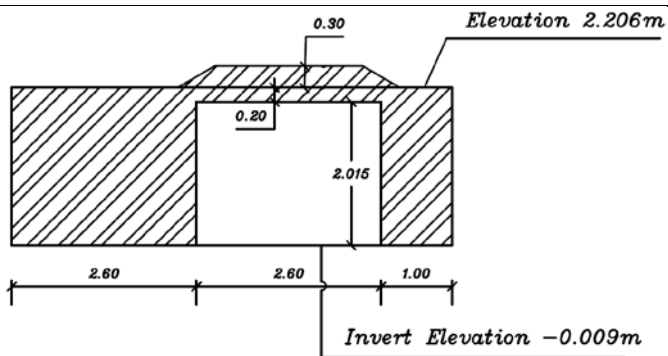


3.3.8 Madiwela South Diversion

ID: MSD-1	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 5+582		
COORDINATE	E		N
	79.915276		6.822245
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



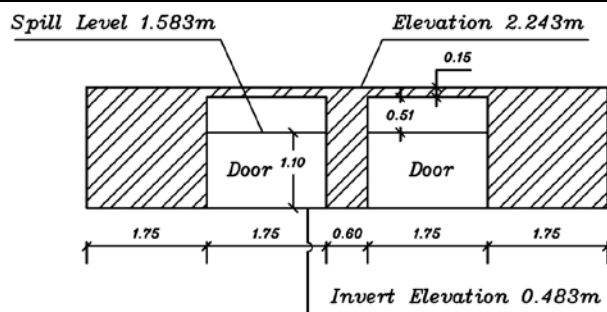
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: MSD-2	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Anicut at 5+151		
COORDINATE	E		N
	79.918777		6.823825
PURPOSE	Anicut		
OPERATION	broken		

DRAWING



(Source: JICA 2003 M/P Report)

SITE CONDITION



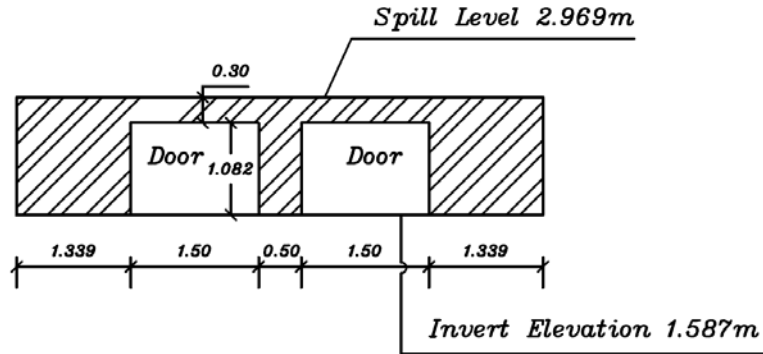
ID: MSD-3	JICA 2003 M/P	SLDC 2017	2018 F/S
	Anicut at 4+739		
COORDINATE	E		N
	79.921356		6.826121
PURPOSE	Anicut		
OPERATION	broken		
DRAWING			
<p style="text-align: center;">(Source: JICA 2003 M/P Report)</p>			

SITE CONDITION



ID: MSD-4	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Anicut at 4+117		
COORDINATE	E		N
	79.926079		6.828120
PURPOSE	Anicut		
OPERATION	in use		

DRAWING



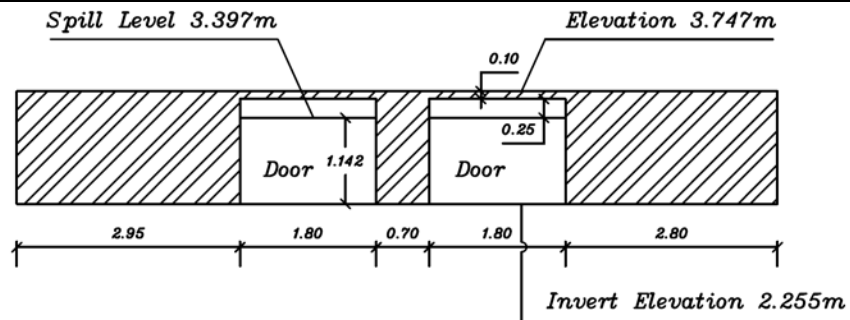
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: MSD-5	JICA 2003 M/P	SLDC 2017	2018 F/S
	Anicut at 3+630		
COORDINATE	E		N
	79.929191		6.830515
PURPOSE	Anicut		
OPERATION	in use		

DRAWING



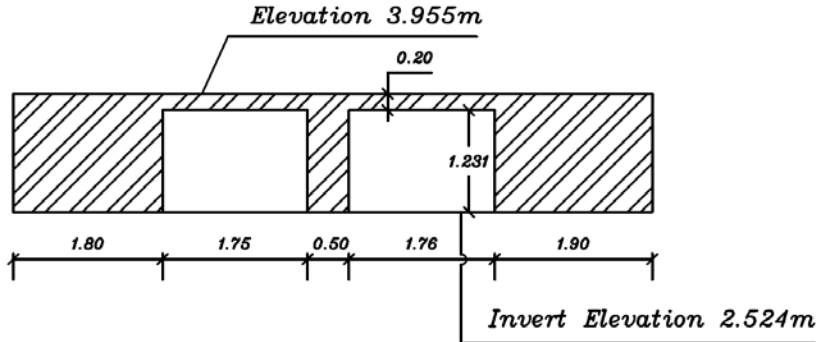
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: MSD-6	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Culvert at 3+277		
COORDINATE	E		N
	79.931744		6.832308
PURPOSE	Culvert		
OPERATION	in use		

DRAWING



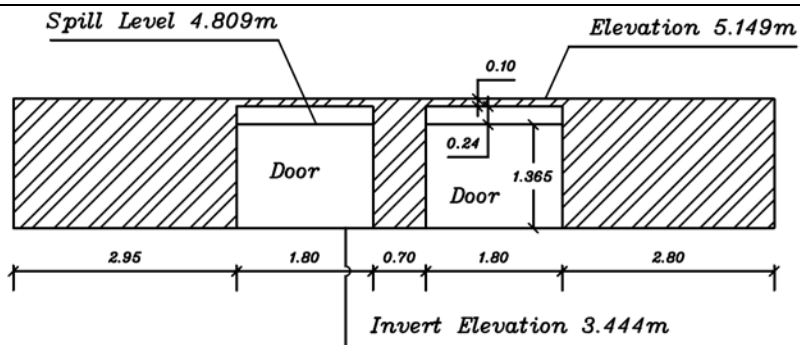
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: MSD-7	JICA 2003 M/P	SLDC 2017	2018 F/S
	Anicut at 2+961		
COORDINATE	E		N
	79.934310		6.833521
PURPOSE	Anicut		
OPERATION	in use		

DRAWING



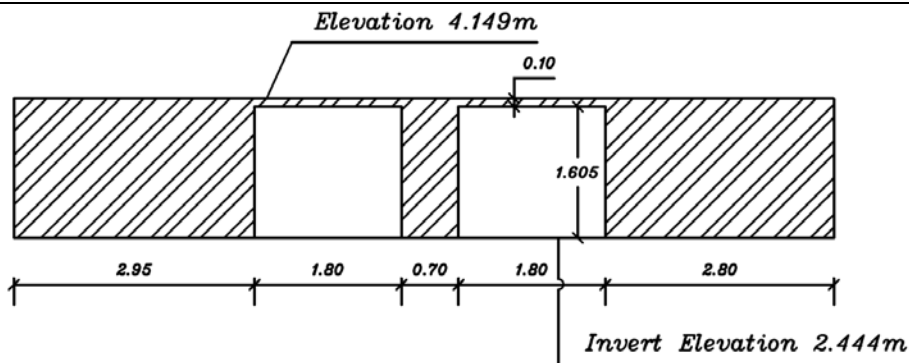
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: MSD-8	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Culvert at 2+900		
COORDINATE	E		N
	79.934814		6.833667
PURPOSE	Culvert		
OPERATION	in use		

DRAWING



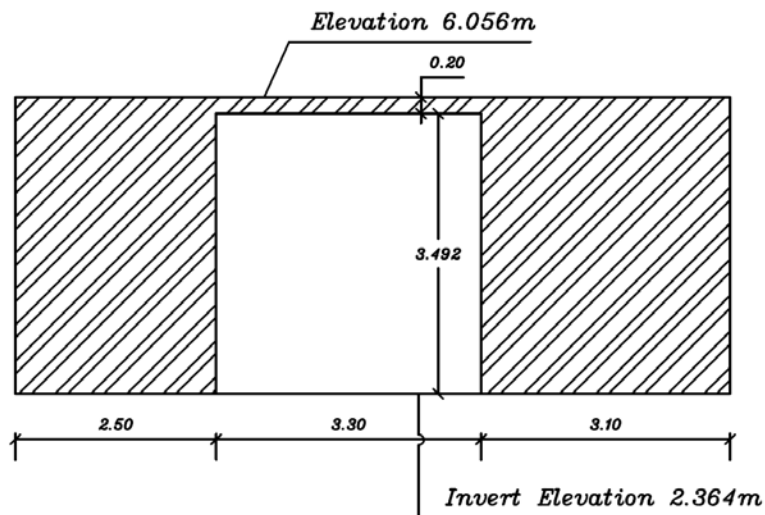
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: MSD-9	JICA 2003 M/P	SLDC 2017	2018 F/S
	Anicut at 2+854		
COORDINATE	E		N
	79.935288		6.833840
PURPOSE	Anicut		
OPERATION	Not confirmed		

DRAWING



(Source: JICA 2003 M/P Report)

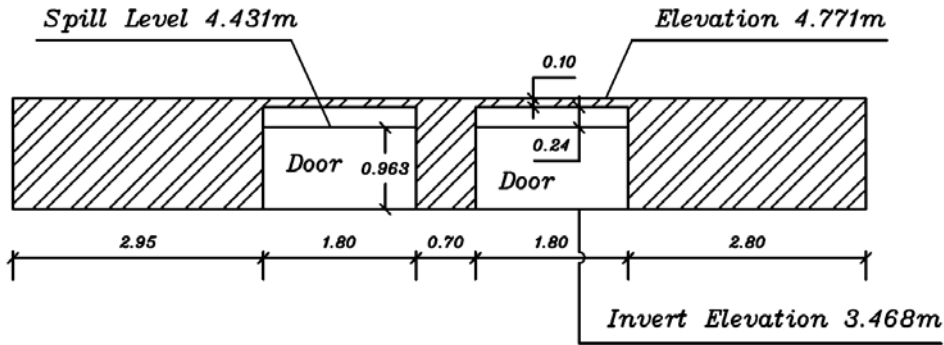
SITE CONDITION



No accessN

ID: MSD-10	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Anicut at 2+622		
COORDINATE	E		N
	79.937233		6.833992
PURPOSE	Anicut		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: MSD-11	JICA 2003 M/P	SLDC 2017	2018 F/S
	Culvert at 2+572		
COORDINATE	E		N
	79.937642		6.833975
PURPOSE	Gate for flood control		
OPERATION	in use		
DRAWING			
(Source: JICA 2003 M/P Report)			

SITE CONDITION

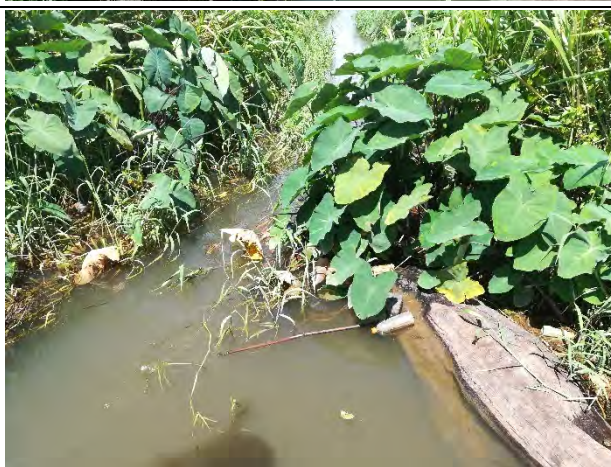




ID: MSD-12	JICA 2003 M/P	SLDC 2017	2018 F/S
	Culvert at 1+795		
COORDINATE	E		N
	79.943193		6.832808
PURPOSE	Gate for flood control		
OPERATION	No longer exist (since 2004)		
DRAWING			
<p style="text-align: center;">Elevation 6.233m</p> <p style="text-align: center;">0.10</p> <p style="text-align: center;">0.82</p> <p style="text-align: center;">1.00 3.20 1.00</p> <p style="text-align: center;">Invert Elevation 5.313m</p> <p style="text-align: center;">(Source: JICA 2003 M/P Report)</p>			
SITE CONDITION			

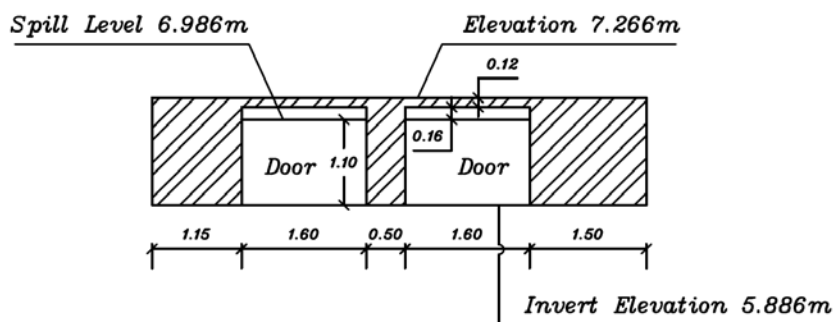
ID: MSD-13	JICA 2003 M/P	SLDLC 2017	2018 F/S
COORDINATE	E		N
	79.943727		6.832835
PURPOSE	Gate for flood control		
OPERATION	in use		
DRAWING			
(No drawing was shown in JICA 2003 M/P Report.)			

SITE CONDITION



ID: MSD-14	JICA 2003 M/P	SLDC 2017	2018 F/S
	Anicut at 1+350		
COORDINATE	E		N
	79.946535		6.833725
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



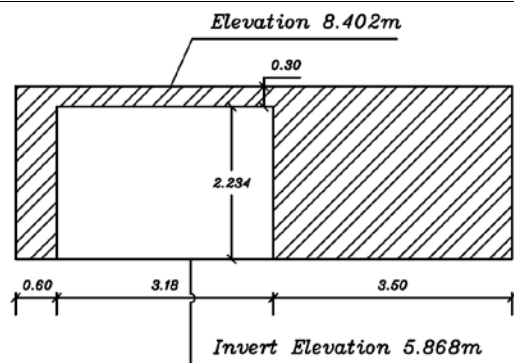
(Source: JICA 2003 M/P Report)

SITE CONDITION



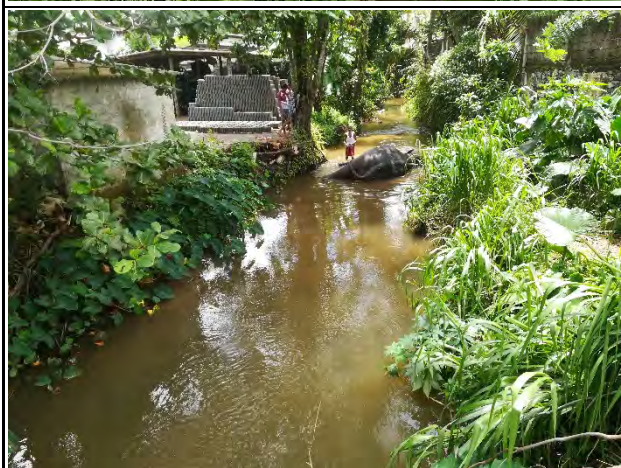
ID: MSD-15	JICA 2003 M/P	SLDC 2017	2018 F/S
	Culvert at 1+289		
COORDINATE	E		N
	79.947398		6.833583
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

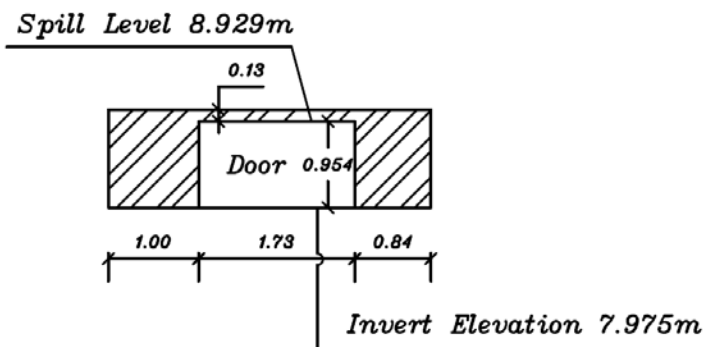
SITE CONDITION



ID: MSD-16	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Anicut at 0+768		
COORDINATE	E		N
	79.951450		6.834704
PURPOSE	Gate for flood control		
OPERATION	in use		
DRAWING			
<p style="text-align: center;">(Source: JICA 2003 M/P Report)</p>			
SITE CONDITION			

ID: MSD-17	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Anicut at 0+483		
COORDINATE	E		N
	79.953526		6.835918
PURPOSE	Anicut		
OPERATION	in use		

DRAWING



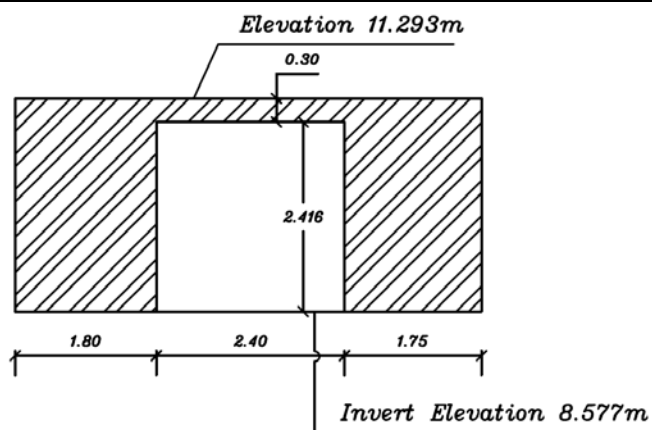
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: MSD-18	JICA 2003 M/P	SLDC 2017	2018 F/S
	Culvert at 0+265		
COORDINATE	E		N
	79.955427		6.836213
PURPOSE	Culvert		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

SITE CONDITION

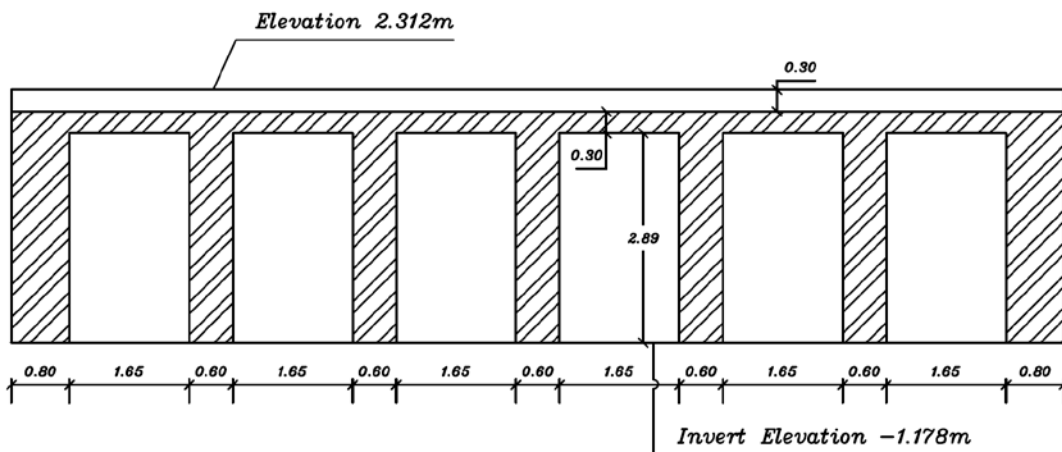


3.3.9 Bolgoda Canal

ID: BC-1	JICA 2003 M/P	SLDC 2017	2018 F/S
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	Bridge at 4+010	
COORDINATE	E	N
	79.891302	6.837412
PURPOSE	Bridge	
OPERATION	in use	

DRAWING



(Source: JICA 2003 M/P Report)

SITE CONDITION



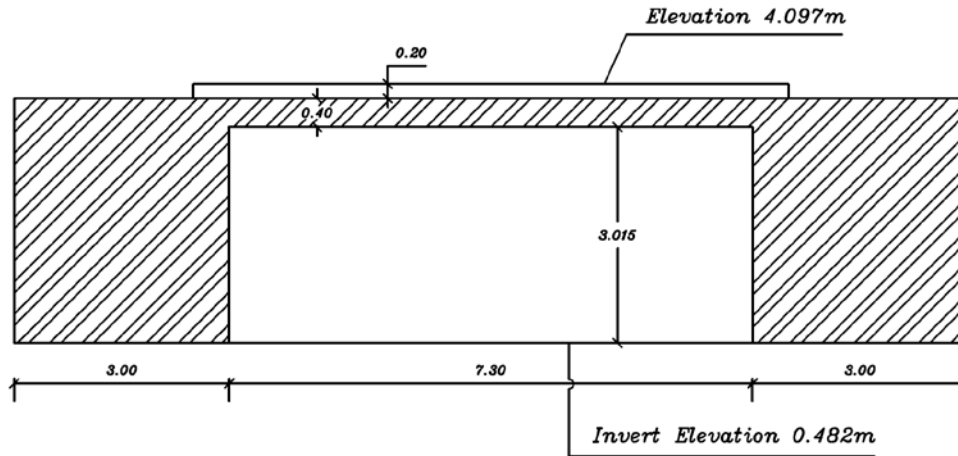


ID: BC-2	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 2+781		
COORDINATE	E		N
	79.884862		6.844686
PURPOSE	Bridge		
OPERATION	in use		
DRAWING			
<p style="text-align: center;">(Source: JICA 2003 M/P Report)</p>			
SITE CONDITION			



ID: BC-3	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 1+605		
COORDINATE	E		N
	79.877091		6.849679
PURPOSE	Bridge		
OPERATION	in use		


DRAWING



(Source: JICA 2003 M/P Report)

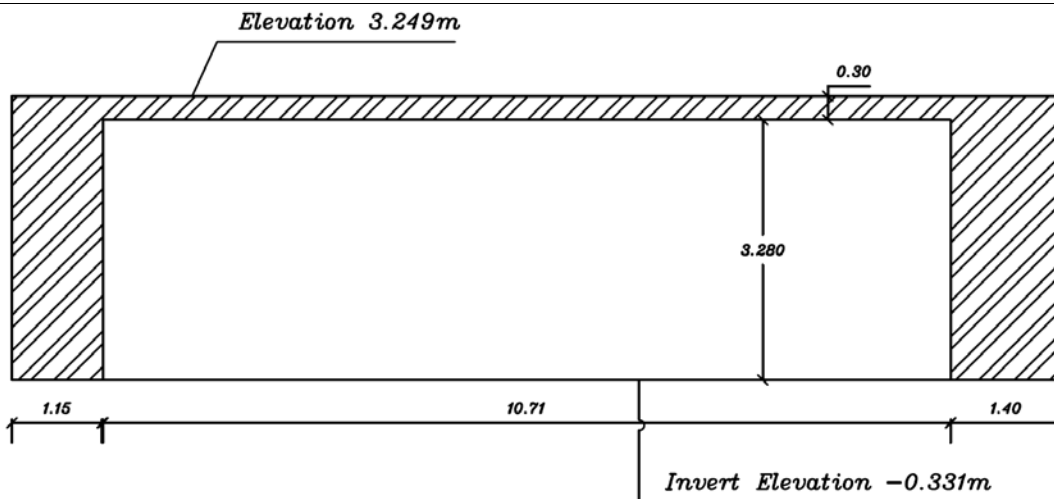
SITE CONDITION



ID: BC-4	JICA 2003 M/P	SLDC 2017	2018 F/S
COORDINATE	E		N
	79.877919		6.855756
PURPOSE	Culvert		
OPERATION	in use		
DRAWING			
(No drawing was shown in JICA 2003 M/P Report.)			
SITE CONDITION			
			

ID: BC-5	JICA 2003 M/P	SLDC 2017	2018 F/S
	Culvert at 0+248		
COORDINATE	E		N
	79.875947		6.861295
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

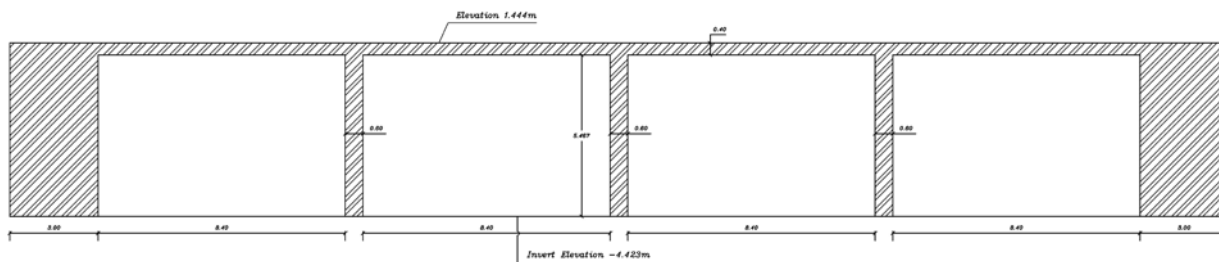
SITE CONDITION



3.3.10 Talpitiya Ela

ID: TP-1	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Bridge at 1+390		
COORDINATE	E		N
	79.929469		6.683002
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

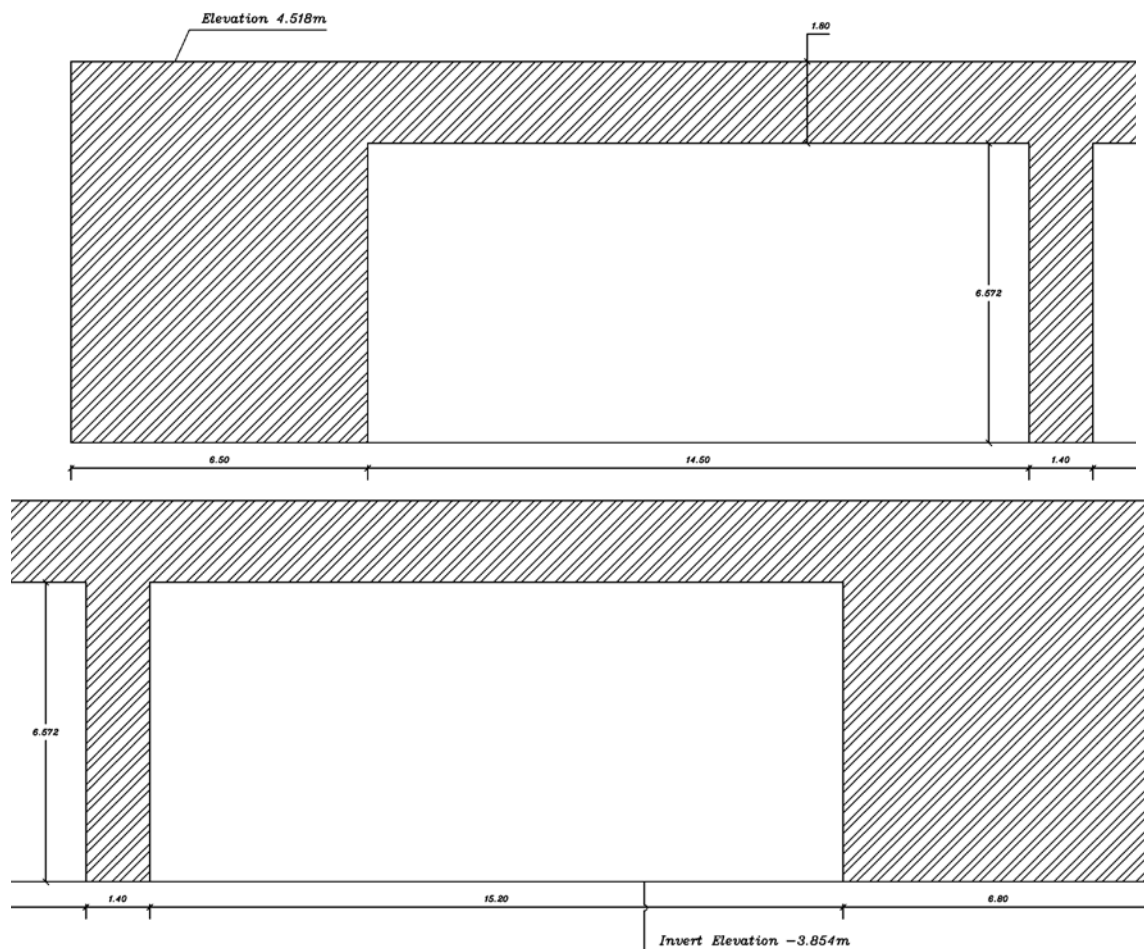
SITE CONDITION





ID: TP-2	JICA 2003 M/P	SLDC 2017	2018 F/S
	Culvert at 2+590		
COORDINATE	E		N
	79.920431		6.683337
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: TP-3	JICA 2003 M/P	SLDC 2017	2018 F/S
COORDINATE	E		N
	79.918276		6.682654
PURPOSE	Bridge		
OPERATION	in use		
DRAWING			
(No drawing was shown in JICA 2003 M/P Report.)			

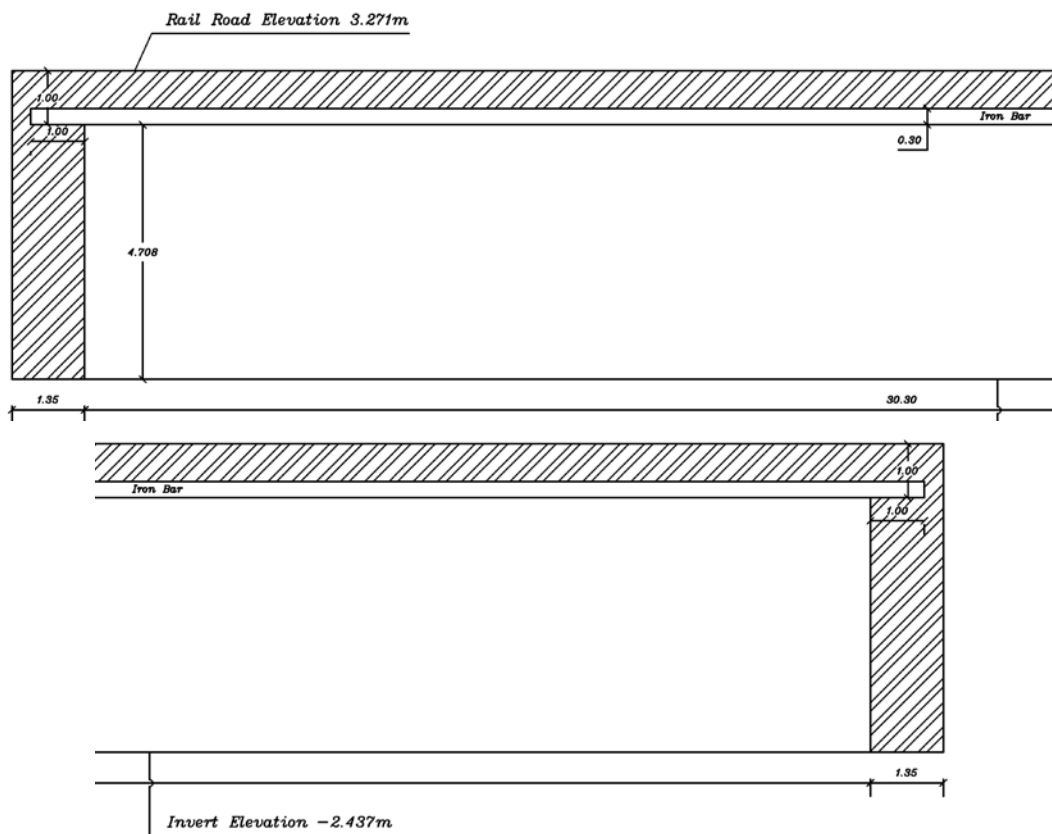
SITE CONDITION



ID: TP-4	JICA 2003 M/P	SLDC 2017	2018 F/S
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	Culvert at 2+877		
COORDINATE	E		N
	79.917752		6.682487
PURPOSE	Culvert		
OPERATION	in use		
OPERATION	in use		

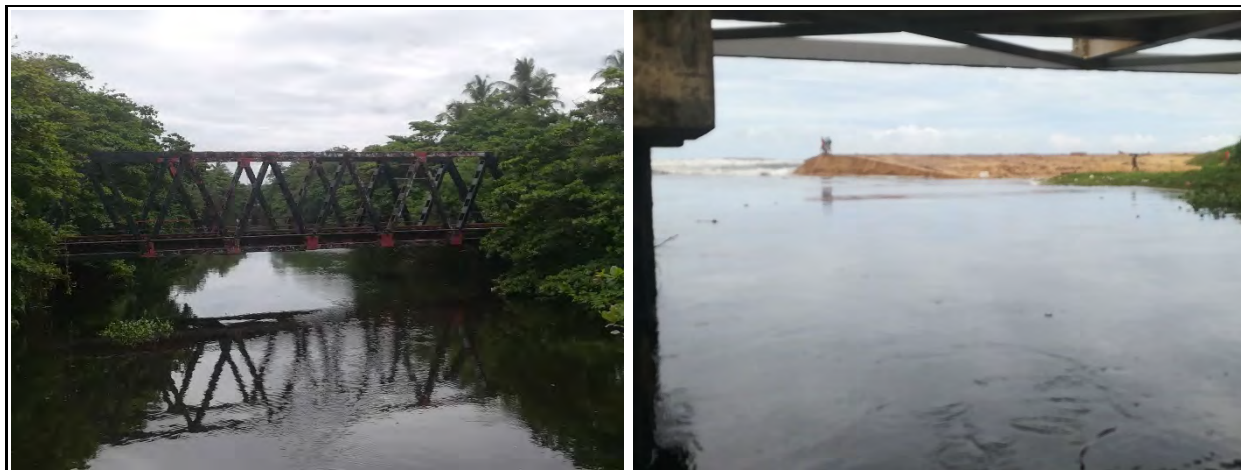
DRAWING



(Source: JICA 2003 M/P Report)

SITE CONDITION

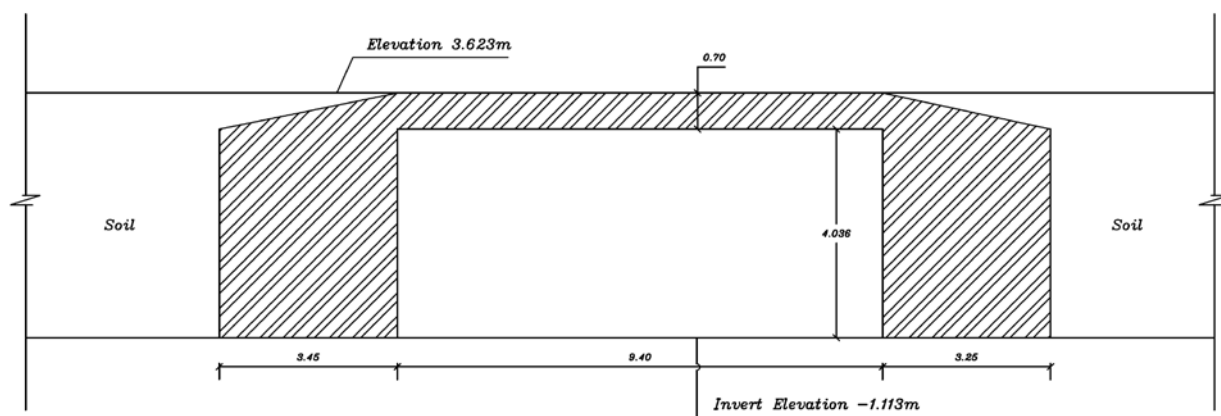




3.3.11 Alut Ela

ID: AE-1	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 0+660		
COORDINATE	E		N
	79.962846		6.676144
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



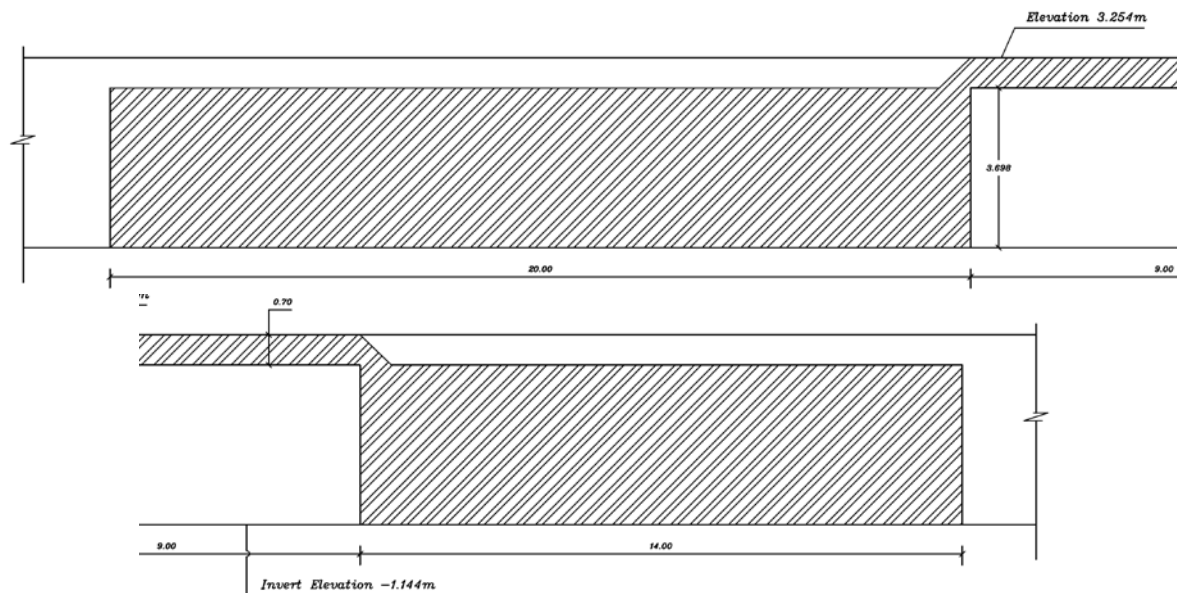
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: AE-2	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 1+946		
COORDINATE	E		N
	79.957949		6.665485
PURPOSE	Bridge		
OPERATION	in use		

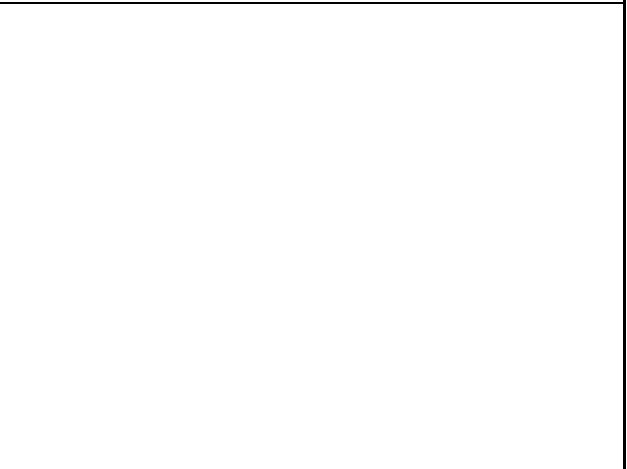
DRAWING



(Source: JICA 2003 M/P Report)

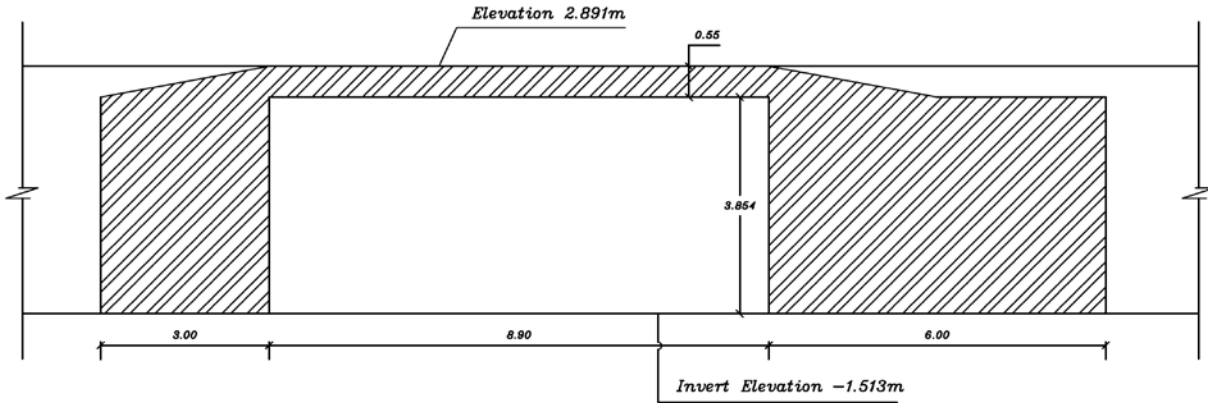
SITE CONDITION





ID: AE-3	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Bridge at 3+330		
COORDINATE	E		N
	79.951819		6.655221
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



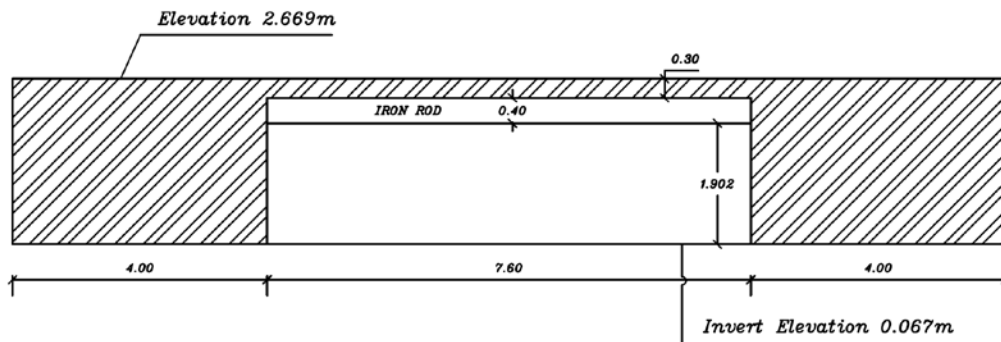
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: AE-4	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 4+281		
COORDINATE	E		N
	79.948310		6.648371
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING

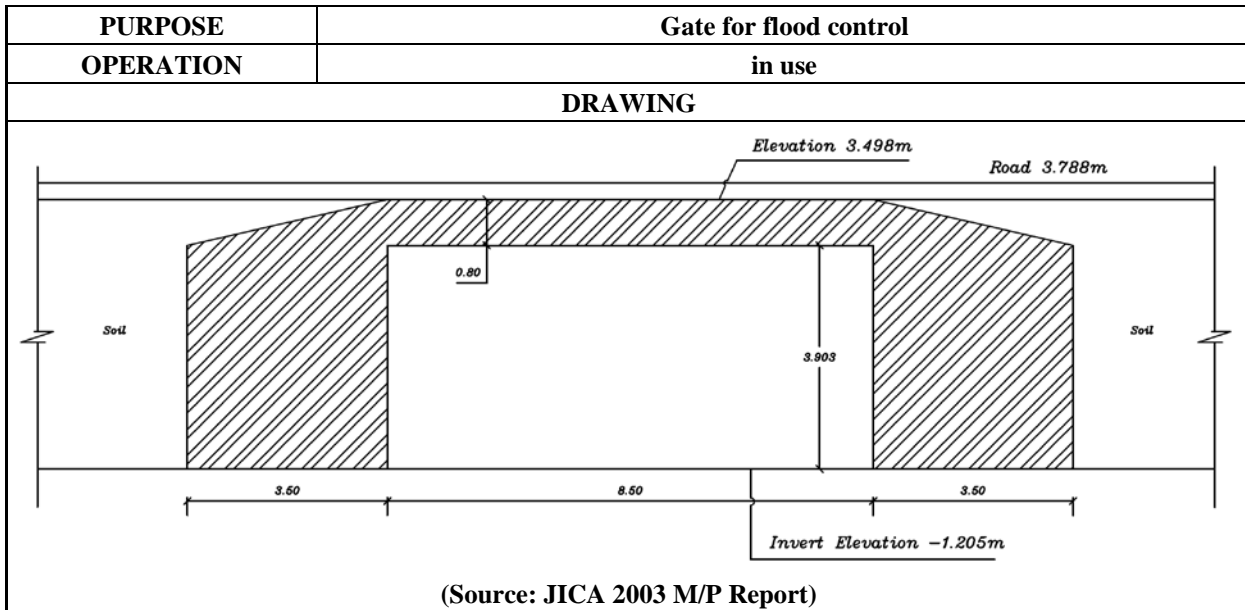


(Source: JICA 2003 M/P Report)

SITE CONDITION

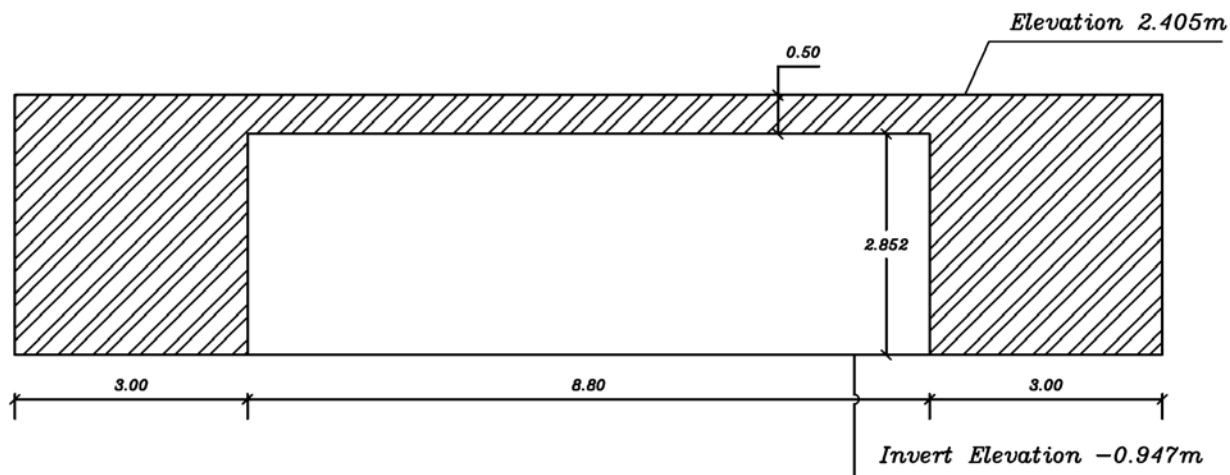


ID: AE-5	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 5+588		
COORDINATE	E		N
	79.953451		6.639514



ID: AE-6	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 6+290		
COORDINATE	E		N
	79.957165		6.635007
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: AE-7	JICA 2003 M/P	SLDC 2017	2018 F/S
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	Bridge at 7+100		
COORDINATE	E		N
	79.956942		6.627714
PURPOSE	Gate for flood control		
OPERATION	in use		
DRAWING			
(Source: JICA 2003 M/P Report)			

SITE CONDITION



ID: AE-8	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 7+790		
COORDINATE	E		N
	79.958215		6.621722
PURPOSE	Gate for flood control		
OPERATION	in use		
DRAWING			

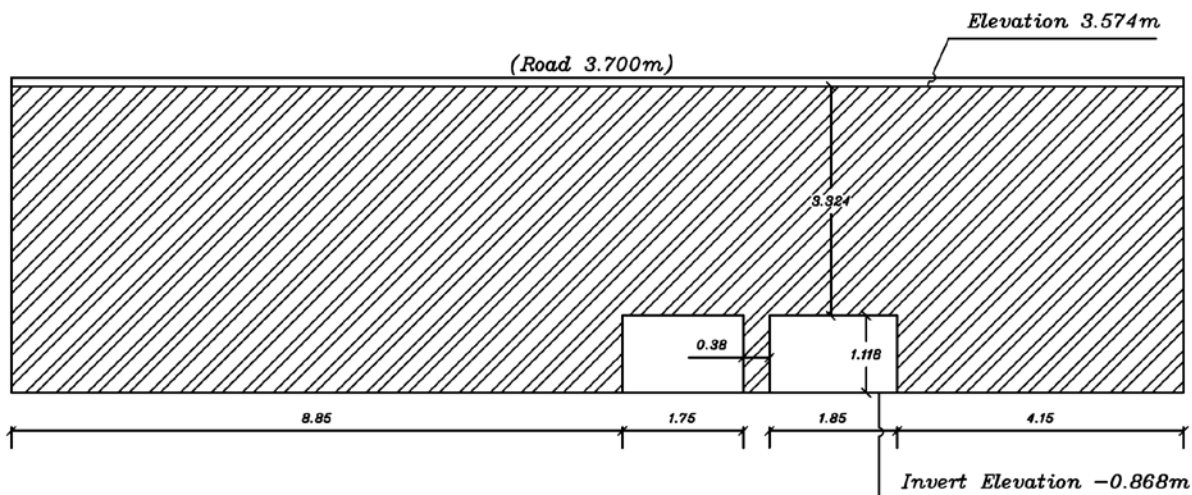
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: AE-9	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Bridge at 8+767		
COORDINATE	E		N
	79.959594		6.613102
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

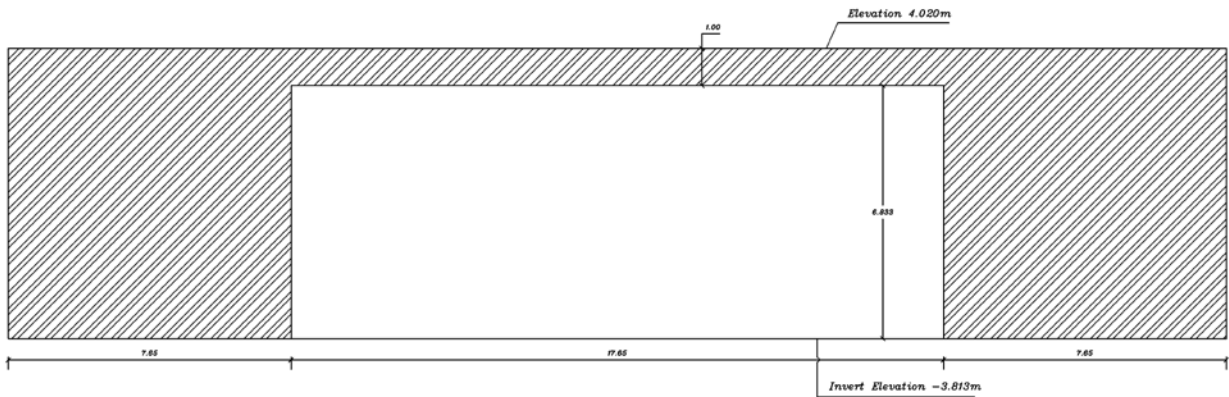
SITE CONDITION



3.3.12 Kapput Ela

ID: KE-1	JICA 2003 M/P	SLLCD 2017	2018 F/S
	Bridge at 1+858		
COORDINATE	E		N
	79.980464		6.686451
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



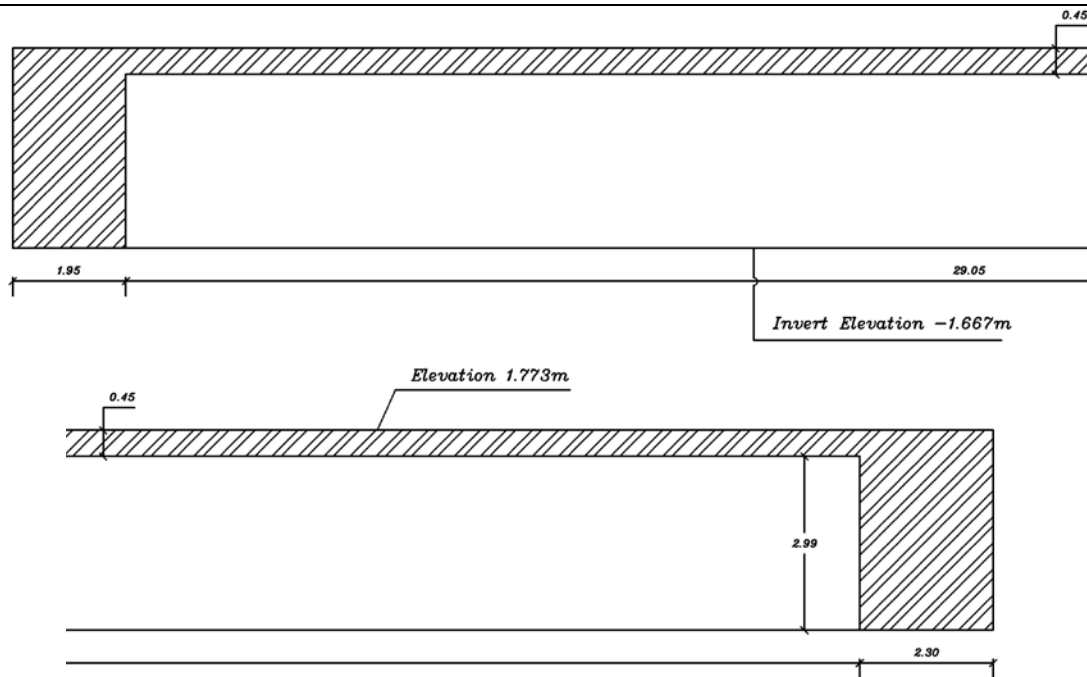
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: KE-2	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 2+731		
COORDINATE	E		N
	79.983087		6.678947
PURPOSE	Gate for flood control		
OPERATION	in use		

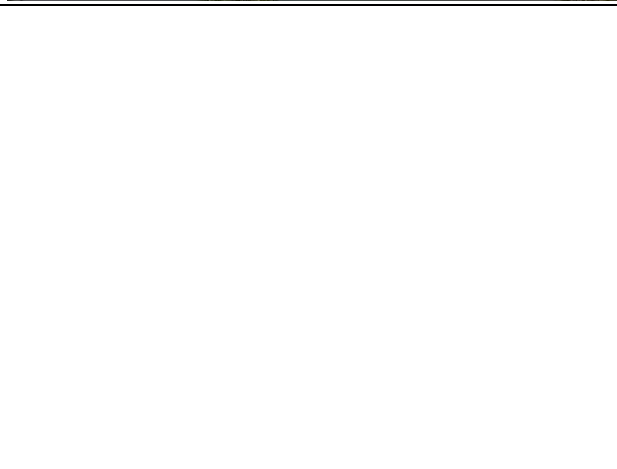
DRAWING



(Source: JICA 2003 M/P Report)

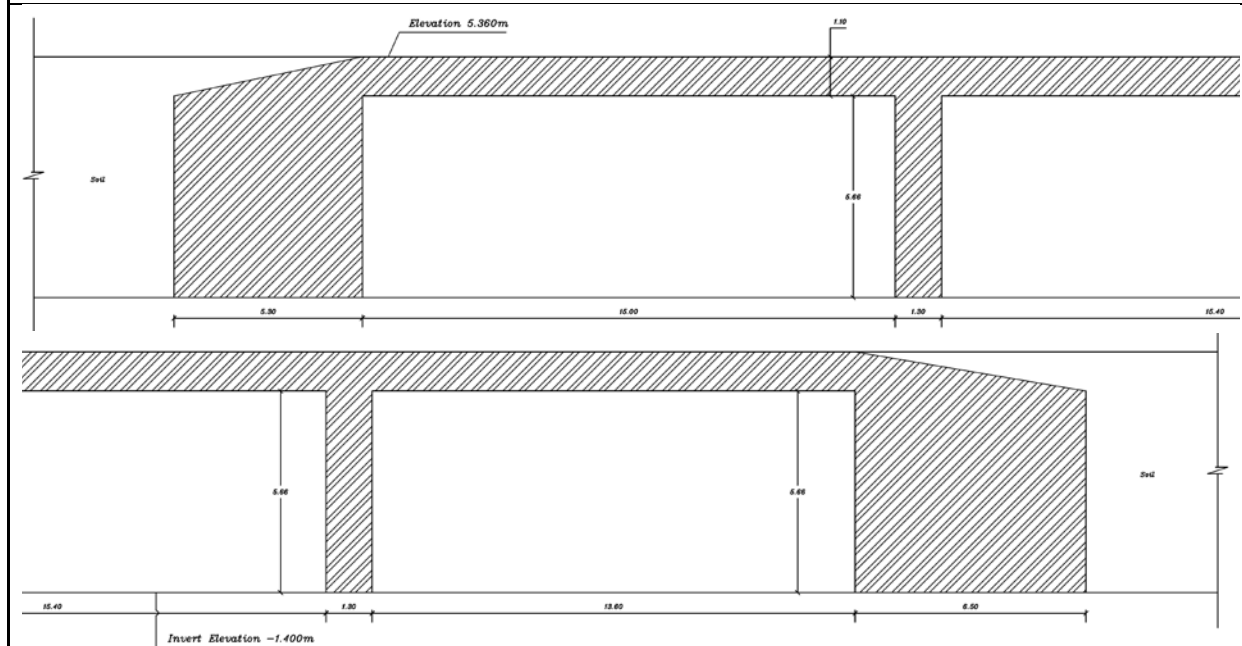
SITE CONDITION





ID: KE-3	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 3+828		
COORDINATE	E		N
	79.986716		6.670445
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: KE-4	JICA 2003 M/P	SLLDC 2017	2018 F/S
	Bridge at 6+714		
COORDINATE	E		N
	79.993142		6.646406
PURPOSE	Gate for flood control		
OPERATION	in use		
DRAWING			
(No drawing was shown in JICA 2003 M/P Report.)			

