of ex-post evaluation.

- a. Reduction of transmission and distribution loss
- b. Reduction of SAIFI in the project areas
- c. Reduction of SAIDI in the project areas

8.2 Project Implementation Scheme

The project implementation scheme for this project is shown as below:

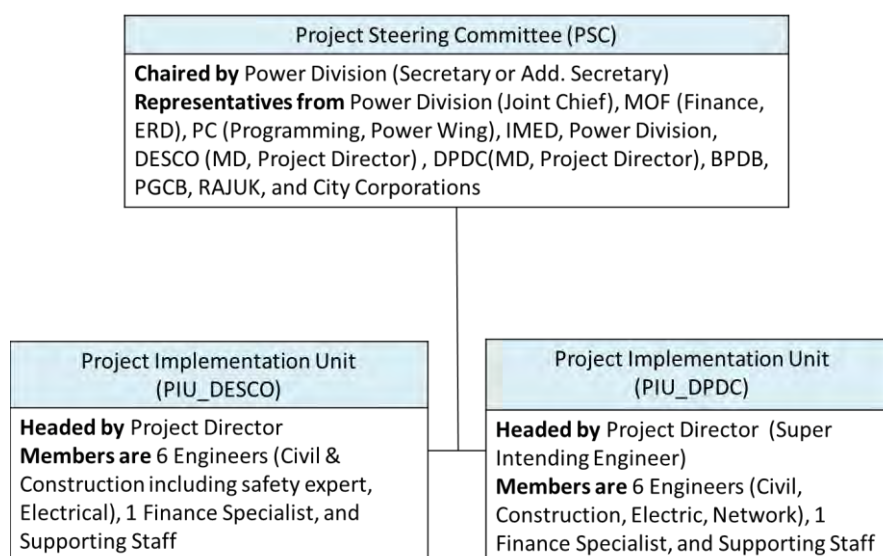
Table 8-2 Project Implementation Scheme

Borrower	The Government of the People's Republic of Bangladesh
Supervision Body	Power Division
Executing Agencies	DESCO, DPDC
Committee	Project Steering Committee
PIU	Each executing agency will establish a PIU.

(Source: DESCO, JICA Survey Team)

In this project, the executing agencies, DESCO and DPDC, will become the main bodies to conduct procurement and contract management on consulting services, civil work, and equipment. Power Division is expected to have a supervisory function and to be reported to periodically on project progress. For ADB's ongoing transmission and distribution project, a Project Steering Committee (PSC) is established to monitor the whole project and for the provision of policy guidance.

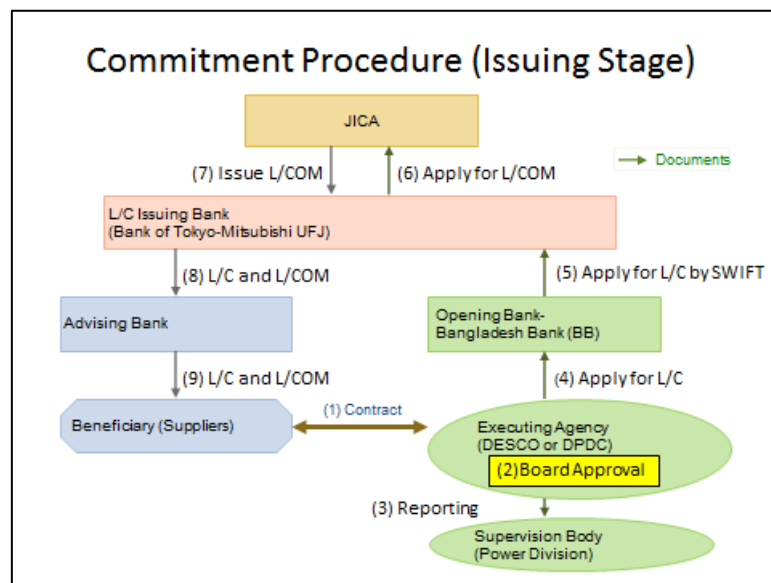
In general, a Project Implementation Unit (PIU) is formed to facilitate smooth loan procedures and project implementation. In this project, each executing agency is expected to have a PIU. The PIU, as the main counterpart of E/S consultants, will play a coordination role within the executing agency. The PIU consists of a Project Director, six engineers (civil, construction, and electric), a financial expert, and a few supporting staff. It is desirable to have one officer who has experience of procurement in each engineering field and to include staff with knowledge of safety facilities in civil and construction fields. The proposed organogram of PSC and PIU is shown in the following figure.



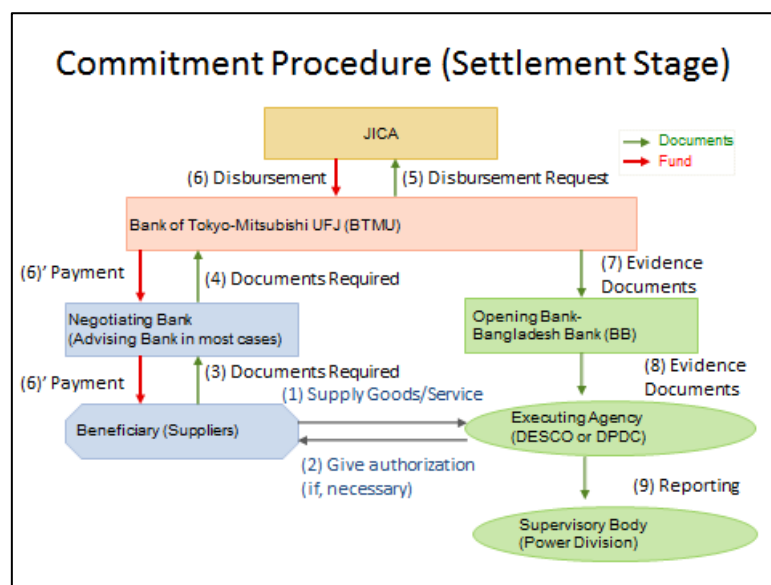
Source: DESCO, JICA Survey Team

Figure 8-2 Organogram of PSC, PIC, PIU

The Government of the People's Republic of Bangladesh is expected to be the borrower for this project and the executing agencies will borrow via an on-lending scheme. While the foreign portion will employ both Commitment Procedure and Transfer Procedure, the local portion will use Transfer Procedure. Both Commitment Procedure and Transfer Procedure are based on the banking arrangements of ongoing ODA loan projects. Since Power Division is expected to have a supervisory function, a reporting step from DESCO or DPDC to Power Division is added. The detailed procedures are shown in the following figures:

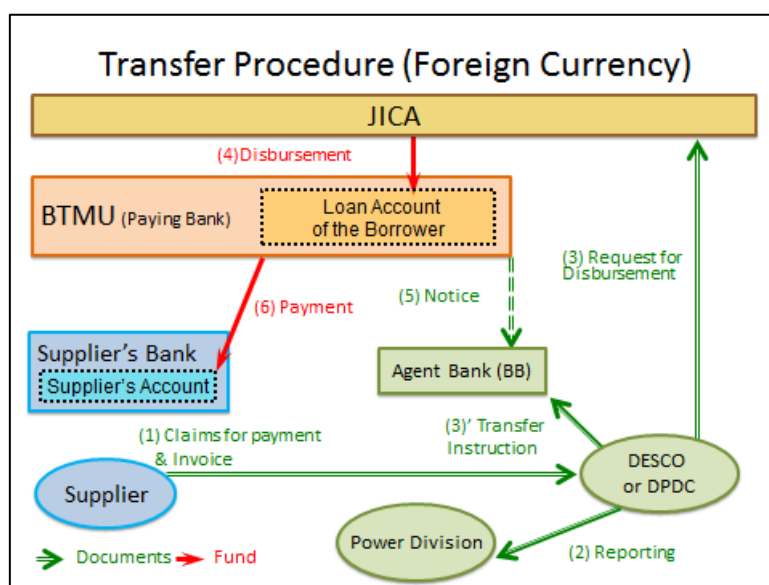


Source: DESCO, JICA Survey Team



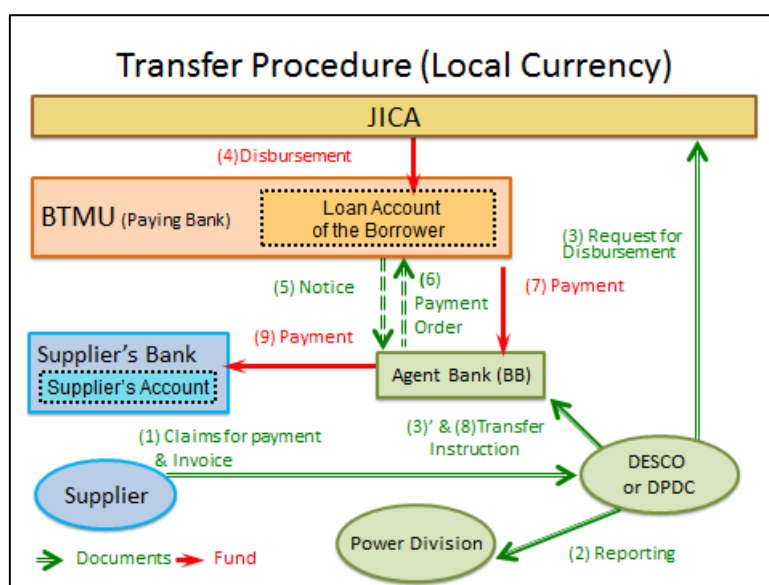
Source: DESCO, JICA Survey Team

Figure 8-3 Procedural Flow for Commitment Procedure (Issuing and Settlement)



Source: DESCO, JICA Survey Team

Figure 8-4 Procedural Flow for Transfer Procedure (Foreign Portion)



Source: DESCO, JICA Survey Team

Figure 8-5 Procedural Flow for Transfer Procedure (Local Portion)

8.3 Engineering Services for the Project

The following tasks are required for the project.

- Detailed Design
- Preparation of bidding document
- Support for tender and contract negotiation by DESCO/DPDC
- Construction Supervisor
- Technical assistant for operation and maintenance

The Terms of Reference (TOR) for the consultant selection is shown in the Appendix. The special points to be considered are as follows.

The project will implement construction of the first underground substation in Bangladesh. It is important for the consultant to recommend a suitable scheme for disaster countermeasures and safety policies, such as evacuation routes, because there are no specific regulations in the Building Code or City Planning Act.

The consultant should provide new viewpoints for Bangladesh, such as compatibility with the superstructure, emergency actions and operation & maintenance for underground substations, because an underground substation is a complex structure including multi-layer floors and a superstructure. In addition, careful supervision is required for safe construction under operation of an existing substation.

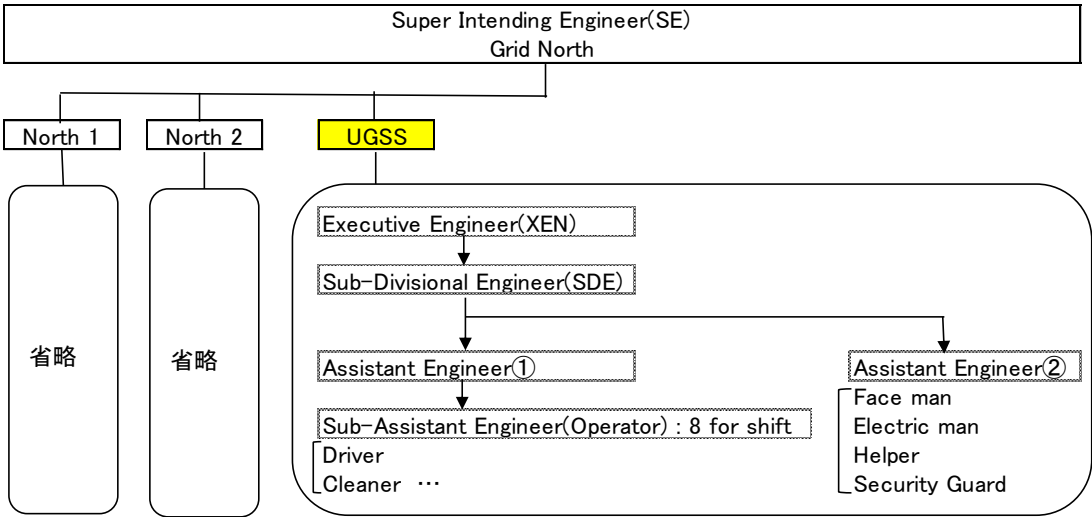
Additionally, the grand-design for the Gulshan site should be considered with related organizations to deal with existing facilities and the future superstructure because the Gulshan project for DESCO affects PGCB and DPDC’s future facilities. The new design for Gulshan SS and TOR for the consultant will be determined according to the grand-design for the Gulshan site. Hence, other consultancy services for the grand-design might be carried out in advance if necessary.

8.4 Operation and Maintenance for the Project’s Underground Substation

The present organization of DESCO/DPDC including O&M, as implementation companies, is shown in Clause 2.2.2. The O&M organization for the underground substations constructed by the project is described in this Clause.

For the new Gulshan substation, a similar organization to the existing substation will be prepared. One shift will consist of four operators.

For the new Kawran Bazar substation, DPDC is considering creating a new unit to monitor the underground substation in the existing Grid North Circle. The composition of the unit is shown below, as per the interview with DPDC.



(Source: Interview with DPDC)

Figure 8-6 (Draft) New O&M Unit for New Kawran Bazar substation

This is the first experience of underground substations in Bangladesh. Hence, some assistance is essential, such as developing human resources for evacuation and initial response in the case of fire, and O&M for the substation building.

Gas Insulated Transformers (GIT) will be employed for the new underground substations. A suitable O&M method should be taught by the Consultant or EPC since a different procedure for gas treatment compared to Gas Insulated Switchgear might be required.

8.5 Operation and Maintenance for the Project's Underground Transmission and Distribution
As for the underground cables for both transmission and distribution, they will be direct-buried type as per typical practice, except for the tunnel portion for cable inlet to underground substation. Hence, the same O&M method will be applied to the project cables. Special O&M techniques and additional units for the project cables will not be required since the existing organization can deal with them.

Manholes and tunnels should be constructed to provide sufficient space to manage a lot of cables near the substation. These facilities are also a first for the country. Therefore, some instruction by the consultant, such for as oxygen measurement and visual inspections, is preferable.

These underground projects require special assistance from both electrical engineers and architects, both of whom have knowledge of underground substations and their building construction design, before the distribution companies hire their engineering consultancies to develop the overall building construction project design in order to acquire RAJUK's approval. The Survey team proposes that JICA assist them with the Supplemental Assistance for Project Implementation scheme. The forms of technical assistance necessary during the project's design stages are design co-ordination between UGSS building and superstructure, power utility's working space study on the ground floor, structural design of the UGSS building to hold the total load of the superstructure, revision of UGSS layout, and cooling system study.

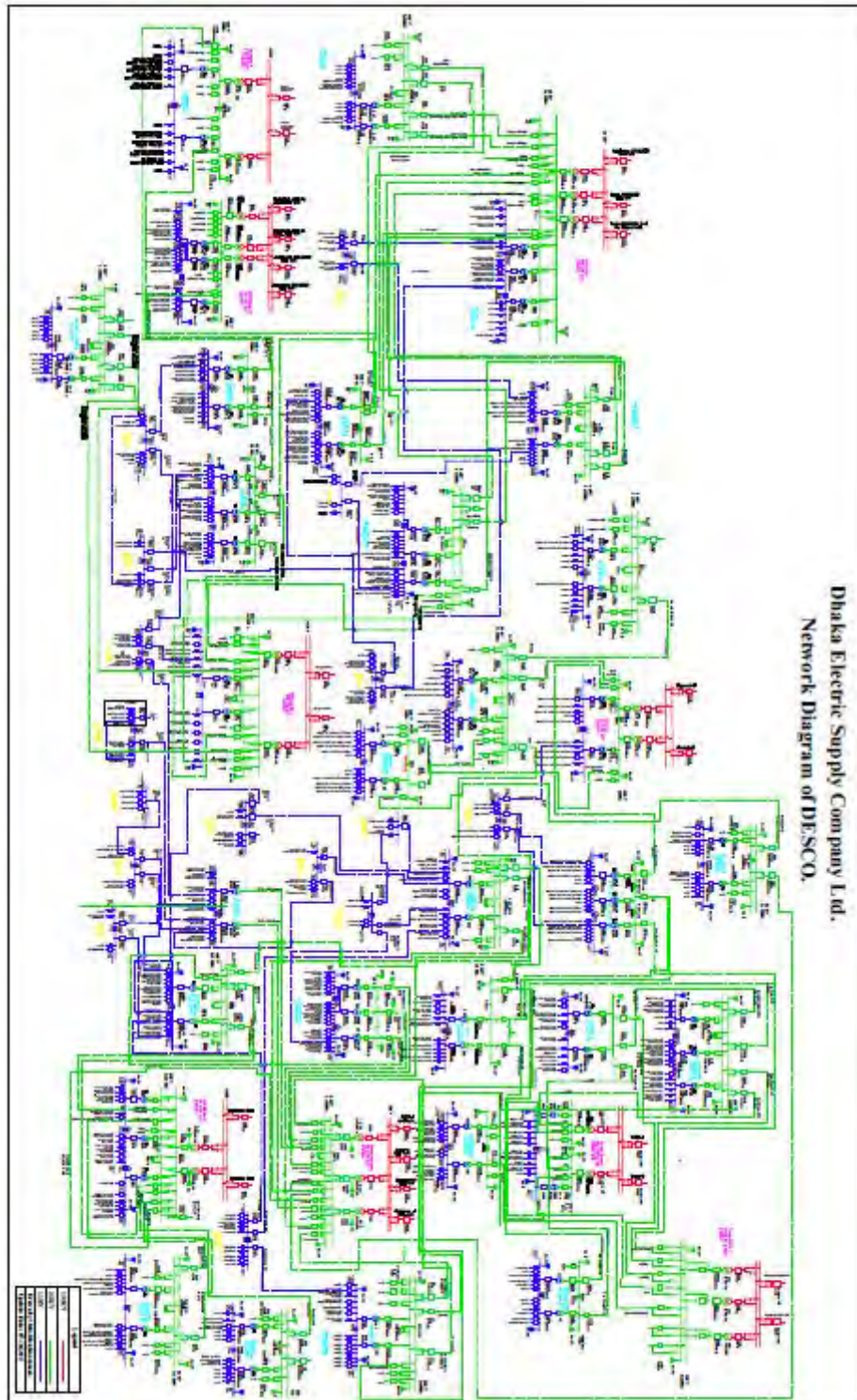
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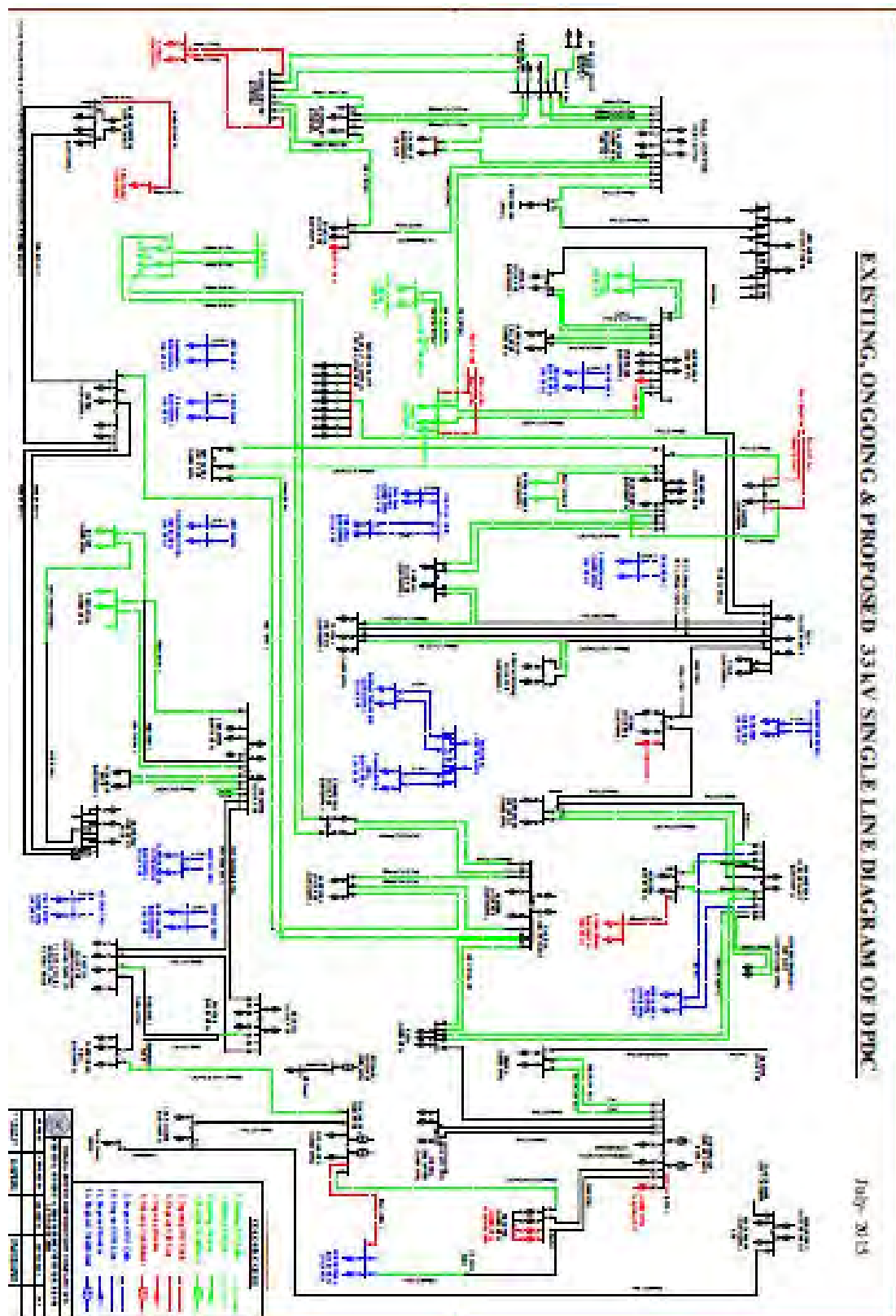
Chapter 10 Appendix

