STUDY AND DESIGN OF WATER DISTRIBUTION SYSYTEM OF OLD DELHI RAILWAY STATION

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE
OF

MASTER OF TECHNOLOGY
IN
ENVIRONMENTAL ENGINEERING

Submitted by:

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CANDIDATE'S DECLARATION

I, VIDRUM GAUR, 2K18/ENE/14 of M.Tech (ENVIRONMENTAL ENGINEERING) hereby declare that the project Dissertatation entitled –"**STUDY AND DESIGN OF WATER DISTRIBUTION SYSTEM OF OLD DELHI RAILWAY STATION"** which is submitted by me to the department of ENVIRONMENTAL ENGINEERING, Delhi Technological University, Delhi in partial fulfillment of the requirements for the award of the degree of Master of Technology, is original and not copied from any source without proper citation. This work has not previously formed the basis for the award of any Degree, Diploma Associateship, Fellowship or other similar or recognition.

(VIDRUM GAUR)

Place: Delhi

Date :14/07/2020

DELHI TECHNOLOGICAL UNIVERSITY
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CERTIFICATE

I hereby certify that the project Dissertation entitled "**STUDY AND DESIGN OF WATER DISTRIBUTION SYSTEM OF OLD DELHI RAILWAY STATION**" which is submitted by [VIDRUM GAUR], Roll No: 2K18/ENE/14 ENVIRONMENTAL ENGINEERING DEPARTMENT, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the degree of Master of Technology is a record of the project work carried out by the students under my provision. To the best of my knowledge this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

Place: Delhi
Date :14/07/2020

Dr. GEETA SINGH

SUPERVISOR

ACKNOWLEDGMENT

Every project big or small is a successful largely due to the effort of a number of wonderful people who have always given their valuable advice or lent a helping hand. I sincerely appreciate the inspiration, support and guidance of all those people who have and will be adamant and instrumental in making this project a success.

I, **Vidrum Gaur**, the student of **Delhi Technological University, New Delhi** is extremely grateful to the "**Department of Environmental Engineering, Delhi Technological University, New Delhi"** for the confidence bestowed in me and entrusting my project entitled "**STUDY AND DESIGN OF WATER DISTRIBUTION SYSTEM OF OLD DELHI RAILWAY STATION**".

At this point I feel deeply honored in expressing my sincere thanks to **Dr. Geeta Singh** (Asst. Professor, Environmental Department) for making the resources available at the right time and providing valuable insights leading to the partial completion of my project.

I would also like to thanks all the faculty members of **Department of Environmental Engineering** for their critical advice and guidance.

Last but not least I place a deep sense of gratitude to my family members and my friends who have been constant source of inspiration during the preparation of this project.

Place: Delhi **(VIDRUM GAUR)**

Date:

ABSTRACT

The present study has been undertaken in order to study and design of water distribution system of OLD DELHI RAILWAY STATION.

To fulfil the demand of water of the rapidly growing population, it is very important to provide sufficient quantity of water by the designed layout of pipes. The general features of the area that should be considered are population, water demand, pumps requirement, distribution network and water tanks are necessary for the efficient design of water distribution system. This design of water distribution network is efficient to meet the daily requirement of water at old delhi railway station. EPANET software is used to design the water supply scheme of that area.

Keywords: Layout, Distribution system, water demand,EPANET

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CHAPTER 1:- INTRODUCTION

1.1 OLD DELHI RAILWAY STATION

This is the oldest railway station of Delhi Division, located near the famous market of Delhi; ChandniChowk. The old Delhi railway station was established by the British Government in 1864 in style of Red Fort. It has been an important railway station of the country, and preceded the New Delhi Railway Station by about 60 years. The station started with a broad gauge train from Calcutta in 1864. Meter gauge track from Delhi to Rewari and further to Ajmer was laid in 1873 by Rajputana Railways and meter gauge trains from this station started in 1876& Agra Delhi line opened in 1904. The present building of the station was built in 1900 and opened for public in 1903.

Figure 1 Old Delhi Railway Station

This station was the main station of Delhi hosting junction of four railways until the opening of New Delhi Railway station in 1926. The station was remodeled in 1934–35, when its platforms were extended and power signals were introduced. A new entrance from Kashmere Gate side was created in 1990s and new platforms were added. The platforms were renumbered in September 2011. The station building is being renovated in 2012-13.

1.2 THE STUDY

Serving such a large population with a huge network, the railway industry requires enormous quantity of water for various activities, especially for coach washing and coach filling.

In this context we did survey of the entire station, collected preliminary information from station, field survey including monitoring/measurements of flows and water quality at several important identified locations of the entire water supply pipeline network and wastewater discharge locations in the station premises.

This report details the proposal of a new layout of water supply system at the Old Delhi Railway Station along with recommendations for better and efficient management of water resources.

CHAPTER 2:- LITERATURE REVIEW

Payal Lungariya et al : observed that failure in pipe disrupted the supply of water to the consumer and also reduce the efficiency of the system. So proper inspection, control, maintenance of the system is required properly. Pressure analysis, elevation, head loss at each pipe can be analysed by EPANET software.

Bentley : studied that the minimum level cannot be achieved due to high head loss. The solution of the problem is WATER GEMS which reduce the losses and cost also.

Dr. G. Venkata Ramana et al. : using EPANET software we can publish the efficient design and pipe layout distribution. This software if useful to determine the demand pattern, rate of flow, losses from bend, head loss due to friction.

Sahita I Waikho et al : discussed the optimization of existing network and ability to deliver water in required quantity and pressure to individual. With the help of EPANET software word is done easily and fast. The result of this software is simulated with actual result and problem is detected and solved.

J.Chena et al.(2013) : discussed two approaches , one for individual water supply and other for water supply as a whole system or region. Practically the prediction of water demand is developed by an integrated Time Series Forecasting Framework (TSFF).

CHAPTER 3 :- OBJECTIVES & SCOPE OF WORK

The main objective of the study was to conduct a comprehensive water audit of selected railway station of the Northern Railway New Delhi to evaluate water use, water quality and identify opportunities for enhancing water use efficiency.

The specific scope of work for this study was:

- To study, establish and draw out the existing water supply network plan at these stations and to identity the losses/leakage within the water distribution system.

- To estimate the water consumption/use through flow measurements and secondary data. This will include water demand and supply situation as well as the water balance of the system.

3.1 DETAILED SCOPE OF WORK

Water at Old Delhi Railway station is an important commodity and its efficient use is crucial to proper functioning of activities on the station.

This project undertakes the study of existing water supply scheme which includes the following key points:-

- To estimate the water consumption for various activities at station through flow measurement and secondary data and to establish the water balance of the station.

- To identify the leakage points within the station and also to determine the quantity of them.

CHAPTER 4:- SOFTWARE USED FOR THE WORK

We have used software known as EPANET 2.0 for designing a new layout of the water distribution system at the Old Delhi Railway Station so as to mitigate the losses and make an efficient use of the existing resources. EPANET 2.0 is wide range software that provides a sole platform so as to carry out both hydraulic modeling and water quality modeling. However, our scope of work is limited to the hydraulic modeling only.

4.1 WHAT IS EPANET?

EPANET is a computer program that performs extended period simulation of hydraulic and water quality behavior within pressurized pipe networks. A network consists of pipes, nodes (pipe junctions), pumps, valves and storage tanks or reservoirs. EPANET tracks the flow of water in each pipe, the pressure at each node, the height of water in each tank, and the concentration of a chemical species throughout the network during a simulation period comprised of multiple time steps. In addition to chemical species, water age and source tracing can also be simulated.

EPANET is designed to be a research tool for improving our understanding of the movement and fate of drinking water constituents within distribution systems. It can be used for many different kinds of applications in distribution systems analysis. Sampling program design, hydraulic model calibration, chlorine residual analysis, and consumer exposure assessment are some examples. EPANET can help assess alternative management strategies for improving water quality throughout a system. These can include:

- Altering source utilization within multiple source systems,
- Altering pumping and tank filling/emptying schedules,
- Use of satellite treatment, such as re-chlorination at storage tanks,
- Targeted pipe cleaning and replacement.

4.2 HYDRAULIC MODELING CAPABILITIES

Full-featured and accurate hydraulic modeling is a prerequisite for doing effective water quality modeling. EPANET contains a state-of-the-art hydraulic analysis engine that includes the following capabilities:

- Places no limit on the size of the network that can be analyzed
- Computes friction headloss using the Hazen-Williams, Darcy-Weisbach, or Chezy-Manning formulas
- Includes minor head losses for bends, fittings, etc.
- Models various types of valves including shutoff, check, pressure regulating, and flow control valves
- Allows storage tanks to have any shape (i.e. diameter can vary with height)
- Considers multiple demand categories at nodes, each with its own pattern of time variation
- Models pressure-dependent flow issuing from emitters (sprinkler heads)
- Can base system operation on both simple tank level or timer controls and on complex rule-based controls.

4.3 STEPS IN USING EPANET

One typically carries out the following steps when using EPANET to model a water distribution system:

1. Draw a network representation of your distribution system or import a basic description of the network placed in a text file.

2. Edit the properties of the objects that make up the system.

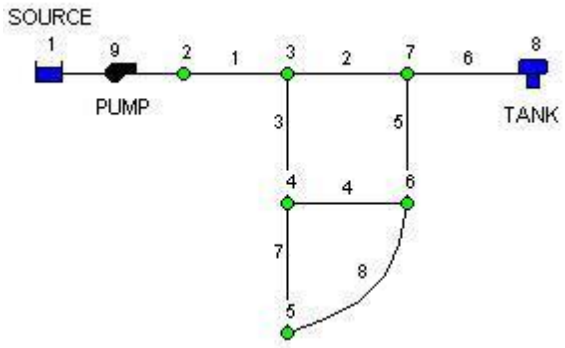
3. Describe how the system is operated.

4. Select a set of analysis options.

5. Run a hydraulic/water quality analysis.

6. View the results of the analysis.

4.4 PICTORIAL PRESENTATION OF DATA INPUT



Example Pipe Network

Node	Elevation (ft)	Demand (gpm)
1	700	0
2	700	0
3	710	150
4	700	150
5	650	200
6	700	150
7	700	0
8	830	0

Example Network Node Properties

Pipe	Length (ft)	Diameter (inches)	C-Factor
1	3000	14	100
2	5000	12	100
3	5000	8	100
4	5000	8	100
5	5000	8	100
6	7000	10	100
7	5000	6	100
8	7000	6	100

Example Network Pipe Properties

CHAPTER 5:- FIELD VISIT AND RECONNAISSANCE SURVEY

Field visits and reconnaissance survey were undertaken to identify the issues in water management system and gather basic information (secondary & primary data) on the water use, supply and wastewater management in the station. The activities undertaken and the findings of these visits are as mentioned below:

5.1 RECONNAISSANCE SURVEY

- During the reconnaissance survey, a walk through was conducted across the station and preliminary information & data were gathered from the concerned DLI station authorities.

- Survey was undertaken for the raw water sources, inlets and outlets of the underground and the overhead tanks, water distribution system for different uses (coach washing, coach filling, apron washing, platform washing, water booths & toilets, offices, waiting and running rooms, etc.),wastewater generation points, drains, etc.

- Basic information on the water supply and wastewater generation was collected from the authorities. Besides this, the locations for water flow and quality monitoring were discussed and finalised with the DLI Railway station officials.

