Environmental Impact Assessment

Project Number: 50165-002
May 2017

Bhutan: Amochhu Land Development and Township Project

Draft Report (Appendixes 16-32)

Prepared by Construction Development Corporation Limited, Royal Government of Bhutan for the Asian Development Bank.

Environmental Impact Assessment (EIA) Report

For

Amochhu Land Development and Township Project (ALDTP), Phuentsholing, Bhutan

MAY 2017

CONSTRUCTION DEVELOPMENT CORPORATION LIMITED, BHUTAN

Appendix 16:
Photographs showing Meteorological data collection

Appendix 16: Photographs showing Meteorological data collection

Photograph 9-3: Meteorological data collection.

Meteorological data collection

Appendix 17:
Compiled mean meteorological data

Appendix 17: Compiled mean meteorological data

Autumn Season

Table 9-28: Compiled mean meteorological data Autumn Season)

Hour	Temp (°C)	Relative Humidity (%)	Wind Speed (m/sec)	Wind Direction (blowing from)	Cloud Cover, (Okras)	Rainfall (mm)
0	19.4	77.4	10.4	NNE	8.6	0.0
1	19.6	78.9	11.9	NNE	5.7	0.0
2	19.4	80.6	13.7	N	15.3	0.0
3	19.6	81.8	14.5	NNE	9.1	0.0
4	19.2	80.8	13.3	NNE	11.6	0.0
5	19.0	81.7	11.5	N	17.9	0.0
6	18.8	82.3	11.5	NNE	9.2	0.0
7	22.0	74.5	11.0	NNE	11.5	0.0
8	24.2	67.9	11.3	N	15.0	0.0
9	25.6	63.6	11.6	NNE	12.9	0.0
10	27.5	58.2	7.0	NNE	8.1	0.0
11	28.8	53.5	3.5	NNW	24.7	0.0
12	29.5	50.9	1.7	WSW	19.7	0.0
13	29.2	51.4	2.1	SW	18.4	0.0
14	28.9	51.9	2.4	WSW	18.7	0.0
15	28.8	52.3	2.3	SW	18.9	0.0
16	26.4	64.0	2.5	SW	15.6	0.0
17	24.4	72.8	2.1	SSW	17.2	0.0
18	22.7	77.8	2.3	ESE	10.0	0.0
19	21.8	78.4	4.5	ENE	12.5	0.0
20	21.2	78.7	7.8	NNE	7.7	0.0
21	20.6	79.0	8.7	NNE	9.6	0.0
22	20.2	79.3	10.9	NNE	9.4	0.0
23	19.8	79.2	11.5	NNE	9.1	0.0
Average	23.2	70.7	7.9	NNE	13.2	0

Winter Season

Table 9-29: Compiled mean meteorological data winter Season)

Hour	Temp (°C)	Relative Humidity (%)	Wind Speed (m/sec)	Wind Direction (blowing from)	Cloud Cover, (Okras)	Rainfall (mm)
0	16.4	64.8	2.9	NE	5.4	0.1
1	16.1	64.9	2.9	NNE	7.1	0.0
2	15.9	65.4	3.1	NNE	7.0	0.1
3	15.7	65.7	3.0	NNE	6.1	0.1
4	15.3	65.8	2.7	NNE	6.5	0.0
5	15.1	65.6	2.5	NNE	6.4	0.0
6	15.2	65.3	2.4	NNE	7.4	0.0
7	16.1	62.6	2.2	NNE	8.2	0.0
8	17.3	60.1	2.4	NNE	9.6	0.0
9	18.7	56.8	2.4	NNE	11.4	0.0
10	20.5	52.2	2.3	NNW	18.0	0.0
11	22.1	49.0	1.7	NW	18.8	0.0
12	23.7	45.2	1.6	NW	17.4	0.1
13	24.4	42.9	1.7	NW	19.3	0.1
14	24.8	42.2	1.9	NW	19.0	0.0
15	24.7	43.7	2.0	NW	18.3	0.0
16	23.4	48.1	1.9	ENE	14.6	0.0
17	21.8	54.4	1.9	NE	12.9	0.0
18	20.2	59.0	1.7	ENE	11.2	0.0
19	19.1	61.5	1.9	NNE	6.0	0.0
20	18.2	62.9	2.2	NNE	4.4	0.0
21	17.5	63.6	2.5	NNE	4.4	0.0
22	17.1	64.1	2.8	NE	3.3	0.0
23	16.6	64.8	2.9	NE	3.4	0.0
Average	19.0	57.9	2.3	NNE	10.3	0

Spring Season

Table 9-30: Compiled mean meteorological data Spring Season)

Hour	Temp (°C)	Relative Humidity (%)	Wind Speed (m/sec)	Wind Direction (blowing from)	Cloud Cover, (Okras)	Rainfall, (mm)
0	25.2	55.6	1.8	NNE	11.8	0.0
1	22.5	60.6	2.6	NNE	4.2	0.0
2	21.9	61.1	2.8	NNE	4.1	0.1
3	21.5	62.1	2.6	NNE	3.7	0.0
4	21.2	62.5	2.3	NNE	2.9	0.0
5	21.1	63.0	2.0	NNE	6.1	0.0
6	20.9	63.0	2.0	NNE	3.6	0.0
7	22.6	60.9	1.4	NNE	6.2	0.0
8	24.0	57.9	1.3	N	13.8	0.0
9	25.3	55.6	1.2	NNE/NNW	17.8	0.0
10	26.8	52.6	1.1	WNW	19.4	0.0
11	27.8	50.2	1.6	W	22.0	0.0
12	29.0	46.9	1.4	W	21.5	0.0
13	29.7	45.5	1.5	W	22.4	0.0
14	29.8	45.4	1.2	WNW	22.4	0.0
15	30.0	44.8	1.2	NW	21.3	0.0
16	29.3	47.6	0.9	WNW	19.6	0.0
17	28.4	50.4	0.9	NW	19.4	0.0
18	27.2	53.9	1.2	ENE	14.0	0.0
19	26.4	56.1	1.4	NNE	9.1	0.2
20	25.8	56.8	1.7	NNE	4.8	0.0
21	25.1	57.7	2.6	NNE	4.0	0.0
22	24.5	58.8	2.6	NNE	6.5	0.0
23	24.0	59.2	2.3	NNE	5.1	0.1
Average	25.4	55.3	1.7	NNE	11.9	0

Appendix 18:
Ambient Air Quality Monitoring Photographs

Photograph 9-4: Ambient Air Quality Monitoring Photographs (1st Season - winter)

AA1 – Outside of river

Filter Paper shown to DHI – Infra representatives after AAQM sampling near STP AA2

AA3 – Near Mobile Tower

AA4 – Chamkuna Village

AA5 – Torsa tar village

AA6 – Near Bridge

Photograph 9-5: Ambient Air Quality Monitoring Photographs (2nd Season - spring)

AA1 – Out Side Of river (Zone – C)

AA2 – Near STP

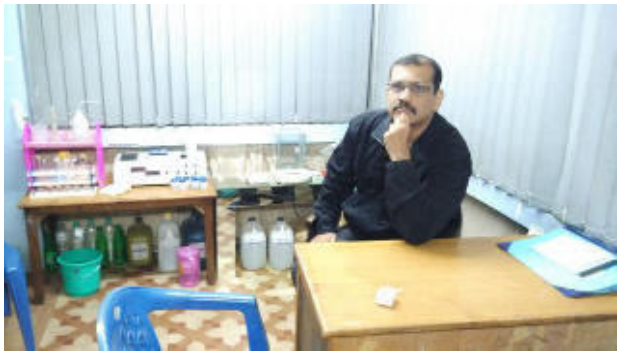
AA3 – Nr Mobile Tower

AA4 – Chamkuna Village

AA5 – Torsatar Village

AA6 – Near Bridge

Photograph 9-6: Photographs of the laboratory



Lab set up

Lab set up for analysis

Appendix 19:
The detailed data, date wise of Ambient Air monitoring

(1st Season- Winter season)

Table 9-31: Ambient Air monitoring (1st Season- Winter season)

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				Time weighted Average	24 Hr.	NS	24 Hr.	NS	24 Hr.	24 Hr.	8 Hr.
					Avg	-	Avg	-	Avg	Avg	Avg
				Industrial Area	500	NS	200	NS	120	120	5000
				Mixed Area	200	NS	100	NS	80	80	2000
				Sensitive Area	100	NS	75	NS	30	30	1000
1	07/01/16	AA01	Near C Zone	Mixed Area	200	140	60	33	4.5	7.4	<1142
2	08/01/16	AA01	Near C Zone	Mixed Area	231	161	70	22	5.0	12.2	<1142
3	11/01/16	AA01	Near C Zone	Mixed Area	213	152	61	34	7.1	12.3	1158
4	12/01/16	AA01	Near C Zone	Mixed Area	121	77	45	21	5.0	10.2	<1142
5	15/01/16	AA01	Near C Zone	Mixed Area	153	95	58	22	7.2	10.5	<1142
6	16/01/16	AA01	Near C Zone	Mixed Area	200	123	77	32	10.1	9.1	<1142
7	18/01/16	AA01	Near C Zone	Mixed Area	205	140	64	29	11.5	16.1	1183
8	19/01/16	AA01	Near C Zone	Mixed Area	161	96	65	26	10.9	13.3	<1142
9	25/01/16	AA01	Near C Zone	Mixed Area	109	66	42	18	7.0	18.1	<1142
10	26/01/16	AA01	Near C Zone	Mixed Area	165	115	50	23	10.4	17.9	<1142
11	29/01/16	AA01	Near C Zone	Mixed Area	186	131	55	24	19.4	19.8	1210
12	30/01/16	AA01	Near C Zone	Mixed Area	139	93	46	16	2.6	19.0	<1142
13	04/02/16	AA01	Near C Zone	Mixed Area	165	112	54	30	6.3	9.1	<1142
14	05/02/16	AA01	Near C Zone	Mixed Area	165	98	67	41	5.3	10.5	<1142
15	19/02/16	AA01	Near C Zone	Mixed Area	162	94	68	32	4.9	10.9	-
16	20/02/16	AA01	Near C Zone	Mixed Area	145	97	48	36	5.4	9.4	<1142
17	22/02/16	AA01	Near C Zone	Mixed Area	150	95	55	36	5.3	11.5	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
18	23/02/16	AA01	Near C Zone	Mixed Area	153	91	61	43	4.2	7.5	<1142
1	01/12/15	AA02	Near STP	Mixed Area	--	--	147	34	--	--	--
2	02/12/15	AA02	Near STP	Mixed Area	--	--	78	19	--	--	--
3	09/12/15	AA02	Near STP	Mixed Area	--	--	126	14	--	--	--
4	10/12/15	AA02	Near STP	Mixed Area	--	--	133	9	--	--	--
5	14/12/15	AA02	Near STP	Mixed Area	--	--	160	13	--	--	--
6	15/12/15	AA02	Near STP	Mixed Area	--	--	146	26	--	--	--
7	18/12/15	AA02	Near STP	Mixed Area	--	--	130	39	1.9	6.1	<1142
8	19/12/15	AA02	Near STP	Mixed Area	--	--	189	32	4.7	5.6	<1142
9	24/12/15	AA02	Near STP	Mixed Area	315	195	120	17	2.3	5.2	<1142
10	25/12/15	AA02	Near STP	Mixed Area	343	167	176	34	3.3	6.8	1305
11	29/12/15	AA02	Near STP	Mixed Area	269	191	78	16	3.6	5.8	1172
12	30/12/15	AA02	Near STP	Mixed Area	372	246	126	35	5.2	7.2	1248
13	02/01/16	AA02	Near STP	Mixed Area	206	123	84	39	3.9	7.5	<1142
14	04/01/16	AA02	Near STP	Mixed Area	215	139	76	35	3.6	11.9	1236
15	09/01/16	AA02	Near STP	Mixed Area	189	109	80	51	9.9	14.4	<1142
16	13/01/16	AA02	Near STP	Mixed Area	154	86	68	36	12.6	13.1	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
17	14/01/16	AA02	Near STP	Mixed Area	153	98	55	32	5.7	9.8	<1142
18	20/01/16	AA02	Near STP	Mixed Area	106	62	44	28	7.5	11.6	<1142
19	21/01/16	AA02	Near STP	Mixed Area	118	77	41	23	15.3	11.7	<1142
20	01/02/16	AA02	Near STP	Mixed Area	138	87	51	25	6.5	14.3	<1142
21	06/02/16	AA02	Near STP	Mixed Area	143	96	47	12	3.5	11.2	<1142
22	09/02/16	AA02	Near STP	Mixed Area	157	98	59	26	3.4	17.5	1292
23	12/02/16	AA02	Near STP	Mixed Area	144	95	49	11	2.6	13.6	-
24	13/02/16	AA02	Near STP	Mixed Area	159	98	60	17	4.4	17.1	-
25	24/02/16	AA02	Near STP	Mixed Area	151	100	51	26	6.8	15.7	1365
26	25/02/16	AA02	Near STP	Mixed Area	140	82	58	30	2.3	7.6	<1142
1	12/03/15	AA03	Nr Mobile Tower	Mixed Area	--	--	73	17	--	--	--
2	12/04/15	AA03	Nr Mobile Tower	Mixed Area	--	--	79	21	--	--	--
3	12/07/15	AA03	Nr Mobile Tower	Mixed Area	--	--	53	14	--	--	--
4	12/08/15	AA03	Nr Mobile Tower	Mixed Area	--	--	172	28	---	--	--
5	16/12/15	AA03	Nr Mobile Tower	Mixed Area	--	--	109	28	4.7	7.3	<1142
6	17/12/15	AA03	Nr Mobile Tower	Mixed Area	--	--	95	26	2.1	4.2	<1142
7	21/12/15	AA03	Nr Mobile Tower	Mixed Area	--	--	158	55	3.8	5.1	1283
8	22/12/15	AA03	Nr Mobile Tower	Mixed Area	--	--	100	24	5.7	8.3	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
9	23/12/15	AA03	Nr Mobile Tower	Mixed Area	255	162	93	17	1.5	5.4	<1142
10	26/12/15	AA03	Nr Mobile Tower	Mixed Area	315	207	108	34	3.3	5.7	1210
11	28/12/15	AA03	Nr Mobile Tower	Mixed Area	341	215	126	31	2.5	3.2	<1142
12	31/12/15	AA03	Nr Mobile Tower	Mixed Area	464	330	134	35	3.4	6.7	1365
13	01/01/16	AA03	Nr Mobile Tower	Mixed Area	177	111	66	36	5.6	7.5	1147
14	05/01/16	AA03	Nr Mobile Tower	Mixed Area	162	88	74	34	8.0	10.5	<1142
15	06/01/16	AA03	Nr Mobile Tower	Mixed Area	287	181	106	21	6.3	10.8	1306
16	22/01/16	AA03	Nr Mobile Tower	Mixed Area	168	85	82	31	11.9	14.4	<1142
17	23/01/16	AA03	Nr Mobile Tower	Mixed Area	135	52	83	31	7.6	16.5	<1142
18	02/02/16	AA03	Nr Mobile Tower	Mixed Area	230	148	83	34	4.6	11.2	1462
19	03/02/16	AA03	Nr Mobile Tower	Mixed Area	237	138	99	59	3.6	10.4	1285
20	10/02/16	AA03	Nr Mobile Tower	Mixed Area	195	117	78	33	6.3	11.5	-
21	11/02/16	AA03	Nr Mobile Tower	Mixed Area	258	152	107	56	3.8	7.6	-
22	16/02/16	AA03	Nr Mobile Tower	Mixed Area	249	154	95	32	2.6	6.5	-
23	17/02/16	AA03	Nr Mobile Tower	Mixed Area	228	155	73	51	5.7	9.5	1290
24	26/02/16	AA03	Nr Mobile Tower	Mixed Area	289	179	110	39	5.8	13.4	<1142
25	27/02/16	AA03	Nr Mobile Tower	Mixed Area	216	130	86	35	4.5	6.0	<1142
1	12/01/15	AA04	Chamkuna Village	Mixed Area	--	--	91	13	--	--	--

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
2	12/02/15	AA04	Chamkuna Village	Mixed Area	--	--	68	13	--	--	--
3	12/09/15	AA04	Chamkuna Village	Mixed Area	--	--	128	35	--	--	--
4	12/10/15	AA04	Chamkuna Village	Mixed Area	--	--	88	17	--	--	--
5	14/12/15	AA04	Chamkuna Village	Mixed Area	--	--	119	27	--	--	--
6	15/12/15	AA04	Chamkuna Village	Mixed Area	--	--	136	19	--	--	--
7	18/12/15	AA04	Chamkuna Village	Mixed Area	--	--	52	16	3.2	4.8	<1142
8	19/12/15	AA04	Chamkuna Village	Mixed Area	--	--	74	20	1.5	2.1	<1142
9	24/12/15	AA04	Chamkuna Village	Mixed Area	136	89	47	24	1.0	2.4	<1142
10	25/12/15	AA04	Chamkuna Village	Mixed Area	120	79	41	18	2.3	3.6	<1142
11	29/12/15	AA04	Chamkuna Village	Mixed Area	173	108	65	22	2.1	2.8	<1142
12	30/12/15	AA04	Chamkuna Village	Mixed Area	110	70	40	20	1.1	2.7	<1142
13	05/01/16	AA04	Chamkuna Village	Mixed Area	164	104	60	30	3.6	5.7	<1142
14	06/01/16	AA04	Chamkuna Village	Mixed Area	213	131	82	38	8.2	7.5	1194
15	09/01/16	AA04	Chamkuna Village	Mixed Area	207	123	84	35	8.7	8.3	1132
16	11/01/16	AA04	Chamkuna Village	Mixed Area	185	122	63	27	5.7	7.0	<1142
17	12/01/16	AA04	Chamkuna Village	Mixed Area	172	117	55	30	10.0	12.0	<1142
18	18/01/16	AA04	Chamkuna Village	Mixed Area	208	130	78	28	14.0	26.7	1181
19	19/01/16	AA04	Chamkuna Village	Mixed Area	220	146	74	27	6.9	9.6	1256
20	02/01/16	AA04	Chamkuna Village	Mixed Area	90	61	28	16	6.4	13.4	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
21	02/06/16	AA04	Chamkuna Village	Mixed Area	153	94	59	23	4.3	15.4	<1142
22	09/02/16	AA04	Chamkuna Village	Mixed Area	136	83	53	28	3.9	8.1	<1142
23	12/02/16	AA04	Chamkuna Village	Mixed Area	142	95	47	20	6.7	8.9	<1142
24	13/02/16	AA04	Chamkuna Village	Mixed Area	133	88	45	21	4.1	12.9	<1142
25	24/02/16	AA04	Chamkuna Village	Mixed Area	163	105	58	15	12.5	9.4	<1142
26	25/02/16	AA04	Chamkuna Village	Mixed Area	105	67	37	18	4.7	5.1	<1142
1	12/03/15	AA05	Torsa Tar Village	Mixed Area	--	--	50	16	--	--	--
2	12/04/15	AA05	Torsa Tar Village	Mixed Area	--	--	58	25	--	--	--
3	12/07/15	AA05	Torsa Tar Village	Mixed Area	--	--	62	14	--	--	--
4	12/08/15	AA05	Torsa Tar Village	Mixed Area	--	--	54	14	--	--	--
5	16/12/15	AA05	Torsa Tar Village	Mixed Area	--	--	57	16	2.6	4.2	1148
6	17/12/15	AA05	Torsa Tar Village	Mixed Area	--	--	49	25	2.9	4.7	<1142
7	22/12/15	AA05	Torsa Tar Village	Mixed Area	--	--	34	10	1.1	3.9	<1142
8	23/12/15	AA05	Torsa Tar Village	Mixed Area	177	139	38	21	2.1	5.5	1190
9	31/12/15	AA05	Torsa Tar Village	Mixed Area	169	118	51	14	1.8	3.8	<1142
10	01/01/16	AA05	Torsa Tar Village	Mixed Area	206	135	71	32	7.2	7.8	1174
11	13/01/16	AA05	Torsa Tar Village	Mixed Area	181	119	62	34	5.2	8.9	<1142
12	14/01/16	AA05	Torsa Tar Village	Mixed Area	216	125	91	32	9.6	13.2	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
13	20/01/16	AA05	Torsa Tar Village	Mixed Area	200	132	68	25	13.1	16.4	1227
14	21/01/16	AA05	Torsa Tar Village	Mixed Area	216	140	76	34	6.4	9.0	1185
15	02-02-16	AA05	Torsa Tar Village	Mixed Area	77	56	20	22	3.9	9.8	<1142
16	03/02/16	AA05	Torsa Tar Village	Mixed Area	129	88	41	29	3.9	7.3	<1142
17	10/02/16	AA05	Torsa Tar Village	Mixed Area	151	95	56	18	3.8	7.6	<1142
18	11/02/16	AA05	Torsa Tar Village	Mixed Area	95	70	25	16	3.5	8.6	<1142
19	16/02/16	AA05	Torsa Tar Village	Mixed Area	113	74	39	27	2.0	4.9	<1142
20	17/02/16	AA05	Torsa Tar Village	Mixed Area	140	86	54	35	1.9	4.3	<1142
21	26/02/16	AA05	Torsa Tar Village	Mixed Area	123	76	47	13	3.3	6.7	<1142
22	27/02/16	AA05	Torsa Tar Village	Mixed Area	127	84	42	28	5.2	5.2	<1142
1	26/12/15	AA06	Near Bridge	Mixed Area	259	156	103	21	5.8	7.3	<1142
2	28/12/15	AA06	Near Bridge	Mixed Area	347	207	140	27	1.0	2.8	1235
1	02/01/16	AA06	Near Bridge	Mixed Area	117	82	35	18	6.3	11.5	<1142
2	04/01/16	AA06	Near Bridge	Mixed Area	124	86	38	15	10.5	11.8	<1142
3	07/01/16	AA06	Near Bridge	Mixed Area	118	76	42	18	3.3	6.3	<1142
4	08/01/16	AA06	Near Bridge	Mixed Area	128	93	35	16	11.2	12.0	<1142
5	15/01/16	AA06	Near Bridge	Mixed Area	145	100	45	27	7.3	10.9	<1142
6	16/01/16	AA06	Near Bridge	Mixed Area	142	86	56	26	10.2	15.8	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
7	22/01/16	AA06	Near Bridge	Mixed Area	100	73	27	15	11.4	15.7	<1142
8	23/01/16	AA06	Near Bridge	Mixed Area	87	57	30	13	7.2	9.7	<1142
9	25/01/16	AA06	Near Bridge	Mixed Area	81	48	33	13	8.8	16.7	<1142
10	26/01/16	AA06	Near Bridge	Mixed Area	117	69	48	19	14.1	19.3	<1142
11	29/01/16	AA06	Near Bridge	Mixed Area	118	74	44	18	12.9	13.8	<1142
12	30/01/16	AA06	Near Bridge	Mixed Area	103	55	48	26	9.5	14.3	<1142
13	04/02/16	AA06	Near Bridge	Mixed Area	138	93	45	25	2.6	5.4	<1142
14	05/02/16	AA06	Near Bridge	Mixed Area	126	87	39	20	3.8	5.7	<1142
15	18/02/16	AA06	Near Bridge	Mixed Area	126	84	42	25	2.0	5.8	<1142
16	19/02/16	AA06	Near Bridge	Mixed Area	142	93	50	19	1.1	3.7	<1142
17	20/02/16	AA06	Near Bridge	Mixed Area	150	94	56	17	1.9	3.1	<1142
18	22/02/16	AA06	Near Bridge	Mixed Area	150	83	68	22	4.3	7.2	<1142
19	23/02/16	AA06	Near Bridge	Mixed Area	149	83	65	31	2.2	5.6	<1142

Ambient Air quality monitoring result (2nd Season – Summer Season)

Table 9-32: Ambient Air monitoring (2nd Season – Summer Season)

