2011

PHE-Design Report for Railway Coach Factory –Lalganj, Raebareli

This document contains information about concept, design and highlight of PHE services of Rail coach factory at Lalganj.

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Introduction

Rail Coach Factory Raebareli

A modern factory For World Class Manufacturing Of Railways Coaches, with state of the art facilities, incorporating best international practices for assured quality & productivity.

Design to built an eco-friendly township with full social infrastructure including housing, schools, hospital & dispensaries, ecological park, recreational facilities, shopping complex etc

An overview of the project

Sanctioned cost	1685 Cr
Capacity	1000 coaches
Land requirement	544 Ha
Factory	172 Ha
Township	353 Ha
Rail connectivity	19 Ha
Employment potential	4000-5000 (direct) + ancillaries

Baseline conditions & constraints

Storm water

1. Watershed lies in catchment of rain drain flowing from South/ South East to North West passing through the said watershed, Land has slope towards drain due to erosion from storm water runoff.
   Natural Storm drain has bed level from 94.8 to 94.25 near end of RCF area Highest Flood Level, HFL reported is 1.2 M (level 94.8) at culvert of Lalganj, Raebareli Road. Culvert size 3 x 4.2 (photo attached)

   Reported Maximum flow rate through weir at road culvert, considering 250 mm of water head, is 40 KL/min

2. It has been planned to realign & hydraulic re design the natural drain for safe disposal of rain water from factory area.

3. Preferred levels for formation were decided, 98.3 for shed and 97.8 for roads. Since minimum cutting and filling is required at 98.3 for FFL of working shed & 97.8 FFL of road, thus these levels have been frozen by Management of M/s. IRCON International Ltd.

4. Natural Storm water drainage is to be redesigned to have minimal possible HFL at 150% of present estimated discharge, so as outfall of internal storm water drains falls more than 1 m above from HFL.

Water supply

5. Water supply for RCF-RBL should meet the requirements of 7500 person, in absence of final figures (demand & quantity at various utility areas) from M/s. IRCON International Ltd. following distribution is considered for calculation of water supply:

   a. 1000 person in administrative building
   b. 2000 person each in all remain 3 sheds
   c. 500 persons at various locations

6. Total demand required by the RCF-RBL, as documented at site was 6 lac lts /day.

7. One overhead tank was found under construction with 20M staging and 3 Lac Litres storage capacity.

8. One bore well has been constructed at the site with depth of nearly 500m from NGL to supply 2000 LPM (as per Jal Nigam design)

Sewer and its disposal

9. It is found in proposed layout plan of factory that area of maximum discharge is on one side of roads, i.e. in shed area and near administration block.

10. M/s. IRCON international Ltd., is looking for treated waste water disposal for irrigation area and if excess it is required to disposed into the realigned drain.

Design Objectives

The following objectives are set for designing of services for RCF-RBL at Lalganj:

1. Attaining the final Formation levels for working sheds and roads,(freeze levels for formation are 98.3 for shed and 97.8 for roads.)

2. Designing of storm water disposal systems with self-cleaning velocity within the provided constrains.

3. Designing of realigned natural storm water drain so as that minimum fall of internal Strom drain & maximum Projected HFL should be minimum 500 mm, for safe & smooth operation during the heavy rain

4. Layout and designing water supply system as per norms laid down by CPHEEO

5. Design and Layout of sewer & water disposal system, with identification of possible recommended technologies.

The Information Provided By The IRCON Is As Under:

1. The soft copy of Topographical survey plan.
2. Soil test report of Workshop as provided by the railways.
3. Bore log and detailed provided by UP Jal Nigam.
4. No. of workers – 7500 for 12 hrs.
5. Water supply requirement for RAF is 337500Lts per day,
6. One overhead tank of 500000 Lts capacity is being constructed at site.

Parameter Selected For the Services Designing As Per the NBC & CPHEEO,

{Ministry of urban development. (Clause 5.2.51 table No 10 part 9 of NBC)}**:**

1. No of WC will be counted as
    a) For men over 200 person 6 +2.5% of targeted population
    b) For women over 200 person 6 +4% of targeted population

2. No of Urinal seat will be counted as
    a) For men over 200 person 6 +2.5% of targeted population
    b) For women over 200 person 6 +4% of targeted population

3. Water requirement will be 900 Lt/WC & 350 Lt/ urinal seat.

4. Total water supply to factory will be computed on the basis of 45 Liter per head.

5. Rain intensity for runoff calculation – 20mm/ hr to 50 mm/hr.. (as per guidelines in manual on sewerage & sewage treatment, second edition, CPHEEO, Ministry of urban development.)

6. Velocity of water in storm water drain will be equal or more than 0.8 m/s but not more than 2 m/s.

7. Velocity in sewer drain shall be more than 0.7 @ half full but not more than 2m/s., minimum pipe size 150 mm,

8. Velocity in drinking water lines at peak should reach 0.65 M/s.

9. Water Conduit, shall be only circular pipes and covered.

10. Storm water management will sub divided into micro zones as per the site plan, excess runoff after rainwater harvesting, will be transport to next micro zone till it reach to natural or realigned storm zone. There shall be escape plan for disposal of storm water without ground water recharging.

11. Disposal of storm water shall be primarily to ground water aquifers, only excess water will be sent to storm water drainage.

12. Natural storm water drain will be aligned as per the requirement of RCF.

13. Water supply will be via overhead tank/s of required staging & as per guidelines of CPHEEO, Ministry of urban development.

14. Water supply shall be of grid & loop type
15. Sewer lines will design as per NBC and CPHEEO.
16. Required pressure for fire hydrant is to be achieved by gravity

Salient Feature of Drinking water

As all the water supply required (as per layout) on one side of road

A single loop / grid system is designed. Please refer to attached drawing & section/ with provision for garden hydrant

Summarized details of water supply network

Material of construction	Ductile Iron Type K-9 confirming to IS 3589-2001
Joint type	Push on
Typical depth of Vertex of pipe	1000 mm below NGL
Network type	Loop with radial branch lines
Minimum residual pressure	4.2 Bar can be utilized for Fire fighting
Overhead tanks	Total 3 OHT 1 Capacity 800000 Lt OHT 2 capacity 300000 Lt OHT 3 capacity 800000 Lt
Water supply Bore well required	Bore well located at various point of supply Grid total pumping capacity 60, 000, 00 Lt per day 6; three working three standbys Pumping capacity @ 2000 LPM each
Pipes:	67
Flow Demands Out:	3.450 m^3/min

System Volume: 159.378 m^3 (does not include any closed pipes)

Total Friction Losses in all pipes is: 53.03 m.hd

Lowest Pressure at any node is: 0.000391 bar (N1)

Highest Pressure at any node is: 4.402492 bar (N6)

Highest Elevation of any node is: 45.000 m (N1)

Please Refer to Annexure I for details

Salient Feature of Sewer line

As the case of water supply waste water will be generated the same bank thus sewer is also planned on the same side (please refer to attached drawing and section)

- To make system more flexible for maintenance it is recommended to have cleanout manhole at maximum distance of 30 m
- System is designed for minimum velocity of 0.7 m/s in SWR pipe. System is designed @ ½ full for dia less than 300 mm and 2/3 @ more than 300 mm
- Maximum sewer life in system is 0.5 hr. which well below the required requirement for India.

Summarized details of Sewer network

Material of construction	Glazed Stone ware pipe confirm to IS
Joint type	S&S type
Minimum depth of Vertex of pipe	500 mm below NGL
Network type	dendrite layout
Minimum velocity @ half full	0.65 m/s
Maximum sewer life	0.75 Hr. At peak flow

Refer to attached Annexure II

Salient Feature of Storm drain (internal)

All drain will carry water to discharge point without rain water recharging

Maximum length of drain is	1750 M
Initial water flow at start point	11 KL/min
Velocity required	1 m/s
Increment of water flow per 24 m of shed (24x40x.02x 0.9) = 3 KL/Min	3 KL/min

At all insertion zone thus it is recommended to change slope at 24 m to minimize the size and maximize the flow rate to achieve minimum drop in invert section of drains attached herewith

Maximum drop is 96.19, which is safe is as per requirement.