10.1 Network Diagrams

10.1.1 DESCO's network

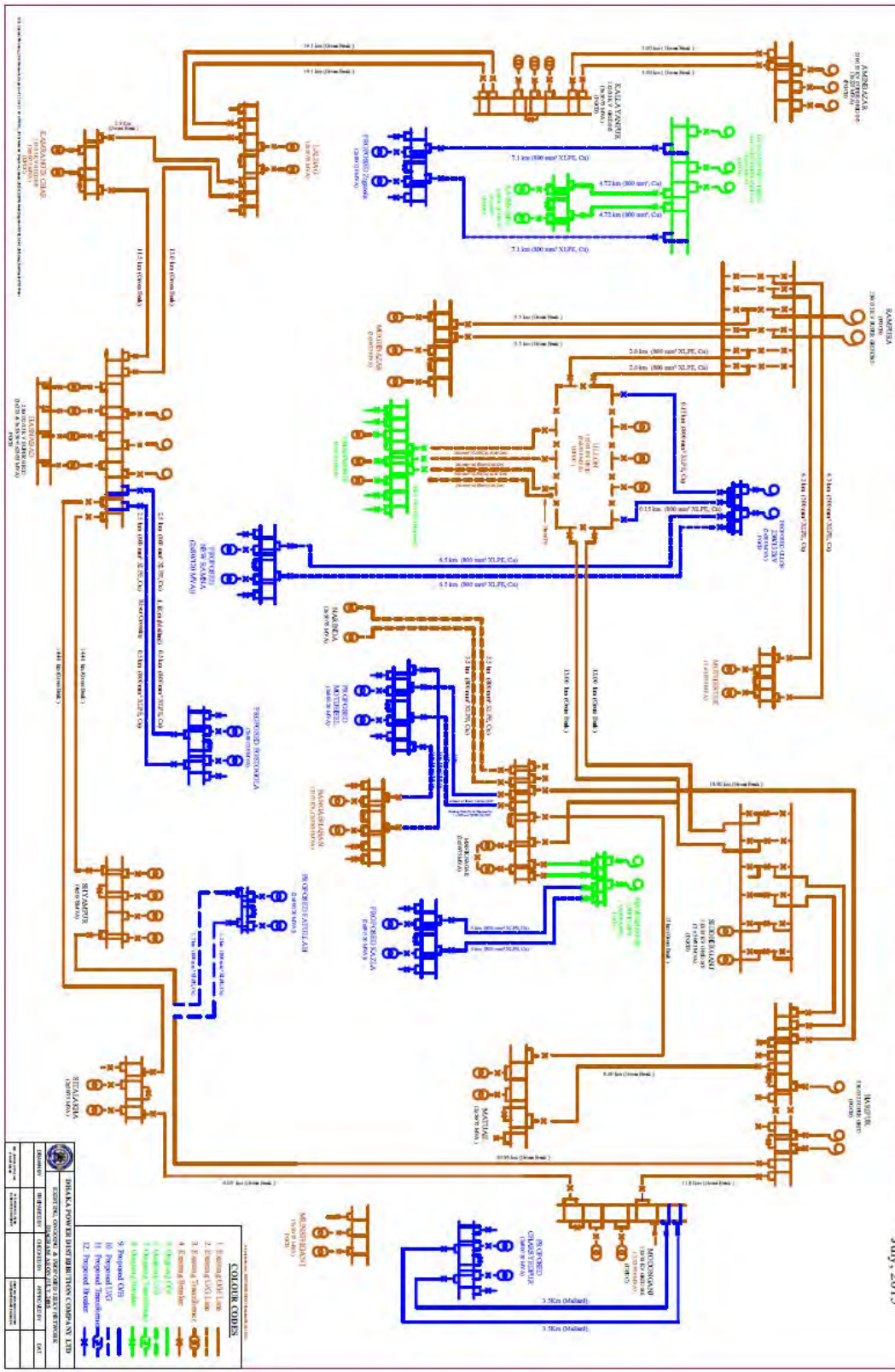


10.1.2 DPDC's network



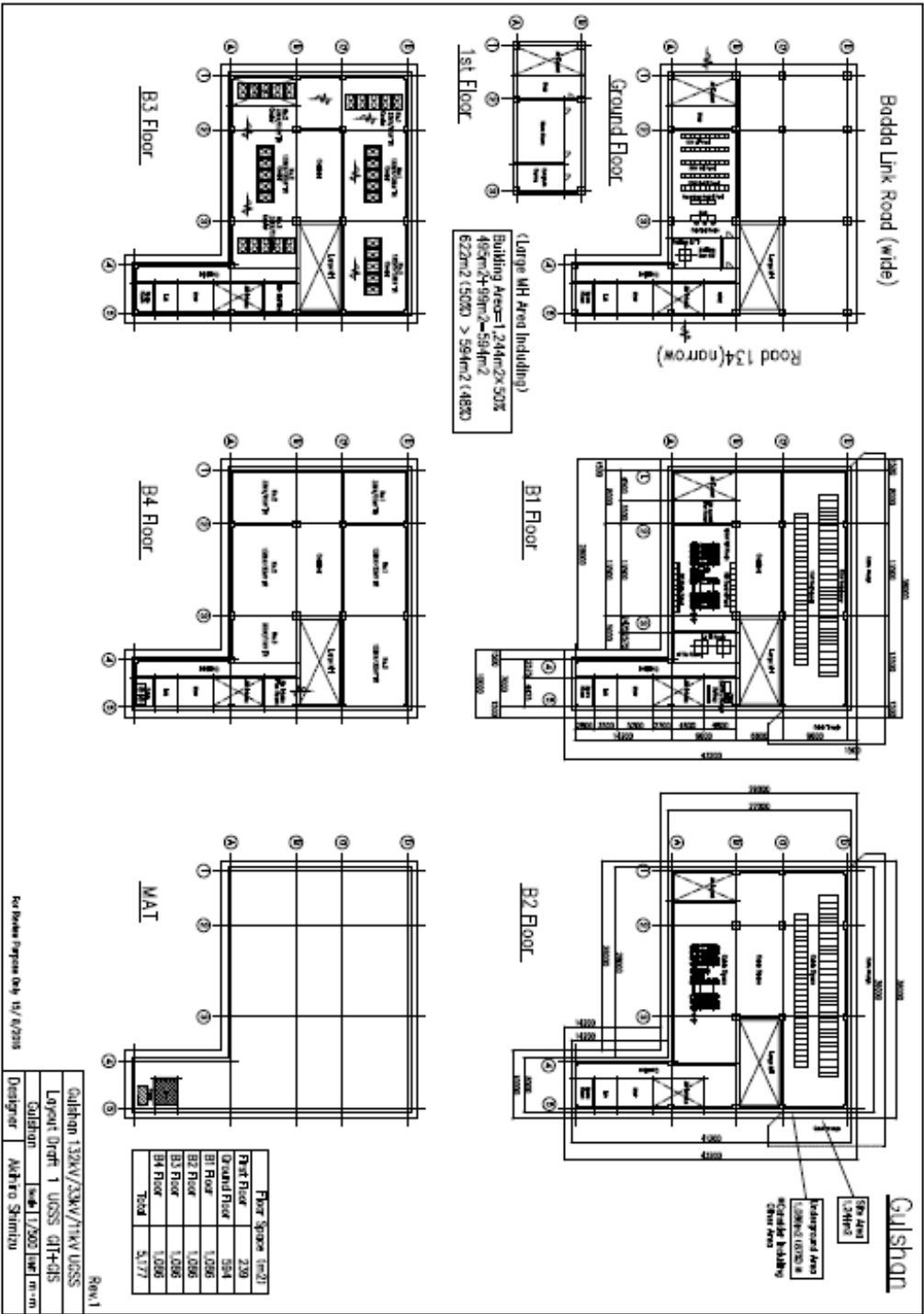
EXISTING, ONGOING & PROPOSED 132KV NETWORK DIAGRAM OF DPDC

July, 2015

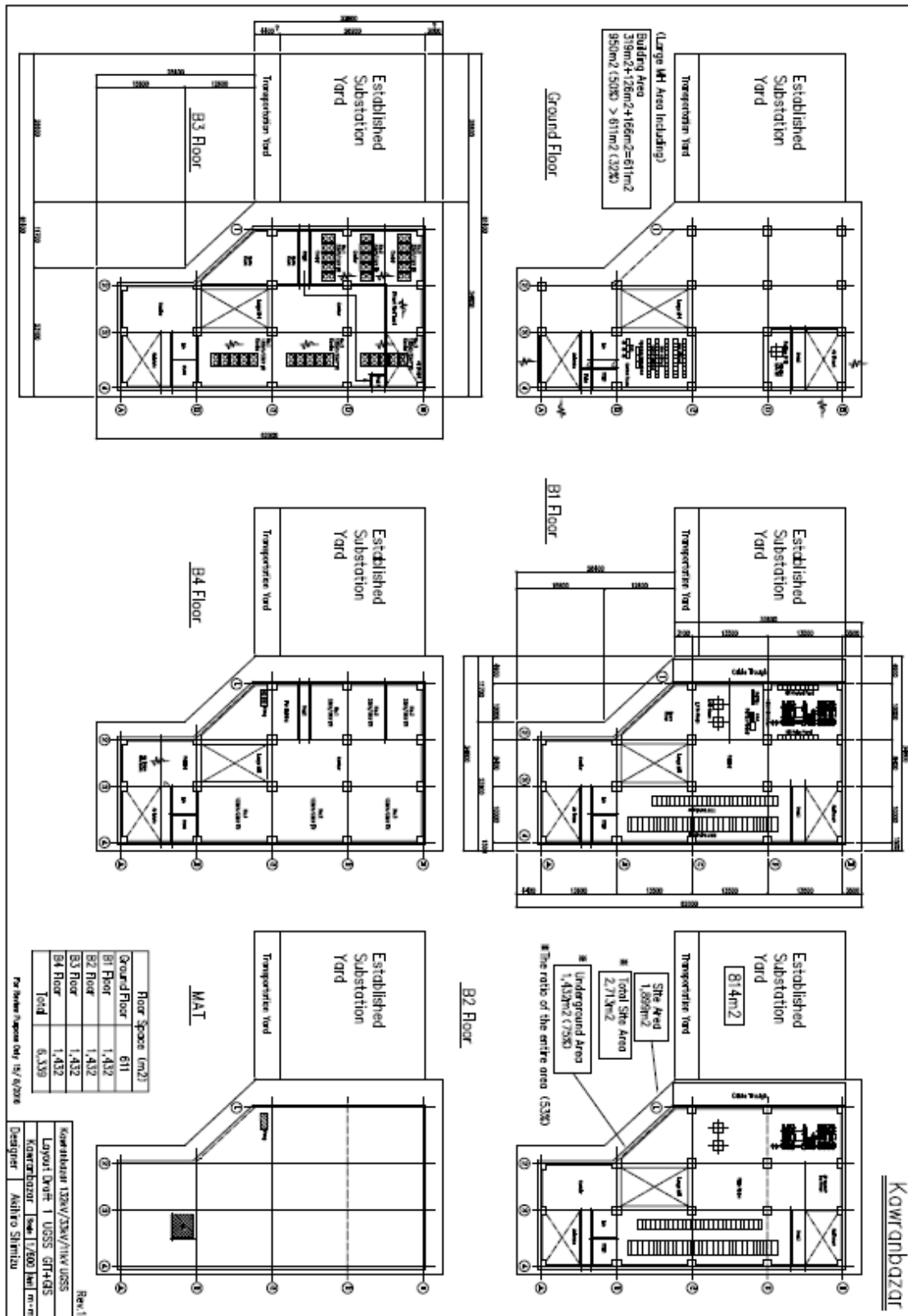


10.2 GIT UGSS layouts for Gulshan and Kawran Bazar

10.2.1 Gulshan GIT UGSS Layout



10.2.2 Kawran Bazar GIT UGSS Layout



10.3 Social and Environmental Screening Forms

10.3.1 DESCO's Screening Format

Name of Proposed Project : Construction of 132/33/11kV Underground Substation at Gulshan
Project Executing Organization : Dhaka Electricity Supply Company Limited (DESCO)
Name, Address, Organization, and Contact Details of Responsible Officer
Name : A.K.M. Akhtaruzzaman, Executive Engineer (P&D)
Address : 22/B, Faruk Sharani, Nikunja-ii, Khilkhet, Dhaka, Dhaka, 1229
Organization : Dhaka Electricity Supply Company Limited (DESCO)
Tel/Fax : Tel +88 02 890 0110, 02 890 0111, Fax +88 02 890 100, 01713 443044
E-Mail : kmakhtar@desco.org.bd

Date:

Signature:

Check Items

Question 1: Address of project site

: Plot 47, Road #134, Gulshan-1, Dhaka 1212, Bangladesh

Question 2: Scale and contents of the project (approximate area, facilities' area, production, electricity generated, etc.)

2-1. Project profile (scale and contents)

This project comprises the following components:

- 1) Construction of 132 33 kV underground substation in Gulshan
- 2) Installation of 132 kV underground transmission (3.4km) cable and manholes
- 3) Extension of 132V Bay at 230/132 kV source substation in Rampura
- 4) Civil work
- 5) Consulting Services

2-2. How was the necessity of the project confirmed? Is the project consistent with a higher program/policy?

☒ YES: Please describe the higher program/policy.

DESCO M/P 2013 (up to 2030), Power System Master Plan 2015, and the Seventh Five Year Development Plan (2016~2020)

☐ NO

2-3. Did the proponent consider alternatives before this request?

☒ YES: Please describe outline of the alternatives

Specifications of substation were examined - either underground or outdoor/indoor, GIT/GIS or OIT. Three alternative locations for substation, Gulshan, Uttara and Baridhara, and alternative routes for transmission line to the nearest source substation (230/132kV) were examined.

☐ NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

☒ Implemented

☐ Not implemented

If implemented, please mark the following stakeholders.

☒ Administrative body (Power Division and Planning Commission)

☒ Local residents

☐ NGO

☐ Other ()

Question 3: Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

☒ New ☐ Ongoing (with complaints) ☐ Ongoing (without complaints)

☐ Other

()

Question 4: Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE), required for the project according to a law or guidelines of the host country? If yes, is an EIA implemented or planned? If necessary, please fill in the reason why an EIA is required.

☒ Necessary ☐ Implemented ☒ Ongoing/planning

(Reason why EIA is required)

"Engineering works with capital over one million BDT", and "Water, Power and Gas distribution line laying/relaying/extension" are listed in the RED CATEGORY project list in the Environmental Conservation Rules stipulated in 1997. DESCO will submit an Initial Environmental Examination (IEE) to the Department of Environment (DOE) for site clearance, an Environmental Impact Assessment (EIA) for environmental clearance, and an Environmental Monitoring Plan (EMP) prior to the project implementation in the country.

☐ Not necessary

☐ Other (please explain)

Question 5: In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.

☐ Approved without a supplementary condition	☐ Approved with a supplementary condition	☐ Under appraisal
---	--	--

(Date of approval: Competent authority:)

☐ Under implementation

☒ Appraisal process not yet started as of 15 September 2016. IEE report was completed at the end of July 2016 and it is undergoing internal appraisal.

☐ Other ()

Question 6: If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

☒ Already certified

Title of the certificate: (Site Clearance Certificate)

☐ Requires a certificate but not yet approved

☐ Not required

☐ Other

()

Question 7: Are any of the following areas present either inside or surrounding the project site?

☒ Yes ☐ No

If yes, please mark the corresponding items.

- ☒ National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage): Gulshan Lake, 300m away from the substation site, is declared as an Environmental Critical Area (ECA) by the Department of Environment (DOE).
- ☐ Primeval forests, tropical natural forests
- ☐ Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.)
- ☐ Habitats of endangered species for which protection is required under local laws and/or international treaties
- ☐ Areas that run the risk of a large scale increase in soil salinity or soil erosion
- ☐ Remarkable desertification areas
- ☐ Areas with special value from an archaeological, historical, and/or cultural point of view
- ☐ Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8: Does the project include any of the following items?

☐ Yes ☒ No

If yes, please mark the appropriate items.

- ☐ Involuntary resettlement (scale: households persons)
- ☐ Groundwater pumping (scale: m3/year)
- ☐ Land reclamation, land development, and/or land-clearing (scale: hectors)
- ☐ Logging (scale: hectors)

Question 9: Please mark related adverse environmental and social impacts, and describe their outlines.

- | | |
|--|---|
| ☒ Air pollution | ☐ Involuntary resettlement |
| ☒ Water pollution | ☒ Local economies, such as employment, livelihood, etc. |
| ☒ Soil pollution | ☒ Land use and utilization of local resources |
| ☒ Waste | ☐ Social institutions such as social infrastructure and local decision-making institutions |
| ☒ Noise and vibrations | ☒ Existing social infrastructures and services |
| ☐ Ground subsidence | ☐ Poor, indigenous, or ethnic people |
| ☒ Offensive odors | ☐ Misdistribution of benefits and damages |
| ☐ Geographical features | ☐ Local conflicts of interest |
| ☐ Bottom sediment | ☐ Gender |
| ☒ Biota and ecosystems | ☐ Children's rights |
| ☐ Water usage | ☐ Cultural heritage |
| ☒ Accidents | ☒ Infectious diseases |
| ☐ Global warming | ☐ Other |

Outline of related impact:

Environmental pollution (air, water, soil, waste, noise and vibrations, and odors) are anticipated during the construction period to some extent and temporarily. Underground cable will be installed across and along the Gulshan Lake. The Lake has been polluted and declared as an "Environmental Critical Area," and special attention shall be required to preserve the urban ecosystem.

The existing substation facilities will be replaced within the present site, which will cause no change in land use, land acquisition or involuntary resettlement. However, temporary requisitions such as restriction of access to the surrounding area and traffic blocking may be forced due to the installation of underground cable. The total length of underground cable to the nearest source station (Rampura) is expected to be as short as 3.3 km.

No adverse impacts on the livelihoods of residents in the site area are anticipated, whereas job opportunities will be available at the construction site and the local economy will grow accordingly. Coughs or allergies could be caused by the dust produced during the construction work. Cold infections and/or other infections communicated by mosquitoes or other intermediaries could spread among workers. Workers' health could be impacted by the construction work. Dust could impact respiratory organs and eyes, noises could impact hearing and high temperatures and humidity could be a factor affecting workers' health during the hot season.

Increase in traffic volume will be caused by the transportation of construction materials and workers. As the traffic volume in the surrounding area is currently heavy, increase in traffic accidents on and out of the construction site, fires, falling or electrocution, work accidents and sickness can occur.

