# APPENDIX FOR CHAPTER 2 CURRENT SITUATIONS AND EFFORT IN ACTIVITIES

## AF2.1 PRESENT SERVICE CONDITIONS IN WASA-F SERVICE AREA

1. Current Production and Water Demand

The present (2016) water source is composed of three groundwater systems and four surface water (WTP) systems. Out of three groundwater system, the largest one is Chenab well field system followed by Jhang Branch Canal (JBC) Well Field system. The Rahk Branch Canal (RBC) well field system is the oldest system, but its capacity is the smallest one. Out of four WTP system, one is newly constructed New Jhal Khanuana WTP and three slow sand filtration plants including Original Jhal Khanuana, Millat Town and Ghulfishan Colony WTPs. The Ghulfishan Colony WTP is presently under rehabilitation. The Production capacity (Design Capacity) and the present production are summarized in the following table.

**Table 1 Production Capacity and Current (2016) Distribution Flow of Water Source Facilities**

| Production Facilities | Production Capacity | | Day Average Distribution | | Day Maximum Distribution | |
|---|---|---|---|---|---|---|
| | $m^3$/day | MGD | $m^3$/day | MGD | $m^3$/day | MGD |
| Chenab Well Field | 254,600 | 56 | 144,540 | 32 | 174.840 | 38 |
| JBC Well Field | 90,900 | 20 | 56,780 | 12 | 90,900 | 20 |
| RBC Well Field | 81,800 | 18 | 7,370 | 2 | 7,370 | 2 |
| New Jhal Khanuana WTP | 45,500 | 10 | 20,440 | 4 | 35,000 | 8 |
| Original Jhal Khanuana WTP | 15,900 | 3.5 | 6,800 | 1 | 6,800 | 1 |
| Millat Town WTP | 4,500 | 1.0 | 4,000 | 1 | 4,000 | 1 |
| Ghulfishan Colony WTP | 6,800 | 1.5 | - | - | - | - |
| Total | 500,000 | 110 | 239,530 | 52 | 318,510 | 70 |

The present water supply area is divided into 15 areas (Distribution Zones) which are supplied from Chenab Well Field system, JBC Well Field system, New and Original Jhal Khanuana WTP system and one slow sand filtration plant system (Millat Town WTP), where well water is transmitted to Terminal reservoir from where water is distributed through Arterial Main network. Jhal Khanuana WTPs distribute finished water through also Arterial Main network. Millat Town WTP distribute finished water locally around the WTP. The service areas fed directly from RBC Tube Well Pumps which supply capacity is too small comparing with potential demand of the service areas, thus the service conditions of these service areas shall be poor. The present number of service connections (Domestic Use) is estimated about 140,000 units, thus average demand per connection is calculated at about 1.714 m3/day/connection (239,930/140,000).

2. Distribution Pumps

The dimension of distribution pump of each system above is summarized in the following table.

**Table 2 Dimensions of Distribution Pumps**

| Production System | Pump A | | | Pump B | | | Total Pump Capacity | |
|---|---|---|---|---|---|---|---|---|
| | Discharge | Head | Number | Discharge | Head | Number | | |
| | $m^3$/min | m | unit | $m^3$/min | m | unit | $m^3$/day | $m^3$/hr |
| Old Terminal Reservoir[*1] | 37.5 | 45.12 | $^{W}5+^{S}2$ | 27.4 | 45.12 | $^{W}2+^{S}1$ | 348,900 | 14,500 |
| New Terminal Reservoir[*2] | 63.2 | 45.12 | $^{W}2+^{S}1$ | 31.6 | 45.12 | $^{W}1+^{S}1$ | 227,500 | 9,480 |
| New Jhal Khanuana WTP | 15.8 | 35 | $^{W}2+^{S}1$ | - | - | - | 45,500 | 1,890 |
| Original Jhal Khanuara WTP | 3.4 | 38 | $^{W}1+^{S}1$ | 5.1 | 36.6 | $^{W}1+^{S}1$ | 12,200 | 510 |
| Millat Town WTP | 5.1 | 36.6 | $^{W}1+^{S}1$ | 3.4 | 30.5 | $^{W}2+^{S}1$ | 14,700 | 610 |
| RBC Well Field[*3] | 1.7 | 39.6 | $^{W}12+^{S}2$ | - | - | - | 7,370 | 612 |

Note: [*1] Supply from Chenab Well Field [*2] Supply from JBC Well Field
[*2] Daily production is estimated based on 6 hours operation of well pumps per day

3. Arterial Main Network

Arterial mains are installed surrounding core area of the City as shown on Fig. 1. The size of arterial main is ranging from 500mm to 1,600mm in diameter. The total length of arterial mains is about 53.9 km including those from Terminal Reservoir system and Original & New Jhal Khanuana WTP systems.