For detailed analysis please refer to attached Annexure III

Salient Feature of Realigned Strom Drain:

1. Since drain has HFL of 1.2 m from bed of culvert, section of 3 m, considering head of 250 mm at weir Maximum discharge is 40KL/min

2. To attain the maximum velocity and at given drop and minimum possible sections & HFL (design) following V= .712 m/s
Outcome is

Width of drain	= 10000	mm
Left bank	= 1000	mm
Right bank	=1000	mm
Depth of water	=300	mm
Wetted perimeter	=10632	mm
Maximum flood level @ 50% increment of runoff due to possible runoff increment in catchment area	=95.2	
Total drop in drain	= 457	mm

Annexure 1

Design of Water supply

Material	Inner Diameter	Length	Mass Flow	Flow	Velocity	Entry Pressure	Exit Pressure	Entry/Exit Diff	Reynolds Number	Flow Type	Friction Factor	Friction Loss
	mm	m	kg/min	m^3/min	m/sec	m.H2O	m.H2O	m.H2O				m.hd
3" I/D GI Pipe class B as per IS 3589-2001	76.2	222.433	184.63	0.185	0.676	42.375	40.645	1.73	51314	Turbulent	0.025	1.733
3" I/D GI Pipe class B as per IS 3589-2001	76.2	104.7	184.63	0.185	0.676	43.189	42.375	0.814	51314	Turbulent	0.025	0.816
3" I/D GI Pipe class B as per IS 3589-2001	76.2	222.4	184.63	0.185	0.676	43.189	41.459	1.73	51314	Turbulent	0.025	1.733
4" I/D DI pipe Type K-9 as per IS 8329/2000	101.6	123.2	369.26	0.37	0.761	44.023	43.189	0.834	76971	Turbulent	0.023	0.836
4" I/D DI pipe Type K-9 as per IS 8329/2000	101.6	410	245.508	0.246	0.506	44.023	42.738	1.285	51176	Turbulent	0.024	1.288
4" I/D DI pipe Type K-9 as per IS 8329/2000	101.6	55.682	122.754	0.123	0.253	42.738	42.69	0.048	25588	Turbulent	0.027	0.048
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	213.24	488.2872	0.489	0.251	44.023	43.946	0.077	50891	Turbulent	0.023	0.077
6" I/D DI pipe Type K-9 as per IS 8329/2000	152.4	199.352	413.4294	0.414	0.378	43.946	43.727	0.219	57452	Turbulent	0.023	0.22
6" I/D DI pipe Type K-9 as per IS 8329/2000	152.4	219.8	268.0523	0.269	0.245	43.727	43.619	0.109	37250	Turbulent	0.025	0.109
6" I/D DI pipe Type K-9 as per IS 8329/2000	152.4	305.26	268.0523	0.269	0.245	43.619	43.468	0.151	37250	Turbulent	0.025	0.151
3" I/D GI Pipe class B as per IS 3589-2001	76.2	48.77	368.262	0.369	1.349	43.468	42.049	1.419	102351	Turbulent	0.024	1.422
3" I/D GI Pipe class B as per IS 3589-2001	76.2	70.2	368.262	0.369	1.349	43.468	41.425	2.043	102351	Turbulent	0.024	2.047

3" I/D GI Pipe class B as per IS 3589-2001	76.2	301.07	368.262	0.369	1.349	41.425	32.663	8.762	102351	Turbulent	0.024	8.78
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	58.34	468.4717	0.469	0.241	43.487	43.468	0.02	48826	Turbulent	0.023	0.02
3" I/D GI Pipe class B as per IS 3589-2001	76.2	48.7	368.262	0.369	1.349	43.487	42.07	1.417	102351	Turbulent	0.024	1.42
3" I/D GI Pipe class B as per IS 3589-2001	76.2	69.84	368.262	0.369	1.349	43.487	41.455	2.032	102351	Turbulent	0.024	2.036
3" I/D GI Pipe class B as per IS 3589-2001	76.2	360.48	368.262	0.369	1.349	41.455	30.966	10.489	102351	Turbulent	0.024	10.51
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	367.6	1204.9957	1.207	0.621	44.74	43.487	1.253	125589	Turbulent	0.02	0.717
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	40.48	1204.9957	1.207	0.621	44.819	44.74	0.079	125589	Turbulent	0.02	0.079
10" I/D DI pipe Type K-9 as per IS 8329/2000	254	93.3	1547.0555	1.55	0.51	0.004	44.819	-44.815	128992	Turbulent	0.02	0.095
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	179	342.0598	0.343	0.176	44.819	44.785	0.034	35651	Turbulent	0.024	0.034
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	364.5	593.143	0.594	0.305	44.785	44.597	0.188	61820	Turbulent	0.022	0.189
3" I/D GI Pipe class B as per IS 3589-2001	76.2	66.702	184.63	0.185	0.676	44.597	44.078	0.519	51314	Turbulent	0.025	0.52
3" I/D GI Pipe class B as per IS 3589-2001	76.2	357.8	184.63	0.185	0.676	44.078	41.295	2.783	51314	Turbulent	0.025	2.788
3" I/D GI Pipe class B as per IS 3589-2001	76.2	40.1	184.63	0.185	0.676	44.597	44.285	0.312	51314	Turbulent	0.025	0.313
3" I/D GI Pipe class B as per IS 3589-2001	76.2	357.5	184.63	0.185	0.676	44.285	41.504	2.781	51314	Turbulent	0.025	2.786
6" I/D DI pipe Type K-9 as per IS 8329/2000	152.4	64.3	223.883	0.224	0.205	44.597	43.678	0.919	31112	Turbulent	0.025	0.023
3" I/D GI Pipe class B as per IS 3589-2001	76.2	66.1	184.63	0.185	0.676	43.678	43.164	0.514	51314	Turbulent	0.025	0.515
3" I/D GI Pipe class B as per IS 3589-2001	76.2	298.1	184.63	0.185	0.676	43.164	40.846	2.318	51314	Turbulent	0.025	2.323
3" I/D GI Pipe class B as per IS 3589-2001	76.2	60.87	184.63	0.185	0.676	43.678	43.205	0.473	51314	Turbulent	0.025	0.474
3" I/D GI Pipe class B as per IS 3589-2001	76.2	298	184.63	0.185	0.676	43.205	40.887	2.318	51314	Turbulent	0.025	2.322
6" I/D DI pipe Type K-9 as per IS 8329/2000	152.4	303	145.377	0.146	0.133	43.727	43.678	0.049	20202	Turbulent	0.028	0.049

8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	199.37	251.0831	0.252	0.129	44.706	44.785	-0.079	26169	Turbulent	0.026	0.021
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	220.7	663.6621	0.665	0.342	44.706	44.566	0.14	69169	Turbulent	0.022	0.141
3" I/D GI Pipe class B as per IS 3589-2001	77.673	51.3	184.63	0.185	0.651	44.566	44.191	0.374	50341	Turbulent	0.026	0.375
3" I/D GI Pipe class B as per IS 3589-2001	76.2	213.9	184.63	0.185	0.676	44.191	42.528	1.664	51314	Turbulent	0.025	1.667
6" I/D DI pipe Type K-9 as per IS 8329/2000	152.4	55.3	479.0321	0.48	0.439	44.566	44.486	0.08	66569	Turbulent	0.023	0.08
3" I/D GI Pipe class B as per IS 3589-2001	76.2	50.99	184.63	0.185	0.676	44.486	44.089	0.397	51314	Turbulent	0.025	0.397
3" I/D GI Pipe class B as per IS 3589-2001	76.2	452.2	184.63	0.185	0.676	44.089	40.572	3.517	51314	Turbulent	0.025	3.524
6" I/D DI pipe Type K-9 as per IS 8329/2000	152.4	89.5	294.4021	0.295	0.27	44.486	44.433	0.053	40912	Turbulent	0.024	0.053
3" I/D GI Pipe class B as per IS 3589-2001	76.2	56.7	184.63	0.185	0.676	44.433	43.992	0.441	51314	Turbulent	0.025	0.442
3" I/D GI Pipe class B as per IS 3589-2001	76.2	358.85	184.63	0.185	0.676	43.992	41.201	2.791	51314	Turbulent	0.025	2.797
6" I/D DI pipe Type K-9 as per IS 8329/2000	152.4	62.02	109.7721	0.11	0.1	44.433	43.931	0.502	15255	Turbulent	0.029	0.006
3" I/D GI Pipe class B as per IS 3589-2001	76.2	56.68	184.63	0.185	0.676	43.931	43.49	0.441	51314	Turbulent	0.025	0.442
3" I/D GI Pipe class B as per IS 3589-2001	76.2	299.42	184.63	0.185	0.676	43.49	41.162	2.329	51314	Turbulent	0.025	2.333
6" I/D DI pipe Type K-9 as per IS 8329/2000	152.4	304.425	74.8579	0.075	0.069	43.946	43.931	0.015	10403	Turbulent	0.032	0.015
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	123.2	914.7453	0.917	0.471	44.849	44.706	0.143	95338	Turbulent	0.021	0.143
6" I/D DI pipe Type K-9 as per IS 8329/2000	152.4	199.79	308.6994	0.309	0.283	44.977	44.849	0.128	42898	Turbulent	0.024	0.128
10" I/D DI pipe Type K-9 as per IS 8329/2000	254	36.642	1965.6446	1.97	0.648	0.004	44.977	-44.973	163894	Turbulent	0.019	0.059
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	19.5	1656.9452	1.66	0.853	44.977	44.907	0.069	172693	Turbulent	0.02	0.07
3" I/D GI Pipe class B as per IS 3589-2001	76.2	80.42	184.63	0.185	0.676	44.907	44.282	0.625	51314	Turbulent	0.025	0.627