During operation of the new substation, more positive impacts are anticipated than negative ones. Noise and vibrations are expected to be less than the present level as the new facilities are more environmentally advanced. It is expected as an indirect positive impact that people will benefit from a more stable power supply. Workers' health could be improved compared with the present situation due to the operation of advanced facilities with a better working environment.

Question 10: In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?

☐ Yes ☐ No ☒ Not Applicable

Question 11: Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

☒ Yes ☐ No

10.3.2 DPDC's Screening Format

Name of Proposed Project : Construction of 132/33/11 kV Underground Substation at Kawran Bazar
Project Executing Organization : Dhaka Power Distribution Company Limited (DPDC)
Name, Address, Organization, and Contact Details of Responsible Officer
Name : Superintending Engineer, Design Circle
Address : 1 Abdul Gani Road, Dhaka 1000
Organization : Dhaka Power Distribution Company Limited (DPDC)
Tel/Fax : Tel +88 02 956 4215, Fax +88 02 956 6518
E-Mail : sed@dpdc.org.bd

Date:

Signature:

Check Items

Question 1: Address of project site

3/1 West Tejturibazar, Karwanbazar, Dhaka, Bangladesh

Question 2: Scale and contents of the project (approximate area, facilities' area, production, electricity generated, etc.)

2-1. Project profile (scale and contents)

This project comprises the following components:

- 1) Construction of 132/33/11 kV underground substation in Kawran Bazar
- 2) Installation of 132 kV underground transmission cable (1.5 km) and manholes
- 3) Installation of 33 and 11 kV underground (feeder) cable lines (25 in number) and manholes
- 4) Extension of 132V Bay
- 5) Civil work
- 6) Consulting Services

2-2. How was the necessity of the project confirmed? Is the project consistent with a higher program/policy?

☒ YES: Please describe the higher program/policy.

DPDC Master Plan, Power System Master Plan 2016, and the Seventh Five Year Development Plan (2016~2020)

☐ NO

2-3. Did the proponent consider alternatives before this request?

☒ YES: Please describe outline of the alternatives

Specifications of substation were examined - either underground or outdoor/indoor, GIT/GIS or OIT/GIS. Three alternative locations for substation, Dhaka University, Kawran Bazar and Lalmatia, and alternative routes for transmission line to the nearest source substation (230/132kV) were examined.

☐ NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

☒ Implemented ☐ Not implemented

If implemented, please mark the following stakeholders.

☒ Administrative body (Power Division and Planning Commission)

☒ Local residents

☐ NGO

☐ Other ()

Question 3: Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

☒ New ☐ Ongoing (with complaints) ☐ Ongoing (without complaints)

☐ Other ()

Question 4: Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE), required for the project according to a law or guidelines of the host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why an EIA is required.

☒ Necessary (☐ Implemented ☒ Ongoing/planning)

(Reason why EIA is required)

“Engineering works with capital over one million BDT”, and “Water, Power and Gas distribution line laying/relaying/extension” are listed in the RED CATEGORY project list in the Environmental Conservation Rules stipulated in 1997. DPDC will submit an Initial Environmental Examination (IEE) to the Department of Environment (DOE) for site clearance, an Environmental Impact Assessment (EIA) for environmental clearance, and an Environmental Monitoring Plan (EMP) prior to the project implementation in the country.

☐ Not necessary

☐ Other (please explain)

Question 5: In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.

☐ Approved without a supplementary condition	☐ Approved with a supplementary condition	☐ Under appraisal
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(Date of approval: Competent authority:)

☐ Under implementation

☒ Appraisal process not yet started as of 15 September 2016

☐ Other ()

Question 6: If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

☒ Already certified

Title of the certificate: (Site Clearance Certificate)

☐ Requires a certificate but not yet approved

☐ Not required

☐ Other ()

Question 7: Are any of the following areas present either inside or surrounding the project site?

☐ Yes ☒ No

If yes, please mark the corresponding items.

- ☐ National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage)
- ☐ Primeval forests, tropical natural forests
- ☐ Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.)
- ☐ Habitats of endangered species for which protection is required under local laws and/or international treaties
- ☐ Areas that run the risk of a large scale increase in soil salinity or soil erosion
- ☐ Remarkable desertification areas
- ☐ Areas with special value from an archaeological, historical, and/or cultural point of view
- ☐ Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8: Does the project include any of the following items?

☐ Yes ☒ No

If yes, please mark the appropriate items.

- ☐ Involuntary resettlement (scale: households persons)
- ☐ Groundwater pumping (scale: m3/year)
- ☐ Land reclamation, land development, and/or land-clearing (scale: hectors)
- ☐ Logging (scale: hectors)

Question 9: Please mark related adverse environmental and social impacts, and describe their outlines.

- | | |
|--|---|
| ☒ Air pollution | ☐ Involuntary resettlement |
| ☒ Water pollution | ☒ Local economies, such as employment, livelihood, etc. |
| ☒ Soil pollution | ☒ Land use and utilization of local resources |
| ☒ Waste | ☐ Social institutions such as social infrastructure and local decision-making institutions |
| ☒ Noise and vibrations | ☒ Existing social infrastructures and services |
| ☐ Ground subsidence | ☐ Poor, indigenous, or ethnic people |
| ☒ Offensive odors | ☐ Misdistribution of benefits and damages |
| ☐ Geographical features | ☐ Local conflicts of interest |
| ☐ Bottom sediment | ☐ Gender |
| ☐ Biota and ecosystems | ☐ Children's rights |
| ☐ Water usage | ☐ Cultural heritage |
| ☒ Accidents | ☒ Infectious diseases |
| ☐ Global warming | ☐ Other |

Outline of related impact:

Environmental pollution (air, water, soil, waste, noise and vibrations, and odors) are anticipated during the construction period to some extent and temporarily. The existing substation facilities in Kawran Bazar will be replaced within the present site, which will cause no change in land use, land acquisition or involuntary resettlement. However, expansion of the road in front of the substation may cause requisition of an area currently occupied by those who run shops, and adverse impacts on their livelihoods may occur. Further study is required to identify who they are and their tenure conditions. Temporary requisitions such as restriction of access to the surrounding area and traffic blocking may also be forced due to the installation of underground cable. The total length of underground cable to the nearest source station (Dhanmondi) is expected to be as short as 1.5 km. Job opportunities will be available at the construction site and the local economy will benefit. Coughs or allergies could be caused by the dust produced during the construction work. Cold infections and/or other infections communicated by mosquitoes or other intermediaries could spread among workers. Workers' health could be impacted by the construction work. Dust could impact respiratory organs and eyes, noises could impact hearing and high temperatures and humidity could be a factor affecting workers' health during the hot season. Increase in traffic volume will be caused by the transportation of construction materials and workers. As the traffic volume in the surrounding area is currently heavy, increase in traffic accidents on and out of the construction site, fires, falling or electrocution, work accidents and sickness can occur. During operation of the new substation, more positive impacts are anticipated than negative ones. Noise and vibrations are expected to be less than the present level as the new facilities are more environmentally advanced. Reconstruction of the road in front of the substation will provide better surrounding conditions. It is expected as an indirect positive impact that people will benefit from a more stable power supply. Workers' health could be improved compared with the present situation due to the operation of advanced facilities with a better working environment.

Question 10: In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?

☐ Yes ☐ No ☒ Not Applicable

Question 11: Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

☒ Yes ☐ No

10.4 Monitoring Form

10.4.1 DESCO's Monitoring Form

The following items should be monitored periodically during each phase.

I Pre-Construction phase (demolition work for existing buildings, distribution line switching and land leveling)

1 Air quality (for demolition work)

(Frequency) 1) When commencing the demolition work 2) Every month (in the first two months), 3) Set the frequency after two months based on the monitoring results.

(Date)

(Location)

Parameter	Unit	Ave. Time	Results	Ambient air quality standards	Remarks
SO ₂	µg/m ³	(1 hr)		350 (1 hr)	
	µg/m ³	(24 hrs)		125 (24 hrs)	
NO ₂	µg/m ³	(1 hr)		200 (1 hr)	
	µg/m ³	(24 hrs)		100 (24 hrs)	
PM ₁₀	µg/m ³	(24 hrs)		150 (24 hrs)	

(Meteorological Conditions)

Location (Date)	Time		Temperature (°C)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
	AM	:					m/sec
	PM	:					m/sec

2 Water quality (Discharge wastewater) (for demolition work)

(Frequency) 1) When commencing the demolition work 2) Every month (in the first two months), 3) Set the frequency after two months based on the monitoring results.

(Date)

(Location)

Parameter	Unit	Result	Wastewater discharge standards			Remarks (Measurement method)
			Surface water	Public sewage water	Irrigation water	
Temperature	°C		-	-	-	
pH	-		6-9	6-9	6-9	
Oil & grease	mg/L		10	20	10	
As	mg/L		0.2	0.05	0.2	
Total fecal coliform	MPN/100mL		-	-	-	

Note: Monitoring should be carried out at discharge site of wastewater treatment facility.

3 Waste (for demolition work)

(Frequency) Continuously

(Unit: ton/gm)

Month	Sample Date	Kinds of Waste (Quality)		Rate of recycling/Reuse (%)		Remarks
		Industrial	Domestic	Industrial	Domestic	
		(A)	(B)	(A)	(B)	

4 Soil conditions (for demolition work)

(Frequency) 1) When commencing the demolition work (Baseline data) 2) When completing the demolition work (collect those parameters detected at the baseline only)

Location	Date	Pollutant detected	Measures	Remarks

5 Noise (for demolition work)

(Frequency) 1) When commencing the demolition work 2) Every month (in the first two months), 3) Set the frequency after two months based on the monitoring results.

(Date)

(Unit: dBA)

Location	Result	Noise standards					Remarks
		A	B	C	D	E	
		Day (6AM-9PM): 45	Day: 50 Night: 40	Day: 60 Night: 50	Day: 70 Night: 60	Day: 70 Night: 70	
		Night (9PM-6AM): 35					

Notes: Category of areas is as follows: A: Silent zone, B: Residential area, C: Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes), D: Commercial area, E: Industrial area.

(Meteorological Conditions)

Location (Date)	Time		Temperature (°C)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
	AM	:					m/sec
	PM	:					m/sec

6 Existing Social Infrastructure and Services

(Frequency) When relocating, reconfiguring and removing service infrastructure

- Conduct site monitoring upon relocating, reconfiguring and removing the existing service facilities

	Responsible organization	Date of work	Location	Situation	Remarks
Electricity line	DESCO				
Gas pipeline	Titas Gas				
Water pipeline	WASA				
Sewage pipeline	WASA				
Telecommunication line	BTCL				
Satellite/dish antenna line	Dish Authority				
Others					

7 Work Environment

(Frequency) Once a year

- Monitor the records of labor accidents

II During Construction Period

1 Air quality

(Frequency) 1) When commencing the construction work 2) Every month (in the first two months), 3) Set the frequency after two months based on the monitoring results.

(Date)

(Location)

Parameter	Unit	Ave. Time	Results	Ambient air quality standards	Remarks
SO ₂	µg/m ³	(1 hr)		350 (1 hr)	
	µg/m ³	(24 hrs)		125 (24 hrs)	
NO ₂	µg/m ³	(1 hr)		200 (1 hr)	
	µg/m ³	(24 hrs)		100 (24 hrs)	
PM ₁₀	µg/m ³	(24 hrs)		150 (24 hrs)	

(Meteorological Conditions)

Location (Date)	Time		Temperature (°C)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
	AM	:					m/sec
	PM	:					m/sec

2 Water quality

(1) Surface Water (Discharge wastewater)
(Frequency) Once every three months

(Date)

(Location)

Parameter	Unit	Result	Wastewater discharge standards			Remarks (Measurement method)
			Surface water	Public sewage water	Irrigation water	
Temperature	°C		-	-	-	
pH	-		6-9	6-9	6-9	
Oil & grease	mg/L		10	20	10	
As	mg/L		0.2	0.05	0.2	
Total fecal coliform	MPN/100mL		-	-	-	

Note: Monitoring should be carried out at discharge site of wastewater treatment facility.

(2) Groundwater

(Frequency) Once every six months

Location	Date	Groundwater level	Temperature °C	Remarks

3 Waste

(Frequency) Continuously

(Unit: ton/gm)

Month	Sample Date	Kinds of Waste (Quality)		Rate of recycling/Reuse (%)		Remarks
		Industrial	Domestic	Industrial	Domestic	
		(A)	(B)	(A)	(B)	

4 Soil conditions

(Frequency) 1) When commencing the construction work (collect those parameters detected at the baseline only)

Location	Date	Pollutant detected	Measures	Remarks

5 Noise

(Frequency) 1) When commencing the construction work 2) Every three months, 3) Separately conduct monitoring for the works which create large-scale noise and vibrations.

(Date)

(Unit: dBA)

Location	Result	Noise standards					Remarks
		A	B	C	D	E	
		Day (6AM-9PM): 45	Day: 50 Night: 40	Day: 60 Night: 50	Day: 70 Night: 60	Day: 70 Night: 70	
		Night (9PM-6AM): 35					

Notes: Category of areas is as follows: A: Silent zone, B: Residential area, C: Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes), D: Commercial area, E: Industrial area.

(Meteorological Conditions)

Location (Date)	Time		Temperature (°C)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
	AM	:					m/sec
	PM	:					m/sec

6 Odors

(Frequency) Continuously during construction period

(Date)

(Location)

Specific malodorous substance	Odor index	Source	Measure	Remarks

7 Stability of surrounding structures

(Frequency) 1) right before excavation work starts 2) right after excavation work is completed 3) right after the UGSS construction is completed

(Date)

Location	Structure, no of stories, years of construction, plot area, total floor area	Physical condition	Displacement and angle	Subsidence and depth

8 Protected Areas

(Frequency) during construction period
Visual monitoring

9 Land use

(Frequency) during construction period
Visual monitoring

10 Infectious diseases

(Frequency) Twice a year
- Monitor the health records through medical check-ups

11 Work Environment

(Frequency) Once a year
- Monitor the records of labor accidents

12 Accidents

(Frequency) Once a year
- Monitor the records of land traffic accidents

10.4.2 DPDC's Monitoring Form

The following items should be monitored periodically during each phase.

I Pre-Construction phase (demolition work for existing buildings, distribution line switching and land leveling)

1 Air quality (for demolition work)

(Frequency) 1) When commencing the demolition work 2) Every month (in the first two months), 3) Set the frequency after two months based on the monitoring results.

(Date)

(Location)

Parameter	Unit	Ave. Time	Results	Ambient air quality standards	Remarks
SO ₂	µg/m ³	(1 hr)		350 (1 hr)	
	µg/m ³	(24 hrs)		125 (24 hrs)	
NO ₂	µg/m ³	(1 hr)		200 (1 hr)	
	µg/m ³	(24 hrs)		100 (24 hrs)	
PM ₁₀	µg/m ³	(24 hrs)		150 (24 hrs)	

(Meteorological Conditions)

Location (Date)	Time		Temperature (°C)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
	AM	:					m/sec
	PM	:					m/sec

2 Water quality (Discharge wastewater) (for demolition work)

(Frequency) 1) When commencing the demolition work 2) Every month (in the first two months), 3) Set the frequency after two months based on the monitoring results.

(Date)

(Location)

Parameter	Unit	Result	Wastewater discharge standards			Remarks (Measurement method)
			Surface water	Public sewage water	Irrigation water	
Temperature	°C		-	-	-	
pH	-		6-9	6-9	6-9	
Oil & grease	mg/L		10	20	10	
As	mg/L		0.2	0.05	0.2	
Total fecal coliform	MPN/100mL		-	-	-	

Note: Monitoring should be carried out at discharge site of wastewater treatment facility.

3 Waste (for demolition work)

(Frequency) Continuously

(Unit: ton/gm)

Month	Sample Date	Kinds of Waste (Quality)		Rate of recycling/Reuse (%)		Remarks
		Industrial	Domestic	Industrial	Domestic	
		(A)	(B)	(A)	(B)	

4 Soil conditions (for demolition work)

(Frequency) 1) When commencing the demolition work (Baseline data) 2) When completing the demolition work (collect those parameters detected at the baseline only)

Location	Date	Pollutant detected	Measures	Remarks

5 Noise (for demolition work)

(Frequency) 1) When commencing the demolition work 2) Every month (in the first two months), 3) Set the frequency after two months based on the monitoring results.

(Date)

(Unit: dBA)

Location	Result	Noise standards					Remarks
		A	B	C	D	E	
		Day (6AM-9PM): 45	Day: 50	Day: 60	Day: 70	Day: 70	
		Night (9PM-6AM): 35	Night: 40	Night: 50	Night: 60	Night: 70	

Notes: Category of areas is as follows: A: Silent zone, B: Residential area, C: Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes), D: Commercial area, E: Industrial area.

(Meteorological Conditions)

Location (Date)	Time		Temperature (°C)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
	AM	:					m/sec
	PM	:					m/sec

6 Temporary Requisition of approach road in front of the existing substation

(Updated List of Households running street shops)

(date)

	Name	Father's Name	No of family members	Asset Inventory	Asset Value	Monthly Income
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

(Frequency) Once every three months (during requisition procedure)

Date	Progress of requisition	Response/Action	Remarks	

7 Existing Social Infrastructure and Services

(Frequency) When relocating, reconfiguring and removing service infrastructure

- Conduct site monitoring upon relocating, reconfiguring and removing the existing service facilities

	Responsible organization	Date of work	Location	Situation	Remarks
Electricity line	DPDC				
Gas pipeline	Titas Gas				
Water pipeline	WASA				
Sewage pipeline	WASA				
Telecommunication line	BTCL				
Satellite/dish antenna line	Dish Authority				
Others					

8 Work Environment

(Frequency) Once a year

- Monitor the records of labor accidents

II During Construction Period

1 Air quality

(Frequency) 1) When commencing the construction work 2) Every month (in the first two months), 3) Set the frequency after two months based on the monitoring results.

(Date)

(Location)

Parameter	Unit	Ave. Time	Results	Ambient air quality standards	Remarks
SO ₂	µg/m ³	(1 hr)		350 (1 hr)	
	µg/m ³	(24 hrs)		125 (24 hrs)	
NO ₂	µg/m ³	(1 hr)		200 (1 hr)	
	µg/m ³	(24 hrs)		100 (24 hrs)	
PM ₁₀	µg/m ³	(24 hrs)		150 (24 hrs)	

(Meteorological Conditions)

Location (Date)	Time		Temperature (°C)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
	AM	:					m/sec
	PM	:					m/sec

2 Water quality

(1) Surface Water (Discharge wastewater)

(Frequency) Once every three months

(Date)

(Location)

Parameter	Unit	Result	Wastewater discharge standards			Remarks (Measurement method)
			Surface water	Public sewage water	Irrigation water	
Temperature	°C		-	-	-	
pH	-		6-9	6-9	6-9	
Oil & grease	mg/L		10	20	10	
As	mg/L		0.2	0.05	0.2	
Total fecal coliform	MPN/100mL		-	-	-	

Note: Monitoring should be carried out at discharge site of wastewater treatment facility.

(2) Groundwater

(Frequency) Once every six months

Location	Date	Groundwater level	Temperature °C	Remarks

3 Waste

(Frequency) Continuously

(Unit: ton/gm)

Month	Sample Date	Kinds of Waste (Quality)		Rate of recycling/Reuse (%)		Remarks
		Industrial	Domestic	Industrial	Domestic	
		(A)	(B)	(A)	(B)	

4 Soil conditions

(Frequency) 1) When commencing the construction work (collect those parameters detected at the baseline only)

Location	Date	Pollutant detected	Measures	Remarks

5 Noise

(Frequency) 1) When commencing the construction work 2) Every three months, 3) Separately conduct monitoring for the works which create large-scale noise and vibrations.

(Date)

(Unit: dBA)

Location	Result	Noise standards					Remarks
		A	B	C	D	E	
		Day (6AM-9PM): 45	Day: 50 Night: 40	Day: 60 Night: 50	Day: 70 Night: 60	Day: 70 Night: 70	
		Night (9PM-6AM): 35					

Notes: Category of areas is as follows: A: Silent zone, B: Residential area, C: Mixed area (mainly residential area, and also simultaneously used for commercial and industrial purposes), D: Commercial area, E: Industrial area.