5.2 FIELD MONITORING AND DATA COLLECTION

Based on the initial reconnaissance survey and preliminary study provided by the officials of Old Delhi Railway Station, a detailed investigative field exercise for water audit (including flow and water quality monitoring) was carried out by our team. The methodology of the water flow and water quality monitoring has been discussed in earlier section. The brief summary of this field visit comprised the following:

- Field measurements and flow monitoring at the identified locations in the station covering the platforms, service buildings and the washing line. The details of the flow monitoring locations and water quality monitoring are given in successive chapters.

- The flow monitoring involved measurements at various pipelines (closed conduits) through ultrasonic flow meters.

CHAPTER 6:- WATER SUPPLY AND DISTRIBUTION SYSTEM

Handling around 3, 00,000 passengers in a day, DLI railway station is one of the five main railway stations in Delhi division. The maintenance activities being carried out at the station coupled with the load of huge population transforms into a very high demand of water for the station premises. This chapter describes the water supply and distribution system of this railway station.

6.1 WATER USAGE AREAS IN DLI RAILWAY STATION

The trains either originate from a station or just pass through it. The ones which originate requires washing and cleaning of the coaches; the task of coach filling is done for both-the ones originating as well as the ones passing through the station. This section describes the various water usage areas in DLI railway station.

The water uses in a railway station can be deciphered into consumptive and non-consumptive uses. The consumptive uses include the water allocated for the drinking water booths whereas the non-consumptive use include coach washing, apron and platform washing etc.

COACH WASHING

Washing of coaches requires a significant amount of water. The originating trains are washed internally & externally. The station comprises of 8 washing lines (namely 18, 19, 20, 21, 22, 23 & 3, 4).

Figure 2 Coach Washing

COACH FILLING

The water in coaches is mainly used for sanitation purposes. The trains that originate from this station are filled mainly in the washing line area whereas the halting/passing trains are filled from the coach filling lines at the platform area laid parallel to the rail tracks. Around 1468 coaches are filled in the station area. There are 12 coach filling lines in the station area along the platform number 1 to 16. Platform number 1/2, 3/4 and 11/12 have common coach filling line.

Figure 3 Coach Filling

APRON WASHING

Aprons are the concrete flooring for the railway track in platform area. The station consists of 16 aprons from platform no. 1 – 16.

Figure 4 Apron Washing

PLATFORM WASHING

Washing platforms is another water usage area in the station. There are 16 working platforms which are washed occasionally.

WATER BOOTHS

Drinking water is provided through water booths for passengers. Each platform consists of several water booths.

OTHERS

Besides above, water is also used for domestic purposes at service buildings, offices, restaurants, restrooms, waiting rooms, police station, barracks, railway quarters, etc.

6.2 SOURCE OF WATER

The raw water is sourced from a Ranney well, constructed at the banks of river Yamuna, which is around 8 km from the DLI railway station. The raw water is supplied to the main underground tank near General Post Office entry gate of the station (Kashmiri gate side). The main underground tank is interconnected with the pump house UGT.

Before the raw water enters the main UGT from the Ranney well water supply line, a connection is given for the Lothian Bridge Colony (LBC) UGT which is used in emergency.

6.3 WATER SUPPLY AND DISTRIBUTION SYSTEM

DLI railway station consists of three underground and three overhead tanks (refer table 5.1). All these tanks together supply the entire station for all the water use activities. The detailed water supply and distribution network is shown later on.

Table 1Detail of UGTs and OHTs at DLI Railway Station

S. No.	Location of the UGT/OHT	Capacity (m^3)
1	Main UGT	450
2	Pump House UGT	450
3	Station UGT	100
4	OHT – 1	225
5	OHT – 2	450
6	OHT – 3	450

UNDERGROUND TANKS (UGT)

1. **Main Underground Tank**: The main UGT also gets water from NDLS if needed. This tank further has four outlets, one each for OHT-1, OHT-2, OHT-3 and pump house UGT.

2. **Pump House Underground Tank**: This tank receives water from three sources–one isfrom the interconnected pipeline from main UGT, second is from the tapping in the main Ranney well pipeline and third from Delhi Jal Board.

3. **Station Underground Tank**: Inlet for this tank is a tapping from the combined line forstation from OHT 2 & 3. Station UGT is located in railway parcel complex near PF 1 entry of the station. The outlet of this tank serves as the inlet for the minor OHT which further supplies to the station building near PF 1.

DRINKING WATER MANAGEMENT

Drinking water to the station is supplied through the main and the pump house UGT at DLI railway station. Before its supply for drinking purposes, the raw water is first disinfected through chlorination carried out at the pump house underground tank. After chlorination, water from the UGT passes through a rapid sand filter before it enters the OHT. The rapid sand filter consists of layers of pebbles along with that of sand & gravel and is considered as an effective technology for providing potable water.

Water after treatment from this system is supplied for drinking purposes to the water booths of all the platforms. The treated water is however also used for all the other non-potable uses as well viz. washing of coaches, platforms and aprons besides coach filling.

Figure 5Rapid Sand Filter

OVERHEAD TANKS (OHT)

1. **OHT-1**: This tank has two outlets; one is dedicated for the administrative buildingsthat include offices, Diesel Filling line, welding workshop, power cabin, and canteen and water plant on PF-16 and is called the power cabin line. The other outlet known as the running room line serves the running room, canteen, RMS (Rail Mail Service), offices, SSE C&W; SSE Electrical & RPF (Railway Police Force) barrack on platform 8 along with the water booths of platform 20.

2. **OHT-2**: This OHT has 2 outlets; one for the washing line 18 & 19 and the othersupplying the rest of the station excluding the washing line 18 & 19. The other outlet further has three distribution lines. Line 1 (known as Atari line) supplies water to coach filling lines of PF-1 & 2 and water booths of platform number 1. Line 2 (known as station line) supplies water to the platform 10/11 coach filling line; platform 9 and 5 coach filling line; platform 6 coach filling line and platform 7 coach filling line. It also supplies water to the SS bungalow, parcel go down and WL 3 & 4.

3. **OHT-3:** This tank supplements the demand of the OHT-2, since this is the main sourcefor the water supply at the station premises. With the two outlets of OHT-3; one outlet taps with the washing line 18 & 19 outlet of OHT-2 whereas the second outlet taps the line-2 i.e. the station line of OHT-2 that supplies water to the washing line 3 & 4 and platforms 5 to 11.

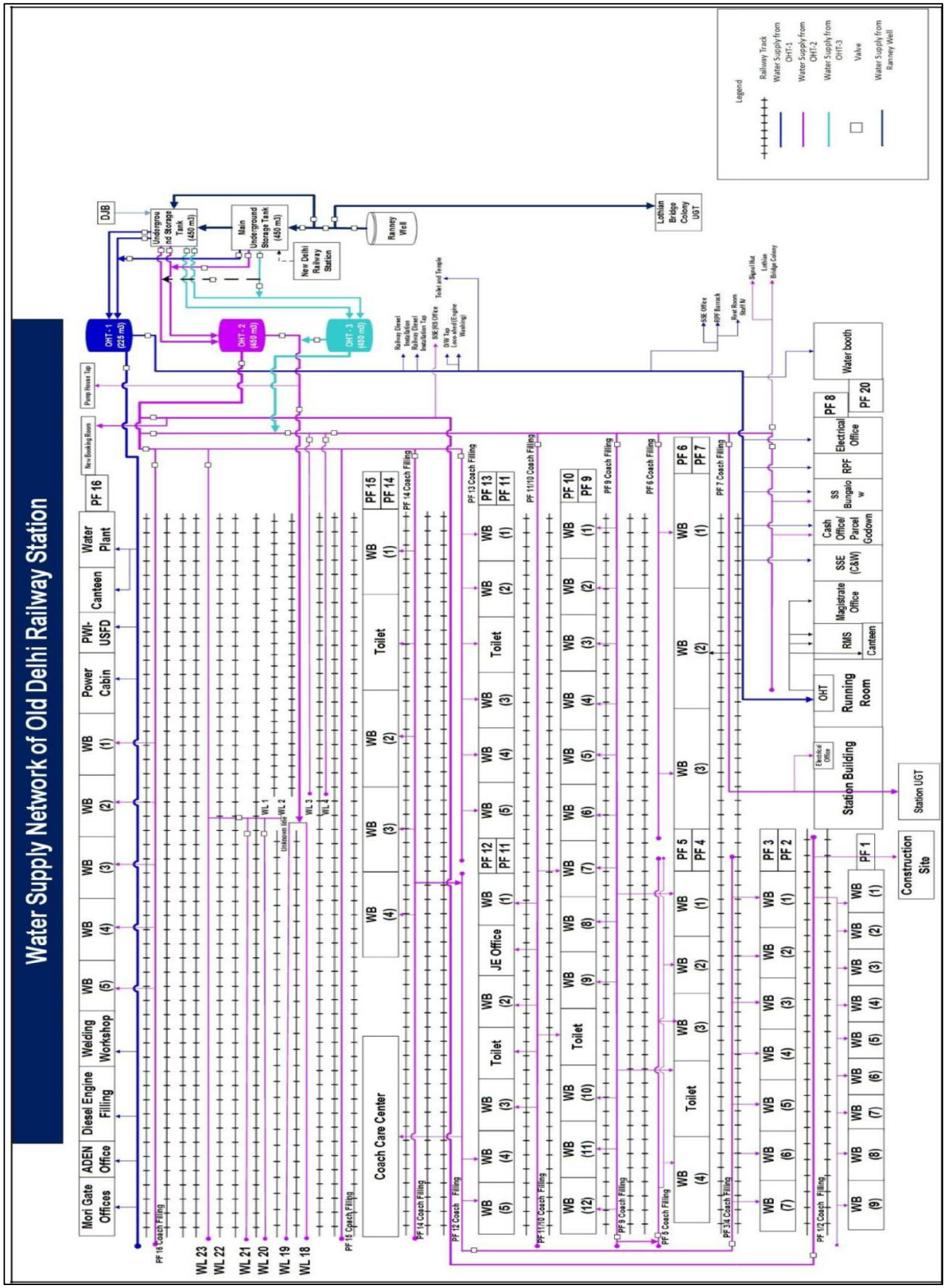
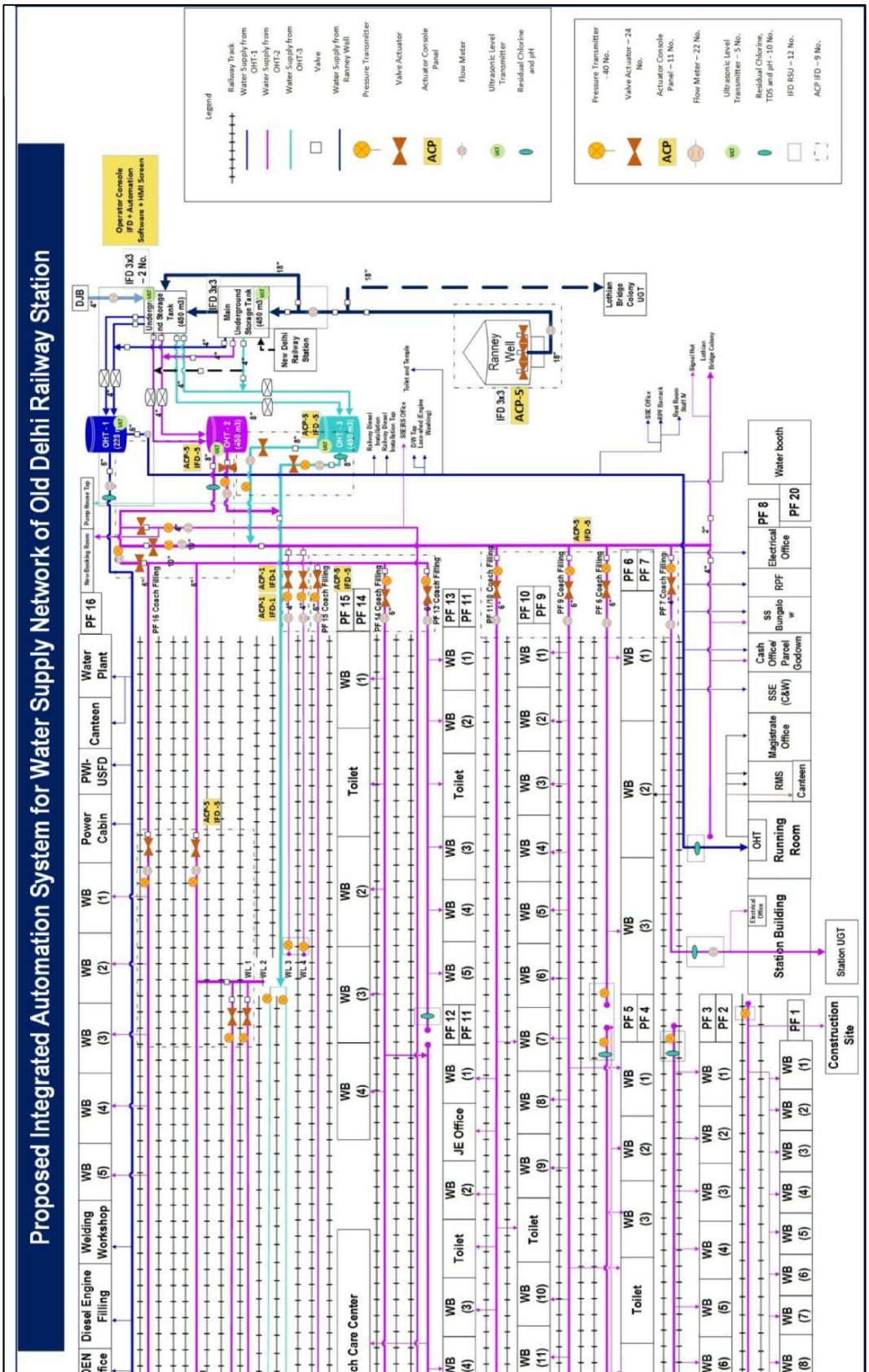