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				Time weighted Average	24 Hr.	NS	24 Hr.	NS	24 Hr.	24 Hr.	8 Hr.
					Avg	-	Avg	-	Avg	Avg	Avg
				Industrial Area	500	NS	200	NS	120	120	5000
				Mixed Area	200	NS	100	NS	80	80	2000
				Sensitive Area	100	NS	75	NS	30	30	1000
1	07.03.2016	AA01	Near C Zone	Mixed Area	156	94	62	18	4.7	6.9	<1142
2	08.03.2016	AA01	Near C Zone	Mixed Area	155	90	65	22	4.8	9.3	<1142
3	15.03.2016	AA01	Near C Zone	Mixed Area	195	108	87	21	5.3	11.7	<1142
4	16.03.2016	AA01	Near C Zone	Mixed Area	146	83	63	17	6.4	10.5	<1142
5	23.03.2016	AA01	Near C Zone	Mixed Area	187	101	85	50	7.3	11.9	<1142
6	24.03.2016	AA01	Near C Zone	Mixed Area	127	85	42	24	6.2	11.8	<1142
7	30.03.2016	AA01	Near C Zone	Mixed Area	176	104	72	29	7.6	12.6	<1142
8	31.03.2016	AA01	Near C Zone	Mixed Area	210	139	71	17	7.8	10.5	<1142
9	06.04.2016	AA01	Near C Zone	Mixed Area	136	82	54	20	7.73	9.82	<1142
10	07.04.2016	AA01	Near C Zone	Mixed Area	159	97	62	35	6.61	12.68	<1142
11	13.04.2016	AA01	Near C Zone	Mixed Area	153	93	60	25	7.31	13.03	<1142
12	14.04.2016	AA01	Near C Zone	Mixed Area	161	100	61	23	7.69	10.92	<1142
13	20.04.2016	AA01	Near C Zone	Mixed Area	139	80	59	24	8.08	11.10	<1142
14	21.04.2016	AA01	Near C Zone	Mixed Area	143	94	50	28	7.98	15.50	<1142
15	27.04.2016	AA01	Near C Zone	Mixed Area	150	96	54	21	8.70	14.19	<1142
16	28.04.2016	AA01	Near C Zone	Mixed Area	144	101	43	32	9.13	13.67	<1142
17	06.05.2016	AA01	Near C Zone	Mixed Area	166	116	50	46	9.9	12.0	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
18	07.05.2016	AA01	Near C Zone	Mixed Area	161	110	51	47	9.3	11.6	<1142
19	13.05.2016	AA01	Near C Zone	Mixed Area	162	109	53	33	9.9	15.0	<1142
20	14.05.2016	AA01	Near C Zone	Mixed Area	160	111	49	43	8.5	13.2	<1142
21	20.05.2016	AA01	Near C Zone	Mixed Area	147	102	45	38	9.7	13.4	<1142
22	21.05.2016	AA01	Near C Zone	Mixed Area	172	117	55	36	6.9	13.6	<1142
23	27.05.2016	AA01	Near C Zone	Mixed Area	148	101	47	36	7.5	12.0	<1142
24	28.05.2016	AA01	Near C Zone	Mixed Area	153	103	50	35	6.1	11.6	<1142
1	01.03.2016	AA02	Near STP	Mixed Area	160	92	69	21	6.4	16.4	<1142
2	02.03.2016	AA02	Near STP	Mixed Area	162	90	72	28	4.8	10.8	<1142
3	09.03.2016	AA02	Near STP	Mixed Area	162	93	68	34	3.5	13.6	<1142
4	10.03.2016	AA02	Near STP	Mixed Area	113	76	37	26	3.8	7.6	<1142
5	17.03.2016	AA02	Near STP	Mixed Area	124	70	54	38	6.5	12.0	<1142
6	18.03.2016	AA02	Near STP	Mixed Area	202	110	92	29	11.3	11.7	<1142
7	25.03.2016	AA02	Near STP	Mixed Area	153	96	57	23	7.2	11.1	<1142
8	26.03.2016	AA02	Near STP	Mixed Area	148	84	64	41	9.0	12.2	<1142
9	01.04.2016	AA02	Near STP	Mixed Area	150	103	47	33	7.96	8.81	<1142
10	02.04.2016	AA02	Near STP	Mixed Area	170	92	78	24	6.56	9.78	<1142
11	08.04.2016	AA02	Near STP	Mixed Area	167	92	74	34	6.25	8.51	<1142
12	09.04.2016	AA02	Near STP	Mixed Area	173	95	78	29	7.42	11.21	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
13	15.04.2016	AA02	Near STP	Mixed Area	155	93	62	30	8.98	14.10	<1142
14	16.04.2016	AA02	Near STP	Mixed Area	96	69	27	26	8.43	13.45	<1142
15	22.04.2016	AA02	Near STP	Mixed Area	138	86	52	26	7.67	14.57	<1142
16	23.04.2016	AA02	Near STP	Mixed Area	149	95	54	31	10.17	14.71	<1142
17	02.05.2016	AA02	Near STP	Mixed Area	131	83	47	17	9.6	13.1	<1142
18	03.05.2016	AA02	Near STP	Mixed Area	120	79	41	21	9.4	14.1	<1142
19	09.05.2016	AA02	Near STP	Mixed Area	119	84	35	20	10.9	12.5	<1142
20	10.05.2016	AA02	Near STP	Mixed Area	121	81	40	26	10.7	11.7	<1142
21	16.05.2016	AA02	Near STP	Mixed Area	123	75	48	29	7.4	14.6	<1142
22	17.05.2016	AA02	Near STP	Mixed Area	127	74	53	23	8.2	11.4	<1142
23	23.05.2016	AA02	Near STP	Mixed Area	120	79	41	25	9.9	14.2	<1142
24	24.05.2016	AA02	Near STP	Mixed Area	133	82	51	20	5.8	11.5	<1142
1	03.03.2016	AA03	Nr Mobile Tower	Mixed Area	233	142	92	45	10.7	13.4	<1142
2	04.03.2016	AA03	Nr Mobile Tower	Mixed Area	234	138	96	51	6.6	13.3	<1142
3	11.03.2016	AA03	Nr Mobile Tower	Mixed Area	221	136	85	37	3.1	10.5	<1142
4	12.03.2016	AA03	Nr Mobile Tower	Mixed Area	402	264	138	55	9.5	13.1	<1142
5	19.03.2016	AA03	Nr Mobile Tower	Mixed Area	391	287	104	34	11.5	10.9	<1142
6	22.03.2016	AA03	Nr Mobile Tower	Mixed Area	214	130	83	35	10.7	10.3	<1142
7	28.03.2016	AA03	Nr Mobile Tower	Mixed Area	138	76	61	43	7.2	10.9	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
8	29.03.2016	AA03	Nr Mobile Tower	Mixed Area	115	72	43	22	6.5	11.4	<1142
9	04.04.2016	AA03	Nr Mobile Tower	Mixed Area	183	109	74	36	5.63	11.04	<1142
10	05.04.2016	AA03	Nr Mobile Tower	Mixed Area	191	113	78	32	9.56	11.30	<1142
11	11.04.2016	AA03	Nr Mobile Tower	Mixed Area	217	141	76	30	8.46	10.39	<1142
12	12.04.2016	AA03	Nr Mobile Tower	Mixed Area	211	133	77	32	8.65	8.78	<1142
13	18.04.2016	AA03	Nr Mobile Tower	Mixed Area	183	114	69	30	8.49	11.66	<1142
14	19.04.2016	AA03	Nr Mobile Tower	Mixed Area	169	106	63	25	9.36	9.60	<1142
15	25.04.2016	AA03	Nr Mobile Tower	Mixed Area	185	121	64	37	8.19	11.61	<1142
16	26.04.2016	AA03	Nr Mobile Tower	Mixed Area	178	113	64	26	10.53	13.33	<1142
17	04.05.2016	AA03	Nr Mobile Tower	Mixed Area	156	99	57	31	8.1	13.8	<1142
18	05.05.2016	AA03	Nr Mobile Tower	Mixed Area	159	108	50	35	8.4	12.0	<1142
19	11.05.2016	AA03	Nr Mobile Tower	Mixed Area	183	119	64	31	9.3	12.5	<1142
20	12.05.2016	AA03	Nr Mobile Tower	Mixed Area	169	101	68	37	10.1	13.1	<1142
21	18.05.2016	AA03	Nr Mobile Tower	Mixed Area	194	131	64	33	9.4	15.7	<1142
22	19.05.2016	AA03	Nr Mobile Tower	Mixed Area	188	112	76	24	10.0	16.5	<1142
23	25.05.2016	AA03	Nr Mobile Tower	Mixed Area	183	120	63	30	6.6	13.1	<1142
24	26.05.2016	AA03	Nr Mobile Tower	Mixed Area	188	121	67	29	11.1	12.6	<1142
1	01.03.2016	AA04	Chamkuna Village	Mixed Area	96	65	30	19	6.7	14.0	<1142
2	02.03.2016	AA04	Chamkuna Village	Mixed Area	104	63	41	34	3.7	10.3	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
3	09.03.2016	AA04	Chamkuna Village	Mixed Area	130	52	78	35	5.7	13.1	<1142
4	10.03.2016	AA04	Chamkuna Village	Mixed Area	269	172	97	30	5.4	8.4	<1142
5	17.03.2016	AA04	Chamkuna Village	Mixed Area	302	207	95	32	8.1	9.9	<1142
6	18.03.2016	AA04	Chamkuna Village	Mixed Area	206	114	91	48	6.4	10.2	<1142
7	25.03.2016	AA04	Chamkuna Village	Mixed Area	219	122	98	25	8.3	11.4	<1142
8	26.03.2016	AA04	Chamkuna Village	Mixed Area	237	145	91	38	6.9	9.4	<1142
9	06.04.2016	AA04	Chamkuna Village	Mixed Area	162	107	55	24	6.80	9.50	<1142
10	07.04.2016	AA04	Chamkuna Village	Mixed Area	151	97	55	27	9.92	9.82	<1142
11	13.04.2016	AA04	Chamkuna Village	Mixed Area	153	90	62	35	9.49	8.93	<1142
12	14.04.2016	AA04	Chamkuna Village	Mixed Area	153	109	44	41	8.31	10.73	<1142
13	20.04.2016	AA04	Chamkuna Village	Mixed Area	157	97	59	31	8.09	10.92	<1142
14	21.04.2016	AA04	Chamkuna Village	Mixed Area	140	89	51	23	8.55	11.56	<1142
15	27.04.2016	AA04	Chamkuna Village	Mixed Area	147	103	44	16	8.59	12.10	<1142
16	28.04.2016	AA04	Chamkuna Village	Mixed Area	147	99	48	29	6.40	9.33	<1142
17	06.05.2016	AA04	Chamkuna Village	Mixed Area	127	84	43	29	9.6	12.6	<1142
18	07.05.2016	AA04	Chamkuna Village	Mixed Area	147	94	53	31	11.9	13.6	<1142
19	13.05.2016	AA04	Chamkuna Village	Mixed Area	158	103	55	30	15.5	14.3	<1142
20	14.05.2016	AA04	Chamkuna Village	Mixed Area	151	96	56	25	14.0	16.9	<1142
21	20.05.2016	AA04	Chamkuna Village	Mixed Area	155	93	61	26	9.0	12.1	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
22	21.05.2016	AA04	Chamkuna Village	Mixed Area	153	98	54	23	11.2	14.4	<1142
23	27.05.2016	AA04	Chamkuna Village	Mixed Area	135	92	43	20	7.2	13.1	<1142
24	28.05.2016	AA04	Chamkuna Village	Mixed Area	150	103	46	21	11.7	14.3	<1142
1	03.03.2016	AA05	Torsa Tar Village	Mixed Area	234	152	82	51	8.3	13.3	<1142
2	04.03.2016	AA05	Torsa Tar Village	Mixed Area	141	76	65	43	5.7	11.9	<1142
3	11.03.2016	AA05	Torsa Tar Village	Mixed Area	207	117	90	24	2.4	8.3	<1142
4	12.03.2016	AA05	Torsa Tar Village	Mixed Area	236	131	104	39	4.8	9.5	<1142
5	19.03.2016	AA05	Torsa Tar Village	Mixed Area	224	148	76	46	6.5	9.9	<1142
6	22.03.2016	AA05	Torsa Tar Village	Mixed Area	276	173	103	46	7.2	12.3	<1142
7	28.03.2016	AA05	Torsa Tar Village	Mixed Area	118	85	33	18	7.6	9.2	<1142
8	29.03.2016	AA05	Torsa Tar Village	Mixed Area	149	96	53	33	9.7	10.0	<1142
9	01.04.2016	AA05	Torsa Tar Village	Mixed Area	144	95	49	29	4.19	9.15	<1142
10	02.04.2016	AA05	Torsa Tar Village	Mixed Area	142	86	56	25	7.05	11.23	<1142
11	08.04.2016	AA05	Torsa Tar Village	Mixed Area	153	98	55	23	7.47	14.09	<1142
12	09.04.2016	AA05	Torsa Tar Village	Mixed Area	134	89	45	24	7.52	11.29	<1142
13	15.04.2016	AA05	Torsa Tar Village	Mixed Area	146	99	46	19	8.17	10.89	<1142
14	16.04.2016	AA05	Torsa Tar Village	Mixed Area	162	105	57	25	5.94	10.37	<1142
15	22.04.2016	AA05	Torsa Tar Village	Mixed Area	146	94	53	29	8.27	9.35	<1142
16	23.04.2016	AA05	Torsa Tar Village	Mixed Area	153	96	57	34	9.18	9.32	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
17	02.05.2016	AA05	Torsa Tar Village	Mixed Area	129	81	48	21	7.9	13.9	<1142
18	03.05.2016	AA05	Torsa Tar Village	Mixed Area	132	92	40	22	8.1	10.6	<1142
19	09.05.2016	AA05	Torsa Tar Village	Mixed Area	148	98	50	20	9.4	9.4	<1142
20	10.05.2016	AA05	Torsa Tar Village	Mixed Area	136	93	43	32	8.0	8.0	<1142
21	16.05.2016	AA05	Torsa Tar Village	Mixed Area	142	87	55	28	12.8	12.3	<1142
22	17.05.2016	AA05	Torsa Tar Village	Mixed Area	146	93	53	25	0.6	1.0	<1142
23	23.05.2016	AA05	Torsa Tar Village	Mixed Area	138	93	45	25	8.8	12.2	<1142
24	24.05.2016	AA05	Torsa Tar Village	Mixed Area	143	94	50	26	4.9	12.3	<1142
1	07.03.2016	AA06	Near Bridge	Mixed Area	226	138	88	31	2.7	12.0	<1142
2	08.03.2016	AA06	Near Bridge	Mixed Area	185	127	57	21	10.4	6.0	<1142
1	15.03.2016	AA06	Near Bridge	Mixed Area	113	84	30	23	6.9	10.7	<1142
2	16.03.2016	AA06	Near Bridge	Mixed Area	224	126	98	53	9.0	10.8	<1142
3	23.03.2016	AA06	Near Bridge	Mixed Area	222	132	90	55	8.3	11.3	<1142
4	24.03.2016	AA06	Near Bridge	Mixed Area	199	123	77	48	10.1	10.4	<1142
5	30.03.2016	AA06	Near Bridge	Mixed Area	123	78	45	23	5.7	11.4	<1142
6	31.03.2016	AA06	Near Bridge	Mixed Area	134	102	31	27	7.2	8.5	<1142
7	04.04.2016	AA06	Near Bridge	Mixed Area	140	97	43	23	6.08	9.84	<1142
8	05.04.2016	AA06	Near Bridge	Mixed Area	167	108	59	22	5.49	9.97	<1142
9	11.04.2016	AA06	Near Bridge	Mixed Area	143	94	49	21	8.46	12.67	<1142

SN.	Date	AAQM Station No.	Location	Area Category	TSPM	SPM	PM10	PM2.5	SO2	NOx	CO
					Maximum Permissible Limits in µg/m3						
ENVIRONMENTAL STANDARDS National Environmental Commission Royal Government of Bhutan November 2010				**Time weighted Average**	**24 Hr.**	**NS**	**24 Hr.**	**NS**	**24 Hr.**	**24 Hr.**	**8 Hr.**
					Avg	**-**	**Avg**	**-**	**Avg**	**Avg**	**Avg**
				Industrial Area	**500**	**NS**	**200**	**NS**	**120**	**120**	**5000**
				Mixed Area	**200**	**NS**	**100**	**NS**	**80**	**80**	**2000**
				Sensitive Area	**100**	**NS**	**75**	**NS**	**30**	**30**	**1000**
10	12.04.2016	AA06	Near Bridge	Mixed Area	148	98	50	17	8.65	10.71	<1142
11	18.04.2016	AA06	Near Bridge	Mixed Area	159	101	58	22	8.84	9.94	<1142
12	19.04.2016	AA06	Near Bridge	Mixed Area	154	99	55	21	7.98	11.69	<1142
13	25.04.2016	AA06	Near Bridge	Mixed Area	147	95	53	22	9.30	12.74	<1142
14	26.04.2016	AA06	Near Bridge	Mixed Area	142	95	46	26	10.08	14.17	<1142
15	04.05.2016	AA06	Near Bridge	Mixed Area	135	92	43	21	8.0	12.3	<1142
16	05.05.2016	AA06	Near Bridge	Mixed Area	136	94	42	29	7.3	12.9	<1142
17	11.05.2016	AA06	Near Bridge	Mixed Area	133	97	36	27	7.3	9.6	<1142
18	12.05.2016	AA06	Near Bridge	Mixed Area	140	94	46	22	7.6	10.9	<1142
19	18.05.2016	AA06	Near Bridge	Mixed Area	137	88	49	27	7.1	12.0	<1142
20	19.05.2016	AA06	Near Bridge	Mixed Area	144	95	49	22	5.5	11.5	<1142
21	25.05.2016	AA06	Near Bridge	Mixed Area	140	87	53	26	6.1	11.3	<1142
22	26.05.2016	AA06	Near Bridge	Mixed Area	143	90	53	30	3.7	12.0	<1142
23	07.03.2016	AA06	Near Bridge	Mixed Area	226	138	88	31	2.7	12.0	<1142
24	08.03.2016	AA06	Near Bridge	Mixed Area	185	127	57	21	10.4	6.0	<1142

Appendix 20:
The overall approach towards the study of noise and vibration

Appendix 20: The overall approach towards the study of noise and vibration

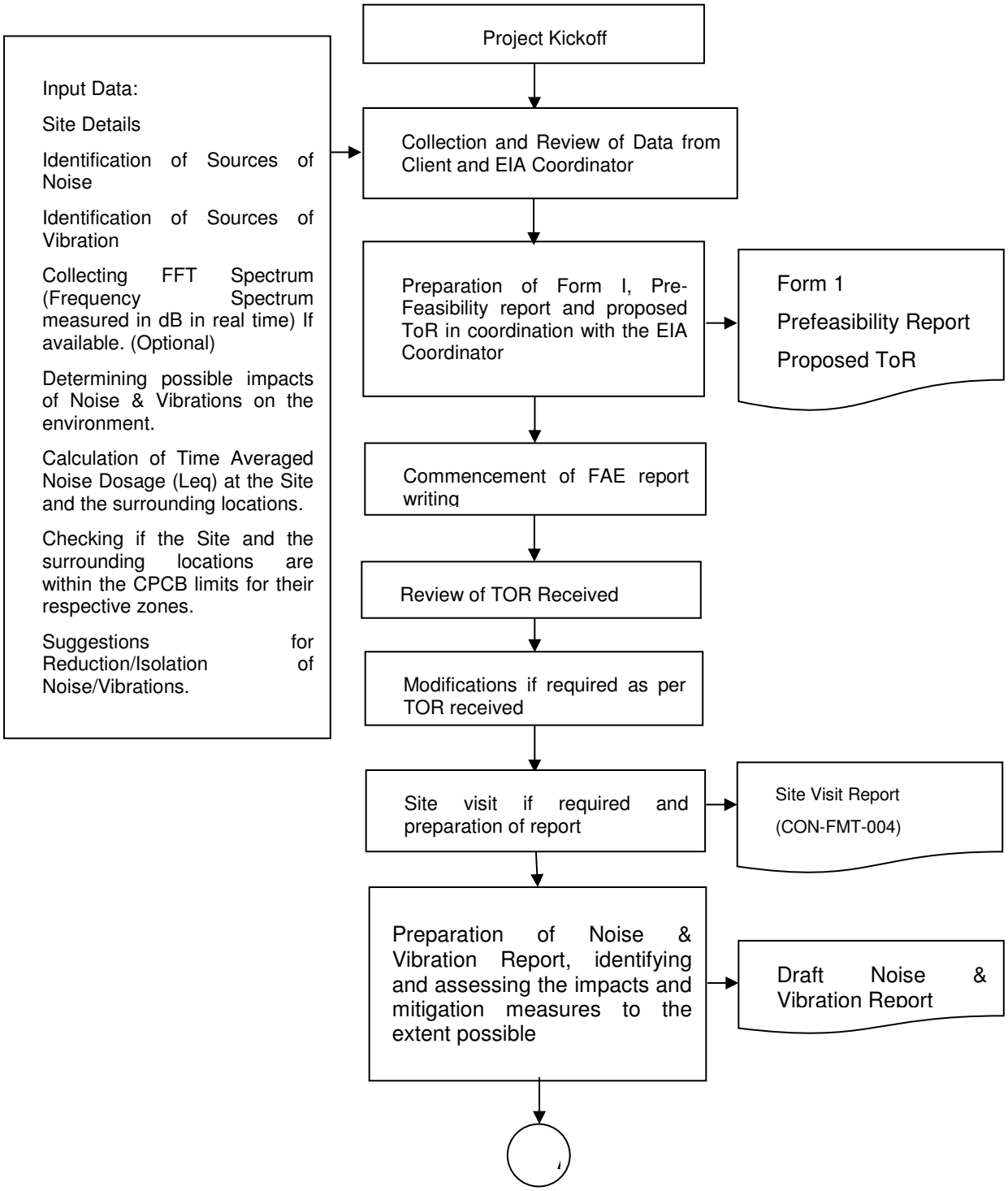
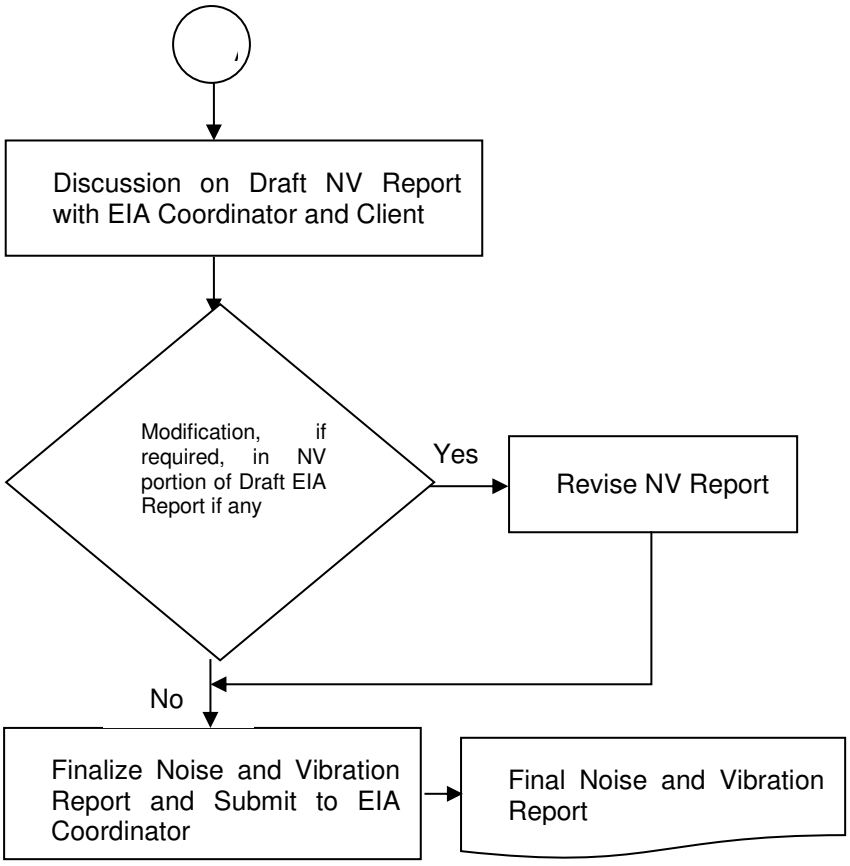