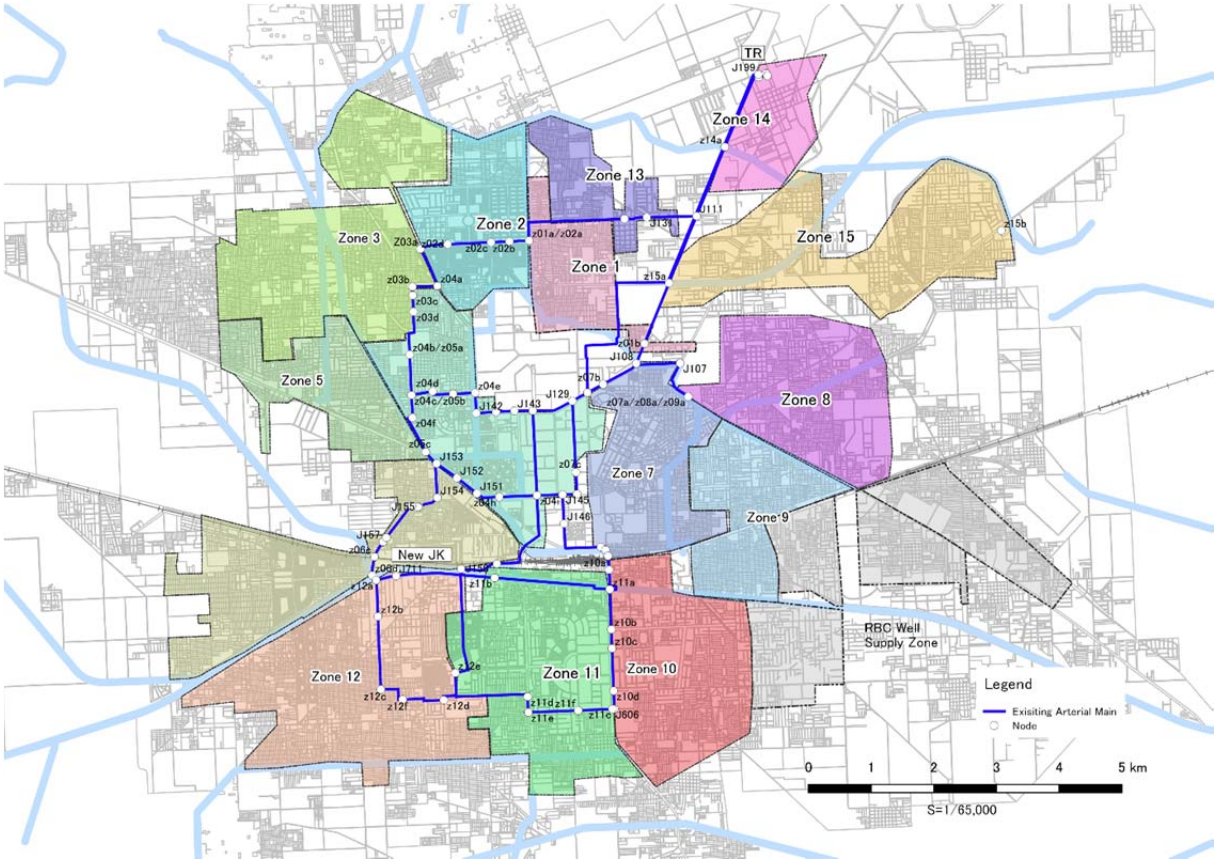



**Fig.1** Arterial Network and Distribution Zones

4. Assessment of Supply Conditions

4.1 Water Demand Distribution

Water demand of each distribution zone (DZ) is estimated based on the ratio of area covered by the tertiary mains (ND 80~100mm). GIS map is used for measuring these areas. The following table presents the demand distribution of DZs.

**Table 3 Demand Distribution to Distribution Zone (DZ)**

| DZ | Area | Water Demand | | | DZ | Area | Water Demand | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Day Average | | Peak Flow | | | Day Average | | Peak Flow |
| | $km^2$ | $m^3$/day | l/s | l/s | | $km^2$ | $m^3$/day | l/s | l/s |
| 1 | 2.118 | 8,990 | 104.1 | 208.1 | 9 | 3.371 | 14,300 | 166.5 | 331.0 |
| 2 | 3.672 | 15,580 | 180.3 | 360.6 | 10 | 3.729 | 15,820 | 183.1 | 366.2 |
| 3 | 6.420 | 27,240 | 315.3 | 630.6 | 11 | 5.326 | 22,600 | 261.6 | 523.1 |
| 4 | 5.071 | 21,510 | 249.0 | 497.9 | 12 | 6.900 | 29,270 | 338.8 | 677.5 |
| 5 | 3.328 | 14,120 | 163.4 | 326.9 | 13 | 1.695 | 7,190 | 83.2 | 166.4 |
| 6 | 3.938 | 16,710 | 193.4 | 386.8 | 14 | 0.954 | 4,050 | 46.9 | 93.8 |
| 7 | 3.169 | 13440 | 155.6 | 311.1 | 15 | 2.524 | 10,710 | 124.0 | 247.9 |
| 8 | 2.610 | 11,070 | 128.1 | 256.3 | Total | 54.825 | 232,600 | 2,692.1 | 5,384.3 |

Note: peak factor of 2.0 is applied

4.2 Overview of the Present Distribution System

Distribution Network System (Arterial Main System) is considered as combined one system fed from Terminal Reservoir and Jhal Khanuana WTP. On the other hand, RBC system is considered separate from the mentioned arterial main network system. Therefore RBC distribution system is considered as independent system.

In service area, there are 40 overhead reservoirs exist. However, the capacity and height of overhead reservoir (OHR) are small, thus the covered area by OHR will be small except a few areas served by large capacity and high height of OHRs. On the other hand, many service areas are considered supplied from the arterial main network directly. These mixed supply conditions from water sources results complex distribution system as a whole.

The arterial main network system is composed of seven grids. The large supply area surrounding this arterial network has been developed. Therefore, supply conditions of surrounding area of the arterial network will be depending on the capacity of the distribution pipelines fed by the arterials network although pressure conditions of arterials network is considered as good.

Considering the present complicated distribution system, limited information of distribution system and time constraint, this assessment will not be accurate enough. However, the assessment will show tendency of deteriorating supply conditions toward remote areas from arterial network.

4.3 Methodology of Hydraulic Analysis

The assessment of service conditions of 15 DZs is carried out as followed:

- Grasping water demand of distribution block in each distribution zone,
- Hydraulic analysis of existing distribution mains (dia. 150mm and above) from the arterials network in each DZ giving assumed tapping pressures,
- Carrying out network analysis of arterial mains using discharge for each distribution zone using the results of network analysis made above, and
- Repeat the above trial analysis to fined similar results of pressure at tapping points for distribution zones on the arterial network.

4.4 Assumption of Hydraulic Analysis

The following assumptions are set-up for hydraulic analysis that

1. Arterial Network from the Terminal Reservoirs (Chenab and JBC Well Field) and New Jhal Khanuana WTP System are connected and they work as one network.
2. In this analysis, all service areas are if they are supplied directly from the arterial network system, although the present distribution system is mixed with direct supply from the arterial network and system through overhead reservoirs partly.
3. Water demand of respective distribution zones is distributed in proportion to the area where tertiary mains are installed.
4. Service area of DZ is further divided into distribution blocks which boundaries are determined in accordance with layout of the existing secondary mains, where water demand is distributed similarly as mentioned above.
5. Hydraulic analysis is made using Hazen & Williams Formula, where loss co-efficient of C as 110 is applied.
6. Effective pressure of 14m at tertiary network (12m tapping pressure to service connection + 2m head loss of tertiary network) is considered as appropriate.
7. Day Average Demand is taken for hydraulic analysis, where peak hourly factor of 2.0 is applied which obtained from SCADA data on fluctuation of distribution flow (Main Report Fig. B3.4.4)
8. Distribution system is assumed to be composed of three groups due to its size, namely primary, secondary and tertiary mains. The size and function of each kind of distribution main is defined as follows:

| Kind of Mains | Primary Main | Secondary Main | Tertiary Main |
|---|---|---|---|
| Size of Mains | ND 300mm or Larger | ND 150 ~ 250mm | ND 80 and 100mm |
| Function | Distribute water in respective area of DZ. | Branch from primary main to distribute water to respective blocks of DZ | Generally service connection is tapped from tertiary mains |

It is assumed that, in general, branch will not be provided from primary main to tertiary mains.

5. Result of Assessment

The result of supply conditions of 15 distribution zones are illustrated in Fig. 2, where pressure conditions of blocks of DZ are shown.

Evaluation criteria of supply conditions are based on the pressure condition of secondary main of service area, and it is set-up as follows:

- "Good" is that pressure condition of 5m or above is observed at 80% or more in DZ.
- "Fair" is that pressure condition with 5m or above is observed at more than 60% in DZ.
- "Poor" is that pressure condition of more than 5m is observed at less than 60% in DZ.

Based on the above evaluation criteria, the service conditions of respective distribution zones are summarized and presented in table below.