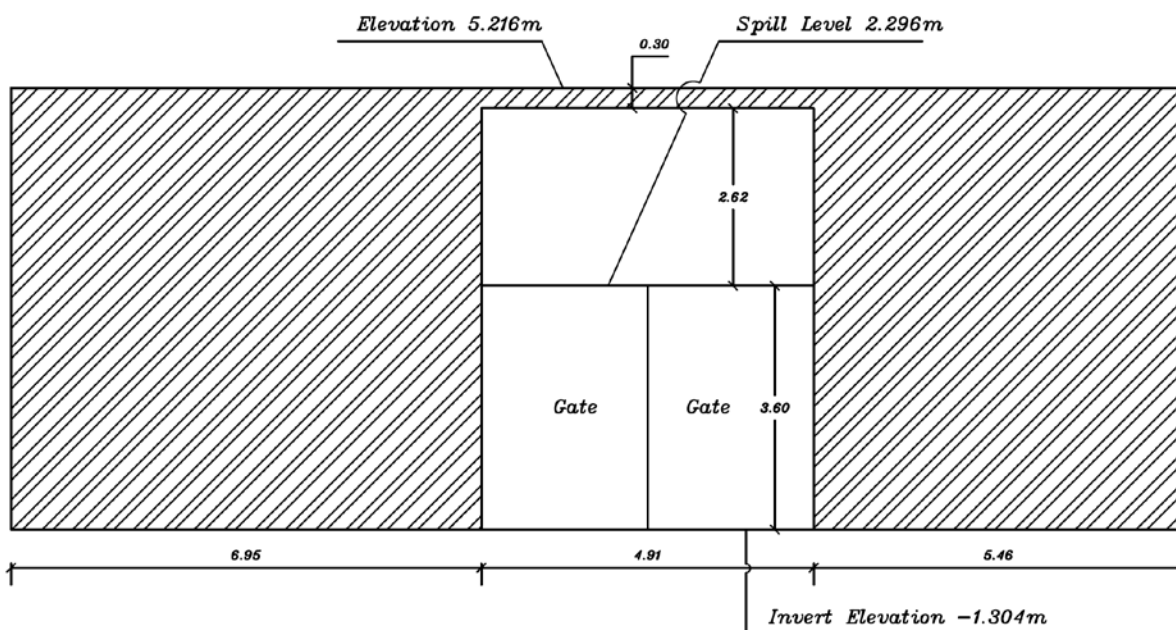
SITE CONDITION



ID: KE-5	JICA 2003 M/P	SLLDC 2017	2018 F/S
COORDINATE	E		N
	80.000308		6.639808
PURPOSE	Not confirmed		
OPERATION	in use		
DRAWING			
(No drawing was shown in JICA 2003 M/P Report.)			
SITE CONDITION			
No access			

ID: KE-6	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Anicut at 8+402		
COORDINATE	E		N
	80.002609		6.637968
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

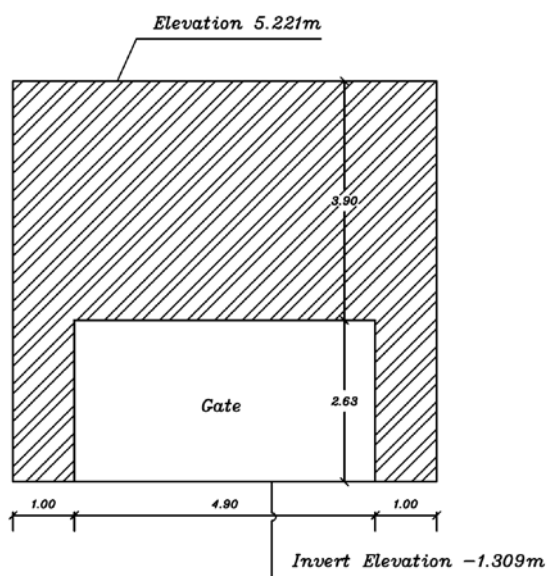
SITE CONDITION





ID: KE-7	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Gate at 8+409		
COORDINATE	E		N
	80.002724		6.637900
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

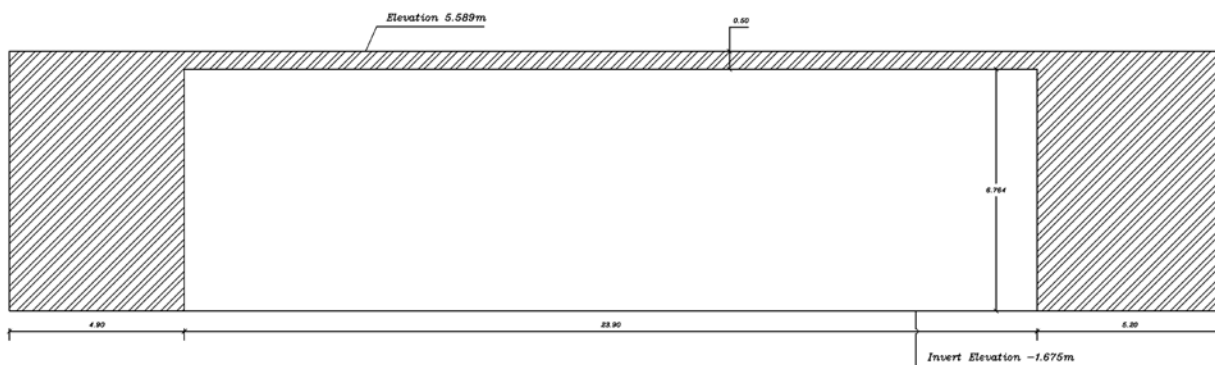
SITE CONDITION





ID: KE-8	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 9+507		
COORDINATE	E		N
	80.009892		6.636096
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

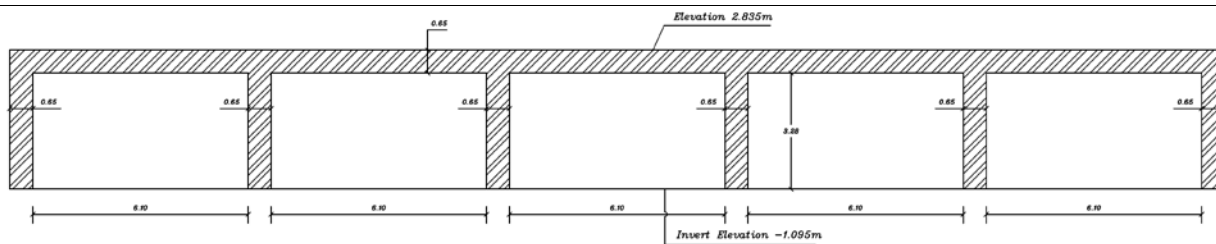
SITE CONDITION



3.3.13 Panape Ela

ID: PE-1	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Bridge at 11+485		
COORDINATE	E		N
	79.997562		6.692770
PURPOSE	Bridge		
OPERATION	in use		


DRAWING



(Source: JICA 2003 M/P Report)

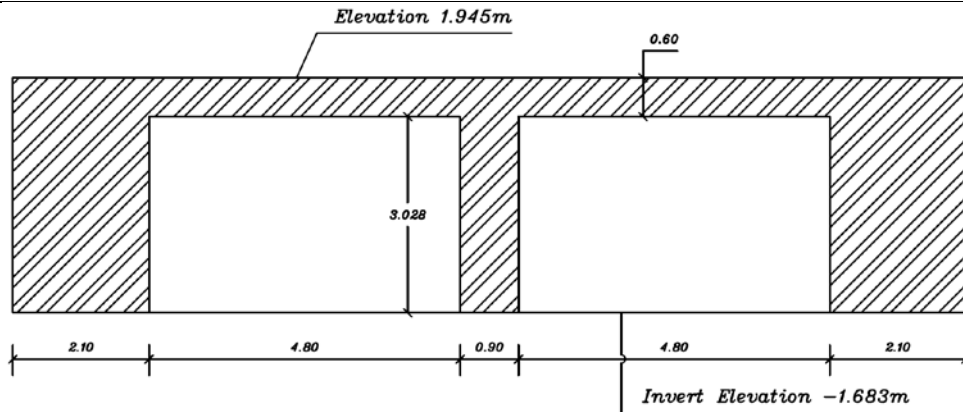
SITE CONDITION



ID: PE-2	JICA 2003 M/P	SLDC 2017	2018 F/S
COORDINATE	E		N
	80.003280		6.696532
PURPOSE	Bridge		
OPERATION	in use		
DRAWING			
(No drawing was shown in JICA 2003 M/P Report.)			
SITE CONDITION			
		No access	

ID: PE-3	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 10+106		
COORDINATE	E		N
	80.007160		6.697707
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



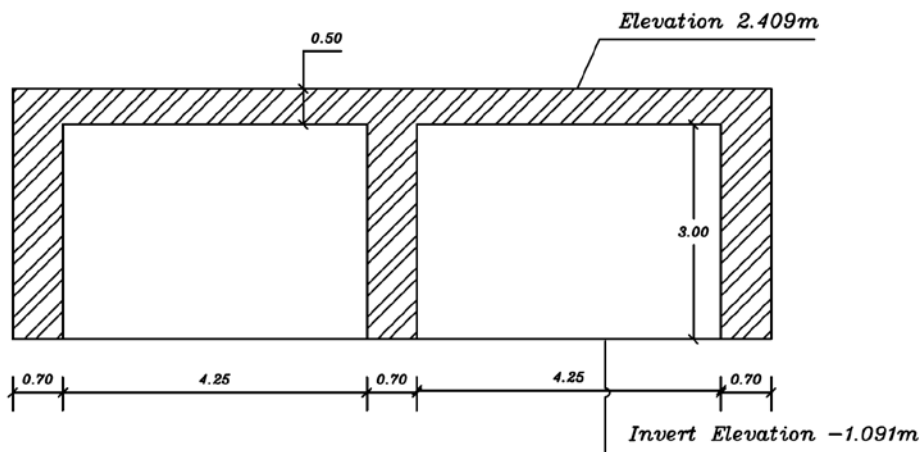
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: PE-4	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Bridge at 8+980		
COORDINATE	E		N
	80.013259		6.696423
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



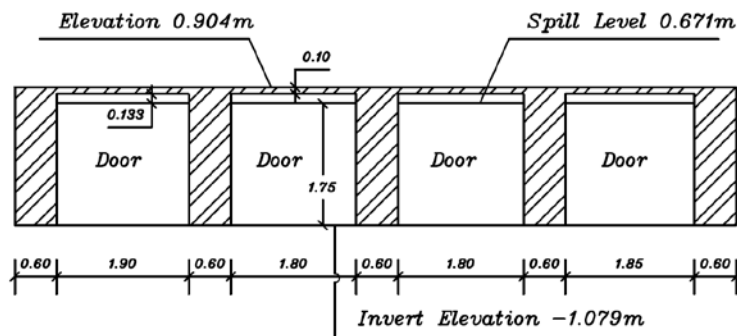
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: PE-5	JICA 2003 M/P	SLDC 2017	2018 F/S
	Anicut at 8+973		
COORDINATE	E		N
	80.013288		6.696342
PURPOSE	Anicut		
OPERATION	in use		

DRAWING



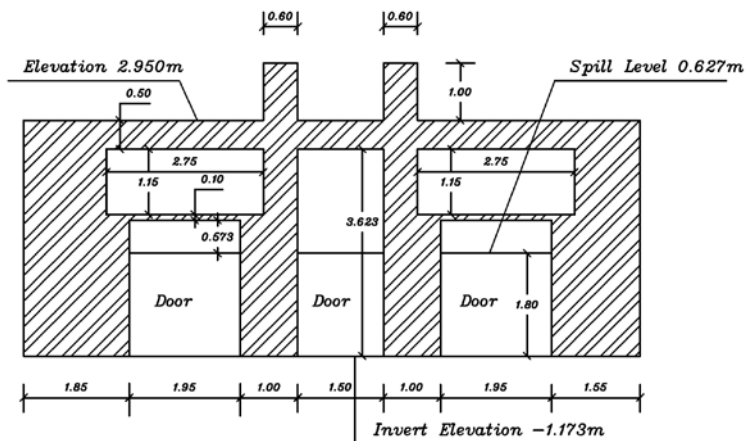
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: PE-6	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Anicut at 7+832		
COORDINATE	E		N
	80.019878		6.696448
PURPOSE	Anicut		
OPERATION	in use		

DRAWING



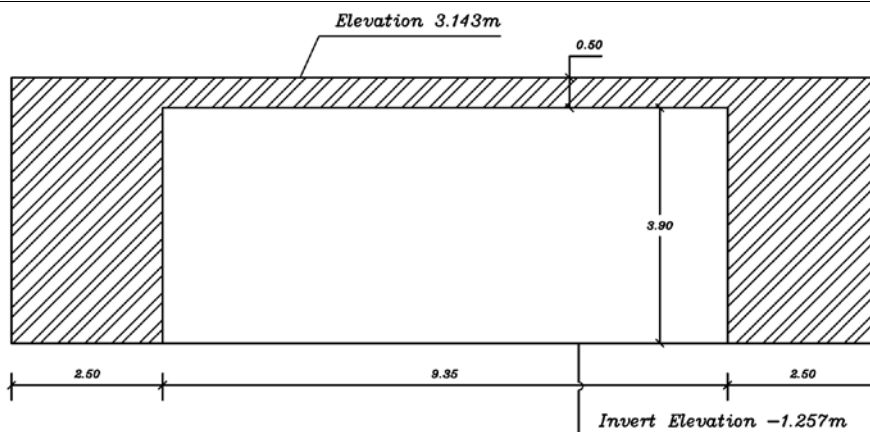
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: PE-7	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 7+642		
COORDINATE	E		N
	80.020022		6.697967
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



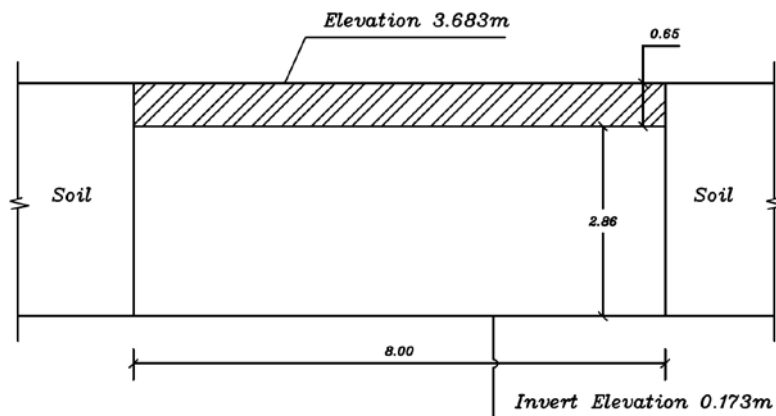
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: PE-8	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 4+703		
COORDINATE	E		N
	80.028162		6.710860
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



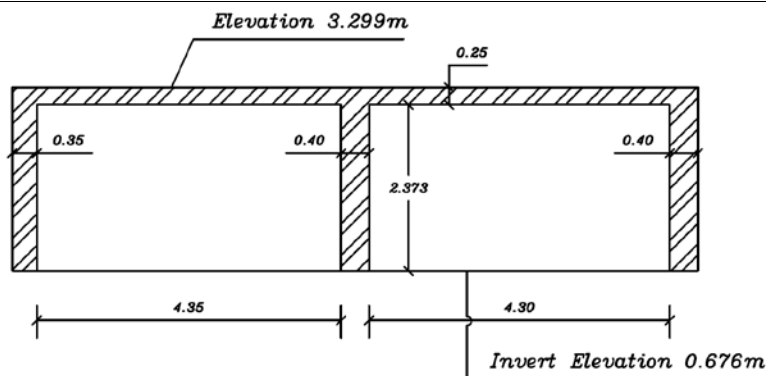
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: PE-9	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 4+517		
COORDINATE	E		N
	80.029251		6.711812
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

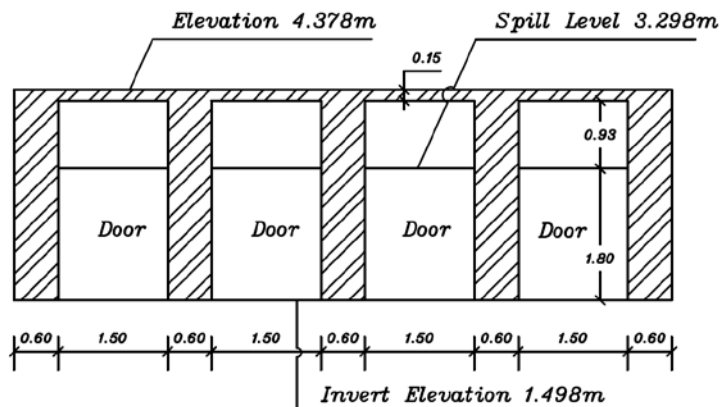
SITE CONDITION





ID: PE-10	JICA 2003 M/P	SLDC 2017	2018 F/S
	Anicut at 3+507		
COORDINATE	E		N
	80.036784		6.712124
PURPOSE	Anicut		
OPERATION	in use		

DRAWING



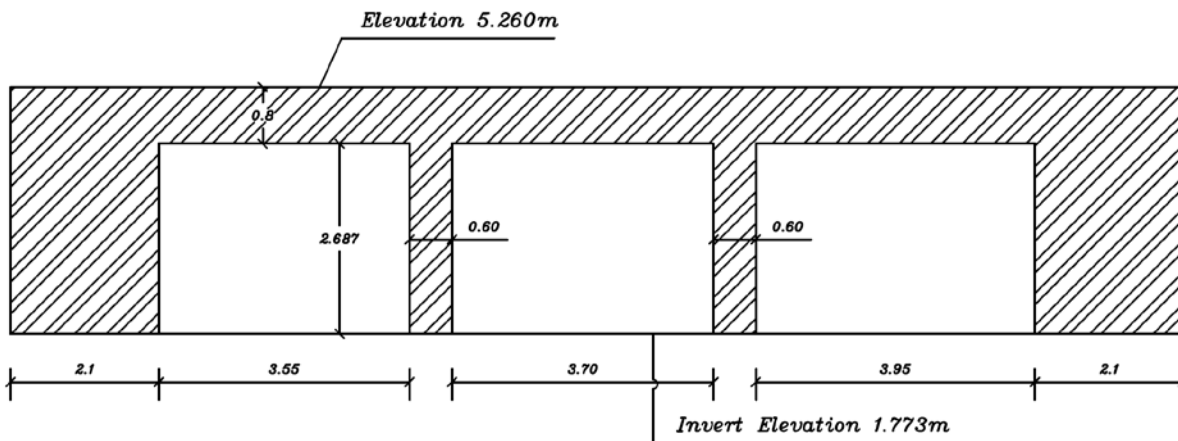
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: PE-11	JICA 2003 M/P	SLDLC 2017	2018 F/S
	Bridge at 3+336		
COORDINATE	E		N
	80.038105		6.712908
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



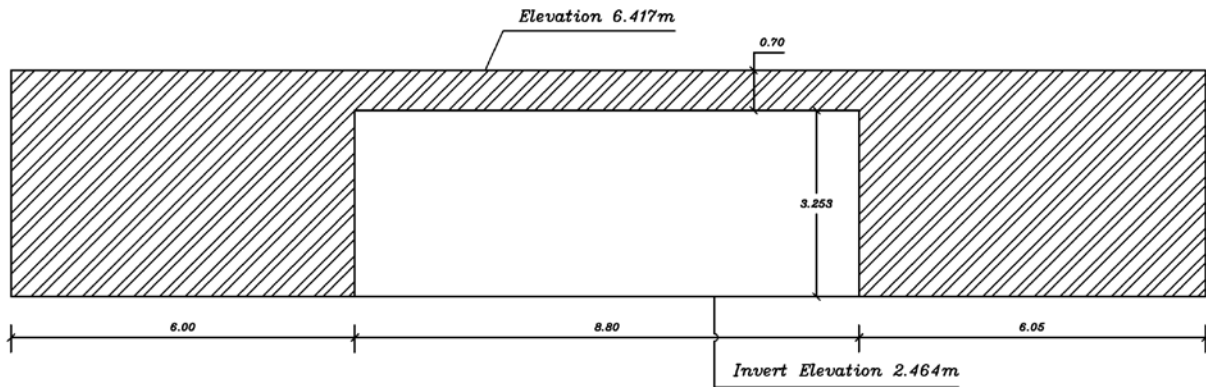
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: PE-12	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 2+028		
COORDINATE	E		N
	80.043017		6.721354
PURPOSE	Bridge		
OPERATION	in use		

DRAWING



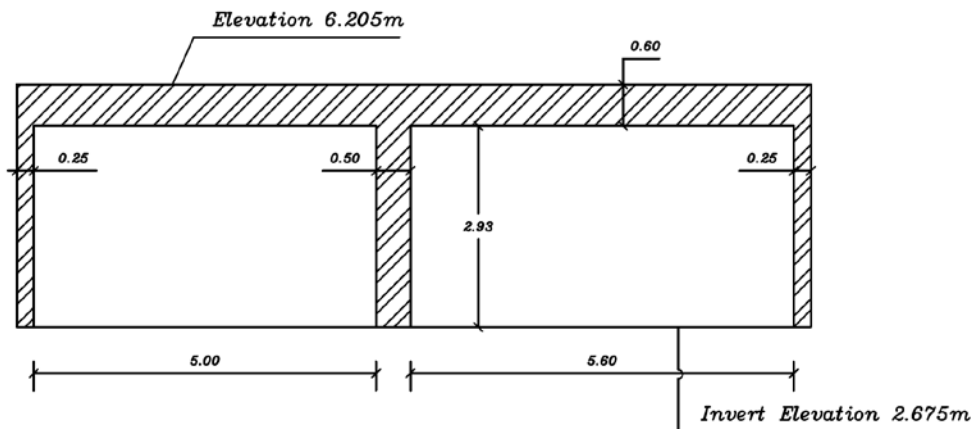
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: PE-13	JICA 2003 M/P	SLDC 2017	2018 F/S
	Bridge at 1+592		
COORDINATE	E		N
	80.042169		6.724555
PURPOSE	Gate for flood control		
OPERATION	in use		

DRAWING



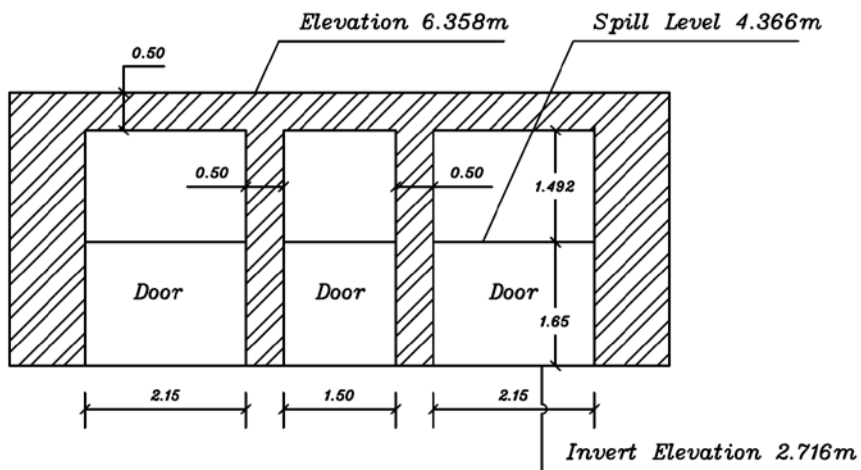
(Source: JICA 2003 M/P Report)

SITE CONDITION



ID: PE-14	JICA 2003 M/P	SLDC 2017	2018 F/S
	Anicut at 1+307		
COORDINATE	E		N
	80.042080		6.726638
PURPOSE	Anicut		
OPERATION	in use		

DRAWING



(Source: JICA 2003 M/P Report)

SITE CONDITION





Appendix-3

Environmental and Social Consideration Related Document

Appendix-3-1

Baseline Environmental and Social Conditions of Project Area
(Mudun Ela Drainage Improvement Project)

1 Existing Natural environment (Baseline Environmental Condition)

1.1 Physical Environment

1.1.1 Topography

The topographic conditions of Mudun Ela area consists of relatively flat terrain where the minimum maximum elevation ranges are -1.5m MSL and 20-25 m MSL. The topographic map is presented in Figure 1-1

.

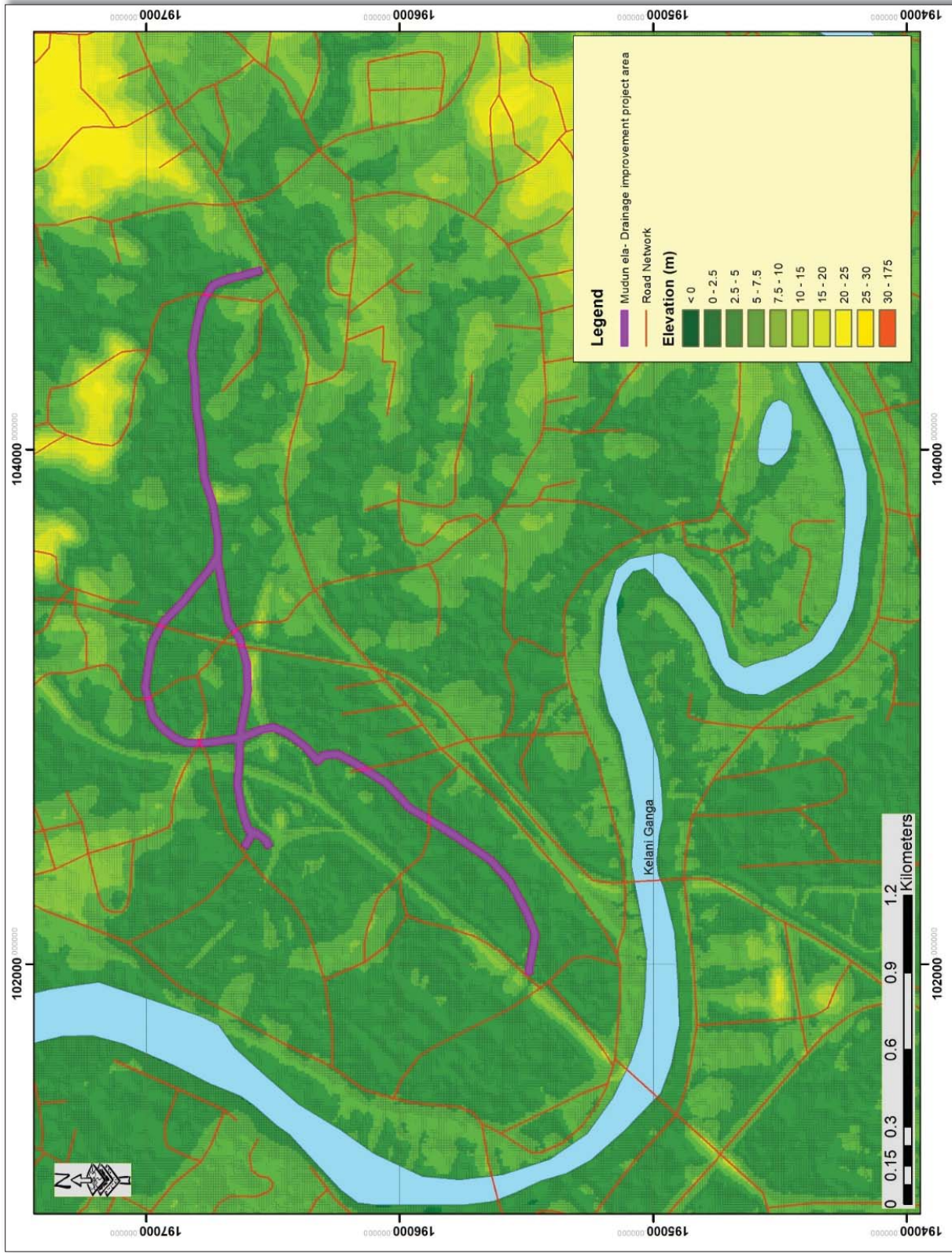


Figure 1-1: Topographic Map of Mudun Ela Area

1.1.2 Geology

The geological map for Mudun Ela is given in Figure 1-2. Although project lies in low lying areas it is not on geologically critical areas.

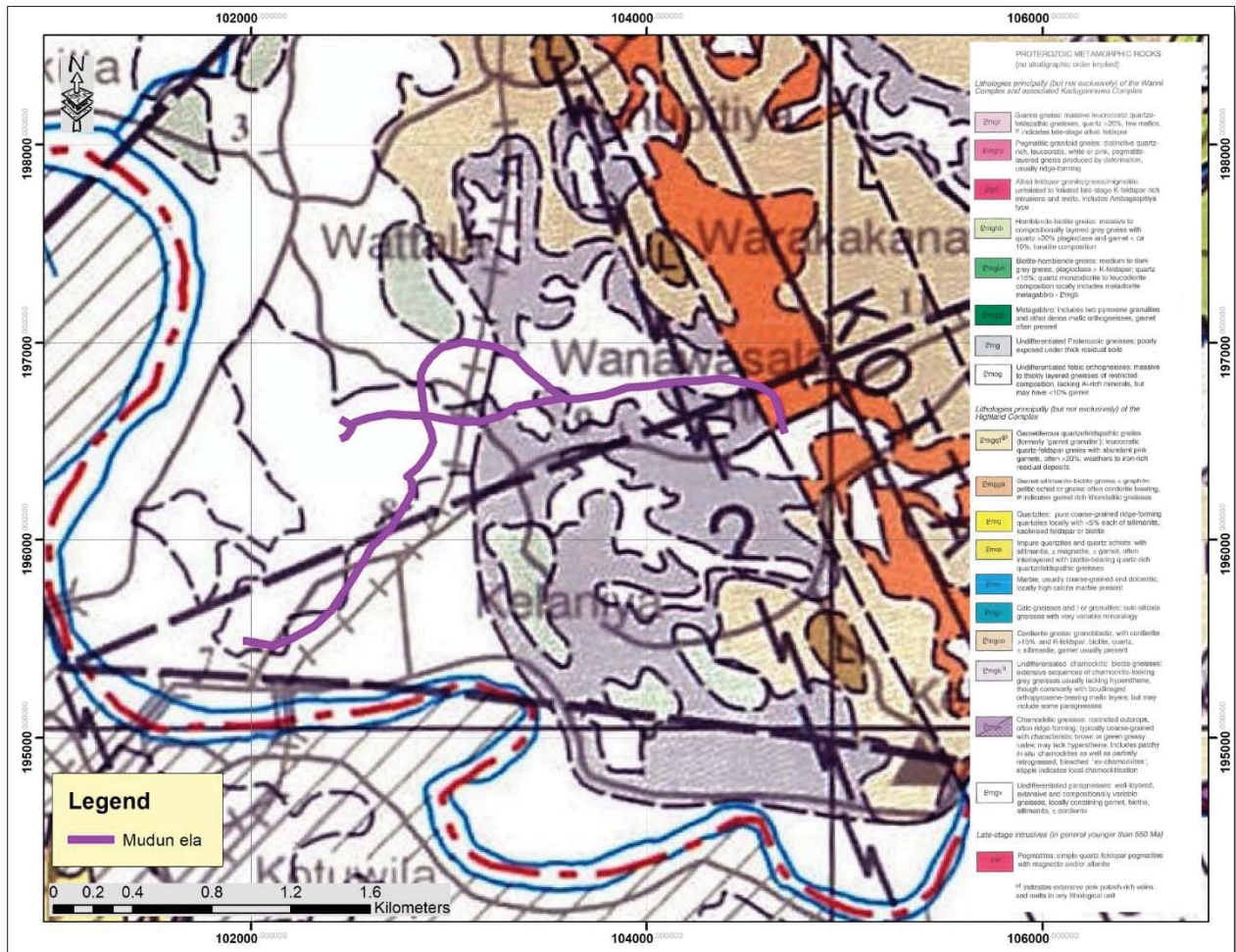


Figure 1-2: Geology Map for Mudun Ela Area

1.1.3 Hydrology

Outline of hydrological condition. Will be provided after receiving data from the JICA team.

1.1.4 Climate

1.1.4.1 Monthly humidity variations.

Monthly humidity variations for Colombo (for the Mudun Ela area) are presented in Table 1-1.

Table 1-1: Monthly Maximum and Minimum Humidity Variation in Colombo

Monthly Maximum Relative Humidity - Colombo												
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	81	82	88	83	85	87	83	84	87	91	91	86
2018	80	83	86	90	90	86	85	86	86	92	91	87
2019	81	86	85	86	84	86	84	87	90	93	93	88
2020	82	79	84	88	87	84	86	84	89	86	90	88
2021		82	89	87	87	85	85	86	87	90	91	87

Monthly Maximum Relative Humidity - Colombo												
Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	84	81	83	90	86	86	85	85				
Average	82	82	86	87	87	86	85	86	88	90	91	87
Monthly Minimum Relative Humidity - Colombo												
Year Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	67	67	71	72	76	79	76	76	79	81	77	70
2018	64	67	72	73	79	79	77	78	73	79	76	70
2019	65	71	68	70	75	78	75	79	80	79	76	74
2020	66	63	68	71	77	76	78	76	80	77	74	72
2021	75	66	72	73	77	77	79	79	79	80	81	71
2022	67	66	70	76	80	80	77	77				
Average	67	67	70	73	77	78	77	78	78	79	77	71

Source: Department of Meteorology

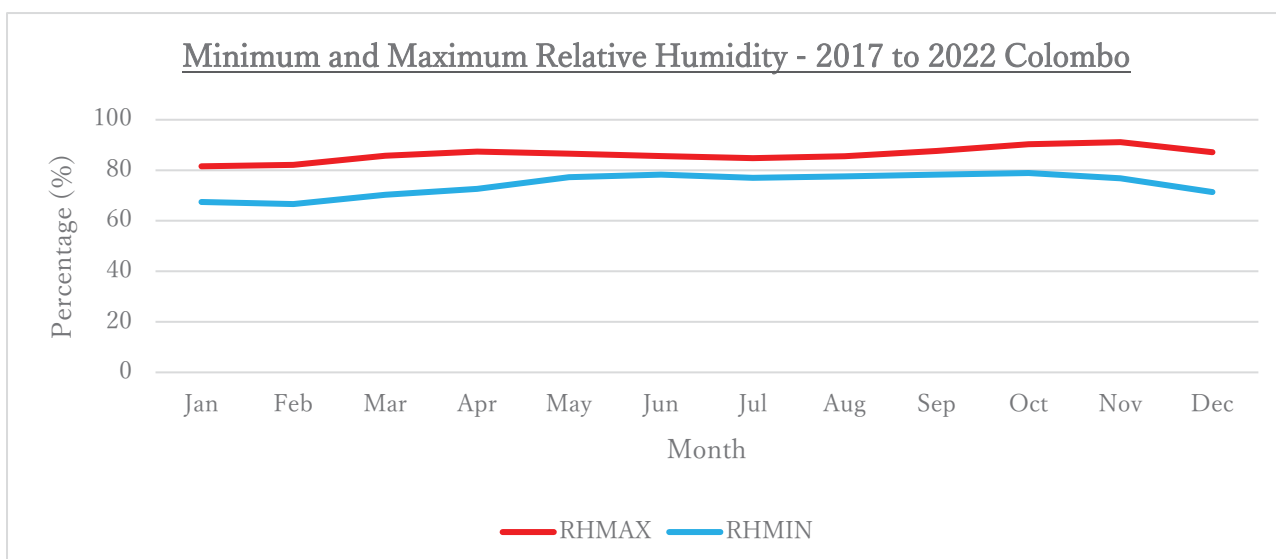


Figure 1-3: Monthly Humidity Variation Colombo

1.1.5 Temperature

Monthly minimum and maximum temperature figures from 2017 to 2022 are given in Table 1-2.

Table 1-2: Monthly Temperature Variation in Colombo

Monthly Maximum Temperature - Colombo												
Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	31.2	31.4	31.3	32.5	31.8	30.7	30.7	30.6	30.3	30.4	30.2	31.1
2018	31.1	31.8	31.6	32.1	30.9	30.5	30.1	29.8	30.9	30.3	30.6	31.2
2019	31.8	31.9	32.2	32.8	32.0	31.4	31.1	30.3	30.0	30.1	31.2	31.3
2020	32.3	33.3	32.9	32.9	31.8	31.3	30.6	30.6	30.0	30.7	31.7	31.0
2021	30.7	32.1	31.6	31.8	31.5	30.9	30.4	30.0	30.4	30.4	29.8	31.6

Monthly Maximum Temperature - Colombo												
Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	32.2	32.1	32.4	31.8	31.0	30.7	30.5	30.0				
Average	31.5	32.1	32.0	32.3	31.5	30.9	30.6	30.2	30.3	30.4	30.7	31.2
Monthly Minimum Temperature - Colombo												
Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	22.9	23.3	24.9	27.0	26.5	26.4	27.2	26.6	25.9	25.2	24.4	23.8
2018	22.9	23.8	25.2	25.0	25.6	26.2	26.5	25.8	25.6	24.6	24.1	23.8
2019	23.5	24.8	25.4	25.8	26.7	26.2	26.2	25.4	24.8	23.8	24.0	24.0
2020	24.2	25.0	25.9	25.6	26.8	26.6	26.1	26.4	25.2	26.1	24.6	24.3
2021	24.0	24.0	24.4	25.6	25.9	26.4	26.2	26.0	25.9	25.2	24.3	24.1
2022	23.9	24.1	25.9	25.3	26.4	26.6	26.3	26.1				
Average	23.6	24.2	25.3	25.7	26.3	26.4	26.4	26.0	25.5	25.0	24.3	24.0

Source- Department of Meteorology

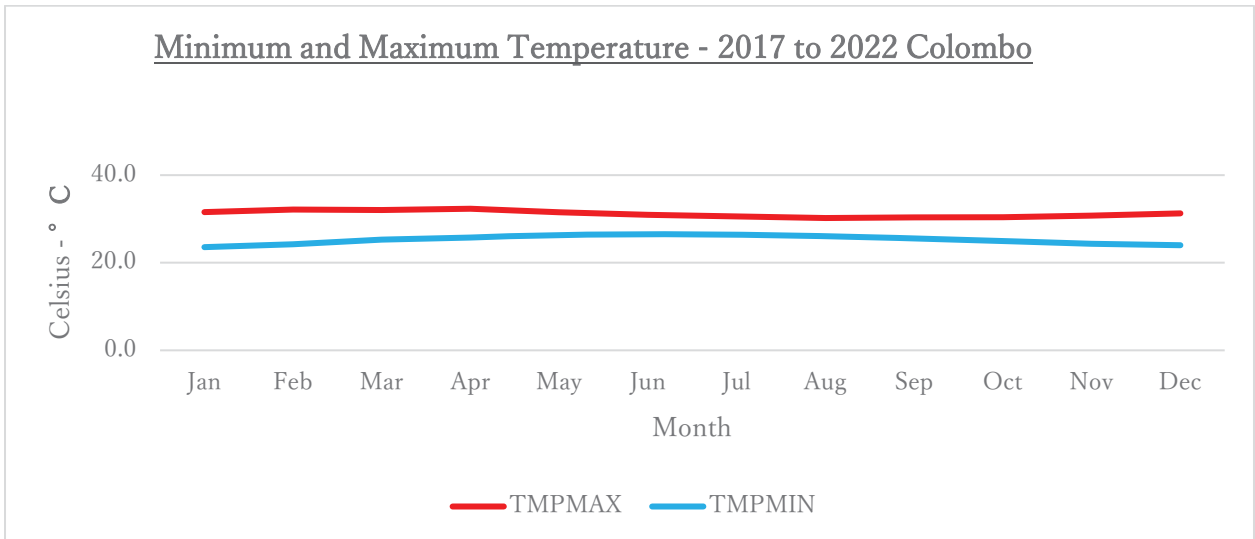


Figure 1-4: Monthly Temperature Variation Colombo

1.1.5.1 Precipitation

Monthly Average Rainfall for Colombo is presented in Figure 1-5.

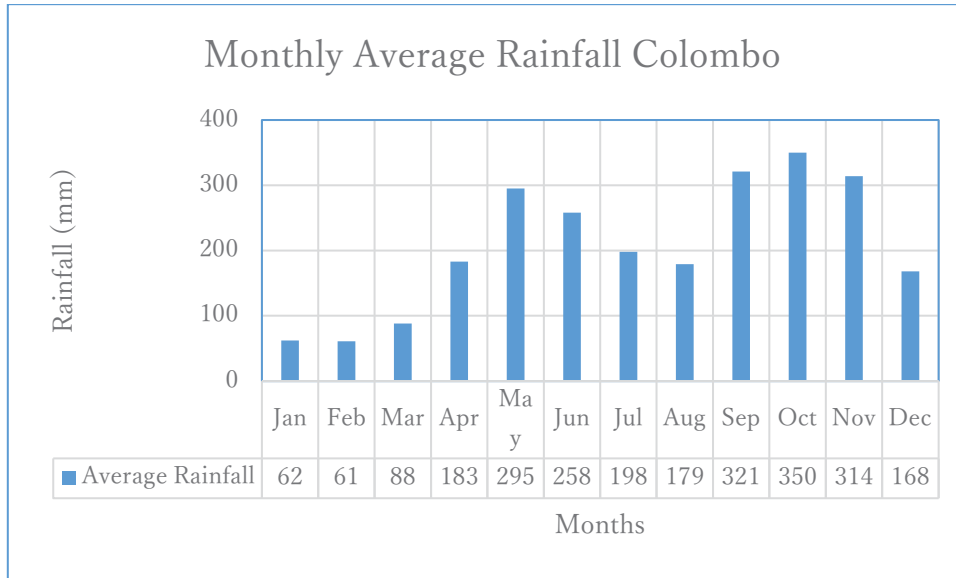


Figure 1-5-Monthly Average Rainfall Colombo

1.1.5.2 Wind

Table 1-3: Monthly Average Wind Speed

Month/Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	6.9	5.7	5.1	5.3	6.1	6.3	6.5	6.9	6.1	3.7	3.8	5.7
2018	5.7	5.4	4.5	4.5	4.9	7.4	6.8	6.1	4.7	3.1	4.3	5.7
2019	7.3	5.3	4.3	3.8	5.5	5.3	5.7	5.8	4.5	2.5	3.1	3.9
2020	5.3	5.4	4.3	3.3	4.5	5.1	3.6	4.1	3.9	4.1	3.7	5.9
2021	3.9	6.0	2.5	3.0	3.3	4.0	5.3	4.3	4.9	3.4	3.3	5.1
2022	4.1	5.5	5.3	3.7	5.4	4.9	4.5					
Average	5.5	5.6	4.3	3.9	5.0	5.5	5.4	5.4	4.8	3.4	3.6	5.3

Source: Department of Meteorology

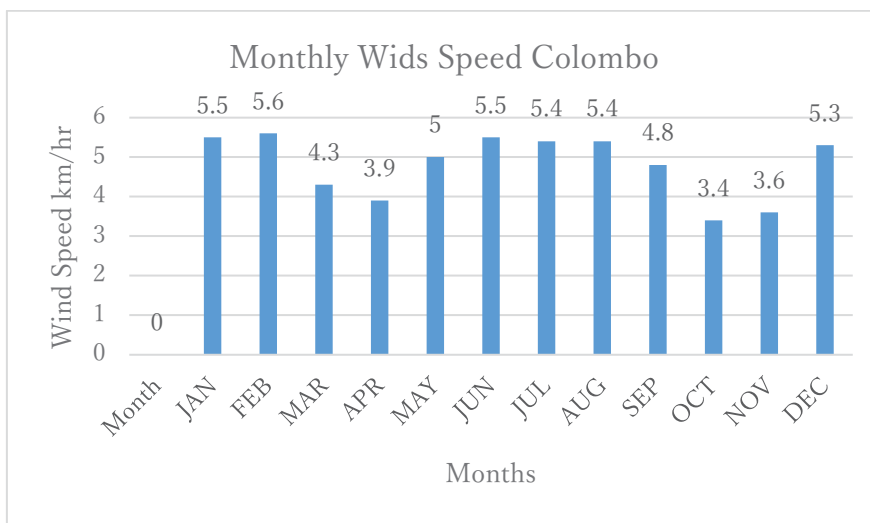


Figure 1-6: Monthly Average Wind Speed Colombo

1.2 Physiochemical Environment

1.2.1 (Pollution control) Air Quality

Measured values with reference to relevant Sri Lankan guideline values: PM2.5, PM10, TSP, Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Carbon Monoxide (CO), Ozone (O₃), Lead (Pb)

Measured values with reference to relevant Sri Lankan guideline values: PM2.5, PM10, TSP, Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Carbon Monoxide (CO), Ozone (O₃), Lead (Pb)

As the proposed project site is located in densely populated urban landscapes, the transport sector and residential activities (mostly from cooking (LP gas, biomass, Kerosene oil), contribute to main man-made sources of air pollution. Windblown road dust and soil dust are also local air pollution sources in the project areas. Other pollution sources that may influence the baseline ambient air quality in the project area are the industries and various service facilities. Additionally, depending on the wind direction/pattern the power plants and oil refinery (at Spugaskanda located abt. 6 Km west from Wanawasala and Kelanitissa power plant) has an influence on the baseline ambient air quality in Mudun Ela basin. The pollutants linked to these sources that are typically of health concerns are lead (Pb), dust (due to re-suspension), particulate matter (PM, PM 10, PM 2.5), oxides of nitrogen (NO_x), and volatile organic compounds (VOC), Photochemical oxidant (ozone), another important pollutant, forms from NO_x and VOCs in the presence of heat and sunlight. In addition to these, emissions from power plants (Mudun Ela), factories, service stations & facilities, also contribute to local air quality in the project areas.

1.2.1.1 Ambient air quality in Mudun Ela catchment area

Ambient air quality measurements taken in a location closer to the proposed site in 2017 is presented in Table 1-4 below. The 24hr average for SO₂, NO₂, PM10 and PM 2.5 levels were well below the National Ambient Air Quality Standards: The National Environmental (Ambient Air Quality) Regulations: No. 1562/22:2008

Table 1-4: Ambient air quality in Mudun Ela Area

Location	Measuring Date	Parameter	24 hour average pollutant concentration (mg/m ³)	24 hour National Ambient Air Quality Standard Levels
Sri Bodhirukkarama Viharaya, Weragoda, Kelaniya	16 – 17/03/2017	SO ₂	0.024	0.080
		NO ₂	0.052	0.100
		PM10	0.048	0.100
		PM2.5	0.026	0.050

Source: EIA report of the proposed metro Colombo solid waste management project

Table 1-5: Details of Air Quality Parameters

Parameter	GPS Coordinates	Date	Concentration (µg/m ³)					
			SO ₂	NO ₂	CO	PM ₁₀	PM _{2.5}	O ₃
Dalugama, Kelaniya	06.9701770 N 79.9048160 E	18 th -19 th January 2022	14	25	<1000	23	13	-
Inside The Power Plant, Sojitz Kelanitissa	06.9515910 N 79.8749570 E	20 th -21 st June 2022	17	20	<1000	47	26	-

Parameter	GPS Coordinates	Date	Concentration ($\mu\text{g}/\text{m}^3$)					
			SO ₂	NO ₂	CO	PM ₁₀	PM _{2.5}	O ₃
Sri Bodhirukkaramaya Viharaya, Waragoda, Kelaniya.	06.9583190 N 79.9055910 E		13	17	<1000	34	19	-
Sri Sudarmaramaya Viharaya, Wanawasala, Kelaniya	06.9746310 N 79.8989100 E		14	18	<1000	31	17	-
Negombo Road, Peliyagoda	6.961238° N 79.882092° E	20 th -21 st June 2022	23	57	<1000	23	13	-
Negombo Road, Peliyagoda	6.960309° N 79.882286° E		35	67	<1000	91	50	-
24hr National Ambient Air Quality Standard			80/24 hr	100/24 hr	68,000 /any time	100/2 4hr	50/24 hr	200 /1hr

Source: National Building Research Organization

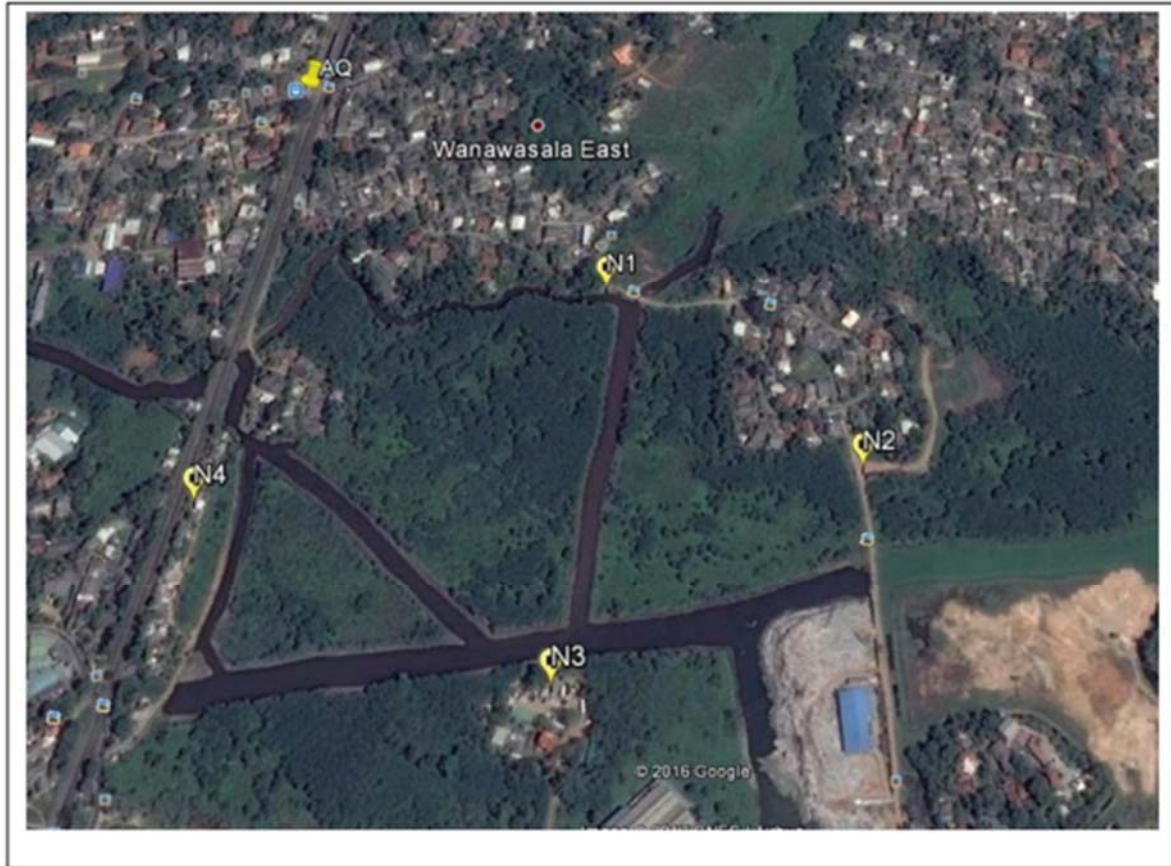
1.2.1.2 Noise and vibration of project sites with reference to relevant Sri Lankan guideline values (if applicable)

Measurements of baseline Noise levels in the Mudun Ela area

Table 1-6: Noise measurements in Mudun Ela (Wanawasala) area

Location	Measuring Date	Time	1 hr Residual Noise Level Leq(A)/dB	Background Noise Level L90(A)/dB
At the Northern boundary of the site	31.05.2017	Day	57	52
		Night	50	47
At the Eastern boundary of the site		Day	59	55
		Night	51	48
At the Southern boundary of the site		Day	60	56
		Night	54	50
At the Western boundary of the site		Day	59	55
		Night	55	50

Source: EIA report of the proposed metro Colombo solid waste management project



Source: EIA report of the proposed metro Colombo solid waste management project

Figure 1-7: Noise monitoring locations in the Proximity of Mudun Ela Area (Wanawasala-Kelaniya)

The past data on noise measurements show variation of the noise levels depending on the location specific noise generating sources. The measured noise levels had exceeded the stipulated levels for urban residential areas due to vehicular noise (new Kelani Bridge), but for other areas the levels were marginal and within the levels stipulated in the national environmental (noise control) regulations: schedule IV: urban residential areas. i.e. Leq 60 (daytime) and Leq 50 (nighttime).

Table 1-7: Noise Level Details

Location Description.	GPS Coordinates	Time Period	Time	Residual Noise Level Leq dB(A)	Background noise level L90 dB(A)
Dalugama, Kelaniya	6.969957° N 79.904856° E	07 th April 2022	Day	58	55
			Night	46	42
New Kelani bridge road.	06057'03.30" N 79052'30.90" E	20 th June 2022	Day	66	63
			Night	65	60
Negombo Road, Peliyagoda	6.961238° N 79.882092° E	29 th March 2022	Day	57	55
			Day	58	55
Standard: Max permissible noise			Day	60	
			Night	50	

Source: National Building Research Organization. ESSD

1.2.1.3 Ground vibration

There are no past measurements on ground vibration in Mudun Ela project area. However, several sources with potential to generate ground vibration are present in the project area. Traffic vibration can be considered as influencing vibration source in project areas.

In addition to road traffic-based vibration, in the Mudun Ela area the highway, the railway traffic-based vibration sources are also present to act as background vibration sources. Road and highway vibration can occur mainly when heavy trucks/vehicles passing at relatively high speed on a road with an uneven surface profile. The interaction between wheels and road surface causes a dynamic excitation which generates waves propagating in the soil and impinging on the foundations of nearby structures. Also, Traffic vibration is perceptible especially when heavy vehicles passing at relatively high speed on a road with an uneven surface profile. It can cause annoyance and stress to nearby residents. It is more perceptible during night as vehicles travel at very high speed on road. However, it is very unlikely to result in even minor superficial damage to buildings. Similarly rail vibration can be perceptible to human when trains are passing at a very high speed. Studies have shown that the rail track induced vibration cause annoyance to nearby residents, but unlikely to cause foundation damage to properly constructed buildings.

1.2.2 Ambient water quality

1.2.2.1 Measured values with reference to relevant Sri Lankan guideline values: Water temperature, TDS, TSS, Color, pH, BOD, COD, DO, SO₄, Cl, NO₂-N, NO₃-N, NH₃-N, T-N, T-P

Past water quality data and visual observations were used to describe the ambient water quality status of the canal proposed for rehabilitation. Past water quality data were available for the Mudun Ela catchment.

In general, the canals proposed for the rehabilitation drain densely populated urban landscapes. It was observed that the water in these canals is exposed to pollution from myriad of sources. Sewage from overflowing septic tanks (especially during heavy rains), intentional direct sewage discharges, poorly treated industrial wastewater discharges, direct disposal of household wastewater from kitchens and bathrooms, laundry wastewater, wastewater from commercial facilities, restaurants, and boutiques, road runoff and surface runoff carrying pollutants and sediments are the main pollution sources responsible for existing water quality in the canals of Mudun Ela.

1.2.2.2 Water quality in Mudun Ela

Major land-uses in the Mudun Ela catchment are urban built-up areas, marshy lands, and bare lands. During the field visit it was observed that large extents of the canal sections are silted and become part of the marsh covered with marshy vegetation such as *Eichhornia*, commonly called **water hyacinth** (Photo 1-1).

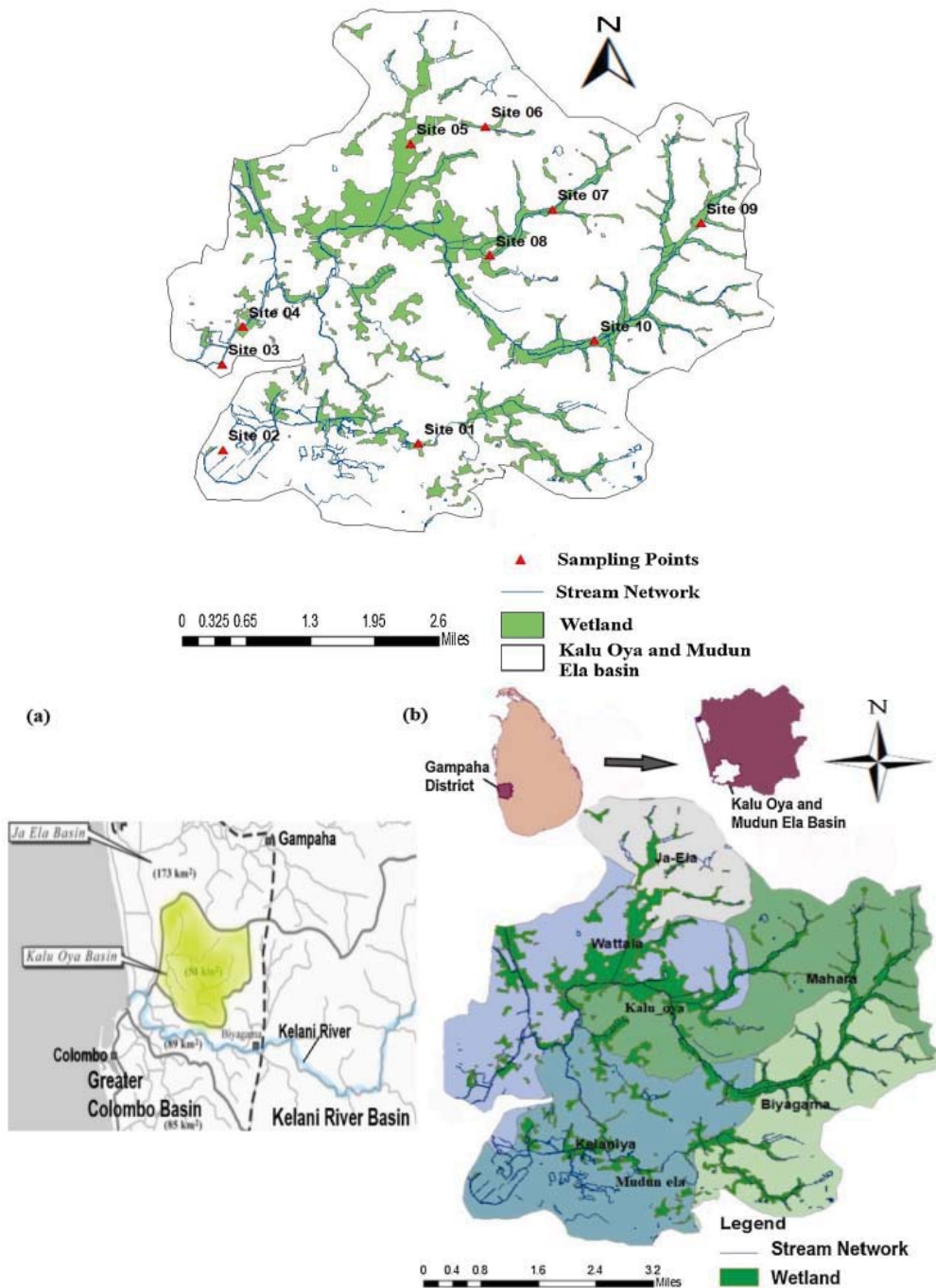


Photo 1-1: The canal sections covered with vegetation

1.2.3 Past studies on the water quality impairment of Mudun Ela

Study on ambient water quality in Kalu Oya and Mudun Ela catchment

A water quality assessment study carried for both Kalu Oya and Mudun Ela basin was used to describe background water quality status of the canals of the proposed project. Of the 10 sampling locations, location 1,2,3 and 4 represent the Mudun Ela. Sampling had been carried out from June to October 2018 to cover dry and wet period, extending up to five sampling occasions. The water quality indicator parameters (temperature, pH, EC, salinity, TDS), organic pollution parameters (DO, BOD₅, COD), nutrients (nitrate and total phosphorus) and oil & grease have been measured in this study.



Source: <https://doi.org/10.1016/j.enmm.2020.100402>: Surface water quality assessment for the management of hydrological regimes: Kalu Oya and Mudun Ela catchment in Sri Lanka

Figure 1-8: Mudun Ela catchment and the water quality sampling locations

The stream water quality with respect to its suitability for different use categories as given in National Environmental (Ambient Water Quality) Regulations, No. 01 of 2019 were compared. The use categories are: Category A: water that requires simple treatment, for drinking; Category B: bathing and contact recreational water; Category C: water suitable for aquatic life; Category D: water source that require to undergo general treatment process, for drinking; Category E: water suitable for irrigation and agricultural activities; Category F shall be water with minimum quality but does not fall into categories A to E. Please note that the author had used the levels stipulated in the interim ambient

water quality standards on the graphs.

When comparing the stream water quality of Mudun Ela with respect to its suitability for different categorical uses it is revealed that high BOD content and low DO levels in the steam water make the water unsuitable for stringent use categories such as Cat A, Cat B, Cat C (Figure 1-11). Both COD and Oil and grease levels too have failed to meet all use categories (Figure 1-12). But the Nitrates and Phosphate levels complies with the requirement for all use categories. (Figure 1-13).