3" I/D GI Pipe class B as per IS 3589-2001	76.2	212.58	184.63	0.185	0.676	44.282	42.628	1.653	51314	Turbulent	0.025	1.657
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	32.9	1472.3152	1.475	0.758	44.907	44.814	0.094	153450	Turbulent	0.02	0.094
3" I/D GI Pipe class B as per IS 3589-2001	76.2	80.229	184.63	0.185	0.676	44.814	44.19	0.624	51314	Turbulent	0.025	0.625
3" I/D GI Pipe class B as per IS 3589-2001	76.2	473.53	184.63	0.185	0.676	44.19	40.507	3.683	51314	Turbulent	0.025	3.69
3" I/D GI Pipe class B as per IS 3589-2001	76.2	19.8	184.63	0.185	0.676	44.814	44.66	0.154	51314	Turbulent	0.025	0.154
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	479.815	1103.0552	1.105	0.568	44.814	44.023	0.79	114965	Turbulent	0.02	0.792
8" I/D DI pipe Type K-9 as per IS 8329/2000	203.2	63.78	606.0459	0.607	0.312	44.883	44.849	0.034	63164	Turbulent	0.022	0.034
10" I/D DI pipe Type K-9 as per IS 8329/2000	254	92.376	851.5539	0.853	0.281	0.004	44.883	-44.879	71002	Turbulent	0.021	0.031
4" I/D DI pipe Type K-9 as per IS 8329/2000	101.6	107	245.508	0.246	0.506	44.883	44.548	0.335	51176	Turbulent	0.024	0.336
4" I/D DI pipe Type K-9 as per IS 8329/2000	101.6	236.089	122.754	0.123	0.253	44.548	44.343	0.205	25588	Turbulent	0.027	0.205

Annexure II

Design of sewer system

Total Area	75	Ha
Water Supply	6000	Kl
Expected Sewage Generated Per Hectare	33.33	LPM

for catchment area Trunk line

Line Element no	starting point	End at manhole No.	Expected Sewage Generated Per Hectare	Catchment Area in Hectare	Estimated discharge in LPM	Estimated flow at in LPM	Design flow in LPM	Pipe size in Inches	Slope ratio	Length of pipeline in Meter	Level of pipeline at starting point in M from NGL	Level of pipeline at end point from NGL	Design Velocity when half full in m/s	Slope 1 in
SL 1.1	MH-1.1	MH-1.2	33.33	**1.86**	92.95	92.95	680.85	8"	0.00440	30.00	-0.90	-1.03	0.7	227
SL 1.2	MH-1.2	MH-1.3	33.33	0.28	13.93	106.87	680.85	8"	0.00440	30.00	-1.03	-1.16	0.7	227
SL 1.3	MH-1.3	MH-1.4	33.33	0.28	13.93	120.80	680.85	8"	0.00440	30.00	-1.16	-1.30	0.7	227
SL 1.4	MH-1.4	MH-1.5	33.33	0.28	13.93	134.72	680.85	8"	0.00440	30.00	-1.30	-1.43	0.7	227
SL 1.5	MH-1.5	MH-1.6	33.33	0.28	13.93	148.65	680.85	8"	0.00440	30.00	-1.43	-1.56	0.7	227
SL 1.6	MH-1.6	MH-1.7	33.33	0.28	13.93	162.57	680.85	8"	0.00440	30.00	-1.56	-1.69	0.7	227
SL 1.7	MH-1.7	MH-1.8	33.33	0.28	13.93	176.50	680.85	8"	0.00440	30.00	-1.69	-1.82	0.7	227
SL 1.8	MH-1.8	MH-1.9	33.33	0.28	13.93	190.42	680.85	8"	0.00440	30.00	-1.82	-1.96	0.7	227
SL 1.9	MH-1.9	MH-1.10	33.33	0.28	13.93	204.35	680.85	8"	0.00440	30.00	-1.96	-2.09	0.7	227
SL 1.10	MH-1.10	MH-1.11	33.33	0.28	13.93	218.27	680.85	8"	0.00440	30.00	-2.09	-2.22	0.7	227
SL 1.11	MH-1.11	MH-1.12	33.33	0.28	13.93	232.20	680.85	8"	0.00440	30.00	-2.22	-2.35	0.7	227
SL 1.12	MH-1.12	MH-1.13	33.33	0.28	13.93	246.12	680.85	8"	0.00440	30.00	-2.35	-2.48	0.7	227
SL 1.13	MH-1.13	MH-1.14	33.33	0.28	13.93	260.05	680.85	8"	0.00440	30.00	-2.48	-2.62	0.7	227
SL 1.14	MH-1.14	MH-1.15	33.33	0.28	13.93	273.97	680.85	8"	0.00440	30.00	-2.62	-2.75	0.7	227

SL 1.15	MH-1.15	MH-1.16	33.33	0.28	13.93	287.90	680.85	8"	0.00440	30.00	-2.75	-2.88	0.7	227
SL 1.16	MH-1.16	MH-1.17	33.33	0.28	13.93	301.82	680.85	8"	0.00440	30.00	-2.88	-3.01	0.7	227
SL 1.17	MH-1.17	MH-1.18	33.33	0.28	13.93	315.75	680.85	8"	0.00440	30.00	-3.01	-3.14	0.7	227
SL 1.18	MH-1.18	MH-1.19	33.33	0.28	13.93	329.67	680.85	8"	0.00440	30.00	-3.14	-3.27	0.7	227
SL 1.19	MH-1.19	MH-1.20	33.33	0.28	13.93	343.60	680.85	8"	0.00440	30.00	-3.27	-3.41	0.7	227
SL 1.20	MH-1.20	MH-1.21	33.33	0.28	13.93	357.52	680.85	8"	0.00440	30.00	-3.41	-3.54	0.7	227
SL 1.21	MH-1.21	MH-1.22	33.33	0.28	13.93	371.45	680.85	8"	0.00440	30.00	-3.54	-3.67	0.7	227
SL 1.22	MH-1.22	MH-1.23	33.33	0.28	13.93	385.37	680.85	8"	0.00440	25.00	-3.67	-3.78	0.7	227
SL 1.23	MH-1.23	MH-1.24	33.33	0.28	13.93	399.30	680.85	8"	0.00440	25.00	-3.78	-3.89	0.7	227
SL 1.24	MH-1.24	MH-1	33.33	0.28	13.93	413.22	680.85	8"	0.00440	20.00	-3.89	-3.98	0.7	227
SL 2.1	MH-2.1	MH-2.2	33.33	**3.05**	152.32	152.32	680.85	8"	0.00440	30.00	-0.90	-1.03	0.7	227
SL 2.2	MH-2.2	MH-2.3	33.33	0.44	22.20	174.52	680.85	8"	0.00440	30.00	-1.03	-1.16	0.7	227
SL 2.3	MH-2.3	MH-2.4	33.33	0.44	22.20	196.73	680.85	8"	0.00440	30.00	-1.16	-1.30	0.7	227
SL 2.4	MH-2.4	MH-2.5	33.33	0.44	22.20	218.93	680.85	8"	0.00440	30.00	-1.30	-1.43	0.7	227
SL 2.5	MH-2.5	MH-2.6	33.33	0.44	22.20	241.13	680.85	8"	0.00440	30.00	-1.43	-1.56	0.7	227
SL 2.6	MH-2.6	MH-2.7	33.33	0.44	22.20	263.34	680.85	8"	0.00440	30.00	-1.56	-1.69	0.7	227
SL 2.7	MH-2.7	MH-2.8	33.33	0.44	22.20	285.54	680.85	8"	0.00440	30.00	-1.69	-1.82	0.7	227
SL 2.8	MH-2.8	MH-2.9	33.33	0.44	22.20	307.74	680.85	8"	0.00440	30.00	-1.82	-1.96	0.7	227
SL 2.9	MH-2.9	MH-2.10	33.33	0.44	22.20	329.95	680.85	8"	0.00440	30.00	-1.96	-2.09	0.7	227
SL 2.10	MH-2.10	MH-2.11	33.33	0.44	22.20	352.15	680.85	8"	0.00440	30.00	-2.09	-2.22	0.7	227
SL 2.11	MH-2.11	MH-2.12	33.33	0.44	22.20	374.35	680.85	8"	0.00440	30.00	-2.22	-2.35	0.7	227
SL 2.12	MH-2.12	MH-2.13	33.33	0.44	22.20	396.55	680.85	8"	0.00440	30.00	-2.35	-2.48	0.7	227
SL 2.13	MH-2.13	MH-2.14	33.33	0.44	22.20	418.76	680.85	8"	0.00440	30.00	-2.48	-2.62	0.7	227
SL 2.14	MH-2.14	MH-2.15	33.33	0.44	22.20	440.96	680.85	8"	0.00440	30.00	-2.62	-2.75	0.7	227
SL 2.15	MH-2.15	MH-2.16	33.33	0.44	22.20	463.16	680.85	8"	0.00440	30.00	-2.75	-2.88	0.7	227
SL 2.16	MH-2.16	MH-2.17	33.33	0.44	22.20	485.37	680.85	8"	0.00440	30.00	-2.88	-3.01	0.7	227