**Table 3 Evaluated Service Condition in Distribution Zones**

| Distribution Zone (DZ) | Estimated Demand*1 | Estimated Connection | Pressure Condition | | Evaluation | Capacity of Distribution | | Distance from Arterial Main*1 |
|---|---|---|---|---|---|---|---|---|
| | | | P > 14m | P > 5m | | Primary | Secondary | |
| | $m^3$/day | units | % | % | | $m^3$/conn. | $m^3$/conn. | km |
| DZ – 1 | 8,990 | 5,250 | 57 | 0 | Poor | - | 0.020 | 1.9 |
| DZ – 2 | 15,580 | 9,090 | 81 | 0 | Good | 0.025 | 0.028 | 1.6 |
| DZ – 3 | 27,240 | 15,890 | 30 | 11 | Poor | 0.028 | 0.034 | 2.7 |
| DZ – 4 | 21,510 | 12,550 | 74 | 12 | Good | 0.006 | 0.039 | 0.7 |
| DZ – 5 | 14,120 | 8,340 | 25 | 40 | Fair | 0.040 | 0.047 | 3.2 |
| DZ – 6 | 16,710 | 9,230 | 49 | 7 | Poor | 0.035 | 0.069 | 2.8 |
| DZ – 7 | 13,440 | 7,840 | 100 | 0 | Good | 0.053 | 0.033 | 2.3 |
| DZ – 8 | 11,070 | 6,450 | 100 | 0 | Good | 0.154 | 0.045 | 2.7 |
| DZ – 9 | 14,300 | 8,340 | 100 | 0 | Good | 0.131 | 0.045 | 2.3 |
| DZ -10 | 15,820 | 9,230 | 32 | 36 | Fair | 0.015 | 0.049 | 2.0 |
| DZ -11 | 22,600 | 13,190 | 66 | 0 | Fair | 0.014 | 0.035 | 1.1 |
| DZ -12 | 29,270 | 17,080 | 28 | 5 | Poor | 0.009 | 0.039 | 3.1 |
| DZ -13 | 7,190 | 4,200 | 100 | 0 | Good | 0.019 | 0.042 | 1.6 |
| DZ -14 | 4,050 | 2,360 | 56 | 44 | Good | 0.037 | 0.020 | 1.4 |
| DZ -15 | 10,710 | 6,250 | 32 | 7 | Poor | 0.012 | 0.028 | 5.0 |

Note * the distance shown is from arterial main to remote end of distribution zones