Table 9-33: Ambient Noise monitoring results



Appendix 21:
Ambient Noise monitoring results

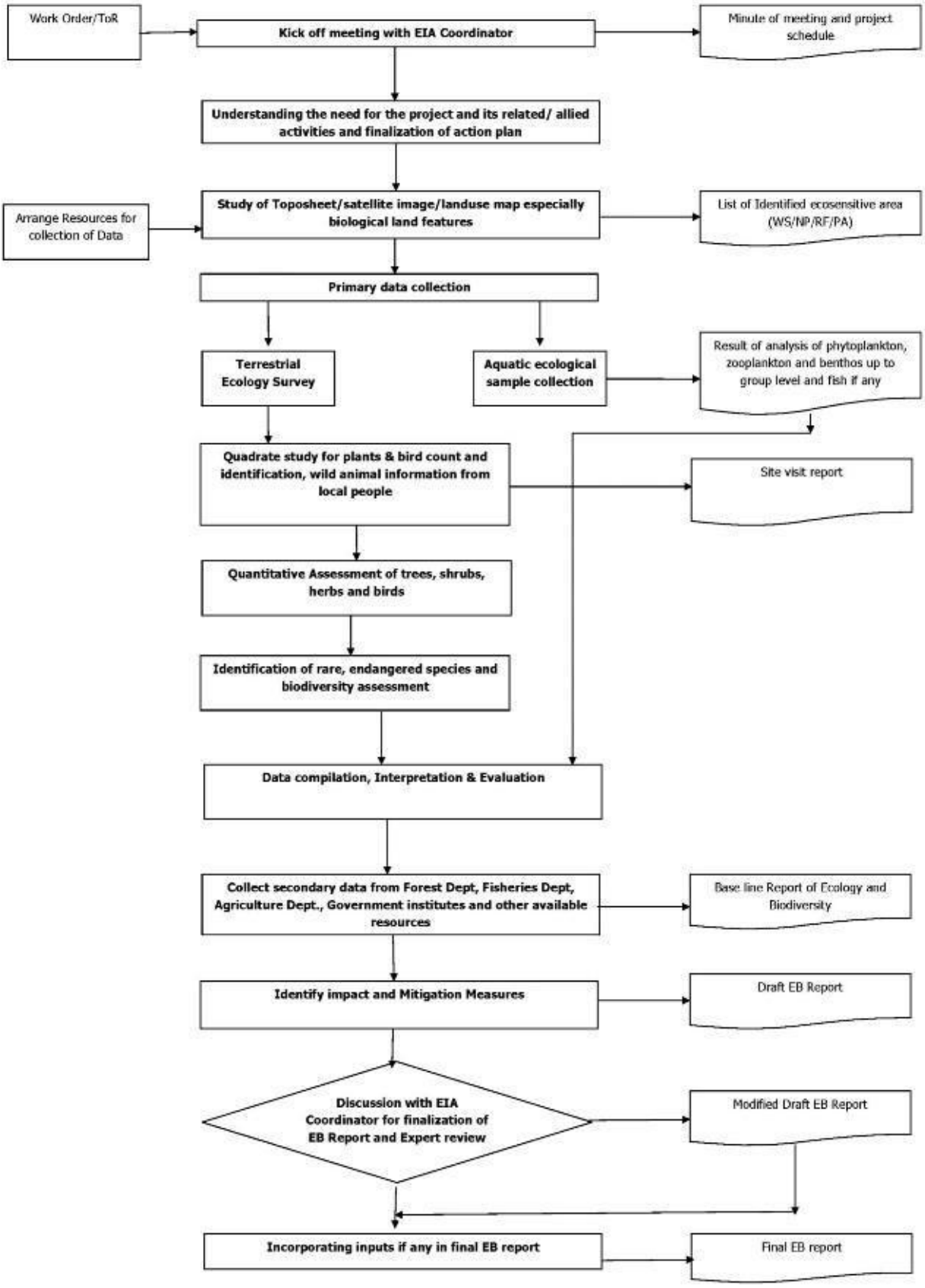
Table 9-34: Ambient Noise monitoring results

Location	**Nr STP Area, db.(A)**	**Nr Old Truck Parking, db.(A)**	**Nr. Bhutan Concrete bricks shop, Torsha, db.(A)**	**Nr Bangay Bazar, db.(A)**	**Chamkuna Village, db.(A)**	**Torsatar village db.(A),**	**NEC's standard db.(A)**
Date	**08.03.16**	**10.03.16**	**22.03.16**	**24.03.16**	**28.03.16**	**30.03.16**	
Time	**NL01**	**NL02**	**NL03**	**NL04**	**NL05**	**NL06**	
6:00	60.05	46.41	58.41	55.18	53.18	65.06	65
7:00	57.56	49.34	65.09	58.44	49.27	68.47	
8:00	59.34	54.25	60.61	53.87	47.08	61.08	
9:00	57.59	55.44	56.04	53.49	47.12	58.43	
10:00	58.42	58.23	55.49	63.15	45.5	68.74	
11:00	60.38	63.31	60.04	65.18	52.58	68.63	
12:00	59.19	64.49	54.04	64.42	55.12	71.36	
13:00	60.73	64.12	63.31	63.06	54.6	65.68	
14:00	55.06	64.78	60.58	59.38	57.82	67.92	
15:00	57.23	64.42	59.26	58.14	54.9	57.07	
16:00	58.86	63.13	58.88	53.4	48.58	60.34	
17:00	57.53	64.82	62.4	55.67	48.99	60.27	
18:00	55.79	63.83	68.29	48.85	48.54	55.87	
19:00	48.21	61.28	64.79	54.62	54.59	56.52	
20:00	48.04	60.79	59.45	65.91	50.5	59.78	
21:00	50.34	64.35	59.04	65.2	53.75	59.82	
Leq, Day	56.52	60.19	60.36	58.62	51.38	62.82	
22:00	54.08	66.84	47.88	60.59	46.02	57.37	55
23:00	52.27	69.6	48.17	57.53	44.22	64.08	
0:00	52.79	59.57	46.39	60.96	44.32	63.23	
1:00	49.07	48.64	46.07	53.85	44.55	59.83	
2:00	45.05	45.7	46.93	52.32	44.61	74.08	
3:00	45.32	45.69	48.45	43.94	41.95	61.65	
4:00	60.79	44.29	48.1	43.55	41.95	68.64	
5:00	61.87	48.33	51.06	50.32	48.05	71.72	
Leq, Night	52.66	53.58	47.88	52.88	44.46	65.08	

Appendix 22:

The overall approach towards the study of ecology and biodiversity

Appendix 22: The overall approach towards the study of ecology and biodiversity



Appendix 23:

Rapid Biodiversity Study Interview Sheets

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 01 **Rapid Biodiversity Assessment**

Date: 15.9.16 Location/office of data collection: Teething Village, near Elephant fence

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members: Mr. Pradeep Pradhan, M.N. Basnet

Name of person interviewed: Longpui [illegible] Gender: F Age: 50

Period of residence at present location: Totopara - (6yrs)

Any other information: Interview at Teething Village, near Elephant fence

1. Wild animals seen previously (not observed now) and last sighting details:
   ~~[illegible]~~ > Monkey

2. Types/names of wildlife observed in recent past (local name):
   (1) Mithun
   (2) Elephant → (~~25~~ to 20-25 in groups) or 5-10 groups
   (3) Monkey

3. Time of observation:
   Season: Monsoon Month: May-June & again Oct-Nov (ripening time of Millet)
   Day Night ✓

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Eating

5. If Eating, type of trees/vegetation/any other food being eaten:
   (1) Ripening Season Maize → May-Jun
   (2) Ripen Seas Millet → Oct-Nov (Rarely)

6. If passing through- Route of migration, direction taken:
   Along the froth (fence)

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)
   Only walking past
   No attack, destruction

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 02 **Rapid Biodiversity Assessment**

Date : 15/7/16 Location/office of data collection: Toribari

Data Collection and Assessment Expert: Dr Dibyendu Banerjee

Other Field members:

Name of person interviewed: Rona Gender F Age: 40 yrs

Period of residence at present location: 12 yrs.

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:
   NA

2. Types/names of wildlife observed in recent past (local name):
   (1) Elephant
   (2) Deer
   (3) Monkey.

3. Time of observation:
   Season: Month: May–June / Sometimes in Winter (Reason not known)
   Day Night ✓ (7–8 pm)

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Walking, Eating.
   (group 3 - 4)

5. If Eating, type of trees/vegetation/any other food being eaten:
   Maize. (Attract the ~~[illegible]~~ 'baby Corn' – they are sweet)

6. If passing through- Route of migration, direction taken:
   Along the village, towards Amochu

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)
   No interaction.
   Walking, Carrying, Eating
   (1) Once a hut was destroyed
   → The hut stored local alcohol (strong smell)

Usually elephant used to be present. But due to fear of elephant they only prepare it only and frequently self consumption.

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 03 **Rapid Biodiversity Assessment**

Date : 18.9.17 Location/office of data collection: Toktapara, Village road

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: Prakash Gender: M Age: 18

Period of residence at present location: 18 yrs

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:

2. Types/names of wildlife observed in recent past (local name):
   (1) Elephant
   (2) Leaf monkey (Cattle has been attacked & eaten)
   (3) Monkeys → (early morning)

3. Time of observation:
   Season: Maize corn Month: May-June (3-4 in group)
   Day Night ✓ & Wild boars → Millet ripening.

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Eating

5. If Eating, type of trees/vegetation/any other food being eaten:
   Maize (May-Jun) Millet (Oct-Nov)

6. If passing through- Route of migration, direction taken:
   Along village

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)
   Calm

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-NFRA

Sheet No 04 **Rapid Biodiversity Assessment**

Date: 15.4.11 Location/office of data collection: Tchaparia (Indian Jaldapara Wildlife Sanc)

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: Not revealed. Gender: F Age: 50

Period of residence at present location:

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:

2. Types/names of wildlife observed in recent past (local name):
   1) Elephant (observed today)
   2) Leopard
   3) Rhinoceros

3. Time of observation:
   Season: Month: April (seen 7 in group)
   Day Night Day (2 calves)

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Walking towards Mushroom plantation

5. If Eating, type of trees/vegetation/any other food being eaten:
   Mushroom plantation, Banana, Maize.
   (Not much to eat in Jungle - Solely visit the area for fuel)

6. If passing through- Route of migration, direction taken:

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 05 **Rapid Biodiversity Assessment**

Date : 7/5/16 Location/office of data collection: Tsetting Village

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members: Mr. P R Pradhan

Name of person interviewed: Sampana Gender F Age: 32 yrs

Period of residence at present location: 32 yrs

Any other information: 26.8 1799 89.33599

1. Wild animals seen previously (not observed now) and last sighting details:
   (1) Nothing
   (2) Elephant

2. Type/names of wildlife observed in recent past (local name):
   Elephant (7-8 in group)
   Snorting

3. Time of observation: → Agni Shakti farm, Not much Observation
   Season: Summer Winter Month:
   Day Night → Both.

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Passing through

5. If Eating, type of trees/vegetation/any other food being eaten:
   Maize, Destroy Oak tree

6. If passing through- Route of migration, direction taken:
   Before going from Amochu land
   After fog - run away in fear

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 02 **Rapid Biodiversity Assessment**

Date : 9/5/16 Location/office of data collection:

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: Gyaman Singh Tamang Gender: M Age: 60y

Period of residence at present location: 60y

Any other information: Fencing stone 2yr

1. Wild animals seen previously (not observed now) and last sighting details:

2. Types/names of wildlife observed in recent past (local name):
   Mithun,
   Bison, Elephant, Monkey — (2-9) in group or alone

3. Time of observation:
   Season: Summer Month: May - June
   Day Night ✓

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):

5. If Eating, type of trees/vegetation/any other food being eaten:
   Maize

6. If passing through- Route of migration, direction taken:
   Pass along the Fencing wall

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 07 **Rapid Biodiversity Assessment**

Date : 4/5/16 Location/office of data collection: Tendrey Village

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members

Name of person interviewed: Lorem Gurung Gender F Age 30 yrs

Period of residence at present location: 30yrs

Any other information: 26.84825 N 89.33467 E

1. Wild animals seen previously (not observed now) and last sighting details:
Leopard

2. Types/names of wildlife observed in recent past (local name):
Elephant
Jackal
~~Leopard~~

3. Time of observation:
Season: Month: June - July (6-10) groups
Day Night
during night

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):

5. If Eating, type of trees/vegetation/any other food being eaten:
Maize, Oak tree & Banana

6. If passing through- Route of migration, direction taken

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)
When seeing the elephant came near it went. But after long time they have taken different Passing through

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 18 **Rapid Biodiversity Assessment**

Date: 4/5/16 Location/office of data collection: Tectheng

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: M Singh Moletam/ Somya Mokta Gender: M/F Age: 57/49

Period of residence at present location: 50 yrs

Any other information: 26.84627 89.33036

1. Wild animals seen previously (not observed now) and last sighting details:

2. Types/names of wildlife observed in recent past (local name):
   Elephant
   Monkey

3. Time of observation:
   Season: Month: Feb 2016 (1 elephant)
   Day ✓ Night Usually (6-7)

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Walking along the fence

5. If Eating, type of trees/vegetation/any other food being eaten:
   General Vegetation

6. If passing through- Route of migration, direction taken:
   (Under the Elec. Fence. Since it was assumed that the Flood wall acts along the fence, but it was built high. Gap is there)

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)
   Normal, Walking Past

   Before fence 1 elephant visited the hut. Rice field & etc was attacked at night.
   (3 yrs during Summer)

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 09 **Rapid Biodiversity Assessment**

Date : 9/5/16 Location/office of data collection: Tsetsing Village (Near Tenpaling Village)

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members: Mr. R. Rai

Name of person interviewed: Jangkarman Makten Gender: M Age: 49

Period of residence at present location: 49 yrs

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:
   Before many Elephant came, now not observed in the land.

2. Types/names of wildlife observed in recent past (local name):
   Elephant
   Mithun
   Monkey
   Leopard

3. Time of observation:
   Season: Summer Month: June-July
   Day Night
   On winter, if they come, they destroy vegetables of beetle nut (Excrement)

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Eating & destroying crops

5. If Eating, type of trees/vegetation/any other food being eaten:
   Beetle nut
   Maize, Rice
   Other Crops
   Bamboo

6. If passing through- Route of migration, direction taken:
   Jaldapara WildLife → Tsetsing.

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)
   Eating

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 10 **Rapid Biodiversity Assessment**

Date : 4/5/16 Location/office of data collection: Tashiding Village Head Horse

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

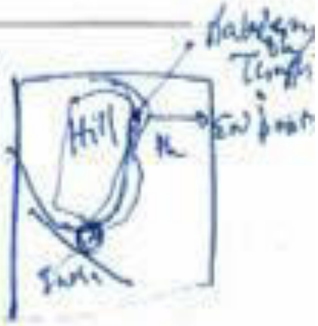
Name of person interviewed: N.J dap Tshering → Range Office. Gender: M Age: 50yr.

Period of residence at present location: Resides at Tading, 4 yrs

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:

This area → not designated as Protected plan by Bhutan Govt. Animals donot stay here permanently.



2. Types/names of wildlife observed in recent past (local name):

Elephants
Python
Leopard
Monkeys, Barking deer, Wild boar, Snakes, Sambar.

3. Time of observation:

Season: Month: June - July (About 7-10 days at the Temple site)

Day Night ✓

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):

Group: 15-20 (Calfs, 1 male (long tusk) Rest female likely.
1 Single sighting.

5. If Eating, type of trees/vegetation/any other food being eaten:

Grass, general vegetation.
Maize, Beetle nut.

6. If passing through- Route of migration, direction taken:

From Jaldapara N.L. Santy to the village.

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

Drinking water in Amochu, near temple & crossing River to P/ling.

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 11 **Rapid Biodiversity Assessment**

Date : 4/5/16 Location/office of data collection: Tashitang village.

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: Lakpa Tamang Gender: M Age: 89 yr.

Period of residence at present location: 59 y

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:

Leopard took away cattle
Royal Bengal tiger — came 10–15 yrs visit this village
Route → from India.

2. Types/names of wildlife observed in recent past (local name):

(1) Elephant
Methun
Bison & small animals also

3. Time of observation:

Season: Mon Month: June-July stay; group in monsoon – 30–40 with calves → [Stay 8–12 days]

Day → Open area or near temple (2–3 days) Night in village (max – 1 to 2 nights) →

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):

Walking.

5. If Eating, type of trees/vegetation/any other food being eaten:

Dumri trees, Ficus, [struck out], etc.
Maize, Millet, Banana, potato. (If maize then – 10 days) (2–3 days)

6. If passing through- Route of migration, direction taken:

Jaigaon, India → Holapara → Pipeline → Tashitang.
Return ← ← (Temple (3–4 stay) (only the rainy))

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

No one attacks.

After finish of ferry → route
Jalpa, [illegible] → Holapara → Tashitang →
Below Indo border → → Temple
(Foot hill of hill)

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

ALRTP, DHI-INFRA

Sheet No 12 **Rapid Biodiversity Assessment**

Date : 4/5/16 Location/office of data collection: Tading village

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: Nima Dorji Gender: M Age: 28

Period of residence at present location: 5 yrs.

Any other information: School in Tading → Elephant Come here near school.

1. Wild animals seen previously (not observed now) and last sighting details:

2. Types/names of wildlife observed in recent past (local name):
   Elephant
   Leopard
   Barking deer. Peacock

3. Time of observation:
   Season: Monsoon Month: May – July → (group 25 numbers) → Lone one (2015)
   Day Night ✓ (mostly) also 3-4 / 1-2 am/hrs.

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Before fence – they destroy crops, trees, vegetables, fruit.
   After fencing – only few come, pass along the fence.

5. If Eating, type of trees/vegetation/any other food being eaten:
   Grass, Bamboo vegetation.

6. If passing through- Route of migration, direction taken:
   Jatteyan → Tading & Back.

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)
   Walking calmly, eating.

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ALRTP, DHI-INFRA

Sheet No 13 **Rapid Biodiversity Assessment**

Date : 4/12/16 Location/office of data collection:

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: Laksay Tamang Gender: F Age: 70

Period of residence at present location:

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:
   4yrs before Elephs used Come & eat crops, fruits, Banana.
2. Types/names of wildlife observed in recent past (local name):
   Elephant
   Wild pig → eat crops.
3. Time of observation:
   Season: Monsoon Month: May - July (5-6 in group)
   Day Night ✓
4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Eating, Walking, Resting.
5. If Eating, type of trees/vegetation/any other food being eaten:
6. If passing through- Route of migration, direction taken:
7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

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ALRTP, DHI-INFRA

Sheet No 14 **Rapid Biodiversity Assessment**

Date : 4/5/16 Location/office of data collection: Tashy Valley

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: Shanu Kanjor Gender: F Age: 44yr.

Period of residence at present location: 44y

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:

2. Types/names of wildlife observed in recent past (local name):

3. Time of observation:
   Season: Month:
   Day Night

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):

5. If Eating, type of trees/vegetation/any other food being eaten:

6. If passing through- Route of migration, direction taken:

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

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ALRTP, DHI-INFRA

Sheet No 15 **Rapid Biodiversity Assessment**

Date : 1/7/16 Location/office of data collection:

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: Tshering Choden Gender: F Age: 23

Period of residence at present location:

Any other information: Teacher in School

1. Wild animals seen previously (not observed now) and last sighting details:

2. Types/names of wildlife observed in recent past (local name):

3. Time of observation:
   Season: Month:
   Day Night

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):

5. If Eating, type of trees/vegetation/any other food being eaten:

6. If passing through- Route of migration, direction taken:

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

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Sheet No 16 **Rapid Biodiversity Assessment**

Date : Location/office of data collection: Tobufong

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: Sitaram Gender: M Age: 40

Period of residence at present location:

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:
   Many Elephant before (Large herds)
   Now seen nil.

2. Types/names of wildlife observed in recent past (local name):
   Elephant

3. Time of observation:
   Season: Month:
   Day Night

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):

5. If Eating, type of trees/vegetation/any other food being eaten:

6. If passing through- Route of migration, direction taken:

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

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ALRTP, DHI-INFRA

Sheet No 17

Rapid Biodiversity Assessment

Date : 4/5 Location/office of data collection: Ballalgai

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members:

Name of person interviewed: Pakeing Lama Gender: M Age: 32

Period of residence at present location: 32

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:

2. Types/names of wildlife observed in recent past (local name):

   Elefant
   Hathi,
   Bison, Sharh, Cheetal. Monkey. → 15-16
   3 cats

3. Time of observation:

   Season: Month: May – July
   Day Night ✓

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):

5. If Eating, type of trees/vegetation/any other food being eaten:

   Bans, Maiz, Paddy. Border

6. If passing through- Route of migration, direction taken:

   Jaldpa Sali

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

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ALRTP, DHI-INFRA

Sheet No 18 **Rapid Biodiversity Assessment**

Date : 4/8/16 Location/office of data collection: Lakabari Beat office

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members: Mr. P.R. Pradhan, Forest Range Officer.

Name of person interviewed: Amrit Gender: M Age: 34

Period of residence at present location: 34

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:
   -
2. Types/names of wildlife observed in recent past (local name):
   Elephant
   Monkey
   Bird
   Snake - Python
3. Time of observation:
   Season: Monsoon Month: June-July
   Day Night
   Group : 10 size
4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Eating vegetation, Banana
5. If Eating, type of trees/vegetation/any other food being eaten:
   Maize, Large tree Banks, fruits
6. If passing through- Route of migration, direction taken:
   Jaldapara towards → Chapri khola
7. Behavioral Observation (Friendly, aggravated, fighting among themselves)
   & Walking Past Calmly.

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ALRTP, DHI-INFRA

Sheet No 109 **Rapid Biodiversity Assessment**

Date: 4/5/11 Location/office of data collection: Tsalumg

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members: Mr. L.A Rasha, Forest Range Offin.

Name of person interviewed: Prem Kumar Tamang Gender: M Age: 58 yr.

Period of residence at present location: 50 yr

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:

2. Types/names of wildlife observed in recent past (local name):
   Bear, Leapard, Monkey, Tiger, Deer

3. Time of observation:
   Season: Monsoon Month: May - July
   Day (Walking) Night (Eating, Resting)

4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Walking, Eating, Group size - 7 - 15

5. If Eating, type of trees/vegetation/any other food being eaten:
   General Vegetation.

6. If passing through- Route of migration, direction taken:
   Walking

7. Behavioral Observation (Friendly, aggravated, fighting among themselves)

To DFO Forest Office Wildlife Division

To continue

Project: Amochu Land Reclamation and Township Planning at Phuentsholing, Bhutan

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Sheet No 00 **Rapid Biodiversity Assessment**

Date : 8/4/16 Location/office of data collection: Kuchthing

Data Collection and Assessment Expert: Dr.Dibyendu Banerjee

Other Field members: M.P.R. Pradhan, Forest Range Office.

Name of person interviewed: Dorya Moktan Gender: F Age: 49

Period of residence at present location: 49

Any other information:

1. Wild animals seen previously (not observed now) and last sighting details:
   Elephant
   Bear
2. Types/names of wildlife observed in recent past (local name):
   Elephant, Monkey.
   On Feb 2016 - 1 Elephant was observed group- 6-7
3. Time of observation:
   Season: Monsoon Month: May - Jun
   Day ✓ Night ✓
4. Activity observed (Eating, bathing, drinking water, Passing through, fighting, mating, etc):
   Walking along the fence.
5. If Eating, type of trees/vegetation/any other food being eaten:
   General Vegetation
   Fruits, Maize,
6. If passing through- Route of migration, direction taken:
   Towards River
7. Behavioral Observation (Friendly, aggravated, fighting among themselves)
   Nan.