Figure 6 Existing Water Distribution Network

Fig


Proposed Integrated Automation System for Water Supply Network of Old Delhi Railway Station
Legend
Railway Track
Water Supply from OHT-1
Water Supply from OHT-2
Water Supply from OHT-3
Valve
Water Supply from Ranney Well
Pressure Transmitter
Valve Actuator
Actuator Console Panel
Flow Meter
Ultrasonic Level Transmitter
Residual Chlorine and pH
Pressure Transmitter – 40 No.
Valve Actuator – 24 No.
Actuator Console Panel – 11 No.
Flow Meter – 22 No.
Ultrasonic Level Transmitter – 5 No.
Residual Chlorine, TDS and pH - 10 No.
IFD RSU – 12 No.
ACP IFD – 9 No.
Operator Console IFD + Automation Software + HMI Screen
IFD 3x3 – 2 No.
DJB
Underground Storage Tank (450 m3)
Main Underground Storage Tank (450 m3)
IFD 3x3
New Delhi Railway Station
Ranney Well
ACP-5
IFD 3x3
Lothian Bridge Colony UGT
OHT - 1 (225 m3)
OHT - 2 (450 m3)
OHT - 3 (450 m3)
ACP-5 IFD-5
Pump House Tap
New Booking Room
PF 16
PF 16 Coach Filling
ACP-1 IFD-1
ACP-2 IFD-1
PF 15
PF 14
PF 14 Coach Filling
PF 13
PF 11
PF 13 Coach Filling
PF 11/10 Coach Filling
PF 10
PF 9
PF 9 Coach Filling
PF 6
PF 7
PF 6 Coach Filling
PF 7 Coach Filling
Water Plant
Canteen
PWI-USFD
Power Cabin
WB (1)
WB (2)
WB (3)
WB (4)
WB (5)
Welding Workshop
Diesel Engine Filling
Toilet
JE Office
PF 12
PF 5
PF 4
PF 3
PF 2
PF 1
Station Building
Parcel Office
OHT
Running Room
RMS
Canteen
Magistrate Office
SSE (C&W)
Cash Office/ Parcel Godown
SS Bungalow
RPF
Electrical Office
PF 8
PF 20
Water booth
Station UGT
Construction Site
Rubwy Diesel Fuel Diesel Installation Tap
SSE/BS Office
Toilet and Temple
DW Tap Lavatory/Urinal (Engine Washing)
SSE Office
ASM Barrack
Rest Room Staff M
Signal Hut
Lothian Bridge Colony

ure 7 Proposed Water Distribution Network

Table 2Network Tables – Nodes Detail

Node ID	Base Demand Litre/min	Demand Litre/min	Head meter
Junc 13	5	5.00	70.99
Junc 14	0	0.00	70.99
Junc 15	5	5.00	70.92
Junc 16	300	300.00	70.88
Junc 17	5	5.00	70.88
Junc 18	5	5.00	70.88
Junc 19	5	5.00	70.88
Junc 20	8	8.00	70.88
Junc 21	2	2.00	70.88
Junc 22	10	10.00	70.88
Junc 23	60	60.00	70.88
Junc 24	0	0.00	70.88
Junc 25	0	0.00	70.88
Junc 26	0	0.00	70.88
Junc 27	0	0.00	70.88
Junc 28	0	0.00	70.88
Junc 29	0	0.00	70.88
Junc 31	0	0.00	70.89
Junc 32	0	0.00	70.92
Junc 33	60	60.00	35.41
Junc 34	60	60.00	35.41
Junc 36	60	60.00	35.41
Junc 37	60	60.00	35.41
Junc 38	60	60.00	35.41

Junc 39	60	60.00	35.70
Junc 40	60	60.00	35.68
Junc 41	60	60.00	35.68
Junc 42	60	60.00	35.41
Junc 43	60	60.00	35.51
Junc 44	0	0.00	35.05
Junc 45	60	60.00	34.98
Junc 46	0	0.00	34.98
Junc 47	60	60.00	34.99
Junc 48	0	0.00	34.99
Junc 49	60	60.00	34.97
Junc 50	60	60.00	35.29
Junc 51	60	60.00	35.26
Junc 52	0	0.00	34.88
Junc 53	0	0.00	34.88
Junc 54	0	0.00	34.88
Junc 55	0	0.00	34.88
Junc 56	0	0.00	36.00
Junc 57	4	4.00	35.99
Junc 58	0	0.00	35.99
Junc 59	60	60.00	34.97
Junc 60	0	0.00	34.97
Junc 61	60	60.00	34.83
Junc 62	5	5.00	34.83
Junc 63	60	60.00	34.83
Junc 64	60	60.00	34.86

Junc 65	0	0.00	34.97
Junc 66	2	2.00	35.99
Junc 67	10	10.00	35.99
Junc 68	10	10.00	35.99
Junc 69	5	5.00	35.99
Junc 70	10	10.00	34.76
Junc 71	138	138.00	70.96
Junc 72	18	18.00	34.88
Junc 73	2	2.00	34.88
Junc 74	12	12.00	34.88
Junc 75	4	4.00	34.88
Junc 76	60	60.00	34.87
Junc 77	56	56.00	34.97
Junc 78	10	10.00	34.99
Junc 79	8	8.00	35.01
Junc 80	4	4.00	35.03
Junc 81	5	5.00	34.87
Junc 82	10	10.00	34.87
Junc 83	4	4.00	34.86
Junc 84	5	5.00	34.86
Junc 85	4	4.00	34.86
Junc 86	4	4.00	34.86
Junc 87	10	10.00	34.83
Junc 88	10	10.00	34.84
Junc 89	5	5.00	34.85
Junc 90	0	0.00	34.85
Junc 91	5	5.00	34.86

Junc 92	5	5.00	34.87
Junc 98	0	0.00	34.86
Junc 99	0	0.00	34.86
Junc 100	0	0.00	34.86
Junc 101	60	60.00	34.86
Junc 102	0	0.00	34.87
Junc 103	0	0.00	34.87
Junc 104	0	0.00	34.87
Junc 105	0	0.00	34.86
Junc 106	0	0.00	34.85
Junc 107	0	0.00	34.85
Junc 108	0	0.00	34.84
Junc 109	0	0.00	34.83
Junc 110	8	8.00	34.83
Junc 111	0	0.00	34.83
Junc 112	8	8.00	34.83
Junc 113	8	8.00	34.76
Junc 114	5	5.00	34.80
Junc 115	5	5.00	34.97
Junc 116	5	5.00	34.97
Junc 117	10	10.00	34.97
Junc 118	0	0.00	34.88
Junc 119	0	0.00	34.88
Junc 120	0	0.00	34.88
Junc 121	0	0.00	34.88
Junc 122	0	0.00	34.88
Junc 123	0	0.00	34.83

Junc 124	0	0.00	34.83
Junc 125	0	0.00	34.83
Junc 126	0	0.00	34.80
Junc 127	0	0.00	34.76
Junc 128	407	407.00	34.76
Junc 129	0	0.00	35.99
Junc 130	0	0.00	35.99
Junc 131	0	0.00	35.99
Junc 132	0	0.00	35.99
Junc 133	0	0.00	34.97
Junc 134	0	0.00	34.97
Junc 135	0	0.00	34.97
Junc 136	0	0.00	34.98
Junc 137	0	0.00	34.98
Junc 138	0	0.00	34.98
Junc 139	0	0.00	35.03
Junc 140	0	0.00	35.01
Junc 141	0	0.00	34.99
Junc 142	60	60.00	35.25
Junc 143	0	0.00	34.97
Junc 1	60	60.00	35.85
Junc 6	60	60.00	35.78
Resvr 5	#N/A	-262.53	0.00
Resvr 7	#N/A	-619.76	0.00
Tank OHT1	#N/A	-280.47	71.00
Tank OHT2	#N/A	-1450.00	36.00
Tank OHT3	#N/A	-53.24	36.00

Source:-Railway land development authoriy

Table 3Network Tables – Pipes Detail

Link ID	Length m	Diameter mm	Roughness mm	Flow Litre/min	Velocity m/s	Unit Head loss m/km	Friction Factor	Status
Pipe 16	44.13	450	0.26	1759.88	0.18	0.08	0.021	Open
Pipe 17	355.03	150	0.26	31.00	0.03	0.01	0.042	Open
Pipe 20	9.76	150	0.26	80.00	0.08	0.06	0.033	Open
Pipe 23	9.14	150	0.26	914.00	0.86	6.12	0.024	Open
Pipe 25	92.87	150	0.26	360.00	0.34	1.02	0.026	Open
Pipe 26	7.62	150	0.26	240.00	0.23	0.48	0.027	Open
Pipe 27	3.67	150	0.26	120.00	0.11	0.13	0.031	Open
Pipe 29	104.74	150	0.26	60.00	0.06	0.04	0.035	Open
Pipe 30	105.35	150	0.26	60.00	0.06	0.04	0.035	Open
Pipe 31	105.35	150	0.26	60.00	0.06	0.04	0.035	Open
Pipe 32	104.13	150	0.26	60.00	0.06	0.04	0.035	Open
Pipe 33	97.13	150	0.26	120.00	0.11	0.13	0.031	Open
Pipe 34	6.58	150	0.26	60.00	0.06	0.04	0.035	Open
Pipe 35	9.70	150	0.26	10.00	0.01	0.00	0.048	Open