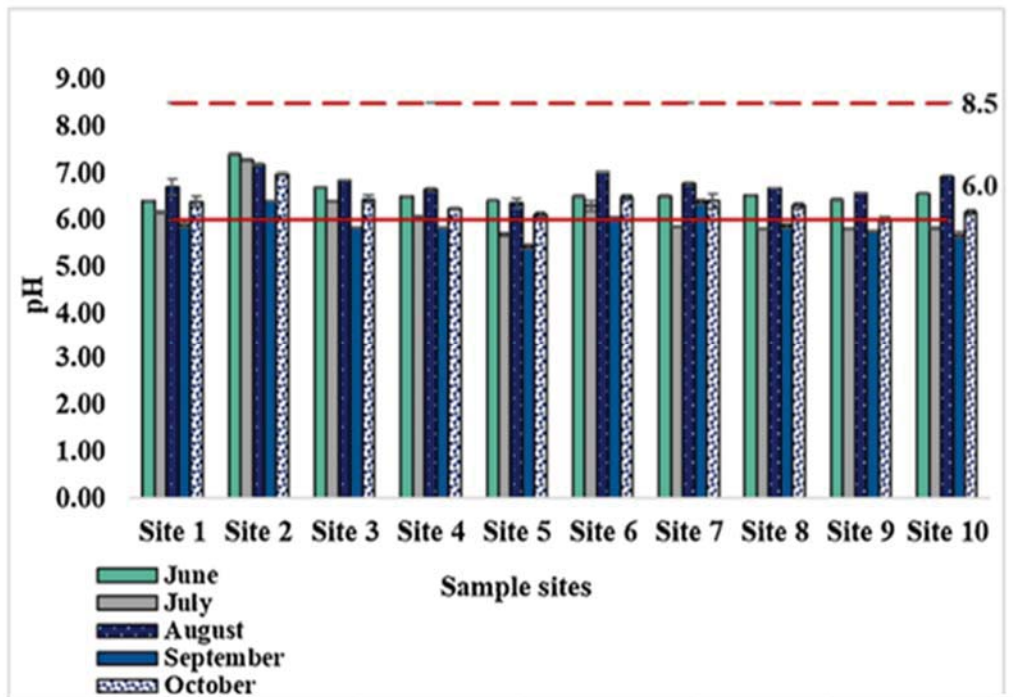
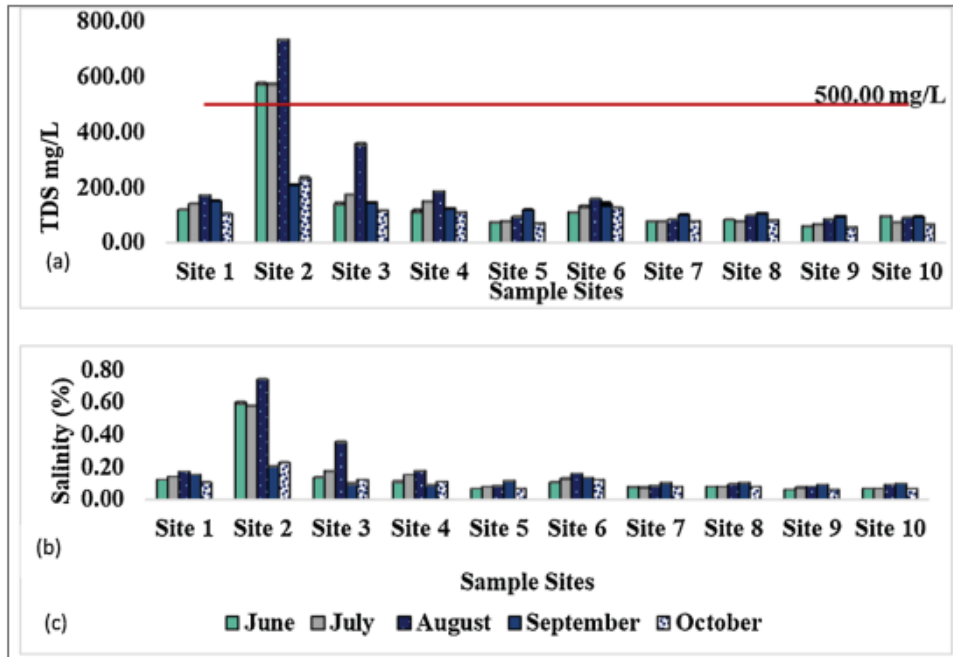


Figure 1-9: Spatial and temporal Variation of pH: Mudun Ela and Kalu Ela

Table 1-8: Spatial and temporal Variation of pH: Mudun Ela and Kalu Ela

Parameter	Unit	Category A	Category B	Category C	Category D	Category E	Category F
pH	-	6.0 – 8.5	6.0 – 9.0	6.0 – 8.5	6.0 – 9.0	6.0 – 8.5	5.5 – 9.0

Source: <https://doi.org/10.1016/j.enmm.2020.100402>: Surface water quality assessment for the management of hydrological regimes: Kalu Oya and Mudun Ela catchment in Sri Lanka



Source: <https://doi.org/10.1016/j.enmm.2020.100402>: Surface water quality assessment for the management of hydrological regimes: Kalu Oya and Mudun Ela catchment in Sri Lanka

Figure 1-10: Spatial and Temporal Variation of TDS(total Dissolved Solids) and Salinity

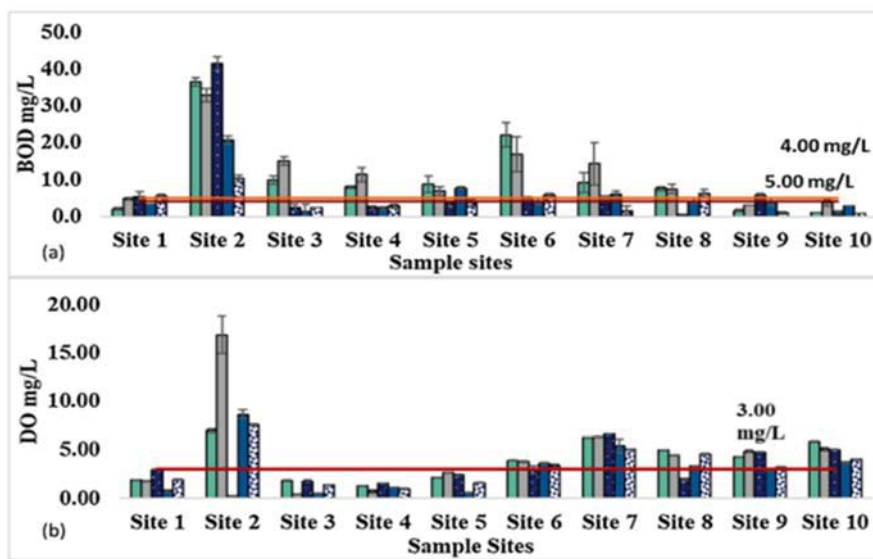


Figure 1-11: Spatial and temporal variation of Biochemical Oxygen Demand and Dissolved Oxygen

Table 1-9: Spatial and temporal variation of Biochemical Oxygen Demand and Dissolved Oxygen

Parameter	Unit	Category A	Category B	Category C	Category D	Category E	Category F
DO at 25°C	mg/l, min	6	5	5	4	3	3
BOD ₅ at 20°C	mg/l, max	3	4	4	5	12	15

Source: <https://doi.org/10.1016/j.enmm.2020.100402>: Surface water quality assessment for the management

of hydrological regimes: Kalu Oya and Mudun Ela catchment in Sri Lanka

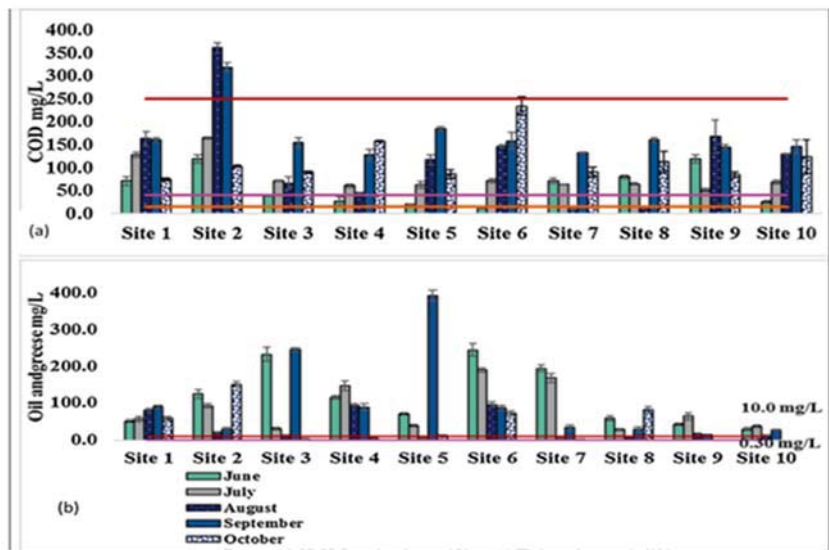


Figure 1-12: Saptial and temporal variation of COD and Oil and greases

Table 1-10: Saptial and temporal variation of COD and Oil and greases

Parameter	Unit	Category A	Category B	Category C	Category D	Category E	Category F
COD	mg/l, max	10	10	15	30	-	40
Oil/Grease	µg/l, max	100	-	100	100	-	300

Source: <https://doi.org/10.1016/j.enmm.2020.100402>: Surface water quality assessment for the management of hydrological regimes: Kalu Oya and Mudun Ela catchment in Sri Lanka

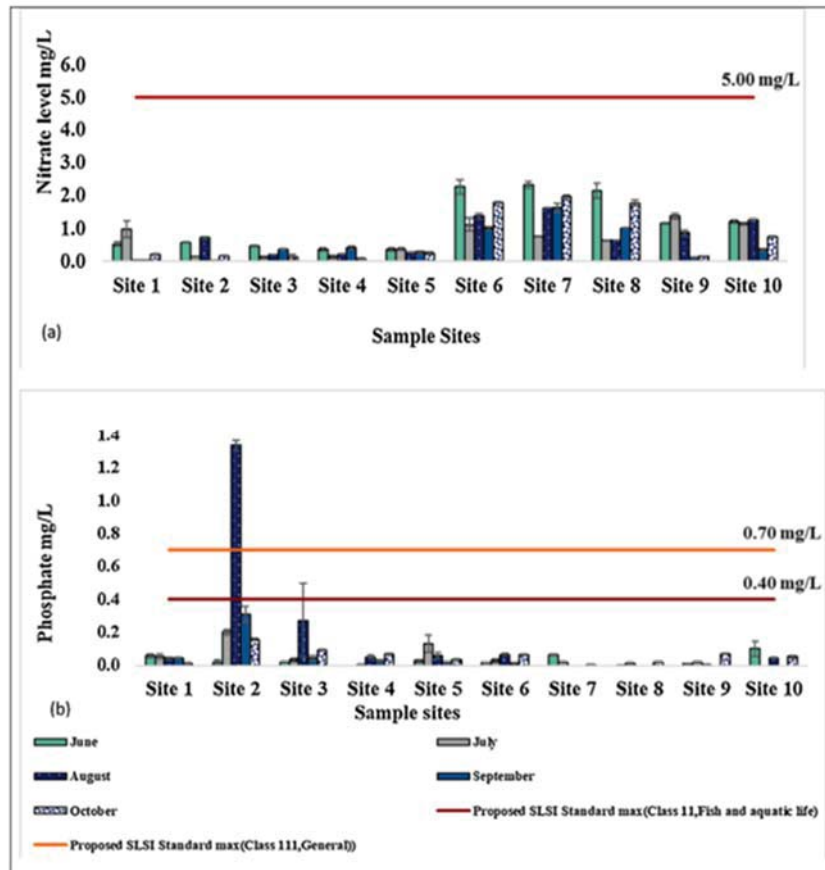


Figure 1-13: Spatial and temporal variation of Nitrates and Phosphates

Table 1-11: Spatial and temporal variation of Nitrates and Phosphates

Parameter	Unit	Category A	Category B	Category C	Category D	Category E	Category F
NO ₃ -N	mg/l, max	10	10	10	10	-	10
PO ₄ -P	mg/l, max	0.7	0.7	0.4	0.7	-	-

Source: <https://doi.org/10.1016/j.enmm.2020.100402>: Surface water quality assessment for the management of hydrological regimes: Kalu Oya and Mudun Ela catchment in Sri Lanka

1.2.3.1 Study on water quality impairment of Mudun Ela and Kalu Oya interpreted by water quality index

The SEA study for Mudun Ela and Kalu Oya reports that the Water Quality Index (WQI) values of the ambient water are at undesirable range. The assessment of surface and groundwater quality of this region during the period spanning from June to October 2016 has indicated the water quality degradation in the two basins. The study reports acidic ground waters (pH below 6), high electrical conductivity above 1000(μS) in the surface waters. The report further states that the results of the WQI calculated using 13 physio-chemical parameters (pH, EC, DO, SO₄²⁻, NO₃⁻, K⁺, Cl⁻, Na⁺, PO₄³⁻, F⁻, Mg₂⁺, HCO₃⁻ and Ca₂⁺) suggesting that the lower sub basin of both Kalu Oya and Mudun Ela are undergoing a rapid deterioration in both surface and ground water quality. According to the study the depletion of water quality was most pronounced in Wattala, Kelaniya, Dalugama, Hunupitiya and Wanawasala areas.

1.2.3.2 Sediment quality and heavy metal pollution in Mudun Ela

Past studies on sediment quality of canals proposed for rehabilitation are not available.

No reports were found out during the in-depth search on reliable published literature of past studies related to sediment quality in Mudun Ela. However, considering the land use character, management of waste including solid waste, wastewater, and hazardous waste, it can be assumed that the sediment may contain toxic pollutants at levels which is environmentally a significant concern. In the field visit, large extents of canal sections were observed with heavy siltation forming almost flat marshland covered with marshy vegetation. These acts as excellent filters to trap pollutants especially heavy metals, however upon their decay they form a part of canal sediments having higher organic matrix trapped with metal pollutants possibly with levels high enough to cause a threat to aquatic life upon their disturbance.

1.3 Ecological Environment

1.3.1 Terrestrial and aquatic habitats

Major natural or semi-natural habitat types found in the areas of the interventions are (i) Herb Dominated Low Vegetation, (ii) Herb Dominated High Vegetation, (iii) Woodlands, (iv) Waterways with Floating and Rooted Aquatic Vegetation, (v) Riparian and Highland or Terrestrial Vegetation and (vi) Open water area. Each of these have been described below. No areas within the zone of intervention are protected.

Herb Dominated Low Vegetation - This type of habitat arises mainly in abandoned paddy cultivations. Some of the common grass species observed in this habitat includes *Digitaria ciliaris* (Guru Tana), *Echinochloa colona* (Gira Tana), *Echinochloa stagnina* (Wel Maratu), *Eragrostis amabilis*, *Isachne globosa* (Bata Della), *Ischaemum rugosum* (Kudu Kedu), *Leersia hexandra* (Lev), *Panicum repens* (Gini Thana). Other common herbaceous species observed in this habitat includes *Scleria poaeformis* (Pothukola Pan), *Actinoscirpus grossus*, *Cyperus* spp., *Eleocharis* spp., *Fimbristylis* spp., *Rhynchospora corymbosa*, *Cyclosorus interruptus*, *Ludwigia peruviana*, *Ludwigia perennis*, *Echinodorus* sp., *Colocasia esculenta* (Gahala), *Limnocharis flava*, *Persicaria attenuata* (Sudu Kimbul Wenna), *Typha angustifolia* (Hambu Pan), *Mikania cordata* (Wathu Palu), *Aniseia martinicensis* (Potu Palaa), *Ipomoea aquatica* (Kan Kun), *Lygodium microphyllum* (Pamba Wel). Sometimes, isolated small trees, *Annona glabra* (Wel Attha), *Cerbera odollam* (Gon Kaduru), *Glochidion zeylanicum* (Hunu Kirilla), *Syzygium caryophyllum* (Heen Dan), *Cassia alata* (Rata Tora) and isolated small shrub patches, *Ipomoea carnea*, *Phyllanthus reticulatus* (Kaila), *Pandanus kaida* (Wata Keyiya), *Premna obtusifolia* (Maha Midi) can be observed within this habitat type. Floating aquatic plant species, *Eichhornia crassipes* (Japan Jabara), *Salvinia molesta* (Salvinia), *Pistia stratiotes* (Diya Paradel) were found on the water of small water paddles in this habitat.

Paddy cultivated lands, also can be classified under this category where the vegetation is dominated by a single species *Oryza sativa* with various weed species such as *Isachne globosa*, *Fimbristylis* sp, *Cyperus* sp, *Panicum repens*, *Echinochloa colona* and *Ludwigia perennis* occurring either within the paddy cultivated area, bunds in the paddy fields or irrigation canals within the paddy cultivated area.

Woodlands: Most of the Woodlands dominated by invasive alien tree species *Annona glabra* (Wel Attha) and therefore can be called as *Annona* woodlands. Some woodlands made by mixture of trees and shrub species including *Annona glabra* (Wel Attha), *Hibiscus tiliaceus* (Beli Patta), *Pandanus kaida* (Wata Keyiya), *Cerbera odollam* (Gon Kaduru), *Barringtonia racemosa* (Diya Midella) and therefore can be called as mixed woodlands.

Water with Floating and Rooted Aquatic Vegetation: Water of the tanks, waterholes, canals, river and streams colonized by various type of aquatic semi-aquatic plant species. *Eichhornia crassipes*

(Japan Jabara), *Salvinia molesta*, *Pistia stratiotes* (Diya Paradel), *Ceratophyllum demersum*, *Hydrilla verticillata*, *Utricularia aurea* (Diya Pasi), *Aponogeton crispus* (Kekatiya), *Nympoides indica* (Kumudu), *Nelumbo nucifera* (Nelum), *Nymphaea pubescens* (Olu), *Nymphaea* spp., *Ipomoea aquatica* (Kan Kun), *Ludwigia adscendens*, *Echinodorus* sp., *Colocasia esculenta* (Gahala), *Limnocharis flava*, *Actinoscirpus grossus*, *Cyperus* spp., *Eleocharis* spp., *Fimbristylis* spp., *Ludwigia perennis*, *Ludwigia peruviana*, *Lagenandra* spp. (Kethala), *Typha angustifolia* (Hambu Pan), *Persicaria attenuata* (Sudu Kimbul Wenna), *Brachiaria mutica* (Diya Tana), *Echinochloa stagnina* (Wel Maratu), *Panicum repens* (Etor), *Cyclosorus interruptus*, *Struchium sparganophorum*, *Eragrostis amabilis*, *Ischaemum rugosum* (Kudu Kedu) are some common plant species inhabited.

1.3.2 Current condition of vegetation and biodiversity

The area has a high potential to support both terrestrial and aquatic biodiversity if managed properly. However, many canal banks and wetlands are reclaimed and encroached upon. These have exemplified many environmental issues including flooding. These issues have reduced the capacity of wetland to provide valuable services and to support biodiversity. Many small industries are in the Mudun Ela basin these lacking proper treatment facilities.

Clearing of canals, maintaining wetlands through protection and regular restoration (removal of weeds), are entrusted to the local authorities (Irrigation Department, Urban Development Authority etc.) which have been neglected. This has resulted in the blockage of canals, dumping of domestic waste and effluents into canals and the overgrowth with of aquatic weeds, which have led to the deterioration of the wetlands reducing soakage and hydraulic bottlenecks hampering waterflow. Progressively the use of eco-friendly agricultural practices has been replaced using synthetic fertilizers and pesticides leading to eutrophication of the water ways. There has been an overall wetland reduction of 10% in both the Kalu Oa and Mudun Ela basins.

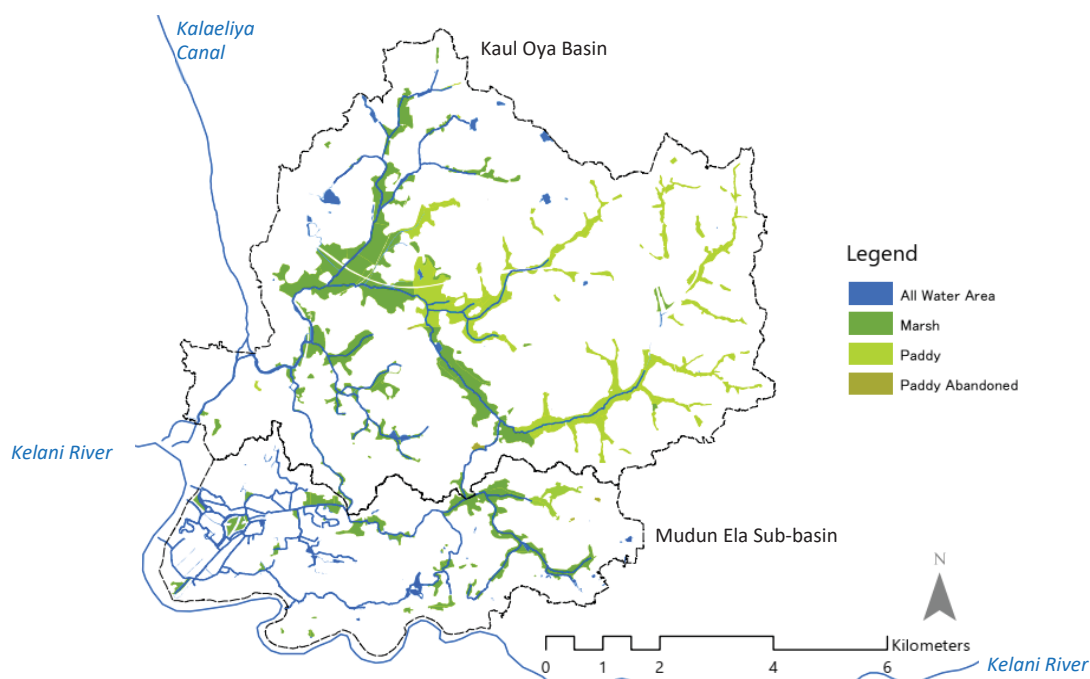
1.3.3 Current ecosystem service and its vulnerability

Wetlands and associated terrestrial habitats serve many important ecological functions that include – providing habitats for biodiversity, water regulation, recycling and trapping sediments / nutrients, flood, carbon sequestration, purification of air and water to name a few. Reclaiming wetland habitats, reduction in-depth of wetland habitats and overgrowth by weeds, and pollution have caused a drastic decline in all of these functions. From a human perspective water regulation led to flood mitigation, a function which has also declined.

In addition, current status of low wetlands in the Kalu Oya and Mudun Ela watersheds were studied and analyzed in detail in the "Wetland Management Strategy for the Kalu Oya and Mudun Ela basins" developed by SLLDC in 2018. Although the marked study area is slightly smaller in area compared to the watersheds covered by this study, the details pertaining to the current status of the low wetlands in the targeted watersheds from the survey results are quoted below.

- - The wetlands in the study area consist of two watersheds: the upper reaches are rice paddies that are still being utilized, while the middle and lower reaches are in the process of transitioning from former rice paddies to abandoned rice paddies and a mosaic of different types of natural vegetation. The current low marsh in the study area is affected only by a small inflow of water during the high tide in the dry season, and taking this into consideration, it can be positioned as a freshwater low marsh in principle.
- The low marsh in the Kalu Oya and Mudun Ela basins consists of three habitat types, namely, 1) open water, 2) herb vegetation dominated areas, and 3) forested areas. Each low wetland type will be a habitat from factors of excellence in management form, hydrodynamics, vegetation, etc.
- In two watersheds, threats to hyporheic habitats have been identified from field surveys in the study area. The most significant impact is the erosion of low wetland sites due to the alteration of low wetlands based on the demands of urbanization and land zoning, as well as the uncontrolled and

large scale disposal of garbage into low wetlands.



Source : JICA study team based on GIS data of Survey Department (2016) and GIS data of LUPPD (2018)

Figure 1-14: Distribution of low wetland Kalu Oya and Mudun Ela basin (2018)

1.3.4 Recorded endemic and threatened species in the area

Recorded Endemic and Nationally Threatened Flora Species

As summarized Table 1-12 and 1-13 below, in Seven endemic plant species, eleven nationally threatened plant species (including two endemic species) and nine nationally near threatened (NT) plant species (including one endemic species) were recorded during the study. *Areca concinna* (Lenteri Puwak), *Cinnamomum zeylanicum* (Kurundu), *Memecylon rostratum* (Heen Kuritiya), *Argyrea populifolia* (Giritilla), *Aporusa lanceolata* (Heen Kebella), *Xanthophyllum zeylanicum* (Palala), *Garcinia quaesita* (Rat Goraka) are recorded endemic plant species and of them *Areca concinna* (Lenteri Puwak) is nationally endangered (EN), *Cinnamomum zeylanicum* (Kurundu) is nationally vulnerable (VU) and *Memecylon rostratum* (Heen Kuritiya) is nationally near threatened (NT).

Among recorded non-endemic plant species, two species, *Aganope heptaphylla*, *Ailanthus triphysa* (Wal Bilin) are critically endangered (CR), seven species, *Anodendron paniculatum* (As Wel), *Aponogeton crispus* (Kekatiya), *Coix lacryma-jobi* (Kirindi), *Tinospora cordifolia* (Rasakinda), *Margaritaria indicus* (Karawu), *Gyrinops walla* (Walla Patta), *Hypolytrum nemorum* are nationally vulnerable (VU) and eight species, *Calophyllum acidus* (Dehi Keena), *Wissadula periplocifolia*, *Monochoria hastata* (Diya Habarala), *Ceratopteris thalictroides*, *Carallia brachiata* (Dawata), *Cyclosorus interruptus*, *Mimusops elengi* (Munamal), *Chrysophyllum roxburghii* (Lawulu) are nationally near threatened (NT) according to 2012 national red data book.

Table 1-12: Number of species confirmed at Kalu Oya and Mudun Ela watersheds

Total Species	Threatened			NT	Endemic	Exotic
	CR	EN	VU			
168	2	1	8	9	7	41

CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened
Source: SLLDC, 2012 national red data book

Table 1-13: Types of Endangered species confirmed at Kalu Oya and Mudun Ela basin

Category	Endemic	Exotic
CR	-	<i>Aganope heptaphylla</i> <i>Ailanthus triphysa</i> (White Siris)
EN	<i>Areca concinna</i> (Lenteri Puwak)	-
VU	<i>Cinnamomum zeylanicum</i> (Kurundu)	<i>Anodendron paniculatum</i> (As Wel) <i>Aponogeton crispus</i> (Kekatiya) <i>Coix lacryma-jobi</i> (Kirindi) <i>Tinospora cordifolia</i> (Rasakinda) <i>Margaritaria indicus</i> <i>Gyrinops walla</i> (Walla Patta) <i>Hypolytrum nemorum</i>
NT	<i>Memecylon rostratum</i> (Heen Kuritiya)	<i>Calophyllum acidus</i> (Dehi-Kina) <i>Wissadula periplocifolia</i> (Kiri-kaju) <i>Monochoria hastata</i> (Diya Habarala) <i>Ceratopteris thalictroides</i> <i>Carallia brachiata</i> (Dawata) <i>Cyclosorus interruptus</i> <i>Mimusops elengi</i> (Munamal) <i>Chrysophyllum roxburghii</i> (Rata Lawulu)

CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened

Source: SLLDC, National red data book (2012)

Alien Invasive plant species

The anthropogenic impacts in these basins are evident by the presence of numerous alien invasive species. These include the aquatic invasives *Salvinia molesta* (Salvinia), *Eichhornia crassipes* (Japan Jabara), *Typha angustifolia* (Hambu Pan), and the semi-aquatic or terrestrial species such as *Annona glabra* (Wel Attha), *Cuscuta campestris* (Aga Mula Neti Wel), *Sphagneticola trilobata*, *Colocasia esculenta* (Gahala) and *Ludwigia peruviana* is potential invasive plant species according to national invasive alien plant species list. Terrestrial species include the potentially invasive plants *Leucaena leucocephala* (Ipil Ipil), *Acacia auriculiformis*, *Muntingia calabura* (Jam) which have been recorded only in woodlands. Some plant species observed in this habitat, such as *Echinodorus* sp., *Dieffenbachia seguine* can be considered as noxious alien plant species due to rapid spreading over this habitat.

Fauna of the Mudun Ela basin

A total number of 186 faunal species including 10 endemic species, 6 nationally threatened (3 Endangered and 3 Vulnerable) species and 9 nationally near threatened species were recorded during the field survey within the study area (Table 1-14).

Table 1-14: Summary of the Faunal Species

Taxonomic Group	Total Number	Endemic Species	Threatened and Near Threatened				Exotic / Feral
			CR	EN	VU	NT	
Birds	83	1	0	0	0	4	2
Butterflies	33	1	0	0	0	0	0
Dragonflies	27	2	0	0	2 (1)	4	0
Mammals	10	1	0	2 (1)	1	0	0
Reptiles	7	2	0	0	0	0	0
Amphibians	4	0	0	0	0	0	0
Fishes	19	3	0	1 (1)	0	1 (1)	6
Snails	3	0	0	0	0	0	1
Total	186	10	0	3 (2)	3 (1)	9 (1)	9

CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened

Recorded Endemic and Nationally Threatened Fauna Species

Ten endemic animal species, six nationally threatened animal species (including three endemic species) and nine nationally near threatened (NT) plant species (including one endemic species) were identified. *Megalaima rubricapilla* (Crimson-fronted Barbet), *Aplocheilus dayi* (Day's killifish), *Clarias brachysoma* (Walking catfish), *Dawkinsia singhala* (Filamented Barb), *Semnopithecus vetulus* (Purple-faced leaf monkey), *Dendrelaphis schokari* (Common bronze back), *Xenochrophis cf. piscator* (Checkered Keelback), *Appias galene* (Lesser albatross), *Libellago adami* (Adam's Gem), *Prodasineura sita* (Stripe-headed Threadtail) are recorded endemic faunal species. Of them fish species, *Aplocheilus dayi* (Day's killifish) and mammalian species, *Semnopithecus vetulus* (Purple-faced leaf monkey) are nationally endangered (EN), damselfly, *Libellago adami* (Adam's Gem) is nationally vulnerable (VU) and fish species, *Clarias brachysoma* (Walking catfish) is nationally near threatened (NT) according to 2012 national red data book.

Among recorded non-endemic faunal species, one mammalian species, *Prionailurus viverrinus* (Fishing cat) is nationally endangered (EN), two species including one mammalian, *Lutra lutra* (Otter) and one damselfly, *Ceriagrion cerinorubellum* (Painted Waxtail) are nationally vulnerable (VU) and eight species including four birds, *Ixobrychus cinnamomeus* (Cinnamon Bittern), *Ixobrychus sinensis* (Yellow Bittern), *Nycticorax nycticorax* (Black-crowned Night Heron), *Phalacrocorax carbo* (Great Cormorant) and four dragonflies, *Diplacodes nebulosa* (Blacktipped Percher), *Orthetrum glaucum* (Asian Skimmer), *Orthetrum luzonicum* (Marsh Skimmer), *Trithemis pallidinervis* (Dancing Dropwing) are nationally near threatened (NT) as in Table 1-15.

Table 1-15: List of the Endangered Species in study areas

Category	Endemic	Exotic
CR	-	-
EN	[Fish] <i>Aplocheilus dayi</i> (Day's killifish) [Mammal] <i>Semnopithecus vetulus</i> (Purple-faced leaf monkey)	[Mammal] <i>Prionailurus viverrinus</i> (Fishing cat)
VU	[Dragonfly] <i>Libellago adami</i> (Adam's Gem)	[Mammal] <i>Lutra lutra</i> (Otter) [Dragonfly] <i>Ceriagrion cerinorubellum</i> (Painted Waxtail)
NT	[Fish] <i>Clarias brachysoma</i> (Walking catfish)	[Bird] <i>Ixobrychus cinnamomeus</i> (Cinnamon Bittern) [Bird] <i>Ixobrychus sinensis</i> (Yellow Bittern) [Bird] <i>Nycticorax nycticorax</i> (Black-crowned Night Heron) [Bird] <i>Phalacrocorax carbo</i> (Great Cormorant) [Dragonfly] <i>Diplacodes nebulosa</i> (Blacktipped Percher) [Dragonfly] <i>Orthetrum glaucum</i> (Asian Skimmer) [Dragonfly] <i>Orthetrum luzonicum</i> (Marsh Skimmer) [Dragonfly] <i>Trithemis pallidinervis</i> (Dancing Dropwing)

Note: CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened
Source: SLLDC, National red data book (2012)

In the Kalu Oya and Mudun Ela watersheds, the Sri Jayawardanapura Sanctuary (a type of protected area designated by the Wildlife Conservation Dept.) is located approximately 4 km to the south. The Sanctuary is located in the area of Lake Diyawana where the Parliament is located, and is about 4.49 km² in size. It is not designated as an Important Bird Area (IBA). Much of the designated area is urbanized.

1.4 Socio-economic Environment Settlement Social Structure

Mudun Ela project is located in 8 Grama Niladari divisions of Kelaniya DS division of Gampaha district of Western province. Pattiya North, Peliyagoda Gangabada East, Meegahawatta, Wanawasala East, Wanawasala West, Dippitigoda, Hibusuwelgoda and Dalugama are attached to Kelaniya DS division.

1.4.1 Population, Density

The Colombo and Gampaha districts are the most populous districts in Sri Lanka. The population density in Gampaha district is 1,719 people per sq. km (Department of Census and Statistics, 2012). Kelaniya DS area is a highly populated area out of all divisional secretariat areas in the Gampaha district and it is around 5,900 persons per sq.km. The population density map prepared for the Mudun Ela project based on data of Department of Census and Statistics is presented as

Figure 1-15.

The total population in 8 Grama Niladari divisions is 32,226 people. This includes 15,274 males and 16,952 females. Refer Table 1-16 below. Most of the population is Sinhalese. There are also other minority populations such as Tamil and Muslims living in the project area.

Table 1-16: Population in GN divisions affected by the project disaggregated by gender

DSD	GND	No. of Families	Male	Female	Total Population
Kelaniya	Pattiya North 173 B	1451	2629	2737	5366
	Peliyagoda Gangabada East 174 B	470	1160	1601	2761
	Meegahawatta 174 C	1508	3375	2953	6328
	Hibusuwelgoda 257 A	865	1954	2109	4063
	Wanawasala East 257 B	942	1677	1972	3649
	Wanawasala West 257	1125	1670	2490	4160
	Dippitigoda 260	1660	1825	2026	3851
	Dalugama 260 A	425	984	1064	2048
Total		8446	15274	16952	32226

Source: Resources profile of Kelaniya – 2021

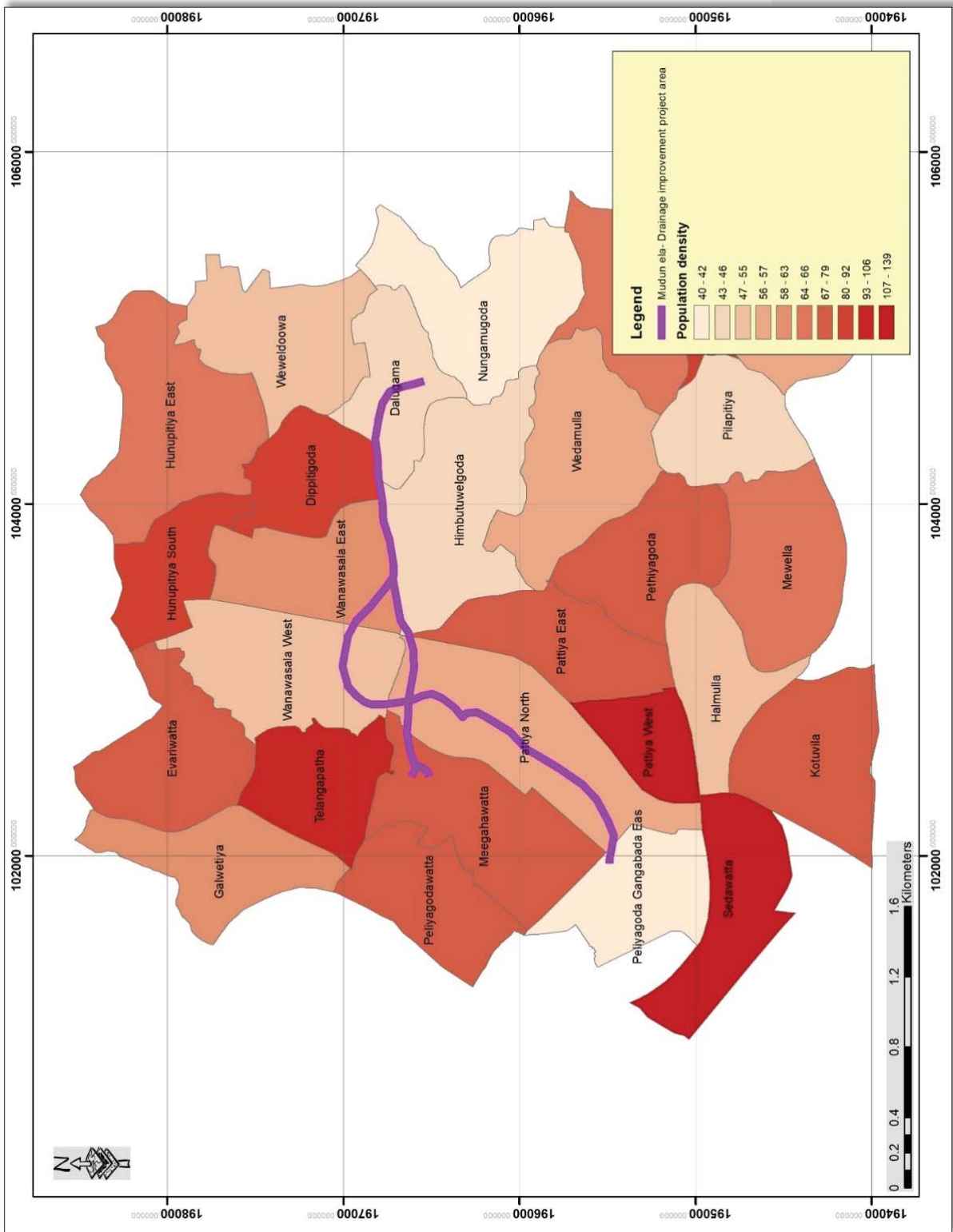


Figure 1-15: Population density of Mudun Ela project area

The administrative map for Mudun Ela area showing the Grama Niladhari and Divisional Secretary boundaries is given in Figure 1-16.

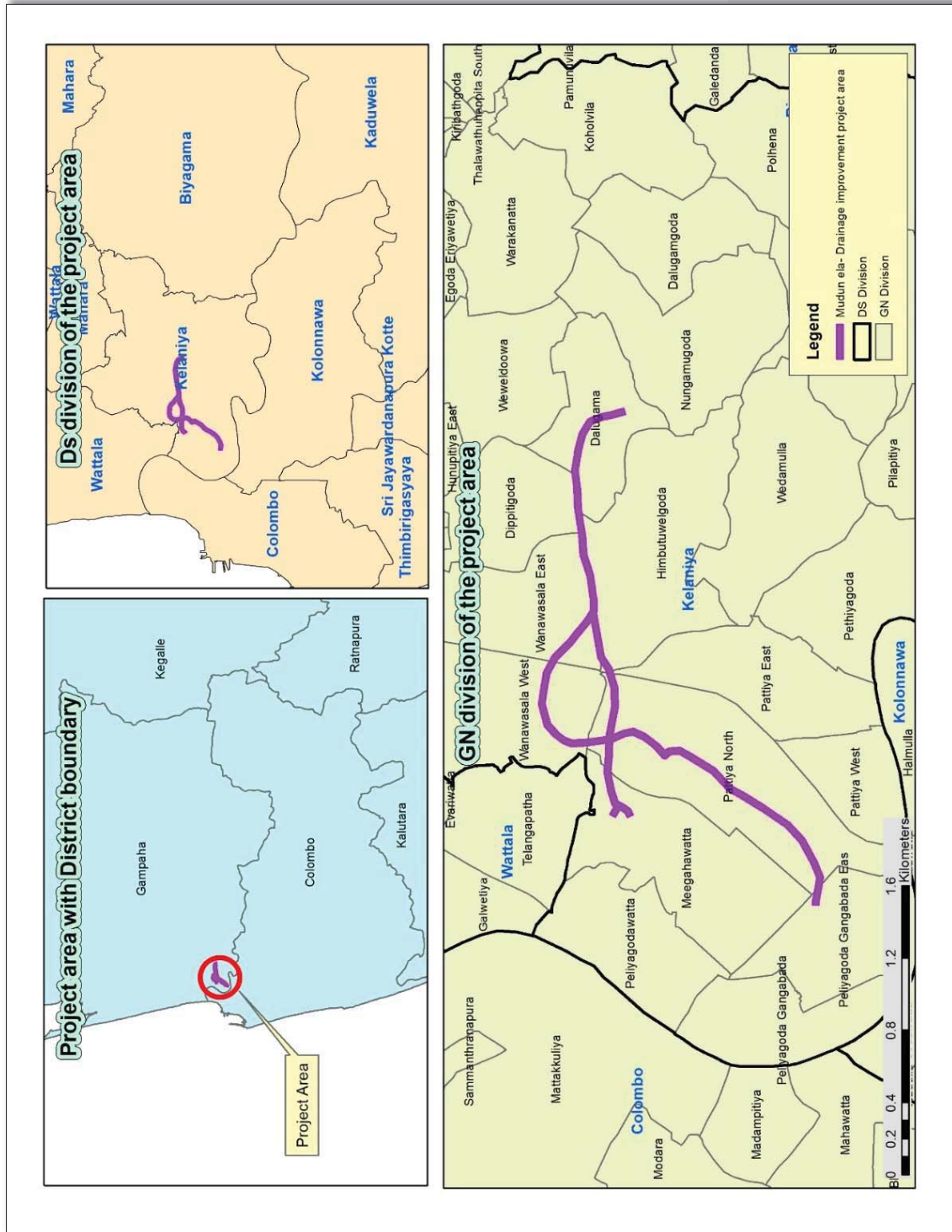


Figure 1-16: Administrative map of Mudun Ela project area

1.4.2 Distribution of settlement

Table below presents the distribution of housing units in each GN division by type of units. When comparing types of housing units in the project area there are higher number of permanent housing units than the semi-permanent and improvised structures. There are low-income housing units especially in Meegahawatta, Pattiya North and Wanawasala East GN divisions of Mudun Ela project area also. The Photo 1-2 present the low-income housing units in the project area.

Table 1-17: Distribution of housing units with type of units in Mudun Ela project area

DSD	GND	Permanent	Semi-Permanent	Improvised	Unclassified
Kelaniya	Pattiya North 173 B	1218	778	421	
	Peliyagoda Gangabada East 174 B	463	333	126	
	Meegahawatta 174 C	1187	865	312	
	Himbutuwelgoda 257 A	849	748	99	
	Wanawasala East	632	46	2	
	Wanawasala West	852	60	0	
	Dippitigoda	873	25	0	
	Dalugama 260 A	481	477	4	-
Total		6,555	3,332	964	-

Source: Resource profile data of Kelaniya – 2021/2020



Photo 1-2: Low-income houses in Mudun Ela project

1.4.3 Land use condition

1.4.3.1 Present Land Use Conditions

The land use map for the Mudun Ela area is given in Figure 1-17. In Mudun Ela area, the common land use is marshy and home gardens. Some marshy lands have been filled for present day developments. The common land use in Mudun Ela project area is home gardens.

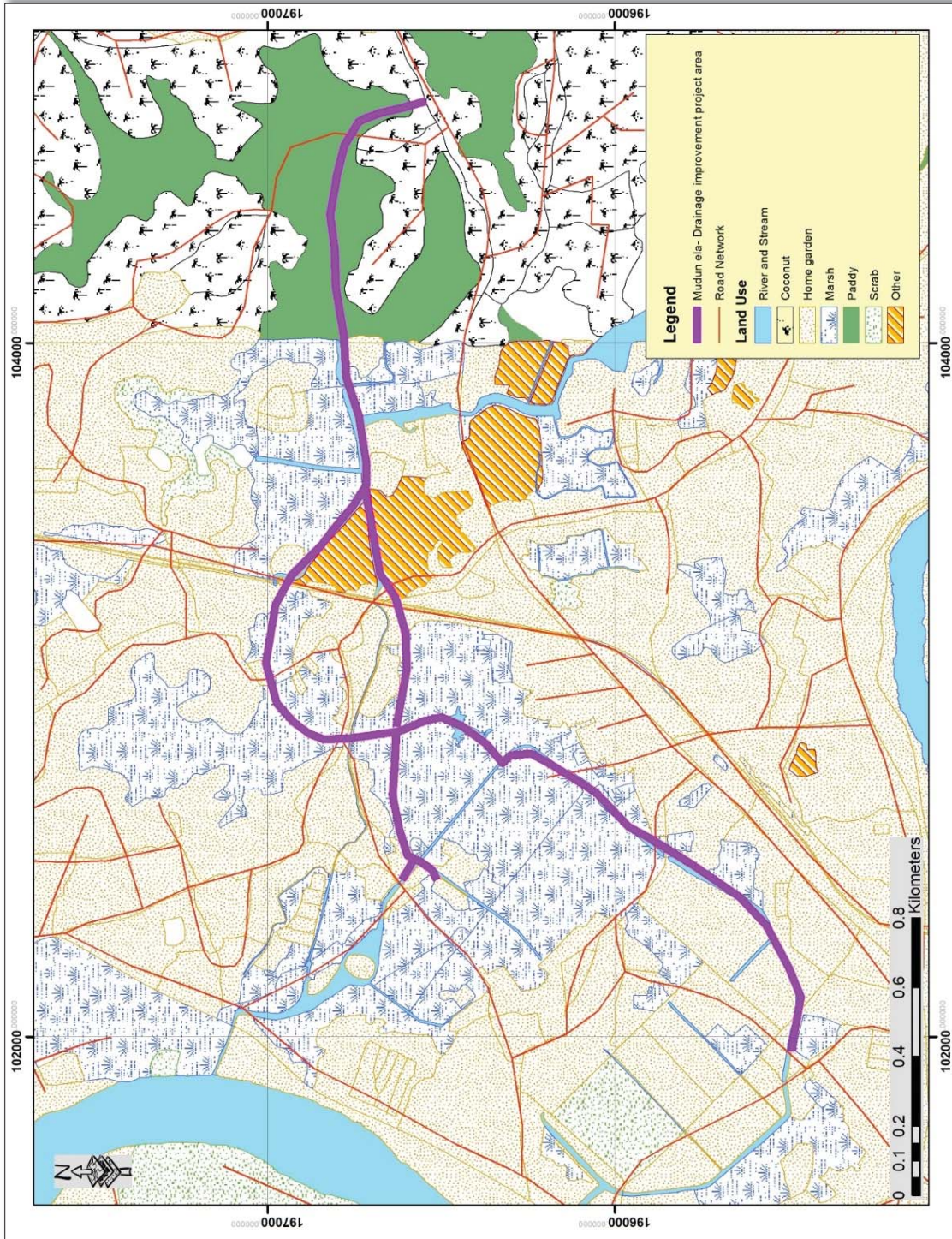


Figure 1-17: Land use for Mudun Ela project area

1.4.3.2 Planned Land Use Conditions

1.4.4 Local resources utilization

Mudun Ela project area also there are settlements, factories/warehouses and Colombo Katunayake expressway is traversing across the wetland area. Residents have home gardens, and they cultivate fruit and coconut trees. For about 30 years back, there had been paddy lands and recently many developments in the project area have taken place by filling wetland and these paddy lands. There is Peliyagoda fish market, solid waste management center and other factories/companies established in the project area. People have encroached Mudun Ela canal reservations and other government lands. There is also a large waste dumping site in Manelgama. Key Informant Interviews and FGDs confirmed that solid waste disposal to canal is a problem in the project area.

1.4.5 Spatial planning

There are development plans prepared by Urban Development Authority for Kelaniya Pradeshiya Sabah.

The plan for the Kelaniya Pradeshiya Sabah area includes following,

- Proposed land use plan 2021-2030 is given in Figure 1-18
- Proposed road and Transport Plan – 2030 is given in Figure 1-19
- Proposed land use plan: cross section of proposed special physical structure is presented in Figure 1-22
- Proposed wetland zoning plan is given in Figure 1-20
- Proposed landscape management plan 2030 is given in Figure 1-21

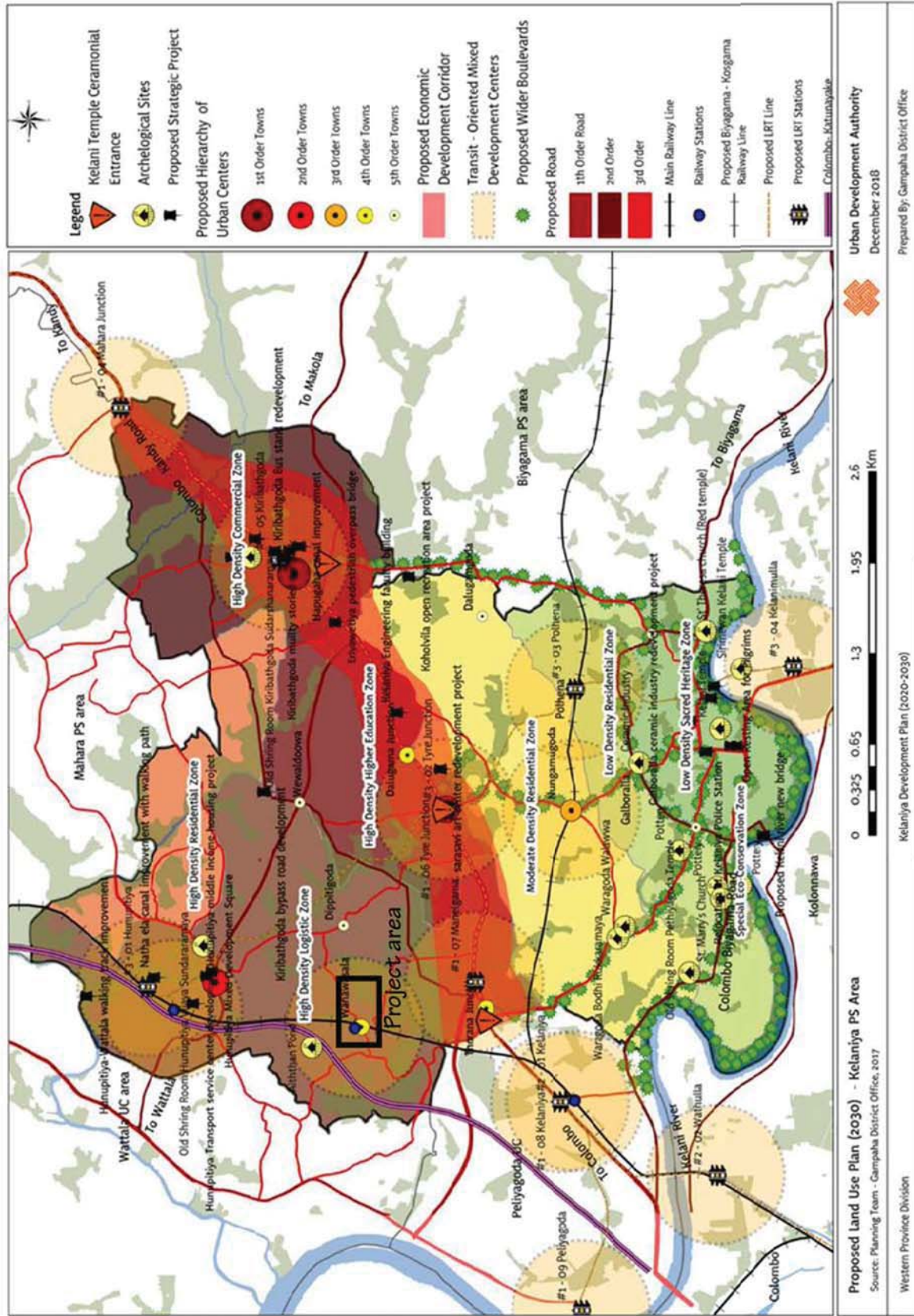


Figure 1-18: Proposed land use plan in Kelaniya – 2030

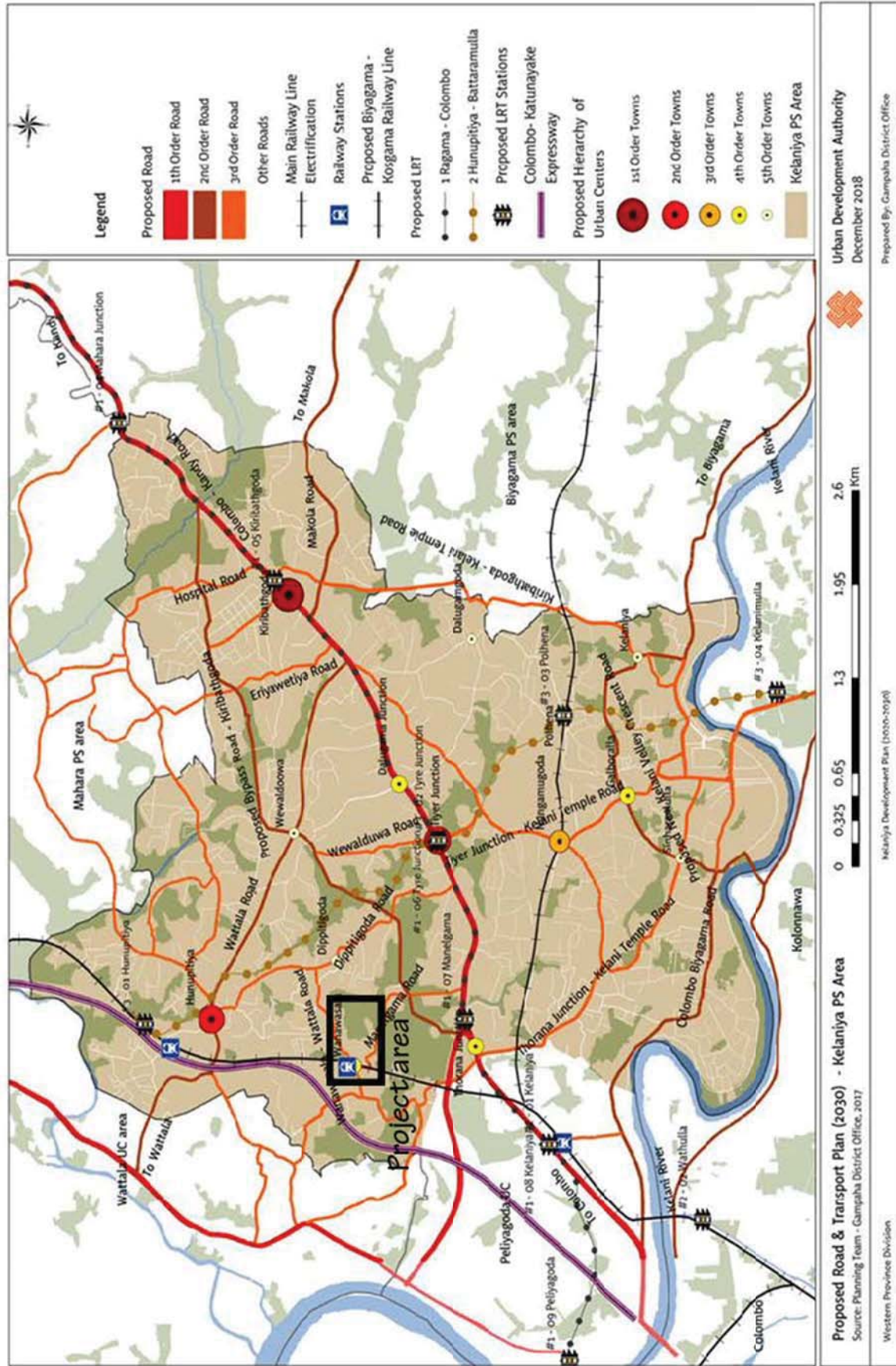


Figure 1-19: Proposed Road & Transport plan in Kelaniya - 2030

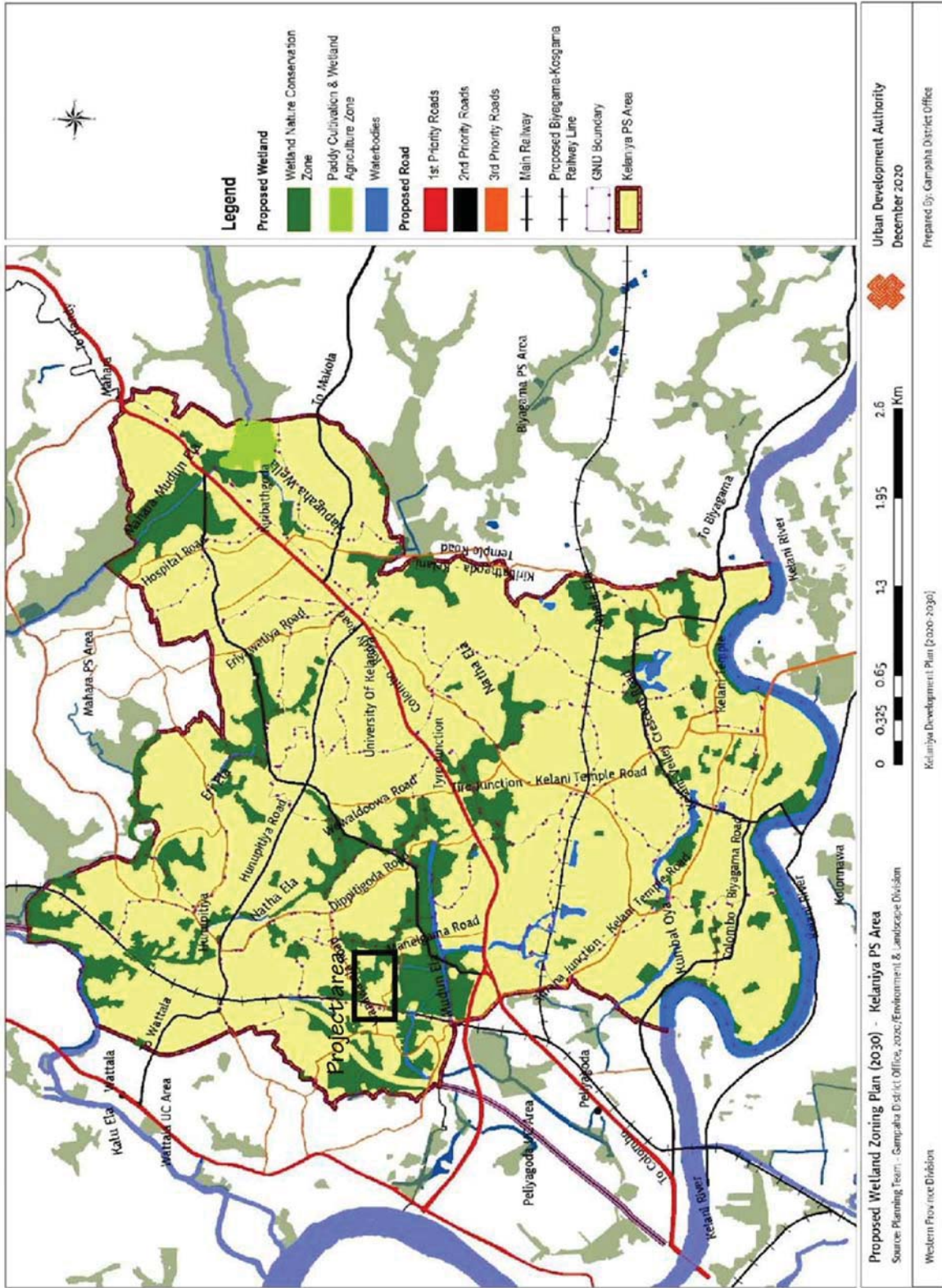


Figure 1-20: Proposed wetland zoning plan in Kelaniya - 2030

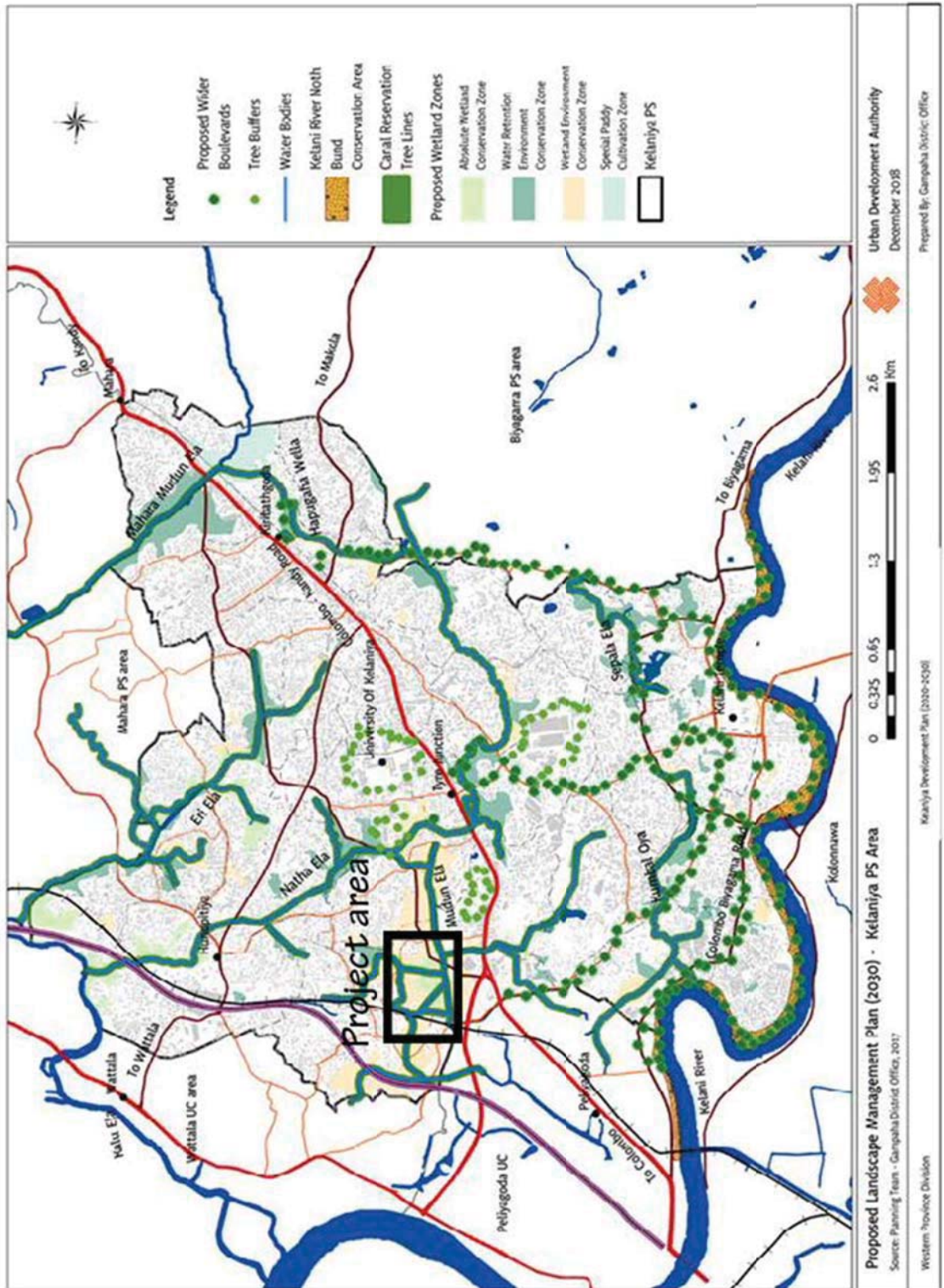


Figure 1-21: Proposed landscape management plan 2030



Figure 1-22: Cross section of proposed special physical structure

1.4.6 Source of Income

Concerning Kelaniya DS, majority of people are engaging in private and skilled/unskilled labor. Refer Table 1-18 below.