Appendix 24:

Flora Species at Core and Buffer Zones

Table 9-35: Flora Species at Core and Buffer Zones

SN	Scientific Name	Local/Common Name	Family	Core Zone	Buffer zone	IUCN	FNCR
TREES							
1	Acacia catechu	Khair	Fabaceae	✓	✓	-	-
2	Aegle marmelos	Bili	Rutaceae	-	✓	-	-
3	Ailanthus grandis	Gokul	Simaroubaceae	-	✓	LC	-
4	Albizia lebbeck	White Siras	Fabaceae	✓	✓	-	-
5	Albizia procera	Kala Siras	Fabaceae	✓	✓	-	-
6	Anthocephalus cadamba	Kadam	Rubiaceae	-	✓	-	-
7	Alstonia scholaris	Saptaparni	Apocynaceae	-	✓	LR/LC	-
8	Areca catechu	Areca palm	Arecaceae	-	✓	-	-
9	Azadirachta indica	Neem	Meliaceae	-	✓	-	-
10	Bauhinia variegata	Kachnar	Fabaceae	-	✓	LC	-
11	Bombax ceiba	Semal	Bombacaceae	✓	✓	-	-
12	Bridelia retusa	Tretashing	Euphorbiaceae	✓	✓	-	-
13	Calicarpa arborea	Beautyberry Tree	Verbenaceae	-	✓	-	-
14	Cassia fistula	Amaltas	Fabaceae	-	✓	-	-
15	Celtis tetrandra	Khari	Ulmaceae	✓	✓	-	-
16	Cycas pectinata	Thakal	Cycadaceae	-	✓	VU	-
17	Dalbergia sisoo	Sissoo	Fabaceae	-	✓	-	-
18	Delonix regia	Gulmohar	Fabaceae	-	✓	LC	-
19	Duabanga grandiflora	lampati	Lythraceae	-	✓	-	-
20	Erythrina indica	Coral Tree	Fabaceae	-	✓	LC	-
21	Eucalyptus sp.	Nilgiri	Myrtaceae	✓	-	-	-
22	Ficus bengalensis	Bargad	Moraceae	-	✓	-	-
23	Ficus hookri	Nebharo	Moraceae	✓	✓	-	-
24	Ficus racemosa	Umro	Moraceae	-	✓	-	-
25	Ficus religiosa	Piplo	Moraceae	-	✓	-	-
26	Garuga pinnata	Garuga	Burseraceae	-	✓	-	-
27	Mangifera indica	Aam	Anacardiaceae	-	✓	DD	-
28	Melia azadarach	Bakain	Meliaceae	-	✓	-	-
29	Moringa oleifera	Saragvo	Moringaceae	-	✓	-	-
30	Morus alba	Shetur	Moraceae	-	✓	-	-
31	Pandanus furcatus	Tarika	Pandanaceae	-	✓	-	-

32	Pentapanax leschenaultii	Paanchpate	Araliaceae	✓	✓	LR/LC	-
33	Polyalthia longifolia	Ashoka	Annonaceae	-	✓	-	-
34	Pletophorum pterocarpum	Gulmohar	Fabaceae	-	✓	-	-
35	Schima wallichii	Schima	Theaceae	-	✓	-	-
36	Syzgium cumini	Jambu	Myrtaceae	-	✓	-	-
37	Terminalia myriocarpa	Panisaj	Combretaceae	-	✓	-	-
38	Tetramieles nudiflora	Maina Kath	Tetramelaceae	-	✓	-	-
39	Tectona grandis	Sagwan	Verbenaceae	-	✓	-	-
40	Ziziphus mauritiana	Bor	Rhamnaceae	✓	✓	-	-
SHRUBS							
1	Abutilon indicum	Indian Mallow	Malvaceae	✓	✓	-	-
2	Adhatoda vasica	Adosa	Acanthaceae	✓	✓	-	-
3	Achyranthes aspera	Latjeera	Amaranthaceae	✓	✓	-	-
4	Bambusa arundinacea	Soh/ bans	Poaceace	-	✓	-	-
5	Calotropis gigantea	Aak	Apocynaceae	✓	✓	-	-
6	Crotalaria spectabilis	Rattle box	Fabiaceae	✓	✓	-	-
7	Dendrocalamus hamiltonii	Tama bans	Poaceae	-	✓	-	-
8	Dendrocalamus hookri	Pagshing	Poaceae	-	✓	-	-
9	Ephedra minuta	Tshey	Ephedraceae	✓	✓	LC	-
10	Eupatorium odoratum	Naamseeling/ Eupatorium	Asteraceae	✓	✓	-	-
11	Ipomea fistulosa	Beshram	Convolvulaceae	✓	-	-	-
12	Jatropha curcas	Ratanjyot	Euphorbiaceae	-	✓	-	-
13	Lantana camara	Lantana	Verbenaceae	✓	✓	-	-
14	Ricinus communis	Arand	Euphorbiaceae	✓	✓	-	-
15	Sida acuta	Chikan	Malvaceae	✓	✓	-	-
16	Sida cordifolia	Khareti	Malvaceae	✓	✓	-	-
17	Triumfetta rhomboidea	Thinjhira	Malvaceae	✓	✓	-	-
18	Zizyphus nummularia	Jhahrberi	Rhamnaceae	✓	✓	-	-
HERBS							
1	Acmella oleracea	Akarkara	Asteraceae	✓	-	-	-
2	Aerva lanata	Mountain knotgrass	Amaranthaceae	✓	✓	-	-
3	Alternanthera pungens	Khaki Weed	Amaranthaceae	✓	✓	-	-

4	Amaranthus viridis	Chaulai	Amaranthaceae	✓	✓	-	-
5	Amaranthus hybridus	Mamja	Amaranthaceae	✓	✓	-	-
6	Anagallis arvensis	Neel	Primulaceae	-	✓	-	-
7	Argemone mexicana	Darudi	Papaveraceae	✓	✓	-	-
8	Blumea lacera	JangliMuli	Asteraceae	✓	-	-	-
9	Borreria articularis	Madanaghanti	Rubiaceae	✓	-	-	-
10	Boerhavia diffusa	Punarnava	Nyctaginaceae	-	✓	-	-
11	Boehmeria macrophylla	False nettle	Urticaceae	✓	✓	-	-
12	Boehmeria platyphylla	Bichua	Urticaceae	✓	✓	-	-
13	Boehmeria ternifolia	-	Urticaceae	✓	✓	-	-
14	Cannabis sativa	Bhang	Cannabaceae	✓	-	-	-
15	Cassia tora	Kasunda	Fabaceae	✓	✓	-	-
16	Centella asiatica	Brahmi	Apiaceae	✓	-	LC	-
17	Chenopodium album	Bathu	Amaranthaceae	✓	✓	-	-
18	Chenopodium ambrosioides	Goosfoot	Amaranthaceae	✓	-	-	-
19	Chenopodium ficifolium	Bathu	Amaranthaceae	✓	✓	-	-
20	Cirsium arvense	Canada thistle	Asteraceae	✓	-	-	-
21	Corchorus olitorius	Nalta Jute	Malvaceae	-	✓	-	-
22	Datura stramonium	Dhatura	Solanaceae	✓	✓	-	-
23	Diplazium esculentum	Vegitable Fern	Athyriaceae	✓	✓	LC	-
24	Eupatorium odoratum	Bitter Bush	Asteraceae	✓	✓	-	-
25	Euphorbia hirta	Snakeweed	Euphorbiaceae	✓	✓	-	
26	Euphorbia serrata	Sawtooth spurge	Euphorbiaceae	-	✓	-	-
27	Fragaria nubicola	Strawberry	Rosaceae	✓	-	-	-
28	Heracleum obtusifolium	-	Umbelliferae	✓	-	-	-
29	Launaea procumbens	Angigobi	Asteraceae	✓	-	-	-
30	Leucas ciliata	Ngoi-phrogpa/Kubi	Lamiaceae	✓	-	-	-
31	Malvestrum coromandelianum	Kharenti	Malvaceae	✓	✓	-	-
32	Marsilea minuta	Waterclover	Marsileaceae	✓		-	-
33	Mimosa pudica	Shame plant	Fabiaceae	-	✓	-	-
34	Parthenium	Congress	Asteraceae	✓	✓	-	-

	hysterophorus	Grass					
35	Plantago depressa	Tasoma/ Isabgol	Plantaginaceae	✓	-	-	-
36	Polygonum molle	Sikkim Knotweed	Polygonaceae	✓	-	-	-
37	Rotale rotundifolia	Dwarf rotala	Lythraceae	✓	-	-	-
38	Rumex nepalensis	Janglipalak	Polygonaceae	✓	-	-	-
39	Silene conoidea	Weed silene	Caryophyllaceae	✓	✓	-	-
40	Solanum indicum	Kantakari	Solanaceae	✓	✓	-	-
41	Solanum nigrum	Makoi	Solanaceae	✓	✓	-	-
42	Sonchus asper	Sowthistle	Asteraceae		✓	-	-
43	Tephrosia purpurea	Wild indigo	Fabaceae	✓	✓	-	-
44	Tridax procumbens	Khal-muriya	Asteraceae	✓	✓	-	-
45	Urena lobata	Bachita	Malvaceae	✓	✓	-	-
46	Xanthium indicum	ChhotaGokhru	Solanaceae	✓	✓	-	-
CLIMBERS							
1	Asparagus racemosus	Shatavari	Asparagaceae	-	✓	-	-
2	Coccinia grandis	Ivy gourd	Cucurbitaceae	✓	✓	-	-
3	Convolvulus arvensis	Bind weed	Convolvulaceae	✓	-	-	-
4	Croton caudatus	Ranhuli	Euphorbiaceae	✓	✓	-	-
5	Cuscuta reflexa	Dodder	Convolvulaceae	-	✓	-	-
6	Dioscorea alata	Yam	Dioscoreaceae	✓	-	-	-
7	Momordica charantia	Bitter cucumber	Cucurbitaceae	-	✓	-	-
8	Tinospora cordifolia	Giloy	Menispermaceae	-	✓	-	-
GRASSES							
9	Brachiaria reptans	Running grass	Poaceae	✓	✓	LC	-
10	Cyndon dactylon	Dub	Poaceae	✓	✓	-	-
11	Dichanthium annulatum	Karad	Poaceae	✓	-	-	-
12	Digitaria ciliaris	Southern crabgrass	Poaceae	✓	-	-	-
13	Digitaria sanguinalis	Hairy crabgrass	Poaceae	✓	-	-	-
14	Heteropogon contortus	Sukhala	Poaceae	✓	-	-	-
15	Saccharum arundinaceum	Devil sugarcane	Poaceae	✓	✓	-	-
16	Saccharum spontaneum	Kaans	Poaceae	✓	✓	LC	-
17	Thysanolaena	Bamboo grass	Poaceae	✓	✓	-	-

	maxima						

LR- low Risk; LC- Least Concern; DD – Data deficient; VU-Vulnerable; EN- Endangered; (-)This taxon has not yet been assessed for the IUCN Red List

Appendix 25:

Faunal Species at Core and Buffer Zones

Table 9-36: Faunal Species at Core and Buffer Zones

S. No.	Scientific Name	Common Name	Core Zone	Buffer Zone	IUCN status	FNCR Status
MAMMALS						
1	Bos frontalis	Mithun	✓		VU	-
2	Muntiacus muntjak	Barking Deer	✓	✓	LC	-
3	Elephas maximus	Asian Elephant		Visitor in Buffer zone	EN	Schedule I
4	Macaca Mulatta	Rhesus Monkey	✓	✓	LC	-
5	Sus scrofa	Wild Boar		✓	LC	-
6	Panthera pardus	Leopard		✓	VU	Schedule I
AMPHIBIAN						
1	Bufo melanostictus	Toad	✓	-	LC	-
BIRDS						
1	Acredotheres tristis	Common Myna	✓	✓	LC	-
2	Columba livia	Blue Rock Pigeon	✓	✓	LC	-
3	Copsychus saularis	Magpie Robin	✓	✓	LC	-
4	Corvus splendens	Common Crow	✓	✓	LC	-
5	Ictinaetus malayensis	Black Eagle	✓	✓	LC	-
6	Egretta garzetta	Little Egret	✓	-	LC	-
7	Halcyon smyrensis	White Breasted Kingfisher	-	✓	LC	-
8	Megalaima asiatica	Bluethroated barbet	✓	-	LC	-
9	Motacilla alba	White wagtail	✓	✓	LC	-
10	Passer domesticus	House Sparrow	✓	✓	LC	-
11	Pericrocotus flammeus	Scarlet minivet	✓	✓	LC	-
12	Phalacrocorax niger	Little Cormorant	✓	-	LC	-
13	Pycnonotus cafer	Red vented Bulbul	-	✓	LC	-
14	Hypsipetes leucocephalus	Black Bulbul	✓	✓	LC	-
15	Saxicola ferrea	Grey bushchat	-	✓	LC	-
16	Streptoplia chinensis	Spotted Dove	-	✓	LC	-
17	Sturnus contra	Pied Myna	✓	-	LC	-
18	Tadorna ferruginea	Ruddy Shelduck	✓	-	LC	-
19	Vanellus duvaucelli	River Lapwing	✓	-	NT	-

Table 9-37: Populations of Important Bird and Biodiversity Area (IBA) trigger species.

Year of most recent IBA criteria assessment: 2004

Species	Season	Year(s) of estimate	Population estimate	IBA Criteria Triggered	Core Zone	Buffer Zone	IUCN Status	FNCR Status
Bengal Florican Houbaropsis bengalensis	resident	2004	present	A1	✓	-	CR	-
Lesser Adjutant Leptoptilos javanicus	resident	2004	present	A1	✓	-	VU	-
Pallas's Fish-eagle Haliaeetus leucoryphus	resident	2004	present	A1	✓	-	VU	Schedule I
Lesser Kestrel Falco naumanni	passage	2004	present	A1	✓	-	LC	-
Black-breasted Parrotbill Paradoxornis flavirostris	resident	2004	present	A1, A2	✓	-	VU	-
Finn's Weaver Ploceus megarhynchus	resident	2004	present	A1	✓	-	VU	-

Note: This table presents the IBA criteria triggered and the species that triggered then at the time of assessment, the current IUCN Red List category may vary from that which was in place at that time.

Appendix 26:

The overall approach towards the study of soil conservation

Appendix 26: The overall approach towards the study of soil conservation

Table 9-38: Overall approach towards the study of soil conservation

Sampling Parameters	Analytical Equipment	Methodology	Remarks
Porosity	-	IS: 2720 Part 7	Trial pit method for topsoil sample collection; disturbed samples
Water holding capacity	Keen Apparatus	HMSO, UK	
Permeability	-	IS: 2720 Part 17	
Moisture content	Electronic Balance	IS: 2720 Part 2	
Texture	-	IS: 2720 Part 4	
Particle size Distribution	Glass wares	IS: 2720 Part 4	5% Leachate to be made and analyzed as per APHA, "Standard Methods" All method numbers are as per APHA "Standard Methods" (21st edition, 2005)
Cation Exchange Capacity	Centrifuge	IS: 2720 Part 24 (1976)	
SAR	F. Photometer (Na, K); Titration (Ca & Mg)	Calculation	
pH	pH Meter	4500 H+B	
Electrical Conductivity	Conductivity Meter	As per IS 14767 -2000	
Calcium	Glass wares	3500 Ca B	
Magnesium	Glass Wares	3500 Mg B	
Sodium (Na)	F.Photometer	3500 Na B	
Potassium	F.Photometer	3500 K B	
Dry Bulk Density	Glass wares Measuring cylinder, Balance	IS: 2720-29(1975)	Laboratory Method
OC (Organic carbon)	Glass wares	IS 2720-22 (1972)	Volumetric Method
Total Nitrogen	Glass wares	IS 2720-22 (1972)	Calculated from OC
Available Phosphorus	Spectro photometric Method	Olsen et al. (1954)	Extraction with O.5M NaHCO3, pH 8.5
Available potassium	F.Photometer	Jackson (1973)	Extraction with Neutral N NH4OAC (ammonium acetate)

Appendix 27:
Aquatic Sampling Photographs

Primary Data Collection

Photograph 9-7-Sampling photographs (1st season)

Xenentodon cancila

Macrobrachium sp.

Anabas Sp.

Heteropneustes fossilis

Labeo sp.

Cast net operation during sampling

Photograph 9-8-Sampling photographs (2nd season)

Cyprinion semiplotum was captured in high velocity Amochhu

Size and length of Cyprinion semiplotum was examined at site

Labeo dyocheilus

Xenentodon cancila

Monopterus cuchia

Chaca chaca

Heteropneustes fossilis

Labeo calbasu

Neolissochilus hexagonolepis

Acanthocobitis sp.

Securicula gora

Barilius bendelisis

Secondary Data from National Research Centre for Lake and Riverine Fisheries

Fish species found during the baseline study period (four season) from Amochhu and its tributaries

Order	Family	Species Recorded	ICUN Status
Cypriniformes	Cyprinidae	*Tor putitora*	EN
		Neolissochilus hexagonolepis	NA
		Semiplotus semiplotus	LC
		Barilius varga	LC
		Barilius bendelisis	LC
		Barilius barna	LC
		Devario aequipinnatus	LC
		Danio rerio	LC
		Chagunius chagunio	LC
		Punitus sophere	LC
		Schizothorax richadsonni	LC
		Gara gotyla	LC
		Gara annandalei	LC
		Acanthocobitis spp.	LC
		Oreichtys crenuchiodes	LC
	Psilorhynchidae	*Psilorhynchus balitora*	LC
	Balitoridae	*Schistura* spp.	LC
Siluriformes	Amblycipitidae	*Amblyceps apangi*	LC
Siluriformes	Claridae	*Clarias gariepinus*	LC
Perciformes	Channidae	*Channa* spp.	LC
		Channa gachuua	LC
	Nandidae	*Badis badis*	LC

Note: EN: Endangered, LC: Least Concern

Annexure 1. List of Fish Species found in Amochu Basin

1.Barilius varga

2. Channa gachuua

3. Oreichthys crenuchides

4. Punitus sophore

5. Psilorhynchus balitora

6. Danio rerio

7. Badis Badis

8. Clarias garicphinus

9. Tor putitora

10. Channa spp

11. Davario aequipinnatus

12. Chagunius chagunio

13. Neolissochilus hexagonolepis

14. Barlius Barna

15. Semipltus smeiplotus

16. Amblyceps apangi

17. Acanthocobitis spp

18. Schistura spp

19. Barlius Bendelisis

20. Gara gotyla

21. Schizothorax richardsonni

22. Gara annandalei

Appendix 28:
Soil Sampling Photographs

Photograph 9-9: Soil Sampling Photographs (1st season- winter season)

Zone C

Zone B

Zone A

Photograph 9-10: Soil sampling Photos (2nd Season)

Zone A

Zone B

Zone C

Appendix 29:
Soil Analysis Result

Appendix 29: Soil Analysis Result

Table 9-39: Soil Analysis Result

Sr. No	Parameter	Unit	WINTER-2016						SUMMER-2016		
			ST1	ST2	ST3	ST4	ST5	ST6	ST1	ST2	ST3
1	Porosity	%	45	37	41	47	50	51	48	56	50
2	Water Holding Capacity	%	39.2	36.7	37.3	42.6	44.0	45.4	43.7	44.2	47.2
3	Permeability	mm/hr.	41.4	62.3	48.6	36.4	28.1	20.2	27.3	24.5	20.2
4	Particle Size Distribution										
a	Sand	%	81.1	97.8	90.6	77.1	66.2	56.8	77.3	73.6	58.8
b	Silt	%	1.7	0.0	0.0	18.7	14.3	22.3	3.3	2.3	23.6
C	Clay	%	17.2	2.2	9.4	9.2	19.4	20.9	19.4	24.2	17.9
5	Texture	--	Loamy sand	Sandy	Sandy	Loamy sand	Sandy loam	Sandy loam	Sandy clay loam	Sandy loam	Sandy loam
6	Bulk Density	g/cm3	1.28	1.26	1.28	1.27	1.43	1.05	-	-	-
7	Cation Exchange capacity	meq/100gm	8.08	6.02	7.60	8.90	12.30	5.60	16.30	17.8	15.10
8	Electrical Conductivity	dS/m	0.174	0.116	0.128	0.174	1.620	0.148	0.128	0.117	0.132
9	Exchangeable Sodium	%	<0.1	<0.1	0.37	0.58	<0.1	<0.1	<0.1	<0.1	<0.1
10	pH		7.12	6.95	7.15	7.48	6.01	6.69	7.25	7.42	7.36
11	OC(Organic carbon)	%	0.15	0.41	0.24	0.85	0.82	1.41	0.99	0.77	0.90
12	Total-N	Kg/ha	296	799	479	1650	1581	2876	1953	1485	1747
13	Available-P2O5	Kg/ha	10.11	7.90	6.10	9.70	14.10	23.20	-	-	-
14	Available-K2O	Kg/ha	75	49	76.20	51.20	62.22	81.33	-	-	-
15	Calcium	g/kg	0.13	0.05	0.19	0.22	0.48	0.13	0.10	0.22	0.19
16	Magnesium	g/kg	0.55	0.21	0.22	0.25	0.87	0.12	0.14	0.36	0.22
17	Sodium	g/kg	0.37	0.26	0.43	0.52	0.31	0.31	0.20	0.20	0.20
18	Potassium	g/kg	0.01	0.01	0.01	0.07	0.01	0.02	0.04	0.03	0.03

Appendix 30:
The overall approach towards the study of Socio-Economic

The methodology adopted for conducting socio-economics study: discussion with local authorities, observations, site visit. It also involves the qualitative and quantitative data collection in field through discussions and consultations with various stakeholders, data analysis and reporting. The data collection methodology for socio-economics is carried out as a two way process in three purposes:

To inform and sensitize the stakeholders or respondents about the Project.

To obtain their views about the Project.

To understand existing social conditions, availability of infrastructure and basic services on ground.

This requires rigorous methods to gather data and record views of all major stakeholder groups. The two data collection methods adopted includes various stakeholders as identified below:

- One-to-one interactions with various stakeholders
- Focus Group Discussions

The following activities are carried out as part of the socio economics study.