Pipe 36	14.15	150	0.26	70.00	0.07	0.05	0.034	Open
Pipe 37	8.08	150	0.26	2.00	0.00	0.00	0.000	Open
Pipe 38	8.96	150	0.26	8.00	0.01	0.00	0.081	Open
Pipe 39	10.38	150	0.26	72.00	0.07	0.05	0.034	Open
Pipe 40	17.22	150	0.26	80.00	0.08	0.06	0.033	Open
Pipe 41	7.99	150	0.26	5.00	0.00	0.00	0.077	Open
Pipe 42	28.58	150	0.26	85.00	0.08	0.07	0.033	Open
Pipe 43	8.27	150	0.26	5.00	0.00	0.00	0.149	Open
Pipe 44	33.74	150	0.26	90.00	0.08	0.08	0.032	Open
Pipe 45	9.26	150	0.26	5.00	0.00	0.00	0.066	Open
Pipe 48	24.06	150	0.26	395.00	0.37	1.22	0.026	Open
Pipe 49	67.33	150	0.26	400.00	0.38	1.25	0.026	Open
Pipe 50	8.04	150	0.26	5.00	0.00	0.00	0.077	Open
Pipe 51	7.51	150	0.26	300.00	0.28	0.73	0.027	Open
Pipe 52	29.08	150	0.26	95.00	0.09	0.09	0.032	Open
Pipe 53	7.56	150	0.26	10.00	0.01	0.00	0.041	Open
Pipe 54	27.41	150	0.26	151.00	0.14	0.20	0.029	Open

Pipe 55	6.34	150	0.26	10.00	0.01	0.00	0.049	Open
Pipe 56	27.71	150	0.26	161.00	0.15	0.23	0.029	Open
Pipe 57	7.72	150	0.26	5.00	0.00	0.00	0.080	Open
Pipe 58	27.71	150	0.26	166.00	0.16	0.24	0.029	Open
Pipe 59	5.73	150	0.26	0.00	0.00	0.00	0.000	Open
Pipe 60	32.59	150	0.26	166.00	0.16	0.24	0.029	Open
Pipe 61	8.03	150	0.26	5.00	0.00	0.00	0.077	Open
Pipe 62	25.88	150	0.26	171.00	0.16	0.25	0.029	Open
Pipe 63	8.16	150	0.26	5.00	0.00	0.00	0.075	Open
Pipe 64	37.08	150	0.26	176.00	0.17	0.27	0.029	Open
Pipe 66	11.28	150	0.26	81.00	0.08	0.07	0.033	Open
Pipe 67	23.21	150	0.26	141.00	0.13	0.18	0.030	Open
Pipe 68	101.39	150	0.26	60.00	0.06	0.04	0.035	Open
Pipe 69	8.24	300	0.26	526.00	0.12	0.07	0.025	Open
Pipe 70	14.62	300	0.26	466.00	0.11	0.05	0.025	Open
Pipe 72	47.23	150	0.26	0.00	0.00	0.00	0.000	Open
Pipe 73	14.01	150	0.26	32.00	0.03	0.01	0.041	Open

Pipe 74	29.84	150	0.26	20.00	0.02	0.00	0.031	Open
Pipe 75	12.49	150	0.26	18.00	0.02	0.00	0.030	Open
Pipe 76	21.77	150	0.26	18.00	0.02	0.00	0.029	Open
Pipe 77	74.38	150	0.26	143.00	0.13	0.18	0.030	Open
Pipe 79	17.11	150	0.26	2.00	0.00	0.00	0.225	Open
Pipe 80	17.59	150	0.26	12.00	0.01	0.00	0.036	Open
Pipe 81	16.50	150	0.26	4.00	0.00	0.00	0.117	Open
Pipe 82	23.21	150	0.26	20.00	0.02	0.00	0.032	Open
Pipe 83	8.91	150	0.26	10.00	0.01	0.00	0.043	Open
Pipe 84	31.97	150	0.26	10.00	0.01	0.00	0.046	Open
Pipe 85	10.96	150	0.26	5.00	0.00	0.00	0.084	Open
Pipe 86	25.88	150	0.26	5.00	0.00	0.00	0.095	Open
Pipe 87	9.76	150	0.26	5.00	0.00	0.00	0.095	Open
Pipe 88	18.51	150	0.26	0.00	0.00	0.00	0.000	Open
Pipe 89	59.10	150	0.26	80.00	0.08	0.06	0.033	Open
Pipe 90	33.12	150	0.26	152.00	0.14	0.20	0.029	Open
Pipe 91	7.25	150	0.26	5.00	0.00	0.00	0.127	Open

Pipe 92	21.62	150	0.26	147.00	0.14	0.19	0.030	Open
Pipe 93	6.95	150	0.26	10.00	0.01	0.00	0.044	Open
Pipe 94	30.45	150	0.26	137.00	0.13	0.17	0.030	Open
Pipe 95	7.55	150	0.26	4.00	0.00	0.00	0.127	Open
Pipe 96	47.20	150	0.26	73.00	0.07	0.05	0.034	Open
Pipe 97	7.62	150	0.26	5.00	0.00	0.00	0.081	Open
Pipe 98	24.66	150	0.26	68.00	0.06	0.05	0.034	Open
Pipe 99	8.19	150	0.26	4.00	0.00	0.00	0.117	Open
Pipe 100	28.93	150	0.26	64.00	0.06	0.04	0.035	Open
Pipe 101	6.95	150	0.26	4.00	0.00	0.00	0.138	Open
Pipe 102	16.51	150	0.26	60.00	0.06	0.04	0.035	Open
Pipe 103	27.41	150	0.26	80.00	0.08	0.06	0.033	Open
Pipe 104	23.45	150	0.26	80.00	0.08	0.06	0.033	Open
Pipe 105	18.52	150	0.26	80.00	0.08	0.06	0.033	Open
Pipe 106	26.12	150	0.26	5.00	0.00	0.00	0.094	Open
Pipe 107	7.00	150	0.26	8.00	0.01	0.00	0.052	Open
Pipe 108	8.66	8	0.26	0.00	0.00	0.00	0.000	Open

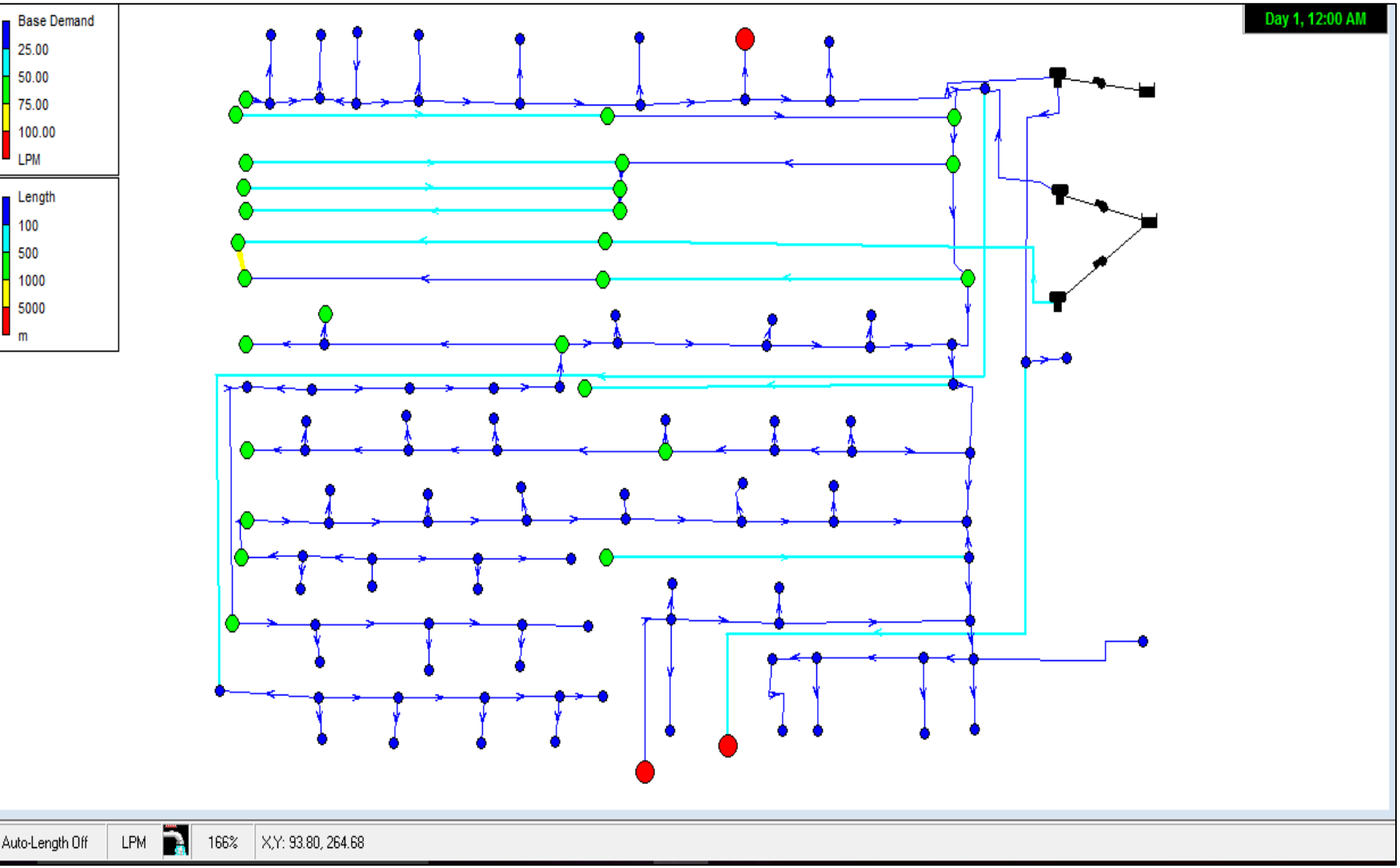
Pipe 109	24.06	150	0.26	13.00	0.01	0.00	0.036	Open
Pipe 110	17.97	150	0.26	13.00	0.01	0.00	0.035	Open
Pipe 111	10.34	150	0.26	8.00	0.01	0.00	0.058	Open
Pipe 112	24.73	150	0.26	21.00	0.02	0.00	0.032	Open
Pipe 113	9.53	150	0.26	2.00	0.00	0.00	0.202	Open
Pipe 114	22.23	150	0.26	29.00	0.03	0.01	0.042	Open
Pipe 115	10.49	150	0.26	10.00	0.01	0.00	0.044	Open
Pipe 116	24.36	150	0.26	19.00	0.02	0.00	0.031	Open
Pipe 117	10.46	150	0.26	10.00	0.01	0.00	0.044	Open
Pipe 118	21.01	150	0.26	9.00	0.01	0.00	0.050	Open
Pipe 119	10.49	150	0.26	5.00	0.00	0.00	0.088	Open
Pipe 120	12.11	150	0.26	4.00	0.00	0.00	0.119	Open
Pipe 121	27.83	150	0.26	31.00	0.03	0.01	0.042	Open
Pipe 122	42.36	300	0.26	407.00	0.10	0.04	0.026	Open
Pipe 123	30.46	150	0.26	425.00	0.40	1.40	0.026	Open
Pipe 124	8.22	150	0.26	5.00	0.00	0.00	0.112	Open
Pipe 125	6.94	150	0.26	8.00	0.01	0.00	0.052	Open