In Kelaniya DS division, 551 households are identified as having the household income below Rs. 6,000/= while 1642 households are getting an income above Rs. 20,000/=. Refer Table 1 18.

Table 1-18: Occupation of people living in affected GN Divisions

Divisional Secretariate	Grama Niladhari Divisions	Government/ Semi Government	Private	Agriculture	Industry	Services	Self-Employment	Skilled/Unskilled Labor	Foreign Employment	Other
Kelaniya	Pattiya North 173 B	165	781	-	-	-	835	1345	141	-
	Peliyagoda Gangabada East 174 B	35	502	-	-	-	32	130	25	-
	Meegahawatta 174 C	61	1490	-	-	-	220	1355	220	-
	Himbutuwelgoda 257 A	329	228	-	-	-	148	578	21	-
	Wanawasala East 257 B	307	258	-	-	-	146	69	40	-
	Wanawasala West 257	83	961	-	-	-	100	55	65	-
	Dippitigoda 260	215	824	-	-	-	475	422	11	-
	Dalugama 260 A	184	178	-	-	-	421	177	64	-
	Total	1,379	5,222				2,377	4,131	587	

Source: Administrative data of Kelaniya – 2021

Other – part-time job + no permanent job + unemployed

Table 1-19: Income of households in affected GN divisions

DSD	GND	Below Rs 6000	Rs 6001 - 15000	Rs 15001 - 20000	Rs 20001 - 30000	Rs 30001 - 50000	Above Rs 50001
Kelaniya	Pattiya North 173 B	135	760	340	144	58	14
	Peliyagoda Gangabada East 174 B	18	180	170	50	52	0
	Meegahawatta 174 C	305	198	360	425	130	90
	Himbutuwelgoda 257 A	62	133	164	184	280	42
	Wanawasala East 257 B	60	132	170	189	321	70
	Wanawasala West 257	145	440	335	155	30	20
	Dippitigoda 260	241	294	478	552	71	24
	Dalugama 260 A	31	121	100	87	86	0
Total		997	2258	2117	1786	1028	260

Source: Administrative data of Kelaniya – 2021 The poor, vulnerable, indigenous, and ethnic people

The official poverty line in Sri Lanka is considered as Rs. 5,223/= per month (DCS, 2012/2013). When considering the income of households in the project area, 997 families are identified as below the poverty line. Other vulnerable population groups are presented in Table below. The indigenous people in Sri Lanka are living in the Uva province, away from Western province. Although there are ethnic minorities such as Tamil and Muslim living in the project area, their rights are guaranteed by the constitution of Sri Lanka.

Table 1-20: Vulnerable population in the project area

DS Division	Vulnerability	Number of Persons
Kelaniya	Elderly people (Over 60 years old)	3658
	Disabled population	184
	Children 0-5 years old	2840
	Children without parental care (parents are abroad, dead or separated)	354
	Number of families below poverty line	997

Source: Administrative data of Kelaniya – 2021/2020

1.4.7 Economic activity

1.4.7.1 Agriculture

There are few families engaged in small-scale home gardening in the project area. Few others are engaged in small-scale poultry farming on their land premises.



Photo 1-3: Raising of domestic pigs as livestock



Photo 1-4: poultry farming

1.4.7.2 Fishery,

There is sea water fishing in coastal areas of Kelaniya DS division. Key Informant Interviews with Grama Niladaries mentioned that there are no fishing activities taking place in project area.

1.4.7.3 Industry

There is development of industries in the Peliyagoda area of Mudun Ela project. Presently Peliyagoda is known as highly facilitating areas for the provision of stores & warehouses. The proximity to port and access to Colombo – Katunayake expressway are main reasons for this. As a result, Industries & stores are spread-out low-lying areas due to the low land values. In Kelaniya DS division, there is also cottage industries such as pottery, brass and envelope making. Out of these industries, envelope making is popular in Manelgama area.

With proximity to the Colombo city and with coastal belt, the tourism industry is also well known. The presence of Kelaniya temple also is an important location for tourism in Mudun Ela project area.



Photo 1-5: Envelope making in Mudun Ela project area

1.4.7.4 Commerce and Other services

The project area is located close to Colombo which is the commercial capital of the country. In Mudun Ela project area, the trade and services are mainly concentrated along Colombo – Kandy Road and Peliyagoda – Puttalam road. Commercial activities including retail and whole sale trade and services take place in the area.



Photo 1-6: Commercial Activities along Colombo – Kandy Road

1.4.8 Social infrastructure and public facilities

1.4.8.1 Road transport

Road transport is the dominant mode of transportation in the project area. In Mudun Ela project area, the road system is linked with two highways, Colombo – Kandy (A001) highway and Peliyagoda – Puttalam (A003) highway. Colombo - Katunayake expressway is also traversing through the project area.

1.4.8.2 Water supply system

Majority (6,663) of households in Mudun Ela project area have water supply connection from National Water supply and Drainage Board. There are also 222 households who use well water as well.

Table 1-21: Sources of drinking water in affected DS divisions

DSD	GND	NSW & DB	Well	Common Well	Community Water Project
Kelaniya	Pattiya North 173 B	1245	-	-	-
	Peliyagoda Gangabada East 174 B	520	1	-	-
	Meegahawatta 174 C	1153	36	-	-
	Himbutuwelgoda 257 A	790	57		
	Wanawasala East 257	656	84		
	Wanawasala West 257 B	1020	10		
	Dippitigoda 260	869	29		
Dalugama 260 A	410	5	-	-	
Total		6663	222	0	0

Source: Administrative data of Kelaniya – 2021

1.4.8.3 Electricity distribution system

Majority (6,811) of households in the project area have the connection from Ceylon electricity board. However, there are around 54 households who do not have electricity facilities.

Table 1-22: Source of lighting in the project area

DSD	GND	National grid	Solar power and other sources	No electricity Facilities
Kelaniya	Pattiya North 173 B	1221	-	24
	Peliyagoda Gangabada East 174 B	515	-	6
	Meegahawatta 174 C	1169	-	20
	Himbutuwelgoda 257 A	846	-	1
	Wanawasala East 257	738	-	2
	Wanawasala West 257 B	1029	-	1
	Dippitigoda 260	898	-	0
	Dalugama 260 A	395	-	0
Total		6,811	0	54

Source: Administrative data of Kelaniya – 2021

1.4.8.4 Telecommunication system

The telecommunication facilities available in the Kelaniya DS division are presented in following table.

Table 1-23: Telecommunication facilities available project area

DS	GND	Fixed Telephone	No Fixed Telephone	Mobile Telephones	Computer Facilities
Kelaniya	Pattiya North – 173 B	363	882	1145	271
	Peliyagoda Gangabada East – 174B	15	506	490	255
	Meegahawatta – 174 C	567	622	850	30
	Himbutuwelgoda – 257 A	505	342	847	195
	Wanawasala East	561	179	565	62
	Wanawasala West	360	670	1160	610
	Dippitigoda	381	517	826	207
	Dalugama 260 A	195	200	196	70

Source: Administrative data of Kelaniya – 2021

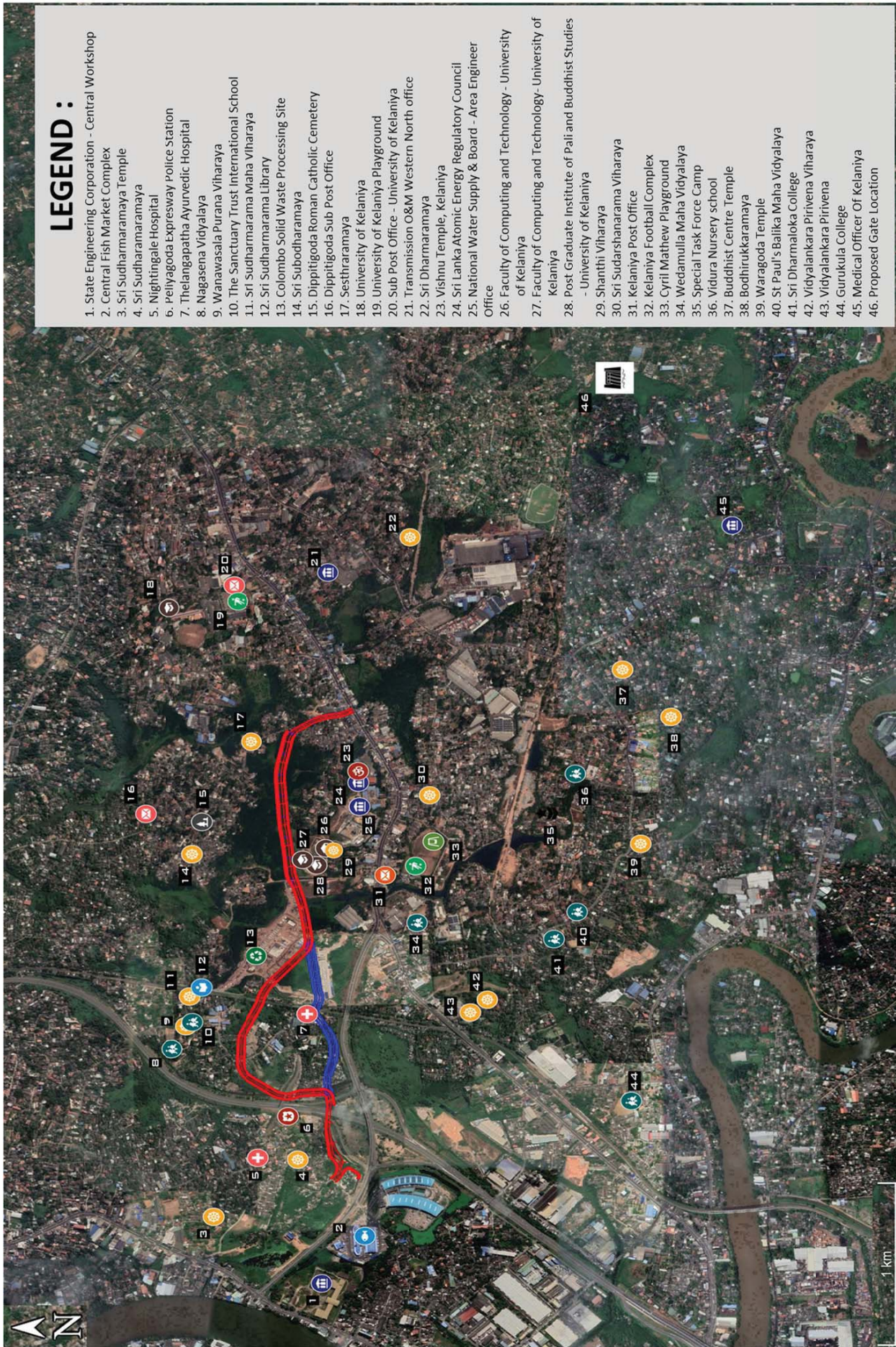


Figure 1-23: Distribution of public facilities – Mudun Ela project area

1.4.8.5 Water supply system

Mudun Ela Project

Since this is large canal, its rehabilitation could be done using water base equipment without an impact to the water supply lines that could exist on the Operation and Maintenance(O&M) Road. There were no visible water supply lines crossing the canal. Since the canal side houses have water supply there should be water mains along the O&M Road with cross lines to houses.

1.4.8.6 Wastewater collection system

Type of Wastewater

The main wastewater generation in Mudun Ela is the households' sewage, kitchen waste and bathroom wastewater. In addition to these, several industries and service facilities generate specific wastewater. Automobile service stations, hotels and restaurants, various food based commercial units and the industries produce wastewater.

Wastewater management

The common domestic wastewater (black & graywater) management practice is that the sewage generated from households is disposed of by sending it through septic tanks. Whereas kitchen wastewater and bathing water are sent to collection pits or directly discharge into storm water drains. The local government regulations require that sewage generated from houses and other facilities should be sent to septic tanks before being released to the environment. However, improperly designed septic tanks and the discharge of sewage directly to the waterways are not uncommon. The CEA environmental regulations have enforced that all industrial and services facilities that require EPL for their operation need treatment of wastewater before releasing it to the environment. Therefore, such service facilities and industries have their own individual treatment facilities to treat facility specific wastewater.

Mudun Ela Project Wastewater Management

There is no sewage management system. The filled sewage pits of the water sealed toilets are emptied using gully suckers.

1.4.8.7 Distribution of public facilities (medical facilities, educational facilities, religious facilities, cultural facilities, tourism spots, etc.)

For the Mudun Ela Project

Figure 1-23 shows the Distribution of public facilities (medical facilities, educational facilities, religious facilities, cultural facilities, tourism spots, etc.

1.4.9 Status of Gender equality in the community

Under article 12 of the Constitution of Sri Lanka, no sex discrimination is allowed. The relevant contents of the Article 12 are presented below. The National Involuntary Resettlement Policy also ensures gender equality and equity. Women's charter of Sri Lanka was approved by the cabinet on 3rd of March 1993 and

this document outlines the rights of women. Ministry of women, Child affairs and Social Empowerment is the responsible ministry to regulate the women’s charter. There are also divisional and district level officers to implement the programs planned by the ministry promoting gender equality.

Right to quality	12. (1) All persons are equal before the law and are entitled to the equal protection of the law (2) No citizen shall be discriminated against on the ground of race, religion, language, caste, sex, political option, place of birth are any one of such grounds
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When considering the project area, the female population is slightly higher (16952 persons) than the male population (15,274 persons). Refer Table 1-16. The sex disaggregated statistics on education is not available for Kelaniya DS division. Majority of people in the project area have completed secondary education. Around 60 persons also have completed postgraduate studies. However, there are 14 persons who have not attended to schools.

People in project area engaged in various employments as depicted in Table 1-18 above. Most of the people are involved in private sector (5,222), followed by skilled/unskilled labours (4,131). FGDs conducted in the project area, confirmed that women engage in home-based self-employments. These include preparation of lunch packets, sewing clothes, making greeting cards and cardboard related employments. At some instances, women help home based industries such as making envelopes. The women in the project area also mentioned that there are women’s societies established in the project area. These societies provide trainings and loans/assistance to women to start self-employments.



Photo 1-7: women engage in home-based self-employments (envelop making)

Table 1-24: Education level of the project area

DSD	GND	No schooling	Minor	Grade 1-5	Up to G.C.E. O/L	Pass G.C.E. O/L	Pass G.C.E. A/L	Graduate	Post Graduate	Other
Kelaniya	Pattiya North 173 B	0	166	508	2110	1260	541	34	0	0
	Peliyagoda Gangabada East 174 B	4	29	537	230	141	82	3	0	0
	Meegahawatta 174 C	3	325	980	3158	898	460	65	7	32
	Himbutuwegoda 257 A	2	103	645	961	997	1031	143	12	0
	Wanawasala East 257 B	5	136	418	1410	881	637	32	11	0
	Wanawasala West 257	0	255	955	1039	1035	545	60	4	0
	Dippitigoda 260	0	36	683	1797	769	424	49	14	4
	Dalugama 260 A	0	30	80	598	526	510	226	12	3
	Total	14	1080	4806	11303	6507	4230	612	60	39

Source: Administrative data of Kelaniya – 2021/2020

1.4.10 Historical and cultural heritage

The DS information states about presence of archeologically important sites in the project area. Following is a list of those sites.

Table 1-25: List of archeological sites in the project area

DS Division	GN Division	Archeological site	Gazette Number	Date
Kelaniya	Pattiya East - 173	Peliyagoda Vidyalankara Pirivena	1085	1999.06.08
	Kelaniya - 264	Kelaniya Raja maha viharaya	1486	2007.02.23
	Pattiya East	St. Maria Church	1486	2007.02.23
	Pethiyagoda 262	Pethiyagoda Darmakara Pirivena	1486	2007.02.23
	Pilapitiya 263 A	Roman Catholic church	Not gazetted	
	Warakanaththa 259	St. Fracis Salis church	Not gazetted	
	Wanawasala West 257	Wanawasala Sudarmarama Viharaya	Not gazetted	
	Wanawasala West 257	Wanawasala Purana Viharaya	Not gazetted	
	Wedamulla 261	Waragoda Bodirukkaramaya	Not gazetted	
	Pilapitiya 263	Location where pottery artifacts were found	Not gazetted	

Source: Administrative data of Kelaniya – 2021

1.4.11 Health, sanitation, and hazard

1.4.11.1 Health status of project areas (analysis using district statistics) - Mudun Ela Related Area

Sources of Information

The consultant has obtained the divisional resource profiles from the Divisional Secretariat, Kelaniya to obtain the statistics at the Divisional levels. Location specific information pertinent to this area are presented in the report.

Medical Administrative Areas

Mudun Ela Basin area in Kelaniya MOH range spreads throughout the Peliyagoda, Wedamulla and Wanawasala Public Health Inspector areas. The health and sanitation status and related hazards of the project areas were approximated using the district statistics from the national data bases.

Health Status

The status of health is interpreted by a range of National indicators and some of the key indicators are presented in this section to describe the status of health using statistics extracted from annual published health statistics data bases of Sri Lanka.

Medical services

The Sri Lankan health system comprises different systems of medicine; Traditional, Western, Ayurvedic, Unani, Sidha, Homeopathy and Acupuncture. Of these, Western or Allopathic medicine is the leading sector catering to the needs of the majority. Allopathic medicine is provided through both public and the private sector, but the share of care is different for inpatients and outpatients. The public sector provides

the bulk of inpatient care, providing a safety net to citizens. The public sector has an extensive network of health care institutions and has a system for Aurvedic care. The private sector provides access to almost all types of care at a cost while the public sector provides free health services at the point of care. The health network is well established and the communities in the project area access these medical services depending on the requirement and the capacity. The Tables below are some statistics pertinent to hospitals and beds in Gampaha district in comparison to National status. The statistics show that a good extent of the medical facilities is concentrated in the two districts where people in the project area can have the access to these medical facilities.

Table 1-26: Distribution of Government Medical Institutions and Beds

RDHS Division	Teaching Hospitals		Provincial General Hospitals		District General Hospitals		Base Hospitals (Type A)		Base Hospitals (Type B)		Divisional Hospitals (Type A)		Divisional Hospitals (Type B)		Divisional Hospitals (Type C) ¹		Primary Medical Care Unit and Maternity Homes		Other Hospitals ²		Total hospitals		Beds per 1000 population
	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	
Gampaha	1	1,694			2	1,474	1	629	2	277	4	625	1	84	7	228			7	1,108	25	6,119	2.5
Sri Lanka	18	23,045	2	3,797	19	13,430	29	9,514	48	8,704	50	5,268	131	8,751	299	8,159	9	115	38	5,806	643	86,589	4.0

Source - Annual health statistics, 2019, Sri Lanka

Table 1-27: Distribution of Inpatients Beds

RDHS Division	Teaching Hospitals	Provincial General Hospitals	District General Hospitals	Base Hospitals (Type A)	Base Hospitals (Type B)	Divisional Hospitals (Type A)	Divisional Hospitals (Type B)	Divisional Hospitals (Type C) ¹	Primary Medical Care Unit and Maternity Homes	Other Hospitals ²	Total hospitals	Inpatient Beds per 1000 population
Gampaha	1,541		1,352	567	243	562	66	185		1,082	5,598	2.3
Sri Lanka	21,646	3,440	12,329	8,473	7,748	4,511	7,419	6,662	89	5,508	77,825	3.6

Source - Annual health statistics, 2019, Sri Lanka

1.4.11.2 Health related hazards and concerns

Health indicators and morbidity, and epidemics - Crude death rate (described using district data)

The Table 1-28 below show the crude death rate, Maternal Mortality, infant Mortality and non-neo-natal mortality statistics of Gampaha district. Higher mortality rates with respect to crude death rate, non-neo natal mortality and infant mortalities were noted highlighting the health concerns over urban population. Similarly, case fatality rates of several non-communicable diseases as depicted in the table below show much higher fatality rates compared to national rates raising concerns of the responsible authorities

Table 1-28: Mortality Rates

District	Crude Birth Rate (CBR)		Crude Death Rate (CDR)		Maternal Mortality Ratio, 2014 (per 100,000 Live Births) *	Infant Mortality Rate, 2015*	Neo-Natal Mortality Rate	
	2018*	2019*	2018*	2019*			2014*	2015*
	Per 1000 population						Per 1000 Live Births	
Gampaha	12.0	11.6	6.3	6.7	24.0	6.7	4.6	5.0
Sri Lanka	15.1	14.6	6.4	6.7	25.7	8.5	5.6	6.0

Source - Annual health statistics, 2019, Sri Lanka

Table 1-29: Hospitalization, Hospital Deaths and Case Fatality Rates

RDHS Area	Neoplasms (C00-D48)			Diabetes mellitus (E10-E14)			Essential hypertension (I10)			Ischaemic heart disease (I20-I25)			Cerebrovascular disease (I60-I69)		
	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*
Gampaha	4,498	294	6.14	8,982	38	0.42	6,819	19	0.28	10,921	854	7.25	5,681	363	6.01
Sri Lanka	156,702	6,296	3.86	106,622	714	0.67	97,885	541	0.55	137,354	8,121	5.58	56,671	4,086	6.73

Source - Annual health statistics, 2019, Sri Lanka

Maternal deaths, stil births, and low birth weight babies

The Maternal deaths, stil births, and low birth weight babies statistics also show higher values compared to national rates

Table 1-30: Hospitalization, Hospital Deaths and Case Fatality Rates

RDHS Area	Bronchitis, emphysema and other chronic obstructive pulmonary disease (J40-J44)			Asthma (J45-J46)			Alcoholic liver disease (K70)			Other diseases of liver (K71-K76)			Renal failure (N17-N19)		
	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*
Gampaha	2,195	102	4.44	17,827	21	0.12	241	32	11.72	2,055	365	15.08	9,322	115	1.22
Sri Lanka	45,715	1,309	2.78	177,225	569	0.32	2,148	179	7.69	14,878	1,873	11.18	144,251	2,169	1.48

Source - Annual health statistics, 2019, Sri Lanka

Table 1-31: Live Births, Maternal Deaths, Still Births and Low Birth Weight Babies in Government Hospitals, 2019

District	Live Births	Maternal Deaths		Still Births		Low Birth Weight ⁴	
		No.	Ratio ¹	No.	Ratio ²	No.	Ratio ³
Gampaha	17,927	1	5.6	108	6.0	2,666	14.9
Sri Lanka	288,666	62	21.5	1,756	6.0	46,174	16.0

¹Per 100,000 live births

²Per 1,000 total births

³Per 100 live births

⁴Birth weight less than 2,500 grams

Source - Annual health statistics, 2019, Sri Lanka

Infectious disease and epidemics

The Table 1-32 below depicts the infectious and vector borne diseases in Gampaha district. Dengue fever and Dysentery occurrences appear high compared to other diseases.

Table 1-32: Notifiable Diseases, 2018

RDHS Division	Dengue	Dysentery	Encephalitis	Enteric Fever	Food Poisoning	Human Rabies	Leptospirosis	Typhus Fever	Viral Hepatitis
Gampaha	5,857	78	13	26	181	1	233	11	15
Sri Lanka	51,659	2,269	208	406	1,170	21	5,257	1,446	388

Source - Annual health statistics, 2018, Sri Lanka

Sexually transmitted diseases: HIV/AIDS cases

There are no statistics on the cases of HIV/AIDS directly reported within the project areas. The statistics below shows the increasing number of patients in the country. Data of health department states that the highest number of HIV patients are found from Colombo and Gampaha Districts. In 1987-2016 period 18.8 patients per 100,000 populations from Gampaha district was reported. (Source: National HIV/STI strategic plan Sri Lanka 2018-2022)

Table 1-33: Reported HIV/AIDS Cases

Reported HIV/AIDS Cases 2021								
Quarter	Cumulative HIV cases at the beginning of the quarter	HIV cases reported during the quarter	Cumulative HIV cases at the end of the quarter	Reported HIV cases with age 15-24 yrs		Cumulative HIV cases by gender		Reported AIDS deaths
				M	F	M	F	
1 st Quarter	3994	79	4073	11	01	2856	1217	10
2 nd Quarter	4073	69	4142	10	03	2912	1230	09
3 rd Quarter	4142	103	4245	10	02	3000	1245	14
4 th Quarter	4245	159	4404	21	01	3130	1274	16
Reported HIV/AIDS Cases 2022								
1 st Quarter	4404	152	4556	18	01	3263	1293	14
2 nd Quarter	4556	130	4686	14	01	3377	1309	11

Source: National STD/AIDS Control Programme, Department of Health Services:

http://www.aidscontrol.gov.lk/images/HIV_2ndQ_2022.pdf

Sanitation condition

Access to treated piped Drinking water: To be included after studying the Divisional Resource profiles.
Availability of safe sanitary disposal systems: To be included after studying the Divisional Resource profiles

Other health and sanitation issues in the project areas

During the field observations, from the discussions with residents and studying the published literature, number issues were noticed which are important for the health and sanitation integrity of the residents in the project areas.

Health and sanitation issues related to sewage disposal: Frequent flooding, stagnation of water is important aspect which has a strong influence on the health and sanitation of the residents in the project area. The floods disperse the polluted wastewater in the canals, overflow the septic tanks spreading contaminated water having substances of health risk such as infectious pathogens, toxic chemicals, etc. Major issue reported was the direct disposal of sewer into canal without sending through properly designed septic systems. As a result, the canals tend to carry sewage in addition to overland runoff. It was

also reported by the interviewed residents that industries intentionally empty their sewage waste and waste sludge into storm water canal at heavy rainfall expecting unnoticed disposal and dilution. A properly planned flood control system while addressing all these issues inclusive would deliver tremendous improvement to related health and sanitation status of the affected communities

Water stagnation and vector borne diseases: Water stagnation is a critical issue even at a small rain spell. The current local drainage is highly unsatisfactory. It was noted that people have constructed parapet walls without considering the drainage paths. Some feeder canal showed permanently stagnant water. Further at some sections the road elevation is higher than the elevations of residents' ground level resulting obvious stagnation of water creating ideal grounds for mosquito breeding and other vector borne diseases. According to residents, dengue is a common occurrence among the them. The proposed flood rehabilitation project will have a great impact on draining excess water into canal and minimizing occurrence of stagnant water in the canals by which favorable habitats for mosquito breeding can be greatly reduced.

Poor solid waste management and potential health issues: Although there is a relatively systematic solid waste management system operational in the project areas, hap hazard disposal of solid waste has been observed at many places. Specially, disposal of solid waste has been observed at many places in the wetlands of the Mudun Ela basin storm water canals. The disposal makes canals to block the flow resulting pollution and stagnation. The waters and canal ecosystem become unacceptably unhealthy. Burning of solid waste including plastic and polythene is a common practice by the people ignoring health impacts by exposure to toxic fumes, dioxins, furans and VOCs.

1.4.12 Historical and cultural heritage-

There are no historical and cultural heritage places in the project area.

1.4.12.1 Health status of project areas (analysis using district statistics) - Bolgoda Area

Sources of Information

The consultant has obtained the details from the divisional profiles from the respective Divisional Secretariats to obtain the statistics at the Divisional levels. Location specific information pertinent to this area are presented in the report.

Medical Administrative Areas

The Bolgoda basin fall in the Moratuwa and Ratmalana areas within the Colombo District. The health and sanitation status and related hazards of the project areas were approximated using the district statistics from the national data bases.

Health Status

The status of health is interpreted by a range of National indicators and some of the key indicators are presented in this section to describe the status of health in two didactics u national using statistics extracted from annual published health statistics data bases of Sri Lanka.

Medical services

The Sri Lankan health system comprises different systems of medicine; Traditional, Western, Ayurvedic, Unani, Sidha, Homeopathy and Acupuncture. Of these, Western or Allopathic medicine is the leading sector catering to the needs of the majority. Allopathic medicine is provided through both public and the private sector, but the share of care is different for inpatients and outpatients. The public sector provides the bulk of inpatient care, providing a safety net to citizens. The public sector has an extensive network of health care institutions and has a system for Aurvedic care. The private sector provides access to almost all types of care at a cost while the public sector provides free health services at the point of care. The health network is well established and the communities in the project area access these medical services depending on the requirement and the capacity. The Tables below are some statistics pertinent to hospitals and beds in Colombo districts in comparison to National status. The statistics show that a good extent of the medical facilities is concentrated in the Colombo district where people in the project area can have the access to these medical facilities.

Table 1-25: Distribution of Government Medical Institutions and Beds

DHS Division	Teaching Hospitals		Provincial General Hospitals		District General Hospitals		Base Hospitals (Type A)		Base Hospitals (Type B)		Divisional Hospitals (Type A)		Divisional Hospitals (Type B)		Divisional Hospitals (Type C) ¹		Primary Medical Care Unit and Maternity Homes		Other Hospitals ²		Total hospitals		Beds per 1000 population
	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	
Colombo	7	8,110					3	1,268	1	294	1	90	6	428	2	71	5	53	11	4,007	36	14,321	5.9
Sri Lanka	18	23,045	2	3,797	19	13,430	29	9,514	48	8,704	50	5,268	131	8,751	299	8,159	9	115	38	5,806	643	86,589	4.0

Source - Annual Health Statistics, 2019, Sri Lanka

Table 1-26: Distribution of Inpatients Beds

RDHS Division	Teaching Hospitals	Provincial General Hospitals	District General Hospitals	Base Hospitals (Type A)	Base Hospitals (Type B)	Divisional Hospitals (Type A)	Divisional Hospitals (Type B)	Divisional Hospitals (Type C) ¹	Primary Medical Care Unit and Maternity Homes	Other Hospitals ²	Total hospitals	Inpatient Beds per 1000 population
Colombo	7,649			1,137	283	86	345	52	53	3,778	13,383	5.5
Sri Lanka	21,646	3,440	12,329	8,473	7,748	4,511	7,419	6,662	89	5,508	77,825	3.6

Source- Annual Health Statistics, 2019, Sri Lanka

1.4.12.2 Health related hazards and concerns

Health indicators and morbidity, and epidemics -Crude death rate (described using district data)

The Table 1-27 below show the crude death rate, Maternal Mortality, infant Mortality and non-neo-natal mortality statistics of Gampaha and Colombo districts. Higher mortality rates with respect to crude death rate, non-neo natal mortality and infant mortalities were noted highlighting the health concerns over urban population living the two districts. Similarly, case fatality rates of several non-communicable diseases as depicted in the table below show much higher fatality rates compared to national rates raising concerns of the responsible authorities

Table 1-27: Mortality Rates

District	Crude Birth Rate (CBR)		Crude Death Rate (CDR)		Maternal Mortality Ratio, 2014 (per 100,000 Live Births) *	Infant Mortality Rate, 2015*	Neo-Natal Mortality Rate	
	2018*	2019*	2018*	2019*			2014*	2015*
	Per 1000 population						Per 1000 Live Births	
Colombo	13.6	13.4	7.4	7.5	18.7	13.4	7.7	8.3
Sri Lanka	15.1	14.6	6.4	6.7	25.7	8.5	5.6	6.0

Source -Annual Health Statistics, 2019, Sri Lanka

Table 1-28: Hospitalization, Hospital Deaths and Case Fatality Rates

RDHS Area	Neoplasms (C00-D48)			Diabetes mellitus (E10-E14)			Essential hypertension (I10)			Ischaemic heart disease (I20-I25)			Cerebrovascular disease (I60-I69)		
	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*
Colombo	66,728	2,527	3.65	12,192	253	2.03	9,686	52	0.53	25,039	1,557	5.85	8,093	641	7.34
Sri Lanka	156,702	6,296	3.86	106,622	714	0.67	97,885	541	0.55	137,354	8,121	5.58	56,671	4,086	6.73

Source- Annual Health Statistics, 2019, Sri Lanka

Maternal deaths, stil births, and low birth weight babies

The Maternal deaths, stil births, and low birth weight babies statistics also show higher values compared to national rates

Table 1-29: Hospitalization, Hospital Deaths and Case Fatality Rates

RDHS Area	Bronchitis, emphysema and other chronic obstructive pulmonary disease (J40-J44)			Asthma (J45-J46)			Alcoholic liver disease (K70)			Other diseases of liver (K71-K76)			Renal failure (N17-N19)		
	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*
Colombo	3,975	184	4.42	13,613	57	0.42	256	58	18.47	3,174	412	11.49	14,902	360	2.36
Sri Lanka	45,715	1,309	2.78	177,225	569	0.32	2,148	179	7.69	14,878	1,873	11.18	144,251	2,169	1.48

Source- Annual Health Statistics, 2019, Sri Lanka

Table 1-30: Live Births, Maternal Deaths, Still Births and Low Birth Weight Babies

District	Live Births	Maternal Deaths		Still Births		Low Birth Weight ⁴	
		No.	Ratio ¹	No.	Ratio ²	No.	Ratio ³
Colombo	34,998	18	51.4	258	7.3	5,744	16.4
Sri Lanka	288,666	62	21.5	1,756	6.0	46,174	16.0

¹Per 100,000 live births

²Per 1,000 total births

³Per 100 live births

⁴Birth weight less than 2,500 grams

Source - Annual Health Statistics, 2019, Sri Lanka

Infectious disease and epidemics

The Table 1-31 below depicts the infectious and vector borne diseases in the Colombo and Gampaha districts. Dengue fever and Dysentery occurrences appear high compared to other diseases.

Table 1-31: Notifiable Diseases

RDHS Division	Dengue	Dysentery	Encephalitis	Enteric Fever	Food Poisoning	Human Rabies	Leptospirosis	Typhus Fever	Viral Hepatitis
Colombo	10,258	102	9	48	43	1	241	16	11
Sri Lanka	51,659	2,269	208	406	1,170	21	5,257	1,446	388

Source: Annual Health Statistics, 2018, Sri Lanka

Sexually transmitted diseases: HIV/AIDS cases

There are no statistics on the cases of HIV/AIDS directly reported within the project areas. The statistics below shows the increasing number of patients in the country. Data of health department states that the highest number of HIV patients are found from Colombo and Gampaha Districts. In 1987-2016 period 35.1 and 18.8 patients per 100,000 populations from Colombo and Gampaha respectively were reported (Source: National HIV/STI strategic plan Sri Lanka 2018-2022)

Table 1-32: Reported HIV/AIDS Cases

Reported HIV/AIDS Cases 2021								
Quarter	Cumulative HIV cases at the beginning of the quarter	HIV cases reported during the quarter	Cumulative HIV cases at the end of the quarter	Reported HIV cases with age 15-24 yrs		Cumulative HIV cases by gender		Reported AIDS deaths
				M	F	M	F	
1 st Quarter	3994	79	4073	11	01	2856	1217	10
2 nd Quarter	4073	69	4142	10	03	2912	1230	09
3 rd Quarter	4142	103	4245	10	02	3000	1245	14
4 th Quarter	4245	159	4404	21	01	3130	1274	16
Reported HIV/AIDS Cases 2021								
1 st Quarter	4404	152	4556	18	01	3263	1293	14
2 nd Quarter	4556	130	4686	14	01	3377	1309	11

Source: National STD/AIDS Control Programme, Department of Health Services:

http://www.aidscontrol.gov.lk/images/HIV_2ndQ_2022.pdf

Sanitation condition

Access to treated piped Drinking water: To be included after studying the Divisional Resource profiles.
Availability of safe sanitary disposal systems: To be included after studying the Divisional Resource profiles

Other health and sanitation issues in the project areas

During the field observations, from the discussions with residents and studying the published literature, number issues were noticed which are important for the health and sanitation integrity of the residents in the project areas.

Health and sanitation issues related to sewage disposal: Frequent flooding, stagnation of water is important aspect which has a strong influence on the health and sanitation of the residents in the project area. The floods disperse the polluted wastewater in the canals, overflow the septic tanks spreading contaminated water having substances of health risk such as infectious pathogens, toxic chemicals, etc. During floods the toilet are overflowing and cannot be flushed and used, this was specifically reported by

some of residents living near the Telawala road canal section. Another issue reported is the direct disposal of toilet waste into canal without sending through properly designed septic systems. As a result, the canals tend to carry sewage in addition to overland runoff. It was also reported by the interviewed residents that industries intentionally empty their sewage waste and waste sludge to storm water canal at heavy rainfall expecting unnoticed disposal and dilution. A properly planned flood control system while addressing all these issues inclusive would deliver tremendous improvement to related health and sanitation status of the affected communities

Water stagnation and vector borne diseases: Water stagnation is a critical issue even at a small rain spell. The current local drainage is highly unsatisfactory. It was noted that people have constructed parapet walls without considering the drainage paths. Some feeder canal showed permanently stagnant water. Further at some sections the road elevation is higher than the elevations of residents' ground level resulting obvious stagnation of water creating ideal grounds for mosquito breeding and other vector borne diseases. According to some dengue is a common occurrence among the residents. The proposed flood rehabilitation project will have a great impact on draining excess water into canal and minimizing occurrence of stagnant water in the canals by which favorable habitats for mosquito breeding can be greatly reduced.

Industrial emissions & health issues related to exposure.

In the field visit the consultants observed flow of colored effluents in the Telawala road. The residents stated that wastewater is being discharged by upstream textile factories. They further informed frequent discharge of different color wastewater having acid fume and kerosene oil smell and reported that find it affect their breathing convenience. And they are worried on Asthma, breathing difficulties and wheezing for their young generations

Poor solid waste management and potential health issues: Although there is a relatively systematic solid waste management system operational in the project areas, hap hazard disposal of solid waste has been observed at many places. Specially, disposal of solid waste has been observed at many places in the wetlands of the Bolgoda basin storm water canals. The disposal makes canals to block the flow resulting pollution and stagnation. The waters and canal ecosystem become unacceptably unhealthy. Burning of solid waste including plastic and polythene is a common practice by the people ignoring health impacts by exposure to toxic fumes, dioxins, furans and VOCs.

1.5 Project Area Specific Details Sent by Medical Officer of Health

1.5.1 Colombo MoH (For Moratuwa Ratmalana)

When considering past years these MOH areas faced several natural disasters such as flood, Tsunami, costal erosion, cyclones and man-made disasters such as fire, chemical injuries and accidents. Disaster risks in MOH areas are further compounded by increasing vulnerabilities such as growing population, the vast disparities in income, rapid urbanization, increasing industrialization, development within high-risk

zone, environmental degradation and climate change

Details of the common notified infectious diseases are presented in the following tables.

Table 1-33: Common notified infectious diseases at MOH Moratuwa

Disease	2018	2019	2020	2021	2022
Dysentery	1	0	2	0	0
Leptospirosis	4	9	5	2	5
Malaria	0	1	0	0	0
Typhus Fever	1	0	0	0	0
Tuberculosis	40	65	39	35	43
Dengue Fever/Dengue Haemorrhagic Fever	261	839	129	256	463
Leishmaniasis	0	0	0	0	1
Leprosy	35	17	16	6	13
Meningitis	2	5	5	0	0

Table 1-34: Common notified infectious diseases at MOH Ratmalana

Disease	2018	2019	2020	2021	2022
Dysentery	16	5	2	4	0
Leptospirosis	11	9	5	5	5
Malaria	0	0	0	0	0
Typhus Fever	1	0	0	0	0
Tuberculosis	60	76	53	52	43
Dengue Fever/Dengue Hemorrhagic Fever	565	779	144	392	570
Leishmaniasis	1	0	0	0	0
Leprosy	17	15	9	5	12
Meningitis	6	2	2	0	0

Appendix-3-2

Baseline Environmental and Social Conditions of Project Area
(Moratuwa-Rathmalana Drainage Improvement Project)

1 Existing Natural environment (Baseline Environmental Condition)

1.1 Physical Environment

1.1.1 Topography

The topographic conditions of Moratuwa Ratmalana area consists of relatively flat terrain where the minimum maximum elevation ranges are -1.5m MSL (low areas such as the canals and Bolgoda Lake and 20-25 m MSL. The topographic maps are presented in Figure 1-1.

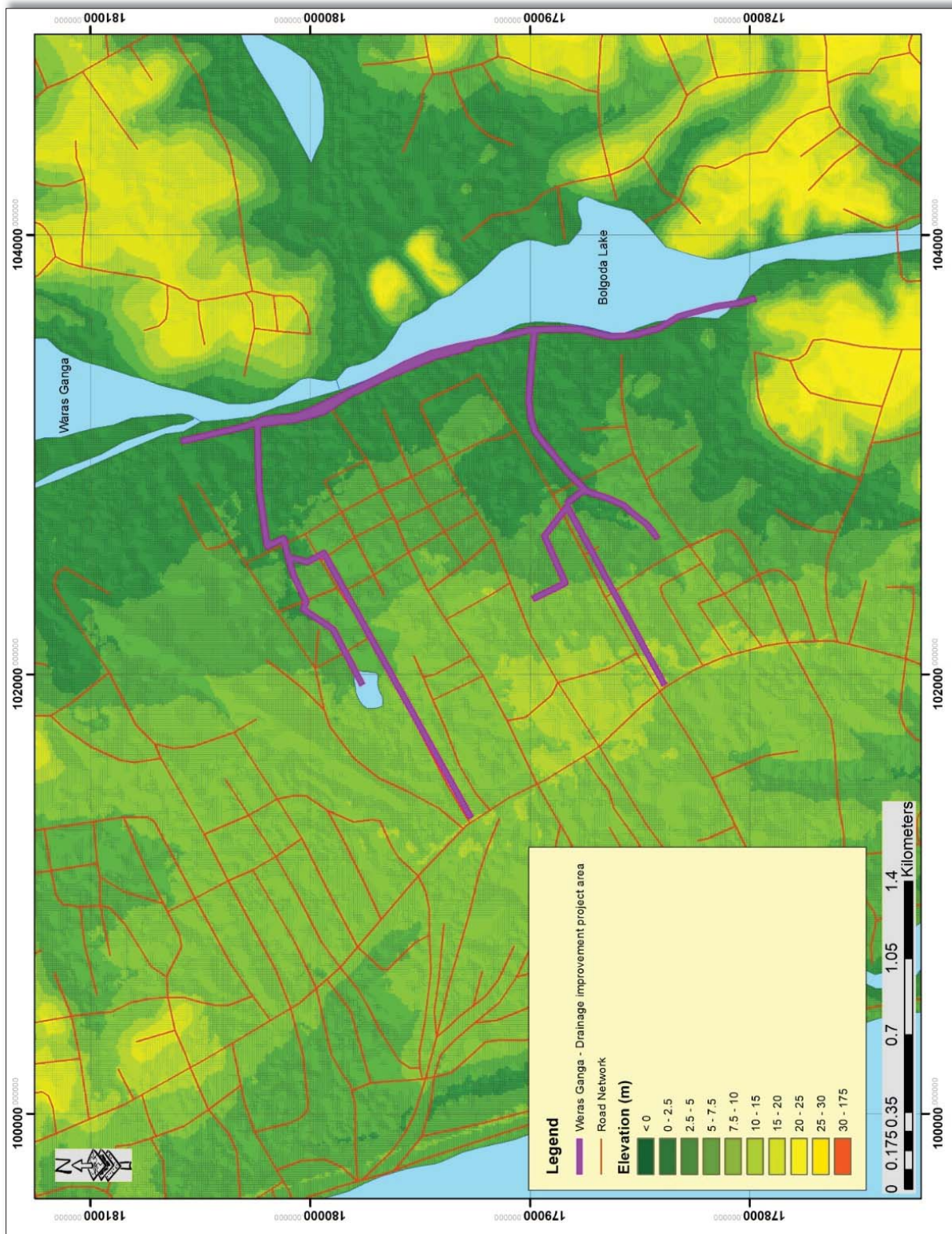


Figure 1-1: Topographic Map Rathmalana Moratuwa Area (Source Survey Department Data)

Outline of topography and distribution of environmentally fragile spots

1.1.2 Geology

The geological map for Moratuwa Rathmalana is given in Figure 1-2. Although the project lies in low lying area it is not on geologically critical area.

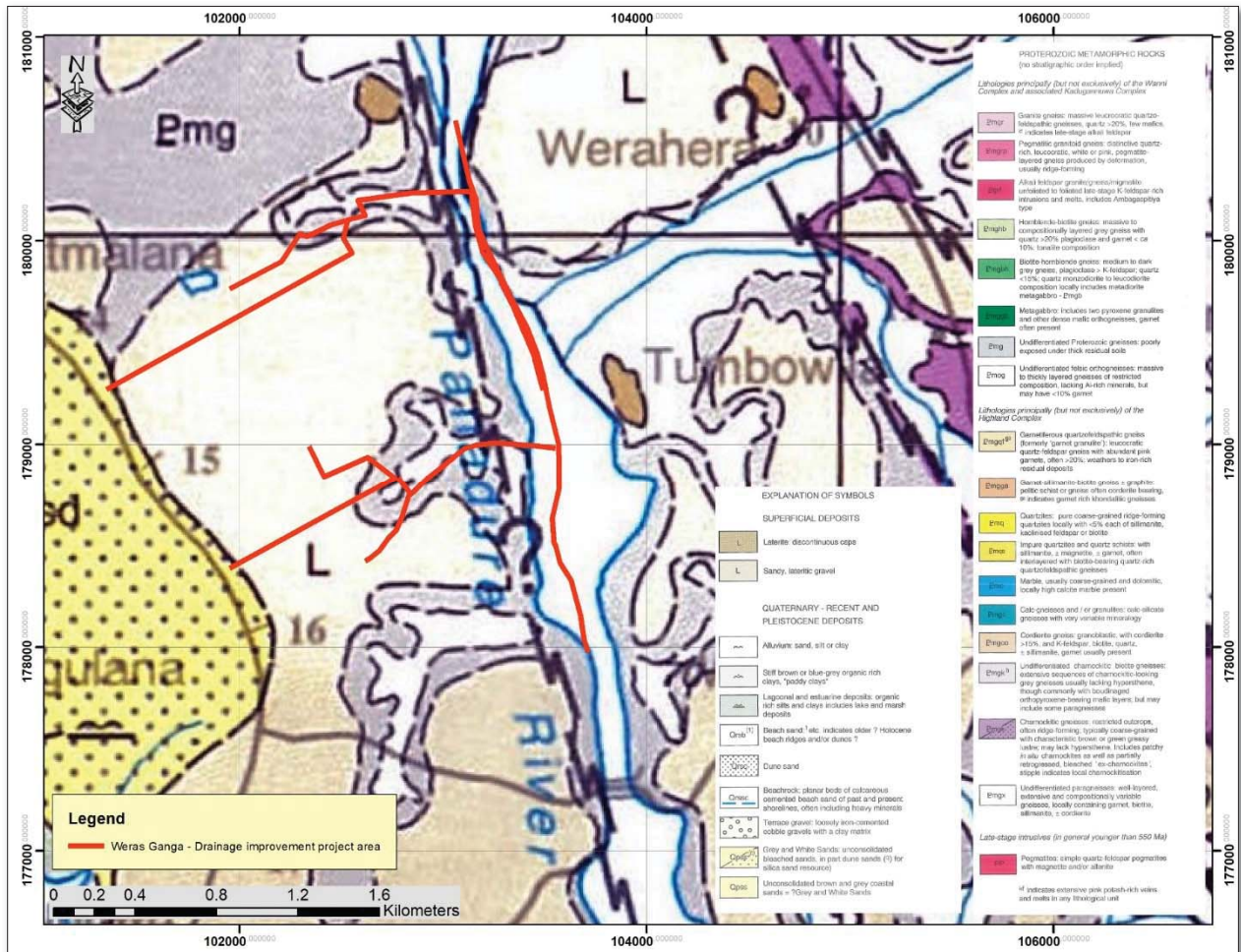


Figure 1-2: Geology Map for Moratuwa Rathmalana Aea (Geology Maps GSMB)

1.1.3 Hydrology

Outline of hydrological condition. Will be provided after receiving data from the JICA team.

1.1.4 Climate

1.1.4.1 Monthly humidity variations.

Monthly humidity variation for the Rathmalana Moratuwa area is presented in Table 1-1.

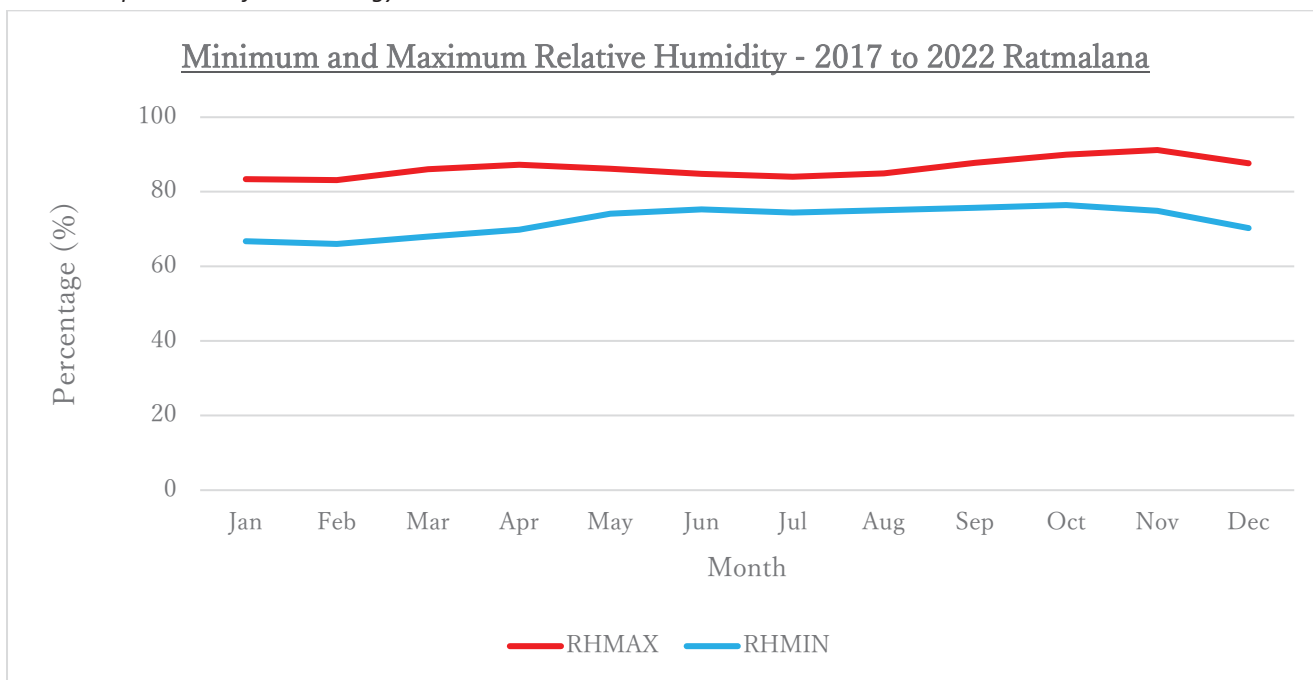
Table 1-1: Monthly Maximum and Minimum Humidity Variation Rathmalana

Monthly Maximum Relative Humidity - Rathmalana												
Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	83	82	88	84	85	86	82	83	88	90	91	
2018	80	84	88	90	88	85	84	85	86	92	91	87
2019	80	86	85	87	84	85	83	86	90	93	92	88
2020	83	81	82	87	86	83	86	84	89	86	91	

Monthly Maximum Relative Humidity - Rathmalana												
Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2021	89	82	89	87	87	85	85	86	87	90	91	88
2022	85	83	84	89		85	84	84				
Average	83	83	86	87	86	85	84	85	88	90	91	88

Monthly Minimum Relative Humidity - Rathmalana												
Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	66	65	68	70	73	77	73	74	77	78	75	69
2018	64	67	70	71	77	76	74	75	71	76	73	69
2019	64	69	66	69	72	75	73	77		77	74	72
2020	65	63	64	66	74	73	76	73	79	74	72	71
2021	74	66	70	70	75	76	76	77	76	77	79	70
2022	67	66	69	73		75	74	74				
Average	67	66	68	70	74	75	74	75	76	76	75	70

Source- Department of Meteorology



Source- Department of Meteorology

Figure 1-3: Monthly Humidity Variation Rathmalana

1.1.5 Temperature

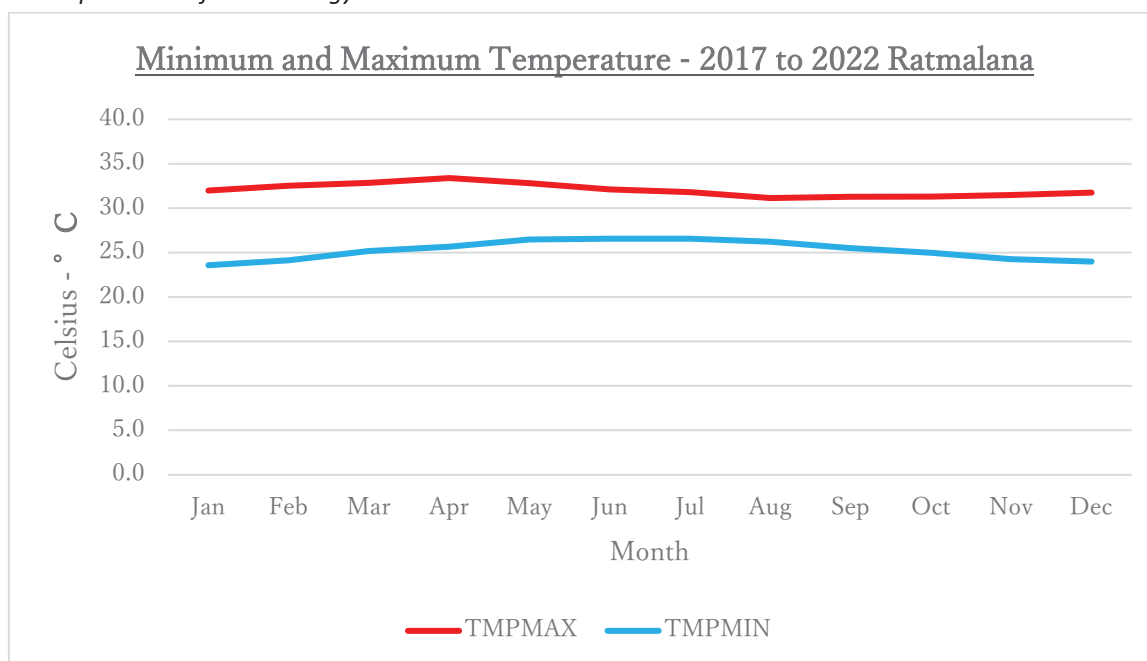
Monthly minimum and maximum temperature figures from 2017 to 2022 are given in Table 1-2.