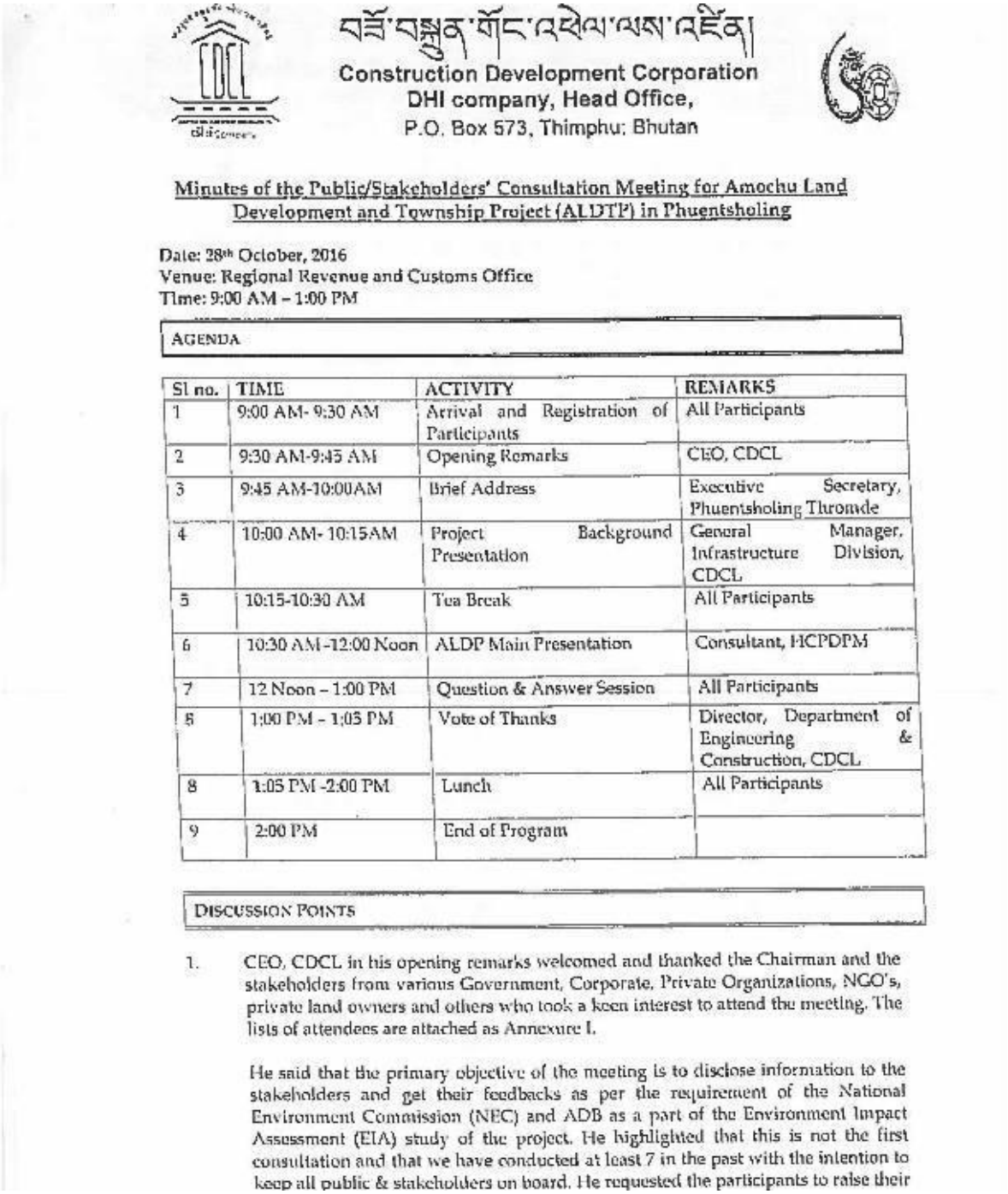
- Understanding the Project
- Identifying Information/ Secondary Data requirement and their sources
- One to One Interactions
- Focus Group Discussion
- Conducting Scoping through Primary Data Collection
- Data Analysis of Socio Economic Profile of Baseline condition
- Inferences derived for
  Demographic –Population, Gender distribution
  Socio Economic - Family size, Family Income, Housing Typology, Services,
- Other Social Issues (Non Safeguard issues) - Poverty, Gender, Labour, Vulnerable population
- Awareness, perception, expectation and suggestion about ALDTP from the stakeholders
- Identification and Assessment of Impact
- Mitigation measures

Appendix 31:
Public Consultation and Information Disclosure

Appendix 31: Public Consultation and Information Disclosure

The consultations with stakeholders were carried out throughout EIA study particularly during gathering primary and secondary data. The official consultation meetings was held 2 times in Phuentsholing on 28th October 2016 and on 31st January 2017.

Detail Agenda, Issues discussed and list of participants are attached below



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Minutes of the Public/Stakeholders' Consultation Meeting for Amochu Land Development and Township Project (ALDTP) in Phuentsholing

Date: 28th October, 2016
Venue: Regional Revenue and Customs Office
Time: 9:00 AM – 1:00 PM

AGENDA

Sl no.	TIME	ACTIVITY	REMARKS
1	9:00 AM- 9:30 AM	Arrival and Registration of Participants	All Participants
2	9:30 AM-9:45 AM	Opening Remarks	CEO, CDCL
3	9:45 AM-10:00AM	Brief Address	Executive Secretary, Phuentsholing Thromde
4	10:00 AM- 10:15AM	Project Background Presentation	General Manager, Infrastructure Division, CDCL
5	10:15-10:30 AM	Tea Break	All Participants
6	10:30 AM -12:00 Noon	ALDP Main Presentation	Consultant, HCPDPM
7	12 Noon – 1:00 PM	Question & Answer Session	All Participants
8	1:00 PM – 1:05 PM	Vote of Thanks	Director, Department of Engineering & Construction, CDCL
8	1:05 PM -2:00 PM	Lunch	All Participants
9	2:00 PM	End of Program	

DISCUSSION POINTS

1. CEO, CDCL in his opening remarks welcomed and thanked the Chairman and the stakeholders from various Government, Corporate, Private Organizations, NGO's, private land owners and others who took a keen interest to attend the meeting. The lists of attendees are attached as Annexure I.

   He said that the primary objective of the meeting is to disclose information to the stakeholders and get their feedbacks as per the requirement of the National Environment Commission (NEC) and ADB as a part of the Environment Impact Assessment (EIA) study of the project. He highlighted that this is not the first consultation and that we have conducted at least 7 in the past with the intention to keep all public & stakeholders on board. He requested the participants to raise their

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concerns and feedbacks for the project in the Q&A session so that it is adequately incorporated in the project.

CEO, CDCL then informed the floor about the amalgamation of DHI- INFRA with CDCL and that the ALDTP has now come under the mandate of the CDCL. He said that the DHI is the owner and the executing agency, and CDCL is the implementing agency for the project.

He explained the importance of the ALDTP for Phuentsholing and the whole country which consists of two main components i.e. a) river training to protect Phuentsholing from the flooding threats and to prevent the erosion of valuable land; b) land reclamation which will provide around 1146 acres of land for development. DHI will be investing in the project and it is likely to adopt financing ratio of 70:30 with 30 percent equity injection. He then informed the floor that ADB has committed to provide major funding for the 1st Phase of the project which comprises of river training, embankment works and development of 160 acres of land in Zone A.

Meanwhile, he introduced M/s HCPDPM, who is based in Ahmedabad, India as the consulting firm for carrying out the Integrated Detailed Project Report (IDPR) for the Project. Further, he mentioned that with the involvement of ADB, they have deputed their Project Preparatory & Technical Assistance (PPTA) consultants under diverse disciplines to review the IDPR. With ADB on board and provided that all Government clearances and approvals are obtained in time, the construction of Phase I (Zone A) is expected to start from the third quarter of 2017.

He committed that CDCL would do its utmost to realize the ALDTP as per the Government's plans and policies. He informed that the ALDTP would bring unprecedented benefits not only to the people of Chhukha and Samtse Dzongkhags but the entire Nation. He also highlighted that some of the benefits would be in the form of job opportunities, commercial enterprises, increase in land values, etc.

2. Following this, the Chairman of the meeting, Executive Secretary of Phuentsholing Thromde addressed the floor wherein he highlighted the importance of ALDTP project to the people of Chhukha and Samtse Dzongkhags and the country as a whole. He emphasized that given the current congestion problem in Phuentsholing city, it is inevitable that the ALDTP project come up in a well-structured and planned manner. He further emphasized on the urgency of the project owing to the constant flooding threats of Amochhu especially during the monsoon in 2015 and 2016. Since the project is falling under the jurisdiction of the Phuentsholing Thromde, the Thromde extends its full support for the project.

   He said that a lot of stakeholder consultations have been carried out for this project in the past and hence, we have incorporated the needs of all the concerned. He urged the participants to be attentive during the presentation and raise all their concerns and feedback so that it can be incorporated in the report before it is too late.

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3. General Manager, Infrastructure Division, CDCL gave a brief presentation on the project background including the project rationale, objectives and vision. The presentation slides is attached as Annexure II.

4. The Consultants, HCPDPM, then made a detailed presentation of the project Masterplan, EIA methodology and process, summary of the proposed Environmental & Social impacts and mitigations measures and a summary of the environmental Management & Monitoring plans. This presentation slides are attached as Annexure III.

5. After this, an opportunity was given to the participants to provide their opinion and concerns pertaining to the project in a Question & Answer session. The questions/concerns raised and their corresponding justifications are reproduced below:

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Sl	Question/Suggestion	Answer
1	Mr. Chenda Dorji, Private Land Representative:	
	a. He firstly thanked CDCL and the team for the excellent presentation. He had heard of ALDTP project from a long time back and is looking forward for the project to come up mainly due to the flood threats but is concerned about the delay in its implementation and hence asked when the project is actually coming up.	a. CDCL clarified that the project is under design stage at the moment. Proper planning is very important for the success of the project and hence the Integrated Detailed Project Report (IDPR) is under preparation and is in its final stage. If the funds are released and clearances and approvals obtained on time, the actual implementation will start in the third quarter of 2017 with river training and embankment works of Phase I.
	b. The LAP land owners funded the diversion works of Amochhu in the beginning of 2016 which did not suffice during the recent flood. He then asked if there are any plans in place for partial diversion of river by the project before the start of the next monsoon and the actual start of the ALDTP.	b. It was informed that while CDCL has obtained the NEC clearance for partial diversion of Amochhu this year which is valid for next two years, there is no fund allotted for this purpose. Hence, Phuentsholing Thromde in collaboration of LAP land owners could carry out the diversion with technical support from CDCL.
	c. How does the Amochhu Hydropower Project (AHEP) proposed upstream of the ALDTP impact the Project.	c. The IDPR of ALDTP has been prepared giving due considerations to the proposed AHEP and it was clarified that there are no significant impacts of the AHEP on the project.
2	Aum Damchoe, BAOWE She appreciated the huge number of participation for the meeting and congratulated CDCL and the team for the wonderful presentation made. With this she said that while the livelihood centers/activities were mentioned to have been included in the project, these centers should be placed in areas which will attract people mainly the low income groups and not just placed in any random locations of the city.	CDCL in response said that a Development Control Regulation (DCR) is being prepared for the ALTDP which will integrate all income group levels to live within the city. The ALDTP Master Plan considers semi residential and mixed use housings which will provide equal opportunities and livelihood needs to all.

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3	Mr. Yeshi Samdrup, Department of Culture. a. What is the Project carrying capacity, has the migration pattern been studied and when will the project be completely occupied	a. CDCL explained that the population in the next 30 years is projected at 48,400 for the new ALDTP town and 80,000 including the existing town based on the existing population growth and in migration pattern of Phuentsholing. The project is expected to be fully occupied by 2046.
	b. How has the tourism plan been formulated? Which is the ALDTP focused group of tourist i.e. regional, international, local etc. If international, then Kaileshwar hill could be explored	b. CDCL in response said that the ALDTP aims to attract both regional and international tourists not only to enjoy the recreational and amusement activities but also to avail hospitality, health & educational facilities in the new township. The possibility of developing Kaileshwer hill with minimal impacts to its ecology could be explored in future as it is not under the current scope of ALDTP.
	c. How the connectivity with India is looked at, is it from the existing entry point or is a separate entry proposed for the city?	c. CDCL informed that the ALDTP will be mainly accessed from the 2nd Indo- Bhutan entry point that is currently under development. Other than this and the existing Phuentsholing entry point, possibility of a new entry from India along the Amochhu left bank has been explored in the Master Plan. This will be developed if required in future. Further, a heliport is also proposed for development in the ALDTP to accommodate around 4-5 helicopters
4	Sonam Choden, WWF a. She emphasized that development activities should give due considerations to environment and social issues and appreciated that ALDTP has thoroughly studied, planned and incorporated the same in the project proposal. However, she asked how CDCL will ensure that the presented is actually implemented in ground without any gaps in quality	a. CDCL acknowledged the concern and said that CDCL always gives importance to quality and will ensure that whatever planned will be implemented. In order to implement the project, CDCL will hire reputed international consultants as discussed with

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	and specifications? Usually projects propose a lot of mitigation measures which are not implemented in actual.	ADB and the project will be implemented under the guidance of the Government, DHI, ADB and CDCL.
	b. Will the ALDTP reports be shared to public so that public can view them and give feedbacks	b. CDCL explained that, it is with the very purpose of getting public views, that this consultation is being carried out and that consultations have been carried out in past and will be carried out in future too. After this meeting a press release will be issued to disclose information to all. Further, the reports will be uploaded in CDCL website for public download. In addition, the final EIA report will be uploaded in the ADB website for public disclosure before endorsement by their Board.
	c. What kind and duration of Amochhu flood history has been studied to come up with the proposed ALDTP structures that will last for hundreds of years?	c. CDCL responded by explaining that initially in a study conducted by Danish Hydraulic Institute (DHI) in the years 2006 & 2007, the flood history was analyzed for the 50 years flood return period as the project was conceptualized only for river training. With township proposed in the project, a flood frequency analysis for 100 years flood return period has been studied using HECRAS hydraulic modelling. The flood data was collected from gauging data at Hashimara for the last 30 years and from Doyagang and Dorokha stations also.
5	Karma C Nyedrup, National Environment Commission a. Main objective of the public consultation report is to get information from the public which is being rightly conducted by CDCL for the ALDTP	

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	b. It was mentioned in the presentation that NEC will issue the EC. This statement has to be revised as NEC is not mandated to compulsorily issue the EC and has the right not to issue one after reviewing the project EIA. c. As per the Water act 2011 the first source of water should be sourced from surface and not underground water. The underground water should be used only when surface water is not available. This should be considered the project. d. Alternative to the project should also be proposed which is important for an EIA study. e. The issue of conservation Golden Mahaseer should be looked into since it is an endangegeared & migratory species. f. Boidiversity Act , 2000 should be corrected to Biodiversity Act, 2003 g. The mitigation measures are all generic and subjective. Specific measures should be proposed in the final EIA report that will be submitted to NEC. h. How will the project deal with affected people and how will the new town be synchronized with the old town? i. What is the implementation schedule and commencement date of the project and what is the budget allocated for the environment from the total project cost? j. In addition to environmental issues, social and economic issues should be adequately addressed. k. Where does NEC stand in the Grievance Redressal System?	CDCL acknowledged the issues raised. It was informed that the EIA report and the ALDTP IDPR is still in the draft stage and will be finalized shortly. All the comments and suggestions made will be duly considered and incorporated in the reports. The final EIA along with the IDPR will be submitted to NEC for approval.

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7	Mr. D.C. Dhimal, Phuentsholing Thromde With the amount of traffic that is expected to flow from the new Indo- Bhutan entry point, the access of ALDTP from this point when it is fully occupied is likely to cause huge traffic congestion in this route. Hence a separate entry point to ALDTP needs to be explored at the moment for the future.	CDCL acknowledged the concern and said that a second entry point along the left bank of Amochhu has been explored in the masterplan. This will be implemented if necessary in future.
8	Sangay Nordu, Environment Officer, Chhukha Dzongkhag Administration (comments provided after the meeting): a. Are there any issues of land and structural resettlement at the project site and have the concerned gewogs and Dzongkhags being consulted?	a. CDCL informed that there are no settlements inside the project area. There were settlements inside in the past which have been successfully relocated by Phuentsholing Thromde in the LAP area adjacent to ALDTP due to their earlier land being submerged by the Amochhu flooding. The Phuentsholing - Samtse highway separates the LAP from the ALDTP area. Further, the concerned neighbouring villages and gewogs have been duly consulted and clearances from the gewogs too have been acquired.
	b. Security issues to be considered during construction phase as the project site shares the border with India. A need of establishing an integrated checkpost should be looked at.	b. CDCL acknowledged the concern raised and duly noted for implementation if possible.
	c. The actual design of the project was not presented such as the embankments, etc., and only prototypes were shown. It would have been nice to see what the technical designs.	c. CDCL responded that since the presentation was mainly focusing on the EIA aspect and on the general understanding by various levels of participants attending the meeting, only general issues were presented and not the technical details. All specific designs are being prepared as a part of the IDPR for the project.

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	d. Distinct cultural infrastructure should be constructed to distinguish the new township from the culture across the border. This will give unique identity to the new town.	d. CDCL appreciated the recommendation made and said that this has already been considered in the project master plan.
	e. Details of aquatic studies should be provided in the EIA report for submission to NEC	e. CDCL informed that the first season aquatic study of Amochhu was conducted in March 2016 and the second season will be conducted within the next two months. Therefore, all aquatic species found from primary sampling and secondary sources will be included in the EIA report
	f. Since the Amochhu is flowing from China, if in case China builds a dam in the river in future, how will it impact the project	f. CDCL clarified that the ALDTP has been designed considering the proposed dam of Amochhu Hydropower Project which has been shelved at the moment. Hence, the possibility of a dam coming upstream has been duly considered.
	g. Since the project proposes to use ground water, the infiltration and contamination of the ground water from the settlements across the border needs to be considered.	g. It was clarified that the ground water was tested for its quality and it was found that the water is good for drinking after disinfection. To this, ALDTP is setting up a water treatment plant to treat the water before distribution.
9	Mr. Gopal Prasad Khanal, National Research Center for Aquaculture (comments sent via email): a. It was noted that, the total length of 300 m wide channel to be 12 km; thus approximately 8.3% of total length of Amochu river (145 km long) falls within project area. From this, it can be assumed that the project is going to have significant effect on the native fishes available within the project area.	a. CDCL thanked for raising the concern and informed that the 300 m channel width of the Amochhu has been proposed after properly analyzing the river hydraulics and it is adequate to contain the river flow in monsoon. In the lean season, the Amochhu width is less than 50 m. It was further highlighted that the Amochhu which has the natural habit of changing its course almost every year during monsoon, will not be blocked at

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		any time both during construction and operation. It will only be diverted during the construction of embankments. Further, geo textile membranes will be used during construction to prevent falling of debris in the river.
	b. The consulting firm during course of fish fauna assessment could capture more than 10 species of fishes. However, they could not capture/record any specimen of golden mahaseer, a globally endangered fish species whose presence in Amochu has been verified by several authors. Thus, it is important to consider the presence of golden masher during development of appropriate EIA Report.	b. The 10 species listed were the result of the first season aquatic study which was conducted in March 2016. A second season sampling is planned to be conducted within the next two months and we are hopeful of finding the golden mahaseer this time. If not, CDCL will be using the secondary Amochhu aquatic data collected from the National Research Center for Riverine & lake Fisheries at Haa.
	c. Attention should be given to golden mahaseer and as well as other native fishes especially during the construction phase and post-construction phase with aim to mitigate the effect of the project. During the construction phase fishes from the diverted river channels is to be captured and released back into the main river while for later phase, certain amount of budget can be earmarked for activities such as "Initiating breeding trial for native species, including golden mahaseer available at Amochu with aim of restocking in future" to replenish the affected fish population.	c. CDCL acknowledged the recommendations made and said that the relevant issues wherever possible will be implemented in the project. Regarding the restocking and breeding of the golden mahaseer, the designated national agencies such as the National Research Center for Aquaculture, Gelephu could be approached in the near future.

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Following the Question & Answer (Q&A) session, the Director, Department of Engineering & Construction, CDCL thanked all the public and stakeholders for taking out their time and attending the meeting. He thanked the floor for overwhelming participation and for the interactive Q&A session.

The meeting was officially concluded at 1:00 PM followed by Lunch.

(Wangchuk Thayey)
Executive Secretary
Phuentsholing Thromde

Executive Secretary
Phuentsholing Thromde

(Phuntsho Gyeltshen)
Chief Executive Officer
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Minutes of the 2nd Public Consultation Meeting for Amochhu Land Development and Township Project (ALDTP) in Phuentsholing

Date: 31st January, 2017
Venue: Hotel Druk Banquet hall
Time: 9:00 AM – 1:00 PM

AGENDA

Sl no.	TIME	ACTIVITY	REMARKS
1	9:00 AM- 9:30 AM	Arrival and Registration of Participants	All Participants
2	9:30 AM-9:45 AM	Opening Remarks	CEO, CDCL
3	9:45 AM-10:15AM	ALDTP Presentation	Project Team, ALDTP, ID, CDCL
5	10:15 AM -10:45 AM	Tea Break	All Participants
6	10:45 AM -11:45 AM	ALDP EIA Presentation	Environment Officer, ALDTP, ID, CDCL
7	11:45 AM – 1:00 PM	Question & Answer Session	All Participants
8	1:00 PM –1:07 PM	Closing Remarks	Director, DEC, CDCL
9	1:07 PM -2:00 PM	Lunch	All Participants
End of Program			

DISCUSSION POINTS

1. CEO, CDCL in his opening remarks welcomed the representatives from various Governments, Corporations, Private Organizations, Civil Society Organizations, private land owners and Bhutanese living in Jaigoan and thanked them for taking their time to attend the 2nd Public consultation meeting for ALDTP. The lists of attendees are attached as Annexure 1.

   He said that the primary objective of this meeting is to disclose information on how the issues raised during the 1st consultation meeting has been addressed in the project. He also requested the participants to raise their concerns and feedbacks during this Q&A session so that it is adequately incorporated in the project and EIA report.

   He reiterated the importance of the ALDTP for Phuentsholing and the whole country which consisted of two main components i.e. a) River training to protect Phuentsholing from the flooding threats and to prevent the erosion of valuable land; &b) Land reclamation which will provide around 1146 acres of land for

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development. He also informed that DHI will be investing in the project and it is likely to adopt financing ratio of 70:30 with 30 percent equity injection from DHI. Along with DHI, ADB has also committed to provide major funding for the Phase I of the project which comprises of river training, embankment works and development of 160 acres of land in Zone A. With ADB on board and provided that all Government clearances and approvals are obtained in time, the construction of Phase I (Zone A) is expected to start from the third quarter of 2017.

He emphasized that given the current congestion problem in Phuentsholing city, it is inevitable that the project come up in a well-structured and planned manner. He further emphasized on the urgency of the project owing to the constant flooding threats of Amochhu especially during the monsoon in 2015 and 2016.

He committed that CDCL would do its utmost to realize the ALDTP as per the Government's plans and policies. He informed that the ALDTP would bring unprecedented benefits not only to the people of Chhukha and Samtse Dzongkhags but the entire Nation.

2. General Manager, Infrastructure Division, CDCL, then gave a brief presentation on the project background mainly focusing on the rationale, location, project site, mandates and the governments support for the project. This was followed by presentation on the project details such as construction of River Training & Flood Protection Works, Embankment & Backfilling Works and Common Urban Infrastructure by the Project Manager. Subsequently the Master Plan Components such as the key issues, vision & objectives, project zoning, and the overall master plan of the ALDTP was presented by Chief Architect, CDCL

3. After the Tea Break, the Environment Officer, CDCL made a presentation on the Environment Impact Assessment of the Project outlining on how the issues raised during the 1st consultation meeting were incorporated in the project, highlighted the summary of the significant environmental impact and mitigation measures and introduced the focal person during the project implementation. The presentation slides are attached as Annexure II.

4. After this, an opportunity was given to the participants to provide their opinion and concerns pertaining to the project in a Question & Answer session. The questions/concerns raised and their corresponding justifications are mentioned below:

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SN.	Question/Suggestion	Answer
1.	Mr. Sonam Rinchen, Dy. Managing Director, Rabten Workshop (Private Sector representative): Have funds been secured for the development of Zone A since the project is expected to start at the fourth quarter of 2017?	CDCL informed that one of the major issue for the development of Phase I is its huge investment especially in the river training works and infrastructural development. For this, an initial cost estimate of $55 million has been proposed out of which, $45 million will be funded by ADB (ADB grant of $26.47 million and concessional ordinary capital resources Lending (COL) of $18.53 Million) and with DHI injecting $10 million as equity. Therefore the funding is secured at the moment. In addition, for the Phase I, package 1 construction is expected to start by September 2017 provided all the clearances and approvals are obtained on time.
2.	Mr. Karma Jigme, Stapels and Jattu Wood Industry, (Private Sector Representative): Since the budget is allocated for the development of Phase 1, who will undertake the development works? Will it be CDCL or there a possibility for the private sectors to participate as well?	CDCL clarified that since the ALDTP is an ADB funded project and CDCL is its implementing agency, this will lead to conflict of interest if CDCL takes up the construction works. It was also informed that due to the huge investment, complexity and uniqueness of the project, an International Competitive Bidding (ICB) will be floated, wherein an opportunity for participating as a single firm or a joint venture/association will be available to the private sector. In addition, it was informed that to ensure the progress and quality of work, a team of Project Implementing Consultants (PIC), Project Implementing Units (PIU) and Project Management Unit (PMU) have been formulated.