(Meteorological Conditions)

Location (Date)	Time		Temperature (°C)		Moisture (%)	Wind	
			Dry	Wet		Direction	Speed
	AM	:					m/sec
	PM	:					m/sec

6 Odors

(Frequency) Continuously during construction period

(Date)

(Location)

Specific malodorous substance	Odor index	Source	Measure	Remarks

7 Stability of surrounding structures

(Frequency) 1) right before excavation work starts 2) right after excavation work is completed 3) right after the UGSS construction is completed

(Date)

Location	Structure, no of stories, years of construction, plot area, total floor area	Physical condition	Displacement and angle	Subsidence and depth

8 Local Economy such as Employment and Livelihood Means

(Frequency) during construction period

Employment records

9 Land use

(Frequency) during construction period

Visual monitoring

10 Infectious diseases

(Frequency) Twice a year

- Monitor the health records through medical check-ups

11 Work Environment

(Frequency) Once a year

- Monitor the records of labor accidents

12 Accidents

(Frequency) Once a year

- Monitor the records of land traffic accidents

10.5 Environmental Checklist

10.5.1 DESCO's Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports already been prepared in official process?	(a) NY	The data collection is complete. The EIA report will be finalized within April 2017.
		(b) Have EIA reports been approved by authorities of the host country's government?	(b) NY	As of March 2017, the EIA report is yet to be submitted. It will be submitted to the Department of Environment and approved in June 2017.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c) NY	It is not decided since the EIA report has not been submitted yet. DESCO assures us it will comply with all conditions to be imposed in EIA approval.
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(d) NY	This Project falls into the RED Category according to the Environmental Conservation Rules 1997 of Bangladesh. DESCO received an official approval for the IEE report from the Department of Environment (DOE) as of 22 February 2017 after reflecting comments by DOE. The official number is 22.02.0000.091.72.155.16/115
	(2) Explanation to the Local Stakeholders	(a) Have the contents of the project and the potential impacts been adequately explained to the local stakeholders based on appropriate procedures, including information disclosure? Has understanding been obtained from the Local stakeholders?	(a) Y	In the IEE implementation period, the project outline was explained to the local stakeholders through focus group discussion with 17 local people (imam, businessmen, van driver, shopkeepers, and students) at two venues in the surrounding area of the project site on 11 August 2016. They expressed no particular opposing view on the implementation of the project. Collected opinions are as follows: <Concerns> - Trenching along the road will cause accessibility problems for vehicles. - Traffic problems would create hazardous situations during cable installation work. - Movement, including that of students, will be affected during construction period both on T/L route and at substation site.
		(b) Have the comments from the stakeholders (such as local residents) been reflected in the project design?	(b) Y	

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				• People would be affected by dust from the demolition work of existing buildings within the project site. • People's health would be at risk during construction phase both on T/L route and at substation site. <Suggestions> • Trenching to be done along south side of the road alignment as there are not many buildings on the southern side. • Use low-noise machinery for construction and avoid work at night. • Avoid traffic congestion and obstructing people's free movement by doing work at night while there is less traffic. • Avoid construction work at school starting hours and office hours. • Total area would be covered as precautionary measure to avoid dust allergy problems and accidental events during demolition of existing buildings at proposed substation site. • Proper safety measures would be taken on T/L route during construction phase of the project. The construction plan was reviewed in accordance with their opinions.
	(3) Examination of Alternatives	(a) Have alternative plans for the project been examined with social and environmental considerations?	(a) Y	Three alternative sites for the substation were examined from technical, financial, environmental and social aspects (Gulshan, Uttara and Baridhara). Gulshan site has been selected for substation construction and associated T/L route to Rampura Substation for 2.8 km.
2 Pollution Control	(1) Water Quality	(a) Is there any possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling, will cause water quality degradation in downstream water areas? If water quality degradation is anticipated, are adequate measures considered?	(a) Y	There will be wastewater from construction machinery, drainage from vehicle cleaning, muddy water and oil runoff from surface runoff during rainfall, and other water, which may cause water pollution of the Gulshan Lake if they are discharged into it. There is a chance that

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				construction with boring, excavation or pile work could impact the ground stratum. As countermeasures, water will be collected into D-WASA's drainage and sewage system.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	Gulshan Lake, which is designated as "Ecologically Critical Area", is near the project site. As the project does not directly address the Lake itself, no adverse impacts on the Lake are anticipated because countermeasures are to be taken during the construction period.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a) N	Not included.
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	(b) N	Not included.
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(c) N	It is not anticipated that the project will affect the ecosystem.
		(d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock?	(d) N	It is not anticipated that the project will obstruct animals' behavior or habitats.
		(e) Is there any possibility that the project will cause negative impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem, due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	(e) N	It is not anticipated that this project will cause adverse impacts on the ecosystem.
		(f) In cases where the project site is located in undeveloped areas, is there any possibility that the new development will result in extensive loss of natural environments?	(f) N	The project site is located in a highly developed area so there is no possibility that the new development will result in extensive loss of natural environments.
3 Natural Environment	(3) Topography and Geology	(a) Is there any soft ground on the route of power transmission and distribution lines that may cause slope failures or	(a) N	No possibility of erosion as project site is located on flat and stable area.

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		landslides? Are adequate measures considered to prevent slope failures or landslides, where needed?		
		(b) Is there any possibility that civil works, such as cutting and filling, will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides?	(b) N	No cutting or filling of earth.
		(c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(c) NY	It is under investigation which organization is responsible for excavated soil and where soil shall be transferred to.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	(a) N	No involuntary resettlement is anticipated.
		(b) Is adequate explanation on compensation and resettlement assistance to be given to affected people prior to resettlement?	(b) N	Not applicable.
		(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	(c) N	Not applicable.
		(d) Are the compensations going to be paid prior to the resettlement?	(d) N	Not applicable.
		(e) Are the compensation policies prepared in a document?	(e) N	Not applicable.
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(f) N	Not applicable.
		(g) Are agreements with the affected people to be obtained prior to resettlement?	(g) N	Not applicable.
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) N	Not applicable.
		(i) Are any plans developed to monitor the impacts of resettlement?	(i) N	Not applicable.
		(j) Is the grievance redress mechanism established?	(j) N	Not applicable.

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a) N	Not applicable.
		(b) Is there a possibility that diseases, including infectious diseases, such as HIV, will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	(b) Y	Numerous laborers will be recruited for the construction work. As the project site is located in the center of Dhaka, there will be a low risk of infectious diseases caused by the project. Pre-employment and periodic medical check-ups will be conducted. Occupational health and safety guidance will be given to them in accordance with the domestic law in Bangladesh.
		(c) Is there any possibility that installation of structures, such as power line towers, will cause radio interference? If any significant radio interference is anticipated, are adequate measures considered?	(c) N	T/L route will be underground with no possibility of radio interference affecting local residents.
		(d) Are the compensations for transmission wires given in accordance with the domestic law?	(d) N	It is not required. T/L route is planned along a public road, which will cause no harm to local residents' land tenure.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	There is no religious heritage in and around T/L route and substation sites.
4 Social Environment	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	There is no such place designated by law in and around T/L route and substation sites.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	(a) N/A	There is no ethnic minority or indigenous people confirmed in the T/L route or substation sites.
		(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(b) N/A	It is not applicable for the project.
	(6) Working Conditions	(a) Is the project proponent not violating any laws or ordinances associated with the working conditions of the country which the project proponent should observe in the project?	(a) Y	DESCO will not violate any laws or ordinances associated with the working conditions of Bangladesh.

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	(b) Y	Contractor shall establish a work safety plan and submit it to the executing agency for their prior approval. The work safety plan will include mitigation measures regarding safety training, etc. and the provision of appropriate protective equipment to workers, etc.
		(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	(c) Y	
		(d) Are appropriate measures taken to ensure that security guards involved in the project do not violate the safety of other individuals involved, or local residents?	(d) Y	
	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and waste)?	(a) Y	Air pollution, noise, water contamination and waste are anticipated during construction stage, but watering on roads, using low noise/vibration equipment, setting sedimentation ponds and promoting recycling and reuse will decrease their impacts. Mitigation measures are included in the Environmental Management Plan, which will be finalized in the EIA Report.
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	(b) N	The project site is adjacent to Gulshan Lake, designated as an Ecologically Critical Area, but the site is not located within the lake. Conventional countermeasures for construction will prevent adverse effect on the lake.
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(c) N	• Employment opportunities will be increased for various subcontract work resulting from T/L extension and substation construction activity. • Labor contracts between the construction industry and children shall be prohibited. Regular patrols to check for child workers will be conducted. • Pre-employment and periodic medical check-ups will be conducted for external workers (technical workers, etc.). • Temporary requisitions such as restriction of access to the surrounding area and traffic blocking may be necessary while installing underground cable. Countermeasures such as covering the

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				restricted area by building temporary fences will be taken. As the traffic volume in the surrounding area is currently heavy, increase in traffic accidents on and out of the construction site, fire, falling or electrocution, work accidents and sickness can occur. A labor safety plan will be developed and implemented to prevent them during construction phase. Increase in traffic volume will be caused by the transportation of construction materials and workers, which will be mitigated by shifting the construction work to night and weekends.
	(2) Monitoring	(a) Will the proponent develop and implement a monitoring program for the environmental items that are considered to have potential impacts?	(a) Y	The Environmental Monitoring Plan (EMoP) was developed and will be finalized in the EIA Report. Compliance with the EMoP and its implementation is mandatory, and items with possible adverse impact will be monitored by DESCO.
		(b) What are the items, methods and frequencies of the monitoring program?	(b)Y	The EMP and EMoP will be inserted into the EIA Report. Specific items will be described in the EIA report.
		(c) Will the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	(c) Y	Measures will be examined for monitoring based on the IEE and EIA reports by DESCO.
		(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(d)Y	These items are identified by laws and regulations in Bangladesh
6 Notes	Reference to Checklists of Other Sectors	(a) Where necessary, pertinent items described in the Road checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a) N	-

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Notes on Using Environmental Checklist	(a) If necessary, the impacts on trans-boundary or global issues should be confirmed, (e.g., the project includes factors that may cause problems such as trans-boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	There will be no impacts on global issues as exhaust gas from construction of T/L will remain at a negligible level. Gas insulated switch gear (GIS) and gas insulated transformers (GIT), which are to be installed in the substation, will use sulfur hexafluoride (SF ₆). The greenhouse gas will be filled in the equipment's enclosure. By applying an appropriate machine specification, the gas leakage will remain at a minimum level.

Source: JICA Survey Team

10.5.2 DPDC's Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports already been prepared in official process?	(e) NY	The data collection is complete. The EIA report will be finalized within April 2017.
		(b) Have EIA reports been approved by authorities of the host country's government?	(f) NY	As of March 2017, the EIA report is yet to be submitted. It will be submitted to the Department of Environment and approved in June 2017.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(g) NY	It is not decided since the EIA report has not been submitted yet. DPDC assures us it will comply with all conditions to be imposed in EIA approval.
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(h) Y	This Project falls into the RED Category according to the Environmental Conservation Rules 1997 of Bangladesh. DESCO received an official approval for the IEE report from the Department of Environment (DOE) as of 22 February 2017 after reflecting comments by DOE. The official number is 22.02.0000.091.72.155.16/116
	(2) Explanation to the Local Stakeholders	(a) Have the contents of the project and the potential impacts been adequately explained to the local stakeholders based on appropriate procedures, including information disclosure? Has understanding been obtained from the Local stakeholders?	(a) Y	In the IEE implementation period, the project outline was explained to the local stakeholders through focus group discussion with 11 local people (housewives, rickshaw driver, security guards, shopkeepers, and businessmen) in the surrounding area of the project site on 14 August 2016. People of study area have shown a positive attitude towards the project. They expressed no particular opposing view on the implementation of the project. The construction plan is under review in consideration of their opinions. Collected opinions are as follows: <Concerns> The Poribag junction road is very narrow and its condition very bad. Waste dumping along the road reduces the effective width of it. Trenching along the road will create severe problems for pedestrians as well as vehicles.
		(b) Have the comments from the stakeholders (such as local residents) been reflected in the project design?	(b) Y	

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				- The Kawran Bazar bypass road is also narrow and will cause similar problems with trenching along the road. - Existing wild herbs, shrubs and trees would be destroyed in proposed underground SS for site preparation. - During installation work for underground cables, serious traffic problems will occur. - During construction period, there will be risks of accident for all local people and operators. <Suggestions> - Dumped waste is to be removed prior to the commencement of the UG TL trenching work. - Excavated debris/soil should be placed such that little disturbance is created for pedestrians and vehicles. - Create opportunity for tree plantation after construction work at Karwanbazar substation site - Effective traffic control should be initialized. - Extra caution should be taken during construction work at site. - Pictorial Safety signs should be placed at hazardous places. Another consultation meeting was held for 15 households, out of whom 10 will likely be affected by the project implementation, at the end of January 2017. It was explained by DPDC that there will be no land acquisition, while the Project will use the fronted road of the Project site during the construction period, which will prevent the operation of 10 street shops. People expressed no objection to the project implementation and showed a willingness to move away from the site.

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(3) Examination of Alternatives	(a) Have alternative plans for the project been examined with social and environmental considerations?	(a) Y	Three alternative sites for the substation were examined from technical, financial, environmental and social aspects (Kawran Bazar, Dhaka University and Lalmatia). Kawran Bazar site has been selected for substation construction and associated T/L route to Dhanmondi Substation.
2 Pollution Control	(1) Water Quality	(a) Is there any possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? If water quality degradation is anticipated, are adequate measures considered?	(a) Y	If there is no countermeasure taken, there will be wastewater from construction machinery, drainage from vehicle cleaning, muddy water and oil runoff from surface runoff during rainfall, and other water during construction period. In order prevent this, water will be collected into D-WASA's drainage and sewage system.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	It is not anticipated that the project will affect protected areas as there is no such area nearby.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	(a) N	Not included.
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	(b) N	Not included.
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(c) N	It is not anticipated that the project will affect the ecosystem.
		(d) Are adequate measures taken to prevent disruption of migration routes and habitat fragmentation of wildlife and livestock?	(d) N	It is not anticipated that the project will obstruct animals' behavior or habitats.
		(e) Is there any possibility that the project will cause negative impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystem, due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	(e) N	It is not anticipated that this project will cause adverse impacts on the ecosystem.

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(f) In cases where the project site is located in undeveloped areas, is there any possibility that the new development will result in extensive loss of natural environments?	(f) N	The project site is located in a highly developed area so there is no possibility that the new development will result in extensive loss of natural environments.
3 Natural Environment	(3) Topography and Geology	(a) Is there any soft ground on the route of power transmission and distribution lines that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed?	(a) N	No possibility of erosion as project site is located on flat and stable area.
		(b) Is there any possibility that civil works, such as cutting and filling, will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides?	(b) N	No cutting or filling of earth
		(c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(c) NY	It is under investigation which organization is responsible for excavated soil and where soil shall be transferred to.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	(a) N	No involuntary resettlement is anticipated.
		(b) Is adequate explanation on compensation and resettlement assistance to be given to affected people prior to resettlement?	(b) N	Not applicable.
		(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	(c) N	Not applicable.
		(d) Are the compensations going to be paid prior to the resettlement?	(d) N	Not applicable.
		(e) Are the compensation policies prepared in a document?	(e) N	Not applicable.
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(f) N	Not applicable.
		(g) Are agreements with the affected people to be obtained prior to resettlement?	(g) N	Not applicable.

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) N	Not applicable.
		(i) Are any plans developed to monitor the impacts of resettlement?	(i) N	Not applicable.
		(j) Is the grievance redress mechanism established?	(j) N	Not applicable.
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	(a) Y	There are 10 street vendors without official permission (10 households) on the frontal road of DPDC's existing substation. The construction work will prevent them from conducting income generating activities. DPDC will pay for their moving expenses, initial investment cost and one-time assistance for business start-up.
		(b) Is there a possibility that diseases, including infectious diseases, such as HIV, will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	(b) Y	Numerous laborers will be recruited for the construction work. As the project site is located in the center of Dhaka, there will be a low risk of infectious diseases caused by the project. Pre-employment and periodic medical check-ups will be conducted. Occupational health and safety guidance will be given to them in accordance with the domestic law in Bangladesh.
		(c) Is there any possibility that installation of structures, such as power line towers, will cause radio interference? If any significant radio interference is anticipated, are adequate measures considered?	(c) N	T/L route will be underground with no possibility of radio interference affecting local residents.
		(d) Are the compensations for transmission wires given in accordance with the domestic law?	(d) N	It is not required. T/L route is planned along a public road, which will cause no harm to local residents' land tenure.
4 Social Environment	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	There is no religious heritage in and around T/L route and substation sites.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	There is no such place designated by law in and around T/L route and substation sites.

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	(a) N/A	There is no ethnic minority or indigenous people confirmed in the T/L route or substation sites.
		(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(b) N/A	It is not applicable for the project.
	(6) Working Conditions	(a) Is the project proponent not violating any laws or ordinances associated with the working conditions of the country which the project proponent should observe in the project?	(a) Y	DPDC will not violate any laws or ordinances associated with the working conditions of Bangladesh.
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	(b) Y	Contractor shall establish a work safety plan and submit it to the executing agency for their prior approval. The work safety plan will include mitigation measures regarding safety training, etc. and the provision of appropriate protective equipment to workers, etc.
		(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	(c) Y	
		(d) Are appropriate measures taken to ensure that security guards involved in the project do not violate the safety of other individuals involved, or local residents?	(d) Y	
	5 Others	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and waste)?	(a) Y	Air pollution, noise, water contamination and waste are anticipated during construction stage, but watering on roads, using low noise/vibration equipment, setting sedimentation ponds and promoting recycling and reuse will decrease their impacts. Mitigation measures are included in the Environmental Management Plan, which will be finalized in the EIA Report.
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	(b) N	No impact on surrounding nature is anticipated as the project is located at the heart of the biggest city in Bangladesh.
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(c) Y	• Employment opportunities will be increased for various subcontract work resulting from T/L extension and substation construction activity. • Labor contracts between the construction industry and children shall be prohibited. Regular patrols to check for child workers will be conducted.

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				• Pre-employment and periodic medical check-ups will be conducted for external workers (technical workers, etc.). • Temporary requisitions such as restriction of access to the surrounding area and traffic blocking may be necessary while installing underground cable. Countermeasures such as covering the restricted area by building temporary fences will be taken. • As the traffic volume in the surrounding area is currently heavy, increase in traffic accidents on and out of the construction site, fire, falling or electrocution, work accidents and sickness can occur. A labor safety plan will be developed and implemented to prevent them during construction phase. Increase in traffic volume will be caused by the transportation of construction materials and workers, which will be mitigated by shifting the construction work to night and weekends. • There are 10 street vendors without official permission (10 households) on the frontal road of DPDC's existing substation. The construction work will prevent them from conducting income generating activities. DPDC will pay for their moving expenses, initial investment cost and one-time assistance for business start-up.
	(2) Monitoring	(a) Will the proponent develop and implement a monitoring program for the environmental items that are considered to have potential impacts?	(a) Y	The Environmental Monitoring Plan (EMoP) was developed and will be finalized in the EIA Report. Compliance with the EMoP and its implementation is mandatory, and items with possible adverse impact will be monitored by DPDC.
		(b) What are the items, methods and frequencies of the monitoring program?	(b)Y	The EMP and EMoP will be inserted into the EIA Report. Specific items will be described in the EIA report.

Category	Environmental Item	Main Check Items	Yes: Y No: N Not Yet: NY Not Applicable: NA	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	(c) Y	Measures will be examined for monitoring based on the IEE and EIA reports by DPDC.
		(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(d)Y	These items are identified by laws and regulations in Bangladesh
	Reference to Checklists of Other Sectors	(a) Where necessary, pertinent items described in the Road checklist should also be checked (e.g., projects including installation of electric transmission lines and/or electric distribution facilities).	(a) N	-
	Notes on Using Environmental Checklist	(a) If necessary, the impacts on trans-boundary or global issues should be confirmed, (e.g., the project includes factors that may cause problems such as trans-boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	There will be no impacts on global issues as exhaust gas from construction of T/L will remain at a negligible level. Gas insulated switch gear (GIS) and gas insulated transformers (GIT), which are to be installed in the substation, will use sulfur hexafluoride (SF ₆). The greenhouse gas will be filled in the equipment's enclosure. By applying an appropriate machine specification, the gas leakage will remain at a minimum level.

Source: JICA Survey Team

10.6 Site Clearance Certificate

10.6.1 DOE Letter to DESCO

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe.gov.bd

Memo No : 22.02.0000.091.72.155.16/115

Date: 22/02/2017

Subject: Site Clearance for Installation of 132/33/11 kV Underground Substation at Gulshan-1 in DESCO Area, Dhaka.