Pipe 126	53.22	150	0.26	430.00	0.41	1.43	0.026	Open
Pipe 127	15.60	150	0.26	256.00	0.24	0.54	0.027	Open
Pipe 128	6.37	150	0.26	10.00	0.01	0.00	0.048	Open
Pipe 129	41.72	150	0.26	266.00	0.25	0.58	0.027	Open
Pipe 130	6.21	150	0.26	8.00	0.01	0.00	0.058	Open
Pipe 131	28.93	150	0.26	274.00	0.26	0.61	0.027	Open
Pipe 132	7.25	150	0.26	4.00	0.00	0.00	0.133	Open
Pipe 133	103.22	150	0.26	60.00	0.06	0.04	0.035	Open
Pipe 134	18.05	150	0.26	80.00	0.08	0.06	0.033	Open
Pipe 135	93.48	150	0.26	183.12	0.17	0.29	0.028	Open
Pipe 137	109.07	150	0.26	123.12	0.12	0.14	0.030	Open
Pipe 139	66.32	150	0.26	116.00	0.11	0.13	0.031	Open
Pipe 140	6.34	150	0.26	56.00	0.05	0.03	0.036	Open
Pipe 141	22.30	150	0.26	60.00	0.06	0.04	0.035	Open
Pipe 142	25.38	150	0.26	10.00	0.01	0.00	0.045	Open
Pipe 143	11.43	150	0.26	5.00	0.00	0.00	0.054	Open
Pipe 145	14.06	150	0.26	1728.88	1.63	21.26	0.024	Open

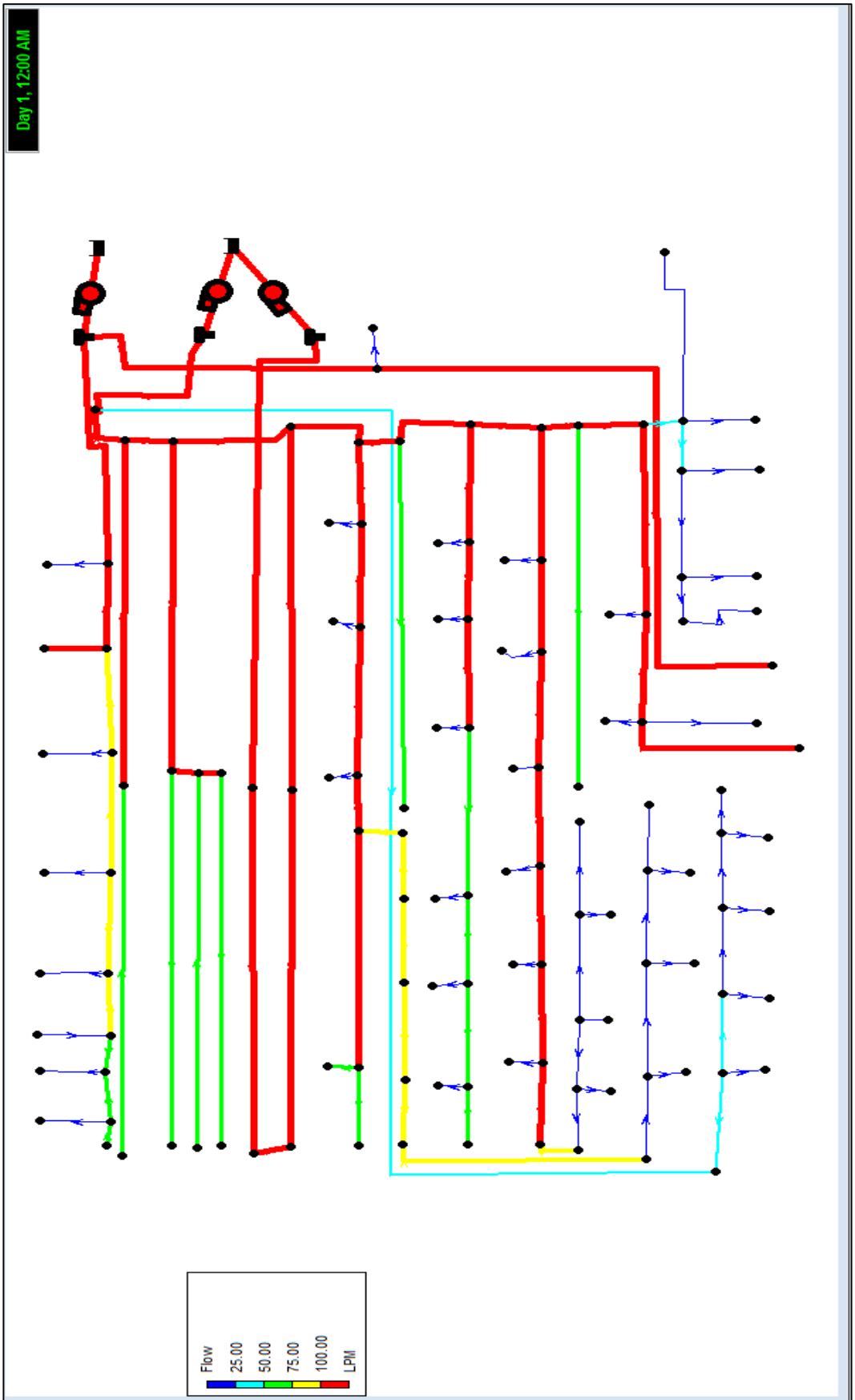
Pipe 146	10.97	150	0.26	1548.88	1.46	17.13	0.024	Open
Pipe 147	28.17	150	0.26	1128.88	1.06	9.23	0.024	Open
Pipe 148	170.68	150	0.26	138.00	0.13	0.17	0.030	Open
Pipe 149	16.16	300	0.26	702.00	0.17	0.11	0.024	Open
Pipe 150	8.83	150	0.26	36.00	0.03	0.02	0.040	Open
Pipe 151	19.86	150	0.26	1192.00	1.12	10.26	0.024	Open
Pipe 152	20.57	150	0.26	854.00	0.81	5.36	0.024	Open
Pipe 153	23.08	150	0.26	278.00	0.26	0.63	0.027	Open
Pipe 3	139.70	150	0.26	363.12	0.34	1.04	0.026	Open
Pipe 4	100.18	150	0.26	303.12	0.29	0.74	0.027	Open
Pipe 1	1000	150	0.26	243.12	0.23	0.49	0.027	Open
Pump P1	#N/A	#N/A	#N/A	262.53	0.00	-71.00	0.000	Open
Pump P2	#N/A	#N/A	#N/A	309.88	0.00	-36.00	0.000	Open
Pump P3	#N/A	#N/A	#N/A	309.88	0.00	-36.00	0.000	Open

SOURCE:-Railway land development authority

Figure 8 Demand Length of Water Distribution Network


Base Demand
25.00
50.00
75.00
100.00
LPM
Length
100
500
1000
5000
m
Day 1, 12:00 AM
Auto-Length Off
LPM
166%
X,Y: 93.80, 264.68