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SN.	Question/Suggestion	Answer
3.	Mr. Karma C. Nyedrup, Environmental Specialist, National Environment Commission (Government representative)	
	1. Concern was raised that the implementation schedule for all the four zones has to be submitted and not just for a single Zone since the environmental clearance would be issued for the whole project and not in a piece-meal basis.	1. CDCL informed that the EIA report has been prepared for the whole project and not just for a particular Zone, therefore the implementation schedule for the entire project will be submitted in the EIA report.
	2. It is understood that it is a requirement for ADB to disclosure EIA report in their website, but what is the purpose of disclosing the EIA report in CDCL website?	2. CDCL informed that like ADB, the EIA report will be disclosed in the CDCL website so as to get relevant feedback from public. In addition, as presented earlier, the focal person from CDCL could be contacted for any comments on the report.
	3. How will you maintain the natural river flow to conserve endangered fish like Golden Mahaseer especially after the construction of river training and embankment works?	3. CDCL informed that, as presented earlier, the width of the Amochhu is around 50 m even during the lean season. After the river training works, a river channel of 300 m is proposed. It is therefore expected the natural flow of the river will not be disturbed. It was also informed that CDCL and ADB has taken into consideration the issue of Golden Mahaseer, an IUCN list endangered species especially during the construction phase. Therefore the impact of such species is considered significantly high in the assessment. In the report, an Environmental Management Plan (EMP) has been proposed which provides the overall guidelines for the contractor to frame a Contractual Environment Management Plan (CEMP). The CEMP will provide site specific mitigation measures for the conservation of such species. In addition, since Bhutan also has a lot of conservation plans carried out for Golden Mahaseer, a possibility to support Department of Livestock for their ongoing works could be explored.

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SN.	Question/Suggestion	Answer
	4. The mitigation measures are subjective at the moment but needs to be detailed in the EIA report for submission to NEC	4. The suggestion will be duly noted and will be considered in the EIA report for onward submission to NEC
	5. It is proposed that the employment and housing opportunities will be provided by the project which is very subjective. A detail quantification of the above needs to be provided during the construction and operation phase for the entire project duration in the EIA report.	5. CDCL informed that ADB has decided to fund the project based on the economic viability of the project i.e Economic Internal Rate of Return (EIRR) which is about 14%. Based on this, a quantification of Employment and housing opportunities has been worked out which will be included in the EIA report.
4.	Aum Damchoe Dem, Chief Executive Officer, BAOWE (Civil Society Organization Representative) BAOWE is glad to see the progress made by the project and the concerns reflected by the stakeholders ensuring an inclusive project envisaged and built for the wellbeing of the people. It was also informed that they was grateful that their concerns were noted. They also thanked ADB for helping create livelihood for more than 3000 families across the nation. She reiterated that their request to create a livelihood centers be addressed in the project for the marginalized levels of society mostly single mothers and unemployed youth and make this project a reality.	CDCL thanked BAOWE for supporting the project and reiterated the importance of empowering women to alleviate poverty. It was informed that the proposal has been duly noted and a provision has been kept for development of informal livelihood centers in the master plan.
5.	Mr. Vijay Moktan, Conservation Director, World Wildlife Fund (Civil Society organization Representative) 1. It was generally observed that all the Environmental Assessments carried out for developmental projects like Urbanization and Hydropower Projects are all very site specific. For this project, has the cumulative impact from the Amochhu Hydro-Electric Project	1. CDCL informed that the project master plan has taken into consideration all the ongoing activities such as the ongoing SASEC road project, upcoming Phuentsholing-Samtse National Highway, the LAP and the AHEP and has assessed its cumulative impact in the project. It was also clarified by NEC that usually to

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SN.	Question/Suggestion	Answer
	(AHEP) upstream and the upcoming road projects being considered for this project?	assess the overall cumulative impact, a Strategic Environmental Assessment (SEA) is required but for this project since there are no new major projects, an EIA would suffice.
	2. Since the project aspires to cater around 80,000 population during the project's operation, it is imperative that the project must remain resilient to cater and sustain its population.	2. CDCL clarified that the projected population of 80,000 is for the entire Phuentsholing Urban Area (PUA) which includes the existing Phuentsholing town and the new town in the next 30 years. However, the concern was duly noted.
6.	**Mr. Pema Wangchuk, Sr. Forest Ranger, Tading Gewog, (Government representative)** There could be a possibility that the demarcated boundary of the project area aroundZone B might be overlapping with the community forest area	CDCL informed that while demarcating the project boundary, a joint consultation has been conducted with Mangmi, Tshogpa and Gup. Therefore, the issue of overlapping the community forest area with the project area might not be possible. However the matter has been noted and will be verified with the concerned village authorities.
7.	**Mr. Phuntsho Wangdi, Private land Owner at LAP (Private Sector representative)** 1. He thanked DHI and CDCL for expediting the project activities in the past 3 months and informed that the land owners and the people of Jaigoan are jointly looking forward to the completion of the project. A clarification with regard to the Phuentsholing-Samtse National Highway and the alternative route to the project was sought.	1. CDCL explained that the new proposed Phuentsholing-Samtse National Highway will be between the Amochhu LAP and the Amochhu Project. It was clarified that the alternative route to the project has also been exploredin the master plan for future requirements.

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SN.	Question/Suggestion	Answer
	2. Is there space earmarked for conducting trade fairs for the promoting of indigenous products and creating sport complex in the project?	2. CDCL informed that there are spaces earmarked for activities such as trade fairs, event places and seasonal orange auction yards in the special development zones of the master plan. With regard to the sports facilities, Zone A does not have any such provisions except for areas that has been allocated for play grounds, pocket parks and promenades. However, provisions have been kept in Zone B and Zone C for sports complex.
	3. What is the current status of the partial diversion of the Amochhu?	3. Phuentsholing Thormde clarified that the partial diversion carried out at the moment is a temporary measure until the ALDTP project commences and is mainly to control the upcoming monsoon. The work is currently carried out by a private contractor at his own expense. The materials from the diversion activities will be used by the contractor to recover his cost.
8.	<u>Mr. Tshering Phuntsho, Chief Urban Planner, Phuentsholing Thormde, (Government representatives)</u>	
	1. Concern was raised that while formulating the land use for the project, a precinct based planning must be used and not specify it as commercial, residential, etc.	1. To this, CDCL informed that the concern will be noted and clarification on the matter will be sought from NLCS and Phuentsholing Thromde.
	2. What are the provisions kept for the town centers?	2. With regard to the town centers, CDCL informed that the details are currently underway. However, provisions for cultural monument and landmark features have been kept in the master plan.
	3. It was also suggested that the space allocated for the development of university and the convention centers which is currently located at different zones as per the master plan could be located together.	3. CDCL informed that all activities that comes under the special development zones and will depend primarily on the demand for such activities. In addition, a comprehensive DCR is currently under preparation which would clearly spell out the land use type allowed in the entire master plan.

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SN.	Question/Suggestion	Answer
9.	**Lobzang, Executive Engineer, Phuentsholing Thormde, (Government representatives)** There is a need to synergize the design level and existing level of the proposed river training works (4.5 m from the riverbed) with the upcoming Phuentsholing-Samtse National Highway and LAP since many construction works are being carried out that the moment.	The suggestion will be duly noted. Further discussions and co-ordinations will be carried out with the concerned agencies.
10.	**Mr. Karma Jigme, Stapels and Jattu Wood Industry, (Private Sector Representative):** 1. As per the discussion, it was observed that there is a need for close consultation with Phuentsholing Thromde and CDCL with regard to the integration of project and LAP. 2. What is the project modality?	1. CDCL acknowledged that the concerns raised are very valid and clarified that CDCL has been working with Phuentsholing Thromde and Department of Roads right from the project inception to the current stage. CDCL informed that there are representatives from these organizations in the Technical Working Group (TWG) of the project. It was mentioned that there has been several rounds of meeting held with Phuentsholing Thromde in the past. It was also informed that the current Executive Secretary of the Phuentsholing Thromde was the Board Director of the erstwhile DHI-INFRA and is fully aware of the project. 2. CDCL informed that as a project implementer, CDCL will only be supervising the construction of the river training, embankment works and the Common Urban Infrastructure like roads, water supply, storm water drainage, power supply and telecommunication. The land will then be made available for the private developers for construction. The lease rate for the land is currently under preparation by DHI.

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SN.	Question/Suggestion	Answer
11.	Sangay Norbu, Environment Officer, Chhukha Dzongkhag Administration (Government representatives)	
	1. How has the ground water abstraction been studied?	1. CDCL informed that the ground water abstraction had been undertaken as a baseline study from the existing water source of the Phuentsholing City. After test, the water has been found suitable for drinking after disinfection.
	2. During the construction stage, will there be a need to acquire separate land outside the project area for the use of machineries such as crushing plants? If so, then appropriate land acquisition process must be conducted.	2. CDCL informed that no separate land will be acquired for the use of machineries during the construction stage. All machineries will be operated within the project premises.
	3. Where are the utility spaces like STP, WTP, etc. located in the master plan?	3. CDCL informed that each zone has its own public utility spaces allocated in the master plan.

Following the Question & Answer (Q&A) session, the Director, Department of Engineering & Construction, CDCL thanked all the public and stakeholders for taking out their time and attending the meeting. He thanked the floor for overwhelming participation and for the interactive Q&A session.
The meeting was officially concluded at 1:07 PM followed by Lunch.

(Tshering Dupchu)
General Manager
Infra Division

(Reezang Wangdi)
Director
Department of Engineering and Construction

(Phuntsho Gyeltshen)
Chief Executive Officer

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Presentation and stakeholders' meeting on Hydrology and Hydraulic study of ALDTP

List of participants and photos will be made available in request basis

REPORT ON
PRESENTATION AND STAKEHOLDERS' MEETING
ON HYDROLOGY AND HYDRAULIC STUDY OF
AMOCHU LAND RECLAMATION AND TOWNSHIP DEVELOPMENT (ALRTP)

Date & Time :May 19, 2014; 1000-1300 HRS
Venue :Druk Hotel, Phuentsholing

I. Brief Background on the ALRTP

The Amochhu Land Reclamation and Township Project (ALRTP) was initially conceived by the Ministry of Works and Human Settlement to address the danger of flooding at the western front of Phuentsholing Town. Past piecemeal attempts to protect the riverbanks have achieved limited success and a long-term solution is required in order to protect Phuentsholing town from flooding. Phuentsholing is also very congested and there is no room for expansion despite huge commercial potential. Therefore, a holistic integrated approach of using the flood protection embankments to reclaim land in order to create additional land for expansion has been studied.

In 2007, a Detailed Feasibility Study and Engineering Design titled **"Toorsa River Flood Mitigation Project,"** was conducted by MoWHS with support from Danida.

Later, the Ministry of Works and Human Settlement (MoWHS), Royal Government of Bhutan handed over the project to Druk Holding and Investments (DHI) to take up the ALRTP which is now being undertaken by DHI INFRA, a subsidiary company of DHI.

DHI engaged Infrastructure Leasing & Financial Services limited (IL & FS) a company based in Kolkata to carry out a feasibility study. Before the feasibility was completed by IL&FS, the consultancy contract had to be terminated owing to development of Amochu Hydro Electric Project (AHEP) upstream. After the detailed project report (DPR) on AHEP was completed and the report was made available, DHI INFRA was necessitated to engage DHI India again to revisit and revise the Hydrological and Hydraulic Studies for ALRTP taking the hydropower project upstream into consideration for any impact on the downstream.

II. Objectives of the Stakeholders' meeting

i. To share the outcome of the report on Revision of the Hydrological & Hydraulic studies.
ii. To provide opportunity to the stakeholders to raise their concerns.
iii. To update the stakeholders on the development of Amochu Land Reclamation & Town Ship Project.
iv. To provide a direct interaction opportunity between stakeholders and experts

III. Stakeholders

The stakeholders invited for the presentation and meeting were from:

1. The Consulate General of India, Phuenthsoling.
2. Phuentsholing Thromde.
3. Druk Holding & Investment (DHI).
4. National Land Commission Secretariat.
5. National Environment Commission Secretariat.
6. Ministry of Works & Human Settlement, Thimphu.
7. Department of Road, MoWHS, Phuentsholing.
8. Phuenthsoling Dungkhag
9. Land owners/ representatives of the land holding in the project area.

The list of the officials who attended the meeting is attached for reference.

IV. Opening address by the Chief Executive Officer, DHI INFRA

Background:

The Chief Executive Officer, DHI INFRA after welcoming the participants, informed about how the project was initially conceived. He said that the objective of the project was initially to explore measures to protect Phuentsholing city from floods. He said that as a result of flood protection and river training works about 865 acres of land would be reclaimed. Therefore, a study on Amochhu Flood Management and Land Reclamation Project was conducted in 2007 by Danish Hydraulic Institute (DHI), India represented by Dr. Jacopson Fleming and Mr. Abrupan.

Finalization of LAP:

Since about 70 acres of private land falls within the project area, relocation of these land has been studied and proposed. In the absence of the sufficient manpower in Phuentsholing Thromde, DHI INFRA prepared the Local Area Plan (LAP) and submitted to Phuentsholing Thromde for implementation.

Hydro Power Project and its Closure:

Meanwhile, the Amochu Hydro Electric Project (AHEP) came into limelight whose project site is located just upstream of the ALRTP. This created the need for a revision of hydrological and hydraulic studies which was conducted earlier by DHI-India. Therefore, to revise the Hydrological and Hydraulic Studies-2007, the same firm, DHI-India was engaged at a cost of about Nu 5.00 million. The scope of the works were basically to study influence on the original design of the project by introduction of the hydropower project upstream and update hydrology analysis with the available additional data.

The CEO informed that although, the Amochu Hydro Electric Project was stalled for quite some time, the consultant was not informed of that decision until the day of the presentation at Phuentsholing.

This was deliberately done to avoid any influence to the study and moreover the hydropower could be taken up anytime.

Purpose of the Presentation:
The CEO informed that the main purpose of the presentation was to disseminate information on the impacts resulted by the study of hydrology with AHEP scenario. The study was mainly focused on the discharge of river, the sediments and the morphological changes that would come as a result of the river protection and river training works.

Way forward:
Soon after the hydrological and hydraulic studies is completed, detailed design of the town would be carried out. In fact, it has already been initiated.
The EIA study for ALRTP would follow soon. The hydrological and hydraulic studies will form the central essence of the EIA study.

V. Key Note address by the Dasho Thrompon, Phuentsholing Thromde

Dasho Thrompon in his key note address, informed the meeting that the presentation was on core technical study on the hydrology, hydraulics and morphology of Amochhu. The experts would touch on impacts on the riverbanks and protection measures considered. He therefore, said it was important that all stakeholders paid due attention to the presentation and ask the relevant questions. He was convinced having interacted with the experts that there were no negative impacts from the project to the Phuentsholing city or on the Indian side. He mentioned that within the one and half years of what is left of his tenure as the Mayor, he would consider it his good fortune if the project, which is obviously the best for Phuentsholing city, could take off. He urged the stakeholders to support the project for speedy implementation.

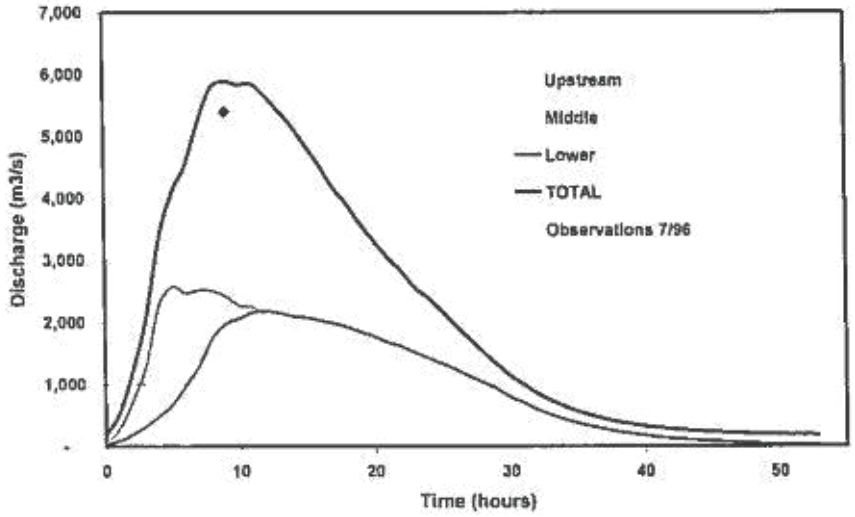
VI. Presentation

The revision of Hydrological and Hydraulic Study was conducted by DHI-India consultants and therefore they were called to make the presentation of their findings.

The main points featured in the presentation were as follows:

- The objective of this project would be the re-evaluation of flood management and land reclamation study done by DHI in 2007 duly accommodating the impact of Amochhu Hydroelectric Project (AHEP).
- The Amochhu has its source from Mount Pauhunri (7,128mAMSL) on the Indo-Sino border. The catchment area down to Hasimara (India) gauging station in India is 4,006 km².
- The area of permanent snow cover is 348 km². The net rain fed area up to Hasimara is 3,658 km

- Comparison between 50 yr Flood and Highest Recorded at Hasimara :



OBSERVED = 5,397 m³/s	ANALYSIS STATISTICAL	SYNTHETIC
50 YEAR	5,355 m /s	5,900 m /s
100 YEAR	6,695 m /s	7,100 m /s

Summary of design flood

The conclusion of the Revision of Hydrology and Hydraulic Study is as follows:

- It is seen due to Amochhu HEP maximum flood moderation of 11% will occur. To achieve that 2 m rise in water level above FRL need to be allowed. This decision can be taken after discussion with Dam monitoring authority. A close monitoring between dam monitoring authority and ALRP committee is also necessary.
- The waterway of 300 m was decided and tested in the mathematical model and was finalized. This waterway was evolved during the field observations. The observations indicated the narrowest waterway found in the vicinity of the study reach No erosion was observed on both the banks in that reach. It is known that the highest observed flood at Hashimara gauging site was 5,397 m³/s in the year 1996. No signs of erosion were observed during the inspections of site. Therefore, the waterway of 300 m was taken as a stable waterway for the river in that reach. It may be noted that the process of evolving the stable waterway was fully based on the field observations, and subsequently confirmed by the mathematical model studies. Therefore, the changes in the design discharges, if any, cannot be co-related to the waterway provided in the design.

- The protection works of both banks was designed using the highest velocities and intensities of discharge observed in the mathematical model. These were the maximum values observed in the model within the specific reaches. It was also observed during mathematical model runs that the changes in the river discharge did not show any significant changes in the velocities and intensity of discharges. The protection works are evolved on the basis of the overall maximum values observed in a specific reach, and not on the parameters from section-to-section. Therefore, the design of protection works will not go any significant change due to small changes in the river discharges
- The discharge observations are made only once a day at 8·00am and may miss the actual peak discharge, which could occur during night or later in the day.
- Some of the major flood peaks are calculated from the rating curves developed for the sites with unstable controls. The discharge may be in error up to 30 . For example, the peak at Hasimara in 1996 is actually observed at 5,397m /s, and corresponds to a lower stage compared to the next highest discharge of 3,800m³/s in 2000, which is derived from a rating curve.
- At present in the river bed, there is a small overall trend towards erosion in Bhutan, around 0.2m from the river bed per annum, with corresponding deposition in India around 0.02m per annum
- With the river constrained by flood and bank protection works, there is slightly reduced erosion in the reach in Bhutan, with slight reduction in deposition in India.
- It is feasible in hydraulic and morphologic terms to constrain the river within a width of around 300m, in the present river bed. A flood with a recurrence interval of 50 years will pass without spilling over the banks.
- The impact of the works downstream in India will be minimal. The existing pattern of gradual erosion in Bhutan and corresponding deposition in India will continue, at a slightly decreased rate. While there will be a small increase in the average flow velocity immediately across the border, velocities along the left bank will be reduced.

VII. Key points raised during the question and answer session

1. ***The Chief Environment Officer, NEC sought clarifications about the total discharge and velocities on upstream and downstream of the project.***

   On Velocities - The consultant responded that the measurements were taken every 15 minutes during daylight hours at the depth of 1.50m on mid-section of the river with highest recorded at **2.2m/sec**. He however, said that 2006 turned out to be relatively dry year with a short flood season, with high velocities observed only during occasional flood events.

   On discharge - The Consultant said that the discharge observations were made at two gauging stations at Dorokha and Doyagang suspension bridge from 2004 to 2012 with a maximum recording of 1600 m /sec at Doyagang suspension bridge and 1400 m /sec at Dorokha. However, the maximum discharge at Hasimara, India has been observed **at 5,397 m³/sec** in 1996.

2. *The Counsel General raised his confusion on the 50 years project life cycle period and 50 years return period flood.*

   On this, the consultant clarified that the 50 years project life cycle referred to a period at the end of which the asset value of the project will become zero. It is just a period that has been considered for financial analysis. Whereas 50 year return period flood referred to the highest flood that could occur within a considered period of 50 years. It is a technical way of calculating a certain expected flood.

3. *From the land owner's side, Mr. Phuntsho Wangdi asked how much would be the reclaimed land area and what part of the reclaimed land would be usable for river training works.*

   On this, CEO, DHI-INFRA responded stating that 865 acres of land would be reclaimed by training the river, but only about 450 acres of land would be used for development. The remaining land would be used for recreation, open space, roads and other common facilities.

4. *Mr. Pema Gyeltshen, one of the land owner representative asked who would be the regulatory authority, how much time would be required for the project to complete and who would be the implementing agency.*

   CEO, DHI-INFRA responded stating that Phuentsholing Thromde would be the regulatory authority whereas DHI INFRA would be the implementing agency. The reclamation of land would take about 5 years. He also informed that the project could kick-start anytime soon if the land issues are resolved and receive the directives from the government/DHI.

5. *One of the land owners (Karma Jigme) pointed out that the delay in AHEP and ALRTP projects have caused delay in finalizing the LAP along the Amochu banks. This has caused delay in construction activities of the land owners.*

   The CEO, DHI-INFRA informed the meeting that due to shortage of manpower in Phuentsholing Thromde, DHI INFRA provided assistance in preparing the LAP for the relocated private land holdings and the LAP has been handed over to Phuentsholing Thromde for implementation.

   The Chief Urban Planner, PT informed that the draft final LAP is ready and very soon, a public consultation meeting would be called for finalizing the LAP. Further, he also clarified that the development activities along the banks has been put on hold since the LAP has to be integrated with the reclamation works and the decision on the alignment of Samtse - Phuentsholing is still being negotiated with DoR, MoWHS, though it is not part of the project area.

6. *Although it is said that there is no impact with Hydropower Project upstream with all the data that you have gathered, is it really safe to have Hydropower project above the settlement with the type of terrain in Bhutan and have you considered all types of natural calamities that may occur along Amochhu?*

   The consultant informed that the main purpose of revision of the study was to see how the discharge would change downstream due to Hydropower dam upstream the project. We have

already proved that in the earlier study in 2007 that channel size of 300m width and 5 meter depth would accommodate the 50year flood. The revision study was carried out to see if there is any reduction in the design of flood protection and river training works with the hydropower plant above so that the cost of the project could be brought down. However, the revision study also suggests that the original design of the channel remains unchanged even with the hydropower upstream.

7. ***The Consul General of India asked what type of software is used for conducting flood simulation and how reliable is the software.***

   The Consultant responded stating that the software called MIKE 11 was used for flood simulation. MIKE 11 is a professional engineering software tool for the simulation of hydrology, hydraulics, water quality and sediment transport in estuaries, rivers, irrigation systems and other inland waters.

   MIKE 11 is the preferred choice of professional river engineers when reliability, versatility, productivity and quality are concerned. MIKE 11 is also accepted by US Federal Emergency Management Agency for use in the National Flood Insurance Program.

8. ***The question was also raised whether the climate-change factor is taken into consideration.***

   The consultant informed that he has not covered climate change factor, however, the dame design has taken a lot of factors into consideration and therefore separate study on climate change may not be required. We have seen that although the 50 year flood is considered, we have tested and found that the system supports even for 100 year flood.