Table 1-2: Monthly Temperature Variation Rathmalana

Monthly Maximum Temperature - Rathmalana												
Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	31.6	31.9	32.5	33.7	32.8	31.7	32.0	31.6	31.3	31.3	31.1	31.7
2018	31.7	32.2	32.4	33.3	32.0	31.7		30.9	31.6	31.3	31.4	31.8
2019	32.4	32.7	33.0	33.6	33.2	32.6	32.2	31.3	31.0	31.0	32.0	31.8
2020	32.7	33.3	33.6	34.0	33.2	32.6	31.8		31.0	31.7	32.4	31.6
2021	31.2	32.6	32.7	33.3	32.8	32.4	31.8	31.1	31.6	31.1	30.5	31.9
2022	32.3	32.4	32.9	32.5		31.8	31.3	30.8				
Average	32.0	32.5	32.8	33.4	32.8	32.1	31.8	31.1	31.3	31.3	31.5	31.8

Monthly Minimum Temperature - Rathmalana												
Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	22.7	23.2	24.7	26.7	26.7	26.3	27.3	26.9	25.6	25.1	24.4	23.8
2018	22.9	23.7	25.0	25.0	25.7	26.3	26.6	26.1	25.6	24.5	24.1	23.8
2019	23.5	24.8	25.3	25.6	27.0	26.7	26.6	25.8		24.1	24.4	24.3
2020	24.3	24.9	25.8	25.7	26.8	26.9	26.1	26.2	24.9	26.0	24.3	24.1
2021	24.2	24.4	24.8	26.0	26.2	26.8	26.6	26.2	26.0	25.1	24.1	24.0
2022	23.8	23.9	25.4	25.0		26.5	26.2	26.1				
Average	23.6	24.1	25.2	25.7	26.5	26.6	26.6	26.2	25.5	25.0	24.3	24.0

Source: Department of Meteorology



Source- Department of Meteorology

Figure 1-4: Minimum Maximum Temperature Moratuwa Rathmalana Area

1.1.5.1 Precipitation

Monthly precipitation for Moratuwa Rathmalana Area from 1996 to 2020 are given in Table 1-3.

Table 1-3: Precipitation Moratuwa Rathmalana Area

Period 25 Years from 1996 to 2020 - units in mm													
No	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1996	44.0	27.5	2.5	66.1	50.1	28.0	55.3	91.9	53.7	56.4	110.8	36.8
2	1997	0.7	30.2	26.0	47.2	62.3	46.3	46.6	32.9	63.3	74.2	56.4	82.3
3	1998	31.3	0.1	62.6	52.1	68.8	40.0	184.6	54.9	102.5	64.0	165.7	193.6
4	1999	24.1	43.4	30.6	259.8	51.5	17.9	28.7	27.8	126.4	236.3	44.9	74.0
5	2000	54.5	52.7	116.5	138.4	43.8	49.5	28.7	51.9	86.6	142.2	136.1	76.7
6	2001	38.9	33.5	25.3	47.2	55.3	76.1	25.8	1.1	81.7	170.6	123.0	78.6
7	2002	23.9	41.0	34.7	46.1	84.2	25.6	10.1	22.2	56.7	117.5	45.7	90.0
8	2003	28.6	22.3	65.6	36.3	57.4	36.9	59.4	16.9	95.3	51.9	57.1	9.1
9	2004	27.2	26.5	10.8	23.1	41.7	39.2	61.7	45.4	159.6	45.5	72.6	21.2
10	2005	62.4	6.2	60.4	47.4	62.9	56.0	36.8	16.0	25.0	93.7	237.2	63.6
11	2006	78.0	58.1	36.2	42.4	43.5	67.6	42.6	45.1	57.1	156.5	156.8	43.9
12	2007	25.3	12.3	24.4	55.1	139.0	23.3	31.1	83.4	24.1	39.5	67.7	65.6
13	2008	24.4	55.4	72.6	140.3	97.1	81.3	22.3	38.5	41.2	197.0	45.2	24.7
14	2009	72.1	4.5	77.8	107.4	41.8	30.8	32.7	37.1	21.1	74.5	210.3	47.5
15	2010	63.6	5.3	33.4	99.0	177.1	39.9	22.1	13.3	53.9	59.2	382.8	93.6
16	2011	21.6	10.4	42.8	77.5	45.9	44.2	43.6	61.0	14.6	64.3	65.7	61.5
17	2012	41.8	24.9	29.1	93.8	50.7	24.3	11.5	36.9	37.3	142.6	52.7	30.1
18	2013	17.7	73.2	20.0	76.5	50.1	90.7	60.3	7.4	54.9	82.9	55.9	8.5
19	2014	30.0	29.2	27.0	79.8	20.2	79.3	22.8	86.6	45.9	81.8	32.5	55.2
20	2015	8.3	30.5	70.7	65.8	42.4	57.4	23.5	20.7	97.0	88.2	58.9	57.5
21	2016	33.2	25.0	32.4	60.2	190.8	33.2	31.5	3.2	8.2	91.3	135.9	91.3
22	2017	54.8	32.8	38.9	43.9	76.7	38.6	9.3	11.5	73.1	78.8	63.7	39.7
23	2018	8.4	15.2	56.2	52.4	36.2	31.0	24.4	41.6	94.2	133.8	43.1	88.8
24	2019	10.4	60.3	42.8	39.4	60.4	86.1	22.4	41.3	158.8	60.0	87.9	70.2

Period 25 Years from 1996 to 2020 - units in mm

No	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
25	2020	50.7	1.0	1.0	48.9	111.8	35.5	77.5	54.5	141.1	28.2	90.4	52.8
	Minimum	0.7	0.1	1.0	23.1	20.2	17.9	9.3	1.1	8.2	28.2	32.5	8.5
	Maximum	78.0	73.2	116.5	259.8	190.8	90.7	184.6	91.9	159.6	236.3	382.8	193.6
	Average	35.0	28.9	41.6	73.8	70.5	47.1	40.6	37.7	70.9	97.2	104.0	62.3
	Standard Deviation	20.6443	20.0318	26.1712	48.9637	42.6133	21.4567	34.7242	25.1391	43.1051	52.2397	79.6542	37.2840

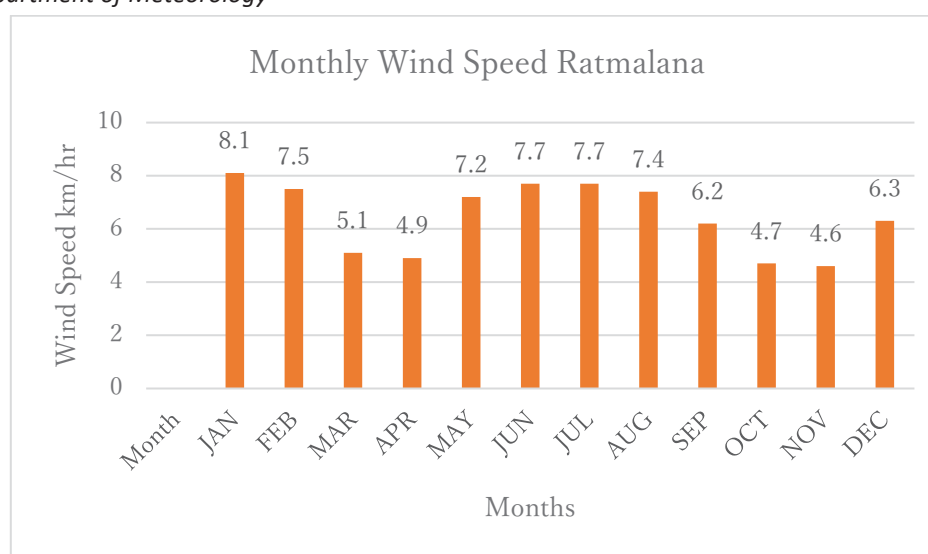
Source: Department of Meteorology

1.1.5.2 Wind

Table 1-4: Monthly Average Wind Speed Rathmalana

Month Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017	8.7	7.2	5.4	6.5	8.3	8.3	8.7	9.3	7.6	5.0	4.8	8.0
2018	9.4	8.0	5.0	5.0	7.0	11.1	9.8	9.1	6.9	5.0	6.5	8.7
2019	11.9	8.3	6.3	5.9	8.7	8.7	8.7	8.5	6.5	4.6	4.6	5.6
2020	8.7	8.3	5.0	4.3	6.7	7.6	6.1	5.7	6.1	5.6	4.4	5.9
2021	5.0	7.2	3.1	4.1	5.6	4.8	5.4	4.3	4.1	3.5	2.8	3.5
2022	4.6	5.7	5.9	3.8	7.1	5.7	7.5					
Avarage	8.1	7.5	5.1	4.9	7.2	7.7	7.7	7.4	6.2	4.7	4.6	6.3

Source- Department of Meteorology



Source- Department of Meteorology

Figure 1-5: Monthly Average Wind Speed Rathmalana

1.2 Physiochemical Environment

1.2.1 (Pollution control) Air Quality

Measured values with reference to relevant Sri Lankan guideline values: PM2.5, PM10, TSP, Sulphur Dioxide (SO₂), Nitrogen Dioxide (NO₂), Carbon Monoxide (CO), Ozone (O₃), Lead (Pb)

The project site is located in densely populated urban landscapes, the transport sector and residential activities (mostly from cooking (LP gas, biomass, Kerosene oil), contribute to main man-made sources of air pollution. Windblown road dust and soil dust are also local air pollution sources in the project areas. Other pollution sources that may influence the baseline ambient air quality in the project area is the industries and various service facilities. The pollutants linked to these sources that are typically of health concerns are lead (Pb), dust (due to re-suspension), particulate matter (PM, PM 10, PM 2.5), oxides of nitrogen (NO_x), and volatile organic compounds (VOC), Photochemical oxidant (ozone), another important pollutant, forms from NO_x and VOCs in the presence of heat and sunlight. In addition to these, emissions from factories, service stations & facilities, also contribute to local air quality in the project areas.

1.2.1.1 Ambient air quality

Ambient air quality measurements taken in locations closer to the proposed site is presented in below. The 24hr average for SO₂, NO₂, PM10 and PM 2.5 levels were well below the National Ambient Air Quality Standards: The National Environmental (Ambient Air Quality) Regulations: No. 1562/22:2008.

1.2.1.2 Ambient air quality Ratmalana and Mount Lavinia Area (Closer to Bolgoda catchment)

Table 1-5: Details of Air Quality Parameters

Parameter	GPS Coordinates	Date	Concentration (µg/m ³)					
			SO ₂	NO ₂	CO	PM ₁₀	PM _{2.5}	O ₃
Mt. Lavinia	06.834045° N 79.879020° E	15th- 16th	11	16	<1000	18	10	13
Mt. Lavinia	06.833985° N 79.879261° E	June 2022	12	15	<1000	23	13	12
Mt. Lavinia	06.834544° N 79.879288° E		14	22	<1000	42	23	14
Associated Battery, Rathmalana	6.828651° N 79.880739° E	27th June 2022	-	-	-	17	-	-
National Ambient Air Quality Standard			80/24hr	100/24hr	68,000/any time	100/24hr	50/24hr	200/1hr

Source: National Building Research Organization

1.2.1.3 Noise and vibration of project sites with reference to relevant Sri Lankan guideline values (if applicable)

Measurements on baseline Noise levels in the Moratuwa –Ratmalana area

The past data on noise measurements show variation of the noise levels depending on the location specific noise generating sources. The measured noise levels however were marginal and within the levels stipulated in the national environmental (noise control) regulations: schedule IV: urban residential areas. i.e. Leq 60 (daytime) and Leq 50 (nighttime).

Table 1-6: Noise Level Details

Location Description.	GPS Coordinates	Time Period	Time	Residual Noise Level Leq dB(A)	Background noise level L90 dB(A)	Standard Max noise Leq
LTL Transformers (Pvt) Ltd, Angulana, Moratuwa	6°48'7.00" N 79°52'43.00"E	26 th April 2022	Day (6:00Hrs-18:00Hrs)	52	49	60
			Night (18:00 Hrs-6:00Hrs)	46	43	50

The past data on noise measurements show variation of the noise levels depending on the location specific noise generating sources. The levels were marginal and within the levels stipulated in the national environmental (noise control) regulations: schedule IV: urban residential areas. i.e. Leq 60 (daytime) and Leq 50 (nighttime).

1.2.1.4 Ground vibration

There are no past measurements on ground vibration in Bolgoda project area. However, several sources with potential to generate ground vibration are present these project areas. In the project

area traffic vibration can be considered as influencing vibration source in project areas.

In addition to road traffic-based vibration, Road vibration can occur mainly when heavy trucks/vehicles passing at relatively high speed on a road with an uneven surface profile. The Interaction between wheels and road surface causes a dynamic excitation which generates waves propagating in the soil and impinging on the foundations of nearby structures. Also, the Ratmalana airport located in the proximity to Kandawala Road canal act as a source of vibration (during take up and landing) in addition to other local vibration sources in the area.

Traffic vibration is perceptible especially when heavy vehicles passing at relatively high speed on a road with an uneven surface profile. It can cause annoyance and stress to nearby residents. It is more perceptible during night as vehicles travel at very high speed on road. However, it is very unlikely to result in even minor superficial damage to buildings. Similarly rail vibration can be perceptible to human when trains are passing at a very high speed. Studies have shown that the rail track induced vibration cause annoyance to nearby residents, but unlikely to cause foundation damage to properly constructed buildings.

1.2.2 Ambient water quality

1.2.2.1 Measured values with reference to relevant Sri Lankan guideline values: Water temperature, TDS, TSS, Color, pH, BOD, COD, DO, SO₄, Cl, NO₂-N, NO₃-N, NH₃-N, T-N, T-P

Past water quality data and visual observations were used to describe the ambient water quality status of the canal proposed for rehabilitation. There were no past water quality measurements for Telawala Road canal or the Kandawala Road canal. However, several of past water quality measurements available for both Weras Ganga and North Bolgoda Lake, the recipient water bodies that receive the discharge of the two canals, were used to approximate the water quality status of these two canals along with the visual observations.

1.2.2.2 Catchment pollution sources

In general, the canals proposed for the rehabilitation drain densely populated urban landscapes. It was observed that the water in these canals is exposed to pollution from myriad of sources. Sewage from overflowing septic tanks (especially during heavy rains), intentional direct sewage discharges, poorly treated industrial wastewater discharges, direct disposal of household wastewater from kitchens and bathrooms, laundry wastewater, wastewater from commercial facilities, restaurants, and boutiques, road runoff and surface runoff carrying pollutants and sediments are the main pollution sources responsible for existing water quality in the canals of Weras Ganga.

1.2.2.3 Water quality in Telawala and Kandawala road stormwater canals

The two canals in the Telawala and Kandawala watersheds receive polluted runoff from densely populated catchment from diversity of pollution sources as mentioned above. The ultimate recipient water body of the two canals is the North Bolgoda/ Weras Ganga.



Source: Google Satellite Imagery

Figure 1-6: The discharge points of Kandawala Rd. canal and Telawala Rd. canal to Veras Ganga

1.2.2.4 Visual observations on water quality impairment in the Telawala Rd. Canal and the Kandawala Rd. canal

Visual observations revealed that several Textile industries are located alongside the Telawala canal discharge their industrial wastewater into the canal. Figure 1-9 below present the visual observations made during the field visit.

Colored effluents were observed in the Telawala road canal network presumably released from textile factories. The residents who live on the sides of the canal confirmed frequent flow of colored effluents, foamy wastewater, discharges with kerosene oil and acid fume smell. Further, at location 1 (Figure 1-8) near the entry point of the Telawala road from the Galle Road, the canal water smelled sewage and H₂S. Some residents informed of septic tank overflow during heavy storms. The black color surface sediments collected from sampling locations (location 3 Figure 1-10) suggest possible high organic pollution, and low oxygen levels of the canal water. High BOD levels, Fecal pollution, low

DO levels, high Turbidity, High temperatures, surfactants, detergent with Phosphates, Ammonia, Nitrates and oils and greases etc. can be expected in the canal water.

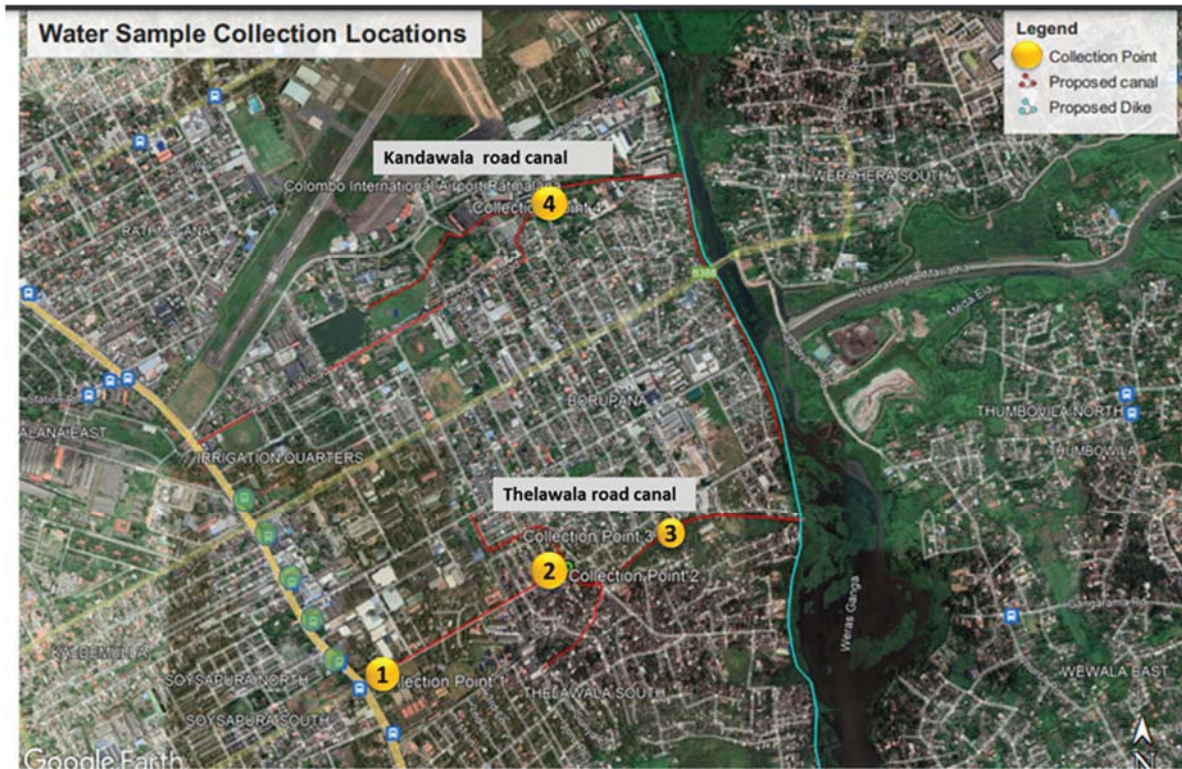


Figure 1-7: Densely populated urban watershed of Telawala and Kandawala drainage area. Indicated are water sampling locations for visual observations used for water quality impairment assessment.



Figure 1-8: Location -1: Telawala Road canal
Stagnant canal water with litter, floating scums and oils; A water sample collected from the Telawala

canal at location 1. The water appears turbid, light straw color and smelled sewage and H₂S, Canal sediment is soft & black in color suggesting impaired water quality



Figure 1-9: Location-2: Telawala canal

The drain carrying green color murky effluent presumably discharged from a textile dyeing factory, Green colored sample of water collected from location 2



Figure 1-10: Location 3: Telawala canal further downstream

Unlined earth drain carrying colored effluent possibly discharged from a textile dyeing factory; The blue

color water (top) and thick black surface sediment (bottom) indicating possible heavy pollution.



Figure 1-11: Kandawala road canal near Galle Road (L): -Fish were observed in the water (R) Kandawala road canal near Kothawala Defense University. Clear water, no bottom sediments, fish were observed suggesting relatively low pollution load in this canal section



Figure 1-12: Location 4: Kandawala Road Canal

Further downstream: murky waters, slicks of oil, dark bottom sediments, growth of microbial slimes indicating water quality impairment; Sample of water collected from the canal with soft black surface sediment suggesting water quality impairment

1.2.2.5 Past studies on the water quality impairment of Weras Ganga and North Bologoda lake

There are no water quality studies on the Telawala road storm water canal network and the Kandawala Road canal Network, as water quality of the Weras Ganga and Bolgoda is partly govern by

the discharges from the two canals, published-Scientific studies on water quality of Weras Ganga and North Bolgoda canal were used to approximate the water quality of the two canals.

1.2.2.6 Study on the nutrient enrichment and eutrophication

A comparative study carried to determine the level current (2011-2013) and past trends (2008) of eutrophication of the Bolgoda North Lake, using *in situ* Chlorophyll-a (Chl-a) nitrate and phosphate levels.

measurements from March to October 2013 has shown that eutrophication of the lake has increased from 2008 to 2011, Heavy eutrophic conditions have been noted in several regions of the lake in 2013, especially

in water stagnant areas and adjacent to freshwater inlets. Eutrophication occurs when water become rich with nutrients, especially Phosphorus. Unplanned urbanization and inadequate facilities for waste management have resulted in heavy eutrophication of the water body according to this study. Table 1-7 present the concentrations of Chlorophyll-a, Nitrates and Total Phosphorus at 4 locations in the North Bolgoda lake.

Table 1-7: Chlorophyll-a and nutrient concentration- North Bolgoda lake

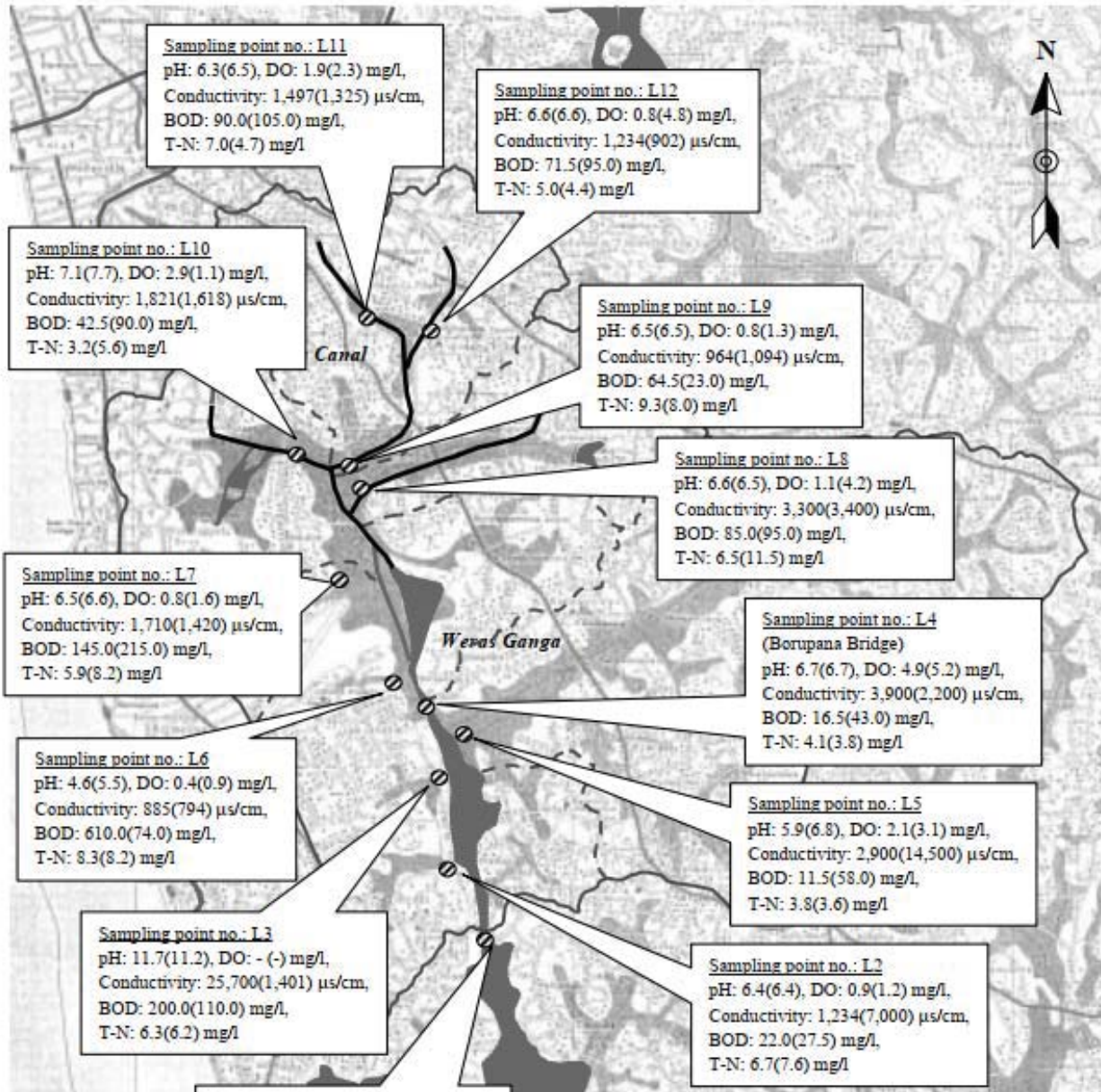
	Site 1	Site 2	Site 3	Site 4	Site 5
Chl-a content (mg/L)	30.35±7.26 ^a (11.5-61.7)	37.01±8.02 ^a (13.7-78.5)	24.96±2.71 ^a (14.8-35.5)	28.97±7.20 ^a (15.1-64.6)	42.43±5.52 ^a (25.5-63.9)
Nitrate Concentration (mg/L)	2.78±0.28 ^b (1.68-3.66)	3.44±0.39 ^b (2.38-5.42)	2.81±0.10 ^b (2.49-3.22)	3.13±0.38 ^b (2.13-4.51)	3.33±0.32 ^b (1.88-4.30)
Total phosphorus concentration (µg/L)	61.57±9.96 ^c (21-109)	71.43±9.51 ^c (39-110)	64.14±3.34 ^c (54-76)	62.43±6.31 ^c (36-88)	88.57±5.69 ^c (74-113)

Mean±SEM values for Chl-a, nitrate and total phosphorus levels in the surface water at the five sampling sites of the Bolgoda North Lake. The are indicated within parentheses. In each row, the values indicated by the same superscript letter are not significantly different from each other (P>0.05)

Source: DOI: 10.4194/1303-2712-v16_3_08 Monitoring Eutrophication Trends in Bolgoda North Lake, Sri Lanka by Satellite Remote Sensing

Study on water quality impairment of Weras Ganga in 2002

Pollution of water in Weras Ganga (to which the proposed rehabilitation canals drain) was a serious issue for decades. A study done in 2000 under “Study on Storm Water Drainage Plan for the Colombo Metropolitan Region in the Democratic Socialist Republic of Sri Lanka, JICA” shows poor surface water quality status in the Weras Ganga as depicted by high BOD, low Dissolved Oxygen and High Total Nitrogen levels at almost all measured locations (Figure 1-8, Figure 1-9, Figure 1-10 and Figure 1-12). The polluted discharges from the canals draining to the Weras Ganga including both Telawala road canal and the Kandawala road canal too had contributed to water quality impairment in this water body. Although data are old, it provides an insight to historical pollution and water quality impairment issues the water bodies in the project area were experiencing.



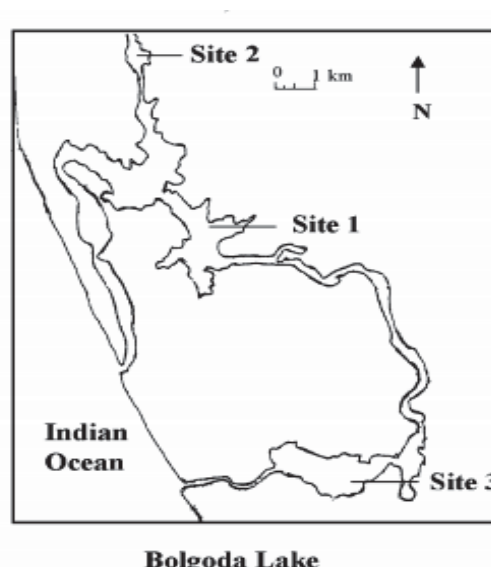
Source: EIA Study on Wera Ganga Sub-basin Storm Water Drainage Plan, JICA Study Team, 2002, "Study on Storm Water Drainage Plan for the Colombo Metropolitan Region in the Democratic Socialist Republic of Sri Lanka, JICA"

Figure 1-13: Surface water quality status in Weras Ganga

Heavy metal pollution in water: in the Bolgoda lake and Weras Ganga in 2005

A study on the “Use of biomarkers in Nile tilapia (*Oreochromis niloticus*) to assess the impacts of pollution in Bolgoda Lake, an urban water body in Sri Lanka”, by A. Pathiratne · et al in 2005 had measured the heavy metal concentration in Bolgoda and Weras Ganga including North Bolgoda lake (the ultimate recipient water body of both Telawala and Kandawala canals).

When results are compared with the allowable limits for stated heavy metals for different use categories in National Environmental (Ambient Water Quality) Regulations, No. 01 of 2019 the limits exceed the allowable 5 micro gram/L for all categories for Cd Table 1-8.



Source: use of biomarkers in Nile tilapia (*Oreochromis niloticus*) to assess the impacts of pollution in Bolgoda Lake, an urban water body in Sri Lanka

Figure 1-14: Sampling locations.

Table 1-8: Heavy Metal Parameter Details

Site	Pb	Cd	Cr	Cu	Zn
April 2005 (dry period)					
Bolgoda North Lake	23.8 - 38.5	7.2 - 14.3	7.3 - 22.6	8.6 - 15.3	21.3 - 29.1
Weras Ganga	28.6 - 32.4	6.3 - 8.1	6.7 - 9.6	9.1 - 40.3	26.3 - 35.8
Bolgoda South Lake	32.1 - 136	3.1 - 4.3	3.4 - 6.5	13.5 - 15.1	19.4 - 35.1
Sep 2005 (wet period)					
Bolgoda North Lake	26.2 - 44.9	2.2 - 4.3	8.3 - 21.3	13.8 - 31	12.1 - 14.8

Source: Source: use of biomarkers in Nile tilapia (*Oreochromis niloticus*) to assess the impacts of pollution in Bolgoda Lake, an urban water body in Sri Lanka

1.2.2.7 Sediment Quality and heavy metals

Past studies on sediment quality of canals proposed for rehabilitation are not available. Nevertheless, data from several sediment quality studies are available for the Weras Ganga & North Bolgoda lake the recipient water bodies of both Telawala Road canal and the Kandawala Road canal. These data were used to get an approximation on the sediment quality of the two canals proposed for rehabilitation. Additionally, one grab sample of surface sediments collected from the location 3 of the Telawala Canal were tested for As, Cd, Cr Cu and Pb.

1.2.2.8 Heavy metal contaminant in Telawala road canal

A grab sample of sediment at location no 03 (Figure 1-10) was collected and tested for heavy metals, Chromium, Cadmium, Lead, Arsenic, Copper. Table 1-9 present the Concentration of tested heavy metals in dry sediment. As Sri Lanka does not have sediment quality guidelines for ambient water bodies the results were compared with Canadian Sediment quality Guidelines for protection of aquatic

life. The heavy metal concentration in the dry sediment were below the ISQG value for all tested heavy metals.

Table 1-9: Measured heavy metal content in sediment: Telawala Rd. canal

Parameter	Unit	Concentration in the dry sediment
Arsenic (as As)	Mg/Kg dry weight	1.3
Cadmium (as Cd)		0.2
Chromium (as Cr)		20.4
Copper (as Cu)		29.0
Lead (as Pb)		22.9

Source: Water quality report, Industrial Technology Institute (Official report is given in Annex 04)

Table 1-10: Canadian sediment quality guidelines for the protection of aquatic life

Heavy Metal	ISQG -Unit mg/kg (dry weight)	PEL Unit mg/kg (Dry weight)
Lead	35	91.3
Cadmium	0.6	3.5
Chromium	37.3	90
Copper	35.7	197
Zinc	124	271
Arsenic	5.9	17
source: https://www.Elaw.org/system/files/sediment_summary_table.pdf :Canadian-Sediment-Quality-Guidelines-for-the-Protection-of-Aquatic-Life		
ISQG: Interim sediment Quality Guideline Value. protection of aquatic life		
PEL: Probable effect level – Above the PEL; the probable effect range within which adverse effects frequently occur.		

1.2.2.9 Study sediment quality- Heavy metal pollution in Weras Ganga and Bolgoda lake

The following Table 1-11 and the Figure 1-15 present the sediment quality in Weras ganga and Bolgoda lake. The results show that the heavy metal levels in the sediment exceed in many cases the recommended guidelines values (SQG) as well as the Probable effect level (PEL: value bey) for the protection of aquatic life suggesting potential risk of heavy metal pollution in the lake sediment and risks on the aquatic life.

Table 1-11: Heavy Metal Parameter Details Bolgoda

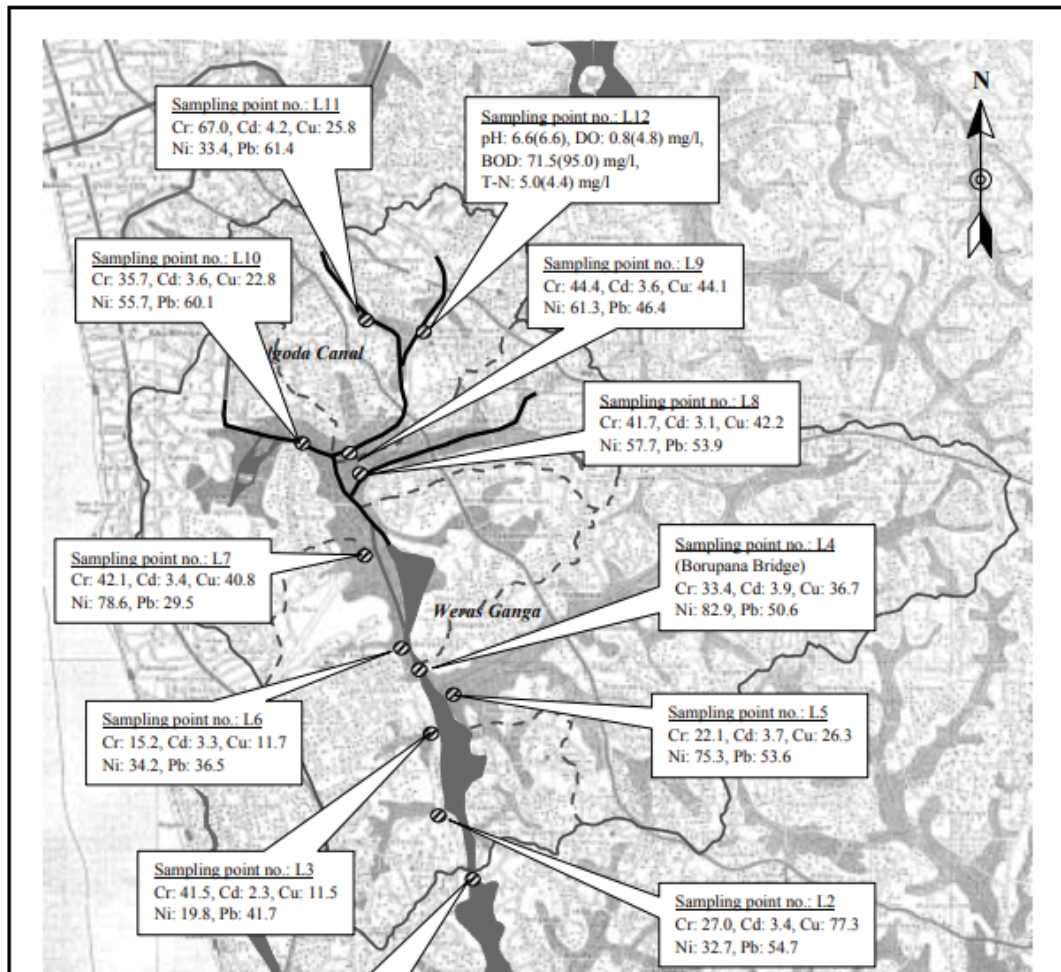
Site	Pb	Cd	Cr	Cu	Zn
April 2005 (dry period)					
Bolgoda North Lake	26.3-44.3	1.8-2.4	85-178	23.6-45.6	136-165
Weras Ganga	26.8-68.7	2.4-4.8	23.4-65.8	45.2-56.8	87-298
Bolgoda South Lake	6.6-54.8	0.7-2.5	46-179.5	12.6-17.5	54.3-67.2
Sep 2005 (wet period)					
Bolgoda North Lake	46.2-54.2	1.3-3.9	98-234	54.3-73.2	64-203
Bathalagoda reservoir	ND-3.8	ND	ND	1.3-5.2	10-21

Data are presented as ranges of metals detected in three sub sampling sites of each main sampling site ND below the detection limits

Source: DOI 10.1007/s10661-008-0490-4 Use of biomarkers in Nile tilapia (*Oreochromis niloticus*) to assess the impacts of pollution in Bolgoda Lake, an urban water body in Sri Lanka

In another study the sediment heavy metal content has been measured in year 2000 for “Study on Storm Water Drainage Plan for the Colombo Metropolitan Region in the Democratic Socialist Republic of Sri Lanka, JICA”. Like previous study the results show that the heavy metal levels have exceeded in

many cases the recommended guideline values further stressing potential threat on the aquatic life. Accordingly, it may be possible that some canal sections in both Telawala road and Kandawala Road may contain sediments at levels threatening aquatic life.



Source: EIA Study on Weras Ganga Sub-basin Storm Water Drainage Plan, JICA Study Team, 2002

Figure 1-15: Unit of all the values is mg/kg dry weight.

1.3 Ecological Environment

1.3.1 Ecological Environment-Weras Ganga Project

1.3.1.1 Terrestrial and aquatic habitats

Despite its rich diversity, very few systematic surveys have been documented with respect to the biodiversity of the Bolgoda basin. Therefore, a rapid assessment survey was carried out in the basin to record habitat types, flora, and fauna. The Bolgoda canal commencing from the Weras Ganga flows through the Bellanwila-Attidiya marsh. Thus, it would be reasonable to assume that many of the species in Bellanwila-Attidiya would also be found in the remnant natural or semi-natural habitats in the wider catchment. Disregarding this information might lead to underestimation of its biotic worth. Therefore, supplementary data have been obtained from such surveys, where information is available.

The Bolgoda basin consists of both aquatic/semi-aquatic and terrestrial habitats. The major aquatic and semi-aquatic habitats include freshwater ponds, canals and marshes, while the terrestrial habitats include woodlands, scrublands, riparian habitats, paddy fields and home gardens

(Henkanathgedara et al., 2005).



Photo 1: Nature of habitats in the Bolgoda catchment (clockwise)



Photo 2: Nature of habitats in the Bolgoda catchment

(The Bellanwila Attitidiya marsh, Kapu Ela with riparian vegetation, mangroves / woodlands along the Bolgoda canal, woodlands around stagnant ponds and home garden habitats.)

Aquatic and riparian habitats are dominated by rooted emergent plants such as *Rhynchospora* sp., *Eleocharis* sp., and grasses such as *Brachiaria* sp. and *Bacopa* sp. that grow extensively along the fringes of ponds (Henkanaththegedara et al, 2005). The water surfaces are covered with invasive plants such as *Salvinia molesta* and *Eichhornia crassipes* and while the rooted flowering ornamental species *Nymphaea* sp. and *Nelumbo nucifera* are also found. The depth of many channels and ponds have reduced due to siltation. The woodland areas have been colonized by the invasion alien *Annona glabra*, while other species such as *Cerbera manghas*, *Syzygium* sp., *Melastoma* sp. (Henkanaththegedara et al., 2005) also occur. Some areas are also invaded by the terrestrial invasive alien species *Lantana camara*.

With respect to fauna, a total of 152 species of vertebrate fauna –11 species of amphibians, 27 reptiles, 14 mammals, 78 birds and 22 fishes, and about 75 species of butterflies have been recorded from the Bolgoda catchment. Wetlands in the Bolgoda basin are important habitats for birds, including migratory species. Many of the common birds observed here include herons, egrets, coots, waterhens, cormorants, kingfishers and pelicans. Some of the more abundant species are the little cormorant (*Microcarbo niger*), Purple heron (*Ardea purpurea*), Pheasant-tailed Jacana (*Hydrophasianus chirurgus*), Lesser Whistling Duck (*Dendrocygna javanica*), Spot Billed Pelican (*Pelecanus philippensis*), Purple Swampphen (*Porphyrio porphyrio*), White-throated Kingfisher (*Halcyon smyrnensis*), White-breasted waterhen (*Amaurornis phoenicurus*), Black-winged stilt (*Himantopus himantopus*) and Brahminy kite (*Haliastur indus*). The riparian vegetation, reed and weed mats provide important breeding grounds of these species.

Table 1-12: Faunal diversity of the Bolgoda basin

	Species	Endemics	Threatened
Fish	22	2	1
Amphibians	11	3	0
Reptiles	27	6	0
Birds	78	4	0
Mammals	14	0	1
Butterflies	75	1	3
Total	227	16	5

Source, Karunaratna et al., 2010

Some of the common species of amphibians that are observed in the area include *Duttaphrynus melanostictus*, *Euphlyctis cyanophlyctis*, *Euphlyctis hexadactylus*, *Hoplobatrachus crassus* and *Philautus popularis*. Some of the rare amphibian species such as *Microhyla rubra*, *Hylarana gracilis* and *Polypedates cruciger* occur in the relatively undisturbed areas. The reptiles include both tetrapods and serpentoids. The common species that have been observed in the area include *Calotes calotes*, *Calotes versicolor*, *Gehyra mutilata*, *Hemidactylus parvimaclatus*, *Hemidactylus frenatus*, *Ptyas mucosa*, *Varanus bengalensis* and *Varanus salvator*. The estuarine crocodile (*Crocodylus porosus*) is also reported from the area and is moderately abundant in the Weras Ganga (river).

The common mammals that can be seen in the Bolgoda basin include *Prionailurus viverrinus* (Fishing cat), *Herpestes brachyurus* (Brown mongoose), *Herpestes edwardsii* (Grey Mongoose), *Hystrix indica* (Porcupine), *Bandicota bengalensis* (Mole rat), *Bandicota indica* (Malabar Bandicoot), *Rattus rattus* (Common rat) and *Funambulus palmarum* (Palm squirrel). Roosting colonies of *Pteropus giganteus* (Flying fox) was also noted in the area. Scat of *Lutra lutra* (Eurasian otter) can be observed commonly in wetlands and marshes. Another important species that is found here is the *Semnopithecus vetulus* (Western Purple faced langur).

The Bolgoda basin is home to many species of fish which include both brackish and freshwater fish. A total of 22 species of species fish have been recorded many of these being invasive species (e.g., *Pterygoplichthys multiradiatus*, *Oreochromis mossambicus*). *Ambassis commersoni* (Common glassfish, Katilla) harvested from the Bolgoda lagoon is known to be a local delicacy.

The entire basin along with home gardens and plantations serve as important habitats of the butterflies. Among the common species are *Papilio domoleus*, *Graphium Agamemnon*, *Leptosia nina*, *Delias eucharis*, *Catopsilia pyranthe*, *Eurema hecabe*, *Danaus genutia*, *Junonia atlites*, *Telicota colon*, *Acraea violae*, *Ypthima ceylonica*, *Jamides celeno* and *Zizula hylax*.

1.3.1.2 Current condition of vegetation and biodiversity

AS with many urban wetlands although the Bolgoda area has a high capacity to support biota, the mismanagement in terms of encroachment of the banks, overgrowth of weeds owing to lack of maintenance and reduction in depth due to accelerated erosion and surface run off has led to the reduction in open water areas. Additionally, pollution from industries, sewage from low-income houses etc. has polluted the water ways. Hence the condition of the entire basin remains in a state of degradation.

1.3.1.3 Current ecosystem services and its vulnerability

The Bolgoda Lake is the largest man-made lake in Sri Lanka, which consists of both freshwater and

brackish water areas in turn supporting a mosaic landscape forming a complex ecological system. The entire basin sustains a rich complement of species of both flora and fauna whilst also providing many benefits to the local people in terms of extractive and non-extractive uses and ecological services. These services include water regulation and purification, sediment trapping which are critical in urbanized landscapes. The provision of breeding grounds for fish and shellfish, providing habitats for terrestrial and aquatic biota, and recreational opportunities for people are additional benefits. Its protective provisions were evident during the tsunami in the Kalutara and Panadura areas, primarily due to the strategic location and the holding capacity. The channels have in the past been used for transportation – pontoons and vessels have been used as a mode of transportation along the Bolgoda Channels. Ferryman transported goods and people from the Colombo District to Anguruwatota in the Kalutara District.

The Bolgoda basin consists of an intricate hydrological network – freshwater channels and pools, marshes, brackish water lagoons which in turn naturally support many types of aquatic and semi-aquatic floral assemblages such as floating and rooted vegetation, reed beds, riparian habitats, terrestrial woodlands, and mangroves. Many of the natural habitats around the periphery of the Bolgoda lagoon are today replaced by anthropogenic habitats. A few marshy areas remain and support remnant patches of mangroves and woodlands. Many of these wetlands have lost their capacity to provide ecological services.

1.3.1.4 Protected habitats

The Bellanwila Attidiya Sanctuary, a type of protected area designated by the Wildlife Conservation Dept. has been declared as a bird sanctuary under the Fauna and Flora Protection Ordinance in 1990. The area is about 3.72 km² in size, was designated on July 25, 1990, IUCN Category IV, and is also designated as an Important Bird Area (IBA). Much of the designated area is built-up and there is an airport. The number of protected area categories and designated areas in Sri Lanka are shown in Table 1-13

Table 1-13: Protected areas in Sri Lanka Category and number

Category	Designated area
Strict Natural Reserve	3
National Park	25
Nature Reserve	9
Jungle Corridor	2
Marine National Park	1
Marine Reserves	0
Buffer zone	0
Sanctuary or a Managed Elephant Reserve	68

Source: Department of Wildlife Conservation (<https://www.dwc.gov.lk/protected-areas/>)

There are eight categories, ranging from Strict Nature Reserves, which require the strictest protection requirements, to Sanctuary or a Managed Elephant Reserve, which is designated for both nature conservation and development on private lands. The Bellanwila Attidiya Sanctuary, where the F/S is located, the eighth of these eight categories and is designated as a sanctuary that includes private land, and is not prohibited from development projects. According to Karunarathna et al. (2010), the endangered fauna identified in the Bellanwila Attidiya Sanctuary is the most endangered in the world. According to Karunarathna et al. (2010), the endangered species of fauna identified in Bellanwila Attidiya Sanctuary are shown in the table below. It is possible that habitats for these endangered species may be present at the project site.

Table 1-14: Endangered Species confirmed at Bellanwila Attidiya Sanctuary (2007 red list)

Category	Species
CR	-
EN	[Butterfly] <i>Eurema andersoni</i> (One-spot grass yellow)
VU	[Mammal] <i>Prionailurus viverrinus</i> (Fishing cat) [Fish] <i>Anguilla nebulosa</i> (Long finned eel) [Butterfly] <i>Hypolycaena nilgirica</i> (Nilgiri tit) [Butterfly] <i>Telicota ancilla</i> (Dark palmdart)
NT	[Reptile] <i>Melanochelys trijuga</i> (Parker's black turtle) [Reptile] <i>Cylindrophis maculata</i> (Sri Lanka Pipe snake) [Fish] <i>Anguilla bicolor</i> (Level finned eel) [Bird] <i>Hirundo daurica</i> (Red-rumped swallow) [Bird] <i>Picus chlorolophus</i> (Lesser yellownape) [Butterfly] <i>Troides darsius</i> (Ceylon birdwing) LC [Butterfly] <i>Chilasa clytia</i> (Mime) [Butterfly] <i>Ideopsis similis</i> (Blue glassy tiger) [Butterfly] <i>Euploea phaenareta</i> (King crow) [Butterfly] <i>Euploea klugii</i> (Brown king crow) [Butterfly] <i>Cupha erymanthis</i> (Rustic) [Butterfly] <i>Charaxes solon</i> (Black rajah)

Note: CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened
Source: Karunaratna et al., 2010, Current Status of Faunal Diversity in Bellawila-Attidiya Sanctuary, Colombo District - Sri Lanka
(https://www.researchgate.net/publication/229428983_Current_Status_of_Faunal_Diversity_in_Bellawila-Attidiya_Sanctuary_Colombo_District_-_Sri_Lanka)

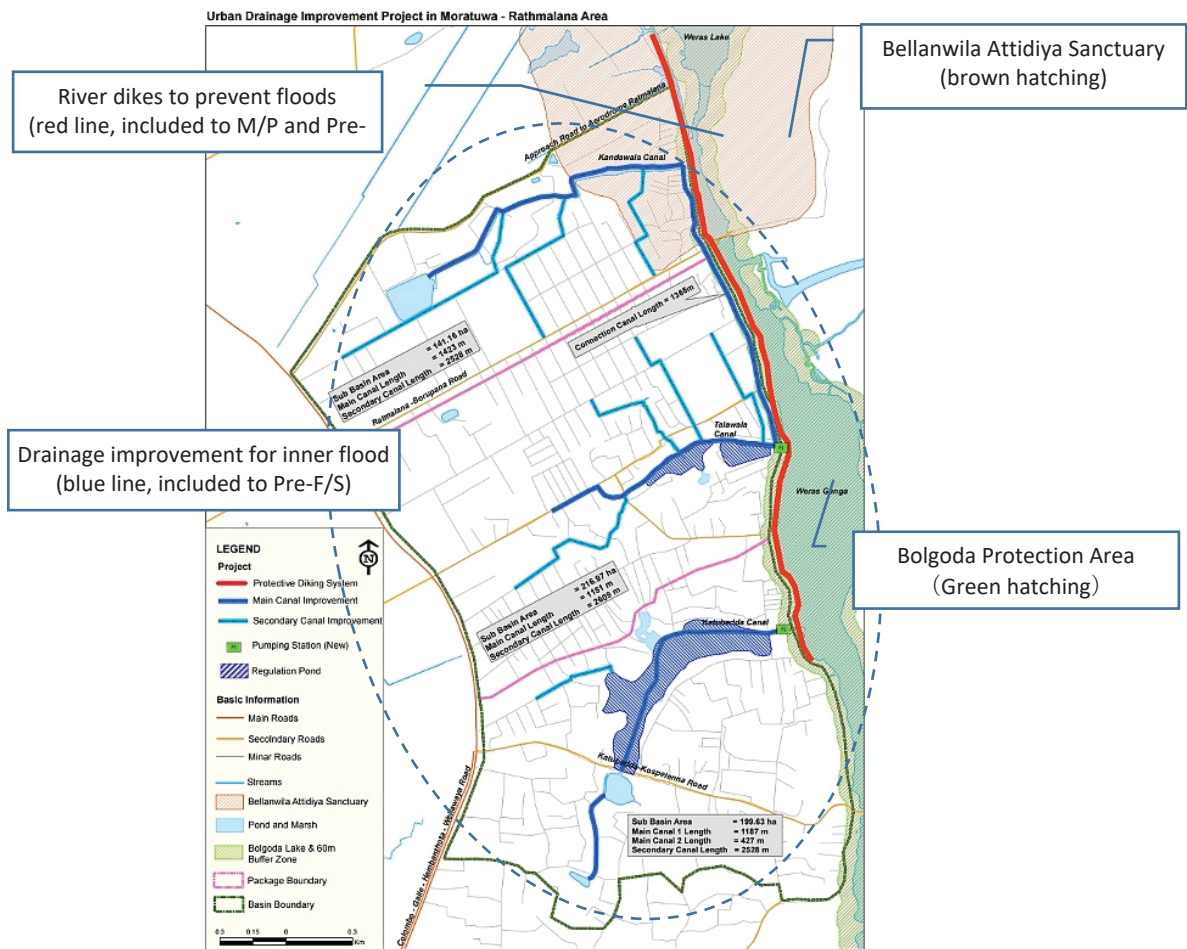
The entire Bolgoda river system has been declared as an Environmental Protection Area by the Central Environmental Authority in 2009. However, the communities that reside around the EPA has very little knowledge about the EPA and what types of activities are allowed in the EPA. The signs conveying the message of ‘this is a strictly protected area’ seems older and faded away without any legibility other than the title. This was the case in all the notice boards from North Lake to South Lake.

Nonetheless, the Protection Area was established by the CEA for the purpose of protection within the river channel, and like the Sanctuary, the Protection Area was not established for the exclusive protection of nature, but for the realization of appropriate development, including flood control. No endangered species of flora were identified at the time of the field check in 2020. As for the fauna, the endangered species shown in Table 1-15 were identified. In addition, the figure below presents location of protected area withing in Moratuwa-Rathmalana area. It is possible that the habitats of these endangered species are present at the proposed project site.

Table 1-15: Endangered Species confirmed at Bolgoda Protection Area (ver 2012 red list)

Category	Species
CR	-
EN	[Reptile] <i>Crocodylus porosus</i> (Saltwater crocodile / Estuarine crocodile)
VU	-
NT	[Amphibian] <i>Philautus popularis</i> (Common shrub frog) [Butterfly] <i>Telicota colon</i> (Pale Palmdart)

Note: CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened
Source: JICA study team



Source: JICA study team

Figure 1-16: Location of Protected areas in Moratuwa-Rathmalana area and Proposed Projects by Pre F/S

1.3.1.5 Endemic and threatened species in the area

Of the faunal diversity of this region includes 16 (7%) endemic species and 5 (2.2 %) species that are listed as nationally threatened. Among the plants recorded, the notable species include *Areca concinna* (Lenteri Puwak), which is listed as nationally endangered (EN) species and *Cinnamomum zeylanicum* (Kurundu), which is listed as a nationally vulnerable (VU) species.

The important species of fauna recorded included the endemic species *Aplocheilus dayi* (Day's killifish), *Clarias brachysoma* (Walking catfish), *Dawkinsia singhala* (Filamented Barb), *Xenochrophis cf. piscator* (Checked Keelback), *Megalaima rubricapilla* (Crimson-fronted Barbet) and *Semnopithecus vetulus* (Purple-faced leaf monkey). Of these endemic species, *Aplocheilus dayi* (Day's killifish) and *Semnopithecus vetulus* (Purple-faced leaf monkey) are listed as nationally endangered (EN) while *Clarias brachysoma* (Walking catfish) as a nationally near threatened (NT). Further, several native species that are listed either as threatened or near threatened such as *Prionailurus viverrinus* (Fishing cat) listed as nationally endangered (EN), *Lutra lutra* (Otter) *Ixobrychus cinnamomeus* (Cinnamon Bittern), *Ixobrychus sinensis* (Yellow Bittern), *Nycticorax nycticorax* (Black-crowned Night Heron), listed as nationally near threatened (NT) species have also been recorded in the Bolgoda basin.

One of the important faunal species found in the basin from Weras Ganga to Bolgoda is the Saltwater Crocodile (*Crocodylus porosus*). This species naturally occurs in the entire basin and should be allowed to thrive here as no serious attacks have been reported. Breeding of the crocodile has been recorded in the banks (riparian habitats) of the Bolgoda basin. Awareness signs warning about the presence of

crocodiles should be erected. Having river and canal reservations will be congenial for the crocodiles who breed in riverbanks.

1.3.2 Landscape and recreational spots

There are no recreation spots within the Project Area at present. However, Bolgoda Lake (Central North and South Lake areas) is a recreation spot for boating , wind surfing etc. Since the Weras Ganga area is full of aquatic plants and pollution has taken place near the proposed dike area recreation activities are not possible. However, after improvement there could be opportunities for recreation in this area.

1.4 Socio-economic Environment Settlement Social Structure

1.4.1 Socio-economic Environment Settlement Social Structure

Moratuwa – Rathmalana drainage improvement project is in 5 Grama Niladari divisions of Moratuwa, Rathmalana DS divisions of Colombo district of Western province. The Grama Niladari divisions of Moratuwa DS division are Thelewala South, Borupana, Thelewala North and Katubedda while Kandawala division is attached to Rathmalana DS.

1.4.2 Population, Density

The Colombo district is one of the most populous districts in Sri Lanka. The population density in the Colombo district is 3,438 people per sq. km (Department of Census and Statistics, 2012). As per the studies of UDA, the housing density in Moratuwa MC area is high with 1,783 housing units per sq.km. The population density map prepared for project based on data of Department of Census and Statistics is presented in Table 1-16.

The total population in 5 Grama Niladari divisions is 37,716 people. This includes 18,838 males and 18,878 females. In all two DS divisions, most of the population is Sinhalese. There are also other minority populations such as Tamil and Muslims living in the project area.

Table 1-16: Population in GN divisions affected by the project disaggregated by gender

DSD	GND	No. of Families	Male	Female	Total Population
Moratuwa	Telawala South 549	958	1948	2230	4178
	Borupana 549 A	1565	3107	3206	6313
	Telawala North 549 B	1284	2876	2869	5745
	Katubedda 551	2350	5867	5436	11303
Rathmalana	Kandawala 543A	2448	5040	5137	10177
Total		8605	18838	18878	37716

Source: Resources profiles of Moratuwa/Rathmalana – 2021

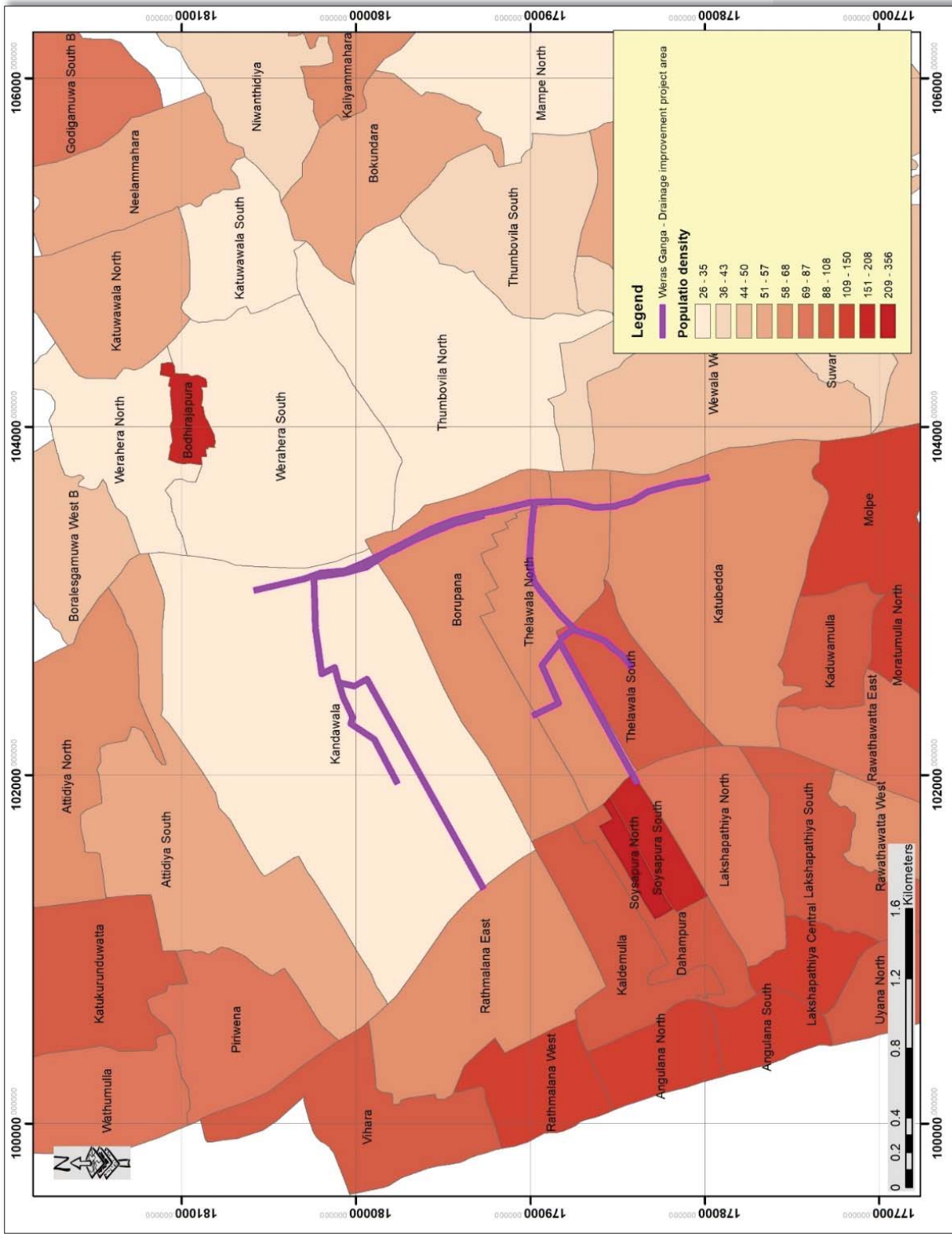


Figure 1-17: Population density of Moratuwa Ratmalana project area

The administrative maps for Moratuwa Rathmalana area showing the Grama Niladhari and Divisional Secretary boundaries are given in Figure 1-18.