Ref: Your Application on 14/11/2016 & 31/01/2017.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance for Installation of 132/33/11 kV Underground Substation at Gulshan-1 in DESCO Area, Dhaka subject to fulfilling the following terms and conditions.

- I. This clearance shall only be applicable for the development of the infrastructure of the said project.
- II. The project authority shall submit a comprehensive Environmental Impact Assessment (EIA) report considering the overall activity of the said Project in accordance with the TOR and time schedule submitted to the Department of Environment (DOE).
- III. The project authority shall prepare EIA report for said project and the EIA shall incorporate the following components/items in addition to the issues mentioned in the proposed TOR for EIA.
 1. Executive summary.
 2. Introduction: (Background, brief description, scope of study, methodology, limitation, EIA team, references).
 3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared).
 - 4a. Project activities:
 - A list of the main project activities to be undertaken during site clearing, construction as well as operation
 - Project Plan, Design, Standard, Specification, Quantification, etc.
 - 4b. Project schedule: The phase and timing for development of the Project.
 - 4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.
 - 4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.
 5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
 - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
 - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
 - Environment Quality : Air, Water, Noise, Vibration, Soil and Sediment Quality

1/3

- Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
 - Population: Demographic profile and ethnic composition
 - Settlement and housing
 - Traffic and transport
 - Public utilities: water supply, sanitation and solid waste
 - Economy and employment: employment structure and cultural issues in employment
 - Fisheries: activities, Farmer communities, commercial important, resources, commercial factors.
 7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).

In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man made or natural, wildlife, socio-economic aspect shall be incorporated in detail.

Appropriate models shall be used for prediction of potential impacts of the project on surface water and ambient air quality using updated data. Model prediction shall be compared with national water and air quality standards and specific sensitivity data of the organisms known to be present in the project area (likely impacted area) for impact assessment.
 8. Management Plan/Procedures:

For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.

An outline of the Environmental Management Plan shall be developed for the project.

In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
 9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)

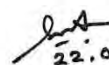
Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
 10. Risk assessment, risk management, system of valuation of environmental and properties damage, damage compensation issues shall be addressed
 11. Conclusion and Recommendations
- IV. Without approval of EIA report by the Department of Environment, Project authority shall not be able to open L/C in favor of importable machineries.
 - V. Without obtaining Environmental Clearance, Project authority shall not start the operation of the project.
 - VI. Rehabilitation of human settlement or compensation for any sort of activity which will incur damage or loss of public or private property shall be addressed as per Government of Bangladesh rules and regulations.
 - VII. Appropriate permission would be required to obtain from the Forest Department in favor of cutting/felling of any plant/tree/sapling forested by any individual or government before doing such type of activity.



2/3

- VIII. No activity of cutting/razing/dressing of hill or hilly land is endorsed without permission/clearance of the concerned authority of the government.
- IX. The project authority shall submit the EIA report along with the no objection certificates (NOCs) from the local authorities and NOC from other relevant agencies to the Dhaka Metropolitan office of DOE, Dhaka with a copy to Head Office of DOE, Dhaka.
- X. A soft copy of the EIA report including image data as well as the maps to be generated from the image shall be submitted to DOE Head Office along with the EIA.
- XI. This clearance is valid for one year from the date of issuance and the project authority shall apply for renewal to the Dhaka Metropolitan offices of DOE, Dhaka with a copy to Head Office of DOE, Dhaka at least 30 days ahead of expiry.

This Site Clearance has been issued with the approval of the appropriate authority.


22.02.2017

(Syed Nazmul Ahsan)

Director (Environmental Clearance)
Phone # 8181673

Chief Engineer (Planning & Design)
Dhaka Electric Supply Company Ltd (DESCO).
22/B, Faruk Sarani, Nikunja – 2, Khilkhet
Dhaka-1229, Bangladesh.

Copy Forwarded to :

- 1) PS to the Secretary, Ministry of Environment and Forests, Bangladesh Secretariat, Dhaka.
- 2) Director, Department of Environment, Dhaka Metropolitan Office, Dhaka.
- 3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

10.6.2 DOE Letter to DPDC

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe.gov.bd

Memo No : 22.02.0000.091.72.151.16/116

Date: 22/02/2017

Subject: Site Clearance for Construction of 132/33 kV and 33/11 kV Underground Substation at Kawranbazar under DPDC.

Ref: Your Application on 22/11/2016 & 31/01/2017.

With reference to the above mentioned subject, the Department of Environment (DOE) hereby accords Site Clearance for Construction of 132/33 kV and 33/11 kV Underground Substation at Kawranbazar under DPDC subject to fulfilling the following terms and conditions.

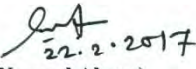
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 3. Legislative, regulation and policy consideration (covering the potential legal, administrative, planning and policy framework within which the EIA will be prepared).
 - 4a. Project activities:
 - A list of the main project activities to be undertaken during site clearing, construction as well as operation
 - Project Plan, Design, Standard, Specification, Quantification, etc.
 - 4b. Project schedule: The phase and timing for development of the Project.
 - 4c. Resources and utilities demand: Resources required to develop the project, such as soil and construction material and demand for utilities (water, electricity, sewerage, waste disposal and others), as well as infrastructure (road, drains, and others) to support the project.
 - 4d. Map and survey information
Location map, Cadastral map showing land plots (project and adjacent area), Topographical map, Geological map showing geological units, fault zone, and other natural features.
 5. Baseline Environmental Condition should include, inter alia, following: (Identification and Quantification of Physical Situation that has been proposed to be changed)
 - Physical Environment : Geology, Topology, Geomorphology, Land-use, Soils, Meteorology, and Hydrology
 - Biological Environment : Habitats, Aquatic life and fisheries, Terrestrial Habitats and Flora and Fauna
 - Environment Quality : Air, Water, Noise, Vibration, Soil and Sediment Quality

1/3

- Relate baseline in both Quantitative and Qualitative term with the anticipated outcomes, achievement of goals, objectives and changes due to project interventions
6. Socio-economic environment should include, inter alia, following:
 - Population: Demographic profile and ethnic composition
 - Settlement and housing
 - Traffic and transport
 - Public utilities: water supply, sanitation and solid waste
 - Economy and employment: employment structure and cultural issues in employment
 - Fisheries: activities, Farmer communities, commercial important, resources, commercial factors.
 7. Identification, Prediction and Evaluation of Potential Impacts (identification, prediction and assessment of positive and negative impacts likely to result from the proposed project).
 In identification and analysis of potential impacts'-the 'Analysis' part shall include the analysis of relevant spatial and non-spatial data. The outcome of the analysis shall be presented with the scenarios, maps, graphics etc. for the cases of anticipated impacts on baseline. Description of the impacts of the project on air, water, land, hydrology, vegetation-man made or natural, wildlife, socio-economic aspect shall be incorporated in detail.
 Appropriate models shall be used for prediction of potential impacts of the project on surface water and ambient air quality using updated data. Model prediction shall be compared with national water and air quality standards and specific sensitivity data of the organisms known to be present in the project area (likely impacted area) for impact assessment.
 8. Management Plan/Procedures:
 For each significant major impact, proposed mitigation measures will be set out for incorporation into project design or procedures, impacts, which are not mitigable, will be identified as residual impacts Both technical and financial plans shall be incorporated for proposed mitigation measures.
 An outline of the Environmental Management Plan shall be developed for the project.
 In Environmental Monitoring Plan, a detail technical and financial proposal shall be included for developing an in-house environmental monitoring system to be operated by the proponent's own resources (equipments and expertise).
 9. Consultation with Stakeholders/Public Consultation (ensures that consultation with interested parties and the general public will take place and their views taken into account in the planning and execution of the project)
 Beneficial Impacts (summarize the benefits of the project to the Bangladesh nation, people and local community and the enhancement potentials)
 10. Risk assessment, risk management, system of valuation of environmental and properties damage, damage compensation issues shall be addressed
 11. Conclusion and Recommendations
- IV. Without approval of EIA report by the Department of Environment, Project authority shall not be able to open L/C in favor of importable machineries.
 - V. Without obtaining Environmental Clearance, Project authority shall not start the operation of the project.
 - VI. Rehabilitation of human settlement or compensation for any sort of activity which will incur damage or loss of public or private property shall be addressed as per Government of Bangladesh rules and regulations.
 - VII. Appropriate permission would be required to obtain from the Forest Department in favor of cutting/felling of any plant/tree/sapling forested by any individual or government before doing such type of activity.

- VIII. No activity of cutting/razing/dressing of hill or hilly land is endorsed without permission/clearance of the concerned authority of the government.
- IX. The project authority shall submit the EIA report along with the no objection certificates (NOCs) from the local authorities and NOC from other relevant agencies to the Dhaka Metropolitan office of DOE, Dhaka with a copy to Head Office of DOE, Dhaka.
- X. A soft copy of the EIA report including image data as well as the maps to be generated from the image shall be submitted to DOE Head Office along with the EIA.
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This Site Clearance has been issued with the approval of the appropriate authority.


22.2.2017
(Syed Nazmul Ahsan)
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Chief Engineer (Planning & Design)
Dhaka Power Distribution Company Ltd.
Biddut Bhaban (11th Floor)
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Bangladesh.

Copy Forwarded to :

- 1) PS to the Secretary, Ministry of Environment and Forests, Bangladesh Secretariat, Dhaka.
- 2) Director, Department of Environment, Dhaka Metropolitan Office, Dhaka.
- 3) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

10.7 FIRR for Gulshan substation (Whole)

Unit: million USD

Project Life	Operation	Year	Expenditure							Revenue				
			Capex	Power Purchase	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers)	Corporate Income Tax	Subtotal	Power Sales	Distribution Loss	Rent Revenue /Reduction	Subtotal	Net Benefits
1		2017	0.00						0.00				0.00	0.00
2		2018	4.06						4.06				0.00	-4.06
3		2019	6.61						6.61				0.00	-6.61
4		2020	23.93						23.93				0.00	-23.93
5		2021	19.99						19.99				0.00	-19.99
6		2022	28.34						28.34				0.00	-28.34
7	1	2023	39.58	15.93	0.17			0.00	55.69	17.91	0.03		17.93	-37.76
8	2	2024	9.72	71.38	0.69			0.56	82.35	80.22	0.11		80.32	-2.03
9	3	2025	2.98	78.87	0.69			0.79	83.33	88.63	0.11		88.73	5.41
10	4	2026		78.87	0.69	0.45		1.13	81.14	88.63	0.11	2.17	90.90	9.76
11	5	2027		78.87	0.69	0.45		1.16	81.16	88.63	0.11	2.21	90.95	9.79
12	6	2028		78.87	0.69	0.45		1.19	81.20	88.63	0.11	2.26	91.00	9.80
13	7	2029		78.87	0.69	0.45		1.23	81.23	88.63	0.11	2.31	91.05	9.81
14	8	2030		78.87	0.69	0.45		1.27	81.27	88.63	0.11	2.36	91.10	9.82
15	9	2031		78.87	0.69	0.45		1.30	81.31	88.63	0.11	2.41	91.14	9.84
16	10	2032		78.87	0.69	0.45		1.34	81.35	88.63	0.11	2.46	91.19	9.85
17	11	2033		78.87	0.69	0.45		1.38	81.38	88.63	0.11	2.51	91.24	9.86
18	12	2034		78.87	0.69	0.45		1.42	81.42	88.63	0.11	2.56	91.29	9.87
19	13	2035		78.87	0.69	0.45		1.45	81.46	88.63	0.11	2.61	91.34	9.89
20	14	2036		78.87	0.69	0.45		1.49	81.49	88.63	0.11	2.66	91.39	9.90
21	15	2037		78.87	0.69	0.45		1.53	81.53	88.63	0.11	2.71	91.44	9.91
22	16	2038		78.87	0.69	0.45		1.56	81.57	88.63	0.11	2.76	91.49	9.92
23	17	2039		78.87	0.69	0.45		1.60	81.61	88.63	0.11	2.81	91.54	9.93
24	18	2040		78.87	0.69	0.45		1.64	81.64	88.63	0.11	2.86	91.59	9.95
25	19	2041		78.87	0.69	0.45		1.68	81.68	88.63	0.11	2.91	91.64	9.96
26	20	2042		78.87	0.69	0.45		1.71	81.72	88.63	0.11	2.96	91.69	9.97
27	21	2043		78.87	0.69	0.45		1.75	81.75	88.63	0.11	3.00	91.74	9.98
28	22	2044		78.87	0.69	0.45		1.79	81.79	88.63	0.11	3.05	91.79	10.00
29	23	2045		78.87	0.69	0.45		1.82	81.83	88.63	0.11	3.10	91.84	10.01
30	24	2046		78.87	0.69	0.45	0.43	1.75	82.18	88.63	0.11	3.15	91.89	9.70
31	25	2047		78.87	0.69	0.45		1.89	81.89	88.63	0.11	3.20	91.93	10.05
32	26	2048		78.87	0.69	0.45		1.90	81.90	88.63	0.11	3.25	91.98	10.08
33	27	2049		78.87	0.69	0.45		1.91	81.91	88.63	0.11	3.30	92.03	10.12
34	28	2050		78.87	0.69	0.45		1.92	81.93	88.63	0.11	3.35	92.08	10.16
35	29	2051		78.87	0.69	0.45		1.93	81.94	88.63	0.11	3.40	92.13	10.19
36	30	2052		78.87	0.69	0.45		1.95	81.95	88.63	0.11	3.45	92.18	10.23
37	31	2053		78.87	0.69	0.45		2.97	82.97	88.63	0.11	3.50	92.23	9.26
38	32	2054		78.87	0.69	0.45		2.98	82.98	88.63	0.11	3.55	92.28	9.30
39	33	2055		78.87	0.69	0.45		2.99	83.00	88.63	0.11	3.60	92.33	9.33
40	34	2056		78.87	0.69	0.45		3.00	83.01	88.63	0.11	3.65	92.38	9.37
41	35	2057		78.87	0.69	0.45		3.02	83.02	88.63	0.11	3.70	92.43	9.41
42	36	2058		78.87	0.69	0.45		3.03	83.03	88.63	0.11	3.75	92.48	9.44
43	37	2059		78.87	0.69	0.45		3.04	83.05	88.63	0.11	3.79	92.53	9.48
44	38	2060		78.87	0.69	0.45		3.05	83.06	88.63	0.11	3.84	92.58	9.52
45	39	2061		78.87	0.69	0.45		3.07	83.07	88.63	0.11	3.89	92.63	9.55
46	40	2062		78.87	0.69	0.45		3.08	83.08	88.63	0.11	3.94	92.68	9.59
47	41	2063		78.87	0.69	0.45		3.09	83.10	88.63	0.11	3.99	92.72	9.63
48	42	2064		78.87	0.69	0.45		3.10	83.11	88.63	0.11	4.04	92.77	9.67
49	43	2065		78.87	0.69	0.45		3.12	83.12	88.63	0.11	4.09	92.82	9.70
50	44	2066		78.87	0.69	0.45	0.43	3.11	83.54	88.63	0.11	4.14	92.87	9.33
51	45	2067		78.87	0.69	0.45		3.23	83.23	88.63	0.11	4.19	92.92	9.69
52	46	2068		78.87	0.69	0.45		3.24	83.25	88.63	0.11	4.24	92.97	9.73
53	47	2069		78.87	0.69	0.45		3.25	83.26	88.63	0.11	4.29	93.02	9.76
54	48	2070		78.87	0.69	0.45		3.27	83.27	88.63	0.11	4.34	93.07	9.80
55	49	2071		78.87	0.69	0.45		3.28	83.28	88.63	0.11	4.39	93.12	9.84
56	50	2072		78.87	0.69	0.45		3.29	83.30	88.63	0.11	4.44	93.17	9.87
Total			135.23	3872.92	33.92	21.11	0.85	106.26	4170.29	4352.14	5.30	155.13	4512.57	342.28
FIRR														6.30%
WACC														5.25%

10.8 FIRR for Gulshan substation (Superstructure)

Unit: million USD

Project Life	Operation	Year	Expenditure							Revenue				Net Benefits
			Capex	Power Purchase	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers)	Corporate Income Tax	Subtotal	Power Sales	Distribution Loss	Rent Revenue /Reduction	Subtotal	
1		2017	0.00						0.00				0.00	0.00
2		2018	0.71						0.71				0.00	-0.71
3		2019	0.28						0.28				0.00	-0.28
4		2020	0.28						0.28				0.00	-0.28
5		2021	0.28						0.28				0.00	-0.28
6		2022	0.28						0.28				0.00	-0.28
7	1	2023	4.68						4.68				0.00	-4.68
8	2	2024	4.68						4.68				0.00	-4.68
9	3	2025	2.98						2.98				0.00	-2.98
10	4	2026				0.45		0.34	0.79			2.17	2.17	1.38
11	5	2027				0.45		0.35	0.80			2.21	2.21	1.41
12	6	2028				0.45		0.36	0.81			2.26	2.26	1.45
13	7	2029				0.45		0.38	0.83			2.31	2.31	1.49
14	8	2030				0.45		0.39	0.84			2.36	2.36	1.52
15	9	2031				0.45		0.40	0.85			2.41	2.41	1.56
16	10	2032				0.45		0.41	0.86			2.46	2.46	1.60
17	11	2033				0.45		0.43	0.88			2.51	2.51	1.63
18	12	2034				0.45		0.44	0.89			2.56	2.56	1.67
19	13	2035				0.45		0.45	0.90			2.61	2.61	1.71
20	14	2036				0.45		0.46	0.91			2.66	2.66	1.75
21	15	2037				0.45		0.48	0.93			2.71	2.71	1.78
22	16	2038				0.45		0.49	0.94			2.76	2.76	1.82
23	17	2039				0.45		0.50	0.95			2.81	2.81	1.86
24	18	2040				0.45		0.51	0.96			2.86	2.86	1.89
25	19	2041				0.45		0.53	0.97			2.91	2.91	1.93
26	20	2042				0.45		0.54	0.99			2.96	2.96	1.97
27	21	2043				0.45		0.55	1.00			3.00	3.00	2.01
28	22	2044				0.45		0.56	1.01			3.05	3.05	2.04
29	23	2045				0.45		0.57	1.02			3.10	3.10	2.08
30	24	2046				0.45	0.43	0.48	1.36			3.15	3.15	1.80
31	25	2047				0.45		0.60	1.05			3.20	3.20	2.15
32	26	2048				0.45		0.61	1.06			3.25	3.25	2.19
33	27	2049				0.45		0.62	1.07			3.30	3.30	2.23
34	28	2050				0.45		0.64	1.09			3.35	3.35	2.26
35	29	2051				0.45		0.65	1.10			3.40	3.40	2.30
36	30	2052				0.45		0.66	1.11			3.45	3.45	2.34
37	31	2053				0.45		0.67	1.12			3.50	3.50	2.38
38	32	2054				0.45		0.69	1.14			3.55	3.55	2.41
39	33	2055				0.45		0.70	1.15			3.60	3.60	2.45
40	34	2056				0.45		0.71	1.16			3.65	3.65	2.49
41	35	2057				0.45		0.72	1.17			3.70	3.70	2.52
42	36	2058				0.45		0.74	1.18			3.75	3.75	2.56
43	37	2059				0.45		0.75	1.20			3.79	3.79	2.60
44	38	2060				0.45		0.76	1.21			3.84	3.84	2.63
45	39	2061				0.45		0.77	1.22			3.89	3.89	2.67
46	40	2062				0.45		0.78	1.23			3.94	3.94	2.71
47	41	2063				0.45		0.80	1.25			3.99	3.99	2.75
48	42	2064				0.45		0.81	1.26			4.04	4.04	2.78
49	43	2065				0.45		0.82	1.27			4.09	4.09	2.82
50	44	2066				0.45	0.43	0.82	1.69			4.14	4.14	2.45
51	45	2067				0.45		0.94	1.38			4.19	4.19	2.81
52	46	2068				0.45		0.95	1.40			4.24	4.24	2.84
53	47	2069				0.45		0.96	1.41			4.29	4.29	2.88
54	48	2070				0.45		0.97	1.42			4.34	4.34	2.92
55	49	2071				0.45		0.98	1.43			4.39	4.39	2.95
56	50	2072				0.45		1.00	1.45			4.44	4.44	2.99
Total			14.19	0.00	0.00	21.11	0.85	29.75	65.90	0.00	0.00	155.13	155.13	89.24
														FIRR 10.03%
														WACC 5.25%