SL 2.17	MH-2.17	MH-2.18	33.33	0.44	22.20	507.57	680.85	8"	0.00440	30.00	-3.01	-3.14	0.7	227
SL 2.18	MH-2.18	MH-2.19	33.33	0.44	22.20	529.77	680.85	8"	0.00440	30.00	-3.14	-3.27	0.7	227
SL 2.19	MH-2.19	MH-2.20	33.33	0.44	22.20	551.98	680.85	8"	0.00440	30.00	-3.27	-3.41	0.7	227
SL 2.20	MH-2.20	MH-2.21	33.33	0.44	22.20	574.18	680.85	8"	0.00440	30.00	-3.41	-3.54	0.7	227
SL 2.21	MH-2.21	MH-2.22	33.33	0.44	22.20	596.38	680.85	8"	0.00440	30.00	-3.54	-3.67	0.7	227
SL 2.22	MH-2.22	MH-2.23	33.33	0.44	22.20	618.58	680.85	8"	0.00440	25.00	-3.67	-3.78	0.7	227
SL 2.23	MH-2.23	MH-2.24	33.33	0.44	22.20	640.79	680.85	8"	0.00440	25.00	-3.78	-3.89	0.7	227
SL 2.24	MH-2.24	MH-2	33.33	0.44	22.20	662.99	680.85	8"	0.00440	20.00	-3.89	-3.98	0.7	227
SL 3.1	MH-3.1	MH-3.2	33.33	**4.29**	214.41	214.41	680.85	8"	0.00440	30.00	-0.90	-1.03	0.7	227
SL 3.2	MH-3.2	MH-3.3	33.33	0.65	32.39	246.80	680.85	8"	0.00440	30.00	-1.03	-1.16	0.7	227
SL 3.3	MH-3.3	MH-3.4	33.33	0.65	32.39	279.20	680.85	8"	0.00440	30.00	-1.16	-1.30	0.7	227
SL 3.4	MH-3.4	MH-3.5	33.33	0.65	32.39	311.59	680.85	8"	0.00440	30.00	-1.30	-1.43	0.7	227
SL 3.5	MH-3.5	MH-3.6	33.33	0.65	32.39	343.98	680.85	8"	0.00440	30.00	-1.43	-1.56	0.7	227
SL 3.6	MH-3.6	MH-3.7	33.33	0.65	32.39	376.37	680.85	8"	0.00440	30.00	-1.56	-1.69	0.7	227
SL 3.7	MH-3.7	MH-3.8	33.33	0.65	32.39	408.76	680.85	8"	0.00440	30.00	-1.69	-1.82	0.7	227
SL 3.8	MH-3.8	MH-3.9	33.33	0.65	32.39	441.16	680.85	8"	0.00440	30.00	-1.82	-1.96	0.7	227
SL 3.9	MH-3.9	MH-3.10	33.33	0.65	32.39	473.55	680.85	8"	0.00440	30.00	-1.96	-2.09	0.7	227
SL 3.10	MH-3.10	MH-3.11	33.33	0.65	32.39	505.94	680.85	8"	0.00440	30.00	-2.09	-2.22	0.7	227
SL 3.11	MH-3.11	MH-3.12	33.33	0.65	32.39	538.33	680.85	8"	0.00440	30.00	-2.22	-2.35	0.7	227
SL 3.12	MH-3.12	MH-3.13	33.33	0.65	32.39	570.72	680.85	8"	0.00440	30.00	-2.35	-2.48	0.7	227
SL 3.13	MH-3.13	MH-3.14	33.33	0.65	32.39	603.11	680.85	8"	0.00440	30.00	-2.48	-2.62	0.7	227
SL 3.14	MH-3.14	MH-3.15	33.33	0.65	32.39	635.51	680.85	8"	0.00440	30.00	-2.62	-2.75	0.7	227
SL 3.15	MH-3.15	MH-3.16	33.33	0.65	32.39	667.90	680.85	8"	0.00440	30.00	-2.75	-2.88	0.7	227
SL 3.16	MH-3.16	MH-3.17	33.33	0.65	32.39	700.29	1031.00	10"	0.00334	30.00	-2.88	-2.98	0.7	299
SL 3.17	MH-3.17	MH-3.18	33.33	0.65	32.39	732.68	1031.00	10"	0.00334	30.00	-2.98	-3.08	0.7	299
SL 3.18	MH-3.18	MH-3.19	33.33	0.65	32.39	765.07	1031.00	10"	0.00334	30.00	-3.08	-3.18	0.7	299

SL 3.19	MH-3.19	MH-3.20	33.33	0.65	32.39	797.46	1031.00	10"	0.00334	30.00	-3.18	-3.28	0.7	299
SL 3.20	MH-3.20	MH-3.21	33.33	0.65	32.39	829.86	1031.00	10"	0.00334	30.00	-3.28	-3.38	0.7	299
SL 3.21	MH-3.21	MH-3.22	33.33	0.65	32.39	862.25	1031.00	10"	0.00334	30.00	-3.38	-3.48	0.7	299
SL 3.22	MH-3.22	MH-3.23	33.33	0.65	32.39	894.64	1031.00	10"	0.00334	25.00	-3.48	-3.56	0.7	299
SL 3.23	MH-3.23	MH-3.24	33.33	0.65	32.39	927.03	1031.00	10"	0.00334	25.00	-3.56	-3.65	0.7	299
SL 3.24	MH-3.24	MH-10	33.33	0.65	32.39	959.42	1031.00	10"	0.00334	20.00	-3.65	-3.71	0.7	299
SL 4.1	MH-4.1	MH-4.2	33.33	**3.91**	195.44	195.44	680.85	8"	0.00262	30.00	-0.90	-0.98	0.7	382
SL 4.2	MH-4.2	MH-4.3	33.33	0.58	29.22	224.66	680.85	8"	0.00440	30.00	-0.98	-1.11	0.7	227
SL 4.3	MH-4.3	MH-4.4	33.33	0.58	29.22	253.88	680.85	8"	0.00440	30.00	-1.11	-1.24	0.7	227
SL 4.4	MH-4.4	MH-4.5	33.33	0.58	29.22	283.11	680.85	8"	0.00440	30.00	-1.24	-1.37	0.7	227
SL 4.5	MH-4.5	MH-4.6	33.33	0.58	29.22	312.33	680.85	8"	0.00440	30.00	-1.37	-1.51	0.7	227
SL 4.6	MH-4.6	MH-4.7	33.33	0.58	29.22	341.55	680.85	8"	0.00440	30.00	-1.51	-1.64	0.7	227
SL 4.7	MH-4.7	MH-4.8	33.33	0.58	29.22	370.77	680.85	8"	0.00440	30.00	-1.64	-1.77	0.7	227
SL 4.8	MH-4.8	MH-4.9	33.33	0.58	29.22	399.99	680.85	8"	0.00440	30.00	-1.77	-1.90	0.7	227
SL 4.9	MH-4.9	MH-4.10	33.33	0.58	29.22	429.22	680.85	8"	0.00440	30.00	-1.90	-2.03	0.7	227
SL 4.10	MH-4.10	MH-4.11	33.33	0.58	29.22	458.44	680.85	8"	0.00440	30.00	-2.03	-2.17	0.7	227
SL 4.11	MH-4.11	MH-4.12	33.33	0.58	29.22	487.66	680.85	8"	0.00440	30.00	-2.17	-2.30	0.7	227
SL 4.12	MH-4.12	MH-4.13	33.33	0.58	29.22	516.88	680.85	8"	0.00440	30.00	-2.30	-2.43	0.7	227
SL 4.13	MH-4.13	MH-4.14	33.33	0.58	29.22	546.10	680.85	8"	0.00440	30.00	-2.43	-2.56	0.7	227
SL 4.14	MH-4.14	MH-4.15	33.33	0.58	29.22	575.33	680.85	8"	0.00440	30.00	-2.56	-2.69	0.7	227
SL 4.15	MH-4.15	MH-4.16	33.33	0.58	29.22	604.55	680.85	8"	0.00440	30.00	-2.69	-2.83	0.7	227
SL 4.16	MH-4.16	MH-4.17	33.33	0.58	29.22	633.77	680.85	8"	0.00440	30.00	-2.83	-2.96	0.7	227
SL 4.17	MH-4.17	MH-4.18	33.33	0.58	29.22	662.99	680.85	8"	0.00440	30.00	-2.96	-3.09	0.7	227
SL 4.18	MH-4.18	MH-4.19	33.33	0.58	29.22	692.21	1031.00	10"	0.00334	30.00	-3.09	-3.19	0.7	299
SL 4.19	MH-4.19	MH-4.20	33.33	0.58	29.22	721.44	1031.00	10"	0.00334	30.00	-3.19	-3.29	0.7	299
SL 4.20	MH-4.20	MH-4.21	33.33	0.58	29.22	750.66	1031.00	10"	0.00334	30.00	-3.29	-3.39	0.7	299