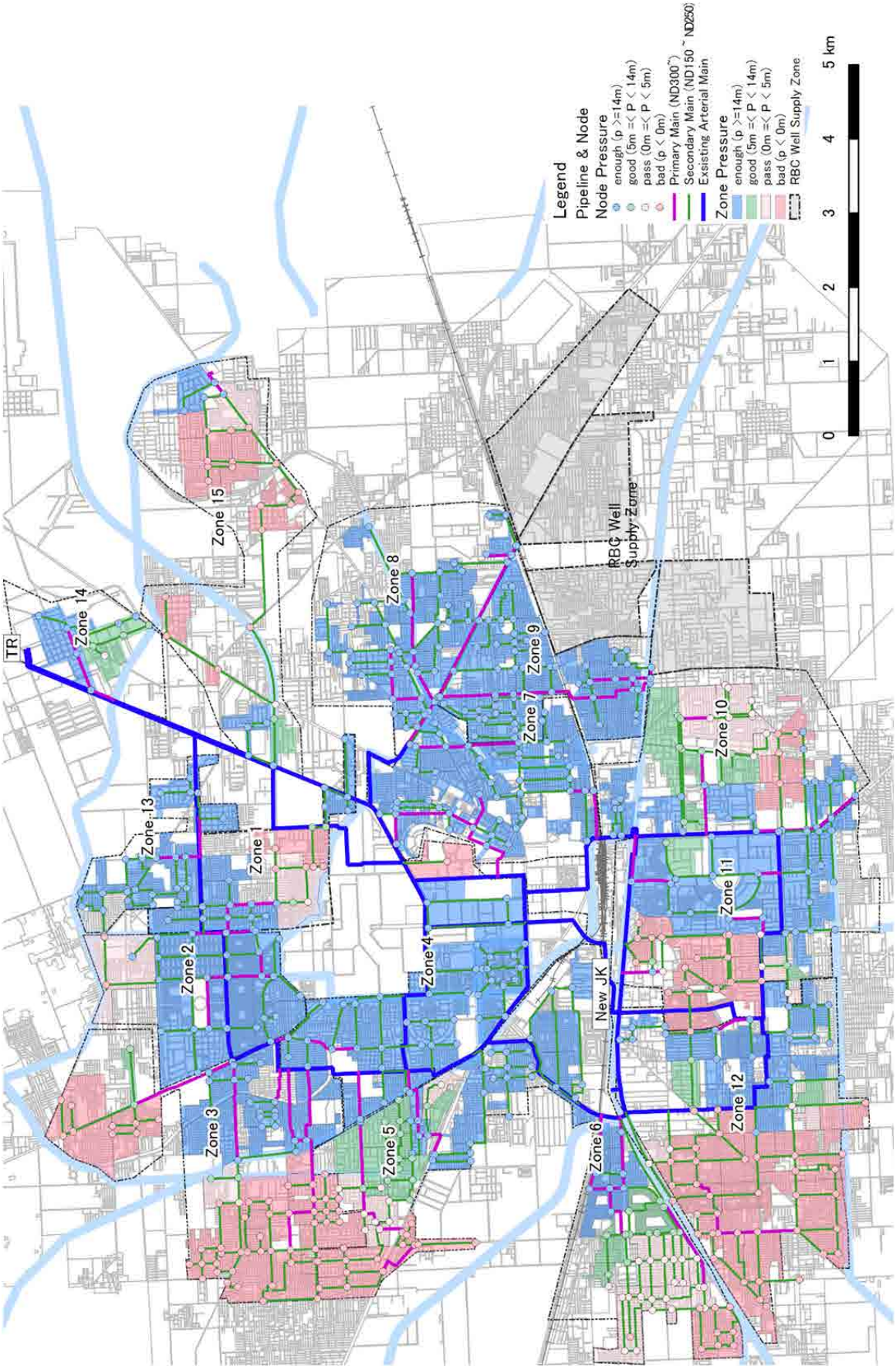



**Fig. 2 Service Conditions of Distribution Zones**

# ATTACHMENT

**ATTACHMENT 1**

# Distribution Block of DZ

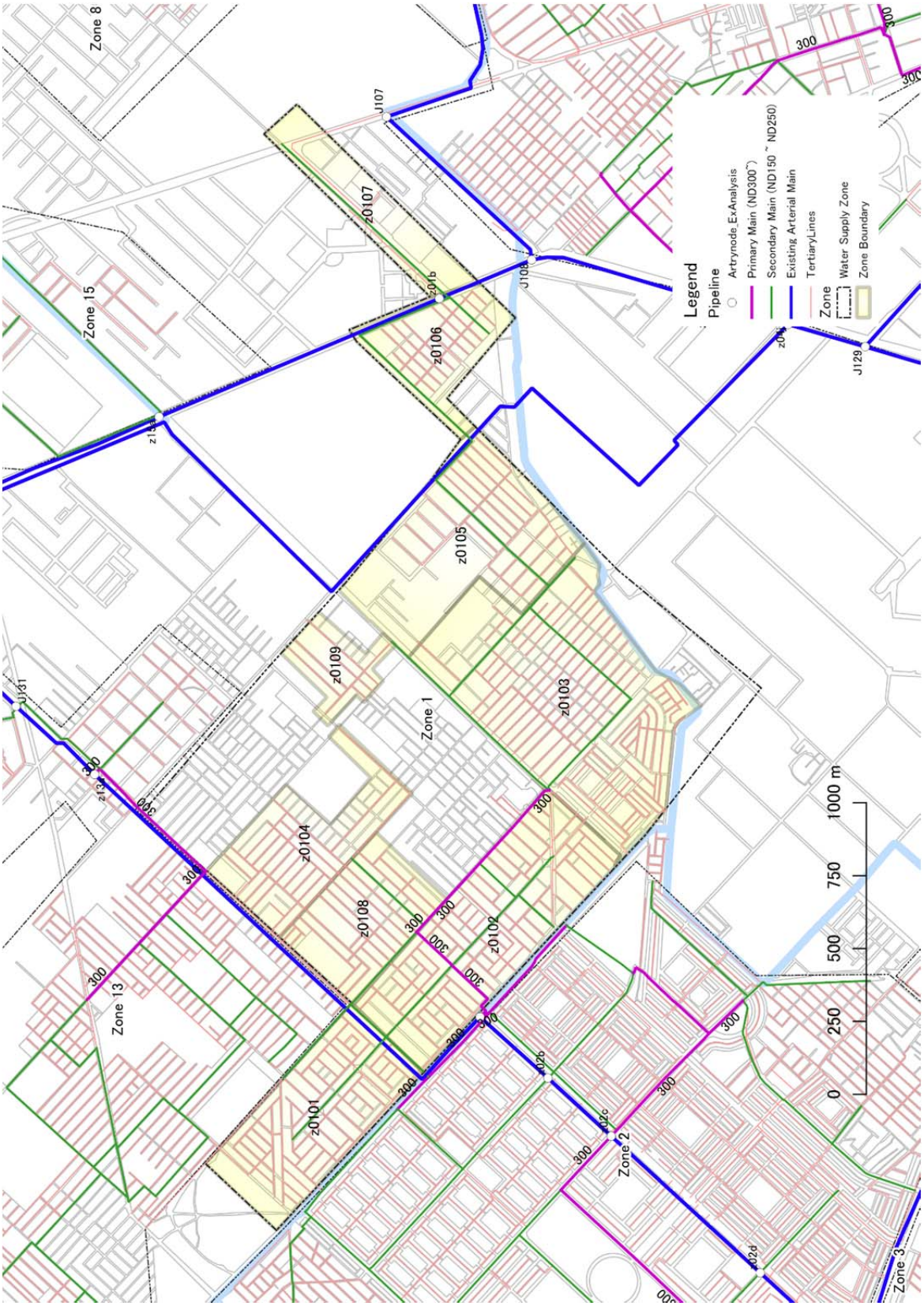