10.9 FIRR for Gulshan substation (UGSS)

Unit: million USD

Project Life	Operation	Year	Expenditure							Revenue				Net Benefits
			Capex	Power Purchase	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers.)	Corporate Income Tax	Subtotal	Power Sales	Distribution Loss	Rent Revenue /Reduction	Subtotal	
1		2017	0.00						0.00				0.00	0.00
2		2018	3.35						3.35				0.00	-3.35
3		2019	6.33						6.33				0.00	-6.33
4		2020	23.65						23.65				0.00	-23.65
5		2021	19.71						19.71				0.00	-19.71
6		2022	28.06						28.06				0.00	-28.06
7	1	2023	34.90	15.93	0.17			0.00	51.01	17.91	0.03		17.93	-33.07
8	2	2024	5.04	71.38	0.69			0.56	77.67	80.22	0.11		80.32	2.65
9	3	2025		78.87	0.69			0.79	80.35	88.63	0.11		88.73	8.39
10	4	2026		78.87	0.69			0.79	80.35	88.63	0.11		88.73	8.39
11	5	2027		78.87	0.69			0.80	80.36	88.63	0.11		88.73	8.37
12	6	2028		78.87	0.69			0.83	80.38	88.63	0.11		88.73	8.35
13	7	2029		78.87	0.69			0.85	80.41	88.63	0.11		88.73	8.32
14	8	2030		78.87	0.69			0.88	80.43	88.63	0.11		88.73	8.30
15	9	2031		78.87	0.69			0.90	80.46	88.63	0.11		88.73	8.27
16	10	2032		78.87	0.69			0.93	80.48	88.63	0.11		88.73	8.25
17	11	2033		78.87	0.69			0.95	80.51	88.63	0.11		88.73	8.23
18	12	2034		78.87	0.69			0.98	80.53	88.63	0.11		88.73	8.20
19	13	2035		78.87	0.69			1.00	80.56	88.63	0.11		88.73	8.18
20	14	2036		78.87	0.69			1.03	80.58	88.63	0.11		88.73	8.15
21	15	2037		78.87	0.69			1.05	80.61	88.63	0.11		88.73	8.13
22	16	2038		78.87	0.69			1.08	80.63	88.63	0.11		88.73	8.10
23	17	2039		78.87	0.69			1.10	80.66	88.63	0.11		88.73	8.08
24	18	2040		78.87	0.69			1.12	80.68	88.63	0.11		88.73	8.05
25	19	2041		78.87	0.69			1.15	80.71	88.63	0.11		88.73	8.03
26	20	2042		78.87	0.69			1.17	80.73	88.63	0.11		88.73	8.00
27	21	2043		78.87	0.69			1.20	80.75	88.63	0.11		88.73	7.98
28	22	2044		78.87	0.69			1.22	80.78	88.63	0.11		88.73	7.95
29	23	2045		78.87	0.69			1.25	80.80	88.63	0.11		88.73	7.93
30	24	2046		78.87	0.69			1.27	80.83	88.63	0.11		88.73	7.90
31	25	2047		78.87	0.69			1.29	80.84	88.63	0.11		88.73	7.89
32	26	2048		78.87	0.69			1.29	80.84	88.63	0.11		88.73	7.89
33	27	2049		78.87	0.69			1.29	80.84	88.63	0.11		88.73	7.89
34	28	2050		78.87	0.69			1.29	80.84	88.63	0.11		88.73	7.89
35	29	2051		78.87	0.69			1.29	80.84	88.63	0.11		88.73	7.89
36	30	2052		78.87	0.69			1.29	80.84	88.63	0.11		88.73	7.89
37	31	2053		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
38	32	2054		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
39	33	2055		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
40	34	2056		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
41	35	2057		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
42	36	2058		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
43	37	2059		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
44	38	2060		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
45	39	2061		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
46	40	2062		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
47	41	2063		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
48	42	2064		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
49	43	2065		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
50	44	2066		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
51	45	2067		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
52	46	2068		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
53	47	2069		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
54	48	2070		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
55	49	2071		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
56	50	2072		78.87	0.69			2.29	81.85	88.63	0.11		88.73	6.88
Total			121.04	3872.92	33.92	0.00	0.00	76.51	4104.40	4352.14	5.30	0.00	4357.44	253.04
FIRR 5.74%														
WACC 5.25%														

10.10 FIRR for Kawran Bazar substation (Whole)

Unit: million USD

Project Life	Operation	Year	Expenditure							Revenue				Net Benefits
			Capex	Power Purchase	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers)	Corporate Income Tax	Subtotal	Power Sales	Distribution Loss	Rent Revenue /Reduction	Subtotal	
1		2017	0.00						0.00				0.00	0.00
2		2018	4.30						4.30				0.00	-4.30
3		2019	6.13						6.13				0.00	-6.13
4		2020	23.91						23.91				0.00	-23.91
5		2021	19.99						19.99				0.00	-19.99
6		2022	28.30						28.30				0.00	-28.30
7	1	2023	40.98	8.30	0.17			0.00	49.45	9.33	0.03		9.36	-40.09
8	2	2024	10.97	36.52	0.68			0.00	48.17	41.05	0.11		41.16	-7.01
9	3	2025	3.98	40.17	0.68			0.00	44.84	45.16	0.11		45.27	0.43
10	4	2026		44.19	0.68	0.60		0.31	45.78	49.68	0.11	1.95	51.74	5.96
11	5	2027		48.61	0.68	0.60		0.32	50.21	54.64	0.11	2.00	56.75	6.53
12	6	2028		53.47	0.68	0.60		0.44	55.20	60.11	0.11	2.04	62.26	7.06
13	7	2029		58.81	0.68	0.60		0.73	60.82	66.12	0.11	2.09	68.31	7.49
14	8	2030		64.69	0.68	0.60		1.03	67.01	72.73	0.11	2.13	74.97	7.96
15	9	2031		71.16	0.68	0.60		1.36	73.81	80.00	0.11	2.17	82.29	8.48
16	10	2032		76.49	0.68	0.60		1.64	79.41	85.99	0.11	2.22	88.32	8.90
17	11	2033		76.49	0.68	0.60		1.69	79.46	85.99	0.11	2.26	88.36	8.90
18	12	2034		76.49	0.68	0.60		1.74	79.51	85.99	0.11	2.31	88.40	8.89
19	13	2035		76.49	0.68	0.60		1.79	79.56	85.99	0.11	2.35	88.45	8.89
20	14	2036		76.49	0.68	0.60		1.84	79.61	85.99	0.11	2.40	88.49	8.88
21	15	2037		76.49	0.68	0.60		1.89	79.66	85.99	0.11	2.44	88.54	8.88
22	16	2038		76.49	0.68	0.60		1.94	79.71	85.99	0.11	2.49	88.58	8.87
23	17	2039		76.49	0.68	0.60		1.99	79.76	85.99	0.11	2.53	88.63	8.87
24	18	2040		76.49	0.68	0.60		2.04	79.81	85.99	0.11	2.57	88.67	8.86
25	19	2041		76.49	0.68	0.60		2.08	79.86	85.99	0.11	2.62	88.72	8.86
26	20	2042		76.49	0.68	0.60		2.13	79.91	85.99	0.11	2.66	88.76	8.85
27	21	2043		76.49	0.68	0.60		2.18	79.96	85.99	0.11	2.71	88.81	8.85
28	22	2044		76.49	0.68	0.60		2.23	80.00	85.99	0.11	2.75	88.85	8.85
29	23	2045		76.49	0.68	0.60		2.28	80.05	85.99	0.11	2.80	88.89	8.84
30	24	2046		76.49	0.68	0.60	0.57	2.13	80.47	85.99	0.11	2.84	88.94	8.47
31	25	2047		76.49	0.68	0.60		2.36	80.14	85.99	0.11	2.89	88.98	8.85
32	26	2048		76.49	0.68	0.60		2.38	80.15	85.99	0.11	2.93	89.03	8.88
33	27	2049		76.49	0.68	0.60		2.39	80.17	85.99	0.11	2.98	89.07	8.91
34	28	2050		76.49	0.68	0.60		2.41	80.18	85.99	0.11	3.02	89.12	8.94
35	29	2051		76.49	0.68	0.60		2.42	80.20	85.99	0.11	3.06	89.16	8.96
36	30	2052		76.49	0.68	0.60		2.44	80.21	85.99	0.11	3.11	89.21	8.99
37	31	2053		76.49	0.68	0.60		3.85	81.62	85.99	0.11	3.15	89.25	7.63
38	32	2054		76.49	0.68	0.60		3.87	81.64	85.99	0.11	3.20	89.29	7.66
39	33	2055		76.49	0.68	0.60		3.88	81.65	85.99	0.11	3.24	89.34	7.68
40	34	2056		76.49	0.68	0.60		3.90	81.67	85.99	0.11	3.29	89.38	7.71
41	35	2057		76.49	0.68	0.60		3.91	81.69	85.99	0.11	3.33	89.43	7.74
42	36	2058		76.49	0.68	0.60		3.93	81.70	85.99	0.11	3.38	89.47	7.77
43	37	2059		76.49	0.68	0.60		3.94	81.72	85.99	0.11	3.42	89.52	7.80
44	38	2060		76.49	0.68	0.60		3.96	81.73	85.99	0.11	3.46	89.56	7.83
45	39	2061		76.49	0.68	0.60		3.98	81.75	85.99	0.11	3.51	89.61	7.86
46	40	2062		76.49	0.68	0.60		3.99	81.76	85.99	0.11	3.55	89.65	7.89
47	41	2063		76.49	0.68	0.60		4.01	81.78	85.99	0.11	3.60	89.70	7.92
48	42	2064		76.49	0.68	0.60		4.02	81.80	85.99	0.11	3.64	89.74	7.94
49	43	2065		76.49	0.68	0.60		4.04	81.81	85.99	0.11	3.69	89.78	7.97
50	44	2066		76.49	0.68	0.60	0.57	4.02	82.36	85.99	0.11	3.73	89.83	7.47
51	45	2067		76.49	0.68	0.60		4.24	82.01	85.99	0.11	3.78	89.87	7.87
52	46	2068		76.49	0.68	0.60		4.25	82.02	85.99	0.11	3.82	89.92	7.89
53	47	2069		76.49	0.68	0.60		4.27	82.04	85.99	0.11	3.87	89.96	7.92
54	48	2070		76.49	0.68	0.60		4.28	82.05	85.99	0.11	3.91	90.01	7.95
55	49	2071		76.49	0.68	0.60		4.30	82.07	85.99	0.11	3.95	90.05	7.98
56	50	2072		76.49	0.68	0.60		4.31	82.09	85.99	0.11	4.00	90.10	8.01
Total			138.56	3561.91	33.72	28.21	1.14	129.15	3892.68	4004.40	5.29	139.84	4149.53	256.85
														FIRR 4.80%
														WACC 4.00%

10.11 FIRR for Kawran Bazar substation (Superstructure)

Unit: million USD

Project Life	Operation	Year	Expenditure							Revenue				Net Benefits
			Capex	Power Purchase	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers.)	Corporate Income Tax	Subtotal	Power Sales	Distribution Loss	Rent Revenue /Reduction	Subtotal	
1		2017	0.00						0.00				0.00	0.00
2		2018	0.95						0.95				0.00	-0.95
3		2019	0.38						0.38				0.00	-0.38
4		2020	0.38						0.38				0.00	-0.38
5		2021	0.38						0.38				0.00	-0.38
6		2022	0.38						0.38				0.00	-0.38
7	1	2023	6.26						6.26				0.00	-6.26
8	2	2024	6.26						6.26				0.00	-6.26
9	3	2025	3.98						3.98				0.00	-3.98
10	4	2026				0.60		0.31	0.91			1.95	1.95	1.04
11	5	2027				0.60		0.32	0.92			2.00	2.00	1.07
12	6	2028				0.60		0.34	0.94			2.04	2.04	1.10
13	7	2029				0.60		0.35	0.95			2.09	2.09	1.13
14	8	2030				0.60		0.37	0.97			2.13	2.13	1.16
15	9	2031				0.60		0.38	0.99			2.17	2.17	1.19
16	10	2032				0.60		0.40	1.00			2.22	2.22	1.22
17	11	2033				0.60		0.42	1.02			2.26	2.26	1.25
18	12	2034				0.60		0.43	1.03			2.31	2.31	1.28
19	13	2035				0.60		0.45	1.05			2.35	2.35	1.30
20	14	2036				0.60		0.46	1.06			2.40	2.40	1.33
21	15	2037				0.60		0.48	1.08			2.44	2.44	1.36
22	16	2038				0.60		0.49	1.09			2.49	2.49	1.39
23	17	2039				0.60		0.51	1.11			2.53	2.53	1.42
24	18	2040				0.60		0.53	1.13			2.57	2.57	1.45
25	19	2041				0.60		0.54	1.14			2.62	2.62	1.48
26	20	2042				0.60		0.56	1.16			2.66	2.66	1.51
27	21	2043				0.60		0.57	1.17			2.71	2.71	1.54
28	22	2044				0.60		0.59	1.19			2.75	2.75	1.57
29	23	2045				0.60		0.60	1.20			2.80	2.80	1.59
30	24	2046				0.60	0.57	0.42	1.59			2.84	2.84	1.25
31	25	2047				0.60		0.63	1.23			2.89	2.89	1.65
32	26	2048				0.60		0.65	1.25			2.93	2.93	1.68
33	27	2049				0.60		0.67	1.27			2.98	2.98	1.71
34	28	2050				0.60		0.68	1.28			3.02	3.02	1.74
35	29	2051				0.60		0.70	1.30			3.06	3.06	1.77
36	30	2052				0.60		0.71	1.31			3.11	3.11	1.80
37	31	2053				0.60		0.73	1.33			3.15	3.15	1.83
38	32	2054				0.60		0.74	1.34			3.20	3.20	1.85
39	33	2055				0.60		0.76	1.36			3.24	3.24	1.88
40	34	2056				0.60		0.77	1.37			3.29	3.29	1.91
41	35	2057				0.60		0.79	1.39			3.33	3.33	1.94
42	36	2058				0.60		0.81	1.41			3.38	3.38	1.97
43	37	2059				0.60		0.82	1.42			3.42	3.42	2.00
44	38	2060				0.60		0.84	1.44			3.46	3.46	2.03
45	39	2061				0.60		0.85	1.45			3.51	3.51	2.06
46	40	2062				0.60		0.87	1.47			3.55	3.55	2.09
47	41	2063				0.60		0.88	1.48			3.60	3.60	2.11
48	42	2064				0.60		0.90	1.50			3.64	3.64	2.14
49	43	2065				0.60		0.91	1.51			3.69	3.69	2.17
50	44	2066				0.60	0.57	0.90	2.07			3.73	3.73	1.67
51	45	2067				0.60		1.11	1.71			3.78	3.78	2.06
52	46	2068				0.60		1.13	1.73			3.82	3.82	2.09
53	47	2069				0.60		1.14	1.74			3.87	3.87	2.12
54	48	2070				0.60		1.16	1.76			3.91	3.91	2.15
55	49	2071				0.60		1.17	1.77			3.95	3.95	2.18
56	50	2072				0.60		1.19	1.79			4.00	4.00	2.21
Total			18.97	0.00	0.00	28.21	1.14	32.03	80.35	0.00	0.00	139.84	139.84	59.49
													FIRR	6.28%
													WACC	4.00%

10.12 FIRR for Kawran Bazar substation (UGSS)

Unit: million USD

Project Life	Operation	Year	Expenditure							Revenue				Net Benefits
			Capex	Power Purchase	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers.)	Corporate Income Tax	Subtotal	Power Sales	Distribution Loss	Rent Revenue /Reduction	Subtotal	
1		2017	0.00						0.00				0.00	0.00
2		2018	3.35						3.35				0.00	-3.35
3		2019	5.75						5.75				0.00	-5.75
4		2020	23.53						23.53				0.00	-23.53
5		2021	19.61						19.61				0.00	-19.61
6		2022	27.92						27.92				0.00	-27.92
7	1	2023	34.72	8.30	0.17			0.00	43.19	9.33	0.03		9.36	-33.84
8	2	2024	4.71	36.52	0.68			0.00	41.91	41.05	0.11		41.16	-0.75
9	3	2025		40.17	0.68			0.00	40.85	45.16	0.11		45.27	4.41
10	4	2026		44.19	0.68			0.00	44.87	49.68	0.11		49.78	4.91
11	5	2027		48.61	0.68			0.00	49.29	54.64	0.11		54.75	5.46
12	6	2028		53.47	0.68			0.11	54.26	60.11	0.11		60.22	5.96
13	7	2029		58.81	0.68			0.37	59.87	66.12	0.11		66.23	6.36
14	8	2030		64.69	0.68			0.66	66.04	72.73	0.11		72.84	6.80
15	9	2031		71.16	0.68			0.98	72.83	80.00	0.11		80.11	7.29
16	10	2032		76.49	0.68			1.24	78.41	85.99	0.11		86.10	7.68
17	11	2033		76.49	0.68			1.28	78.45	85.99	0.11		86.10	7.65
18	12	2034		76.49	0.68			1.31	78.48	85.99	0.11		86.10	7.62
19	13	2035		76.49	0.68			1.34	78.51	85.99	0.11		86.10	7.58
20	14	2036		76.49	0.68			1.38	78.55	85.99	0.11		86.10	7.55
21	15	2037		76.49	0.68			1.41	78.58	85.99	0.11		86.10	7.52
22	16	2038		76.49	0.68			1.44	78.62	85.99	0.11		86.10	7.48
23	17	2039		76.49	0.68			1.48	78.65	85.99	0.11		86.10	7.45
24	18	2040		76.49	0.68			1.51	78.68	85.99	0.11		86.10	7.41
25	19	2041		76.49	0.68			1.54	78.72	85.99	0.11		86.10	7.38
26	20	2042		76.49	0.68			1.58	78.75	85.99	0.11		86.10	7.35
27	21	2043		76.49	0.68			1.61	78.78	85.99	0.11		86.10	7.31
28	22	2044		76.49	0.68			1.64	78.82	85.99	0.11		86.10	7.28
29	23	2045		76.49	0.68			1.68	78.85	85.99	0.11		86.10	7.25
30	24	2046		76.49	0.68			1.71	78.88	85.99	0.11		86.10	7.21
31	25	2047		76.49	0.68			1.73	78.90	85.99	0.11		86.10	7.20
32	26	2048		76.49	0.68			1.73	78.90	85.99	0.11		86.10	7.20
33	27	2049		76.49	0.68			1.73	78.90	85.99	0.11		86.10	7.20
34	28	2050		76.49	0.68			1.73	78.90	85.99	0.11		86.10	7.20
35	29	2051		76.49	0.68			1.73	78.90	85.99	0.11		86.10	7.20
36	30	2052		76.49	0.68			1.73	78.90	85.99	0.11		86.10	7.20
37	31	2053		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
38	32	2054		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
39	33	2055		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
40	34	2056		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
41	35	2057		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
42	36	2058		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
43	37	2059		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
44	38	2060		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
45	39	2061		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
46	40	2062		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
47	41	2063		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
48	42	2064		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
49	43	2065		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
50	44	2066		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
51	45	2067		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
52	46	2068		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
53	47	2069		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
54	48	2070		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
55	49	2071		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
56	50	2072		76.49	0.68			3.12	80.30	85.99	0.11		86.10	5.80
Total			119.59	3561.91	33.72	0.00	0.00	97.11	3812.34	4004.40	5.29	0.00	4009.69	197.36
													FIRR	4.53%
													WACC	4.00%