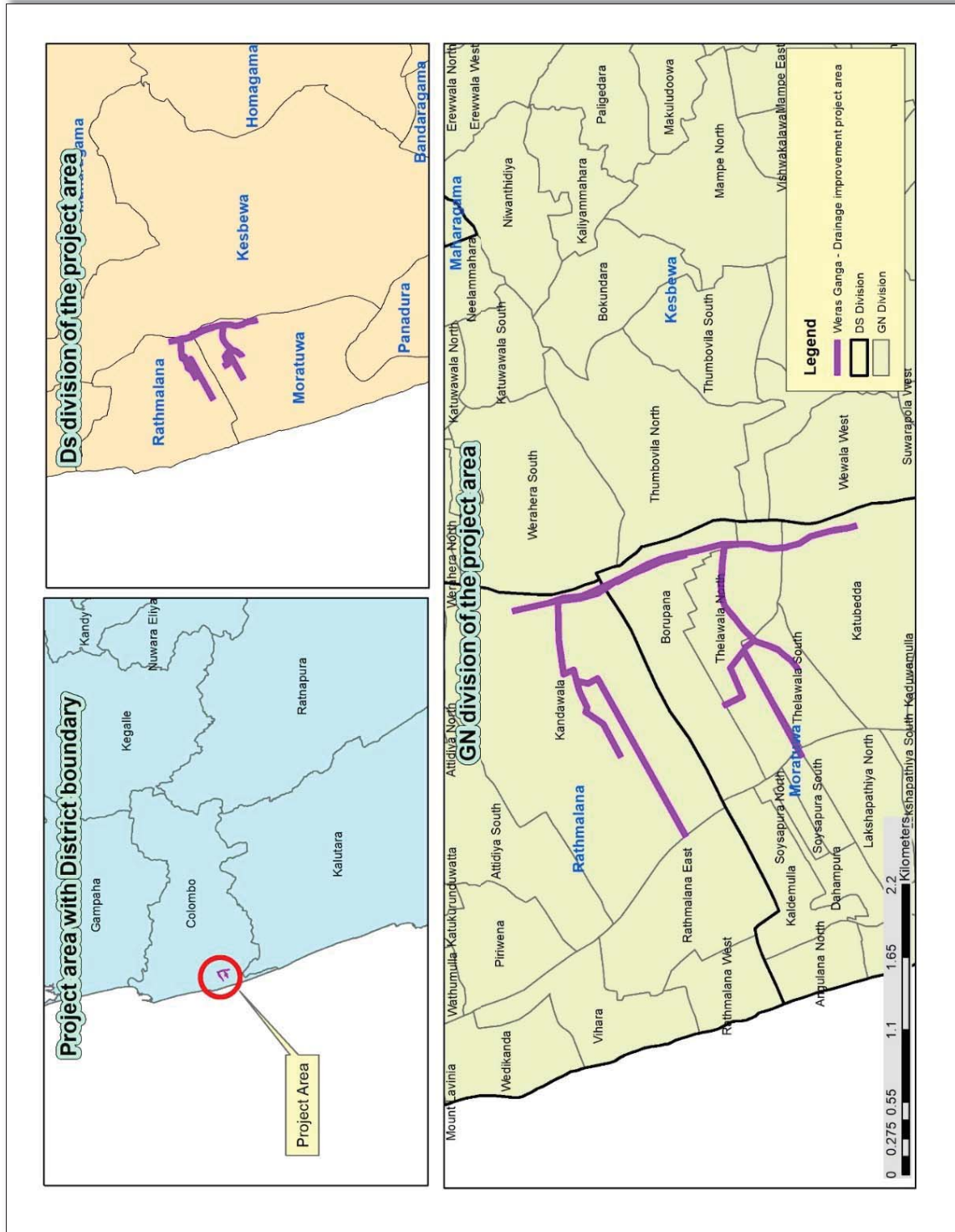


Figure 1-18: Administrative map of Moratuwa Rathmalana project area

1.4.3 Distribution of settlement

Table below presents the distribution of housing units in each GN division by type of units. The number of housing units in Moratuwa Ratmalana project area is higher. Katubedda and Kandawala GN Divisions can be identified as having majority of housing units and it is 4830 and 4514 housing units respectively. Refer Table 1-17 below. The field observation in proposed dike area of Moratuwa-Rathmalana drainage improvement project confirmed that most of the settlements are low-income housing units, and some structures are connected to each other. In Kandawala GN division, high rise apartments provided for tsunami affected families were also observed. The Photo 3 and 4 present the low-income housing units in the project area.

Table 1-17: Distribution of housing units with type of units in the project area

DSD	GND	Permanent	Semi-Permanent	Improved	Unclassified
Moratuwa	Thelawala South 549	950	876	72	2
	Borupana 549 A	1460	1289	164	7
	Thelawala North 549 B	1508	1373	128	7
	Katubedda 551	2415	2189	217	9
Rathmalana	Kandawala 543A	2257	2000	251	6
Total		8590	7727	832	31

Source: Resource profile data of Moratuwa/Ratmalana – 2021/2020



Photo 3: Tsunami housing units in Werasinga

Photo 4: Low-income houses in Werasinga

1.4.4 Land use condition

1.4.4.1 Present Land Use Conditions

The land use map for the Moratuwa Ratmalana Area is given in Figure 1 19.

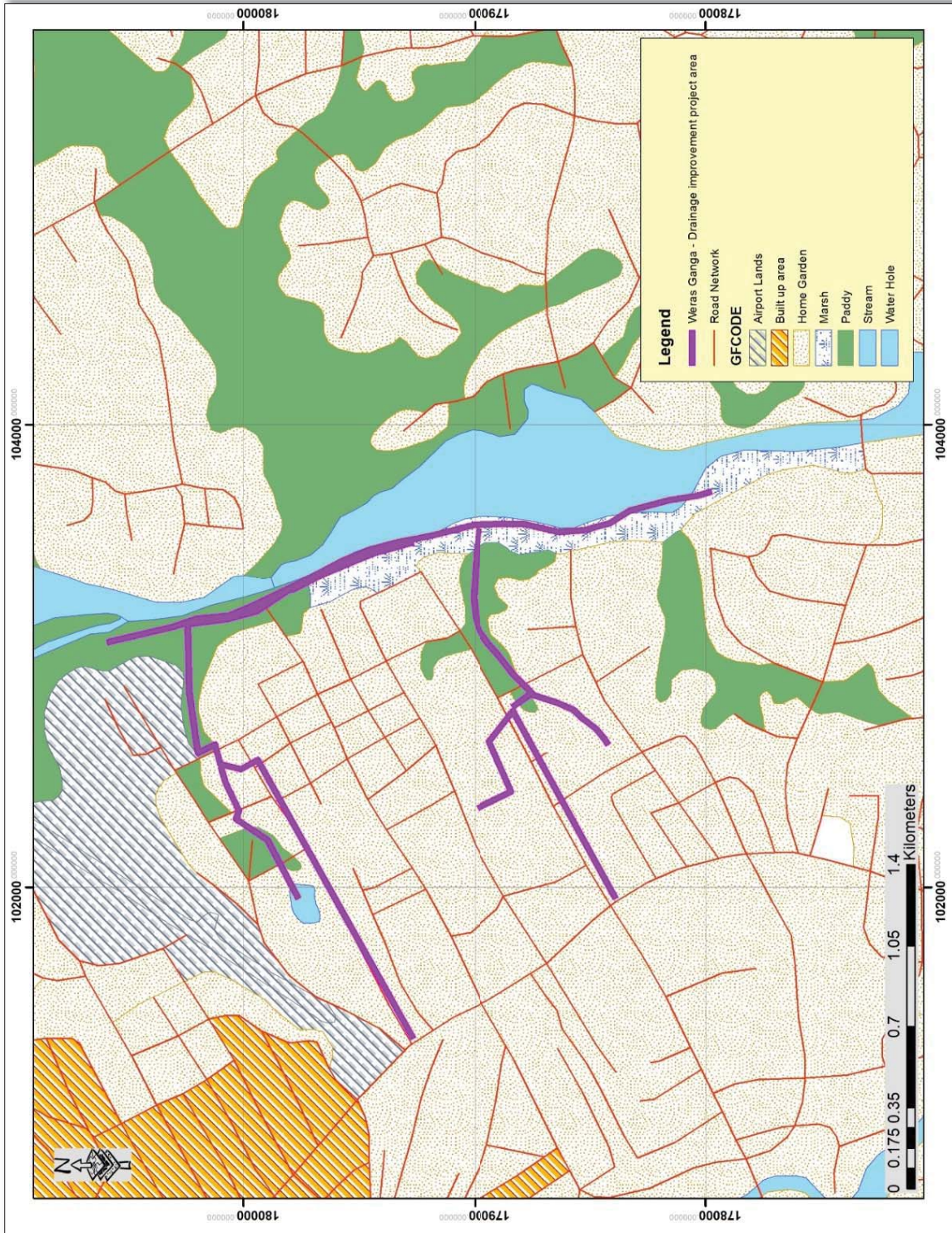


Figure 1-19: Land use of Moratuwa Rathmalana project area

1.4.4.2 Planned Land Use Conditions

1.4.5 Local resources utilization

Moratuwa Ratmalana project area is a built-up area consisting of settlements, education institutes and factories/companies. People have small home gardens in their spaces, and they grow trees such as bananas, coconut and mangoes. According to Bolgoda Environment Protection Area gazette by Central Environment Authority, there is a 60m buffer for the Weras ganga. However, many people living close to Weras ganga and other canals have encroached reservation area. There has been purposive land filling in the area and solid waste disposal to canals and river area is a common sight. FGDs conducted with communities in the project area confirmed that, only few residents in the project area engage in fishing.

1.4.6 Spatial planning

There are development plans prepared by Urban Development Authority for the Moratuwa Municipal Council area.

The plan for the Moratuwa Municipal area includes following,

- The proposed land use plan of Moratuwa Municipal Council 2030 is given in Figure 1-20.
- Development of 6 land use zones. A cross section of the plan is given in Figure 1-22.
- Urban settlement development plan includes relocation of low-income families in the same area without disturbing their economic and social activities. Around 900 housing units are proposed to be developed in Dadeniyawatta and 700 housing units are planned to be developed in Batarywatta. Further, existing underutilized housing schemes such as Soyasapura and Tsunami housing schemes will be redeveloped. Refer Figure 1-21.
- Proposed transport plan 2030 is given in Figure 1-23 and Figure 1-24 presents the walking and cycling network.

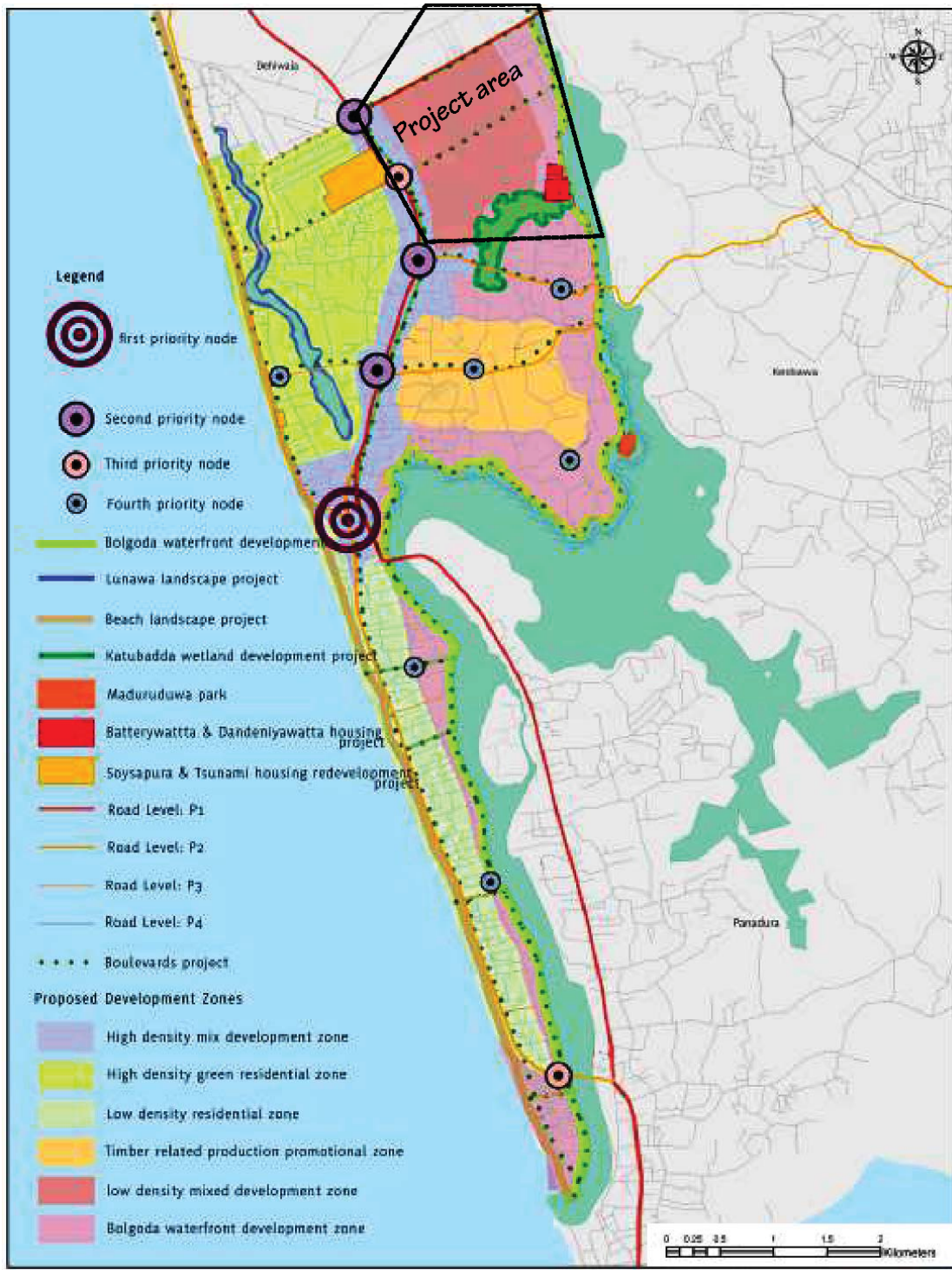
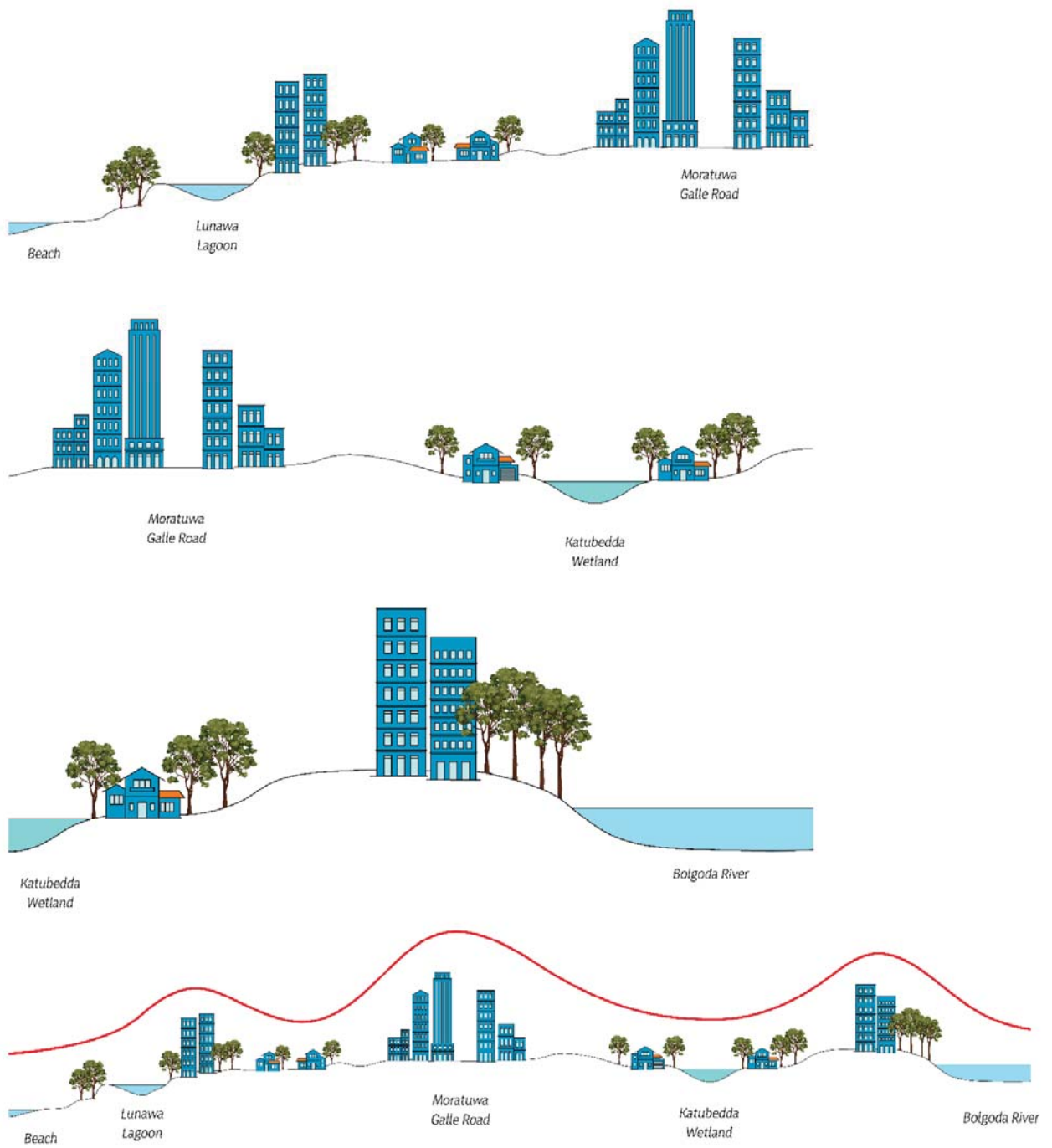


Figure 1-20: Planned Land Use Map (UDA)



Figure 1-21: Urban Settlement Development Plan – 2030



Cross Section of the Proposed Urban Framework
 Source : Urban Development Authority, 2021

Figure 1-22: Cross Sections of the Urban Framework (Bolgoda Area)

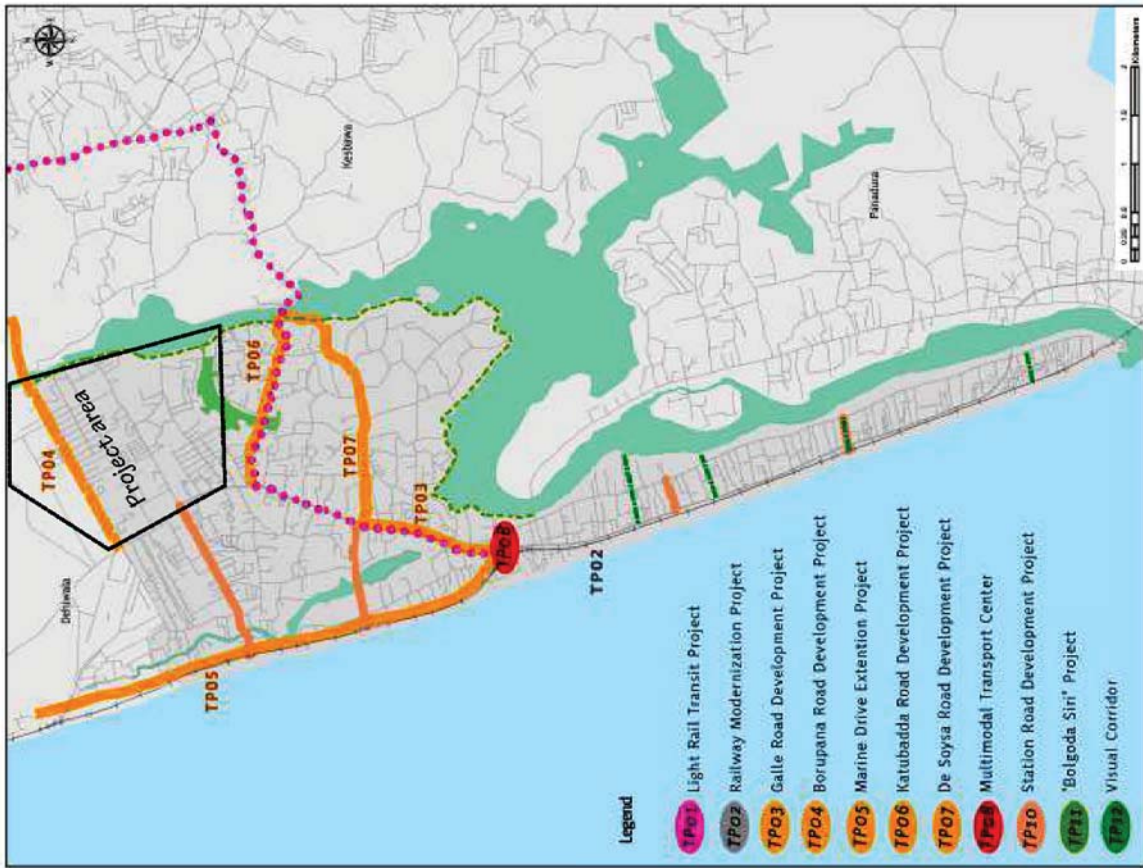


Figure 1-23: Transport Plan (Moratuwa 2030)

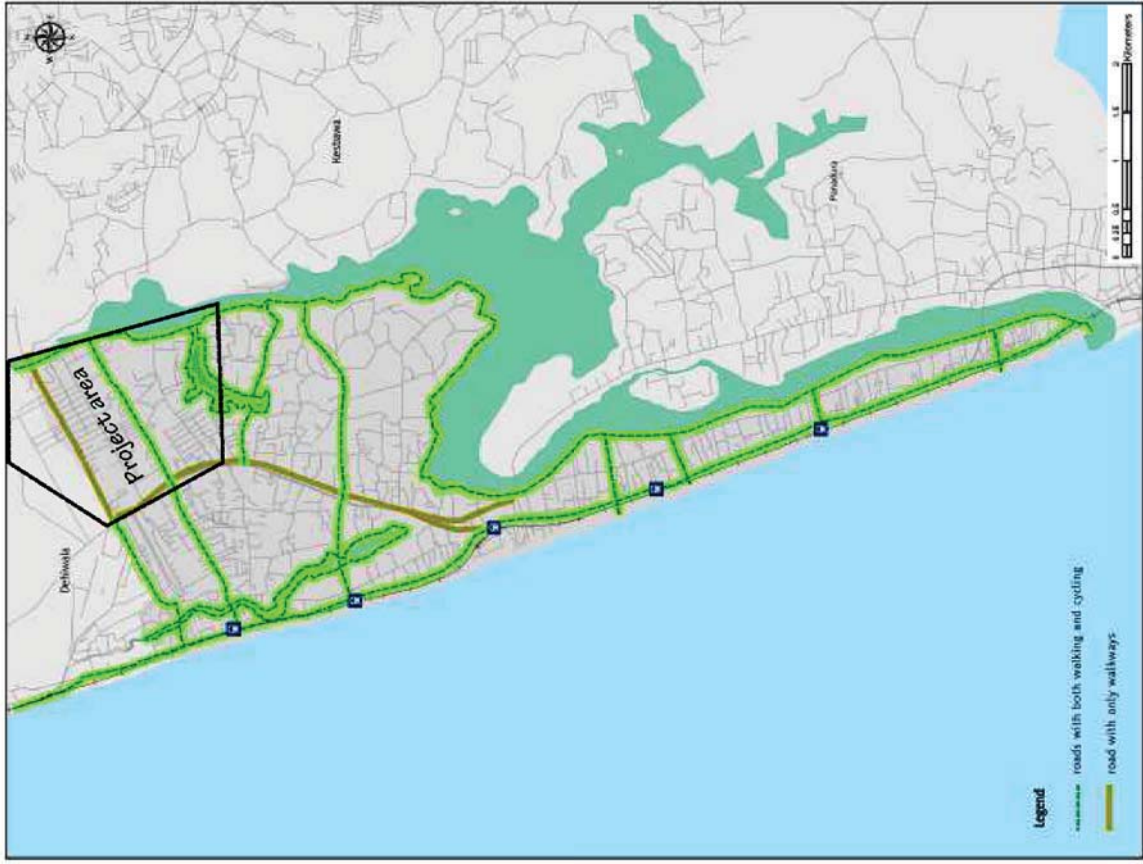


Figure 1-24: Working & Cycling Network- Moratuwa - 2030

1.4.7 Source of Income

The majority of people in Moratuwa and Ratmalana DS divisions engage in private/government sector employment, self-employment and skilled/unskilled labour. Refer Table 1-18 below.

Around 365 households in Moratuwa and Ratmalana DS divisions, have an income below Rs. 3,000/= 551 households are identified as having the household income below Rs. 6,000/= while 1642 households are getting an income above Rs. 20,000/=. Refer Table 1-19.

Table 1-18: Occupation of people living in affected GN Divisions

Divisional Secretariate	Grama Niladhari Divisions	Government/ Semi Government		Private		Agriculture		Industry		Services		Self-Employment (Non Agriculture)		Skilled/ Unskilled Labor		Foreign Employment		Other	
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Moratuwa	Telawala South 549	168	276	467	603	201	307	18	0	12	0	221	307	428	43	26	16	0	0
	Borupana 549 A	120	161	609	518	0	0	28	8	471	460	28	109	361	115	34	22	67	82
	Telawala North 549 B	304	398	374	413	0	0	22	0	38	27	75	62	550	321	15	27	1407	832
	Katubedda	80	49	402	105	0	0	45	10	90	60	4	23	136	129	15	6	47	53
Ratmalana	Kandawala	386	424	2329	932	10	08	172	08	159	138	29	85	61	09	18	51	1457	2132

Source: Administrative data of Moratuwa/Rathmalana – 2021

Other – part-time job + no permanent job + unemployed

Table 1-19: Income of households in affected GN divisions

DSD	GND	Below Rs. 3,000/=	Rs. 3,000/= – Rs. 5,000/=	Rs. 5,000/= - Rs. 10,000/=	Rs. 10,000 – Rs. 20,000/=	Rs. 20,000 – Rs. 25,000/=	Above Rs. 25,000/=
Moratuwa	Telawala South 549	23	37	45	484	301	96
	Borupana 549 A	79	0	0	101	0	1398
	Telawala North 549 B	0	0	318	298	502	497
Rathmalana	Katubedda	178	0	0	120	580	180
	Kandawala	85	141	455	882	821	64
Total		365	178	818	1885	2204	2235

Source: Administrative data of Moratuwa/Ratmalana – 2021

1.4.8 The poor, vulnerable, indigenous, and ethnic people

The official poverty line in Sri Lanka is considered as Rs. 5,223/= per month (DCS, 2012/2013). When considering the income of households in the project area, around 543 households are identified as below the poverty line. Other vulnerable population groups are presented in Table below. The indigenous people in Sri Lanka are living in the Uva province, away from Western province. Although there are ethnic minorities such as Tamil and Muslim living in the project area, their rights are guaranteed by the constitution of Sri Lanka.

Table 1-20: Vulnerable population in the project area

DS Division	Vulnerability	Number of Persons
Moratuwa	Elderly people (Over 60 years old)	3458
	Disabled population	40
	Children 0-4 years old	1540
	Children without parental care (parents are abroad, dead or separated)	121
	Number of families below poverty line	317
Rathmalana	Elderly people (Over 60 years old)	1290 (640 Males and 650 Females)
	Disabled population	14
	Children 0-4 years old	600 (297 Males and 303 Females)
	Children without parental care (parents are abroad, dead or separated)	86
	Number of families below poverty line	226

Source: Administrative data of Moratuwa/Rathmalana – 2021/2020

1.4.9 Economic activity-

1.4.9.1 Agriculture,

There are few families engaged in small-scale home gardening in Telawala and Katubedda GN areas where the reservation lands are available near the Weras Ganga. Few others are engaged in small-scale poultry farming on their land premises.



Photo 5: Small-scale poultry farming



Photo 6: Small-scale home gardening



Photo 7: Pig farming in Borupana GN area



Photo 8: Coconut trees

1.4.9.2 Fishery,

There are three types of fishing in Moratuwa-Rathmalana area. Sea water fishing, Lagoon water fishing and inland water fishing. Sea water fishing is concentrated along the coastal area while inland water fishing is carried out in Bolgoda lake. Bolgoda river estuary area is known for lagoon water fishing. Although fishing is popular in the area, FGDs with residents in the project area confirmed that very few people engage in catching fish in Weras ganga/Bolgoda lake.

1.4.9.3 Industry

Moratuwa is popular for timber industry. This industry has acquired the national recognition through specialization and has established a trade name. However, timber industry is not prevalent in the Moratuwa Rathmalana project area. There is garment, medium scale cement brick and pot production industries and other industries in the project area. The population in the area are employed in these industries. The location, name and address of the industries within 100m from the proposed canals and dikes were officially obtained from the Central Environmental Authority (CEA). A summary detail is presented in Figure 1-25. The letter from CEA and the industry location map is given in Annex 03.

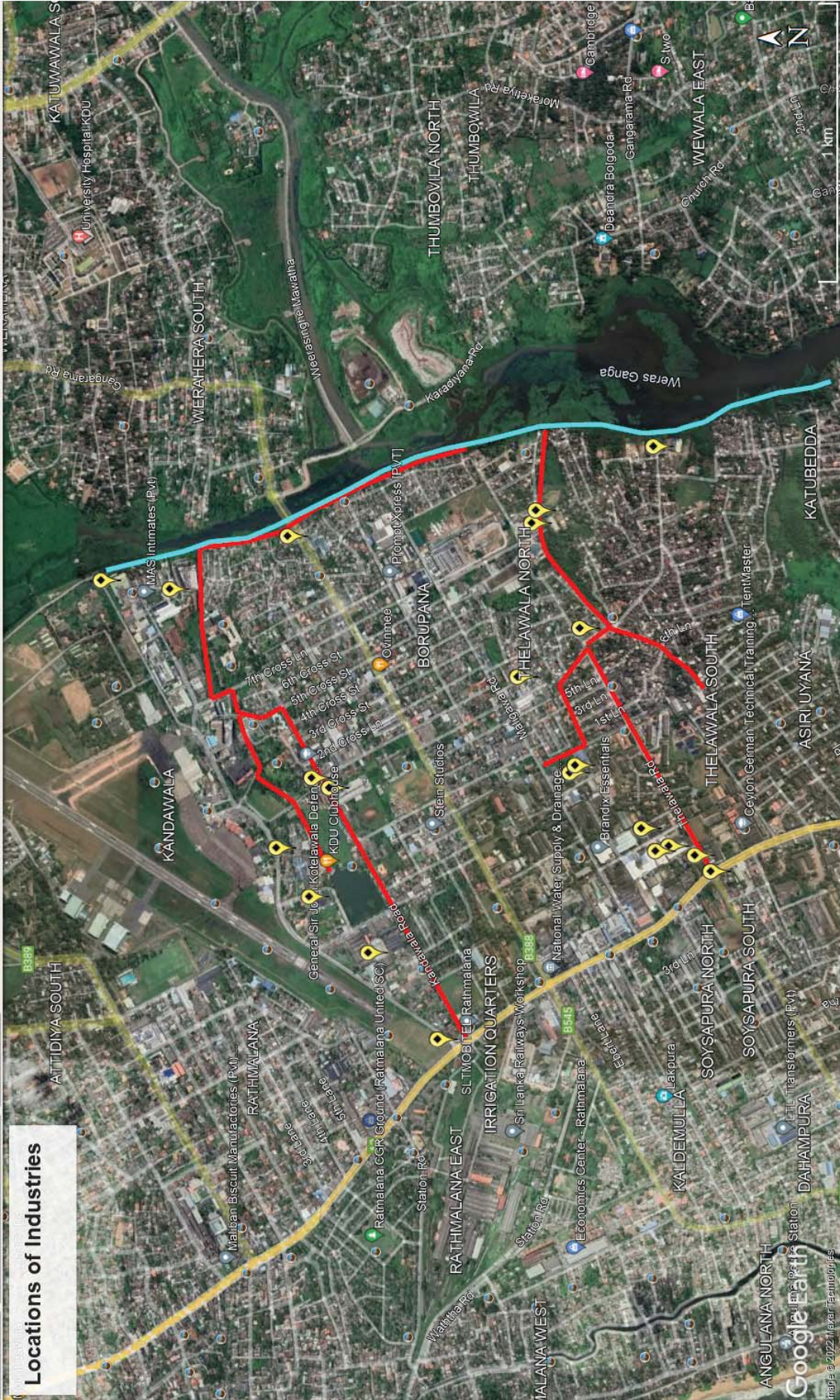


Figure 1-25- Location of Industries



Photo 9: Cement pot making in Weras Ganga Photo 10: Garment industry in Weras ganga

1.4.9.4 Commerce and Other services

The project area is located close to Colombo which is the commercial capital of the country. In Moratuwa-Rathmalana project area, the commerce and services are mainly concentrated along Colombo-Galle Road. Commercial activities including retail and whole sale trade and services take place in the area.



Photo 11: Commercial Activities along Colombo – Galle Road

1.4.10 Social infrastructure and public facilities

1.4.10.1 Road transport

Road transport is the dominant mode of transportation in the project area. The main highway in Moratuwa- Rathmalana area is Colombo- Galle- Hambantota- Wellawaya (A002 highway. Other roads are connected to this highway.

1.4.10.2 Water supply system

Majority (11,250) of households in the project area have water supply connection from National water supply and drainage board. There are also 20 households who use well water as well.

Table 1-21: Sources of drinking water in affected DS divisions

DSD	GND	NSW & DB	Well	Common Well	Community Water Project
Moratuwa	Telawala South 549	958	-	-	-
	Borupana 549 A	1578	-	-	-
	Telawala North 549 B	1615	1	-	-
	Katubedda	4651	7	-	-
Rathmalana	Kandawala	2448	12	-	-
Total		11250	20	0	0

Source: Administrative data of Moratuwa/Rathmalana – 2021

1.4.10.3 Electricity distribution system

Majority (7,672) of households in the project area have the connection from Ceylon electricity board. However, there are around 4 households who do not have electricity facilities.

Table 1-22: Source of lighting in the project area

DSD	GND	National grid	Solar power and other sources	No electricity Facilities
Moratuwa	Thelawala South 549	958	0	0
	Borupana 549 A	1474	0	1
	Thelawala North 549 B	1807	2	0
	Katubedda	985	0	3
Rathmalana	Kandawala	2448	21	-
Total		7672	23	4

Source: Administrative data of Moratuwa/Rathmalana/ – 2021

1.4.10.4 Telecommunication system

The telecommunication facilities available in the DS division are presented in following table.

Table 1-23: Telecommunication facilities available project area

DS	GND	Fixed Telephone	No Fixed Telephone	Mobile Telephones	Computer Facilities
Moratuwa	Thelawala South 549				
	Borupana 549 A				
	Thelawala North 549 B				
	Katubedda				
Rathmalana	Kandawala				

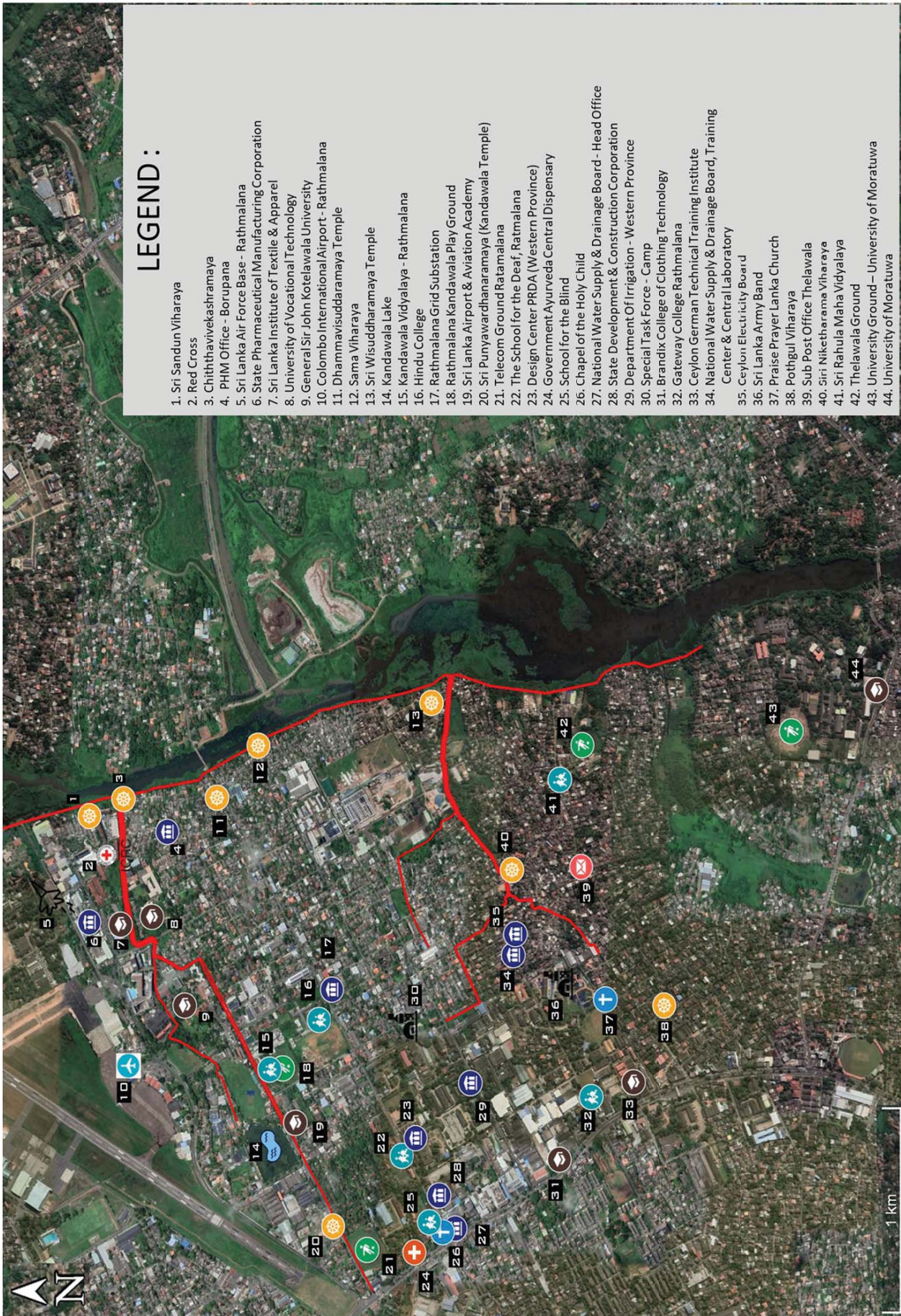


Figure 1-26: Distribution of public facilities – Moratuwa Ratmalana project area

1.4.10.5 Water supply system

Bolgoda Project

Like the sewerage lines given in the section below in Bolgoda Project there are water supply mains and cross connections to houses both in Telawala Road and Kandawala Road where these proposed drains are. The details of the lines could be obtained from NWSDB before the time of construction.

1.4.10.6 Wastewater collection system

Type of Wastewater

The main wastewater generation in Weras Ganga is the households' sewage, kitchen waste and bathroom wastewater. In addition to these, several industries and service facilities generate specific wastewater. Automobile service stations, hotels and restaurants, various food based commercial units and the industries produce wastewater. In Weras ganga catchment several textile processing industries and food processing industries produce a substantial quantity of wastewater.

Wastewater management

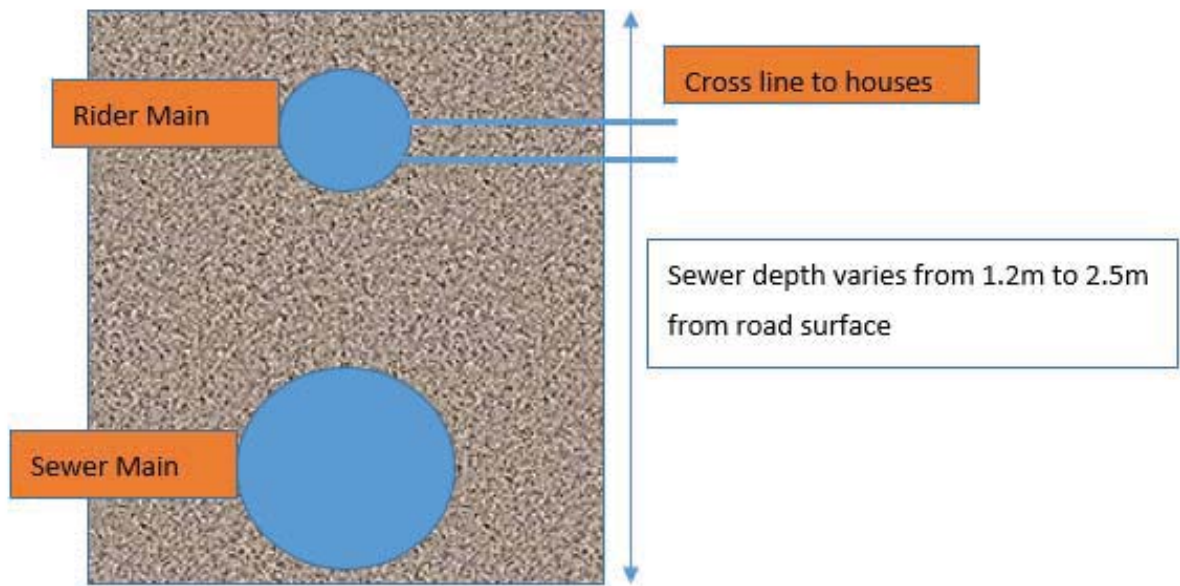
The common domestic wastewater (black & graywater) management practice is that the sewage generated from households is disposed of by sending it through septic tanks. Whereas kitchen wastewater and bathing water are sent to collection pits or directly discharge into storm water drains. The local government regulations require that sewage generated from houses and other facilities should be sent to septic tanks before being released to the environment. However, improperly designed septic tanks and the discharge of sewage directly to the waterways are not uncommon. The CEA environmental regulations have enforced that all industrial and services facilities that require EPL for their operation need treatment of wastewater before releasing it to the environment. Therefore, such service facilities and industries have their own individual treatment facilities to treat facility specific wastewater.

Bolgoda Project Wastewater Management

The Weras Ganga catchment has many heavy polluting industries (textile processing and food processing etc.) and the population density too is very high. There is a common sewage treatment facility covering some sections of the Weras ganga area (refer attached map). Both household wastewater and industrial wastewater are connected to this common sewerage. This common sewerage facility has a treatment facility at Zoyzapura. Its operational management is done by National Water Supply and Drainage Board. Direct disposal of untreated wastewater and poor treatment has resulted in releasing pollutants to waterways deteriorating the water quality in both catchments

Details of the sewer lines for Bolgoda project was obtained from NWSDB as part of the proposed drains follow the roadside of Telawala Road and Kandawala Road. The existing and proposed sewer lines are presented in Figure 1-27 . These sewer lines are at 1.4m depth and the connecting manholes are seen on the roadside. In some instances, the sewer depth goes up to about 2.5m. There is the sewer main underneath and there is a rider main above this. Cross lines start from this rider main. While doing the canal improvements these cross lines could be affected by the construction equipment. The sewer

arrangement is given under the following sketch.



Sketch on Sewer Cross Section arrangement on Roads

1.4.10.7 Distribution of public facilities (medical facilities, educational facilities, religious facilities, cultural facilities, tourism spots, etc.)

For the Moratuwa Ratmalana Project

The Distribution of public facilities (medical facilities, educational facilities, religious facilities, cultural facilities, tourism spots, etc. are presented in figure below.

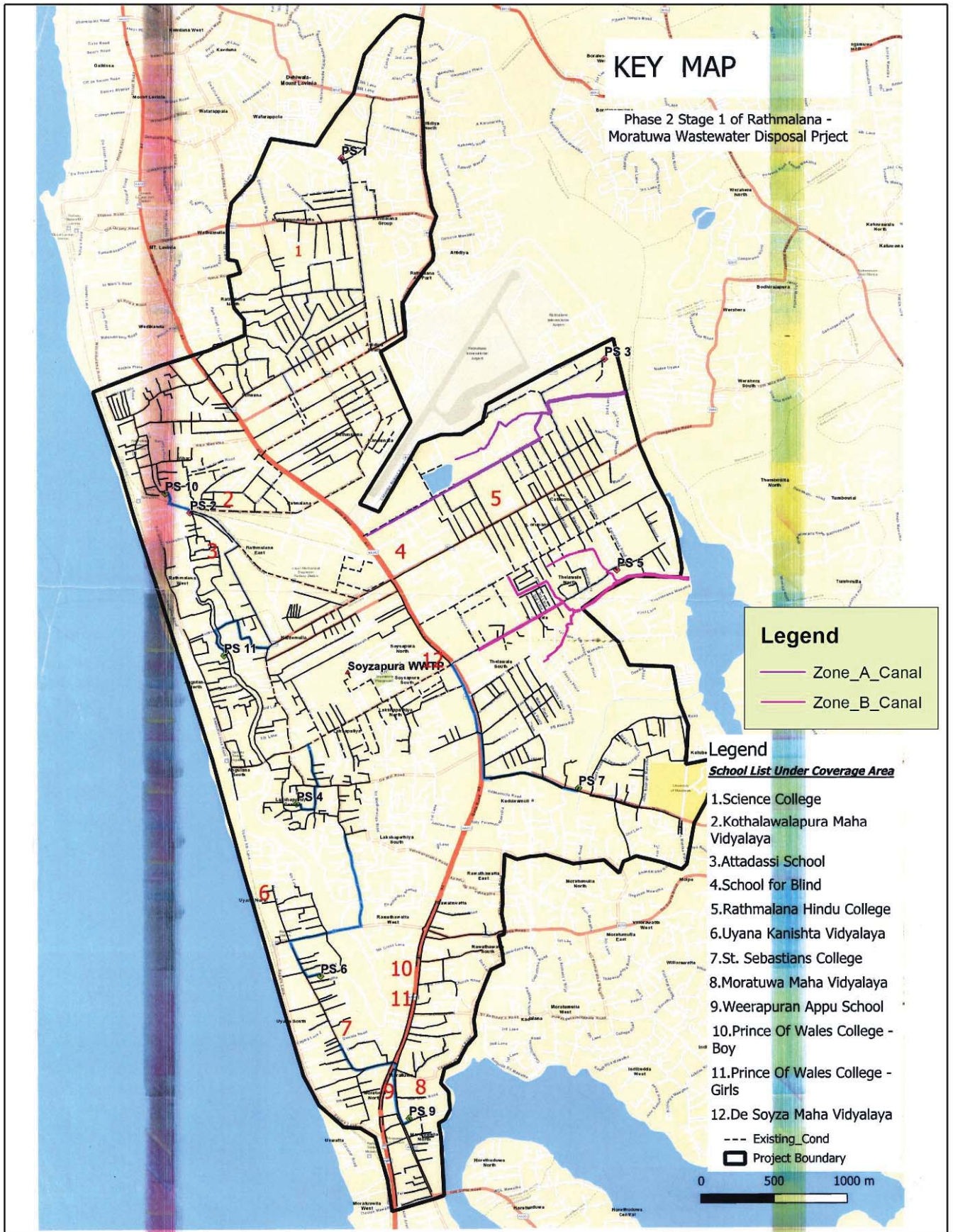


Figure 1-27- Key Map of the Sewer lines in Moratuwa Rathmalana Area

1.4.11 Status of Gender equality in the community

Under article 12 of the Constitution of Sri Lanka, no sex discrimination is allowed. The relevant contents of the Article 12 are presented below. The National Involuntary Resettlement Policy also ensures gender equality and equity. Women’s charter of Sri Lanka was approved by the cabinet on 3rd of March 1993 and this document outlines the rights of women. Ministry of women, Child affairs and Social Empowerment is the responsible ministry to regulate the women’s charter. There are also divisional and district level officers to implement the programs planned by the ministry promoting gender equality.

Right to quality	12. (1) All persons are equal before the law and are entitled to the equal protection of the law (2) No citizen shall be discriminated against on the ground of race, religion, language, caste, sex, political option, place of birth are any one of such grounds
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When considering the project area, the female population is slightly higher (18,878 persons) than the male population (18,838 persons). Refer Table 1-16. The sex disaggregated statistics on education is available for Moratuwa- Rathmalana project area. Majority of both males and females in the project area have completed secondary education. Around 81 females also have completed postgraduate studies. However, there are 380 females who have not attended to schools.

Females in Moratuwa-Rathmalana project area engage in various employments as depicted in Table 1-18 above. When compared with males, females are mostly involved in government/semi government sector, self-employments, foreign employments and other employments. FGDs conducted in the project area, confirmed that women engage in home-based self-employments. These include preparation of lunch packets, making carpets with pieces of clothes, sewing clothes, making greeting cards and cardboard related employments. At some instances, women help home based industries such as making cement pots and making incense sticks. The women in the project area also mentioned that there are women’s societies established in the project area. These societies provide trainings and loans/assistance to women to start self-employments.



Photo 12: Making greeting cards



Photo 13: Assembling cardboard separators

Table 1-24: Education level of the project area

DSD	GND	No schooling		Minor		Grade 1-5		Up to G.C.E. O/L		Pass G.C.E. O/L		Up to G.C.E. A/L		Pass G.C.E. A/L		Graduate		Post Graduate		Other	
		M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Moratuwa	Thelawala South 549	0	0	36	59	44	87	116	148	132	298	0	0	92	118	2	6	4	3	1	2
	Borupana 549 A	16	11	125	144	166	180	221	236	243	255	262	321	171	192	91	102	13	7	0	0
	Thelawala North 549 B	155	192	144	125	229	198	259	231	287	215	584	848	321	261	203	324	9	12	0	0
	Katubedda	120	150	100	85	30	35	500	400	235	300	185	220	55	75	64	85	30	50	74	90
Rathmalana	Kandawala	13	27	226	208	269	249	469	584	1910	2501	598	471	441	497	46	53	11	9	41	61

Source: Administrative data of Moratuwa/Rathmalana – 2021/2020

1.4.12 Historical and cultural heritage-

There are no historical and cultural heritage places in the project area.

1.4.12.1 Health status of project areas (analysis using district statistics) - Bolgoda Area

Sources of Information

The consultant has obtained the details from the divisional profiles from the respective Divisional Secretariats to obtain the statistics at the Divisional levels. Location specific information pertinent to this area are presented in the report.

Medical Administrative Areas

The Bolgoda basin fall in the Moratuwa and Ratmalana areas within the Colombo District. The health and sanitation status and related hazards of the project areas were approximated using the district statistics from the national data bases.

Health Status

The status of health is interpreted by a range of National indicators and some of the key indicators are presented in this section to describe the status of health in two didactics u national using statistics extracted from annual published health statistics data bases of Sri Lanka.

Medical services

The Sri Lankan health system comprises different systems of medicine; Traditional, Western, Ayurvedic, Unani, Sidha, Homeopathy and Acupuncture. Of these, Western or Allopathic medicine is the leading sector catering to the needs of the majority. Allopathic medicine is provided through both public and the private sector, but the share of care is different for inpatients and outpatients. The public sector provides the bulk of inpatient care, providing a safety net to citizens. The public sector has an extensive network of health care institutions and has a system for Aurvedic care. The private sector provides access to almost all types of care at a cost while the public sector provides free health services at the point of care. The health network is well established and the communities in the project area access these medical services depending on the requirement and the capacity. The Tables below are some statistics pertinent to hospitals and beds in Colombo districts in comparison to National status. The statistics show that a good extent of the medical facilities is concentrated in the Colombo district where people in the project area can have the access to these medical facilities.

Table 1-25: Distribution of Government Medical Institutions and Beds

DHS Division	Teaching Hospitals		Provincial General Hospitals		District General Hospitals		Base Hospitals (Type A)		Base Hospitals (Type B)		Divisional Hospitals (Type A)		Divisional Hospitals (Type B)		Divisional Hospitals (Type C) ¹		Primary Medical Care Unit and Maternity Homes		Other Hospitals ²		Total hospitals		Beds per 1000 population
	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	Ins.	Beds	
Colombo	7	8,110					3	1,268	1	294	1	90	6	428	2	71	5	53	11	4,007	36	14,321	5.9
Sri Lanka	18	23,045	2	3,797	19	13,430	29	9,514	48	8,704	50	5,268	131	8,751	299	8,159	9	115	38	5,806	643	86,589	4.0

Source - Annual Health Statistics, 2019, Sri Lanka

Table 1-26: Distribution of Inpatients Beds

RDHS Division	Teaching Hospitals	Provincial General Hospitals	District General Hospitals	Base Hospitals (Type A)	Base Hospitals (Type B)	Divisional Hospitals (Type A)	Divisional Hospitals (Type B)	Divisional Hospitals (Type C) ¹	Primary Medical Care Unit and Maternity Homes	Other Hospitals ²	Total hospitals	Inpatient Beds per 1000 population
Colombo	7,649			1,137	283	86	345	52	53	3,778	13,383	5.5
Sri Lanka	21,646	3,440	12,329	8,473	7,748	4,511	7,419	6,662	89	5,508	77,825	3.6

Source- Annual Health Statistics, 2019, Sri Lanka

1.4.12.2 Health related hazards and concerns

Health indicators and morbidity, and epidemics -Crude death rate (described using district data)

The Table 1-27 below show the crude death rate, Maternal Mortality, infant Mortality and non-neo-natal mortality statistics of Gampaha and Colombo districts. Higher mortality rates with respect to crude death rate, non-neo natal mortality and infant mortalities were noted highlighting the health concerns over urban population living the two districts. Similarly, case fatality rates of several non-communicable diseases as depicted in the table below show much higher fatality rates compared to national rates raising concerns of the responsible authorities

Table 1-27: Mortality Rates

District	Crude Birth Rate (CBR)		Crude Death Rate (CDR)		Maternal Mortality Ratio, 2014 (per 100,000 Live Births) *	Infant Mortality Rate, 2015*	Neo-Natal Mortality Rate	
	2018*	2019*	2018*	2019*			2014*	2015*
	Per 1000 population					Per 1000 Live Births		
Colombo	13.6	13.4	7.4	7.5	18.7	13.4	7.7	8.3
Sri Lanka	15.1	14.6	6.4	6.7	25.7	8.5	5.6	6.0

Source -Annual Health Statistics, 2019, Sri Lanka

Table 1-28: Hospitalization, Hospital Deaths and Case Fatality Rates

RDHS Area	Neoplasms (C00-D48)			Diabetes mellitus (E10-E14)			Essential hypertension (I10)			Ischaemic heart disease (I20-I25)			Cerebrovascular disease (I60-I69)		
	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*
Colombo	66,728	2,527	3.65	12,192	253	2.03	9,686	52	0.53	25,039	1,557	5.85	8,093	641	7.34
Sri Lanka	156,702	6,296	3.86	106,622	714	0.67	97,885	541	0.55	137,354	8,121	5.58	56,671	4,086	6.73

Source- Annual Health Statistics, 2019, Sri Lanka

Maternal deaths, stil births, and low birth weight babies

The Maternal deaths, stil births, and low birth weight babies statistics also show higher values compared to national rates

Table 1-29: Hospitalization, Hospital Deaths and Case Fatality Rates

RDHS Area	Bronchitis, emphysema and other chronic obstructive pulmonary disease (J40-J44)			Asthma (J45-J46)			Alcoholic liver disease (K70)			Other diseases of liver (K71-K76)			Renal failure (N17-N19)		
	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*	Live Discharges	Deaths	Case Fatality Rate*
Colombo	3,975	184	4.42	13,613	57	0.42	256	58	18.47	3,174	412	11.49	14,902	360	2.36
Sri Lanka	45,715	1,309	2.78	177,225	569	0.32	2,148	179	7.69	14,878	1,873	11.18	144,251	2,169	1.48

Source- Annual Health Statistics, 2019, Sri Lanka

Table 1-30: Live Births, Maternal Deaths, Still Births and Low Birth Weight Babies

District	Live Births	Maternal Deaths		Still Births		Low Birth Weight ⁴	
		No.	Ratio ¹	No.	Ratio ²	No.	Ratio ³
Colombo	34,998	18	51.4	258	7.3	5,744	16.4
Sri Lanka	288,666	62	21.5	1,756	6.0	46,174	16.0

¹Per 100,000 live births

²Per 1,000 total births

³Per 100 live births

⁴Birth weight less than 2,500 grams

Source - Annual Health Statistics, 2019, Sri Lanka

Infectious disease and epidemics

The Table 1-31 below depicts the infectious and vector borne diseases in the Colombo and Gampaha districts. Dengue fever and Dysentery occurrences appear high compared to other diseases.

Table 1-31: Notifiable Diseases

RDHS Division	Dengue	Dysentery	Encephalitis	Enteric Fever	Food Poisoning	Human Rabies	Leptospirosis	Typhus Fever	Viral Hepatitis
Colombo	10,258	102	9	48	43	1	241	16	11
Sri Lanka	51,659	2,269	208	406	1,170	21	5,257	1,446	388

Source: Annual Health Statistics, 2018, Sri Lanka

Sexually transmitted diseases: HIV/AIDS cases

There are no statistics on the cases of HIV/AIDS directly reported within the project areas. The statistics below shows the increasing number of patients in the country. Data of health department states that the highest number of HIV patients are found from Colombo and Gampaha Districts. In 1987-2016 period 35.1 and 18.8 patients per 100,000 populations from Colombo and Gampaha respectively were reported (Source: National HIV/STI strategic plan Sri Lanka 2018-2022)

Table 1-32: Reported HIV/AIDS Cases

Reported HIV/AIDS Cases 2021								
Quarter	Cumulative HIV cases at the beginning of the quarter	HIV cases reported during the quarter	Cumulative HIV cases at the end of the quarter	Reported HIV cases with age 15-24 yrs		Cumulative HIV cases by gender		Reported AIDS deaths
				M	F	M	F	
1 st Quarter	3994	79	4073	11	01	2856	1217	10
2 nd Quarter	4073	69	4142	10	03	2912	1230	09
3 rd Quarter	4142	103	4245	10	02	3000	1245	14
4 th Quarter	4245	159	4404	21	01	3130	1274	16
Reported HIV/AIDS Cases 2021								
1 st Quarter	4404	152	4556	18	01	3263	1293	14
2 nd Quarter	4556	130	4686	14	01	3377	1309	11

Source: National STD/AIDS Control Programme, Department of Health Services:

http://www.aidscontrol.gov.lk/images/HIV_2ndQ_2022.pdf

Sanitation condition

Access to treated piped Drinking water: To be included after studying the Divisional Resource profiles.
Availability of safe sanitary disposal systems: To be included after studying the Divisional Resource profiles

Other health and sanitation issues in the project areas

During the field observations, from the discussions with residents and studying the published literature, number issues were noticed which are important for the health and sanitation integrity of the residents in the project areas.