9. ***Mr. Passang Dorji, Director DHI said, the cost of the project in 2007 report was about Nu 3.7 billion and now it has changed to over Nu 5.00 billion although there is no substantial change in the design. Is this change occurred only due to inflation or there are some changes in the design?***

   The consultant informed that the increase in the project cost is mainly due to price escalation and inflation.

10. ***The Phuentsholing Thromde sought clarification whether the available reclaimed land of 865 acres includes 300m width channel. Also whether will there be any reduction in the channel width with the Hydropower plant upstream and have more reclaimed land?***

    It was clarified that the reclaimed land of 865 acres is excluding 300m width channel. The consultant also informed that considering the design parameters of the dam spillways and the storage capacity of the reservoir, reduction of 300m channel width is still not possible. Any reduction in the dimensions would create flood risks and flow changes downstream.

11. ***The Consul General said that somewhere in the presentation the consultant has said that there will be reduction of velocity on the left side of the river. Does it mean that velocity on the right side will increase and thereby further erode the hill slopes?***

The consultant clarified by showing the mathematical simulation graphs again that although there will be some differences in the velocity on left and right banks the changes were more or less same as the original river without the protection embankments. Therefore, the impacts on the sides as well as the Indian side would be minimum.

12. *NEC reminded that 30 m free zone has to be kept in mind while constructing physical structures like buildings, etc. which is required by the country's legislation.*

13. *Someone mentioned that people are thinking a tunnel through the Kaileshwar Hill would be a good option to eliminate flood risk, what would be your comments?*

The study does not cover investigations for tunnel alternative. However, according to the topographical situation of the site, a tunnel would create huge changes in the flow velocity and high cost to construct it.

Conclusion

The meeting was concluded at 1300 hrs. with a vote of thanks by the Offtg. General Manager, Business Development, DHI-NFRA

PHOTOGRAPHS

Appendix 32:
Air Quality Modelling Assessment of ALDTP

Selection of model type:

Air quality modelling for industrial, mining and related sources is effective way of promoting sustainable development and minimizes emissions to the atmosphere. The ALDTP is expected to generate pollutants, especially in the form of particulate matter. Generation will be from pre-construction stage, equipment mobilization, construction stage including various sub activities. Operational stage is also expected to generate air pollutants due to increase in vehicular movement.

During construction, it is anticipated that dust will be generated from different sites and activities although they cannot be classified as point or line sources. Line sources onsite would include movement of heavy goods vehicles along unpaved roads and such movements would also be construction site specific. Thus, an air quality model that will do justice to this project would be that, which caters to an unspecific emission over the entire area and will include all point and line sources.

The Inputs required for air quality modelling will include:

- Source and emission details
- Site specific meteorology data- Wind speed and Direction
- Receptor area- Cartesian grid

About the Software:

The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) was formed to introduce state-of-the-art modelling concepts into the EPA's air quality models. Through AERMIC, a modelling system, AERMOD, was introduced that incorporated air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain.

AMS/EPA Regulatory Model (AERMOD) is a steady-state plume model. It is designed to apply to source releases and meteorological conditions that can be assumed to be steady over individual modelling periods (typically one hour or less). AERMOD has been designed to handle the computation of pollutant impacts in both flat and complex terrain within the same modelling framework. In fact, with the AERMOD structure, there is no need for the specification of terrain type (flat, simple, or complex) relative to stack height since receptors at all elevations are handled with the same general methodology. To define the form of the AERMOD concentration equations, it is necessary to simultaneously discuss the handling of terrain.

AERMET is an input data processor that is one of the regulatory components of the AERMOD modelling system. It incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts.

Meteorological Parameters

Surface meteorological data at project site was collected for two season (December-February, 2016 and March-May 2016). The hourly meteorological data considered during this period were:

- Wind speed;
- Wind Direction;
- Ambient atmospheric temperature;
- Cloud cover;
- Relative Humidity;
- Precipitation;
- Following parameters were considered for dispersion modeling – Point source:
- Quantity of fuel;
- Emission rate of pollutants;
- Stack;
- Internal diameter at top of stack;
- Height of stack;
- Exit gas velocity;

- Exit gas temperature

Following parameters were considered for dispersion modeling –Line source:

- Length of road
- Width of road
- Silt content %
- Truck trip/day
- Vehicle movement per day

SOURCE OF EMISSION

Construction stage

Line Source: Emissions from the Movement of trucks for transportation of filling material from selected mine during construction stage were analyzed for their impacts on sensitive receptors using the ISCST 3 of the United States Environmental Protection Agency (USEPA). The line source algorithm is used. The input parameters used are given in below Table 9-40.

Table 9-40: Input data for line source modelling

Type of Road	Length of Road (km)	Width of road (m)	Silt Content (%)	No. of Trucks/day	TSPM Emission (gm/sec per m^2)
Paved	~1.15	6.0	5.5	250	0.00000375
Unpaved (Zone A + B)	~3.0	6.0	10	250	0.00000330
Unpaved (Zone C)	~4.5	6.0	5	250	0.00000203

Volume Source is not considered assuming that crushed gravels from mine site will be transported at construction site. Area source is not considered as there is no area source.

Operation stage

Point Source:

The stack details along with emission rate of Pollutants are given as Table 9-41.

Table 9-41: Stack details and emission rate of pollutants

Stack No.	Stack Attached to	Capacity	Stack Ht., m	Fuel Used	Fuel Consumption (Kg/Hr.)	SO2 Emitted, gm/sec	PM Emitted, gm/sec	NOx Emitted, gm/s
C1	**C2**	**C3**	**C4**	**C10**	**C11**	**C15**	**C20**	**C23**
Sub Station: 1								
1	DG sets-Working	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
2	DG sets-Standby	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
Sub Station: 2								
1	DG sets-Working	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
2	DG sets-Standby	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
Sub Station: 3								
1	DG sets-	315	30	ULS	55.04	0.0005	0.002	0.28

	Working	KVA		D				
2	DG sets-Standby	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
Sub Station: 4								
1	DG sets-Working	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
2	DG sets-Standby	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
Sub Station: 6								
1	DG sets-Working	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
2	DG sets-Standby	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
Sub Station: 7								
1	DG sets-Working	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
2	DG sets-Standby	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
Sub Station: 8								
1	DG sets-Working	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28
2	DG sets-Standby	315 KVA	30	ULSD	55.04	0.0005	0.002	0.28

Assumption

The dispersion modelling assumptions considered are as follows:

- The emission rate for SO2 was calculated based on 0. 0015% Sulphur content in the ULSD
- The emission rate for PM was calculated based on 0.01% ash content in the ULSD.
- The emission rate for NO_x was calculated based on MOEF&CC guideline for emission limit of 75 to 800 KW DG sets.
- The terrain of the study area was considered as FLAT.
- Stability class was evaluated based on solar insulation and cloud cover.
- The mathematical equations used for the dispersion modelling assumes that the earth surface acts as a perfect reflector of plume and physic-chemical processes such as dry and wet deposition and chemical transformation of pollutants are negligible.
- Study has been conducted for winter season 1st March, 2016 – 31st May, 2016.

Air Quality Dispersion Modelling Results

Emission from line source during Construction stage

Total Suspended Particulate MATTER (TSPM)

The results of incremental GLC for Total Suspended Particulate Matter (TSPM) for the above mentioned emissions is given in Table 9-42 and & Table 9-43. The Isopleths for the same is given in ***Figure-9-21 and Figure 9-22.***

Table 9-42: Periodical 24 Hour Maximum Incremental GLC of TSPM from Filling Material Transportation by Truck from Mines in Zone A+B (Constructions stage)

DIRECTION (DEGREES)	DISTANCE (METERS)												
	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000
10	2.4	2.7	2.0	1.5	1.4	1.5	1.5	1.6	1.6	1.6	2.2	4.2	4.0
20	2.4	2.8	2.2	1.6	1.5	1.5	1.5	1.6	1.6	1.5	2.8	6.8	4.8
30	2.4	2.8	2.3	1.8	1.6	1.6	1.5	1.6	1.6	1.6	3.6	15.2	7.4
40	2.3	2.9	2.6	2.0	1.8	1.8	1.9	1.9	1.9	1.9	4.5	30.4	8.5
50	2.2	2.9	2.8	2.2	1.9	1.8	1.9	1.9	2.0	2.0	5.7	74.4	19.5
60	2.1	2.8	2.9	2.6	2.1	1.8	1.8	1.8	1.9	1.9	10.9	35.0	14.2
70	2.0	2.5	2.9	2.9	2.7	2.3	1.9	1.8	1.9	1.9	10.0	37.2	21.5
80	2.1	2.2	2.6	2.9	3.1	3.0	2.8	2.6	2.3	2.3	9.2	52.0	13.7
90	2.1	2.1	2.2	2.3	2.6	2.9	3.1	3.3	3.5	3.7	9.7	61.0	13.6
100	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.6	2.9	3.7	7.9	41.0	22.4
110	2.1	2.2	2.3	2.5	2.6	2.8	2.9	2.9	3.2	3.6	7.1	20.9	11.0
120	2.1	2.3	2.5	2.6	2.5	2.1	1.4	1.9	3.0	3.4	6.4	23.6	4.8
130	2.1	2.4	2.5	2.2	1.4	1.3	1.2	1.7	2.6	3.2	5.7	22.0	5.4
140	2.2	2.4	2.3	1.4	1.2	1.2	1.2	1.4	2.0	2.9	4.9	30.7	5.7
150	2.2	2.4	1.9	1.2	1.1	1.2	1.2	1.2	1.6	2.1	3.8	12.5	24.3
160	2.2	2.4	1.5	1.2	1.1	1.1	1.1	1.2	1.2	1.5	3.5	4.3	17.8
170	2.3	2.3	1.2	1.1	1.1	1.1	1.1	1.1	1.2	1.2	2.6	3.0	3.8
180	2.3	2.2	1.1	1.1	1.0	1.1	1.1	1.1	1.1	1.1	2.0	2.3	2.6
190	2.2	2.2	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.1	1.3	1.4	1.9
200	2.2	2.2	1.2	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.0	1.1
210	2.2	2.2	1.4	1.1	1.1	1.0	1.0	1.0	1.0	1.0	0.9	1.0	0.8

220	2.2	2.3	1.7	1.1	1.1	1.1	1.0	1.0	1.0	1.0	0.8	0.7	0.7
230	2.1	2.3	2.0	1.2	1.1	1.1	1.1	1.0	1.0	1.0	0.8	0.7	0.6
240	2.1	2.2	2.2	1.7	1.1	1.1	1.0	1.0	0.9	0.9	0.7	0.6	0.5
250	2.0	2.1	2.2	2.1	1.8	1.4	1.0	0.9	0.9	0.9	0.7	0.6	0.4
260	2.0	2.0	2.1	2.1	2.1	2.0	1.9	1.7	1.4	1.2	0.6	0.6	0.5
270	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.8	1.8	1.4	0.7	0.5
280	2.0	1.9	1.9	1.8	1.8	1.7	1.7	1.6	1.6	1.6	1.3	0.9	0.8
290	2.0	1.9	1.8	1.7	1.6	1.6	1.6	1.6	1.7	1.7	1.1	0.8	0.8
300	1.9	1.8	1.9	1.9	1.9	1.9	1.7	1.5	1.4	1.3	1.0	0.9	0.9
310	1.9	2.1	2.2	2.0	1.8	1.5	1.3	1.3	1.3	1.3	1.0	1.1	2.2
320	1.9	2.3	2.2	1.8	1.4	1.3	1.3	1.3	1.3	1.4	1.2	2.1	1.1
330	2.1	2.5	2.1	1.5	1.4	1.3	1.3	1.4	1.4	1.4	1.7	1.8	1.6
340	2.2	2.6	2.0	1.4	1.4	1.4	1.4	1.4	1.5	1.6	1.4	1.6	1.3
350	2.3	2.6	1.9	1.4	1.4	1.4	1.4	1.4	1.7	1.8	1.6	2.5	2.8
360	2.4	2.6	1.9	1.4	1.4	1.4	1.4	1.5	1.7	1.8	2.5	2.1	2.3

Figure-9-21: Isopleth of 24 Hour Maximum Incremental GLC of Total Suspended Particulate Matter (TSPM) from Filling Material Transportation by Truck from Mines in Zone A+B (Constructions stage)

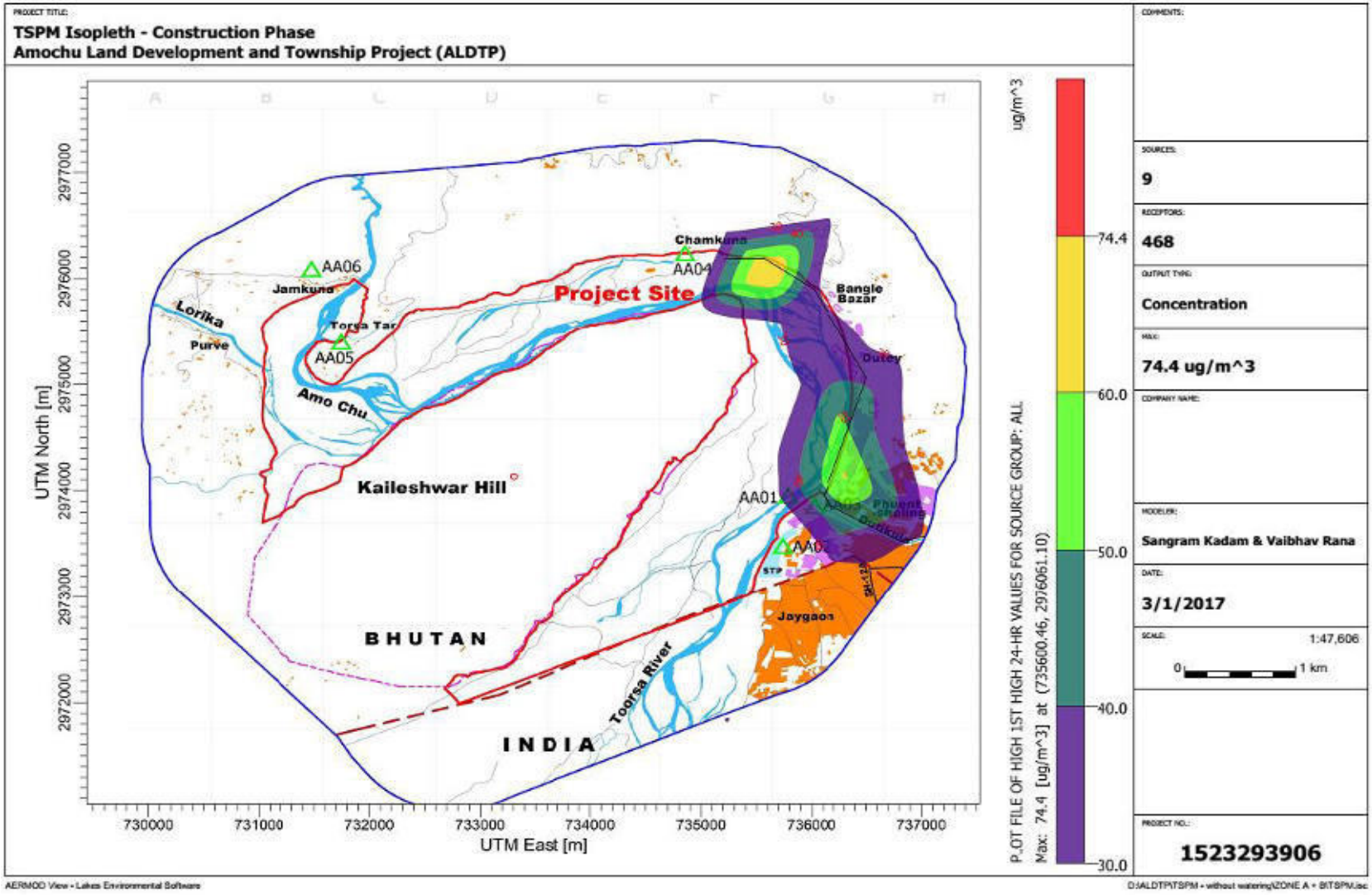
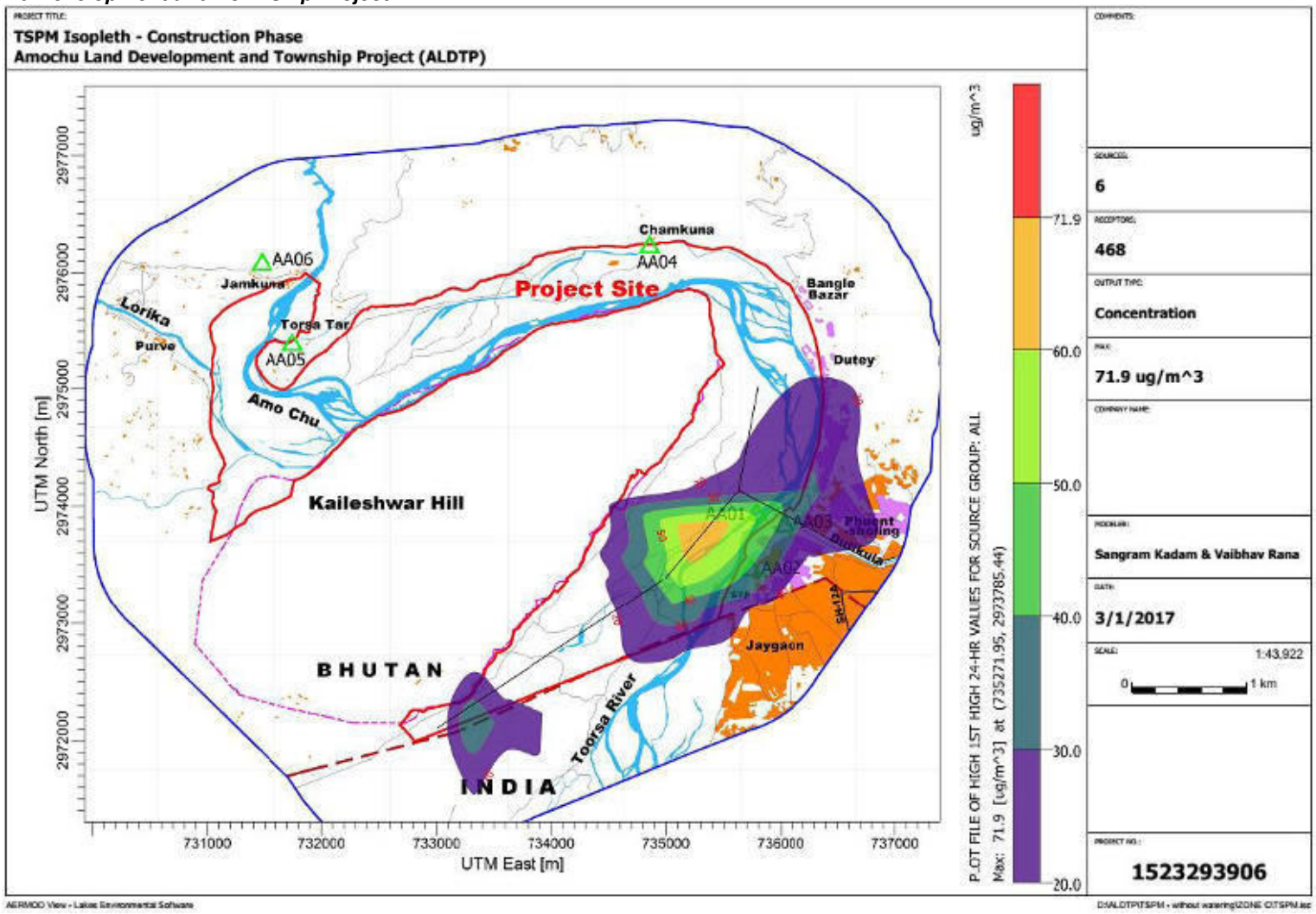

TSPM Isopleth - Construction Phase
Amochu Land Development and Township Project (ALDTP)
Project Site
Kaileshwar Hill
BHUTAN
INDIA
Chamkuna
Jamkuna
Torsa Tar
Lorika
Purve
Amo Chu
Bangle Bazar
Outer
Jaygaon
Toorsa River
AA01
AA04
AA05
AA06
STP
UTM North [m]
UTM East [m]
2977000
2976000
2975000
2974000
2973300
2972000
730000
731000
732000
733000
734000
735000
736000
737000
ug/m^3
74.4
60.0
50.0
40.0
30.0
P.OT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL
Max: 74.4 [ug/m^3] at (735600.46, 2976061.10)
COMMENTS:
SOURCES:
9
RECEPTORS:
468
OUTPUT TYPE:
Concentration
MAX:
74.4 ug/m^3
COMPANY NAME:
MODELER:
Sangram Kadam & Vaibhav Rana
DATE:
3/1/2017
SCALE:
1:47,606
0
1 km
PROJECT NO.:
1523293906
AERMOD View - Lakes Environmental Software
D:\ALDTP\TSPM - without watering\ZONE A + BKTSPM.isc

Table 9-43 : Periodical 24 Hour Maximum Incremental GLC of Total Suspended Particulate Matter (TSPM) from Filling Material Transportation by Truck from Mines in Zone A+B (Constructions stage

DIRECTION (DEGREES)	DISTANCE (METERS)												
	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000
10	2.4	2.7	2.0	1.5	1.4	1.5	1.5	1.6	1.6	1.6	2.2	4.2	4.0
20	2.4	2.8	2.2	1.6	1.5	1.5	1.5	1.6	1.6	1.5	2.8	6.8	4.8
30	2.4	2.8	2.3	1.8	1.6	1.6	1.5	1.6	1.6	1.6	3.6	15.2	7.4
40	2.3	2.9	2.6	2.0	1.8	1.8	1.9	1.9	1.9	1.9	4.5	30.4	8.5
50	2.2	2.9	2.8	2.2	1.9	1.8	1.9	1.9	2.0	2.0	5.7	74.4	19.5
60	2.1	2.8	2.9	2.6	2.1	1.8	1.8	1.8	1.9	1.9	10.9	35.0	14.2
70	2.0	2.5	2.9	2.9	2.7	2.3	1.9	1.8	1.9	1.9	10.0	37.2	21.5
80	2.1	2.2	2.6	2.9	3.1	3.0	2.8	2.6	2.3	2.3	9.2	52.0	13.7
90	2.1	2.1	2.2	2.3	2.6	2.9	3.1	3.3	3.5	3.7	9.7	61.0	13.6
100	2.1	2.2	2.2	2.3	2.4	2.4	2.5	2.6	2.9	3.7	7.9	41.0	22.4
110	2.1	2.2	2.3	2.5	2.6	2.8	2.9	2.9	3.2	3.6	7.1	20.9	11.0
120	2.1	2.3	2.5	2.6	2.5	2.1	1.4	1.9	3.0	3.4	6.4	23.6	4.8
130	2.1	2.4	2.5	2.2	1.4	1.3	1.2	1.7	2.6	3.2	5.7	22.0	5.4
140	2.2	2.4	2.3	1.4	1.2	1.2	1.2	1.4	2.0	2.9	4.9	30.7	5.7
150	2.2	2.4	1.9	1.2	1.1	1.2	1.2	1.2	1.6	2.1	3.8	12.5	24.3
160	2.2	2.4	1.5	1.2	1.1	1.1	1.1	1.2	1.2	1.5	3.5	4.3	17.8
170	2.3	2.3	1.2	1.1	1.1	1.1	1.1	1.1	1.2	1.2	2.6	3.0	3.8
180	2.3	2.2	1.1	1.1	1.0	1.1	1.1	1.1	1.1	1.1	2.0	2.3	2.6
190	2.2	2.2	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.1	1.3	1.4	1.9
200	2.2	2.2	1.2	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.0	1.1
210	2.2	2.2	1.4	1.1	1.1	1.0	1.0	1.0	1.0	1.0	0.9	1.0	0.8

220	2.2	2.3	1.7	1.1	1.1	1.1	1.0	1.0	1.0	1.0	0.8	0.7	0.7
230	2.1	2.3	2.0	1.2	1.1	1.1	1.1	1.0	1.0	1.0	0.8	0.7	0.6
240	2.1	2.2	2.2	1.7	1.1	1.1	1.0	1.0	0.9	0.9	0.7	0.6	0.5
250	2.0	2.1	2.2	2.1	1.8	1.4	1.0	0.9	0.9	0.9	0.7	0.6	0.4
260	2.0	2.0	2.1	2.1	2.1	2.0	1.9	1.7	1.4	1.2	0.6	0.6	0.5
270	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.8	1.8	1.4	0.7	0.5
280	2.0	1.9	1.9	1.8	1.8	1.7	1.7	1.6	1.6	1.6	1.3	0.9	0.8
290	2.0	1.9	1.8	1.7	1.6	1.6	1.6	1.6	1.7	1.7	1.1	0.8	0.8
300	1.9	1.8	1.9	1.9	1.9	1.9	1.7	1.5	1.4	1.3	1.0	0.9	0.9
310	1.9	2.1	2.2	2.0	1.8	1.5	1.3	1.3	1.3	1.3	1.0	1.1	2.2
320	1.9	2.3	2.2	1.8	1.4	1.3	1.3	1.3	1.3	1.4	1.2	2.1	1.1
330	2.1	2.5	2.1	1.5	1.4	1.3	1.3	1.4	1.4	1.4	1.7	1.8	1.6
340	2.2	2.6	2.0	1.4	1.4	1.4	1.4	1.4	1.5	1.6	1.4	1.6	1.3
350	2.3	2.6	1.9	1.4	1.4	1.4	1.4	1.4	1.7	1.8	1.6	2.5	2.8
360	2.4	2.6	1.9	1.4	1.4	1.4	1.4	1.5	1.7	1.8	2.5	2.1	2.3

Figure 9-22: Isopleth of 24 Hour Maximum Incremental GLC of Total Suspended Particulate Matter (TSPM) from Filling Material Transportation by Truck from Mines in Zone C (Constructions phase)



Emission from point source during operation stage

Particulate Matter (PM10)

The results of incremental GLC for Particulate Matter (PM10-0) for the above mentioned emissions in Table 9-44 . The Isopleth for the same is given as Figure 9-23.