10.13 EIRR for Gulshan substation (Whole)

Unit: million USD

Project Life	Operation	Year	Cost					Benefits					Net Benefits
			Capex	Generation Cost (General)	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers)	Subtotal	Incremental Benefits	Distribution Loss	Rent Revenue /Reduction	Subtotal	
1		2017	0.00					0.00				0.00	0.00
2		2018	3.05					3.05				0.00	-3.05
3		2019	5.03					5.03				0.00	-5.03
4		2020	15.51					15.51				0.00	-15.51
5		2021	12.90					12.90				0.00	-12.90
6		2022	18.23					18.23				0.00	-18.23
7	1	2023	26.07	8.64	0.16			34.87	20.12	0.03		20.15	-14.72
8	2	2024	7.09	38.71	0.65			46.46	90.15	0.12		90.27	43.81
9	3	2025	2.31	42.77	0.65			45.73	99.60	0.12		99.72	54.00
10	4	2026		42.77	0.65	0.37		43.79	99.60	0.12	2.42	102.15	58.36
11	5	2027		42.77	0.65	0.37		43.79	99.60	0.12	2.48	102.20	58.41
12	6	2028		42.77	0.65	0.37		43.79	99.60	0.12	2.53	102.26	58.47
13	7	2029		42.77	0.65	0.37		43.79	99.60	0.12	2.59	102.31	58.52
14	8	2030		42.77	0.65	0.37		43.79	99.60	0.12	2.65	102.37	58.58
15	9	2031		42.77	0.65	0.37		43.79	99.60	0.12	2.70	102.42	58.63
16	10	2032		42.77	0.65	0.37		43.79	99.60	0.12	2.76	102.48	58.69
17	11	2033		42.77	0.65	0.37		43.79	99.60	0.12	2.81	102.54	58.74
18	12	2034		42.77	0.65	0.37		43.79	99.60	0.12	2.87	102.59	58.80
19	13	2035		42.77	0.65	0.37		43.79	99.60	0.12	2.92	102.65	58.85
20	14	2036		42.77	0.65	0.37		43.79	99.60	0.12	2.98	102.70	58.91
21	15	2037		42.77	0.65	0.37		43.79	99.60	0.12	3.03	102.76	58.97
22	16	2038		42.77	0.65	0.37		43.79	99.60	0.12	3.09	102.81	59.02
23	17	2039		42.77	0.65	0.37		43.79	99.60	0.12	3.14	102.87	59.08
24	18	2040		42.77	0.65	0.37		43.79	99.60	0.12	3.20	102.92	59.13
25	19	2041		42.77	0.65	0.37		43.79	99.60	0.12	3.25	102.98	59.19
26	20	2042		42.77	0.65	0.37		43.79	99.60	0.12	3.31	103.03	59.24
27	21	2043		42.77	0.65	0.37		43.79	99.60	0.12	3.36	103.09	59.30
28	22	2044		42.77	0.65	0.37		43.79	99.60	0.12	3.42	103.14	59.35
29	23	2045		42.77	0.65	0.37		43.79	99.60	0.12	3.47	103.20	59.41
30	24	2046		42.77	0.65	0.37	0.35	44.14	99.60	0.12	3.53	103.25	59.11
31	25	2047		42.77	0.65	0.37		43.79	99.60	0.12	3.59	103.31	59.52
32	26	2048		42.77	0.65	0.37		43.79	99.60	0.12	3.64	103.36	59.57
33	27	2049		42.77	0.65	0.37		43.79	99.60	0.12	3.70	103.42	59.63
34	28	2050		42.77	0.65	0.37		43.79	99.60	0.12	3.75	103.48	59.68
35	29	2051		42.77	0.65	0.37		43.79	99.60	0.12	3.81	103.53	59.74
36	30	2052		42.77	0.65	0.37		43.79	99.60	0.12	3.86	103.59	59.79
37	31	2053		42.77	0.65	0.37		43.79	99.60	0.12	3.92	103.64	59.85
38	32	2054		42.77	0.65	0.37		43.79	99.60	0.12	3.97	103.70	59.90
39	33	2055		42.77	0.65	0.37		43.79	99.60	0.12	4.03	103.75	59.96
40	34	2056		42.77	0.65	0.37		43.79	99.60	0.12	4.08	103.81	60.02
41	35	2057		42.77	0.65	0.37		43.79	99.60	0.12	4.14	103.86	60.07
42	36	2058		42.77	0.65	0.37		43.79	99.60	0.12	4.19	103.92	60.13
43	37	2059		42.77	0.65	0.37		43.79	99.60	0.12	4.25	103.97	60.18
44	38	2060		42.77	0.65	0.37		43.79	99.60	0.12	4.30	104.03	60.24
45	39	2061		42.77	0.65	0.37		43.79	99.60	0.12	4.36	104.08	60.29
46	40	2062		42.77	0.65	0.37		43.79	99.60	0.12	4.41	104.14	60.35
47	41	2063		42.77	0.65	0.37		43.79	99.60	0.12	4.47	104.19	60.40
48	42	2064		42.77	0.65	0.37		43.79	99.60	0.12	4.53	104.25	60.46
49	43	2065		42.77	0.65	0.37		43.79	99.60	0.12	4.58	104.30	60.51
50	44	2066		42.77	0.65	0.37	0.35	44.14	99.60	0.12	4.64	104.36	60.22
51	45	2067		42.77	0.65	0.37		43.79	99.60	0.12	4.69	104.42	60.62
52	46	2068		42.77	0.65	0.37		43.79	99.60	0.12	4.75	104.47	60.68
53	47	2069		42.77	0.65	0.37		43.79	99.60	0.12	4.80	104.53	60.73
54	48	2070		42.77	0.65	0.37		43.79	99.60	0.12	4.86	104.58	60.79
55	49	2071		42.77	0.65	0.37		43.79	99.60	0.12	4.91	104.64	60.84
56	50	2072		42.77	0.65	0.37		43.79	99.60	0.12	4.97	104.69	60.90
Total			90.19	2100.31	32.18	17.31	0.70	2240.69	4891.24	5.95	173.70	5070.89	2830.21
													EIRR 38.35%
													SDR 15.00%

10.14 EIRR for Gulshan substation (Superstructure)

Unit: million USD

Project Life	Operation	Year	Cost					Benefits				Subtotal	Net Benefits
			Capex	Generation Cost (General)	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers.)	Subtotal	Incremental Benefits	Distribution Loss	Rent Revenue / Reduction		
1		2017	0.00					0.00				0.00	0.00
2		2018	0.55					0.55				0.00	-0.55
3		2019	0.22					0.22				0.00	-0.22
4		2020	0.22					0.22				0.00	-0.22
5		2021	0.22					0.22				0.00	-0.22
6		2022	0.22					0.22				0.00	-0.22
7	1	2023	3.62					3.62				0.00	-3.62
8	2	2024	3.62					3.62				0.00	-3.62
9	3	2025	2.31					2.31				0.00	-2.31
10	4	2026				0.37		0.37			2.42	2.42	2.06
11	5	2027				0.37		0.37			2.48	2.48	2.11
12	6	2028				0.37		0.37			2.53	2.53	2.17
13	7	2029				0.37		0.37			2.59	2.59	2.22
14	8	2030				0.37		0.37			2.65	2.65	2.28
15	9	2031				0.37		0.37			2.70	2.70	2.33
16	10	2032				0.37		0.37			2.76	2.76	2.39
17	11	2033				0.37		0.37			2.81	2.81	2.44
18	12	2034				0.37		0.37			2.87	2.87	2.50
19	13	2035				0.37		0.37			2.92	2.92	2.55
20	14	2036				0.37		0.37			2.98	2.98	2.61
21	15	2037				0.37		0.37			3.03	3.03	2.66
22	16	2038				0.37		0.37			3.09	3.09	2.72
23	17	2039				0.37		0.37			3.14	3.14	2.77
24	18	2040				0.37		0.37			3.20	3.20	2.83
25	19	2041				0.37		0.37			3.25	3.25	2.89
26	20	2042				0.37		0.37			3.31	3.31	2.94
27	21	2043				0.37		0.37			3.36	3.36	3.00
28	22	2044				0.37		0.37			3.42	3.42	3.05
29	23	2045				0.37		0.37			3.47	3.47	3.11
30	24	2046				0.37	0.35	0.72			3.53	3.53	2.81
31	25	2047				0.37		0.37			3.59	3.59	3.22
32	26	2048				0.37		0.37			3.64	3.64	3.27
33	27	2049				0.37		0.37			3.70	3.70	3.33
34	28	2050				0.37		0.37			3.75	3.75	3.38
35	29	2051				0.37		0.37			3.81	3.81	3.44
36	30	2052				0.37		0.37			3.86	3.86	3.49
37	31	2053				0.37		0.37			3.92	3.92	3.55
38	32	2054				0.37		0.37			3.97	3.97	3.60
39	33	2055				0.37		0.37			4.03	4.03	3.66
40	34	2056				0.37		0.37			4.08	4.08	3.71
41	35	2057				0.37		0.37			4.14	4.14	3.77
42	36	2058				0.37		0.37			4.19	4.19	3.83
43	37	2059				0.37		0.37			4.25	4.25	3.88
44	38	2060				0.37		0.37			4.30	4.30	3.94
45	39	2061				0.37		0.37			4.36	4.36	3.99
46	40	2062				0.37		0.37			4.41	4.41	4.05
47	41	2063				0.37		0.37			4.47	4.47	4.10
48	42	2064				0.37		0.37			4.53	4.53	4.16
49	43	2065				0.37		0.37			4.58	4.58	4.21
50	44	2066				0.37	0.35	0.72			4.64	4.64	3.92
51	45	2067				0.37		0.37			4.69	4.69	4.32
52	46	2068				0.37		0.37			4.75	4.75	4.38
53	47	2069				0.37		0.37			4.80	4.80	4.43
54	48	2070				0.37		0.37			4.86	4.86	4.49
55	49	2071				0.37		0.37			4.91	4.91	4.54
56	50	2072				0.37		0.37			4.97	4.97	4.60
Total			10.98	0.00	0.00	17.31	0.70	28.99	0.00	0.00	173.70	173.70	144.71
EIRR 16.22%													
SDR 15.00%													

10.15 EIRR for Gulshan substation (UGSS)

Unit: million USD

Project Life	Operation	Year	Cost						Benefits				Net Benefits
			Capex	Generation Cost (General)	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers.)	Subtotal	Incremental Benefits	Distribution Loss	Rent Revenue / Reduction	Subtotal	
1		2017	0.00					0.00				0.00	0.00
2		2018	2.50					2.50				0.00	-2.50
3		2019	4.81					4.81				0.00	-4.81
4		2020	15.29					15.29				0.00	-15.29
5		2021	12.68					12.68				0.00	-12.68
6	1	2022	18.02					18.02				0.00	-18.02
7	2	2023	22.44	8.64	0.16			31.25	20.12	0.03		20.15	-11.09
8	3	2024	3.47	38.71	0.65			42.84	90.15	0.12		90.27	47.44
9	4	2025		42.77	0.65			43.42	99.60	0.12		99.72	56.30
10	5	2026		42.77	0.65			43.42	99.60	0.12		99.72	56.30
11	6	2027		42.77	0.65			43.42	99.60	0.12		99.72	56.30
12	7	2028		42.77	0.65			43.42	99.60	0.12		99.72	56.30
13	8	2029		42.77	0.65			43.42	99.60	0.12		99.72	56.30
14	9	2030		42.77	0.65			43.42	99.60	0.12		99.72	56.30
15	10	2031		42.77	0.65			43.42	99.60	0.12		99.72	56.30
16	11	2032		42.77	0.65			43.42	99.60	0.12		99.72	56.30
17	12	2033		42.77	0.65			43.42	99.60	0.12		99.72	56.30
18	13	2034		42.77	0.65			43.42	99.60	0.12		99.72	56.30
19	14	2035		42.77	0.65			43.42	99.60	0.12		99.72	56.30
20	15	2036		42.77	0.65			43.42	99.60	0.12		99.72	56.30
21	16	2037		42.77	0.65			43.42	99.60	0.12		99.72	56.30
22	17	2038		42.77	0.65			43.42	99.60	0.12		99.72	56.30
23	18	2039		42.77	0.65			43.42	99.60	0.12		99.72	56.30
24	19	2040		42.77	0.65			43.42	99.60	0.12		99.72	56.30
25	20	2041		42.77	0.65			43.42	99.60	0.12		99.72	56.30
26	21	2042		42.77	0.65			43.42	99.60	0.12		99.72	56.30
27	22	2043		42.77	0.65			43.42	99.60	0.12		99.72	56.30
28	23	2044		42.77	0.65			43.42	99.60	0.12		99.72	56.30
29	24	2045		42.77	0.65			43.42	99.60	0.12		99.72	56.30
30	25	2046		42.77	0.65			43.42	99.60	0.12		99.72	56.30
31	26	2047		42.77	0.65			43.42	99.60	0.12		99.72	56.30
32	27	2048		42.77	0.65			43.42	99.60	0.12		99.72	56.30
33	28	2049		42.77	0.65			43.42	99.60	0.12		99.72	56.30
34	29	2050		42.77	0.65			43.42	99.60	0.12		99.72	56.30
35	30	2051		42.77	0.65			43.42	99.60	0.12		99.72	56.30
36	31	2052		42.77	0.65			43.42	99.60	0.12		99.72	56.30
37	32	2053		42.77	0.65			43.42	99.60	0.12		99.72	56.30
38	33	2054		42.77	0.65			43.42	99.60	0.12		99.72	56.30
39	34	2055		42.77	0.65			43.42	99.60	0.12		99.72	56.30
40	35	2056		42.77	0.65			43.42	99.60	0.12		99.72	56.30
41	36	2057		42.77	0.65			43.42	99.60	0.12		99.72	56.30
42	37	2058		42.77	0.65			43.42	99.60	0.12		99.72	56.30
43	38	2059		42.77	0.65			43.42	99.60	0.12		99.72	56.30
44	39	2060		42.77	0.65			43.42	99.60	0.12		99.72	56.30
45	40	2061		42.77	0.65			43.42	99.60	0.12		99.72	56.30
46	41	2062		42.77	0.65			43.42	99.60	0.12		99.72	56.30
47	42	2063		42.77	0.65			43.42	99.60	0.12		99.72	56.30
48	43	2064		42.77	0.65			43.42	99.60	0.12		99.72	56.30
49	44	2065		42.77	0.65			43.42	99.60	0.12		99.72	56.30
50	45	2066		42.77	0.65			43.42	99.60	0.12		99.72	56.30
51	46	2067		42.77	0.65			43.42	99.60	0.12		99.72	56.30
52	47	2068		42.77	0.65			43.42	99.60	0.12		99.72	56.30
53	48	2069		42.77	0.65			43.42	99.60	0.12		99.72	56.30
54	49	2070		42.77	0.65			43.42	99.60	0.12		99.72	56.30
55	50	2071		42.77	0.65			43.42	99.60	0.12		99.72	56.30
56	51	2072		42.77	0.65			43.42	99.60	0.12		99.72	56.30
Total			79.21	2100.31	32.18	0.00	0.00	2211.70	4891.24	5.95	0.00	4897.19	2685.49
												EIRR 39.90%	
												SDR 15.00%	

10.16 EIRR for Kawran Bazar substation (Whole)

Unit: million USD

Project Life	Operation	Year	Cost					Benefits					Net Benefits
			Capex	Generation Cost (General)	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers)	Subtotal	Incremental Benefits	Distribution Loss	Rent Revenue /Reduction	Subtotal	
1		2017	0.00					0.00				0.00	0.00
2		2018	3.23					3.23				0.00	-3.23
3		2019	4.66					4.66				0.00	-4.66
4		2020	15.78					15.78				0.00	-15.78
5		2021	13.15					13.15				0.00	-13.15
6		2022	18.56					18.56				0.00	-18.56
7	1	2023	27.60	4.51	0.16			32.27	10.49	0.03		10.52	-21.74
8	2	2024	8.10	19.83	0.65			28.58	46.17	0.12		46.29	17.71
9	3	2025	3.08	21.81	0.65			25.54	50.79	0.12		50.91	25.37
10	4	2026		23.99	0.65	0.49		25.13	55.87	0.12	1.99	57.98	32.84
11	5	2027		26.39	0.65	0.49		27.53	61.45	0.12	2.03	63.61	36.08
12	6	2028		29.03	0.65	0.49		30.17	67.60	0.12	2.08	69.80	39.63
13	7	2029		31.93	0.65	0.49		33.07	74.36	0.12	2.12	76.60	43.53
14	8	2030		35.13	0.65	0.49		36.27	81.80	0.12	2.17	84.09	47.82
15	9	2031		38.64	0.65	0.49		39.78	89.98	0.12	2.21	92.31	52.53
16	10	2032		41.53	0.65	0.49		42.67	96.71	0.12	2.26	99.09	56.42
17	11	2033		41.53	0.65	0.49		42.67	96.71	0.12	2.31	99.13	56.46
18	12	2034		41.53	0.65	0.49		42.67	96.71	0.12	2.35	99.18	56.51
19	13	2035		41.53	0.65	0.49		42.67	96.71	0.12	2.40	99.22	56.55
20	14	2036		41.53	0.65	0.49		42.67	96.71	0.12	2.44	99.27	56.60
21	15	2037		41.53	0.65	0.49		42.67	96.71	0.12	2.49	99.31	56.64
22	16	2038		41.53	0.65	0.49		42.67	96.71	0.12	2.53	99.36	56.69
23	17	2039		41.53	0.65	0.49		42.67	96.71	0.12	2.58	99.40	56.73
24	18	2040		41.53	0.65	0.49		42.67	96.71	0.12	2.62	99.45	56.78
25	19	2041		41.53	0.65	0.49		42.67	96.71	0.12	2.67	99.50	56.82
26	20	2042		41.53	0.65	0.49		42.67	96.71	0.12	2.71	99.54	56.87
27	21	2043		41.53	0.65	0.49		42.67	96.71	0.12	2.76	99.59	56.92
28	22	2044		41.53	0.65	0.49		42.67	96.71	0.12	2.80	99.63	56.96
29	23	2045		41.53	0.65	0.49		42.67	96.71	0.12	2.85	99.68	57.01
30	24	2046		41.53	0.65	0.49	0.47	43.14	96.71	0.12	2.89	99.72	56.58
31	25	2047		41.53	0.65	0.49		42.67	96.71	0.12	2.94	99.77	57.10
32	26	2048		41.53	0.65	0.49		42.67	96.71	0.12	2.99	99.81	57.14
33	27	2049		41.53	0.65	0.49		42.67	96.71	0.12	3.03	99.86	57.19
34	28	2050		41.53	0.65	0.49		42.67	96.71	0.12	3.08	99.90	57.23
35	29	2051		41.53	0.65	0.49		42.67	96.71	0.12	3.12	99.95	57.28
36	30	2052		41.53	0.65	0.49		42.67	96.71	0.12	3.17	99.99	57.32
37	31	2053		41.53	0.65	0.49		42.67	96.71	0.12	3.21	100.04	57.37
38	32	2054		41.53	0.65	0.49		42.67	96.71	0.12	3.26	100.08	57.41
39	33	2055		41.53	0.65	0.49		42.67	96.71	0.12	3.30	100.13	57.46
40	34	2056		41.53	0.65	0.49		42.67	96.71	0.12	3.35	100.18	57.50
41	35	2057		41.53	0.65	0.49		42.67	96.71	0.12	3.39	100.22	57.55
42	36	2058		41.53	0.65	0.49		42.67	96.71	0.12	3.44	100.27	57.60
43	37	2059		41.53	0.65	0.49		42.67	96.71	0.12	3.48	100.31	57.64
44	38	2060		41.53	0.65	0.49		42.67	96.71	0.12	3.53	100.36	57.69
45	39	2061		41.53	0.65	0.49		42.67	96.71	0.12	3.57	100.40	57.73
46	40	2062		41.53	0.65	0.49		42.67	96.71	0.12	3.62	100.45	57.78
47	41	2063		41.53	0.65	0.49		42.67	96.71	0.12	3.67	100.49	57.82
48	42	2064		41.53	0.65	0.49		42.67	96.71	0.12	3.71	100.54	57.87
49	43	2065		41.53	0.65	0.49		42.67	96.71	0.12	3.76	100.58	57.91
50	44	2066		41.53	0.65	0.49	0.47	43.14	96.71	0.12	3.80	100.63	57.49
51	45	2067		41.53	0.65	0.49		42.67	96.71	0.12	3.85	100.67	58.00
52	46	2068		41.53	0.65	0.49		42.67	96.71	0.12	3.89	100.72	58.05
53	47	2069		41.53	0.65	0.49		42.67	96.71	0.12	3.94	100.76	58.09
54	48	2070		41.53	0.65	0.49		42.67	96.71	0.12	3.98	100.81	58.14
55	49	2071		41.53	0.65	0.49		42.67	96.71	0.12	4.03	100.86	58.18
56	50	2072		41.53	0.65	0.49		42.67	96.71	0.12	4.07	100.90	58.23
Total			94.17	1933.92	32.01	23.13	0.93	2084.17	4503.50	5.95	142.43	4651.88	2567.71
													EIRR 27.99%
													SDR 15.00%