**Fig. A.1.1 Distribution Zone 01**

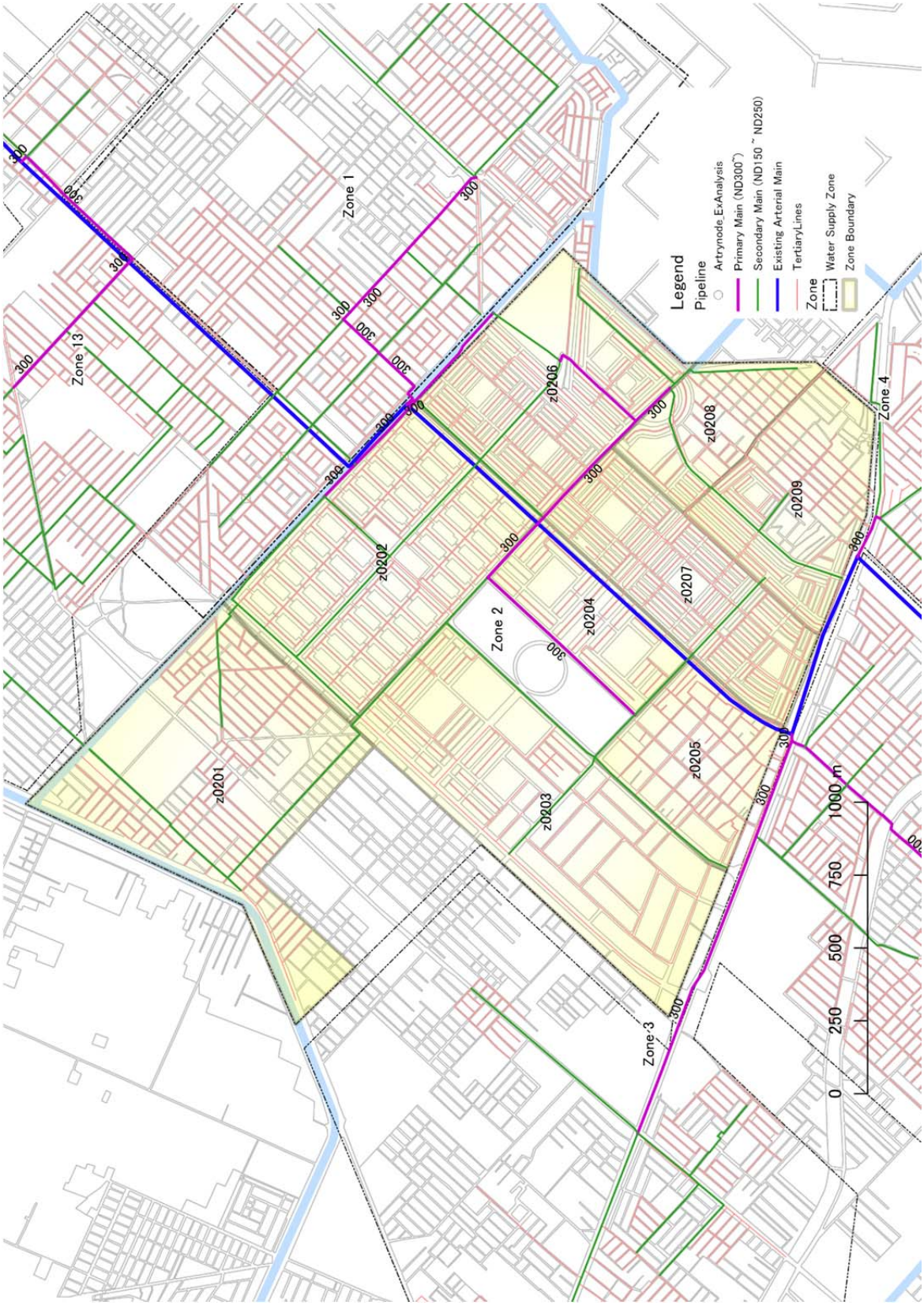



**Fig. A.1.2 Distribution Zone 02**

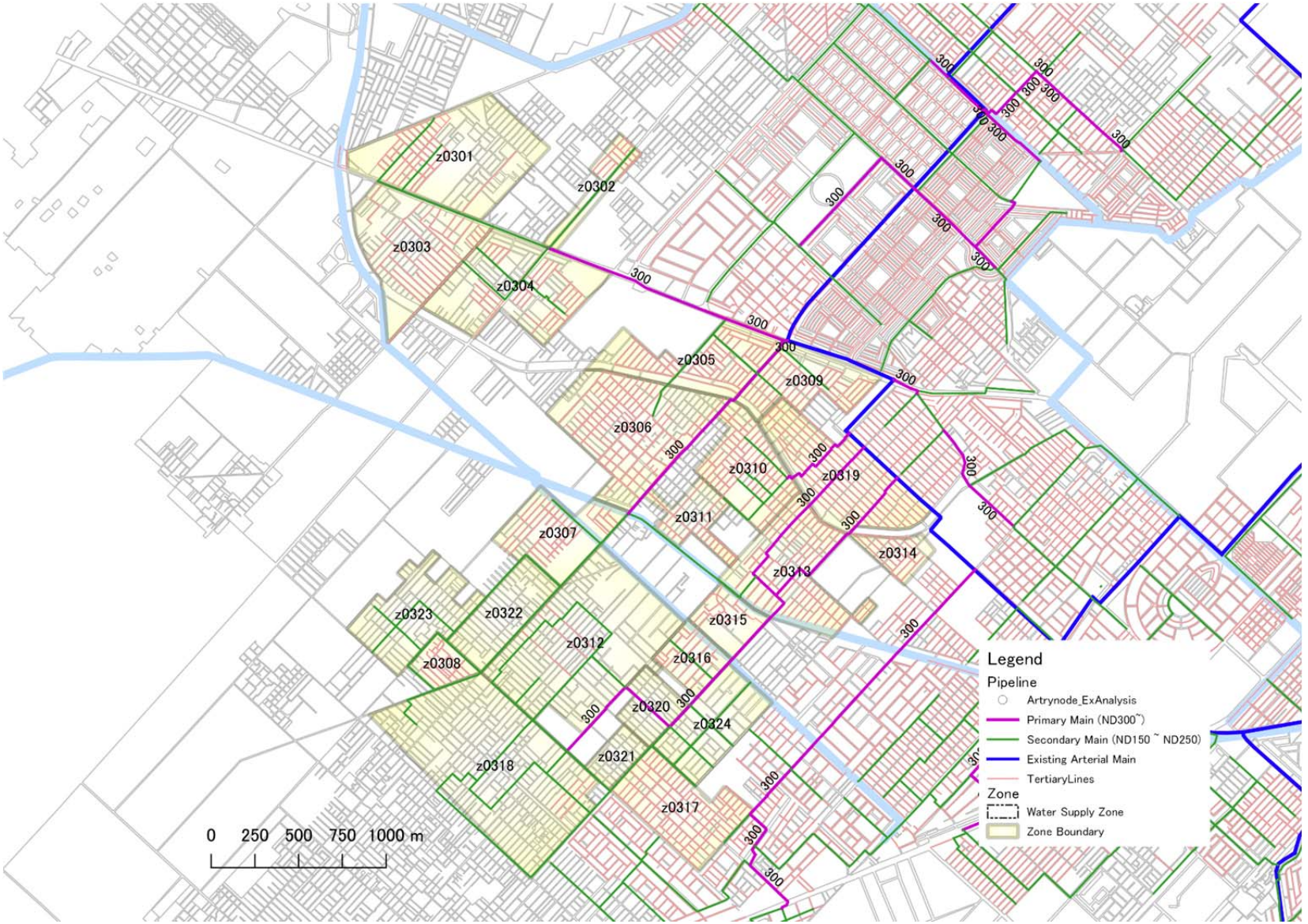