SL 4.21	MH-4.21	MH-4.22	33.33	0.58	29.22	779.88	1031.00	10"	0.00334	25.00	-3.39	-3.47	0.7	299
SL 4.22	MH-4.22	MH-4.23	33.33	0.58	29.22	809.10	1031.00	10"	0.00334	25.00	-3.47	-3.56	0.7	299
SL 4.23	MH-4.23	MH-4.24	33.33	0.58	29.22	838.32	1031.00	10"	0.00334	25.00	-3.56	-3.64	0.7	299
SL 4.24	MH-4.24	MH-17	33.33	0.58	29.22	867.55	1031.00	10"	0.00334	20.00	-3.64	-3.71	0.7	299
SL 5.1	MH-5.1	MH-5.2	33.33	**2.75**	137.54	137.54	680.85	8"	0.00440	30.00	-0.90	-1.03	0.7	227
SL 5.2	MH-5.2	MH-5.3	33.33	0.40	20.06	157.61	680.85	8"	0.00440	30.00	-1.03	-1.16	0.7	227
SL 5.3	MH-5.3	MH-5.4	33.33	0.40	20.06	177.67	680.85	8"	0.00440	30.00	-1.16	-1.30	0.7	227
SL 5.4	MH-5.4	MH-5.5	33.33	0.40	20.06	197.73	680.85	8"	0.00440	30.00	-1.30	-1.43	0.7	227
SL 5.5	MH-5.5	MH-5.6	33.33	0.40	20.06	217.80	680.85	8"	0.00440	30.00	-1.43	-1.56	0.7	227
SL 5.6	MH-5.6	MH-5.7	33.33	0.40	20.06	237.86	680.85	8"	0.00440	30.00	-1.56	-1.69	0.7	227
SL 5.7	MH-5.7	MH-5.8	33.33	0.40	20.06	257.93	680.85	8"	0.00440	30.00	-1.69	-1.82	0.7	227
SL 5.8	MH-5.8	MH-5.9	33.33	0.40	20.06	277.99	680.85	8"	0.00440	30.00	-1.82	-1.96	0.7	227
SL 5.9	MH-5.9	MH-5.10	33.33	0.40	20.06	298.06	680.85	8"	0.00440	30.00	-1.96	-2.09	0.7	227
SL 5.10	MH-5.10	MH-5.11	33.33	0.40	20.06	318.12	680.85	8"	0.00440	30.00	-2.09	-2.22	0.7	227
SL 5.11	MH-5.11	MH-5.12	33.33	0.40	20.06	338.18	680.85	8"	0.00440	30.00	-2.22	-2.35	0.7	227
SL 5.12	MH-5.12	MH-5.13	33.33	0.40	20.06	358.25	680.85	8"	0.00440	30.00	-2.35	-2.48	0.7	227
SL 5.13	MH-5.13	MH-5.14	33.33	0.40	20.06	378.31	680.85	8"	0.00440	30.00	-2.48	-2.62	0.7	227
SL 5.14	MH-5.14	MH-5.15	33.33	0.40	20.06	398.38	680.85	8"	0.00440	30.00	-2.62	-2.75	0.7	227
SL 5.15	MH-5.15	MH-5.16	33.33	0.40	20.06	418.44	680.85	8"	0.00440	30.00	-2.75	-2.88	0.7	227
SL 5.16	MH-5.16	MH-5.17	33.33	0.40	20.06	438.51	680.85	8"	0.00440	30.00	-2.88	-3.01	0.7	227
SL 5.17	MH-5.17	MH-5.18	33.33	0.40	20.06	458.57	680.85	8"	0.00440	30.00	-3.01	-3.14	0.7	227
SL 5.18	MH-5.18	MH-5.19	33.33	0.40	20.06	478.63	680.85	8"	0.00440	30.00	-3.14	-3.27	0.7	227
SL 5.19	MH-5.19	MH-5.20	33.33	0.40	20.06	498.70	680.85	8"	0.00440	30.00	-3.27	-3.41	0.7	227
SL 5.20	MH-5.20	MH-5.21	33.33	0.40	20.06	518.76	680.85	8"	0.00440	30.00	-3.41	-3.54	0.7	227
SL 5.21	MH-5.21	MH-5.22	33.33	0.40	20.06	538.83	680.85	8"	0.00440	30.00	-3.54	-3.67	0.7	227
SL 5.22	MH-5.22	MH-5.23	33.33	0.40	20.06	558.89	680.85	8"	0.00440	25.00	-3.67	-3.78	0.7	227

SL 5.23	MH-5.23	MH-5.24	33.33	0.40	20.06	578.96	680.85	8"	0.00440	25.00	-3.78	-3.89	0.7	227
SL 5.24	MH-5.24	MH-24	33.33	0.40	20.06	599.02	681.85	8"	0.00440	20.00	-3.89	-3.98	0.7	227
SL 1	MH-1	MH-2	33.33	8.26	413.00	812.30	1531.00	12"	0.00256	31.00	-3.98	-4.06	0.7	391
SL 2	MH-2	MH-3	33.33	13.26	663.00	1475.30	1531.00	12"	0.00256	30.00	-4.06	-4.13	0.7	391
SL 3	MH-3	MH-4	33.33	0.00	0.00	1475.30	1531.00	12"	0.00256	30.00	-4.13	-4.21	0.7	391
SL 4	MH-4	MH-5	33.33	0.00	0.00	1475.30	1531.00	12"	0.00256	30.00	-4.21	-4.29	0.7	391
SL 5	MH-5	MH-6	33.33	0.00	0.00	1475.30	1531.00	12"	0.00256	30.00	-4.29	-4.37	0.7	391
SL 6	MH-6	MH-7	33.33	0.00	0.00	1475.30	1531.00	12"	0.00256	30.00	-4.37	-4.44	0.7	391
SL 7	MH-7	MH-8	33.33	0.00	0.00	1475.30	1531.00	12"	0.00256	25.00	-4.44	-4.51	0.7	391
SL 8	MH-8	MH-9	33.33	0.00	0.00	1475.30	1531.00	12"	0.00256	25.00	-4.51	-4.57	0.7	391
SL 9	MH-9	MH-10	33.33	0.00	0.00	1475.30	1531.00	12"	0.00256	23.00	-4.57	-4.61	0.7	391
SL 10	MH-10	MH-11	33.33	19.19	959.50	2434.80	2940.00	14"	0.00170	30.00	-4.61	-4.66	0.7	587
SL 11	MH-11	MH-12	33.33	0.00	0.00	2434.80	2940.00	14"	0.00170	30.00	-4.66	-4.71	0.7	587
SL 12	MH-12	MH-13	33.33	0.00	0.00	2434.80	2940.00	14"	0.00170	30.00	-4.71	-4.76	0.7	587
SL 13	MH-13	MH-14	33.33	0.00	0.00	2434.80	2940.00	14"	0.00170	30.00	-4.76	-4.81	0.7	587
SL 14	MH-14	MH-15	33.33	0.00	0.00	2434.80	2940.00	14"	0.00170	30.00	-4.81	-4.86	0.7	587
SL 15	MH-15	MH-16	33.33	0.00	0.00	2434.80	2940.00	14"	0.00170	30.00	-4.86	-4.92	0.7	587
SL 16	MH-16	MH-17	33.33	0.00	0.00	2434.80	2940.00	14"	0.00170	15.78	-4.92	-4.94	1.7	587
SL 17	MH-17	MH-18	33.33	17.35	867.50	3302.30	3853.00	16"	0.00142	30.00	-4.94	-4.99	2.7	702
SL 18	MH-18	MH-19	33.33	0.00	0.00	3302.30	3853.00	16"	0.00142	30.00	-4.99	-5.03	3.7	702
SL 19	MH-19	MH-20	33.33	0.00	0.00	3302.30	3853.00	16"	0.00142	30.00	-5.03	-5.07	4.7	702
SL 20	MH-20	MH-21	33.33	0.00	0.00	3302.30	3853.00	16"	0.00142	30.00	-5.07	-5.11	5.7	702
SL 21	MH-21	MH-22	33.33	0.00	0.00	3302.30	3853.00	16"	0.00142	30.00	-5.11	-5.16	6.7	702
SL 22	MH-22	MH-23	33.33	0.00	0.00	3302.30	3853.00	16"	0.00142	30.00	-5.16	-5.20	7.7	702
SL 23	MH-23	MH-24	33.33	0.00	0.00	3302.30	3853.00	16"	0.00142	20.43	-5.20	-5.23	8.7	702
SL 24	MH-24	**STP**	33.33	11.98	599.00	3901.30	3950.00	16"	0.00150	100.00	-5.23	-5.38	9.7	668

Annexure III

Design of storm water drain

Design of U drain		@	N=	0.013					
	Drain cross section size in mm (Depth X width) at strart	**Length of drain segment from SP**	**distance of strat point for drain element from SP in M**	**Invert of drain at starting point in M from Road level**	**Invert Lvel at end of Drain in M from Road level**	**Slope 1 in**	**slop ratio**	**velocity m/s**	**Discharge in Cu m/min**
	150X250	15	0	-0.25	-0.3409	165	0.00606	1.0	1.09
	240X250	15	15	-0.3409	-0.41175	212	0.004723	1.0	
	310X250	15	30	-0.41175	-0.47545	235	0.004247	1.0	
	375X250	15	45	-0.47545	-0.5349	252	0.003963	1.0	
	435X250	15	60	-0.5349	-0.59163	264	0.003782	1.0	
	490X250	15	75	-0.59163	-0.64647	274	0.003656	1.0	
	545X350	15	90	-0.64647	-0.684	400	0.002502	1.0	
	584X450	15	105	-0.684	-0.71257	525	0.001905	1.0	
	612X450	30	120	-0.71257	-0.76876	534	0.001873	1.0	
	668X450	50	150	-0.76876	-0.85966	550	0.001818	1.0	
	759X450	50	200	-0.85966	-0.94701	572	0.001747	1.0	
	847X550	100	250	-0.94701	-1.08441	728	0.001374	1.0	19.75
		350	350						