Fig



ure 9 Flow of Water Distribution Network

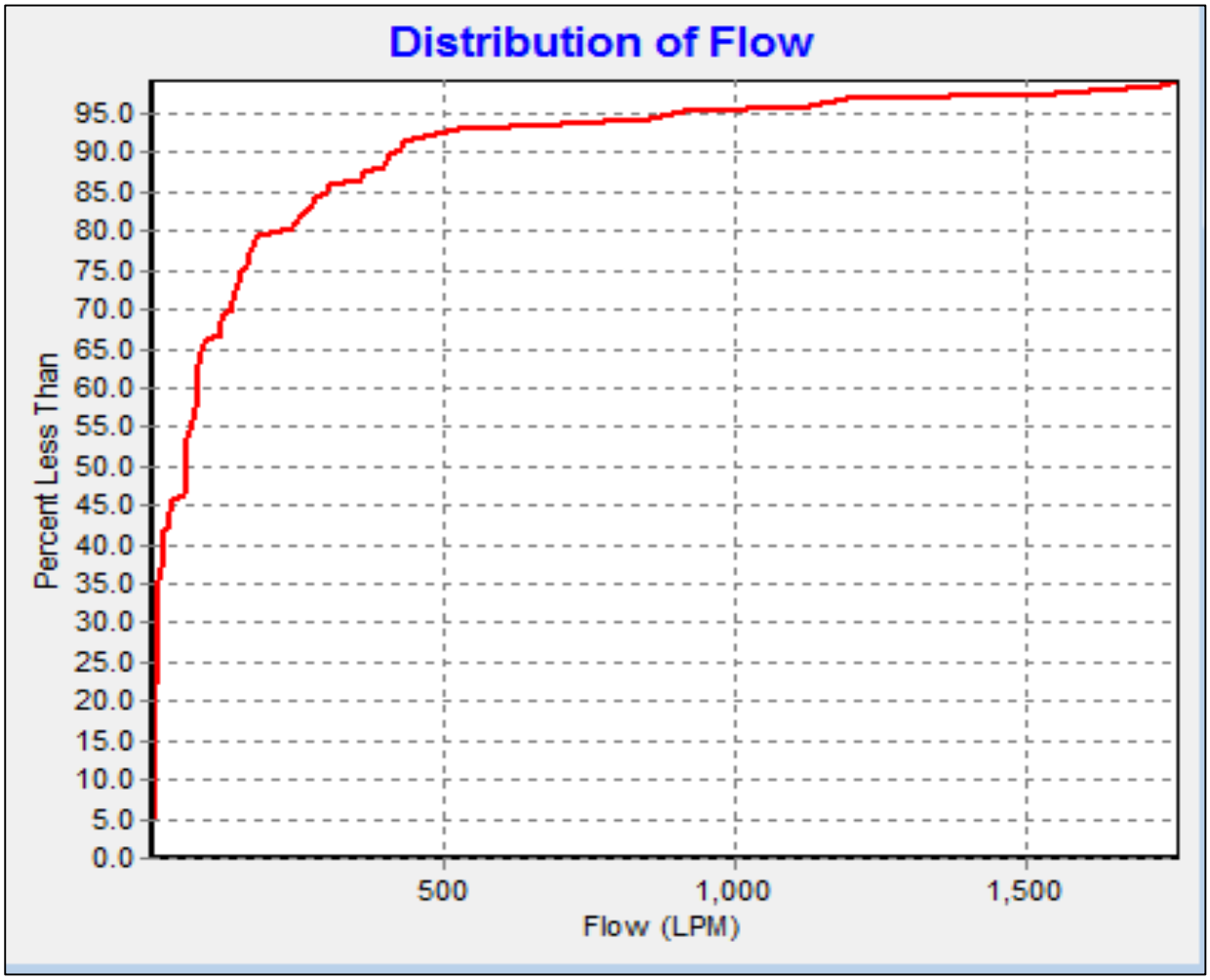


Figure 10 Flow curve of Water Distribution Network

Figure 11
Friction Factor

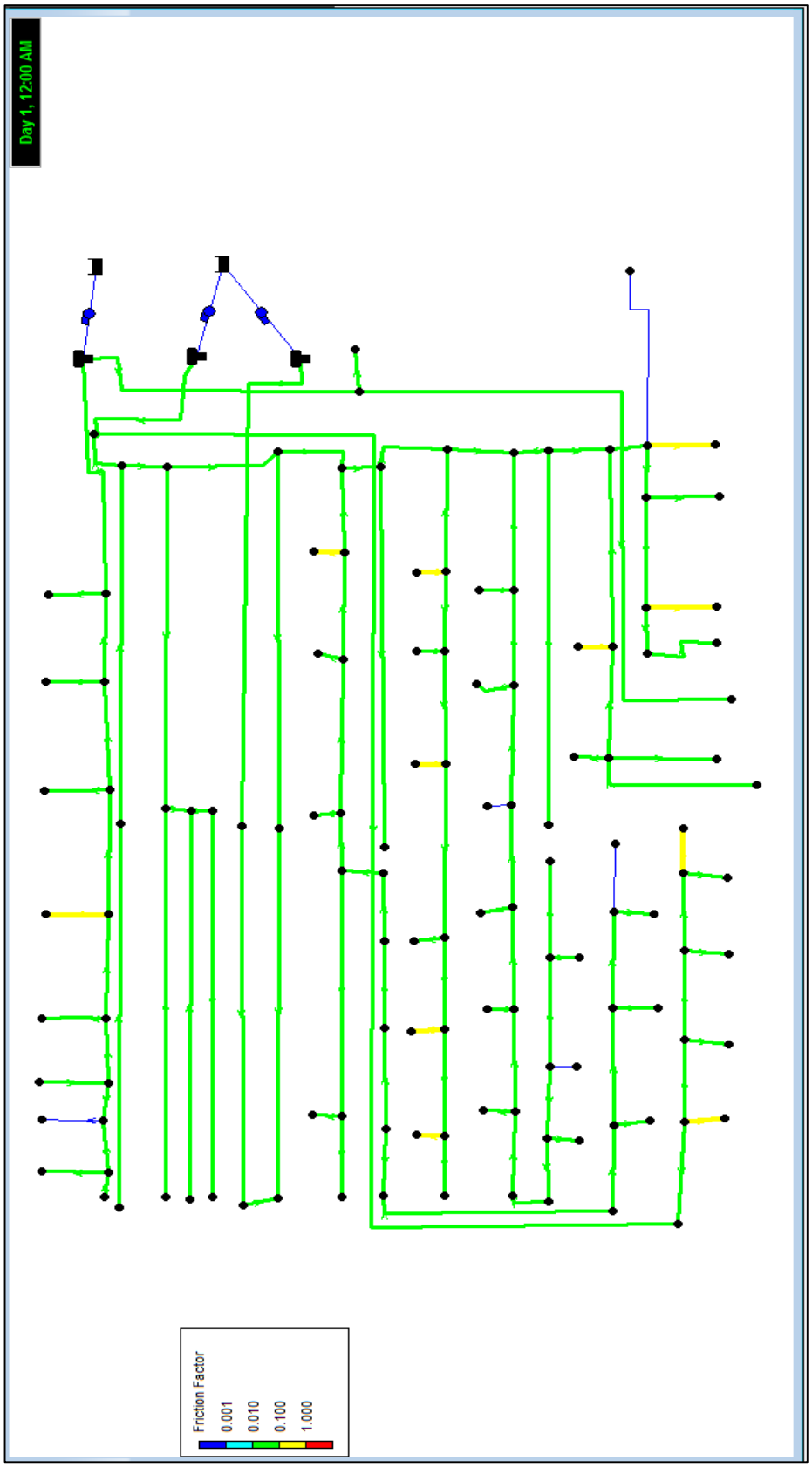
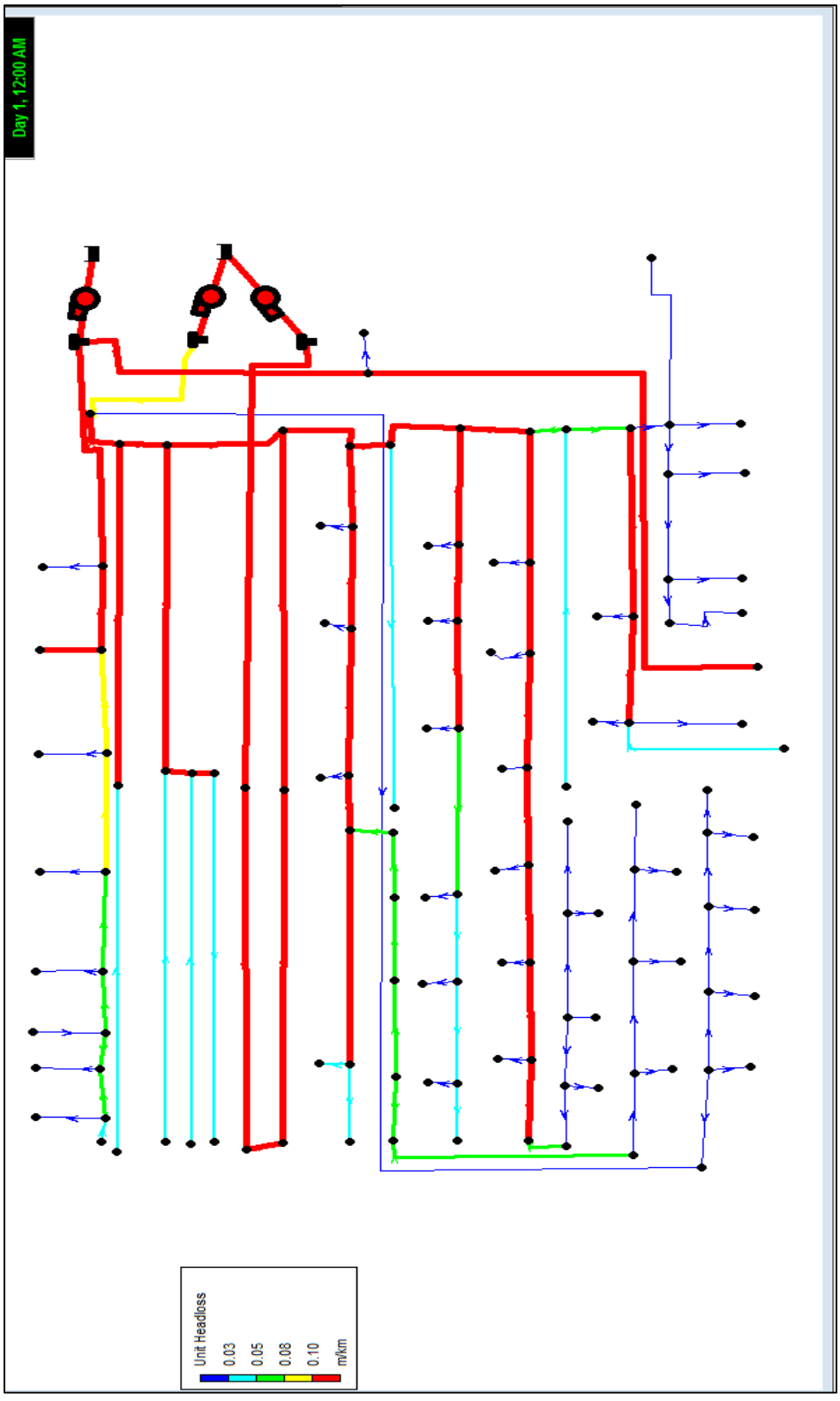


Diagram of Water Distribution Network

Figure 12 Unit Heat Loss of



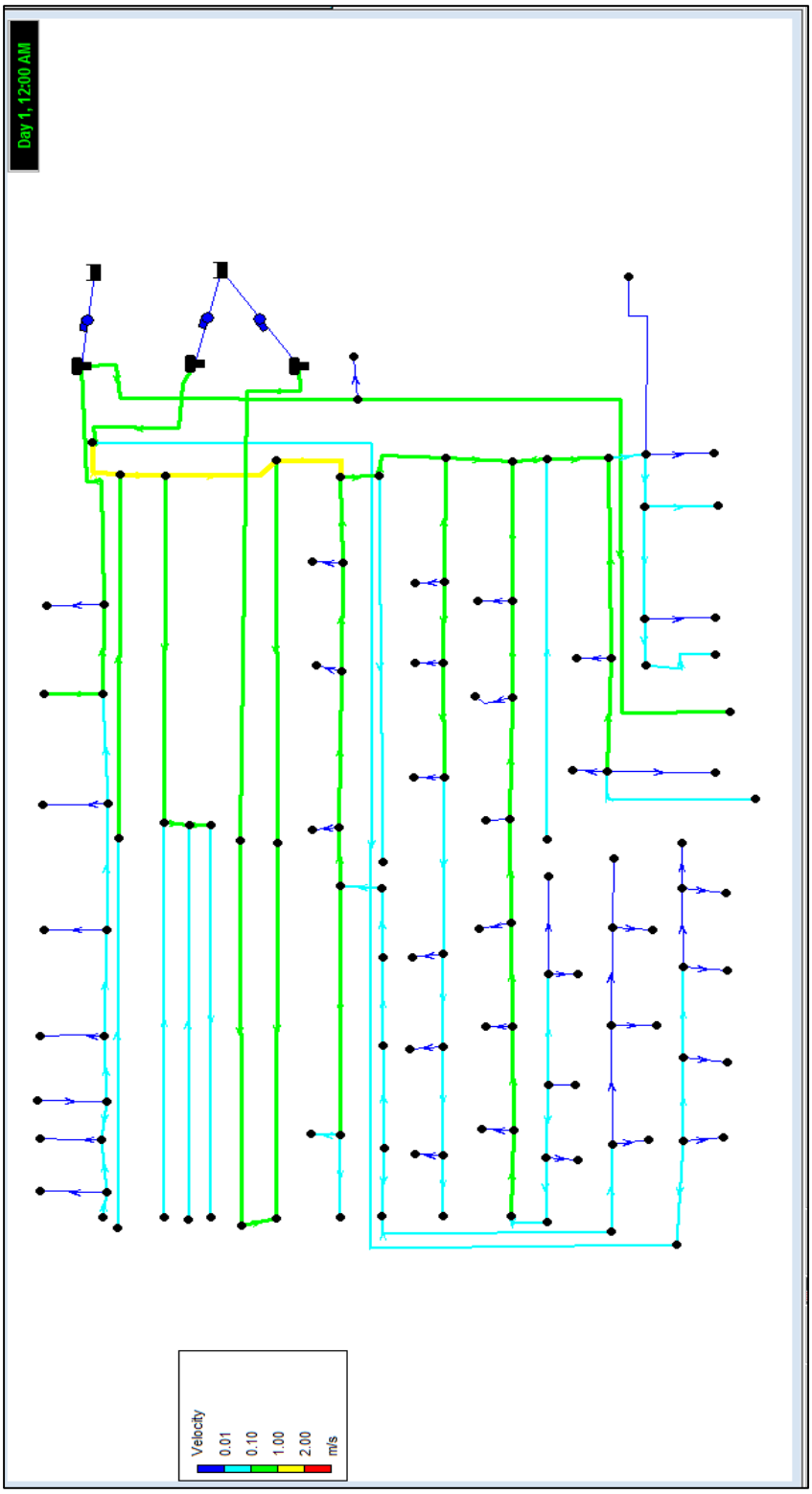
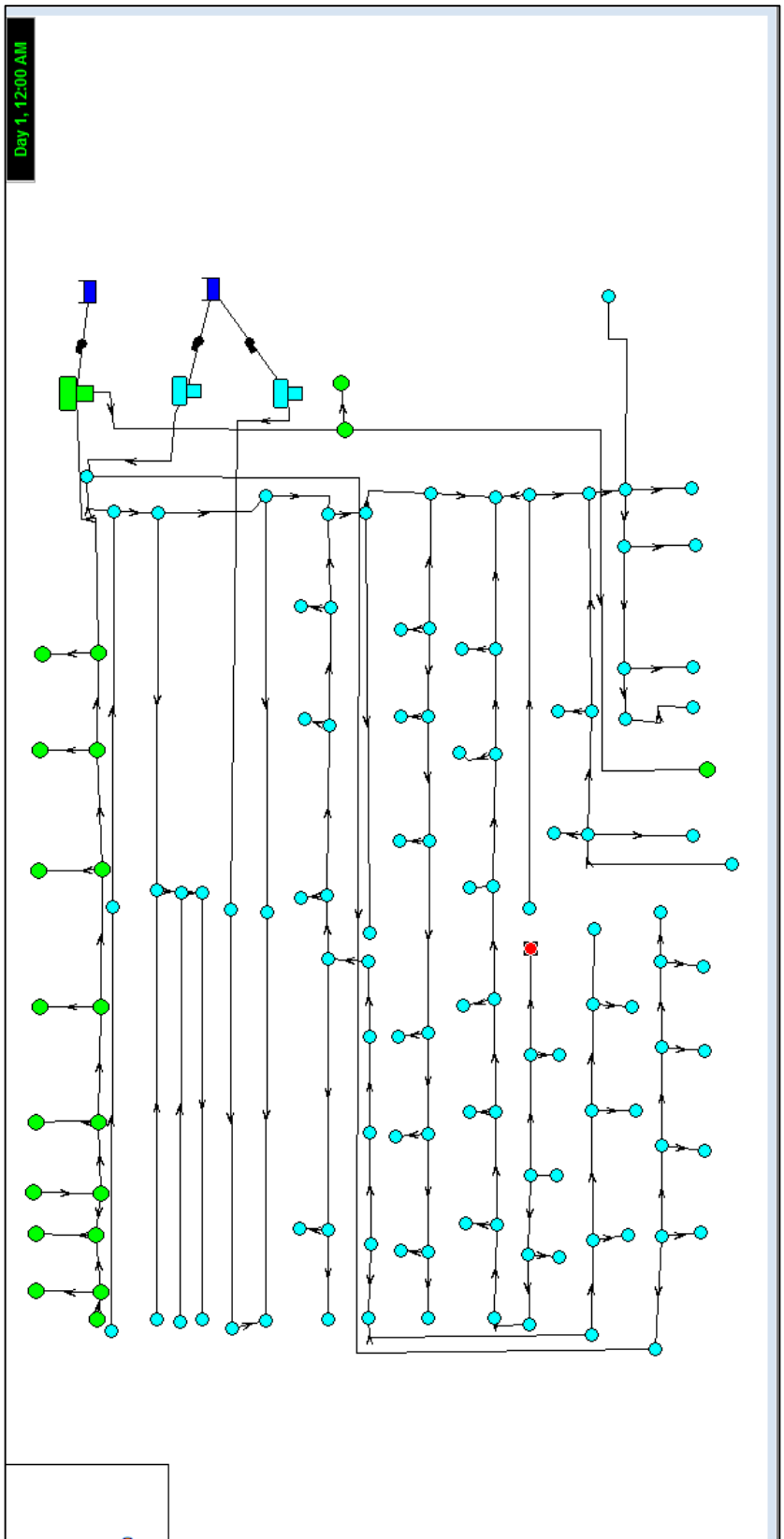