**Fig. A.1.3 Distribution Zone 03**

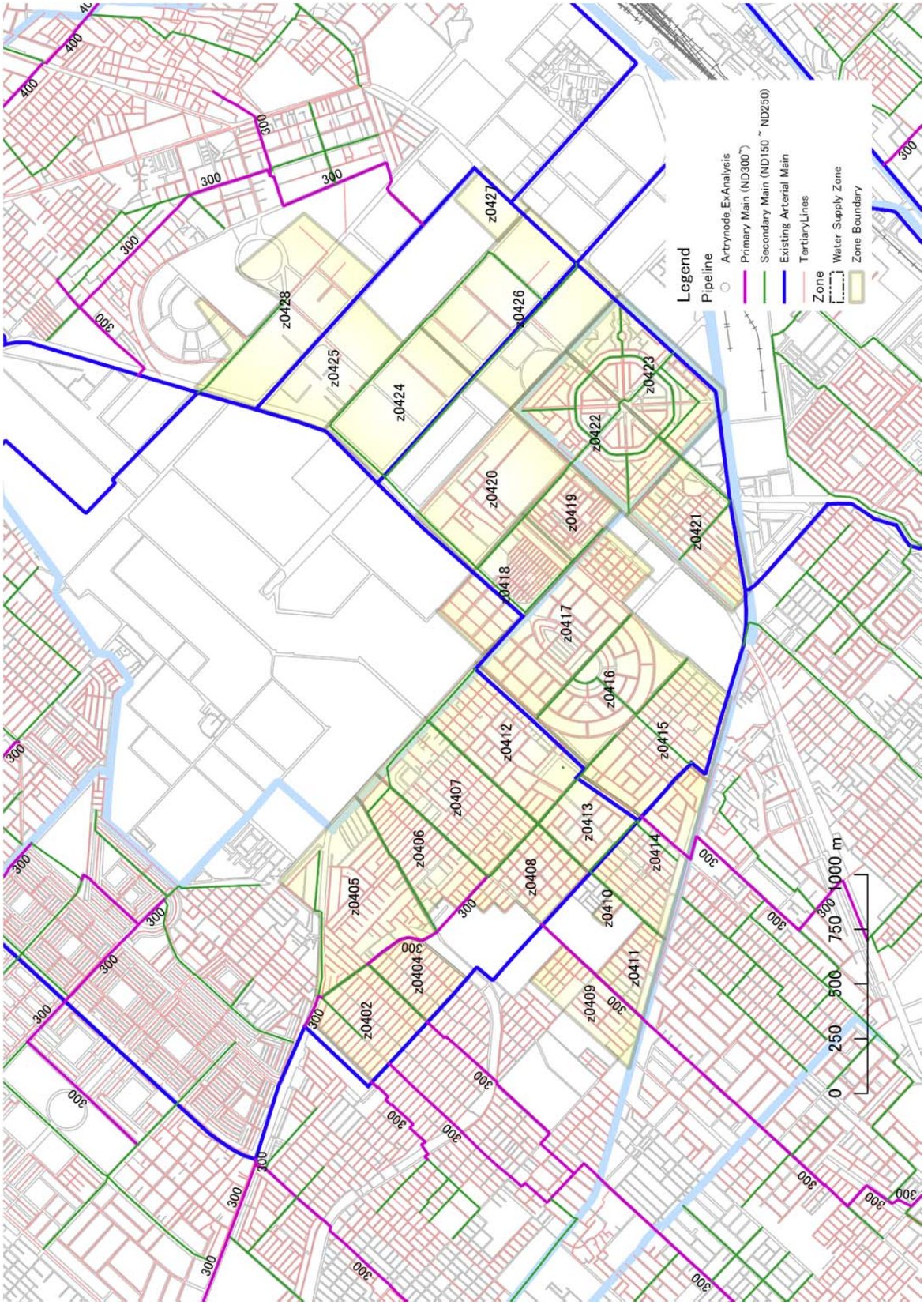



**Fig. A.1.4 Distribution Zone 04**

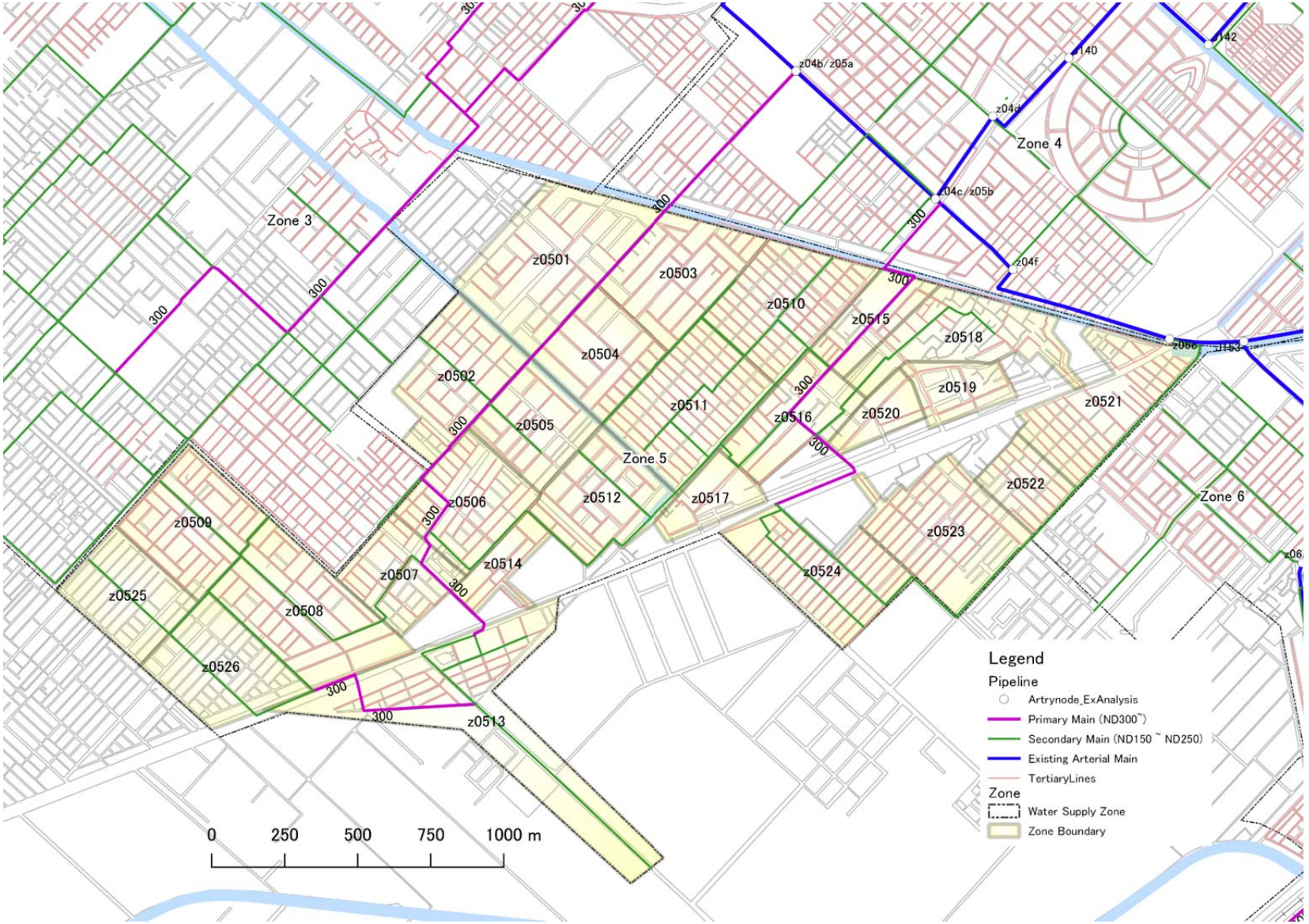