Analyses Of Rain Drain Rd-1

Parameter for design

Rain fall	20	mm/hr.
Area of micro watershed	2776	Sq. m
Runoff Coeff.	0.65	
Expected runoff generated	36.09	Cu m/hr.
	0.601	Cu m /min
formation LVL	97.8	M

segment No.	initial flow	Unit	addition		Total discharge	pipe size		slope	initial LVL in m		Length of segment		Final LVL ref NGL	LVL
	0	Kl/m			0	500	mm	0.002205	-1	mm	0	m	-1.00	96.800
sg1	0	Kl/m	0.60	Kl/min	0.6	500	mm	0.002205	-1.000	mm	24	m	-1.05	96.747
sg2	0.6015	Kl/m	0.60	Kl/min	1.2	500	mm	0.002205	-1.053	mm	48	m	-1.16	96.641
sg3	1.2029	Kl/m	0.60	Kl/min	1.8	500	mm	0.002205	-1.159	mm	48	m	-1.26	96.535
sg4	1.8044	Kl/m	0.60	Kl/min	2.41	500	mm	0.002205	-1.265	mm	48	m	-1.37	96.430
sg5	2.4059	Kl/m	0.30	Kl/min	2.71	500	mm	0.002205	-1.370	mm	24	m	-1.42	96.377
sg6	2.7059	Kl/m	0.60	Kl/min	3.31	500	mm	0.002205	-1.423	mm	48	m	-1.53	96.271
sg7	3.3073	Kl/m	0.60	Kl/min	3.91	500	mm	0.002205	-1.529	mm	48	m	-1.64	96.165
sg8	3.9088	Kl/m	0.60	Kl/min	4.51	500	mm	0.002205	-1.635	mm	48	m	-1.74	96.059
sg9	4.5103	Kl/m	0.60	Kl/min	5.11	500	mm	0.002205	-1.741	mm	48	m	-1.85	95.953
sg10	5.1117	Kl/m	0.60	Kl/min	5.71	500	mm	0.002205	-1.847	mm	48	m	-1.95	95.847
sg11	5.7132	Kl/m	0.60	Kl/min	6.31	500	mm	0.002205	-1.953	mm	48	m	-2.06	95.742
sg12	6.3147	Kl/m	0.60	Kl/min	6.92	500	mm	0.002205	-2.058	mm	48	m	-2.16	95.636
sg13	6.9161	Kl/m	0.60	Kl/min	7.52	500	mm	0.002205	-2.164	mm	48	m	-2.27	95.530
sg14	7.5176	Kl/m	0.60	Kl/min	8.12	500	mm	0.002205	-2.270	mm	48	m	-2.38	95.424

sg15	8.1191	Kl/m	0.60	Kl/min	8.72	600	mm	0.001730	-2.376	mm	48	m	-2.56	95.241
sg16	8.7205	Kl/m	0.60	Kl/min	9.32	600	mm	0.001730	-2.559	mm	48	m	-2.64	95.158
sg17	9.322	Kl/m	0.60	Kl/min	9.92	600	mm	0.001730	-2.642	mm	48	m	-2.73	95.075
sg18	9.9235	Kl/m	0.60	Kl/min	10.5	600	mm	0.001730	-2.725	mm	48	m	-2.81	94.992

Analyses Of Rain Drain Rd-2

Parameter for design

Rain fall	20	mm/hr.
Area of micro watershed	5502	Sq. m
Runoff Coeff.	0.9	
Expected runoff generated	99.04	Cu m/hr.
	1.651	Cu m /min
Area of micro watershed	29107	Sq. m
Runoff Coeff.	0.65	
Expected runoff generated	378.4	Cu m/hr.
	6.307	Cu m /min
formation LVL	97.8	

segment No.	initial flow		addition		Total discharge	pipe size		slope	initial LVL		Length of segment		Final LVL ref NGL	LVL
	6.3	Kl/m			6.3	600	mm	0.00173	-1	mm	0	m	-1.00	96.800
sg1	6.3	Kl/m	1.6506	Kl/min	7.95	600	mm	0.00173	-1.000	mm	24	m	-1.04	96.758
sg2	7.9506	Kl/m	1.6506	Kl/min	9.6	600	mm	0.00173	-1.042	mm	48	m	-1.12	96.675
sg3	9.6012	Kl/m	1.6506	Kl/min	11.3	600	mm	0.00173	-1.125	mm	48	m	-1.21	96.592
sg4	11.2518	Kl/m	1.6506	Kl/min	12.9	600	mm	0.00235	-1.208	mm	48	m	-1.32	96.480
sg5	12.9024	Kl/m	1.753	Kl/min	14.7	600	mm	0.00235	-1.320	mm	51	m	-1.44	96.360
sg6	14.6554	Kl/m	1.6506	Kl/min	16.3	800	mm	0.001179	-1.440	mm	48	m	-1.70	96.103
sg7	16.306	Kl/m	1.6506	Kl/min	18	800	mm	0.001179	-1.697	mm	48	m	-1.75	96.047
sg8	17.9566	Kl/m	1.6506	Kl/min	19.6	800	mm	0.001179	-1.753	mm	48	m	-1.81	95.990

sg9	19.6072	Kl/m	1.6506	Kl/min	21.3	800	mm	0.001179	-1.810	mm	48	m	-1.87	95.933
sg10	21.2578	Kl/m	1.6506	Kl/min	22.9	1000	mm	0.000875	-1.867	mm	48	m	-2.11	95.691
sg11	22.9084	Kl/m	1.6506	Kl/min	24.6	1000	mm	0.000875	-2.109	mm	48	m	-2.15	95.649
sg12	24.559	Kl/m	1.6506	Kl/min	26.2	1000	mm	0.000875	-2.151	mm	48	m	-2.19	95.607
sg13	26.2096	Kl/m	1.6506	Kl/min	27.9	1000	mm	0.000875	-2.193	mm	48	m	-2.23	95.565
sg14	27.8602	Kl/m	1.6506	Kl/min	29.5	1000	mm	0.000875	-2.235	mm	48	m	-2.28	95.523
sg15	29.5108	Kl/m	1.6506	Kl/min	31.2	1000	mm	0.000875	-2.277	mm	48	m	-2.32	95.481
sg16	31.1614	Kl/m	1.6506	Kl/min	32.8	1000	mm	0.000875	-2.319	mm	48	m	-2.36	95.439
sg17	32.812	Kl/m	1.6506	Kl/min	34.5	1000	mm	0.00126	-2.361	mm	48	m	-2.42	95.379
sg18	34.4626	Kl/m	1.6506	Kl/min	36.1	1000	mm	0.00126	-2.421	mm	48	m	-2.48	95.318

Analyses Of Rain Drain Rd-3

Parameter for design

Rain fall	20	mm/hr.
Area of micro watershed	4082	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	73.48	Cu m/hr.
	1.225	Cu m /min
Area of micro watershed	3404	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	61.27	Cu m/hr.
	1.021	Cu m /min
formation LVL	97.8	

segment No.	initial flow		addition		Total discharge	pipe size		slope	initial LVL		Length of segment		Final LVL ref NGL	LVL
	1.021	Kl/m			1.021	500	mm	0.002205	-1	mm	0	m	-1.00	96.800
sg1	1.021	Kl/m	1.2246	Kl/min	2.2456	500	mm	0.002205	-1.000	mm	24	m	-1.05	96.747
sg2	2.2456	Kl/m	1.2246	Kl/min	3.4702	500	mm	0.002205	-1.053	mm	48	m	-1.16	96.641
sg3	3.4702	Kl/m	1.2246	Kl/min	4.6948	500	mm	0.002205	-1.159	mm	48	m	-1.26	96.535
sg4	4.6948	Kl/m	1.2246	Kl/min	5.9194	500	mm	0.002205	-1.265	mm	48	m	-1.37	96.430
sg5	5.9194	Kl/m	1.2246	Kl/min	7.144	500	mm	0.002205	-1.370	mm	48	m	-1.48	96.324
sg6	7.144	Kl/m	1.2246	Kl/min	8.3686	600	mm	0.001732	-1.476	mm	48	m	-1.66	96.141
sg7	8.3686	Kl/m	1.2246	Kl/min	9.5932	600	mm	0.001732	-1.659	mm	48	m	-1.74	96.057

sg8	9.5932	Kl/m	1.2246	Kl/min	10.8178	600	mm	0.001732	-1.743	mm	48	m	-1.83	95.974
sg9	10.818	Kl/m	1.2246	Kl/min	12.0424	600	mm	0.001732	-1.826	mm	48	m	-1.91	95.891
sg10	12.042	Kl/m	1.2246	Kl/min	13.267	800	mm	0.00118	-1.909	mm	48	m	-2.17	95.635
sg11	13.267	Kl/m	1.2246	Kl/min	14.4916	800	mm	0.00118	-2.165	mm	48	m	-2.22	95.578
sg12	14.492	Kl/m	1.2246	Kl/min	15.7162	800	mm	0.00118	-2.222	mm	48	m	-2.28	95.521
sg13	15.716	Kl/m	1.2246	Kl/min	16.9408	800	mm	0.00118	-2.279	mm	48	m	-2.34	95.465
sg14	16.941	Kl/m	1.2246	Kl/min	18.1654	1000	mm	0.000875	-2.335	mm	48	m	-2.58	95.223
sg15	18.165	Kl/m	0.6123	Kl/min	18.7777	1000	mm	0.000875	-2.577	mm	24	m	-2.60	95.202
sg16	18.778	Kl/m	1.2246	Kl/min	20.0023	1000	mm	0.000875	-2.598	mm	16	m	-2.61	95.188