Day 1, 12:00 AM
Velocity
0.01
0.10
1.00
2.00
m/s

Figure 13 Velocity Diagram of Water Distribution Network


Day 1, 12:00 AM

Distributuion Diagram

CHAPTER7:-WATER AUDIT

Water audit helps in development of an integrated water management strategy, which optimizes efficient use of water, improves water productivity, reduces losses and helps in identifying interventions for water conservation such as recycling and reuse of wastewater for various process and non-process uses, rain water harvesting & groundwater recharge. The activities ensure co-benefits in energy saving, treatment costs, water quality improvement etc.

Water audit exercise conducted for DLI Railway Station is an attempt towards improvement in water management at the station. This section highlights the major findings of the water audit exercise carried out at the station.

7.1 WATER AUDIT FINDINGS & WATER BALANCE OF THE STATION

As discussed earlier in order to assess the existing conditions and suggest recommendations for improving water supply and wastewater management, complete water audit comprising the water flow measurement, assessment of leakages and losses as well as water quality assessment was undertaken. The approach and methodology for the same is discussed in chapter-2. The findings of the assessment and the current water balance are presented in subsequent sections.

Flow measurements were undertaken for the entire water supply and distribution network at more than 75 important selected locations. The list of these locations/points where the flow measurements were undertaken as well as the measured values of the flows (volume) is presented in the subsequent sections.

The following table presents the list of locations along with the observed values of flow measurements conducted at DLI Railway Station.

Table 4 Locations and the measured flow values of flow monitoring conducted

S. No	Locations	m^3/day
1	Water supply from Ranney well to main UGT	6450.0
2	Water supply to main UGT after tapping for Lothian bridge Colony	6434.0
3	Water supply from UGT to OHT-1 before sand filter inlet 1	393.0
4	Water supply from UGT to OHT-1 before sand filter inlet 2	274.0
5	Water supply to OHT-1 from UGT after Sand filter inlet 1	382.0
6	Water supply to OHT-1 from UGT after Sand filter inlet 2	264.0
7	Water supply to Running room from OHT-1	317.0
8	Water supply to railway diesel installation (near OHT 1, tapping from running room outlet)	6.0
9	Water supply to railway diesel installation (tapping from running room outlet)	2.0
10	Water supply to loco shed from running room line	18.0
11	Water supply to toilet and temple from running room line	3.0
12	Water supply to SSE & yard office	0.2
13	Water supply to RPF Barrack	5.0
14	Water supply to rest room staff IV	6.0
15	Water supply to electrical office from running room line	2.0
16	Water supply to water booth from running room line on PF-20	0.2
17	Water supply to RPF office from running room line	4.0
18	Water supply to SS Bungalow from running room line	6.0
19	Water supply to cash office from running room line	4.0
20	Water supply to running room roof RO plant	52.0
21	Water supply to running room OHT from running room line before RO plant	138.0
22	Water supply to magistrate office from running room OHT	2.0
23	Water supply to RMS from running room OHT	23.0
24	Water supply to RMS from running room OHT	2.0
25	Water supply to power cabin & water plant from OHT-1	452.0
26	Water supply to water plant from OHT-1 (Power cabin line)	196.0
27	Water supply to water plant canteen from OHT-1 (Power Cabin(PC) line)	15.3
28	Water supply to PWI from OHT-1 (PC Line)	0.0
29	Water supply to Power cabin from OHT-1 (PC line)	4.0
30	Water supply to welding workshop water tap supply from OHT-1 (PC line)	2.0
31	Water supply to diesel engine filling supply from OHT-1 PC Line	17.0
32	Water supply to ADEN office - tapping one from OHT-1 PC Line	1.2
33	Water supply to mori gate side offices from OHT-1 PC Line	8.2
34	Water supply from UGT to OHT-2 before sand filter inlet 1	1677.0
35	Water supply from UGT to OHT-2 before sand filter inlet 2	1692.0

36	Water supply to OHT-2 from UGT after Sand filter inlet 1	1625.0
37	Water supply to OHT-2 from UGT after Sand filter inlet 2	1628.0
38	Water supply to station from OHT-2	3340.5
39	Water supply to washing line from OHT-2	2.0
40	Overflow of OHT-2	87.0
41	Over flow of OHT-1	19.0
42	Water supply to Atari Line from OHT-2	264.0
43	Water supply to station from OHT-2	1149.0
44	Water supply to coach filling lines	1928.0
45	Water supply to SSE/RS office from Atari line	0.0
46	Water supply to PF1&2 coach filling	220.0
47	Water supply to water booth common header on PF-1	42.0
48	Water supply to construction site from PF1 CF line	12.0
49	Water supply to new booking from Atari line	13.0
50	Water supply to washing line 3 from OHT 2	41.0
51	Water supply to washing line 4 from OHT 2	67.0
52	Water supply to PF 10&11 CF line from OHT2	307.0
53	Water supply to PF 9 CF line from OHT2	445.0
54	Water supply to PF 6 CF line from OHT2	71.0
55	Water supply to PF 7 CF line from OHT3	758.0
56	Water supply to offices from OHT 2	28.0
57	Water supply to WB 1 PF 11&12	4.0
58	Water supply to WB 2 PF 11&13	3.0
59	Water supply to WB 3 PF 11&14	0.1
60	Water supply to JE Office from PF 10&11 CF line	1.0
61	Water supply to WB 1 PF 9&10	0.6
62	Water supply to WB 2 PF 9&10	19.0
63	Water supply to WB 3 PF 9&10	0.6
64	Water supply to WB 4 PF 9&10	3.0
65	Water supply to WB 5 PF 9&10	7.0
66	Water supply to WB 6 PF 9&10	2.0
67	Water supply to WB 7 PF 9&10	2.0
68	Water supply to WB 8 PF 9&10	0.5
69	Water supply to WB 9 PF 9&10	2.0
70	Water supply to WB 10 PF 9&10	9.0
71	Water supply to WB 11 PF 9&10	1.0
72	Water supply to PF 5CF line from PF 9 CF line	56.0
73	Water supply to water booth of PF4&5 common header	37.0
74	Water supply to WB 3 from PF 5 CF Line	1.0
75	Water supply to Toilet on PF 4&5 from PF 5 CF Line	8.0

CHAPTER 8:-- WATER CONSUMPTION FOR VARIOUS PURPOSES (FIGURES)

8.1 WATER CONSUMPTION IN VARIOUS ACTIVITIES AT DLI RAILWAY STATION

The following section presents the water consumption for each of the water usage areas in the railway station as observed during the water audit.

COACH FILLING

About 2419 m3/day of water was used/ consumed for filling 1468 coaches including both the filling at washing line and that at platform area. The quantum of water that is being consumed during coach filling at platform area is about 1269 m3/day and about 1150 m3/day of water is consumed in washing lines. It may be noted that the number of trains halting at DLI railway station is more than the ones originating from it.

COACH WASHING

Water consumption for coach washing was observed to be about 271m3/day.

APRON WASHING

About 216 m3/day i.e. 3% of total water was used to wash 15 platform aprons once in a day.

PLATFORM WASHING

The platforms at DLI railway station are washed occasionally.

WATER BOOTHS

About 380 m3 of water is consumed daily for the purpose of drinking from the water booths. This accounts for 4% of the total water consumption by the DLI railway station.

OFFICES

About 914m3/day, which is 19% of the total intake water, is used in offices at the station that includes booking office, police stations, engineering offices, Service buildings, Waiting rooms, rest rooms and running rooms etc.

OTHERS

Other water consuming areas includes toilets on platforms, canteen and railway quarters. About 1539 m3/day of water is consumed in these activities. This volume of water also includes the total water that is under storage in the UGTs and OHTs.

- A total of 643 m3/day of water is used for other activities that include toilets on platforms, canteen and quarters. This quantity also includes the total water that is under storage in the UGTs and OHTs.