**Fig. A.1.5 Distribution Zone 05**

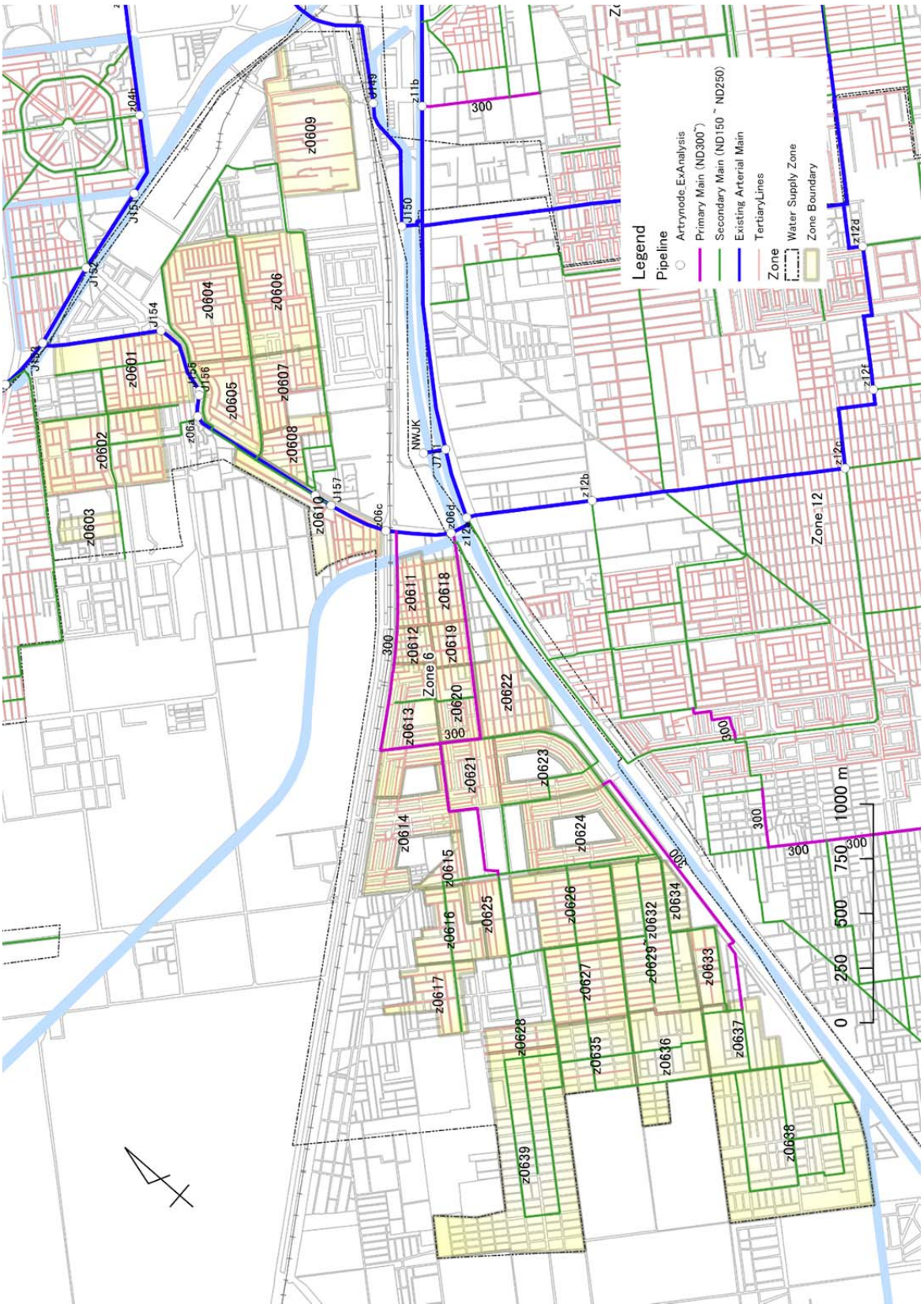



**Fig. A.1.6 Distribution Zone 06**

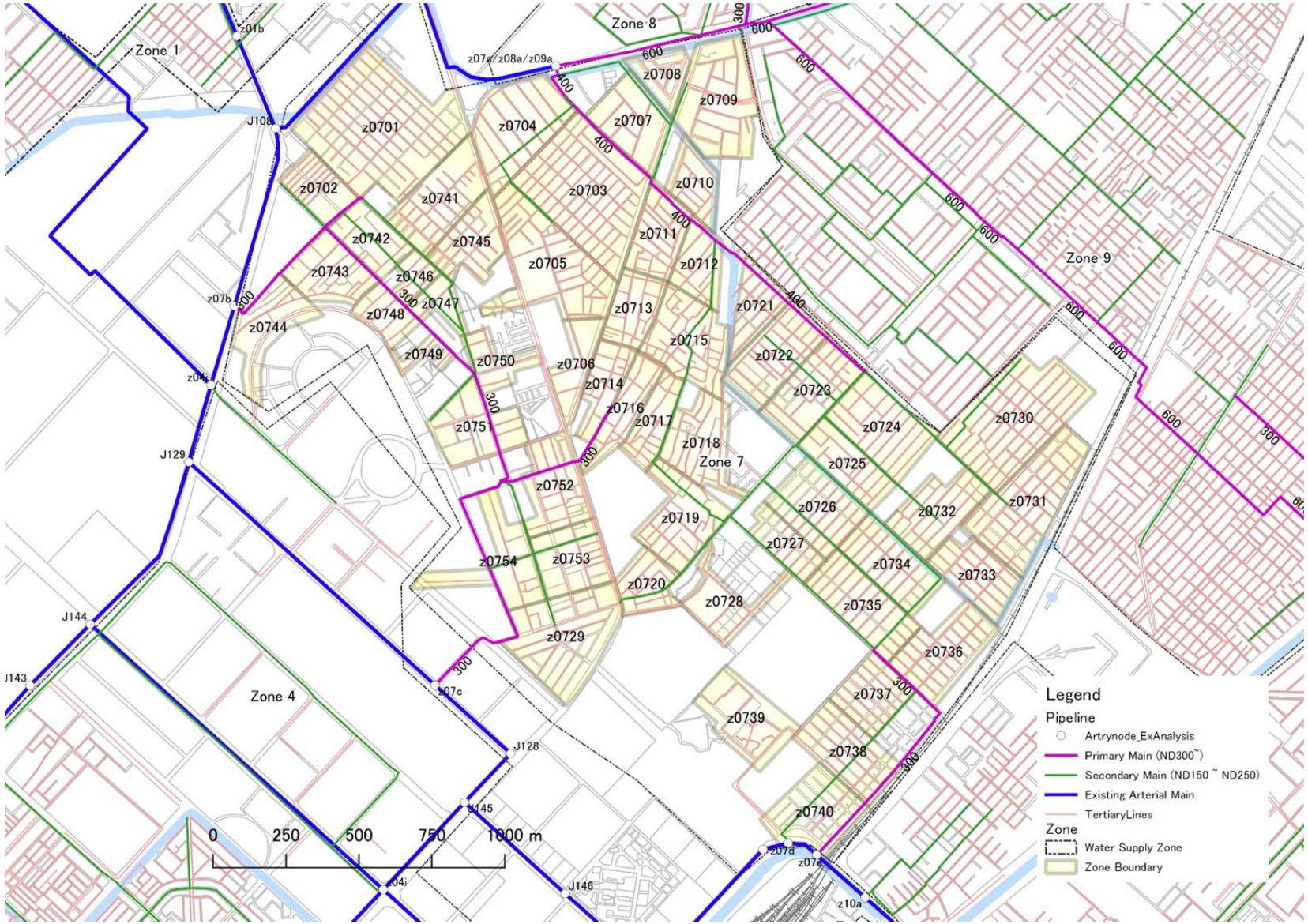