10.17 EIRR for Kawran Bazar substation (Superstructure)

Unit: million USD

Project Life	Operation	Year	Cost						Benefits				Net Benefits
			Capex	Generation Cost (General)	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers.)	Subtotal	Incremental Benefits	Distribution Loss	Rent Revenue / Reduction	Subtotal	
1		2017	0.00					0.00				0.00	0.00
2		2018	0.73					0.73				0.00	-0.73
3		2019	0.29					0.29				0.00	-0.29
4		2020	0.29					0.29				0.00	-0.29
5		2021	0.29					0.29				0.00	-0.29
6		2022	0.29					0.29				0.00	-0.29
7	1	2023	4.84					4.84				0.00	-4.84
8	2	2024	4.84					4.84				0.00	-4.84
9	3	2025	3.08					3.08				0.00	-3.08
10	4	2026				0.49		0.49			1.99	1.99	1.50
11	5	2027				0.49		0.49			2.03	2.03	1.54
12	6	2028				0.49		0.49			2.08	2.08	1.59
13	7	2029				0.49		0.49			2.12	2.12	1.63
14	8	2030				0.49		0.49			2.17	2.17	1.68
15	9	2031				0.49		0.49			2.21	2.21	1.72
16	10	2032				0.49		0.49			2.26	2.26	1.77
17	11	2033				0.49		0.49			2.31	2.31	1.81
18	12	2034				0.49		0.49			2.35	2.35	1.86
19	13	2035				0.49		0.49			2.40	2.40	1.90
20	14	2036				0.49		0.49			2.44	2.44	1.95
21	15	2037				0.49		0.49			2.49	2.49	1.99
22	16	2038				0.49		0.49			2.53	2.53	2.04
23	17	2039				0.49		0.49			2.58	2.58	2.08
24	18	2040				0.49		0.49			2.62	2.62	2.13
25	19	2041				0.49		0.49			2.67	2.67	2.18
26	20	2042				0.49		0.49			2.71	2.71	2.22
27	21	2043				0.49		0.49			2.76	2.76	2.27
28	22	2044				0.49		0.49			2.80	2.80	2.31
29	23	2045				0.49		0.49			2.85	2.85	2.36
30	24	2046				0.49	0.47	0.96			2.89	2.89	1.94
31	25	2047				0.49		0.49			2.94	2.94	2.45
32	26	2048				0.49		0.49			2.99	2.99	2.49
33	27	2049				0.49		0.49			3.03	3.03	2.54
34	28	2050				0.49		0.49			3.08	3.08	2.58
35	29	2051				0.49		0.49			3.12	3.12	2.63
36	30	2052				0.49		0.49			3.17	3.17	2.67
37	31	2053				0.49		0.49			3.21	3.21	2.72
38	32	2054				0.49		0.49			3.26	3.26	2.76
39	33	2055				0.49		0.49			3.30	3.30	2.81
40	34	2056				0.49		0.49			3.35	3.35	2.86
41	35	2057				0.49		0.49			3.39	3.39	2.90
42	36	2058				0.49		0.49			3.44	3.44	2.95
43	37	2059				0.49		0.49			3.48	3.48	2.99
44	38	2060				0.49		0.49			3.53	3.53	3.04
45	39	2061				0.49		0.49			3.57	3.57	3.08
46	40	2062				0.49		0.49			3.62	3.62	3.13
47	41	2063				0.49		0.49			3.67	3.67	3.17
48	42	2064				0.49		0.49			3.71	3.71	3.22
49	43	2065				0.49		0.49			3.76	3.76	3.26
50	44	2066				0.49	0.47	0.96			3.80	3.80	2.84
51	45	2067				0.49		0.49			3.85	3.85	3.35
52	46	2068				0.49		0.49			3.89	3.89	3.40
53	47	2069				0.49		0.49			3.94	3.94	3.44
54	48	2070				0.49		0.49			3.98	3.98	3.49
55	49	2071				0.49		0.49			4.03	4.03	3.54
56	50	2072				0.49		0.49			4.07	4.07	3.58
Total			14.67	0.00	0.00	23.13	0.93	38.74	0.00	0.00	142.43	142.43	103.69
												EIRR 10.62%	
												SDR 15.00%	

10.18 EIRR for Kawran Bazar substation (UGSS)

Unit: million USD

			Cost						Benefits				
Project Life	Operation	Year	Capex	Generation Cost (General)	O&M (UGSS)	O&M (Supers.)	Repair Work (Supers)	Subtotal	Incremental Benefits	Distribution Loss	Rent Revenue /Reduction	Subtotal	Net Benefits
1		2017	0.00					0.00				0.00	0.00
2		2018	2.50					2.50				0.00	-2.50
3		2019	4.37					4.37				0.00	-4.37
4		2020	15.49					15.49				0.00	-15.49
5		2021	12.86					12.86				0.00	-12.86
6	1	2022	18.27					18.27				0.00	-18.27
7	2	2023	22.76	4.51	0.16			27.42	10.49	0.03		10.52	-16.90
8	3	2024	3.26	19.83	0.65			23.74	46.17	0.12		46.29	22.56
9	4	2025		21.81	0.65			22.46	50.79	0.12		50.91	28.45
10	5	2026		23.99	0.65			24.64	55.87	0.12		55.99	31.35
11	6	2027		26.39	0.65			27.04	61.45	0.12		61.58	34.54
12	7	2028		29.03	0.65			29.68	67.60	0.12		67.72	38.04
13	8	2029		31.93	0.65			32.58	74.36	0.12		74.48	41.90
14	9	2030		35.13	0.65			35.78	81.80	0.12		81.92	46.14
15	10	2031		38.64	0.65			39.29	89.98	0.12		90.10	50.81
16	11	2032		41.53	0.65			42.18	96.71	0.12		96.83	54.65
17	12	2033		41.53	0.65			42.18	96.71	0.12		96.83	54.65
18	13	2034		41.53	0.65			42.18	96.71	0.12		96.83	54.65
19	14	2035		41.53	0.65			42.18	96.71	0.12		96.83	54.65
20	15	2036		41.53	0.65			42.18	96.71	0.12		96.83	54.65
21	16	2037		41.53	0.65			42.18	96.71	0.12		96.83	54.65
22	17	2038		41.53	0.65			42.18	96.71	0.12		96.83	54.65
23	18	2039		41.53	0.65			42.18	96.71	0.12		96.83	54.65
24	19	2040		41.53	0.65			42.18	96.71	0.12		96.83	54.65
25	20	2041		41.53	0.65			42.18	96.71	0.12		96.83	54.65
26	21	2042		41.53	0.65			42.18	96.71	0.12		96.83	54.65
27	22	2043		41.53	0.65			42.18	96.71	0.12		96.83	54.65
28	23	2044		41.53	0.65			42.18	96.71	0.12		96.83	54.65
29	24	2045		41.53	0.65			42.18	96.71	0.12		96.83	54.65
30	25	2046		41.53	0.65			42.18	96.71	0.12		96.83	54.65
31	26	2047		41.53	0.65			42.18	96.71	0.12		96.83	54.65
32	27	2048		41.53	0.65			42.18	96.71	0.12		96.83	54.65
33	28	2049		41.53	0.65			42.18	96.71	0.12		96.83	54.65
34	29	2050		41.53	0.65			42.18	96.71	0.12		96.83	54.65
35	30	2051		41.53	0.65			42.18	96.71	0.12		96.83	54.65
36	31	2052		41.53	0.65			42.18	96.71	0.12		96.83	54.65
37	32	2053		41.53	0.65			42.18	96.71	0.12		96.83	54.65
38	33	2054		41.53	0.65			42.18	96.71	0.12		96.83	54.65
39	34	2055		41.53	0.65			42.18	96.71	0.12		96.83	54.65
40	35	2056		41.53	0.65			42.18	96.71	0.12		96.83	54.65
41	36	2057		41.53	0.65			42.18	96.71	0.12		96.83	54.65
42	37	2058		41.53	0.65			42.18	96.71	0.12		96.83	54.65
43	38	2059		41.53	0.65			42.18	96.71	0.12		96.83	54.65
44	39	2060		41.53	0.65			42.18	96.71	0.12		96.83	54.65
45	40	2061		41.53	0.65			42.18	96.71	0.12		96.83	54.65
46	41	2062		41.53	0.65			42.18	96.71	0.12		96.83	54.65
47	42	2063		41.53	0.65			42.18	96.71	0.12		96.83	54.65
48	43	2064		41.53	0.65			42.18	96.71	0.12		96.83	54.65
49	44	2065		41.53	0.65			42.18	96.71	0.12		96.83	54.65
50	45	2066		41.53	0.65			42.18	96.71	0.12		96.83	54.65
51	46	2067		41.53	0.65			42.18	96.71	0.12		96.83	54.65
52	47	2068		41.53	0.65			42.18	96.71	0.12		96.83	54.65
53	48	2069		41.53	0.65			42.18	96.71	0.12		96.83	54.65
54	49	2070		41.53	0.65			42.18	96.71	0.12		96.83	54.65
55	50	2071		41.53	0.65			42.18	96.71	0.12		96.83	54.65
56	51	2072		41.53	0.65			42.18	96.71	0.12		96.83	54.65
Total			79.49	1933.92	32.01	0.00	0.00	2045.43	4503.50	5.95	0.00	4509.45	2464.02
EIRR													29.60%
SDR													15.00%

10.19 Draft TOR of ES Consultant

(1) Basic design

The Consultant shall:

- (a) Review and verify all available primary and secondary data collected during the JICA's preparatory survey and Special Assistance for Project Implementation for the Project;
- (b) Carry out all the required engineering surveys and investigations such as topographical survey, geotechnical survey, route survey for underground transmission lines, etc, as applicable to the concerned project components.
- (c) Prepare a work plan, progress reports and implementation schedule for the Project to ensure effective monitoring and timely project outputs, and regularly update the same; and
- (d) Prepare the basic design of the Project in sufficient detail to ensure clarity and understanding by the DESCO/DPDC, contractors and other relevant stakeholders. All the design should be in conformity with the Bangladesh Standards (if available), or with the appropriate international standards.
- (e) Assist the preparation of Building Construction Application by DESCO/DPDC
- (f) Assist the consultations with relevant authorities to clarify necessary designs for underground substation.

The basic design will, as a minimum, include construction drawings, detailed cost estimates, necessary calculations to determine and justify the engineering details for the Project, associated contract documentation to include detailed specifications, bill of quantities (BOQ), implementation schedule for the Project. Such detailed specifications will contain those in relation to i) quality control of transmission line, underground substation materials and workmanship, ii) safety, and iii) protection of the environment and social issue. The basic design shall be prepared in close consultation with, and to meet the requirements of DESCO/DPDC and will be incorporated into the basic design report to be submitted for approval of DESCO/DPDC.

(2) Tender assistance

● Assistance in the Bidding Procedures

The Consultant shall:

- (a) Prepare bidding documents in accordance with the latest version of Standard Bidding Documents under Japanese ODA Loans for Procurement of Design Build together with all relevant specifications, drawings and other documents;
- (b) Define technical and financial requirements, capacity and/or experience for bidder qualification criteria taking into consideration technical feature of the Project;
- (c) Prepare bidding documents which includes i) clauses stating that the Contractor is to comply with the requirement of the Environmental Management Plan (EMP) and JICA Guidelines for environmental and social considerations (April 2010) (JICA Environmental Guidelines), ii) the specification clearly stipulating the safety requirements in accordance with the laws and regulations in the country of the Borrower, relevant international standards (including guidelines of international organization), if any, and also in consideration of "the Guidance for the Management of Safety for Construction Works in Japanese ODA Projects of JICA," iii) the requirement to furnish a safety plan to meet the safety requirements, iv) the

requirement for the personnel for key positions to include an accident prevention officer, and v) the requirement to submit method statements of safety to DPDC/DESCO and the consultant at the construction stage. (注：下線部分は、「ODA 建設工事安全管理ガイドダンス」の活用につき、借入人又は実施機関より合意が得られた場合のみ記載。それ以外の場合は削除する。)

- (d) Assist DESCO/DPDC in issuing bid invitation, conducting pre-bid conferences, issuing addendum/corrigendum, and clarifications to bidders' queries.
- (e) Evaluate bids in accordance with the criteria set forth in the bidding documents. In such evaluation, the Consultant shall carefully confirm that bidders' submissions in their technical proposal including, but not limited to; site organization, mobilization schedule, method statement, construction schedule, safety plan, and EMP, have been prepared in consistent with each other and meet requirements set forth in applicable laws and regulations, specifications and other parts of the bidding documents;
- (f) Prepare a bid evaluation report for approval of the bid evaluation committee;
- (g) Assist DESCO/DPDC in contract negotiation by preparing agenda and facilitating negotiations including preparation of minutes of negotiation meeting; and
- (h) Prepare a draft and final contract agreement.

(3) Construction supervision

The Consultant shall perform his duties during the contract implementation period of the contracts to be executed by the Employer and the Contractor. Standard Bidding Documents under Japanese ODA Loans for Procurement of Design Build by the Contractor will be applied to this Project. In this context, the Consultant shall:

(Example)

- (a) Act as the Engineer to execute construction supervision and contract administration services in accordance with the power and authority to be delegated by the Employer;
- (b) Provide assistance to the Employer concerning variations and claims which are to be ordered/issued at the initiative of the Employer. Advise the Employer on resolution of any dispute with the Contractor;
- (c) Issue instructions, approvals and notices as appropriate;
- (d) Provide recommendation to the Employer for acceptance of the Contractor's performance security, advance payment security and required insurances;
- (e) Provide commencement order to the Contractor;
- (f) Assess adequacy of all inputs such as materials, labor and equipment provided by the Contractor;
- (g) Check and approve the Contractor's method of work, including site organization, program of performance, quality assurance system, safety plan, method statements of safety, and environmental monitoring plan so that the requirements set forth in the applicable laws and regulations, the specifications or other parts of the contract are to be duly respected; (注：下線部分は、「ODA 建設工事安全管理ガイドダンス」の活用につき、借入人又は実施機関より合意が得られた場合のみ記載。それ以外の場合は、削除する。)
- (h) Regularly monitor physical and financial progress, and take appropriate action to expedite progress if necessary, so that the time for completion set forth in the contract will be duly respected by the Contractor;
- (i) Explain and/or adjust ambiguities and/or discrepancies in the Contract Documents and issue any necessary clarifications or instructions;
- (j) Review and approve the Contractor's design for the works to be constructed, working drawings, shop drawings and drawings for temporary works; including but not limited to the

following technical documents:

For transmission and distribution lines

- Overall line designs, route map, and plan & profile drawing
- underground tunnel design and cable laying designs including workshop drawings, test procedure;

- equipment and material specifications and drawings
- installation procedures, tension design
- Any other design aspects required during EPC contract execution

For underground substation

- Underground substation layouts and sections,
- Single line diagrams
- UGSS building design drawings
- Equipment foundation designs
- Control System
- Cable trenches
- Ventilation systems
- Approach and internal roads of the UGSS
- Machine hatch and substation corridor
- Evacuation route inside underground substation
- Protection and control schematic diagrams
- Substation Automation System
- Interlocking schemes
- Equipment specifications and drawings
- Current transformer's design and calculation
- Power transformers and station transformers
- Fiber optic multiplexer equipment
- AC and DC power supply systems
- Earthing systems
- Room ventilation and lightings, machine and electricity design of the building
- Air conditioning
- UGSS building's waterproofing design
- Power cable inlet design, and its specification
- UGSS building's sewage and water pumping system
- UGSS building's power cable laying design and its fixtures
- Equipment installation plan and work procedure for substation components
- Design co-ordination between superstructure and underground substation
- Any other design aspects required during EPC contract execution

- (k) Liaise with the appropriate authorities to ensure that all the affected utility services are promptly relocated;
- (l) Carry out field inspections on the Contractor's setting out of the works in relation to original points, lines and levels of reference specified in the contract;
- (m) Organize, as necessary, management meetings with the Contractor to review the arrangements for future work. Prepare and deliver minutes of such meetings to the Employer and the Contractor;
- (n) Supervise the works so that all the contractual requirements are met by the Contractor, including those in relation to i) quality of the works, ii) safety and iii) protection of the environment. Confirm that an accident prevention officer proposed by the Contractor is duly assigned at the project site. Require the Contractor to take appropriate remedies if any questions are recognized regarding the safety measures;

- (o) Supervise field tests, sampling and laboratory test to be carried out by the Contractor;
- (p) Inspect the construction method, equipment to be used, workmanship at the site, and attend shop inspection and manufacturing tests in accordance with the Employer's Requirements;
- (q) Verify statements submitted by the Contractor and issue payment certificates such as interim payment certificates and final payment certificate as specified in the contract;
- (r) Coordinate the works among different contractors employed for the Project;
- (s) Modify the Employer's Requirements as may be necessary in accordance with the actual site conditions, and issue variation orders (including necessary actions in relation to the works performed by other contractors working for other projects, if any);
- (t) Carry out timely reporting to the Employer for any inconsistency in executing the works and suggesting appropriate corrective measures to be applied;
- (u) Inspect, verify and fairly determine claims issued by the parties to the contract (i.e. the Employer and Contractor) in accordance with the contract;
- (v) Supervise the Test on Completion carried out by the Contractor and assist the Employer in carrying out the Test after Completion, if applicable;
- (w) Perform the inspection of the works and to issue certificates such as the Taking-Over Certificate, Performance Certificate as specified in the contract,
- (x) Provide periodic and/or continuous inspection services during defects notification period and if any defects are noted, instruct the Contractor to rectify;
- (y) Check and certify as-built drawings prepared by the Contractor; and
- (z) Check and certify the operation and maintenance manual prepared by the Contractor.

Prepare and submit reports to DPDC/DESCO, which are detailed in Chapter 6 in relation to the implementation of the Project.

(4) Facilitation of implementation of Environmental Management Plan (EMP) including Environmental Monitoring Plan (EMoP)

The Consultant shall:

- (a) Update EMP as appropriate; incorporate necessary technical specifications with design and contract documentation; *(In case EIA (Environmental Impact Assessment) or IEE (Initial Environmental Examination) has been carried out in an insufficient manner during feasibility study, supplemental surveys and/or investigations should be carried out. The following activities are some examples :)*
- (b) Assist DPDC/DESCO in preparation of additional documents in accordance with EIA and the conditions stated in environmental clearance certifications (ECC) for the Project, if necessary; *(* Examples of the documents are as follows; Hazardous Waste Management Plan and etc.)*
- (c) Assist DPDC/DESCO in dissemination and explanation of additionally confirmed and identified environmental issues to public including holding public consultations;
- (d) During the preparation of bidding documents, clearly identify environmental responsibilities as explained in the EIA/IEE and EMP;
- (e) Assist DPDC/DESCO to review the EPC Contractor's Environmental Program to be prepared by the contractor in accordance with EMP, relevant plans and JICA Environmental Guidelines and to make recommendations to DPDC/DESCO regarding any necessary amendments for its approval
- (f) Assist DPDC/DESCO to implement the measures identified in the EMP
- (g) Monitor the effectiveness of EMP and negative impacts on environment caused by the

- construction works and provide technical advice, including a feasible solution, so that DPDC/DESCO can improve situation when necessary;
- (h) Assist DPDC/DESCO in monitoring the compliance with conditions stated in the ECC and the requirements under EMP and JICA Environmental Guidelines;
 - (i) Assist DPDC/DESCO in preparation of the answer to the request from JICA's advisory committee for environmental and social considerations if necessary
 - (j) Assist DPDC/DESCO in the capacity building of DPDC/DESCO staff on environmental management through on-the-job training on environmental assessment techniques, mitigation measure planning, supervision and monitoring, and reporting.
 - (k) Monitor temporary requisition of land along the ROW and around substation site, and compensation activities being undertaken by DPDC/DESCO and/or competent authorities, and report the results in monthly progress reports;
 - (l) Assist DPDC/DESCO in establishment of grievance redress mechanism;
 - (m) Assist DPDC/DESCO to ensure that the project affected people are fully aware of the grievance redress procedure and the process of bringing their complaints, investigate the veracity of the complaints, and recommends actions/measures to settle them amicably, fairly and transparently before they go to the redress committee or the courts of law;

(5) Technology transfer

The Consultant shall carry out the technology transfer as an important aspect in design and supervision works. The Consultant shall provide the opportunity to the DPDC/DESCO officers and staffs to be involved in the working team of the Consultant during the design, contract administration and supervision works for their capacity building wherever possible. If requested by DPDC/DESCO, the Consultant shall brief and demonstrate the survey and design procedure, the construction supervision and contract management process and procedures. The consultant shall assist DPDC/DESCO and its staff to build their capacity as a part of on the job training under the Project.