- **PF toilets:** The water supplied to toilets on platform accounts for about 26m3/day.

- **Canteen/restaurants:** About 15 m3/day of water is supplied to the canteens and restaurants in the station premises.

- **Railway Staff Quarters:** About 21m3/day is supplied at railway quarters at Lothian Bridge colony.

- **Diesel Engine Installation:** The water supplied to the diesel engine installation accounted for about 17m3/day.

- About 12 m3/day of water is supplied for the construction activities near PF 1 and nearly 3m3/day is supplied to the temple near OHT 2.

- **Storage:** Nearly 549m3/day was under storage in the UGTs and OHTs out of the total water supplied to the station from the Ranney well and DJB.

LEAKAGES AND LOSSES

Considering water loss due to leakages in the water supply and distribution system was observed during the water audit of the entire DLI railway station. There were many locations where wastage and/or leakages of water were observed (refer table 3). Attempts were made to estimate the quantum of water lost at these locations. There exists a significant opportunity to save considerable amount of water at DLI railway station by curbing the leakages/losses through appropriate interventions.

Table 5Details of observed leakages at DLI Railway Station

S. No	Locations	Volume (m^3/day)
1	Leakages at Platform No - 1 Coach Filling	9
2	Leakages at Platform No - 3 & 4 Coach Filling	88
3	Leakages at Platform No - 5 Coach Filling	13
4	Leakages at Platform No - 6 Coach Filling	34
5	Leakages at Platform No - 7 Coach Filling	174
6	Leakages at Platform No - 9 Coach Filling	49
7	Leakages at Platform No - 10 & 11 Coach Filling	10
8	Leakages at Platform No - 12 Coach Filling	0
9	Leakages at Platform No - 13 Coach Filling	29
10	Leakages at Platform No - 14 Coach Filling	20
11	Leakages at Platform No - 15 Coach Filling	25
12	Leakages at Platform No - 16 Coach Filling	68
13	Leakages at Washing Line No – 3	20
14	Leakages at Washing Line No – 4	18
15	Leakages at Washing Line No – 18	66
16	Leakages at Washing Line No – 19	35
17	Leakages at Washing Line No – 20	68
18	Leakages at Washing Line No – 21	48
19	Leakages at Washing Line No – 22	63
	Total Volume	***836***

It may be noted that an estimated amount of about 836 m_3/day of water is lost through leakages in the water supply distribution at the DLI railway station. These leakages should be immediately plugged to save water.

- Most of the observed leakages were from hydrants of the coach filling lines. Immediate action must be taken to plug these leakages to conserve water.

- **Filter losses**: About 518m^3/day of water was observed to be lost from the filters of OHT-1, 2 & 3. Water losses from OHT-1, OHT-2 & OHT-3 accounts for about 21m^3/day, 116m^3/day and 381m^3/day respectively.

The following figure depicts some of the pictures of the leakages and losses of water observed during the water audit. It is suggested that a comprehensive leak detection exercise be carried out for the entire station to ascertain that these losses are immediately checked.

Figures 11 Measured leakages at Old Delhi Railway Station

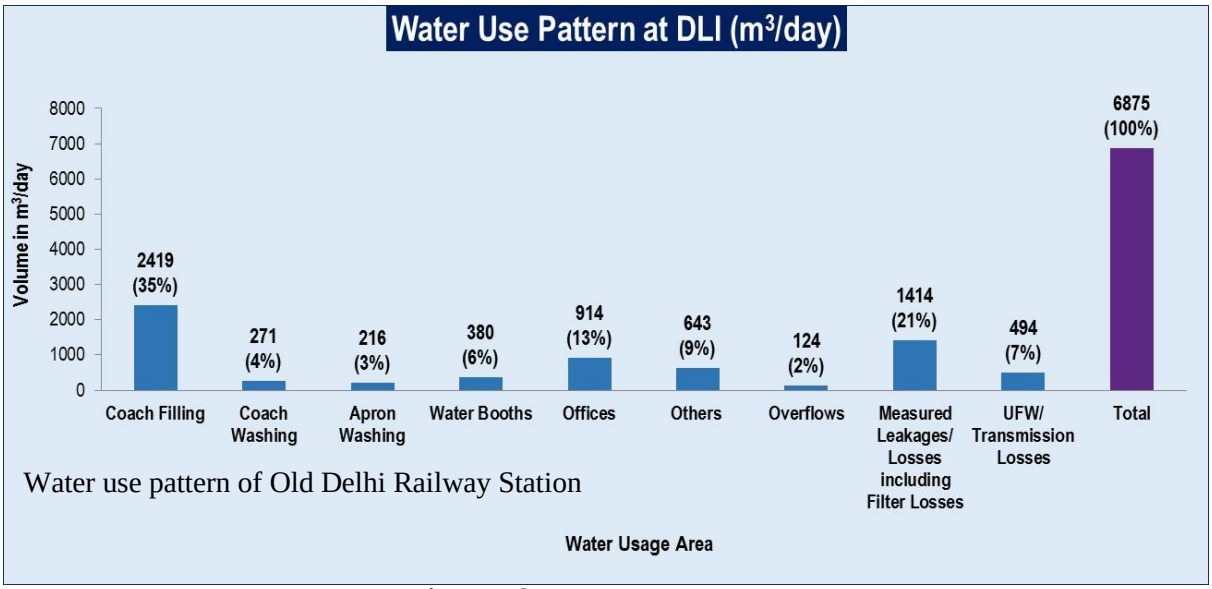
Figure 15Leakages points at Station

At the DLI railway station overflows were mainly observed in all the OHTs. About 124 m3/day of water i.e. 2% of the total water supplied to the DLI station is lost as overflows from the UGTs and the OHTs.

8.2 WATER USE PATTERN AT DLI STATION

The total intake water of DLI railway station of about 6875 m3/day is supplied for several activities in the station area ranging from washing of trains to water used for drinking purposes from the water booths etc. However a significant part of this supplied water is lost through various leakages (21%) and overflows (2%), as mentioned above. Besides leakages and

overflows, a substantial amount of 7% of water is estimated to be the UFW (unaccounted for water). Thus, the total water actually used for all the mentioned activities at the station is about 4843 m3/day which is about 70% of the total water intake by the station. The remaining 30% of water (viz. 2032 m3/day) is actually lost in leakages/overflows/UFW. It is thus obvious that a significant volume of water can be directly saved by curing & controlling the leakages, the overflows and identifying & reducing the UFWs. Figure 12 depicts the water use pattern and the losses in the system i.e. around 6875 m3/day.



Water use pattern of Old Delhi Railway Station

Figure16 Water use Pattern

8.3 SPECIFIC WATER CONSUMPTION (M3/COACH)

The water used to provide a service or a product can be represented in terms of Specific Water Consumption (SWC). Since the industry in consideration is railways which provide a service of transportation for the people, therefore all the activities undertaken are to facilitate transportation of people through the departure or running of the trains.

As mentioned earlier, water at the railway station is used for coach washing and filling, apron and platform washing, drinking purposes at the platforms, toilets, offices, etc. With increasing water scarcity, there is a need for progressive management interventions for water conservation to ensure efficient water management for the station operations.

Specific water consumption (expressed in m_3 /coach) is a key indicator for assessing the water use efficiency of the station.

Based on the observed flow and water audit exercise conducted at the station, the specific water consumption of DLI railway station is presented below.

Table 6Specific water consumption of DLI Railway Station

Water Usages Area	Actual Water Consumption (m_3/day)	Specific Water Consumption (m_3/coach)	Percent (%)
Coach Filling	2419	1.65	35.2
Coach Washing	271	0.18	3.9
Apron & PF Washing	216	0.15	3.1
Water Booths	380	0.26	5.5
Offices	914	0.62	13.3
Leakages and Overflows	1538	1.05	22.4
UFW/ Transmission Losses	494	0.34	7.2
Others	643	0.44	9.4
Total	**6875**	**4.68**	**100**

The specific water consumption of DLI Railway Station is **4.68 m3/coach**.

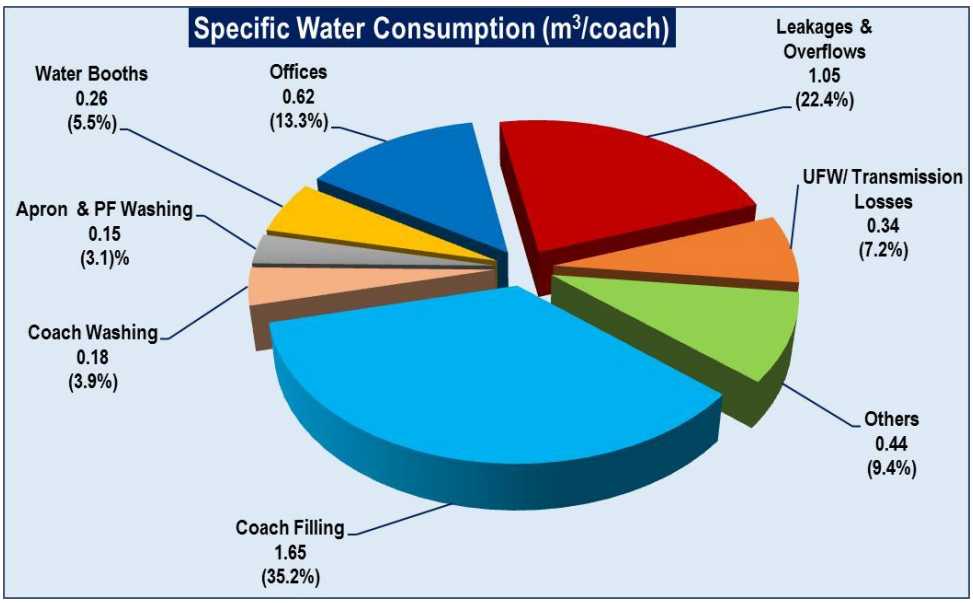


Figure 17Specific water consumption of Old Delhi Railway Station

It may be noted that

- SWC for leakages and overflows is significantly high. Attempts must be made to curb and control these leakages/overflows.

- SWC for UFW/Transmission losses is considerably high. Attempt must be made to identify and reduce the UFW/losses.

Excessive water consumption not only increases the cost of water treatment but also imparts additional burden to the natural source. Saving and conserving water can reduce the freshwater requirement thus reducing the financial burden and stress on the natural resources, besides efficient use of water at the station.

CHAPTER 9:- OBSERVATIONS & DISCUSSIONS

This water audit study is an opportunity for the DLI railway station to optimize the station water use as well as save significant amount of water.

9.1 KEY OBSERVATIONS

A total of about 6875 m3/day of water is supplied to the DLI railway station for various activities. Out of this about 6450 m3/day of water is sourced from the Ranney well , about 106 m3/day of water is sourced from Delhi Jal Board (DJB) and rest about 319 m3/day of water is supplied from the storage of UGTs & OHTs.

9.2 Water Saving Potential

About 136m^3/day of water can be saved if this intervention is adopted.

Table7Water saving potential through automatic coach washing system

Particulars	**Volume Saved**	**Unit**
Current water used for coach washing	600	L/coach
Water used for external coach washing	450	L/coach
Water required by automatic coach washing plant	150	L/coach
Total saving potential	300	L/coach
Total water saved for 452 coaches in a day	**136**	**m3/day**
Tentative capital cost of Automatic coach washing system	272 lakh	

CHAPTER 10:-REFERENCES

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