Analyses Of Rain Drain Rd-4

Parameter for design

Rain fall	20	mm/hr.
Area of micro watershed	5614	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	101.1	Cu m/hr.
	1.684	Cu m /min
Rain fall	20	mm/hr.
Area of micro watershed	3404	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	61.27	Cu m/hr.
	1.021	Cu m /min

segment No.	initial flow		addition		Total discharge	pipe size		slope	initial LVL		Length of segment		Final LVL ref NGL	LVL
	1.02	Kl/m			1.02	500	mm	0.002205	-1	mm	0	m	-1.00	96.800
sg1	1.02	Kl/m	1.6842	Kl/min	2.704	500	mm	0.002205	-1.000	mm	24	m	-1.05	96.747
sg2	2.7042	Kl/m	1.6842	Kl/min	4.388	600	mm	0.001730	-1.053	mm	48	m	-1.24	96.564
sg3	4.3884	Kl/m	1.6842	Kl/min	6.073	600	mm	0.001730	-1.236	mm	48	m	-1.32	96.481
sg4	6.0726	Kl/m	1.6842	Kl/min	7.757	600	mm	0.001730	-1.319	mm	48	m	-1.40	96.398
sg5	7.7568	Kl/m	1.6842	Kl/min	9.441	600	mm	0.001730	-1.402	mm	48	m	-1.49	96.315
sg6	9.441	Kl/m	1.6842	Kl/min	11.13	600	mm	0.001730	-1.485	mm	48	m	-1.57	96.232
sg7	11.125	Kl/m	1.6842	Kl/min	12.81	800	mm	0.001179	-1.568	mm	48	m	-1.82	95.975
sg8	12.809	Kl/m	1.6842	Kl/min	14.49	800	mm	0.001179	-1.825	mm	48	m	-1.88	95.919

sg9	14.494	Kl/m	1.6842	Kl/min	16.18	800	mm	0.001179	-1.881	mm	48	m	-1.94	95.862
sg10	16.178	Kl/m	1.6842	Kl/min	17.86	800	mm	0.001179	-1.938	mm	48	m	-1.99	95.806
sg11	17.862	Kl/m	1.6842	Kl/min	19.55	800	mm	0.001179	-1.994	mm	48	m	-2.05	95.749
sg12	19.546	Kl/m	1.6842	Kl/min	21.23	800	mm	0.003434	-2.051	mm	48	m	-2.22	95.584
sg13	21.23	Kl/m	1.6842	Kl/min	22.91	800	mm	0.003434	-2.216	mm	48	m	-2.38	95.419
sg14	22.915	Kl/m	1.6842	Kl/min	24.6	800	mm	0.003434	-2.381	mm	48	m	-2.55	95.254
sg15	24.599	Kl/m	0.8421	Kl/min	25.44	800	mm	0.003434	-2.546	mm	24	m	-2.63	95.172
sg16	25.441	Kl/m	1.6842	Kl/min	27.13	800	mm	0.003434	-2.628	mm	16	m	-2.68	95.117
sg17	27.125	Kl/m	1.6842	Kl/min	48.81	1000	mm	0.002380	-2.683	mm	50	m	-3.00	94.798
sg18	48.812	Kl/m	1.6842	Kl/min	50.5	1000	mm	0.002380	-3.002	mm	50	m	-3.12	94.679
sg19	50.496	Kl/m	1.6842	Kl/min	52.18	1000	mm	0.002380	-3.121	mm	38.5	m	-3.21	94.587

Analyses Of Rain Drain Rd-5

Parameter for design

Rain fall	20	mm/hr.
Area of micro watershed	3986	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	71.75	Cu m/hr.
	1.196	Cu m /min
Area of micro watershed	3404	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	61.27	Cu m/hr.
	1.021	Cu m /min
Formation LVL	97.8	

segment No.	initial flow		addition		Total discharge	pipe size		slope	initial LVL		Length of segment		Final LVL ref NGL	LVL
		Kl/m			1.02	500	mm	0.002205	-1.000	mm	0	m	-1.00	96.800
sg1	1.02	Kl/m	1.1958	Kl/min	2.22	500	mm	0.002205	-1.000	mm	24	m	-1.05	96.747
sg2	2.2158	Kl/m	1.1958	Kl/min	3.41	500	mm	0.002205	-1.053	mm	48	m	-1.16	96.641
sg3	3.4116	Kl/m	1.1958	Kl/min	4.61	500	mm	0.002205	-1.159	mm	48	m	-1.26	96.535
sg4	4.6074	Kl/m	1.1958	Kl/min	5.8	500	mm	0.002205	-1.265	mm	48	m	-1.37	96.430
sg5	5.8032	Kl/m	1.1958	Kl/min	7	500	mm	0.002205	-1.370	mm	48	m	-1.48	96.324
sg6	6.999	Kl/m	1.1958	Kl/min	8.19	500	mm	0.002205	-1.476	mm	48	m	-1.58	96.218
sg7	8.1948	Kl/m	1.1958	Kl/min	9.39	600	mm	0.001730	-1.582	mm	48	m	-1.77	96.035
sg8	9.3906	Kl/m	1.1958	Kl/min	10.6	600	mm	0.001730	-1.765	mm	24	m	-1.81	95.993

sg9	10.586	Kl/m	1.1958	Kl/min	12.7	600	mm	0.001730	-1.807	mm	84	m	-1.95	95.848
sg10	12.65	Kl/m	1.1958	Kl/min	13.8	800	mm	0.001180	-1.952	mm	48	m	-2.21	95.591
sg11	13.846	Kl/m	1.1958	Kl/min	15	800	mm	0.001180	-2.209	mm	48	m	-2.27	95.535
sg12	15.042	Kl/m	1.1958	Kl/min	16.2	800	mm	0.001180	-2.265	mm	48	m	-2.32	95.478
sg13	16.237	Kl/m	1.1958	Kl/min	17.4	800	mm	0.001180	-2.322	mm	48	m	-2.38	95.421
sg14	17.433	Kl/m	1.1958	Kl/min	18.6	800	mm	0.001180	-2.379	mm	48	m	-2.44	95.365
sg15	18.629	Kl/m	1.1958	Kl/min	19.8	800	mm	0.001180	-2.435	mm	48	m	-2.49	95.308
sg16	19.825	Kl/m	1.1958	Kl/min	21	800	mm	0.001180	-2.492	mm	15	m	-2.51	95.290

Analyses Of Rain Drain Rd-6

Parameter for design

Rain fall	20	mm/hr.
Area of micro watershed	5594	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	101	Cu m/hr.
	1.68	Cu m /min
Area of micro watershed	3404	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	61.3	Cu m/hr.
	1.02	Cu m /min

segment No.	initial flow		addition		Total discharge	pipe size		slope	initial LVL		Length of segment		Final LVL ref NGL	LVL
	1.02	Kl/m			1.02	500	mm	0.002205	-1.000	mm	0	m	-1.00	96.800
sg1	1.02	Kl/m	1.6782	Kl/min	2.7	500	mm	0.002205	-1.000	mm	24	m	-1.05	96.747
sg2	2.6982	Kl/m	1.6782	Kl/min	4.38	500	mm	0.002205	-1.053	mm	48	m	-1.16	96.641
sg3	4.3764	Kl/m	1.6782	Kl/min	6.05	500	mm	0.002205	-1.159	mm	48	m	-1.26	96.535
sg4	6.0546	Kl/m	1.6782	Kl/min	7.73	500	mm	0.002205	-1.265	mm	48	m	-1.37	96.430
sg5	7.7328	Kl/m	1.6782	Kl/min	9.41	600	mm	0.001730	-1.370	mm	48	m	-1.55	96.247
sg6	9.411	Kl/m	1.6782	Kl/min	11.1	600	mm	0.001730	-1.553	mm	48	m	-1.64	96.163
sg7	11.089	Kl/m	1.6782	Kl/min	12.8	800	mm	0.001180	-1.637	mm	48	m	-1.89	95.907