Health and sanitation issues related to sewage disposal: Frequent flooding, stagnation of water is important aspect which has a strong influence on the health and sanitation of the residents in the project area. The floods disperse the polluted wastewater in the canals, overflow the septic tanks spreading contaminated water having substances of health risk such as infectious pathogens, toxic chemicals, etc. During floods the toilet are overflowing and cannot be flushed and used, this was specifically reported by

some of residents living near the Telawala road canal section. Another issue reported is the direct disposal of toilet waste into canal without sending through properly designed septic systems. As a result, the canals tend to carry sewage in addition to overland runoff. It was also reported by the interviewed residents that industries intentionally empty their sewage waste and waste sludge to storm water canal at heavy rainfall expecting unnoticed disposal and dilution. A properly planned flood control system while addressing all these issues inclusive would deliver tremendous improvement to related health and sanitation status of the affected communities

Water stagnation and vector borne diseases: Water stagnation is a critical issue even at a small rain spell. The current local drainage is highly unsatisfactory. It was noted that people have constructed parapet walls without considering the drainage paths. Some feeder canal showed permanently stagnant water. Further at some sections the road elevation is higher than the elevations of residents' ground level resulting obvious stagnation of water creating ideal grounds for mosquito breeding and other vector borne diseases. According to some dengue is a common occurrence among the residents. The proposed flood rehabilitation project will have a great impact on draining excess water into canal and minimizing occurrence of stagnant water in the canals by which favorable habitats for mosquito breeding can be greatly reduced.

Industrial emissions & health issues related to exposure.

In the field visit the consultants observed flow of colored effluents in the Telawala road. The residents stated that wastewater is being discharged by upstream textile factories. They further informed frequent discharge of different color wastewater having acid fume and kerosene oil smell and reported that find it affect their breathing convenience. And they are worried on Asthma, breathing difficulties and wheezing for their young generations

Poor solid waste management and potential health issues: Although there is a relatively systematic solid waste management system operational in the project areas, hap hazard disposal of solid waste has been observed at many places. Specially, disposal of solid waste has been observed at many places in the wetlands of the Bolgoda basin storm water canals. The disposal makes canals to block the flow resulting pollution and stagnation. The waters and canal ecosystem become unacceptably unhealthy. Burning of solid waste including plastic and polythene is a common practice by the people ignoring health impacts by exposure to toxic fumes, dioxins, furans and VOCs.

1.5 Project Area Specific Details Sent by Medical Officer of Health

1.5.1 Colombo MoH (For Moratuwa Ratmalana)

When considering past years these MOH areas faced several natural disasters such as flood, Tsunami, costal erosion, cyclones and man-made disasters such as fire, chemical injuries and accidents. Disaster risks in MOH areas are further compounded by increasing vulnerabilities such as growing population, the vast disparities in income, rapid urbanization, increasing industrialization, development within high-risk

zone, environmental degradation and climate change

Details of the common notified infectious diseases are presented in the following tables.

Table 1-33: Common notified infectious diseases at MOH Moratuwa

Disease	2018	2019	2020	2021	2022
Dysentery	1	0	2	0	0
Leptospirosis	4	9	5	2	5
Malaria	0	1	0	0	0
Typhus Fever	1	0	0	0	0
Tuberculosis	40	65	39	35	43
Dengue Fever/Dengue Haemorrhagic Fever	261	839	129	256	463
Leishmaniasis	0	0	0	0	1
Leprosy	35	17	16	6	13
Meningitis	2	5	5	0	0

Table 1-34: Common notified infectious diseases at MOH Ratmalana

Disease	2018	2019	2020	2021	2022
Dysentery	16	5	2	4	0
Leptospirosis	11	9	5	5	5
Malaria	0	0	0	0	0
Typhus Fever	1	0	0	0	0
Tuberculosis	60	76	53	52	43
Dengue Fever/Dengue Hemorrhagic Fever	565	779	144	392	570
Leishmaniasis	1	0	0	0	0
Leprosy	17	15	9	5	12
Meningitis	6	2	2	0	0

Appendix-3-3

Environmental Checklist (Mudun Ela Drainage Improvement Project)

Appendix 3-3 Environmental Checklist for Mudun Ela Drainage Improvement Project

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N (b) N (c) N (d) N	(a) Basic Information Questionnaire, a screening procedure for IEE/EIA, was submitted to the CEA and the needs for an IEE/EIA was screened by CEA for the Project. A formal letter from the CEA notified that an IEE was not required for this project due to the size and nature of the Project. (b) Ditto (c) Ditto (d) There are no specific requests for other permits at this time.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) Seven Focus Group Discussions were conducted with the surrounding population in the Project area. As a whole, a total of 92 participants, 36 men and 56 women participated to the FDGs. This FDGs provided an overview of the Project, its expected impacts and the possibility of resettlement and land acquisition. (b) Local Residents' views on the Project were collected in the FDGs mentioned above.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) As necessary flood control measures in the Project, various measures were considered from a technical point of view, and measures were selected taking into account the natural environmental aspects (ecological conservation) and social aspects.
2 Pollution Control	(1) Water Quality	(a) Is there a possibility that changes in river flow downstream (mainly water level drawdown) due to the project will cause areas that do not comply with the country's ambient water quality standards?	(a) N	(a) During construction, water quality is expected to be affected by construction due to excavation in the drainage channel. In addition, there is a possibility of water pollution due to wastewater from the construction site, heavy machinery, vehicles, and construction camps. Since this is not a large-scale project, the impact is expected to be limited, but adequate environmental protection measures. During operation phase, the drainage function will be improved and the amount of wastewater discharged downstream will increase, but since this is not a large-scale project, the impact is expected to be limited.
	(2) Wastes	(a) In the case of that large volumes of excavated/dredged materials are generated, are the	(a) Y	(a) During construction, construction waste is generated during construction and needs to be properly disposed of. During

Appendix 3-3 Environmental Checklist for Mudun Ela Drainage Improvement Project

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		excavated/dredged materials properly treated and disposed of in accordance with the country's standards?		operation phase, the Project is not envisaged as it is a rehabilitation of the existing drainage and pumping station and is not a waste-generating project.
	(3) Subsidence	(a) Is there a possibility that the excavation of waterways will cause groundwater level drawdown or subsidence? Are adequate measures taken, if necessary?	(a) N	(a) Not applicable.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a (b) possibility that the project will affect the protected areas?	(a) N	(a) Not applicable. (b) Ditto
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that hydrologic changes, such as reduction of the river flow, and seawater intrusion up the river will adversely affect downstream aquatic organisms, animals, vegetation, and ecosystems? (e) Is there a possibility that the changes in water flows due to the project will adversely affect aquatic environments in the river? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a) N (b) N (c) N (d) N (e) N	(a) Not applicable. (b) Ditto (c) Ditto (d) Ditto (e) Ditto
	(3) Hydrology	(a) Is there a possibility that hydrologic changes due to the project will adversely affect surface water and groundwater flows?	(a) N	(a) During construction, excavation in the watercourse for drainage channel rehabilitation will take place, which will have an impact on hydrology. In operation phase, as the area has suffered from flood damage for a long period of time, the Project will improve the operational status of the drainage system, which will be

Appendix 3-3 Environmental Checklist for Mudun Ela Drainage Improvement Project

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				properly managed to control flood damage.
	(4) Topography and Geology	(a) Is there a possibility that excavation of rivers and channels will cause a large-scale alteration of the topographic features and geologic structures in the surrounding areas?	(a) N	(a) During construction, widening of the drainage channel may cause topographical changes at the excavation and downstream of it due to instability of the channel banks and bed material, but the area altered is limited and no significant impact is envisaged.
4 Social Environment	(1) Resettlement	<p>(a) involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?</p> <p>(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?</p> <p>(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?</p> <p>(d) Is the compensations going to be paid prior to the resettlement?</p> <p>(e) Is the compensation policies prepared in document?</p> <p>(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?</p> <p>(g) Are agreements with the affected people obtained prior to resettlement?</p> <p>(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?</p> <p>(i) Are any plans developed to monitor the impacts of resettlement?</p> <p>(j) Is the grievance redress mechanism established?</p>	<p>(a) N</p> <p>(b) N</p> <p>(c) N</p> <p>(d) Y</p> <p>(e) N</p> <p>(f) N</p> <p>(g) N</p> <p>(h) Y</p> <p>(i) N</p> <p>(j) Y</p>	<p>(a) Land needs to be secured for the rehabilitation of the waterway, which will result in small scale resettlement and land acquisition. At present, a resettlement plan has not been drawn up because the implementation of the Project has not been finalized, but it is urgent to draw up a resettlement plan to inform the relevant parties when the implementation of the project is clear and to avoid illegal resettlement measures.</p> <p>(b) The official meeting is not yet done because the implementation of the project has not been finalized. However, in order to prepare a resettlement framework for this study, some focus group meeting for the affected people has already been held to explain the impact of the Project.</p> <p>(c) Not yet.</p> <p>(d) Land acquisition will be carried out in accordance with Sri Lanka's national legislation and compensation will be paid in cash before the land is handed over.</p> <p>(e) The land acquisition will be carried out by SLLDC after the completion of this study, so the document has not yet been formulated at this stage. In this study, JICA Study team prepared/proposed the draft land acquisition and resettlement policy framework.</p> <p>(f) Not yet. The policy framework prepared by the JICA study team proposes the following support for PAPs who has no land title.i) Replacement cost of resident (or ancillary structures) installed by the inhabitants should be covered, ii) - If relocation sites are made available by the project proponent, resettlement to the site is recommended, and iii)The costs of transporting and relocating construction materials should be covered as compensation.</p> <p>(g) Not yet.</p> <p>(h) The CP, SLLDC, have a dedicated department responsible for land</p>

Appendix 3-3 Environmental Checklist for Mudun Ela Drainage Improvement Project

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				<p>acquisition. SLLDC has experience of resettlement and land acquisition for international project and is considered to have sufficient capacity for implementation. The same applies to budgetary measures.</p> <p>(i) Considering the scale and content of the project's site acquisition, it is proposed to carry out internal monitoring and external monitoring for land acquisition of Pre F/S projects.</p> <p>(j) In project implementation, GRMs are encouraged to be established at field, district and regional/central government levels.</p>
	(2) Living and Livelihood	<p>(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?</p> <p>(b) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect the downstream fisheries and other water uses?</p> <p>(c) Is there a possibility that water-borne or water-related diseases (e.g., schistosomiasis, malaria, filariasis) will be introduced?</p>	<p>(a) N (b) N (c) N</p>	<p>(a) The drainage function will be improved and the amount of wastewater discharged downstream will increase, but since this is not a large-scale project, the impact is expected to be limited. The Project does not envisage water use as it aims at flood control. The project implementation is expected to reduce flood damage to the entire region and improve the livelihoods of the entire population living in and using the current flood plains.</p> <p>(b) Not applicable. (c) Not applicable.</p>
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) Not applicable as no cultural assets are located in the area of the Project.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) Not applicable
4 Social Environment	(5) Ethnic Minorities and Indigenous Peoples	<p>(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?</p> <p>(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources to be respected?</p>	<p>(a) N (b) N</p>	<p>(a) Not applicable. There are no confirmed minority or indigenous peoples living in the project area.</p> <p>(b) Not applicable.</p>
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in	<p>(a) Y (b) Y (c) Y (d) Y</p>	(a) The project proponent is proposed to comply with the laws and ordinances related to employment conditions in the domestic labor laws, IFC guidelines, World Bank EHS guidelines, etc.

Appendix 3-3 Environmental Checklist for Mudun Ela Drainage Improvement Project

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		<p>the project?</p> <p>(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?</p> <p>(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?</p> <p>(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?</p>		<p>(b) Specific safety considerations are proposed to be implemented for project stakeholders, such as installation of safety equipment to prevent industrial accidents and control of hazardous substances.</p> <p>(c) The Project requires the project proponent and industrialists to implement safety and environmental training programs for construction personnel, including security personnel, as a mitigation measure.</p> <p>(d) Ditto</p>
5 Others	(1) Impacts during Construction	<p>(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?</p> <p>(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?</p> <p>(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?</p>	<p>(a) Y</p> <p>(b) Y</p> <p>(c) Y</p>	<p>(a) Mitigation measures due to pollution during construction (noise, vibration, turbidity, dust, emissions and waste) will be proposed for consideration within the EIA procedure.</p> <p>(b) As the works are to be carried out in the river channel, there are concerns regarding the generation of turbid water downstream from the works during the construction period. Environmental protection measures are required by implementing the works in the dry season and adopting a half river closure.</p> <p>(c) The proposed site is located in urban area, so some impact on the social environment is expected due to air quality, noise/vibration, water quality and others from the construction work is expected. On the other hand, the scale of the works is not large, and no serious impacts are envisaged due to environmental mitigation measures during the construction phase. In addition, the influx of construction workers may cause conflicts with local residents and hygiene problems, and education programs for workers should be implemented.</p>
	(2) Monitoring	<p>(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?</p>	<p>(a) Y</p> <p>(b) Y</p> <p>(c) Y</p> <p>(d) Y</p>	<p>(a) Under Sri Lanka's laws, Implementation agency is required to submit an environmental monitoring plan during the EIA process. As the Project does not require EIA/IEE procedures due to the</p>

Appendix 3-3 Environmental Checklist for Mudun Ela Drainage Improvement Project

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?		project type, this study will propose a draft environmental monitoring plan in the report. (b) JICA team will propose to SLLDC that the proposed monitoring plan include information on items, methods, frequency, implementing agencies, etc. (c) Monitoring will be carried out under the responsibility of each facility manager and Project Management Unit (PMU) of SLLDC as project owner. (d) The method and frequency of reporting to JICA/CEA will be indicated in the proposed monitoring plan.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry checklist should also be checked.	(a) N	(a) Not applicable
	Note on Using Environmental Checklist	(a) (a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(b) N	(a) Not applicable
1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience). 2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.				

Appendix-3-4

Environmental Checklist (Moratuwa-Rathmalana Drainage Improvement Project)

Appendix 3-4 Environmental Checklist for Moratuwa-Rathmalana Drainage Improvement Project)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	<p>(a) Have EIA reports been already prepared in official process?</p> <p>(b) Have EIA reports been approved by authorities of the host country's government?</p> <p>(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?</p> <p>(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?</p>	<p>(a) N</p> <p>(b) N</p> <p>(c) N</p> <p>(d) N</p>	<p>(a) Basic Information Questionnaire, a screening procedure for IEE/EIA, was submitted to the CEA and the needs for an IEE/EIA was screened by CEA for the Project. A letter from the CEA indicated that they cannot judge the clarification based on the existing design level because the project is currently in the Pre-F/S implementation stage, which does not provide the level of design required for an IEE/EIA review. Considering the response and other circumstances, SLLDC shall re-consult with CEA once the project implementation will be decided.</p> <p>(b) Ditto</p> <p>(c) Ditto</p> <p>(d) There are no specific requests for other permits currently.</p>
	(2) Explanation to the Local Stakeholders	<p>(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?</p> <p>(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?</p>	<p>(a) Y</p> <p>(b) Y</p>	<p>(a) 8 FGDs were conducted with project affected people in the area. A total of 58 participants consists of 15 men and 43 women participated to the FDGs.. This FGDs provided an overview of the Project, its expected impacts and the possibility of resettlement and land acquisition.</p> <p>(b) Local Residents' views on the Project were collected in the FGDs mentioned above.</p>
	(3) Examination of Alternatives	<p>(a) Have alternative plans of the project been examined with social and environmental considerations?</p>	<p>(a) Y</p>	<p>(a) As necessary flood control measures in the Project, various measures were considered from a technical point of view, and measures were selected taking into account the natural environmental aspects (ecological conservation) and social aspects (especially the preservation of cultural heritage).</p>
2 Pollution Control	(1) Water Quality	<p>(a) Is there a possibility that changes in river flow downstream (mainly water level drawdown) due to the project will cause areas that do not comply with the country's ambient water quality standards?</p>	<p>(a) N</p>	<p>(a) Excavation and filling work will be carried out in the drainage canal and along the Weras Ganga for construction of embankments, and water quality is expected to be affected by the construction works. There is also potential for water pollution from the construction site, heavy machinery, vehicles and effluents from construction accommodation. As this is not a large-scale construction project, the impact on downstream area is assumed to be limited, but adequate environmental protection measures are required.</p>

Appendix 3-4 Environmental Checklist for Moratuwa-Rathmalana Drainage Improvement Project)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Wastes	(a) In the case of that large volumes of excavated/dredged materials are generated, are the excavated/dredged materials properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) During construction, construction waste is generated during construction and needs to be properly disposed of. It is anticipated that no large construction soils will be generated in this project due to the balance between cut and fill. A waste management plan will need to be prepared from the planning stage to ensure appropriate waste disposal.
	(3) Subsidence	(a) Is there a possibility that the excavation of waterways will cause groundwater level drawdown or subsidence? Are adequate measures taken, if necessary?	(a) N	(a) Not applicable.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) The project site alters part of the Bolgoda Environmental Protection Area (CEA management), but the implementation of the project within this Protection Area is not regulated and no special permits or approvals are required to implement the Project.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that hydrologic changes, such as reduction of the river flow, and seawater intrusion up the river will adversely affect downstream aquatic organisms, animals, vegetation, and ecosystems? (e) Is there a possibility that the changes in water flows due to the project will adversely affect aquatic environments in the river? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a) N (b) N (c) N (d) N (e) N	(a) Construction of the embankment along the Weras Ganga is foreseen to have a significant impact on the ecosystems within the Protection area; if the EIA survey confirms the presence of important species etc., monitoring of the effectiveness of conservation measures for each species should be carried out. If necessary, to take action from the perspective of ecosystem protection, for example by adding mitigation measures. (b) Ditto (c) Ditto (d) Ditto (e) Ditto
	(3) Hydrology	(a) Is there a possibility that hydrologic changes due to the project will	(a) N	(a) During construction, excavation in the watercourse for drainage channel

Appendix 3-4 Environmental Checklist for Moratuwa-Rathmalana Drainage Improvement Project)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		adversely affect surface water and groundwater flows?		rehabilitation will take place, which will have an impact on hydrology. In operation phase, as the area has suffered from flood damage for a long period of time, the Project will improve the operational status of the drainage system, which will be properly managed to control flood damage.
	(4) Topography and Geology	(a) Is there a possibility that excavation of rivers and channels will cause a large-scale alteration of the topographic features and geologic structures in the surrounding areas?	(a) N	(a) During construction, widening of the drainage channel/construction embankment may cause topographical changes at the excavation and downstream of it due to instability of the channel banks and bed material, but the area altered is limited and no significant impact is envisaged.
4 Social Environment	(1) Resettlement	<p>(a) involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?</p> <p>(b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?</p> <p>(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?</p> <p>(d) Is the compensations going to be paid prior to the resettlement?</p> <p>(e) Is the compensation policies prepared in document?</p> <p>(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?</p> <p>(g) Are agreements with the affected people obtained prior to resettlement?</p> <p>(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?</p> <p>(i) Are any plans developed to monitor the impacts of resettlement?</p> <p>(j) Is the grievance redress mechanism established?</p>	<p>(a) N</p> <p>(b) N</p> <p>(c) N</p> <p>(d) Y</p> <p>(e) N</p> <p>(f) N</p> <p>(g) N</p> <p>(h) Y</p> <p>(i) N</p> <p>(j) Y</p>	<p>(a) The number of people to be resettled is less than 200, but as large-scale land acquisition will take place, it will be necessary to prepare a resettlement plan and work on compensation based on this plan. At present, a resettlement plan has not been drawn up because the implementation of the Project has not been finalized, but it is urgent to draw up a resettlement plan to inform the relevant parties when the implementation of the project is clear and to avoid illegal resettlement measures.</p> <p>(b) The official meeting is not yet done because the implementation of the project has not been finalized. However, in order to prepare a resettlement framework for this study, some focus group meeting for the affected people has already been held to explain the impact of the Project.</p> <p>(c) Not yet.</p> <p>(d) Land acquisition will be carried out in accordance with Sri Lanka's national legislation and compensation will be paid in cash before the land is handed over.</p> <p>(e) The land acquisition will be carried out by SLLDC after the completion of this study, so the document has not yet been formulated at this stage. In this study, JICA Study team prepared/proposed the draft land acquisition and resettlement policy framework.</p> <p>(f) Not yet. The policy framework prepared by the JICA study team proposes the following support for PAPs who has no land title.i) Replacement cost of resident (or ancillary structures) installed by the inhabitants should be covered, ii) - If</p>

Appendix 3-4 Environmental Checklist for Moratuwa-Rathmalana Drainage Improvement Project)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				<p>relocation sites are made available by the project proponent, resettlement to the site is recommended, and iii)The costs of transporting and relocating construction materials should be covered as compensation.</p> <p>(g) Not yet.</p> <p>(h) The CP, SLLDC, have a dedicated department responsible for land acquisition. SLLDC has experience of resettlement and land acquisition for international project and is considered to have sufficient capacity for implementation. The same applies to budgetary measures.</p> <p>(i) Considering the scale and content of the project's site acquisition, it is proposed to carry out internal monitoring and external monitoring for land acquisition of Pre F/S projects.</p> <p>(j) In project implementation, GRMs are encouraged to be established at field, district and regional/central government levels.</p>
	(2) Living and Livelihood	<p>(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?</p> <p>(b) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect the downstream fisheries and other water uses?</p> <p>(c) Is there a possibility that water-borne or water-related diseases (e.g.,schistosomiasis, malaria, filariasis) will be introduced?</p>	<p>(a) N</p> <p>(b) N</p> <p>(c) N</p>	<p>(a) The project implementation is expected to reduce flood damage to the entire region and improve the livelihoods of the entire population living in and using the current flood plains. On the other hand, resettlement/land acquisition by the Project are expected to be implemented. To minimize the impact on livelihoods, mitigation measures such as adequate compensation/minimization of relocation should be implemented.</p> <p>(b) Not applicable.</p> <p>(c) Not applicable.</p>
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) Not applicable as no cultural assets are located in the area of the Project.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) Not applicable
4 Social Environment	(5) Ethnic Minorities and Indigenous	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	<p>(a) N</p> <p>(b) N</p>	<p>(a) Not applicable. There are no confirmed minority or indigenous peoples living in the project area.</p> <p>(b) Not applicable.</p>

Appendix 3-4 Environmental Checklist for Moratuwa-Rathmalana Drainage Improvement Project

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Peoples	(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources to be respected?		
	(6) Working Conditions	<p>(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?</p> <p>(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?</p> <p>(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?</p> <p>(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?</p>	<p>(a) Y</p> <p>(b) Y</p> <p>(c) Y</p> <p>(d) Y</p>	<p>(a) The project proponent is proposed to comply with the laws and ordinances related to employment conditions in the domestic labor laws, IFC guidelines, World Bank EHS guidelines, etc.</p> <p>(b) Specific safety considerations are proposed to be implemented for project stakeholders, such as installation of safety equipment to prevent industrial accidents and control of hazardous substances.</p> <p>(c) The Project requires the project proponent and industrialists to implement safety and environmental training programs for construction personnel, including security personnel, as a mitigation measure.</p> <p>(d) Ditto</p>
5 Others	(1) Impacts during Construction	<p>(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?</p> <p>(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?</p> <p>(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?</p>	<p>(a) Y</p> <p>(b) Y</p> <p>(c) Y</p>	<p>(a) Mitigation measures due to pollution during construction (noise, vibration, turbidity, dust, emissions and waste) will be proposed for consideration within the EIA procedure.</p> <p>(b) As the works are to be carried out in the river channel, there are concerns regarding the generation of turbid water downstream from the works during the construction period. Environmental protection measures are required by implementing the works in the dry season and adopting a half river closure.</p> <p>(c) The proposed site is located in urban area, so some impact on the social environment is expected due to air quality, noise/vibration, water quality and others from the construction work is expected. On the other hand, the scale of the works is not large, and no serious impacts are envisaged due to environmental mitigation measures during the construction phase. In addition, the influx of construction</p>

Appendix 3-4 Environmental Checklist for Moratuwa-Rathmalana Drainage Improvement Project)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				workers may cause conflicts with local residents and hygiene problems, and education programs for workers should be implemented.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) Y (c) Y (d) Y	(a) Under Sri Lanka's laws, Implementation agency is required to submit an environmental monitoring plan during the EIA process. As the Project does not require EIA/IEE procedures due to the project type, this study will propose a draft environmental monitoring plan in the report. (b) JICA team will propose to SLLDC that the proposed monitoring plan include information on items, methods, frequency, implementing agencies, etc. (c) Monitoring will be carried out under the responsibility of each facility manager and Project Management Unit (PMU) of SLLDC as project owner. (d) The method and frequency of reporting to JICA/CEA will be indicated in the proposed monitoring plan.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry checklist should also be checked.	(a) N	(a) Not applicable
	Note on Using Environmental Checklist	(a) (a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(b) N	(a) Not applicable
<p>1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience)</p> <p>2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.</p>				

Appendix-3-5

Environmental Monitoring Form (Mudun Ela Drainage Improvement Project)

Environmental Monitoring Form

The latest result of the monitoring items shall be submitted to the part of Quarterly Progress Report throughout the construction phase.

Date of record: / / (Day /Month/ Year)

Design/Pre-Construction Phase

1. Information Disclosure

Date of Disclosure	Target	Location	Methods

2. Plans to be prepared

Plans	Date of Preparation Day-MM-Year	Disclose	Remark
Training plan			
Traffic management plan			
Safety management plan			

Environmental Monitoring Form

The latest result of the monitoring items shall be submitted to the part of Quarterly Progress Report throughout the construction phase.

Date of record: / / (Day /Month/ Year)

Construction Phase

1. Mitigation measures related to Construction works

Date	Location	Mitigation Measures	Action which was taken by contractor

2. Pollution

Noise & Vibration (Several points on boundary of the project site, number of points can be modified)

Parameter	Unit	Measured Value	Tolerance limits for discharge of trade effluent		Baseline (During)	Location (Measured point, Source, Implant Recipients)	Note (Frequency etc.)
			limits	for			
Noise 1	dB	(Leq)	55 (Daytime)	65 (Daytime)	53.1 (Average of day time)		
Noise 2	dB	(Leq)					
Noise 3	dB	(Leq)					
Noise 4	dB	(Leq)					
Parameter	Unit	Measured Value	Max. Acceptable Limit of ISO 2372& VDI 2056 Group G				
Vibration 1	mm/s		1.81 to 4.5		1.9		
Vibration 2	mm/s						
Vibration 3	mm/s						
Vibration 4	mm/s						

Water quality

Parameter	Unit	Measured Value	Tolerance limits for discharge of trade effluent	Baseline (During)	Location (Measured point, Source, Implant Recipients)	Note (Frequency etc.)

This form is provisional prepared based on the result of EIA study for the Preparatory Survey on the Project for the Setting-up of All India Institute of Medical Sciences Madurai as of Dec. 2020, subject to modification based on instruction by SPCB and other relevant authorities.

					into Inland Surface Water	Dry season)	
Open well located at southern part of the site	BOD	mg/L			30	< 1.0	
	COD	mg/L			250	< 1.0	
	pH	-			5.5 to 9.0	7.0	
	Oil and grease	mg/L			10	< 1.0	
	Total Coliform	MPN /100 mL			-	< 2.0	
	TDS	mg/L			2100	962	
	TN	mg/L			100	< 0.7	
TP	mg/L			-	< 0.2		

Waste (Generation of Waste)

Item	Unit	Volume	Period	Explanation of status (Example XXXXm3 Surplus soil has carried to the contractor's stock yard)	Note (Frequency, data source etc.)
Generated waste	Construction	m ³	From	To	
Treated	Construction waste	m ³			
Generated	General waste	m ³			
Treated	General waste	m ³			

Waste (Status of waste management)

Item	Description / Photo of the disposal site	Observations (e.g. Distance from the residence, messy/ tidy)	Note (Frequency, data source etc.)
Status of the storage site			

Status of the disposal site			
Sediment Quality			
Item	Description	Observations	Note (Frequency, responsible person etc.)
Physical and chemical properties of sediments As decided by the Project's Technical Evaluation Committee appointed by the CEA (TEC-CEA), the committee may consider following sediment quality monitoring to decide on most appropriate disposal option General: Water-sediment ratio, Grain size distribution, Organic matter content	(List of machineries utilizing oil, frequency of maintenance, status of oil handling area)		
Potential acidity	(date, time, source of leakage etc)		(measures to prevent accidents)
For disposal at a sanitary landfill: USEPA: Toxicity Characteristic Leaching Procedure (TCLP) : consider option of disposal at a sanitary landfill site: 40 parameters listed under maximum concentration of contaminants for toxicity characteristic			
Dumping at sea: Parameters listed under schedule II of Marine Pollution Prevention Act. No 1816/37-2013			

* The latest result of the monitoring items shall be submitted the lenders on every month for the first two years of operation.

Date of record: / / (Day /Month/ Year)

Operation Phase

1. Lifestyle and livelihood/Local conflict of interests/ Ecosystem/Water quality

Mitigation Measures	Record	Response/ Action which was taken by project proponent
Continuous monitoring and strict regulations should be there to avoid encroachments	(date, time, source of leakage etc)	
Awareness to public not to encroach canal/river reservations		
Continuous monitoring and strict regulations should be there to avoid encroachments	(date, time, source of leakage etc)	
Awareness to public not to encroach canal/river reservations		
Continuous monitoring and strict regulations should be there to avoid encroachments	(date, time, source of leakage etc)	

End

Appendix-3-6

Environmental Monitoring Form (Moratuwa-Rathmalana Drainage Improvement Project)

Environmental Monitoring Form

The latest result of the monitoring items shall be submitted to the part of Quarterly Progress Report throughout the construction phase.

Date of record: / / (Day /Month/ Year)

Design/Pre-Construction Phase 1. Information Disclosure

Date of Disclosure	Target	Location	Methods

2. Plans to be prepared

Plans	Date of Preparation Day-MM-Year	Disclose	Remark
Training plan			
Traffic management plan			
Safety management plan			

Environmental Monitoring Form

The latest result of the monitoring items shall be submitted to the part of Quarterly Progress Report throughout the construction phase.

Date of record: / / (Day /Month/ Year)

Construction Phase	

1. Mitigation measures related to Construction works

Date	Location	Mitigation Measures	Action which was taken by contractor

2. Pollution

Noise & Vibration (Several points on boundary of the project site, number of points can be modified)

Parameter	Unit	Measured Value	Tolerance limits for discharge of trade effluent		Baseline (Average of day time)	Location (Measured point, Source, Implant Recipients)	Note (Frequency etc.)
			Measured Value	Measured Value			
Noise 1	dB	(Leq)	55 (Daytime)	65 (Daytime)	53.1		
Noise 2	dB	(Leq)					
Noise 3	dB	(Leq)					
Noise 4	dB	(Leq)					
Parameter	Unit	Measured Value	Max. Acceptable Limit of ISO 2372& VDI 2056 Group G				
Vibration 1	mm/s		1.81 to 4.5		1.9		
Vibration 2	mm/s						
Vibration 3	mm/s						
Vibration 4	mm/s						

Water quality

Parameter	Unit	Measured Value	Tolerance limits for discharge of trade effluent	Baseline (During Recipients)	Location (Measured point, Source, Implant Recipients)	Note (Frequency etc.)

This form is provisional prepared based on the result of EIA study for the Preparatory Survey on the Project for the Setting-up of All India Institute of Medical Sciences Madurai as of Dec. 2020, subject to modification based on instruction by SPCB and other relevant authorities.

Open well located at southern part of the site	BOD	mg/L		into Inland Surface Water	Dry season)				
	COD	mg/L	30		< 1.0				
	pH	-	250		< 1.0				
	Oil and grease	mg/L	5.5 to 9.0		7.0				
	Total Coliform	MPN /100 mL	10		< 1.0				
	TDS	mg/L	-		< 2.0				
	TN	mg/L	2100		962				
TP	mg/L	100		< 0.7					
			-		< 0.2				

Waste (Generation of Waste)

Item	Unit	Volume	Period	Explanation of status (Example XXXXm ³ Surplus soil has carried to the contractor's stock yard)	Note (Frequency, data source etc.)
Generated waste	m ³		From		
Treated Construction waste	m ³		To		
Generated General waste	m ³				
Treated General waste	m ³				

Waste (Status of waste management)

Item	Description / Photo of the disposal site	Observations (e.g. Distance from the residence, messy/ tidy)	Note (Frequency, data source etc.)
Status of the storage site			

Status of the disposal site			
Sediment Quality			
Item	Description	Observations	Note (Frequency, responsible person etc.)
Physical and chemical properties of sediments As decided by the Project's Technical Evaluation Committee appointed by the CEA (TEC-CEA), the committee may consider following sediment quality monitoring to decide on most appropriate disposal option General: Water-sediment ratio, Grain size distribution, Organic matter content	(List of machineries utilizing oil, frequency of maintenance, status of oil handling area)		
Potential acidity	(date, time, source of leakage etc)		(measures to prevent accidents)
For disposal at a sanitary landfill: USEPA: Toxicity Characteristic Leaching Procedure (TCLP) : consider option of disposal at a sanitary landfill site: 40 parameters listed under maximum concentration of contaminants for toxicity characteristic			
Dumping at sea: Parameters listed under schedule II of Marine Pollution Prevention Act. No 1816/37-2013			

* The latest result of the monitoring items shall be submitted the lenders on every month for the first two years of operation.

Date of record: / / (Day /Month/ Year)

Operation Phase

1. Lifestyle and livelihood/Local conflict of interests/ Ecosystem/Water quality

Mitigation Measures	Record	Response/ Action which was taken by project proponent
Continuous monitoring and strict regulations should be there to avoid encroachments	(date, time, source of leakage etc)	
Awareness to public not to encroach canal/river reservations		
Continuous monitoring and strict regulations should be there to avoid encroachments	(date, time, source of leakage etc)	
Awareness to public not to encroach canal/river reservations		
Continuous monitoring and strict regulations should be there to avoid encroachments	(date, time, source of leakage etc)	

End

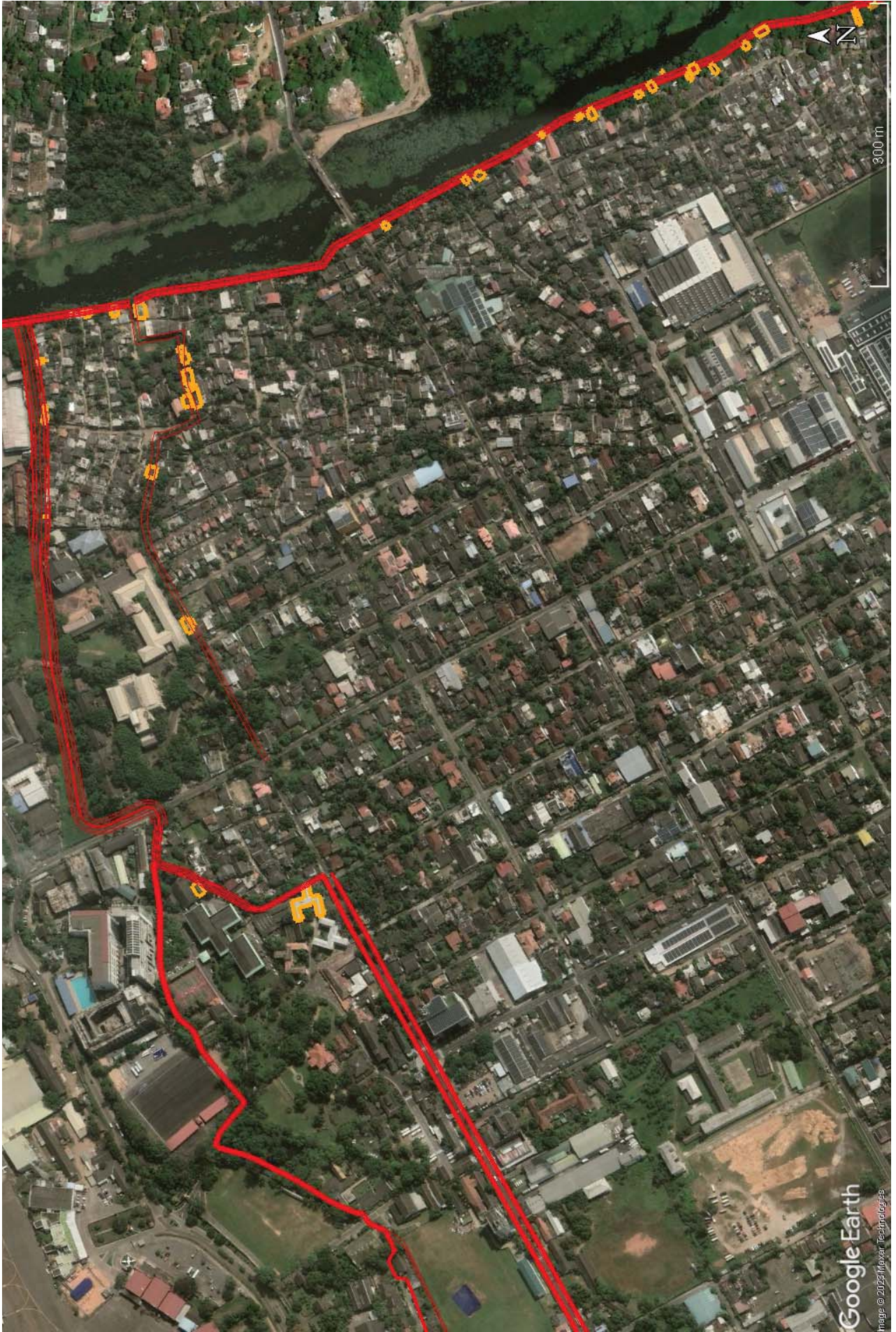
Appendix-3-7

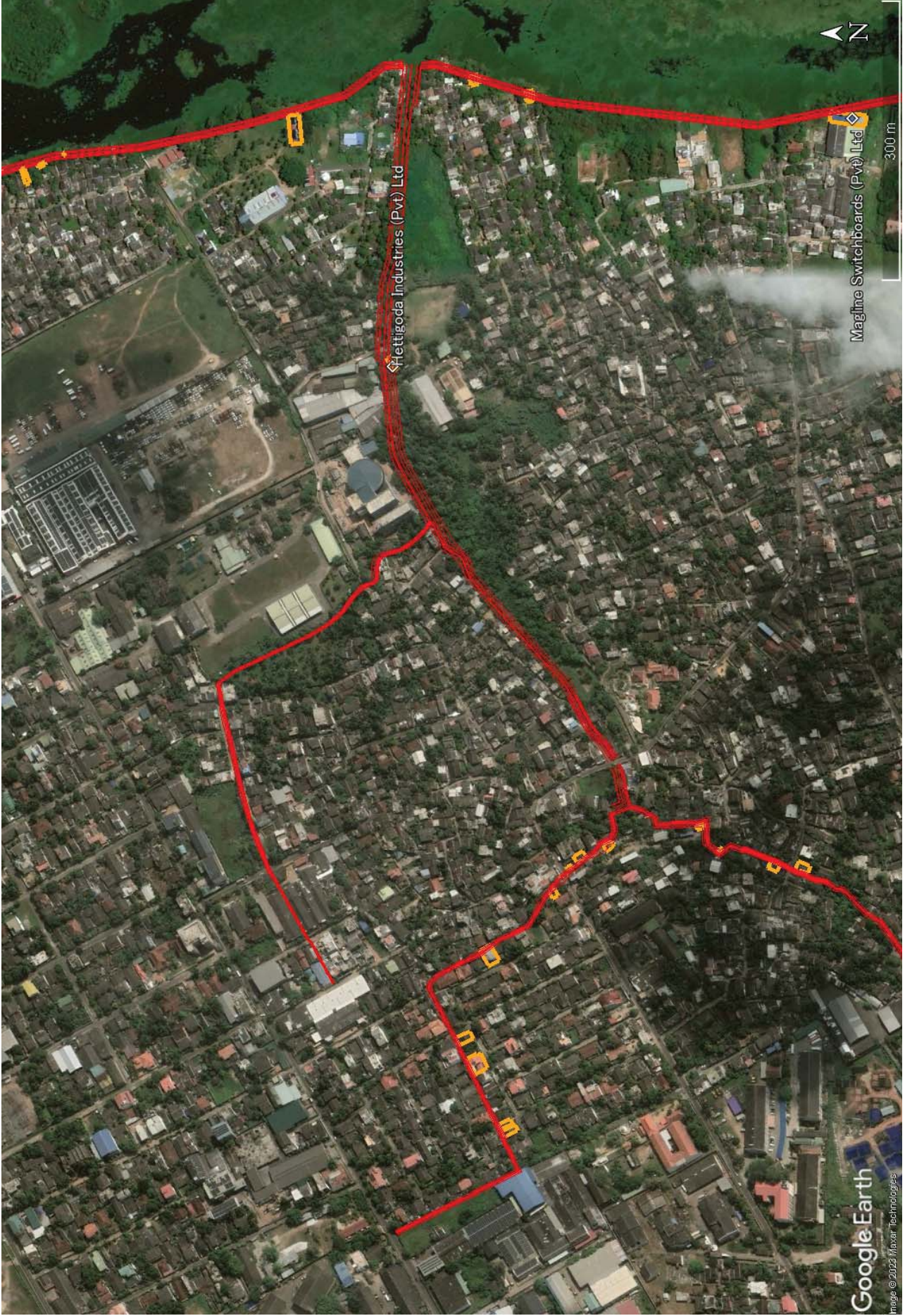
Location of Affected Structures

Mudun Ela Drainage Improvement Project (1/2)











Appendix-3-8

Monitoring form for Land Acquisition and Involuntary Resettlement

Land Acquisition and Involuntary Resettlement _Internal Monitoring Form

The latest result of the monitoring items shall be submitted to the part of Quarterly Progress Report throughout the project implementation until completion of resettlement.

Date of record: / / (Day /Month/ Year)

Category	Item	Unit	Planned Total/Target	Progress in %			Progress in Nos.		Expected Date of Completion	Responsible Organization
				Up to the month	Till last month	During the month	Up to the month	Till last month		
1) Recruitment, training and deployment of staff	1. Deployment of managerial staff	Man-month								PMU SLLDC
	2. Deployment of resettlement workers	Man-month								PMU SLLDC
2) Adopting /progress of Resettlement Action Plan	1. Review of RAP	%								PMU SLLDC/ Consultant
	2. Progress of Resettlement	%								PMU SLLDC/ Consultant
3) Livelihood recovery program	1. Participation to program	Nos (PAHs)								PMU SLLDC/ Consultant
	2. Satisfaction to the topic of program	Average Score (x/10)								PMU SLLDC/ Consultant
	3. Satisfaction to contents of program	Average Score (x/10)								PMU SLLDC/ Consultant
4) Level of Satisfaction to compensation/ replacement	1. Satisfaction to replaced housing	Average Score (x/10)								PMU SLLDC/ Consultant
	2. a) Satisfaction to compensation for expected business losses(amount)	Average Score (x/10)								PMU SLLDC/ Consultant

THE PROJECT FOR STORM WATER DRAINAGE PLAN IN SELECTED AREAS IN COLOMBO METROPOLITAN REGION

Category	Item	Unit	Planned Total/Target	Progress in %			Progress in Nos.		Expected Date of Completion	Responsible Organization
				Up to the month	Till last month	During the month	Up to the month	Till last month		
4) Level of Satisfaction to compensation/replacement	b) Satisfaction to compensation for expected business losses (timing)	Average Score (x/10)								PMU SLLDC/ Consultant
	c) Satisfaction to compensation for expected business losses (method of compensation)	Average Score (x/10)								PMU SLLDC/ Consultant
	3 a) Satisfaction to compensation for expected damage to housing structure (amount)	Average Score (x/10)								PMU SLLDC/ Consultant
5) Consistency with Entitlement Matrix	b) Satisfaction to compensation for expected damage to housing structure (timing)	Average Score (x/10)								PMU SLLDC/ Consultant
	c) Satisfaction to compensation for expected damage to housing structure (method of compensation)	Average Score (x/10)								PMU SLLDC/ Consultant
	1 Identification of Eligible Persons (EPs)	Nos.								PMU SLLDC
	2 Progress of compensation to Land owners with title for residents	%								PMU SLLDC

THE PROJECT FOR STORM WATER DRAINAGE PLAN IN SELECTED AREAS IN COLOMBO METROPOLITAN REGION

Category	Item	Unit	Planned Total/Target	Progress in %			Progress in Nos.		Expected Date of Completion	Responsible Organization	
				Up to the month	Till last month	During the month	Up to the month	Till last month			
	3	Progress of compensation to lessee resident	%							PMU SLLDC	
	4	Progress of compensation to informal settler (resident)	%							PMU SLLDC	
	5	Progress of compensation to owners of registered business	%							PMU SLLDC	
	6	Progress of compensation to non-registered business	%							PMU SLLDC	
	7	Progress of compensation to Lessee for business	%							PMU SLLDC	
	6) Grievance Redress Mechanism (GRM)	1	Receiving complaints / claims from EPs	EP							PMU SLLDC
		2	Disposing of complaints	Nos.							PMU SLLDC
3		Assist EPs in replacement structures and other financial assistance.	HHs							PMU SLLDC	

Land Acquisition and Involuntary Resettlement _External Monitoring Form

Date of record: / / (Day /Month/ Year)

No.	Major items of action	Specific action steps (sub-items)	Unit	Planned Total	Progress During the Quarter	Progress Till the Last Quarter	Total Progress	%	Remarks
1	Process/ Institutional arrangement	SLLDC staff employed (functional wise)	Nos.						
		Resettlement and land acquisition staff employed	Nos.						
		Awareness meetings held with the stake holders	Nos.						
		Training programmes held for the officers	Nos.						
2	Outputs	Informative leaflets distributed	Nos.						
		Private structures acquired	Nos.						
		Business structures acquired	Nos.						
		Community structures acquired	Nos.						
		Households Displaced according to type of losses	Nos.						
		Allowances paid	Rs						
3	Household Earning Capacity	Resettlement sites developed	% (area)						
		APs who loss employment	Nos.						
		APs suffered from loss of income from Business	Nos.						
		APs who have lost income from inaccessible loans	Nos.						
		APs who have lost income by no assistance by project proponent	Nos.						

THE PROJECT FOR STORM WATER DRAINAGE PLAN IN SELECTED AREAS IN COLOMBO METROPOLITAN REGION

No.	Major items of action	Specific action steps (sub-items)	Unit	Planned Total	Progress During the Quarter	Progress Till the Last Quarter	Total Progress	%	Remarks
		APs suffered from loss of income by no provision of employment by the project	Nos.						
		Participation in Community Based activities	times						
4	Changes to Status of Women	Loss of employment	Nos.						
		Aggravation /facilitation of gender issues	Nos.						
		Participation in project activities	Nos.						
5	Changes to status of Children	Changes in school attendance by gender wise	Nos.						
		Inability to attend schools, gender wise	Nos.						
6	Settlement & Population	Generation of new businesses	Nos.						
		Influx of population	Nos.						
		Increase in encroachers / squatters in state lands	Nos.						

Appendix-4
Geotechnical Investigation Result



Figure 1a: Map showing borehole locations (BH-01 and BH-03) in Moratuwa-Rathmalana Area

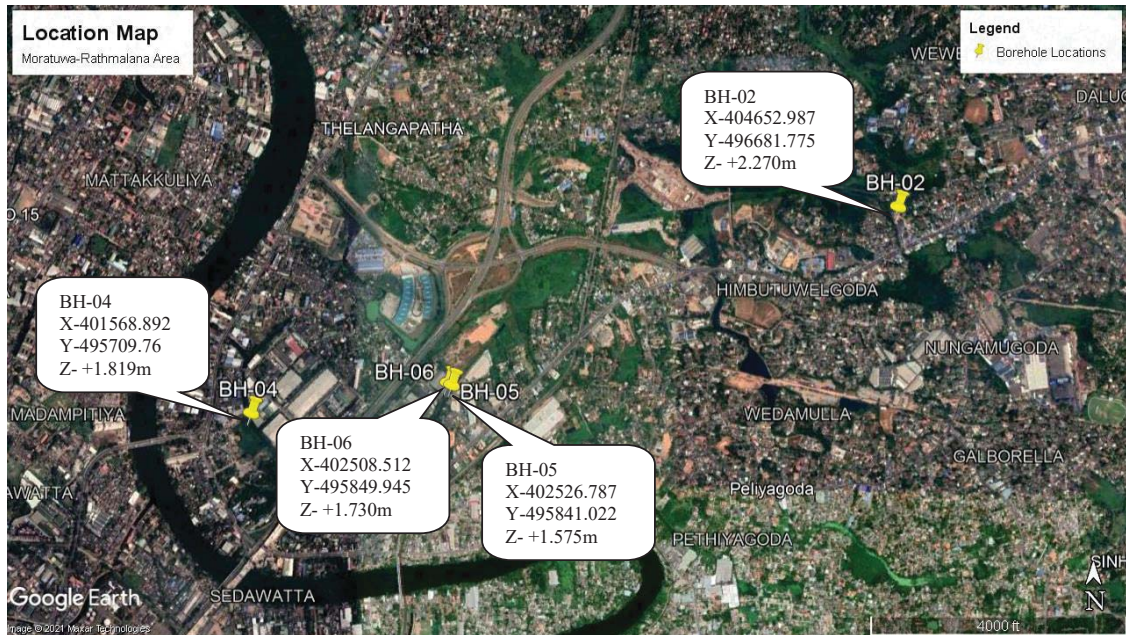


Figure 1b: Map showing borehole locations (BH-02, BH-04, BH-05 & BH-06) in the Mudun Ela sub basin

Table 4: Summary of laboratory test results and soil classification

Borehole No.	Sample Type/Depth (m)	Classification (ASTM D 2487-06)		Particle size Distribution					Atterberg Limit Test			Consolidation Test				Moisture Content (%)	Average Specific Gravity, GSAV	
		Group Symbol	Group Name	$\Phi_{60\%}$ (mm)	$\Phi_{30\%}$ (mm)	$\Phi_{10\%}$ (mm)	C_u	C_c	Liquid Limit %	Plastic Limit %	Plasticity Index %	P_c (kPa)	Compression Index C_c	Compression Ratio C_r	Swell Index C_s			
BH - 01	1.00-1.45m (SPT)	SW-SM	Well-graded sand with silt and gravel	2.433	1.039	0.355	6.853	1.251	-	-	-	-	-	-	-	-	20.1	2.67
	2.00-2.45m (SPT)	SM	Silty sand with gravel	3.107	0.529	0.053	58.924	1.711	-	-	-	-	-	-	-	-	-	2.61
	2.50-3.00m (UDS)	-	-	-	-	-	-	-	-	-	49.5	1.535	0.299	0.199	117.4	-	-	
	3.00-3.45m (SPT)	CL	Lean clay with sand	0.066	0.050	<0.001	-	-	-	-	-	-	-	-	-	-	85.7	2.47
	4.00-4.45m (SPT)	CL	Lean clay with sand	0.047	0.002	<0.001	-	-	-	35	14	21	-	-	-	-	-	2.61
	4.50-5.00m (UDS)	-	-	-	-	-	-	-	-	-	-	-	58.5	0.090	0.024	29.6	-	-
	5.00-5.45m (SPT)	CL	Sandy lean clay	0.071	0.007	<0.001	-	-	-	28	10	18	-	-	-	-	17.5	2.60
	6.00-6.45m (SPT)	SC	Clayey sand	0.151	0.052	<0.001	-	-	-	-	-	-	-	-	-	-	17.3	2.64
	7.00-7.45m (SPT)	SM	Silty sand	0.251	0.068	0.024	10.599	0.789	Non Plastic			-	-	-	-	-	43.9	2.65
	8.00-8.45m (SPT)	SM	Silty sand	0.316	0.127	0.050	6.337	1.014	-	-	-	-	-	-	-	-	28.8	2.71
BH - 02	1.00-1.45m (SPT)	MH/ML	Sandy silt	0.085	0.059	0.003	25.779	12.356				-	-	-	-	-	51.3	2.31
	3.50-4.00m (UDS)	CH	Sandy fat clay	0.171	0.049	<0.001	-	-	-	51	25	26	-	-	-	-	26.9	2.54
	4.00-4.45m (SPT)	SC	Clayey sand	0.883	<0.075	<0.075	-	-	-	46	20	26	-	-	-	-	17.3	2.64
	5.00-5.45m (SPT)	SC	Clayey sand	1.580	0.130	<0.001	-	-	-	73	29	44	-	-	-	-	19.3	2.53

Borehole No.	Sample Type/Depth (m)	Classification		Particle size Distribution					Atterberg Limit Test			Consolidation Test				Moisture Content (%)	Average Specific Gravity, GSAV	
		Group Symbol	Group Name	$\Phi_{60\%}$ (mm)	$\Phi_{30\%}$ (mm)	$\Phi_{10\%}$ (mm)	C_u	C_c	Liquid Limit %	Plastic Limit %	Plasticity Index %	P_c (kPa)	Compression Index C_c	Compression Ratio C_r	Swell Index C_s			
BH - 02	7.00-7.45m (SPT)	SC	Clayey sand	0.326	0.071	<0.001	-	-	-	52	20	32	-	-	-	-	20.6	2.49
	8.00-8.45m (SPT)	SM	Silty sand	0.460	0.161	<0.075	-	-	-	-	-	-	-	-	-	-	14.5	2.57
	9.00-9.45m (SPT)	SM	Silty sand	1.234	0.395	<0.075	-	-	-	-	-	-	-	-	-	-	10.3	2.59
	10.00-10.45m (SPT)	MH/ML	Sandy silt	0.130	0.021	<0.001	-	-	-	-	-	-	-	-	-	-	37.5	2.46
	11.00-11.45m (SPT)	MH/ML	Sandy silt	0.203	0.028	0.001	136.518	2.562	-	-	-	-	-	-	-	-	32.3	2.37
	12.00-12.45m (SPT)	SM	Silty sand	0.410	0.059	0.002	164.727	3.474	-	-	-	-	-	-	-	-	20.0	2.55
	13.00-13.45m (SPT)	SM	Silty sand with gravel	0.719	0.115	0.006	122.913	3.131	-	-	-	-	-	-	-	-	18.8	2.46
	1.00-1.45m (SPT)	SP	Poorly graded sand with gravel	1.003	0.457	0.192	5.230	1.084	-	-	-	-	-	-	-	-	14.8	2.66
	2.00-2.45m (SPT)	SP	Poorly graded sand with gravel	1.470	0.780	0.424	3.468	0.976	-	-	-	-	-	-	-	-	13.9	2.61
	4.00-4.45m (SPT)	SP	Poorly graded sand	0.467	0.246	0.157	2.970	0.825	-	-	-	-	-	-	-	-	22.0	2.49
BH - 03	5.00-5.45m (SPT)	SC	Clayey sand	0.494	0.211	0.054	9.146	1.676	23	15	8	-	-	-	-	-	18.1	2.60
	6.00-6.45m (SPT)	SC	Clayey sand	0.442	0.063	<0.001	-	-	36	17	19	-	-	-	-	-	23.1	2.53
	7.00-7.45m (SPT)	CL	Sandy lean clay	0.353	0.004	<0.001	-	-	45	24	21	-	-	-	-	-	17.9	2.50
	8.00-8.45m (SPT)	CH	Sandy fat clay	0.063	0.002	<0.001	-	-	68	31	37	-	-	-	-	-	33.1	2.38