Table 9-44: Incremental GLC of Particulate Matter (PM10) from Flue Gas Stacks (Fuel-ULSD) (Operation stage)

DIRECTION	**DISTANCE (METERS)**																						
(DEGREES)	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1500**	**2000**	**2500**	**3000**	**3500**	**4000**
10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
20	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01
30	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01
40	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.03	0.02	0.01
50	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

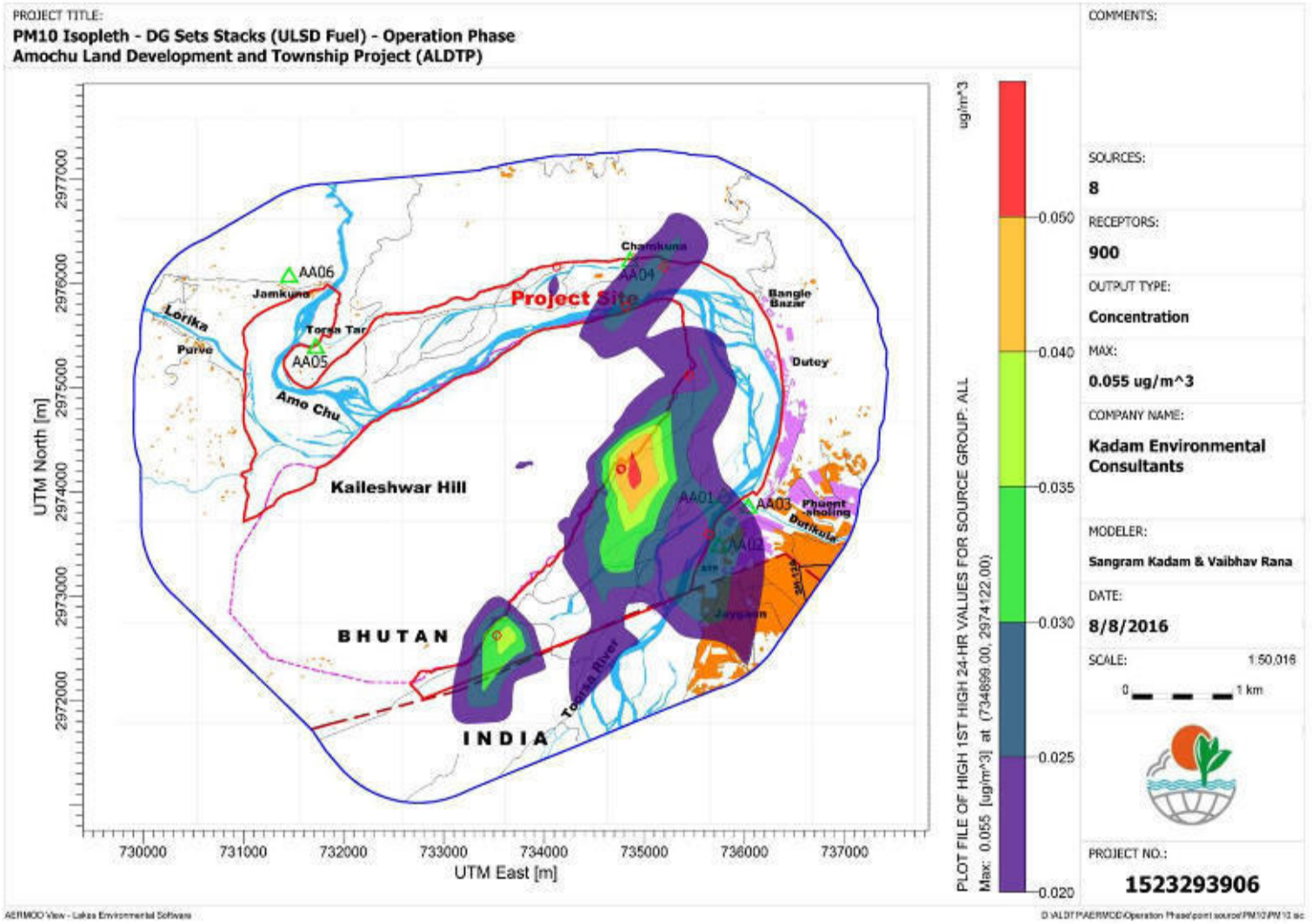
	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1	2	1	1	1	2	2	3	2	1	1
70	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.02	0.03	0.03	0.01	0.01	0.01
80	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.05	0.03	0.02	0.02	0.01	0.01
90	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.06	0.03	0.02	0.01	0.01	0.01
100	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.03	0.02	0.01	0.01
110	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.02
120	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.04	0.02	0.03	0.02	0.01	0.01
130	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02
140	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01

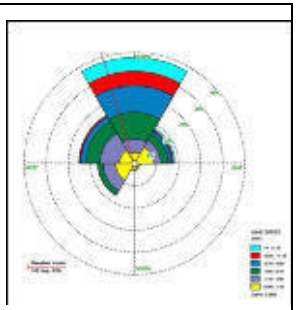
150	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01
160	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01
170	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.02	0.01	0.02	0.02	0.02	0.02
180	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.02	0.01	0.01	0.01	0.01
190	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01
200	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.02
210	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
220	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02
230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
240	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
250	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
260	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
270	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
280	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
290	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
300	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01
310	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.02	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.00	0.01	0.11	0.00
320	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.02	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.01	0.11	0.01
330	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.02	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.01	0.11	0.01
340	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.02	0.22	0.02	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.01	0.00	0.00
350	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.02	0.22	0.02	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.01	0.00	0.00
360	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.02	0.22	0.02	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.11	0.01	0.01	0.00	0.00

Figure 9-23: Isopleth of Incremental GLC of Particulate Matter (PM10) from Flue Gas stacks (fuel-ULSD) (Operation stage)


PROJECT TITLE:
PM10 Isopleth - DG Sets Stacks (ULSD Fuel) - Operation Phase
Amochu Land Development and Township Project (ALDTP)
UTM North [m]
UTM East [m]
2977000
2976000
2975000
2974000
2973000
2972000
730000
731000
732000
733000
734000
735000
736000
737000
AA01
AA02
AA03
AA04
AA05
AA06
Project Site
Kaileshwar Hill
Jamkuna
Lorika
Purve
Torsa Tar
Amo Chu
Chamkuna
Bangle Bazar
Dutey
Phuent-sholing
Dutikola
Jaysan
Torsa River
BHUTAN
INDIA
ug/m^3
0.050
0.040
0.035
0.030
0.025
0.020
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL
Max: 0.055 [ug/m^3] at (734699.00, 2974122.00)
COMMENTS:
SOURCES:
8
RECEPTORS:
900
OUTPUT TYPE:
Concentration
MAX:
0.055 ug/m^3
COMPANY NAME:
Kadam Environmental Consultants
MODELER:
Sangram Kadam & Vaibhav Rana
DATE:
8/8/2016
SCALE:
1:50,016
0
1 km
PROJECT NO.:
1523293906



Oxide of Sulphur (SO2)

The results of incremental GLC for Oxides of Sulphur (SO2) for the above mentioned emissions in Table 9-46. The Isopleth for the same is given as Figure 9-24.

Table 9-45: Incremental GLC of Oxides of Sulphur Dioxide (SO2) from Flue Gas stacks (fuel-ULSD) (Operation stage)

DIRECTION	**DISTANCE (METERS)**																							
(DEGREES)	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1500**	**2000**	**2500**	**3000**	**3500**	**4000**
10	0.0001	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0010	0.0000	0.0000	0.0000	0.0000
20	0.0001	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0022	0.0011	0.0011	0.0011	0.0011
30	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	2	2	2	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	2	2	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	2	2	2	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	2	4	2	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	2	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	3	2	2	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	3	2	2	2	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	2	2	2	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
130	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2	1	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
170	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1	2	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

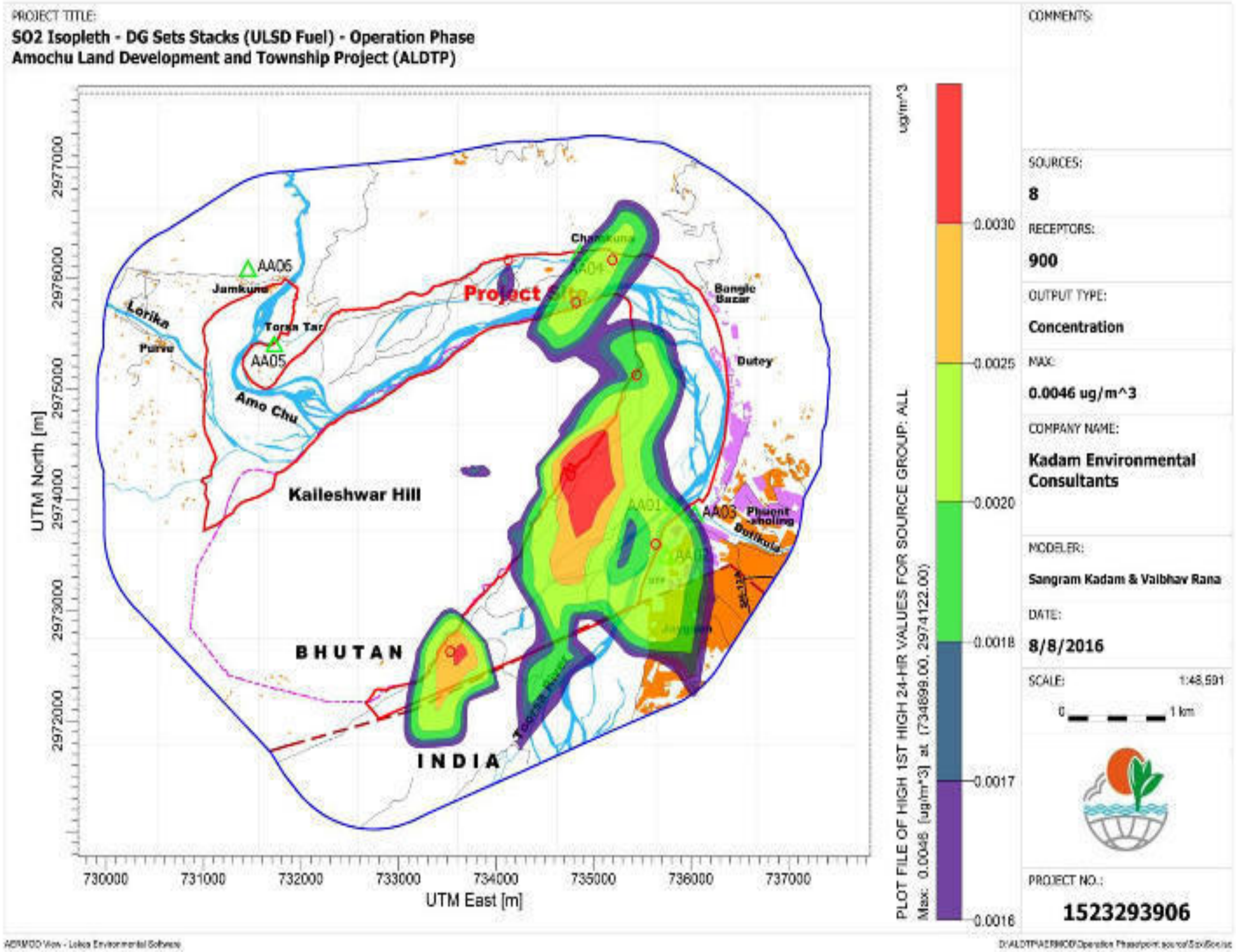
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
190	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
210	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
220	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

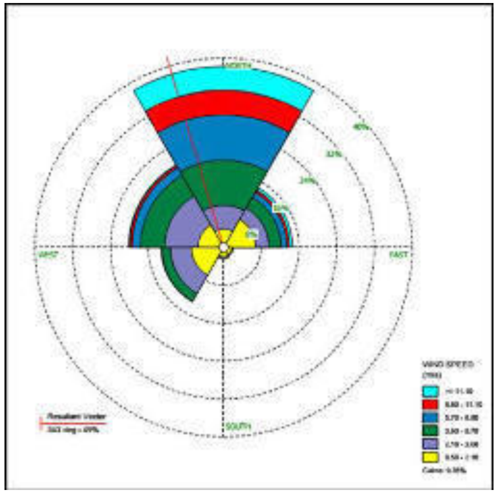
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
240	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
270	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
280	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
290	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
310	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
360	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0

Figure 9-24: isopleth of Incremental GLC of Oxides of Sulphur dioxide (SO2) from Flue Gas stacks (fuel-ULSD) (Operation stage)


PROJECT TITLE:
SO2 Isopleth - DG Sets Stacks (ULSD Fuel) - Operation Phase
Amochu Land Development and Township Project (ALDTP)
UTM North [m]
UTM East [m]
730000
731000
732000
733000
734000
735000
736000
737000
2972000
2973000
2974000
2975000
2976000
2977000
AA06
Jamkuna
Lorika
Torsa Tar
AA05
Amo Chu
Project Site
AA04
Bangle Bazar
Dutey
Kaileshwar Hill
AA01
AA03
Phuentsholing
BHUTAN
INDIA
ug/m^3
0.0030
0.0025
0.0020
0.0018
0.0017
0.0016
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL
Max: 0.0046 [ug/m^3] at (734899.00, 2974122.00)
COMMENTS:
SOURCES:
8
RECEPTORS:
900
OUTPUT TYPE:
Concentration
MAX:
0.0046 ug/m^3
COMPANY NAME:
Kadam Environmental Consultants
MODELER:
Sangram Kadam & Vaibhav Rana
DATE:
8/8/2016
SCALE:
1:48,591
0
1 km
PROJECT NO.:
1523293906
AERMOD View - Lakes Environmental Software


NORTH
SOUTH
WEST
EAST

Oxides of Nitrogen (NO_x)

The results of incremental GLC for Oxides of Nitrogen (NO_x) for the above mentioned emissions in Table 9-46. The Isopleth for the same is given as Figure 9-25.

Table 9-46: Incremental GLC of Oxides of Nitrogen (NO_x) from Flue Gas stacks (fuel-HSD) (Operation stage)

DIRECTION	**DISTANCE (METERS)**																						
(DEGREES)	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**200**	**300**	**400**	**500**	**600**	**700**	**800**	**900**	**1000**	**1500**	**2000**	**2500**	**3000**	**3500**	**4000**
10	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.5	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.5	0.4	0.3	0.2	0.2	0.2
20	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.8	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.7	1.0	0.7	0.4	0.3	0.3
30	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.8	0.6	0.6	0.7	0.7	0.6	0.5	0.6	0.7	0.8	0.8	0.6	0.4	0.5	0.5
40	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.7	0.6	0.7	0.7	0.7	0.6	0.6	0.7	0.8	1.3	1.3	1.2	0.7	0.5
50	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.9	0.8	0.6	0.7	0.7	0.7	0.6	0.6	0.7	0.8	0.9	0.8	0.8	0.6	0.5
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.	0.	0.	1.	0.	0.	0.

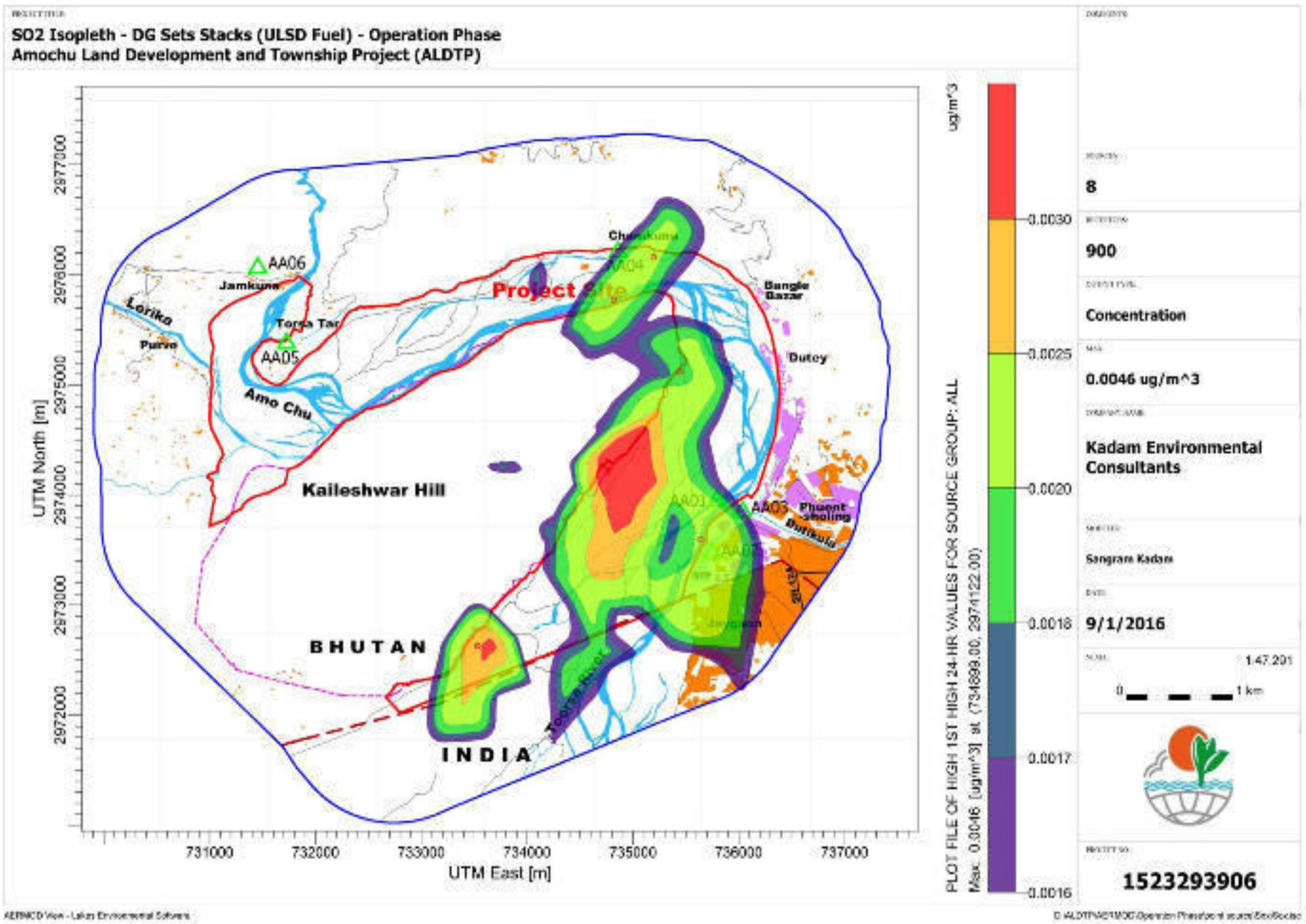
	.5	.5	.5	.5	.5	.6	.6	.6	.6	.6	.8	.9	.9	.7	.7	.7	.6	.6	7	8	9	2	7	6	5
70	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.8	0.9	1.0	1.0	0.7	0.6	0.7	0.7	0.6	1.0	1.4	1.2	0.6	0.6	0.5
80	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.8	0.9	0.9	0.9	0.7	0.6	0.7	0.9	2.3	1.2	0.8	0.8	0.6	0.7
90	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.5	0.5	0.6	0.6	0.8	2.6	1.2	0.8	0.6	0.6	0.5
100	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.8	0.8	1.0	1.9	1.0	1.3	0.8	0.6	0.5
110	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.8	0.8	0.9	1.1	1.6	1.0	1.3	0.9	0.8	0.7
120	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.9	1.0	1.0	1.6	1.1	1.4	1.0	0.7	0.5
130	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.8	0.9	0.8	0.9	1.3	0.8	0.8	0.8	0.8	0.8
140	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.8	0.9	1.1	0.6	0.6	0.5	0.6

	5	5	5	5	5	5	5	5	5	5	5	5	6	6	7	8	7	7							
150	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.7	0.7	0.7	0.7	1.1	0.8	0.5	0.5	0.4
160	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.9	0.8	0.9	0.8	0.6	0.5
170	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	1.8	0.8	0.7	0.7	0.8	0.8
180	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	1.4	1.4	0.7	0.6	0.6	0.5
190	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8	0.9	0.8	0.6	0.6	0.5
200	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.7	0.8	0.8	0.8	0.9
210	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.6	0.7
220	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8

230	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6
240	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.7	0.7	0.7	0.7	0.6
250	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.4	0.4
260	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3
270	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3
280	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.3	0.3	0.3	0.3	0.3
290	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.6	0.6	0.6	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2
300	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.6	0.5	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.3
310	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.	0.	0.	0.	0.	0.	0.

	.5	.5	.5	.5	.5	.6	.6	.6	.6	.6	.7	.7	.6	.4	.4	.4	.4	.4	4	3	2	2	3	3	2
320	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.3	0.2	0.4	0.3	0.3	0.3
330	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.3	0.3	0.4	0.3	0.3	0.2
340	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.1
350	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.2	0.1	0.1
360	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.5	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.1	0.1	0.1

Figure 9-25: Isopleth for Incremental GLC of Oxides of Nitrogen (NO_x) from Flue Gas stacks (fuel-ULSD) (Operation stage)


SO2 Isopleth - DG Sets Stacks (ULSD Fuel) - Operation Phase
Amochu Land Development and Township Project (ALDTP)
UTM North [m]
UTM East [m]
Project Site
Kaileshwar Hill
BHUTAN
INDIA
Amo Chu
Jamkuna
Torsa Tar
Lorika
Purve
Chamkuna
Bangle Bazar
Dutey
Phuent sholing
AA01
AA03
AA04
AA05
AA06
ug/m^3
PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL
Max: 0.0046 [ug/m^3] at (734899.00, 2974122.00)
0.0030
0.0025
0.0020
0.0018
0.0017
0.0016
8
900
Concentration
0.0046 ug/m^3
Kadam Environmental Consultants
Sangram Kadam
9/1/2016
1:47,201
0
1 km
1523293906