sg8	12.767	Kl/m	1.6782	Kl/min	14.4	800	mm	0.001180	-1.893	mm	24	m	-1.92	95.879
sg9	14.446	Kl/m	1.6782	Kl/min	16.1	800	mm	0.001180	-1.921	mm	84	m	-2.02	95.779
sg10	16.124	Kl/m	1.6782	Kl/min	17.8	800	mm	0.001180	-2.021	mm	48	m	-2.08	95.723
sg11	17.802	Kl/m	1.6782	Kl/min	19.5	800	mm	0.001180	-2.077	mm	48	m	-2.13	95.666
sg12	19.48	Kl/m	1.6782	Kl/min	21.2	800	mm	0.001180	-2.134	mm	48	m	-2.19	95.609
sg13	21.158	Kl/m	1.6782	Kl/min	22.8	1000	mm	0.002380	-2.191	mm	48	m	-2.50	95.295
sg14	22.837	Kl/m	1.6782	Kl/min	24.5	1000	mm	0.002380	-2.505	mm	48	m	-2.62	95.181
sg15	24.515	Kl/m	1.6782	Kl/min	26.2	1000	mm	0.002380	-2.619	mm	48	m	-2.73	95.067
sg16	26.193	Kl/m	1.6782	Kl/min	27.9	1000	mm	0.002380	-2.733	mm	48	m	-2.85	94.953
sg17	27.871	Kl/m	1.6782	Kl/min	50.6	1000	mm	0.002380	-2.847	mm	50	m	-2.97	94.834
sg18	50.57	Kl/m	1.6782	Kl/min	52.2	1000	mm	0.002380	-2.966	mm	50	m	-3.09	94.715
sg19	52.248	Kl/m	1.6782	Kl/min	53.9	1000	mm	0.002380	-3.085	mm	38.5	m	-3.18	94.623

Analyses Of Rain Drain Rd-7

Parameter for design

Rain fall	20	mm/hr.
Area of micro watershed	4985	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	89.7	Cu m/hr.
	1.5	Cu m /min
Area of micro watershed	3404	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	61.3	Cu m/hr.
	1.02	Cu m /min

segment No.	initial flow		addition		Total discharge	pipe size		slope	initial LVL		Length of segment		Final LVL ref NGL	LVL
	1.02	Kl/m			1.02	500	mm	0.002205	-1.000	mm	0	m	-1.00	96.800
sg1	1.02	Kl/m	1.4955	Kl/min	2.52	500	mm	0.002205	-1.000	mm	24	m	-1.05	96.747
sg2	2.5155	Kl/m	1.4955	Kl/min	4.01	500	mm	0.002205	-1.053	mm	48	m	-1.16	96.641
sg3	4.011	Kl/m	1.4955	Kl/min	5.51	500	mm	0.002205	-1.159	mm	48	m	-1.26	96.535
sg4	5.5065	Kl/m	1.4955	Kl/min	7	500	mm	0.002205	-1.265	mm	48	m	-1.37	96.430
sg5	7.002	Kl/m	1.4955	Kl/min	8.5	600	mm	0.001730	-1.370	mm	48	m	-1.55	96.247
sg6	8.4975	Kl/m	1.4955	Kl/min	9.99	600	mm	0.001730	-1.553	mm	48	m	-1.64	96.163
sg7	9.993	Kl/m	1.4955	Kl/min	11.5	800	mm	0.001180	-1.637	mm	48	m	-1.89	95.907
sg8	11.489	Kl/m	1.4955	Kl/min	13	800	mm	0.001180	-1.893	mm	24	m	-1.92	95.879
sg9	12.984	Kl/m	1.4955	Kl/min	14.5	800	mm	0.001180	-1.921	mm	84	m	-2.02	95.779

sg10	14.48	Kl/m	1.4955	Kl/min	16	800	mm	0.001180	-2.021	mm	48	m	-2.08	95.723
sg11	15.975	Kl/m	1.4955	Kl/min	17.5	800	mm	0.001180	-2.077	mm	48	m	-2.13	95.666
sg12	17.471	Kl/m	1.4955	Kl/min	19	800	mm	0.001180	-2.134	mm	48	m	-2.19	95.609
sg13	18.966	Kl/m	1.4955	Kl/min	20.5	1000	mm	0.000875	-2.191	mm	48	m	-2.43	95.367
sg14	20.462	Kl/m	1.4955	Kl/min	22	1000	mm	0.000875	-2.433	mm	48	m	-2.47	95.325
sg15	21.957	Kl/m	1.4955	Kl/min	23.5	1000	mm	0.000875	-2.475	mm	48	m	-2.52	95.283
sg16	23.453	Kl/m	1.4955	Kl/min	24.9	1000	mm	0.000875	-2.517	mm	25	m	-2.54	95.262

Analyses Of Rain Drain Rd-8

Parameter for design

Rain fall	20	mm/hr.
Area of micro watershed	2619	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	47.142	Cu m/hr.
	0.7857	Cu m /min
Area of micro watershed	3404	Sq m
Runoff Coeff.	0.9	
Expected runoff generated	61.272	Cu m/hr.
	1.0212	Cu m /min

segment No.	initial flow		addition		Total discharge	pipe size		slope	initial LVL		Length of segment		Final LVL ref NGL	LVL
	1.02	Kl/m			1.02	500	mm	0.002205	-1.000	mm	0	m	-1.00	96.800
sg1	1.02	Kl/m	0.7857	Kl/min	1.8057	500	mm	0.002205	-1.000	mm	24	m	-1.05	96.747
sg2	1.8057	Kl/m	0.7857	Kl/min	2.5914	500	mm	0.002205	-1.053	mm	48	m	-1.16	96.641
sg3	2.5914	Kl/m	0.7857	Kl/min	3.3771	500	mm	0.002205	-1.159	mm	48	m	-1.26	96.535
sg4	3.3771	Kl/m	0.7857	Kl/min	4.1628	500	mm	0.002205	-1.265	mm	48	m	-1.37	96.430
sg5	4.1628	Kl/m	0.7857	Kl/min	4.9485	500	mm	0.002205	-1.370	mm	48	m	-1.48	96.324
sg6	4.9485	Kl/m	0.7857	Kl/min	5.7342	600	mm	0.001730	-1.476	mm	48	m	-1.66	96.141
sg7	5.7342	Kl/m	0.7857	Kl/min	6.5199	600	mm	0.001730	-1.659	mm	48	m	-1.74	96.058
sg8	6.5199	Kl/m	0.7857	Kl/min	7.3056	600	mm	0.001730	-1.742	mm	24	m	-1.78	96.016
sg9	7.3056	Kl/m	0.7857	Kl/min	8.0913	600	mm	0.001730	-1.784	mm	84	m	-1.93	95.871

sg10	8.0913	Kl/m	0.7857	Kl/min	8.877	600	mm	0.001730	-1.929	mm	48	m	-2.01	95.788
sg11	8.877	Kl/m	0.7857	Kl/min	9.6627	600	mm	0.001730	-2.012	mm	48	m	-2.10	95.705
sg12	9.6627	Kl/m	0.7857	Kl/min	10.448	800	mm	0.001180	-2.095	mm	48	m	-2.35	95.448
sg13	10.448	Kl/m	0.7857	Kl/min	11.234	800	mm	0.001180	-2.352	mm	48	m	-2.41	95.391
sg14	11.234	Kl/m	0.7857	Kl/min	12.02	800	mm	0.001180	-2.409	mm	48	m	-2.47	95.335
sg15	12.02	Kl/m	0.7857	Kl/min	12.806	800	mm	0.001180	-2.465	mm	48	m	-2.52	95.278
sg16	12.806	Kl/m	0.7857	Kl/min	13.591	1000	mm	0.000875	-2.522	mm	48	m	-2.76	95.036
sg17	13.591	Kl/m	0.7857	Kl/min	39.325	1000	mm	0.000875	-2.764	mm	50	m	-2.81	94.992
sg18	39.325	Kl/m	0.7857	Kl/min	40.111	1000	mm	0.000875	-2.808	mm	50	m	-2.85	94.949
sg19	40.111	Kl/m	0.7857	Kl/min	40.896	1000	mm	0.000875	-2.851	mm	38.5	m	-2.89	94.915

Annexure IV

Analyses of Open Rain Drain

Rain fall	20	mm/hr.
Area of micro watershed	237407	SqM
Runoff Coeff.	0.65	
Expected runoff generated	3086.291	Cu m/hr.
	51.43818	Cu m /min
Manning's coefficient	0.014	
internal Height	609	mm
internal width	1500	mm
Left Bank Width	304.8	mm
Right Bank Width	304.8	mm
Fluid Depth	457	mm
Free Board	150	mm
Fluid Cross Section Area	0.790316	SqM
Wetted Perimeter	2522.33	mm
Hydraulic radius	313.328	mm
Fluid Velocity	1.5	m/s
Fluid Surface width	1597.2	mm
Water Flow Rate	70.907	cum/min
Slope Ratio	0.002059	
excepted Length of drain	941	m
Slope up to 300 m	0.002063	
Slope after 300 m	0.000901	

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