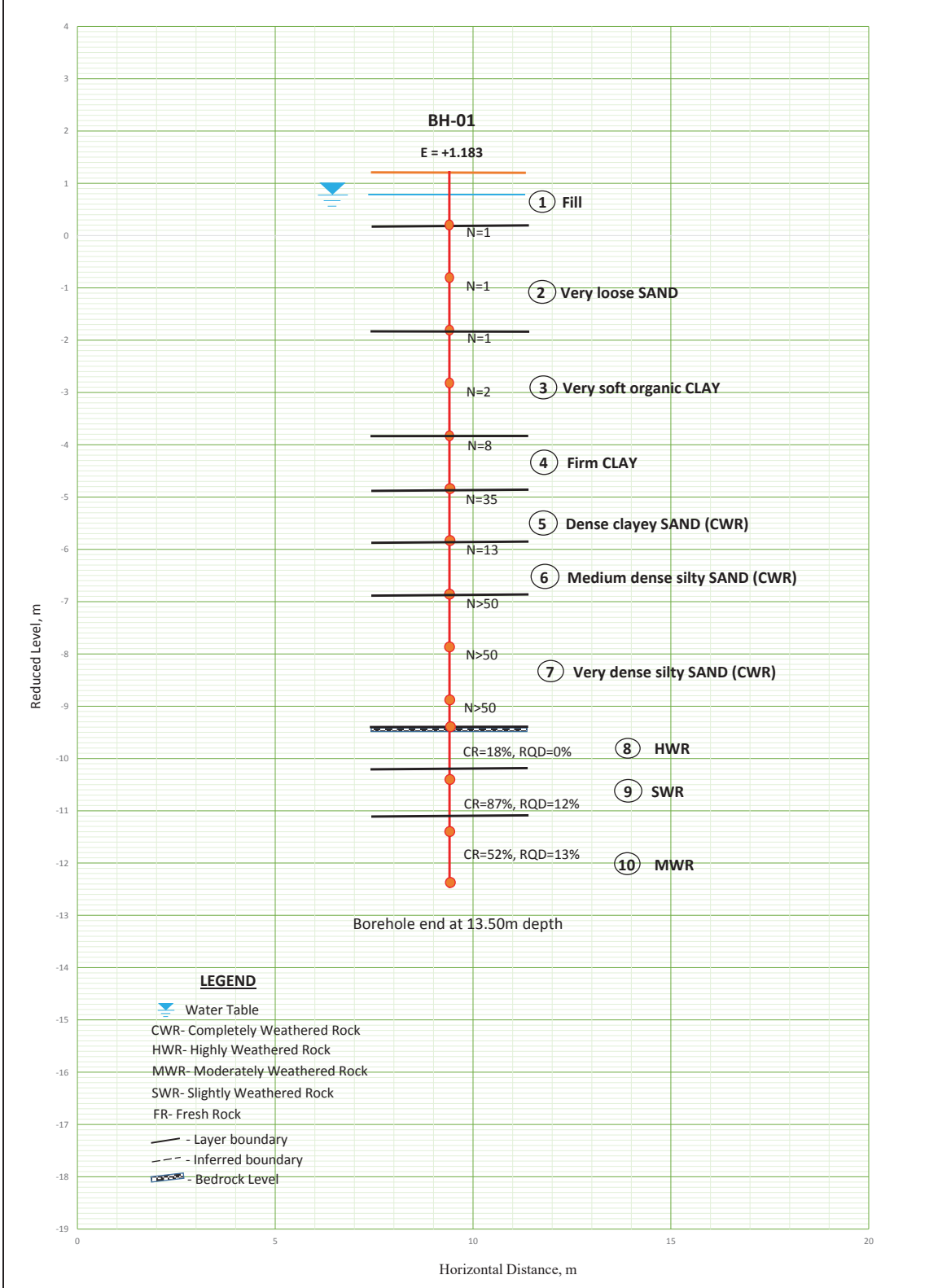
Borehole No.	Sample Type/Depth (m)	Classification		Particle size Distribution					Atterberg Limit Test			Consolidation Test				Moisture Content (%)	Average Specific Gravity, GSAV	
		Group Symbol	Group Name	$\Phi_{60\%}$ (mm)	$\Phi_{30\%}$ (mm)	$\Phi_{10\%}$ (mm)	Cu	Cc	Liquid Limit %	Plastic Limit %	Plasticity Index %	Pc (kPa)	Compression Index Cc	Compression Ratio Cc'	Swell Index Cs			
BH - 03	9.00-9.45m (SPT)	MH	Sandy silt	0.389	<0.075	<0.075	-	-	-	-	-	-	-	-	-	-	30.7	2.48
	10.00-10.45m (SPT)	MH	Sandy elastic silt	0.256	<0.075	<0.075	-	-	52	33	19	-	-	-	-	-	33.7	2.48
	11.00-11.45m (SPT)	SM	Silty sand	0.314	0.065	0.002	162.380	7.059	-	-	-	-	-	-	-	-	33.0	2.42
	12.00-12.45m (SPT)	SM	Silty sand	0.287	0.058	0.002	148.430	6.068	-	-	-	-	-	-	-	-	26.1	2.52
	14.00-14.45m (SPT)	SM	Silty sand	0.323	0.061	0.002	149.685	5.387	-	-	-	-	-	-	-	-	25.8	2.56
BH - 04	2.50-3.00m (UDS)	MH	Elastic silt with sand	<0.075	<0.075	<0.075	-	-	64	32	32	73.3	0.695	0.081	0.039	-	71.6	2.34
	5.50-6.00m (UDS)	SM	Silty sand	0.652	<0.075	<0.075	-	-	Non Plastic			48	1.171	0.293	0.012	-	289.5	1.93
	10.00-10.45m (SPT)	ML	Silt with sand	<0.075	<0.075	<0.075	-	-	-	-	-	-	-	-	-	-	109.6	2.36
	13.00-13.45m (SPT)	CH/CL	Clay with sand	<0.075	<0.075	<0.075	-	-	-	-	-	-	-	-	-	-	81.8	2.54
	15.00-15.45m (SPT)	SC	Clayey sand	0.155	0.065	<0.001	-	-	-	-	-	-	-	-	-	-	27.5	2.7
	16.00-16.45m (SPT)	SC	Clayey sand	0.165	0.068	<0.001	-	-	-	-	-	-	-	-	-	-	30.4	2.69
	17.00-17.45m (SPT)	SC	Clayey sand	0.163	<0.075	<0.075	-	-	30	15	15	-	-	-	-	-	32.7	2.69

Borehole No.	Sample Type/Depth (m)	Classification		Particle size Distribution					Atterberg Limit Test			Consolidation Test				Moisture Content (%)	Average Specific Gravity, GSAV	
		Group Symbol	Group Name	$\Phi_{60\%}$ (mm)	$\Phi_{30\%}$ (mm)	$\Phi_{10\%}$ (mm)	C_u	C_c	Liquid Limit %	Plastic Limit %	Plasticity Index %	P_c (kPa)	Compression Index C_c	Compression Ratio C_r	Swell Index C_s			
BH - 05	1.00-1.45m (SPT)	CL/CH	Sandy clay	<0.075	<0.075	<0.075	-	-	-	-	-	-	-	-	-	-	47.3	2.52
	2.00-2.45m (SPT)	CL/CH	Sandy clay	<0.075	<0.075	<0.075	-	-	-	-	-	-	-	-	-	-	51.1	2.60
	3.60-4.00m (UDS)	CH	Sandy fat clay	0.157	<0.075	<0.075	-	-	53	27	26	31.4	1.186	0.317	0.093	105.4	2.35	
	6.00-6.45m (SPT)	SP	Poorly graded sand	0.460	0.316	0.165	2.796	1.315	-	-	-	-	-	-	-	20.5	2.68	
	8.00-8.45m (SPT)	SP	Poorly graded sand	0.421	0.304	0.116	3.625	1.895	-	-	-	-	-	-	-	24.2	2.66	
	10.00-10.45m (SPT)	SP	Poorly graded sand	0.398	0.255	0.080	4.985	2.056	-	-	-	-	-	-	-	40.5	2.65	
	11.00-11.45m (SPT)	SP	Poorly graded sand	0.386	0.241	0.094	4.090	1.589	-	-	-	-	-	-	-	25.7	2.68	
	12.00-12.45m (SPT)	SP	Poorly graded sand	0.423	0.318	0.165	2.573	1.453	-	-	-	-	-	-	-	24.6	2.69	
	15.00-15.45m (SPT)	SP	Poorly graded sand	0.486	0.326	0.145	3.341	1.510	-	-	-	-	-	-	-	22.7	2.66	
	16.00-16.45m (SPT)	SP	Poorly graded sand	0.513	0.355	0.190	2.704	1.296	-	-	-	-	-	-	-	21.4	2.69	
	17.00-17.45m (SPT)	SP	Poorly graded sand	0.509	0.350	0.186	2.739	1.299	-	-	-	-	-	-	-	19.6	2.68	
	18.00-18.45m (SPT)	SP	Poorly graded sand	0.488	0.338	0.172	2.838	1.357	-	-	-	-	-	-	-	26.5	2.72	
20.00-20.45m (SPT)	SW	Well-graded sand with gravel	1.386	0.431	0.195	7.120	0.687	-	-	-	-	-	-	-	16.0	2.76		

Borehole No.	Sample Type/Depth (m)	Classification		Particle size Distribution					Atterberg Limit Test			Consolidation Test				Moisture Content (%)	Average Specific Gravity, GSAV	
		Group Symbol	Group Name	$\Phi_{60\%}$ (mm)	$\Phi_{30\%}$ (mm)	$\Phi_{10\%}$ (mm)	C_u	C_c	Liquid Limit %	Plastic Limit %	Plasticity Index %	P_c (kPa)	Compression Index C_c	Compression Ratio C_r	Swell Index C_s			
BH - 06	1.00-1.45m (SPT)	CL/CH	Sandy clay	<0.075	<0.075	<0.075	-	-	-	-	-	-	-	-	-	-	29.30	2.63
	2.00-2.45m (SPT)	CL/CH	Sandy clay	0.088	<0.075	<0.075	-	-	-	-	-	-	-	-	-	-	50.40	2.67
	3.50-4.00m (UDS)	ML	Sandy silt	<0.075	<0.075	<0.075	-	-	47	25	22	41.5	1.188	0.325	0.073	-	92.90	2.45
	5.00-5.45m (SPT)	SM	Silty sand	0.193	0.084	<0.075	-	-	-	-	Non plastic	-	-	-	-	-	62.50	2.28
	6.00-6.45m (SPT)	SP	Poorly graded sand	0.494	0.340	0.176	2.809	1.332	-	-	-	-	-	-	-	-	23.70	2.68
	7.00-7.45m (SPT)	SP	Poorly graded sand	0.446	0.332	0.165	2.83	1.432	-	-	-	-	-	-	-	-	30.00	2.69
	9.00-9.45m (SPT)	SP	Poorly graded sand	0.423	0.319	0.126	3.366	1.910	-	-	-	-	-	-	-	-	25.30	2.70
	11.00-11.45m (SPT)	SP/SM	Poorly graded sand with silt	0.405	0.290	<0.075	-	-	-	-	-	-	-	-	-	-	25.50	2.70
	12.00-12.45m (SPT)	SP/SM	Poorly graded sand with silt	0.416	0.305	0.089	4.669	2.513	-	-	-	-	-	-	-	-	22.60	2.63
	13.00-13.45m (SPT)	SP/SM	Poorly graded sand with silt	0.432	0.314	0.121	3.579	1.892	-	-	-	-	-	-	-	-	27.70	2.67
	15.00-15.45m (SPT)	SP/SM	Poorly graded sand with silt	0.433	0.321	0.110	3.950	2.169	-	-	-	-	-	-	-	-	23.20	2.72
	18.00-18.45m (SPT)	SP	Poorly graded sand with gravel	0.992	0.500	0.293	3.385	0.861	-	-	-	-	-	-	-	-	15.60	2.70
	19.00-19.45m (SPT)	SP	Poorly graded sand with gravel	1.912	0.478	0.184	10.398	0.651	-	-	-	-	-	-	-	-	14.00	2.70

PROJECT	Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area
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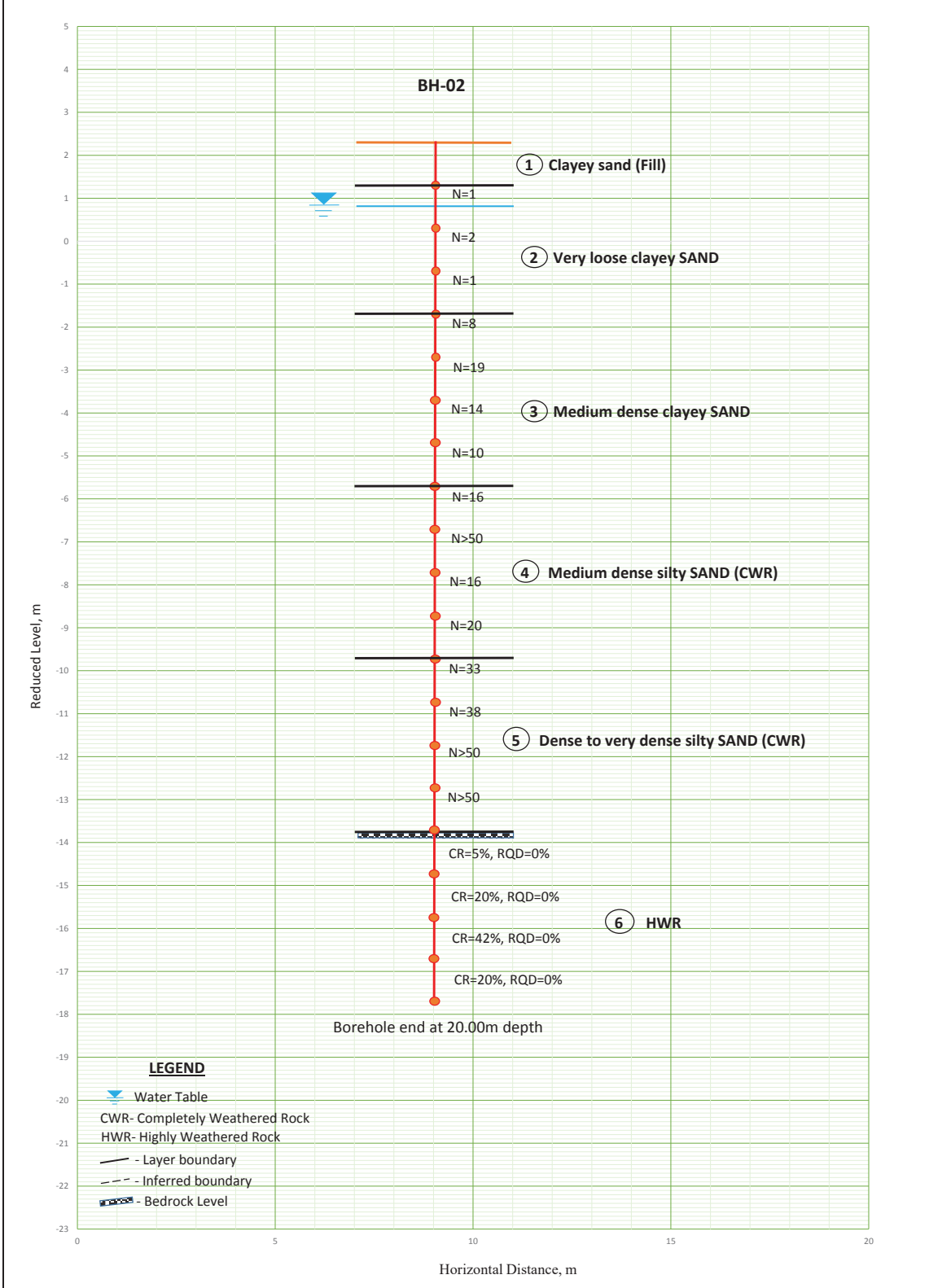
Job Number SPI/GI/081	Geotechnical Section at BH-01
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Interpreted by: HMMSJ - Geologist	 Central Engineering Consultancy Bureau No.11, Jawatta Road, Colombo 05 Sri Lanka	Drawing No.
Checked by: Eng. S.S.I.Kodagoda		CB/SPI/MESB&MR/01
Date	02.08.2021	

PROJECT	Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area
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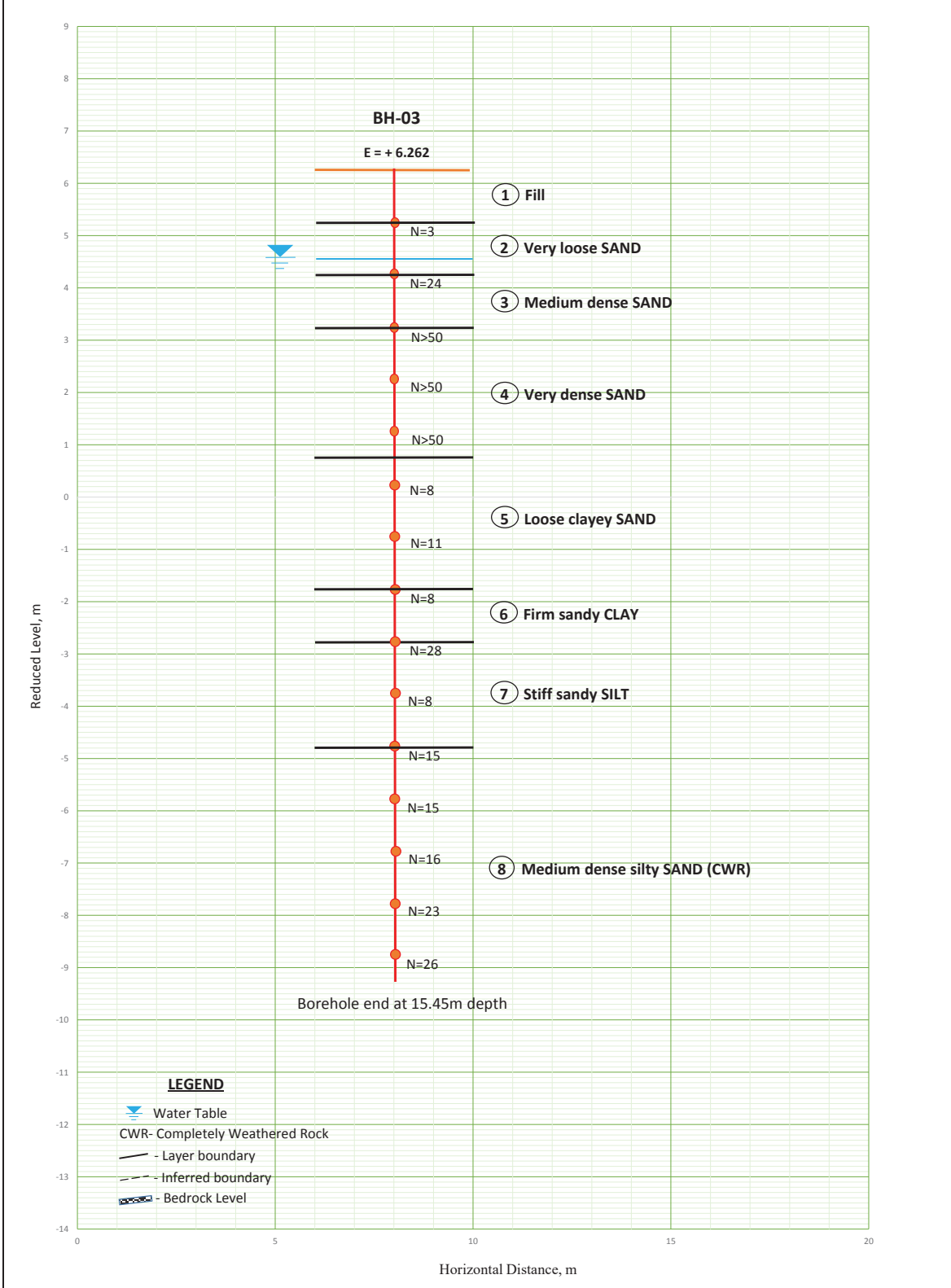
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Checked by: Eng. S.S.I.Kodagoda		CB/SPI/MESB&MR/02
Date	02.08.2021	

PROJECT	Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area
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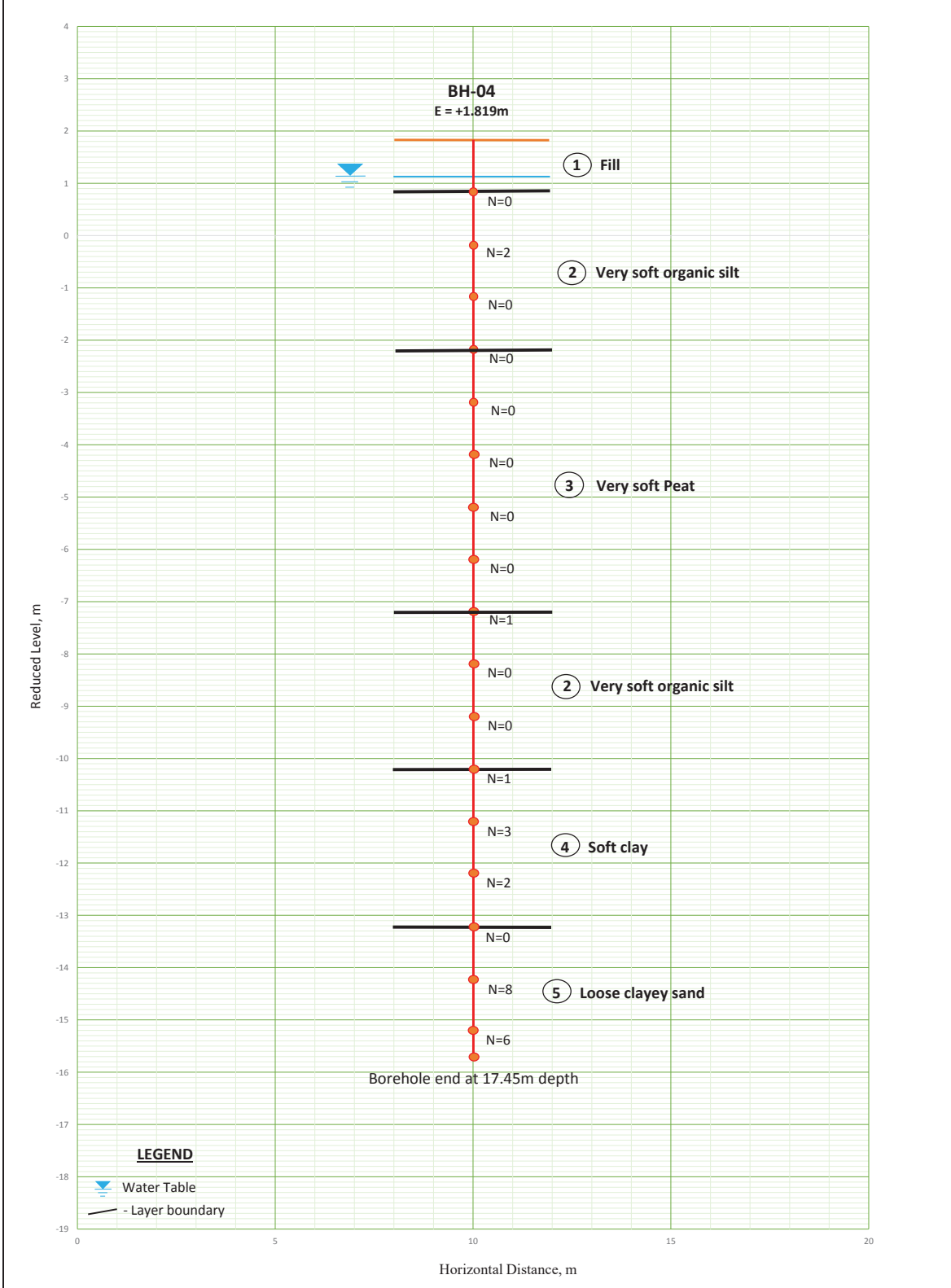
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PROJECT	Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area
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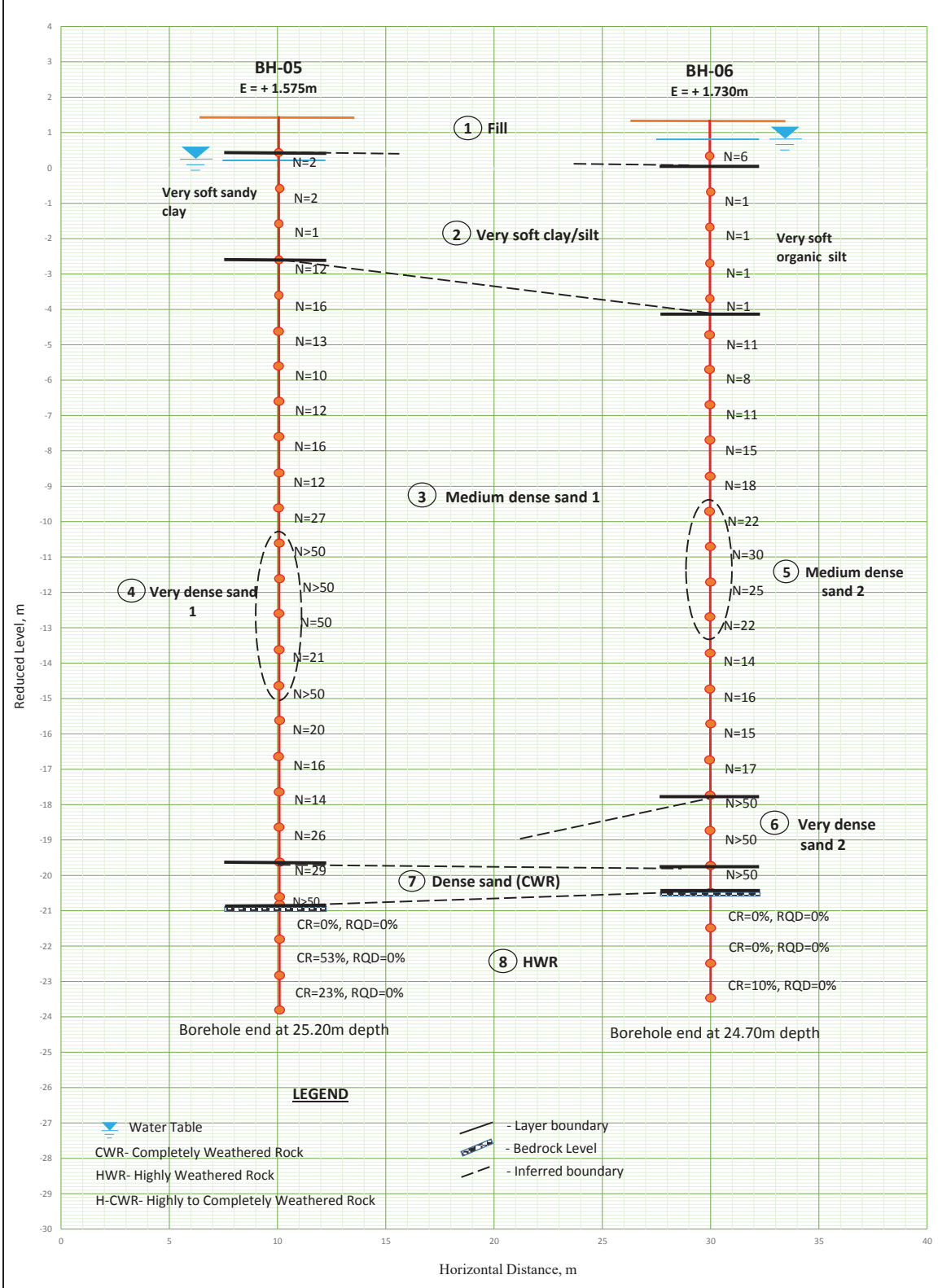
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Date	20.08.2021	

PROJECT	Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area
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Job Number SPI/GI/081	Geotechnical Section across BH-05 and BH-06 (Mudun Ela)
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Checked by: Eng. S.S.I.Kodagoda		CB/SPI/MESB&MR/05
Date	08.10.2021	

BOREHOLE LOG



NATURAL RESOURCES MANAGEMENT & LABORATORY SERVICES (NRM&LS)
 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-01

Type of Rig		TONE	Location		Borupana-Rathmalana	Client		CTI Engineering International Co.Ltd.											
Drilling Method		Rotary	Ground Elevation (MSL)		1.183 m	Date Started		07.07.2021											
Bit Size		NX	X Coordinate		403397.942	Date Finished		08.07.2021											
Casing Diameter		NX	Y Coordinate		479010.625	Drilling Forman		WCD											
Cased Depth		10.50m	Angle of Hole		Vertical	Scale		NTS											
Flushing Medium		Water	Depth of G.W.L		0.35m	Total Depth of Hole		13.50m											
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks				
									Depth Tested (m)	Number	N Value								
											Graphical Representation								
10	20	30	40	50	60														
0.00		1.183																	
1.00		0.183	Brown, sandy GRAVEL Fill	1.00					SPT	1.00-1.45	1								
2.00		-0.817	Very loose, brown, fine to coarse SAND with fine to medium gravel.	1.00					SPT	2.00-2.45	1								
3.00		-1.817	Very loose, blackish, organic silty fine to coarse SAND with fine gravel. (ALLUVIAL DEPOSIT)	1.00					UDS	2.50-3.00									
4.00		-2.817	Very soft, blackish, organic CLAY with fine to coarse sand. (ESTUARINE DEPOSIT)	1.00					SPT	3.00-3.45	1								
5.00		-3.817	Very soft, dark grey CLAY with fine to coarse sand. (ESTUARINE DEPOSIT)	1.00					UDS	4.50-5.00									
6.20		-5.017	Firm, grey sandy CLAY. Sand is fine to medium. (ESTUARINE DEPOSIT)	1.20					SPT	4.00-4.45	2								
7.00		-5.817	Dense, grey, clayey fine to medium SAND (COMPLETELY WEATHERED ROCK)	0.80					SPT	5.00-5.45	8								
8.00		-6.817	Medium dense, greenish grey, silty fine to medium SAND. (COMPLETELY WEATHERED ROCK)	1.00					SPT	6.00-6.45	35								
									SPT	7.00-7.45	13								
									SPT	8.00-8.45	>50								Hammer bounced after penetrating 35cm
Legend			GRAVEL/ FILL		Completely weathered rock						Logged by	Checked by							
			SAND, Clayey SAND, Silty SAND		Highly weathered rock						HMMSJ	HMJMKH							
			SILT, Sandy SILT		Moderately weathered rock						SHEET No. 1 of 2								
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock						Date : 12.07.2021								
Issue : 01				Revision : 00															

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



NATURAL RESOURCES MANAGEMENT & LABORATORY SERVICES (NRM&LS)
 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-01

Type of Rig		TONE	Location		Borupana-Rathmalana	Client		CTI Engineering International Co.Ltd.											
Drilling Method		Rotary	Ground Elevation (MSL)		1.183 m	Date Started		07.07.2021											
Bit Size		NX	X Coordinate		403397.942	Date Finished		08.07.2021											
Casing Diameter		NX	Y Coordinate		479010.625	Drilling Forman		WCD											
Cased Depth		10.50m	Angle of Hole		Vertical	Scale		NTS											
Flushing Medium		Water	Depth of G.W.L		0.35m	Total Depth of Hole		13.50m											
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks				
									Depth Tested (m)	Number	N Value								
											Graphical Representation								
10	20	30	40	50	60														
8.00		-6.817																	
9.00		-7.817	Very dense, grey, silty fine to medium SAND (COMPLETELY WEATHERED ROCK)	1.00				SPT	9.00-9.45	>50									Hammer bounced. No SPT sample recovered
					0	0		Rock	9.00-10.00										
			Highly to completely weathered rock in the form of very dense, grey silty SAND	1.50				SPT	10.00-10.45	>50									
					0	0		Rock	10.00-10.50										
10.50		-9.317																	
			Highly weathered Biotite GNEISS	0.80		18	0	Rock	10.50-11.50										
11.30		-10.117																	
			Slightly to moderately weathered, greyish, narrowly foliated, medium to coarse grined Biotite GNEISS. Closely to very closely spaced fractures dipping at 60°, planar rough fracture surfaces with greenish yellow and yellowish brown surface coatings	0.90	87	12		Rock	11.50-12.50										
11.50		-11.017																	
12.20		-11.017																	
			Moderately weathered, greenish grey, narrowly foliated, medium to coarse grained Biotite GNEISS. Intensely fractured	1.30	52	13		Rock	12.50-13.50										
12.50		-12.317																	
13.50		-12.317																	
			<i>Borehole terminated at 13.50m depth.</i>																
Legend			GRAVEL/ FILL		Completely weathered rock						Logged by		Checked by						
			SAND, Clayey SAND, Silty SAND		Highly weathered rock						HMMSJ		HMJMKH						
			SILT, Sandy SILT		Moderately weathered rock						SHEET No. 2 of 2								
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock														
Issue : 01				Revision : 00						Date : 12.07.2021									

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



NATURAL RESOURCES MANAGEMENT & LABORATORY SERVICES (NRM&LS)
 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-02

Type of Rig		TONE	Location		Eksath Mawatha-Kelaniya	Client		CTI Engineering International Co.Ltd.											
Drilling Method		Rotary	Ground Elevation (MSL)		2.270 m	Date Started		12.07.2021											
Bit Size		NX	X Coordinate		404659.4 m	Date Finished		15.07.2021											
Casing Diameter		NX	Y Coordinate		496676.3 m	Drilling Forman		WCD											
Cased Depth		16.00m	Angle of Hole		Vertical	Scale		NTS											
Flushing Medium		Water	Depth of G.W.L		1.5 m	Total Depth of Hole		20.00m											
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks				
									Depth Tested (m)	Number	N Value								
											10	20	30	40		50	60		
0.00		2.270																	
1.00		1.270	Brown clayey SAND with gravel (TOP SOIL)	1.00				SPT	1.00-1.45	1									
2.40		-0.130	Very loose, dark grey clayey fine to coarse SAND with fine to medium gravel. (ALLUVIAL DEPOSIT)	1.40				SPT	2.00-2.45	2									
4.00		-1.730	Very loose, greyish yellow clayey fine to coarse SAND. (ALLUVIAL DEPOSIT)	1.60				SPT	3.00-3.45	1									
								UDS	3.50-4.00										
5.00		-2.730	Loose, pale brown, reddish and grey clayey fine to coarse SAND with fine gravel. (RESIDUAL SOIL)	1.00				SPT	4.00-4.45	8									
7.00		-4.730	Medium dense, reddish brown and grey clayey fine to coarse SAND with fine gravel. (RESIDUAL SOIL)	2.00				SPT	5.00-5.45	19									
									6.00-6.45	14									
8.00		-5.730	Loose, pale reddish brown and grey clayey fine to coarse SAND. (RESIDUAL SOIL)	1.00				SPT	7.00-7.45	10									
									8.00-8.45	16									
Legend			GRAVEL/ FILL		Completely weathered rock					Logged by		Checked by							
			SAND, Clayey SAND, Silty SAND		Highly weathered rock					HMMSJ		HMJMKH							
			SILT, Sandy SILT		Moderately weathered rock					SHEET No. 1 of 3									
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock														
Issue : 01				Revision : 00				Date : 19.07.2021											

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



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 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-02

Type of Rig		TONE	Location		Eksath Mawatha-Kelaniya	Client		CTI Engineering International Co.Ltd.										
Drilling Method		Rotary	Ground Elevation (MSL)		2.270 m	Date Started		12.07.2021										
Bit Size		NX	X Coordinate		404652.987	Date Finished		15.07.2021										
Casing Diameter		NX	Y Coordinate		496681.775	Drilling Forman		WCD										
Cased Depth		16.00m	Angle of Hole		Vertical	Scale		NTS										
Flushing Medium		Water	Depth of G.W.L		1.5 m	Total Depth of Hole		20.00m										
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks			
									Depth Tested (m)	Number	N Value							
											Graphical Representation	10	20	30		40	50	60
8.00		-5.730																
9.00		-6.730	Medium dense, greyish, silty fine to coarse SAND. (COMPLETELY WEATHERED ROCK)	1.00				SPT	9.00-9.45	>50								Hammer bounced
10.00		-7.730	Very dense, greyish brown, silty fine to coarse SAND with fine gravel. (COMPLETELY WEATHERED ROCK)	1.00				SPT	10.00-10.45	16								
11.00		-8.730	Stiff, yellowish and greenish grey sandy SILT. Sand is fine to coarse. (COMPLETELY WEATHERED ROCK)	1.00				SPT	11.00-11.45	20								
12.00		-9.730	Medium dense, yellowish and grey silty fine to coarse SAND. (COMPLETELY WEATHERED ROCK)	1.00				SPT	12.00-12.45	33								
13.00		-10.730	Dense, whitish, silty fine to coarse SAND. (COMPLETELY WEATHERED ROCK)	1.00				SPT	13.00-13.45	38								
14.60		-12.330	Dense to very dense, pale yellowish brown, silty fine to coarse SAND with fine gravel. (COMPLETELY WEATHERED ROCK)	1.60				SPT	14.00-14.45	>50								Hammer bounced
16.00		-13.730	Highly to completely weathered rock	1.40				SPT	15.00-15.45	>50								Hammer bounced No sample recovered
Legend			GRAVEL/ FILL		Completely weathered rock				Logged by		Checked by							
			SAND, Clayey SAND, Silty SAND		Highly weathered rock				HMMSJ		HMJMKH							
			SILT, Sandy SILT		Moderately weathered rock				SHEET No. 2 of 3									
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock													
Issue : 01				Revision : 00				Date : 19.07.2021										

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



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 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-02

Type of Rig		TONE	Location		Eksath Mawatha-Kelaniya	Client		CTI Engineering International Co.Ltd.												
Drilling Method		Rotary	Ground Elevation (MSL)		2.270 m	Date Started		12.07.2021												
Bit Size		NX	X Coordinate		404659.4 m	Date Finished		15.07.2021												
Casing Diameter		NX	Y Coordinate		496676.3 m	Drilling Forman		WCD												
Cased Depth		16.00m	Angle of Hole		Vertical	Scale		NTS												
Flushing Medium		Water	Depth of G.W.L		1.5 m	Total Depth of Hole		20.00m												
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks					
									Depth Tested (m)	Number	N Value									
											10	20	30	40		50	60			
16.00		-13.730																		
17.00			Highly weathered Garnetiferous granitic biotite GNEISS.	1.00	5	0		Rock	16.00-17.00											
			Moderately to highly weathered Garnetiferous granitic biotite GNEISS. Fractures parallel to core axis, very closely spaced fractures parallel and sub-parallel to foliation. Planar rough fracture surfaces with yellowish surface staining	3.00	20	0		Rock	17.00-18.00											
					42	0		Rock	18.00-19.00											
20.00		-17.730	<i>Borehole terminated at 20.00m depth.</i>																	
Legend		GRAVEL/ FILL	Completely weathered rock			Logged by		Checked by												
		SAND, Clayey SAND, Silty SAND	Highly weathered rock			HMMSJ		HMJMKH												
		SILT, Sandy SILT	Moderately weathered rock			SHEET No. 3 of 3														
		CLAY, Sandy CLAY	Slightly weathered / Fresh rock																	
Issue : 01				Revision : 00				Date : 19.07.2021												

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



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 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-03

Type of Rig		TONE	Location		Thelawala-Rathmalana	Client		CTI Engineering International Co. Ltd.											
Drilling Method		Rotary	Ground Elevation (MSL)		6.262 m	Date Started		21.07.2021											
Bit Size		NX	X Coordinate		402306.868	Date Finished		22.07.2021											
Casing Diameter		NX	Y Coordinate		478581.559	Drilling Forman		WCD											
Cased Depth		15.00m	Angle of Hole		Vertical	Scale		NTS											
Flushing Medium		Water	Depth of G.W.L		1.70m	Total Depth of Hole		15.45m											
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks				
									Depth Tested (m)	Number	N Value								
											10	20	30	40		50	60		
0.00		6.262																	
1.00		5.262	Dark brown gravelly SAND with shell fragments. (Beach Sand)	1.00				SPT	1.00-1.45	3									
2.00		4.262	Very loose, greyish fine to coarse SAND with fine to medium gravel. (MARINE DEPOSIT)	1.00				SPT	2.00-2.45	24									
3.00		3.262	Medium dense, whitish, medium to coarse SAND with fine to medium gravel. (MARINE DEPOSIT)	1.00				SPT	3.00-3.45	>50									
5.00		1.262	Very dense, blackish, fine to coarse SAND. (MARINE DEPOSIT)	2.00				SPT	4.00-4.45	>50									
0.50		5.762	Very dense, dark grey, clayey fine to coarse SAND. (MARINE DEPOSIT)	0.50				SPT	5.00-5.45	>50									
6.50		-0.238	Loose, dark grey clayey fine to coarse SAND. (MARINE DEPOSIT)	1.00				SPT	6.00-6.45	8									
8.00		-1.738	Loose, pale greyish, clayey fine to coarse SAND. (MARINE DEPOSIT)	1.50				SPT	7.00-7.45	11									
Legend			GRAVEL/ FILL		Completely weathered rock					Logged by	Checked by								
			SAND, Clayey SAND, Silty SAND		Highly weathered rock					HMMSJ	HMJMKH								
			SILT, Sandy SILT		Moderately weathered rock					SHEET No. 1 of 2									
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock														
Issue : 01				Revision : 00				Date : 26.07.2021											

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



NATURAL RESOURCES MANAGEMENT & LABORATORY SERVICES (NRM&LS)
 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-03

Type of Rig		TONE	Location		Thelawala-Rathmalana	Client		CTI Engineering International Co. Ltd.											
Drilling Method		Rotary	Ground Elevation (MSL)		6.262 m	Date Started		21.07.2021											
Bit Size		NX	X Coordinate		402306.868	Date Finished		22.07.2021											
Casing Diameter		NX	Y Coordinate		478581.559	Drilling Forman		WCD											
Cased Depth		15.00m	Angle of Hole		Vertical	Scale		NTS											
Flushing Medium		Water	Depth of G.W.L		1.70m	Total Depth of Hole		15.45m											
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks				
									Depth Tested (m)	Number	N Value								
											10	20	30	40		50	60		
8.00		-1.738																	
9.00		-2.738	Firm, pale greyish sandy CLAY. Sand is fine to coarse. (MARINE DEPOSIT)	1.00				SPT	9.00-9.45	28									
10.00		-3.738	Very stiff, pale greyish, sandy SILT. Sand is fine to coarse. (MARINE DEPOSIT)	1.00				SPT	10.00-10.45	8									
11.00		-4.738	Firm, pale greyish, sandy SILT. Sand is fine to coarse. (MARINE DEPOSIT)	1.00				SPT	11.00-11.45	15									
15.45		-9.188	Medium dense, grey silty fine to coarse SAND. (COMPLETELY WEATHERED ROCK)	4.45				SPT	12.00-12.45	15									
								SPT	13.00-13.45	16									
								SPT	14.00-14.45	23									
								SPT	15.00-15.45	26									
			<i>Borehole terminated at 15.45m depth</i>																
Legend		GRAVEL/ FILL	Completely weathered rock	Logged by		Checked by													
		SAND, Clayey SAND, Silty SAND	Highly weathered rock	HMMSJ		HMJMKH													
		SILT, Sandy SILT	Moderately weathered rock																
		CLAY, Sandy CLAY	Slightly weathered / Fresh rock																
Issue : 01				Revision : 00				Date : 26.07.2021											

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



NATURAL RESOURCES MANAGEMENT & LABORATORY SERVICES (NRM&LS)
 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
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 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-04

Type of Rig		TONE	Location		Peliyagoda	Client		CTI Engineering International Co. Ltd.											
Drilling Method		Rotary	Ground Elevation (MSL)		1.819 m	Date Started		29.07.2021											
Bit Size		NX	X Coordinate		401568.89	Date Finished		30.07.2021											
Casing Diameter		NX	Y Coordinate		495709.76	Drilling Forman		WCD											
Cased Depth		17.00m	Angle of Hole		Vertical	Scale		NTS											
Flushing Medium		Water	Depth of G.W.L		0.70m	Total Depth of Hole		17.45m											
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks				
									Depth Tested (m)	Number	N Value								
											Graphical Representation								
10	20	30	40	50	60														
0.00		1.819																	
1.00		0.819	Brown sandy CLAY. (Surface Fill)	1.00				SPT	1.00-1.45	0									
3.00		-1.181	Very soft, blackish organic SILT with sand (MARSH DEPOSIT)	2.00				SPT	2.00-2.45	2									
								UDS	2.50-3.00										
4.00		-2.181	Very soft, blackish organic SILT (MARSH DEPOSIT)	1.00				SPT	3.00-3.45	0									
8.00		-6.181	Very soft, black, Peat (MARSH DEPOSIT)	4.00				SPT	4.00-4.45	0									
								SPT	5.00-5.45	0									
								UDS	5.50-6.00										
								SPT	6.00-6.45	0									
								SPT	7.00-7.45	0									
								SPT	8.00-8.45	0									
Legend			GRAVEL/ FILL		Completely weathered rock						Logged by		Checked by						
			SAND, Clayey SAND, Silty SAND		Highly weathered rock						HMMSJ		HMJMKH						
			SILT, Sandy SILT		Moderately weathered rock						SHEET No. 1 of 3								
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock														
Issue : 01				Revision : 00				Date : 02.08.2021											

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



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 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-04

Type of Rig		TONE	Location		Peliyagoda	Client		CTI Engineering International Co. Ltd.															
Drilling Method		Rotary	Reduced Level		1.819 m	Date Started		29.07.2021															
Bit Size		NX	X Coordinate		401568.89	Date Finished		30.07.2021															
Casing Diameter		NX	Y Coordinate		495709.76	Drilling Forman		WCD															
Cased Depth		17.00m	Angle of Hole		Vertical	Scale		NTS															
Flushing Medium		Water	Depth of G.W.L		0.70m	Total Depth of Hole		17.45m															
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks								
									Depth Tested (m)	Number	N Value												
											Graphical Representation												
10	20	30	40	50	60																		
8.00		-6.181																					
9.00		-7.181	Very soft, black, Peat (MARSH DEPOSIT)	1.00				SPT	9.00-9.45	1													
12.00		-10.181	Very soft, black, organic SILT with sand and some decomposed wood fragments (MARSH DEPOSIT)	3.00				SPT	10.00-10.45	0													
								SPT	11.00-11.45	0													
								SPT	12.00-12.45	1													
15.00		-13.181	Very soft, dark grey CLAY with sand (MARSH DEPOSIT)	3.00				SPT	13.00-13.45	3													
								SPT	14.00-14.45	2													
16.00		-14.181	Very loose, grey, clayey fine to medium SAND (MARSH DEPOSIT)	1.00				SPT	15.00-15.45	0													
								SPT	16.00-16.45	8													
Legend			GRAVEL/ FILL		SAND, Clayey SAND, Silty SAND					Completely weathered rock					Logged by	Checked by							
			SILT, Sandy SILT		CLAY, Sandy CLAY					Highly weathered rock					HMMSJ	HMJMKH							
								Moderately weathered rock					SHEET No. 2 of 3										
												Date : 02.08.2021											
Issue : 01				Revision : 00																			

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



NATURAL RESOURCES MANAGEMENT & LABORATORY SERVICES (NRM&LS)
 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
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 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-04

Type of Rig	TONE		Location	Peliyagoda		Client	CTI Engineering International Co. Ltd.										
Drilling Method	Rotary		Reduced Level	1.819 m		Date Started	29.07.2021										
Bit Size	NX		X Coordinate	401568.89		Date Finished	30.07.2021										
Casing Diameter	NX		Y Coordinate	495709.76		Drilling Forman	WCD										
Cased Depth	17.00m		Angle of Hole	Vertical		Scale	NTS										
Flushing Medium	Water		Depth of G.W.L	0.70m		Total Depth of Hole	17.45m										
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks		
									Depth Tested (m)	Number	N Value						
											Graphical Representation						
16.00		-14.181															
17.45		-15.631	Loose, grey clayey fine to medium SAND. (MARSH DEPOSIT)	1.45				SPT	17.00-17.45	6							
			<i>Borehole terminated at 17.45m depth</i>														
Legend			GRAVEL/ FILL		Completely weathered rock					Logged by		Checked by					
			SAND, Clayey SAND, Silty SAND		Highly weathered rock					HMMSJ		HMJMKH					
			SILT, Sandy SILT		Moderately weathered rock					SHEET No. 3 of 3							
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock												
			Issue : 01	Revision : 00					Date : 02.08.2021								

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



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 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-05

Type of Rig		TONE	Location			Dutugemunu Mawatha - Peliyagoda	Client		CTI Engineering International Co. Ltd										
Drilling Method		Rotary	Elevation (MSL)			1,575 m	Date Started		05.08.2021										
Bit Size		NX	X Coordinate			402526.787	Date Finished		17.08.2021										
Casing Diameter		NX	Y Coordinate			495841.022	Drilling Forman		WCD										
Cased Depth		22.2 m	Angle of Hole			Vertical	Scale		NTS										
Flushing Medium		Water	Depth of G.W.L			1.2 m	Total Depth of Hole		25.20m										
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks				
									Depth Tested (m)	Number	N Value								
											Graphical Representation								
10	20	30	40	50	60														
0.00		1.575																	
1.00		0.575	Fill material	1.00					SPT	1.00-1.45	2								
4.00		-2.425	Very soft, yellowish brown sandy CLAY. (ALLUVIAL DEPOSIT)	3.00					SPT	2.00-2.45	2								
									SPT	3.00-3.45	1								No sample recovered
									UDS	3.60-4.00									
									SPT	4.00-4.45	12								
7.00		-5.425	Medium dense, brownish fine to coarse SAND. (ALLUVIAL DEPOSIT)	3.00					SPT	5.00-5.45	16								
									SPT	6.00-6.45	13								
8.00		-6.425	Medium dense, greyish fine to medium SAND. (ALLUVIAL DEPOSIT)	1.00					SPT	7.00-7.45	10								
									SPT	8.00-8.45	12								
Legend			GRAVEL/ FILL		Completely weathered rock				Logged by		Checked by								
			SAND, Clayey SAND, Silty SAND		Highly weathered rock				HMMSJ		HMJMKH								
			SILT, Sandy SILT		Moderately weathered rock														
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock														
				Issue : 01				Revision : 00				Date : 19.08.2021							

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



NATURAL RESOURCES MANAGEMENT & LABORATORY SERVICES (NRM&LS)
 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-05

Type of Rig		TONE		Location		Dutugemunu Mawatha - Peliyagoda		Client		CTI Engineering International Co. Ltd												
Drilling Method		Rotary		Reduced Level		1.575 m		Date Started		05.08.2021												
Bit Size		NX		X Coordinate		402526.787		Date Finished		17.08.2021												
Casing Diameter		NX		Y Coordinate		495841.022		Drilling Forman		WCD												
Cased Depth		22.2 m		Angle of Hole		Vertical		Scale		NTS												
Flushing Medium		Water		Depth of G.W.L		1.2 m		Total Depth of Hole		25.20m												
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test					Remarks								
									Depth Tested (m)	Number	N Value											
											Graphical Representation											
10	20	30	40	50	60																	
8.00		-6.425																				
9.00		-7.425	Medium dense, greyish fine to medium SAND. (ALLUVIAL DEPOSIT)	1.00				SPT	9.00-9.45	16												
								SPT	10.00-10.45	12												
			Medium dense, dark grey fine to medium SAND. (ALLUVIAL DEPOSIT)	3.00				SPT	11.00-11.45	27												
12.00		-10.425						SPT	12.00-12.45	>50												
								SPT	13.00-13.45	>50												
			Very dense, greyish brown fine to medium SAND. (ALLUVIAL DEPOSIT)	3.00				SPT	14.00-14.45	50												
15.00		-13.425						SPT	15.00-15.45	21												
								SPT	16.00-16.45	>50												
16.00		-14.425	Medium dense, brownish fine to coarse SAND. (ALLUVIAL DEPOSIT)	1.00																		
Legend		GRAVEL/ FILL		Completely weathered rock		Logged by		Checked by														
		SAND, Clayey SAND, Silty SAND		Highly weathered rock		HMMSJ		HMJMKH														
		SILT, Sandy SILT		Moderately weathered rock		SHEET No. 2 of 4																
		CLAY, Sandy CLAY		Slightly weathered / Fresh rock																		
Issue : 01				Revision : 00				Date : 19.08.2021														

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



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 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-05

Type of Rig		TONE	Location				Dutugemunu Mawatha - Peliyagoda	Client		CTI Engineering International Co. Ltd										
Drilling Method		Rotary	Reduced Level				1.575 m	Date Started		05.08.2021										
Bit Size		NX	X Coordinate				402526.787	Date Finished		17.08.2021										
Casing Diameter		NX	Y Coordinate				495841.022	Drilling Forman		WCD										
Cased Depth		22.2 m	Angle of Hole				Vertical	Scale		NTS										
Flushing Medium		Water	Depth of G.W.L				1.2 m	Total Depth of Hole		25.20m										
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test					Remarks						
									Depth Tested (m)	Number	N Value									
											Graphical Representation									
10	20	30	40	50	60															
16.00		-14.425																		
			Medium dense, brownish, fine to coarse SAND. (ALLUVIAL DEPOSIT)	4.00				SPT	17.00-17.45	20										
			Medium dense, greyish brown fine to coarse SAND with some fine to medium gravels. (ALLUVIAL DEPOSIT)	1.00				SPT	18.00-18.45	16										
			Medium dense, yellowish fine to coarse SAND with some fine gravel. (COMPLETELY WEATHERED ROCK)	1.00				SPT	19.00-19.45	14										
20.00		-18.425						SPT	20.00-20.45	26										
21.00		-19.425						SPT	21.00-21.45	29										
22.00		-20.425						SPT	22.00-22.45	>50										
22.20		-20.625	Very dense, greyish brown fine to coarse SAND with weathered rock fragments	0.20				Rock	22.20-23.20											
23.20		-21.625	Highly to completely weathered rock	1.00	0	0		Rock	23.20-24.20											
24.20		-22.625	Moderately weathered, grey, narrowly foliated, medium to coarse grained Biotite GNEISS. Very closely spaced fractures dipping at 60-80°, planar rough fracture surfaces with pale grey surface staining	1.00	53	0		Rock												
Legend			GRAVEL/ FILL		Completely weathered rock					Logged by		Checked by								
			SAND, Clayey SAND, Silty SAND		Highly weathered rock					HMMSJ		HMJMKH								
			SILT, Sandy SILT		Moderately weathered rock					SHEET No. 3 of 4										
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock															
Issue : 01				Revision : 00				Date : 19.08.2021												

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



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 No.11, Jawatte Road,
 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-05

Type of Rig	TONE		Location	Dutugemunu Mawatha - Peliyagoda		Client	CTI Engineering International Co. Ltd												
Drilling Method	Rotary		Reduced Level	1.575 m		Date Started	05.08.2021												
Bit Size	NX		X Coordinate	402526.787		Date Finished	17.08.2021												
Casing Diameter	NX		Y Coordinate	495841.022		Drilling Forman	WCD												
Cased Depth	22.2 m		Angle of Hole	Vertical		Scale	NTS												
Flushing Medium	Water		Depth of G.W.L	1.2 m		Total Depth of Hole	25.20m												
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks				
									Depth Tested (m)	Number	N Value								
											Graphical Representation								
											10	20	30	40		50	60		
24.20		-22.625																	
25.20	////	-23.625	Moderately to highly weathered, grey, narrowly foliated, medium to coarse grained Biotite GNEISS. Very closely spaced fractures dipping at 60-80°, planar rough fracture surfaces with pale grey surface staining	1.00	23	0													
			<i>Borehole terminated at 25.20m depth</i>																
Legend			GRAVEL/ FILL		Completely weathered rock						Logged by	Checked by							
			SAND, Clayey SAND, Silty SAND		Highly weathered rock						HMMSJ	HMJMKH							
			SILT, Sandy SILT		Moderately weathered rock						SHEET No. 4 of 4								
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock														
Issue : 01				Revision : 00				Date : 19.08.2021											

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



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 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-06

Type of Rig		TONE	Location		Peliyagoda	Client		CTI Engineering International Co. Ltd.											
Drilling Method		Rotary	Elevation (MSL)		1.730 m	Date Started		15.09.2021											
Bit Size		NX	X Coordinate		402508.512	Date Finished		06.10.2021											
Casing Diameter		NX	Y Coordinate		495849.945	Drilling Forman		WCD											
Cased Depth		21.70 m	Angle of Hole		Vertical	Scale		NTS											
Flushing Medium		Bentonite	Depth of G.W.L		0.5 m	Total Depth of Hole		24.70 m											
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks				
									Depth Tested (m)	Number	N Value								
											10	20	30	40		50	60		
0.00		1.73																	
1.00		0.73	Clayey SAND with gravel and cobbles (Fill Material)	1.00															
2.00		-0.27	Firm, yellowish brown sandy CLAY. (ALLUVIAL DEPOSIT)	1.00				SPT	1.00-1.45	6									
3.00		-1.27	Very soft, grey sandy CLAY. (ALLUVIAL DEPOSIT)	1.00				SPT	2.00-2.45	1									
5.40		-3.67	Very soft, dark brown, Sandy organic SILT (ALLUVIAL DEPOSIT)	2.40				SPT	3.00-3.45	1									
								UDS	3.50-4.00										
								SPT	4.00-4.45	1									
								SPT	5.00-5.45	1									
8.00		-6.27	Loose to medium dense, grey fine to coarse SAND. (ALLUVIAL DEPOSIT)	2.60				SPT	6.00-6.45	11									
								SPT	7.00-7.45	8									
								SPT	8.00-8.45	11									
Legend			GRAVEL/ FILL		Completely weathered rock						Logged by		Checked by						
			SAND, Clayey SAND, Silty SAND		Highly weathered rock						HMMSJ		HMJMKH						
			SILT, Sandy SILT		Moderately weathered rock						SHEET No. 1 of 4								
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock														
Issue : 01				Revision : 00				Date : 07.10.2021											

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



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 CENTRAL ENGINEERING CONSULTANCY BUREAU (CECB)
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 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-06

Type of Rig		TONE	Location		Peliyagoda	Client		CTI Engineering International Co. Ltd.											
Drilling Method		Rotary	Reduced Level		1.730 m	Date Started		15.09.2021											
Bit Size		NX	X Coordinate		402508.512	Date Finished		06.10.2021											
Casing Diameter		NX	Y Coordinate		495849.945	Drilling Forman		WCD											
Cased Depth		21.70 m	Angle of Hole		Vertical	Scale		NTS											
Flushing Medium		Water	Depth of G.W.L		0.5 m	Total Depth of Hole		24.70 m											
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test						Remarks				
									Depth Tested (m)	Number	N Value								
											10	20	30	40		50	60		
16.00		-14.27																	
			Medium dense, brown, medium to coarse SAND. (ALLUVIAL DEPOSIT)	3.00				SPT	17.00-17.45	15									
19.00		-17.27						SPT	18.00-18.45	17									
			Very dense, brown, medium to coarse SAND. (ALLUVIAL DEPOSIT)	1.00				SPT	19.00-19.45	>50								Hammer bounced	
20.00		-18.27						SPT	20.00-20.45	>50									Hammer bounced
			Very dense, greyish, medium to coarse SAND. (ALLUVIAL DEPOSIT)	1.00				SPT	21.00-21.45	>50									Hammer bounced
21.00		-19.27						SPT	21.00-21.45	>50									Hammer bounced
			Very dense, yellowish brown, silty SAND. (COMPLETELY WEATHERED ROCK)	0.70				SPT / ROCK	21.70	>50									Hammer bounced
21.70		-19.97			0	0		SPT / ROCK	21.70	>50									Hammer bounced
			Highly Weathered Rock	2.00	0	0		SPT / ROCK	22.70	>50									Hammer bounced
23.70																			
Legend			GRAVEL/ FILL		Completely weathered rock					Logged by		Checked by							
			SAND, Clayey SAND, Silty SAND		Highly weathered rock					HMMSJ		HMJMKH							
			SILT, Sandy SILT		Moderately weathered rock					SHEET No. 3 of 4									
			CLAY, Sandy CLAY		Slightly weathered / Fresh rock														
Issue : 01				Revision : 00				Date : 07.10.2021											

Code : CECB Drilling / Drill Hole Log

BOREHOLE LOG



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 Colombo 05.

Geotechnical Investigation at the Mudun Ela Sub Basin and Moratuwa-Rathmalana Area

BOREHOLE NO: BH-06

Type of Rig	TONE		Location	Peliyagoda		Client	CTI Engineering International Co. Ltd.								
Drilling Method	Rotary		Reduced Level	1.730 m		Date Started	15.09.2021								
Bit Size	NX		X Coordinate	402508.512		Date Finished	06.10.2021								
Casing Diameter	NX		Y Coordinate	495849.945		Drilling Forman	WCD								
Cased Depth	21.70 m		Angle of Hole	Vertical		Scale	NTS								
Flushing Medium	Water		Depth of G.W.L	0.5 m		Total Depth of Hole	24.70 m								
Depth (m)	Mosaic Log	Reduced Level (m)	Description	Layer Thickness (m)	Total Core Recovery (%)	R.Q.D (%)	Fracture Frequency (per m)	Type of Sample / Test	Standard Penetration Test					Remarks	
									Depth Tested (m)	Number	N Value				
											Graphical Representation				
23.70		-21.97													
			Highly weathered, grey, intensely fractured Biotite gneiss	1.00	10	0		Rock	23.70-24.70						
24.70		-22.97													
			<i>Borehole terminated at 24.70m depth</i>												
Legend			GRAVEL/ FILL	Completely weathered rock					Logged by	Checked by					
			SAND, Clayey SAND, Silty SAND	Highly weathered rock					HMMSJ	HMJMKH					
			SILT, Sandy SILT	Moderately weathered rock					SHEET No. 4 of 4						
			CLAY, Sandy CLAY	Slightly weathered / Fresh rock											
Issue : 01				Revision : 00					Date : 07.10.2021						

Code : CECB Drilling / Drill Hole Log