**Fig. A.1.7 Distribution Zone 07**

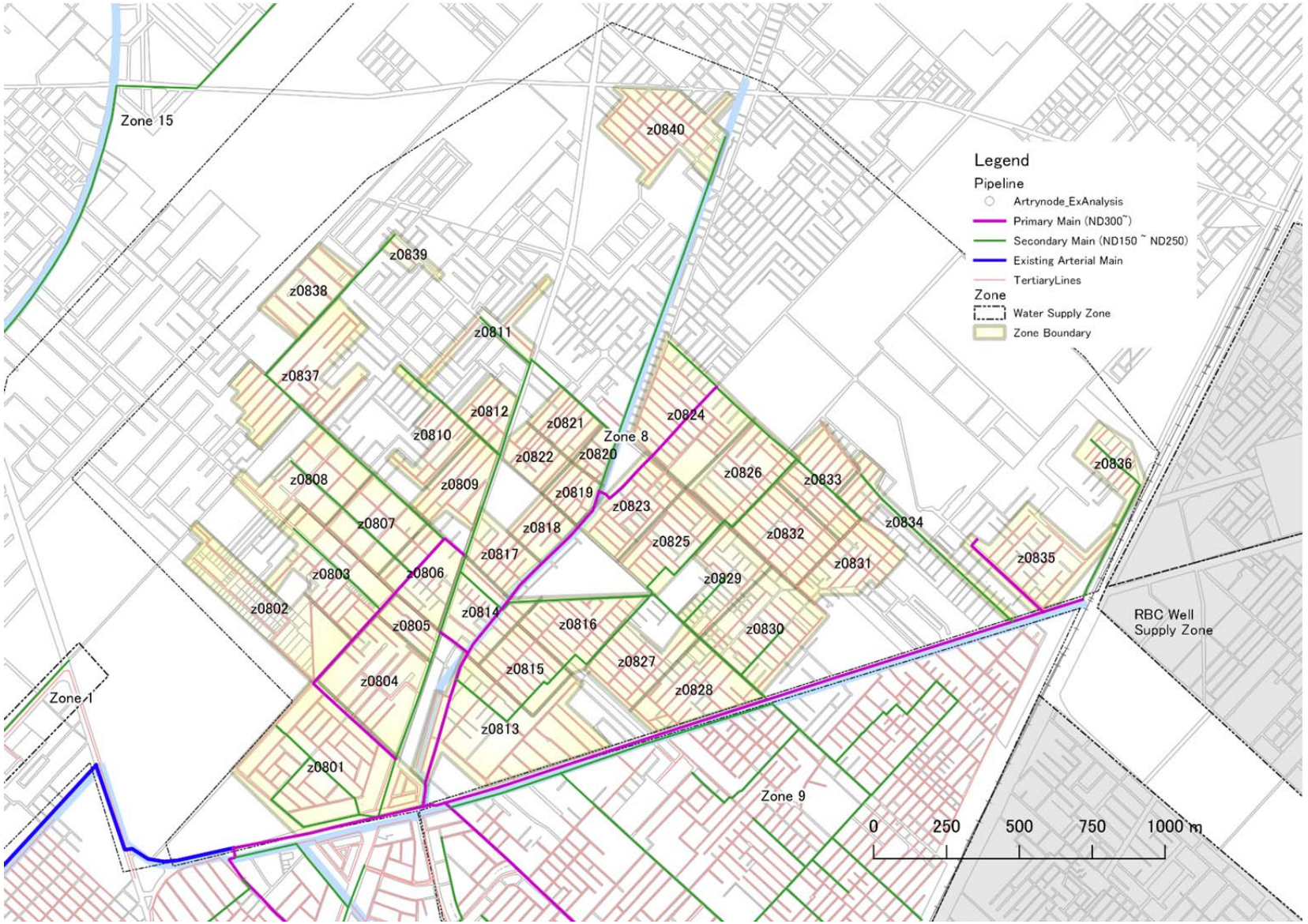



**Fig. A.1.8 Distribution Zone 08**

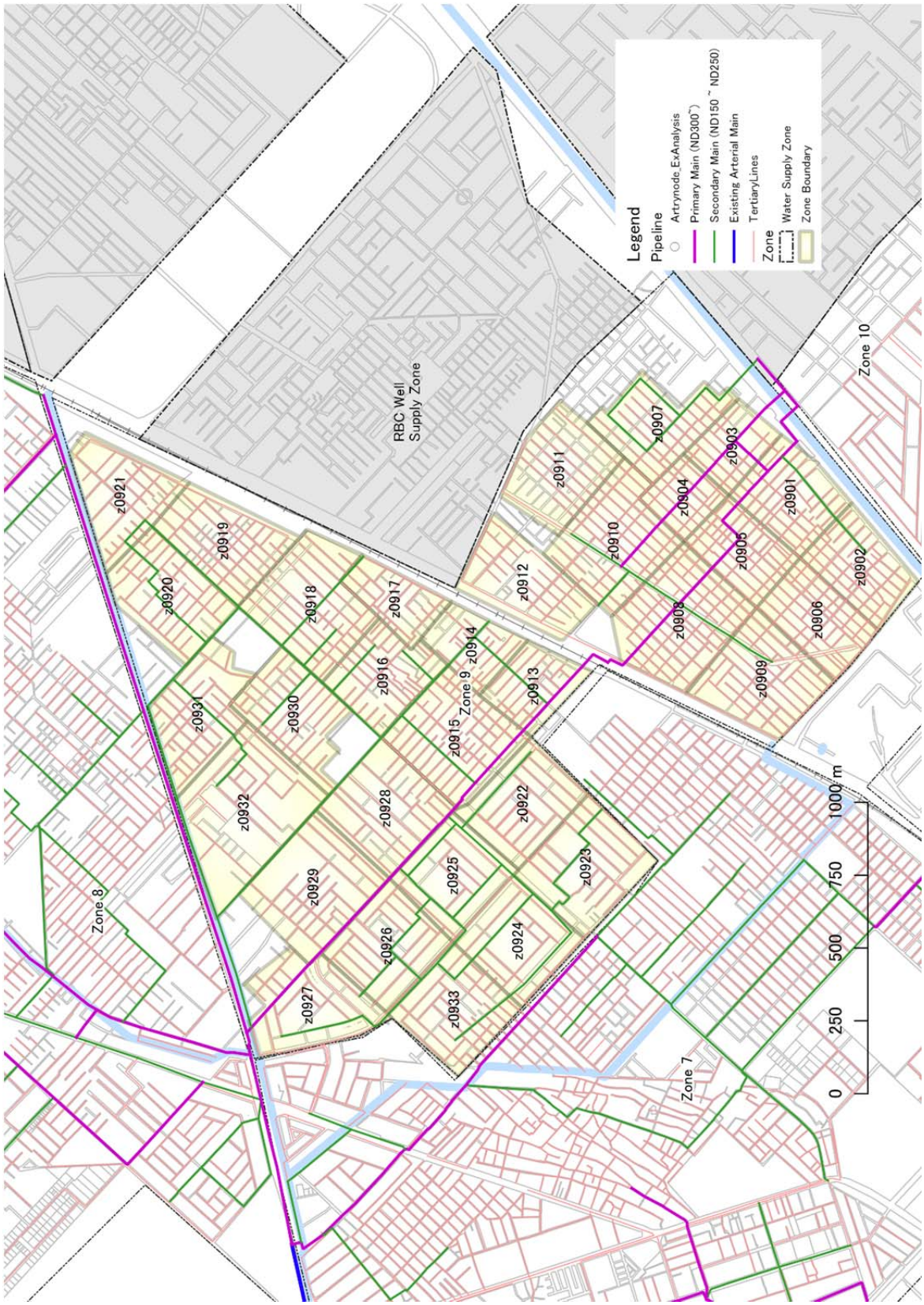



**Fig. A.1.9 Distribution Zone 09**

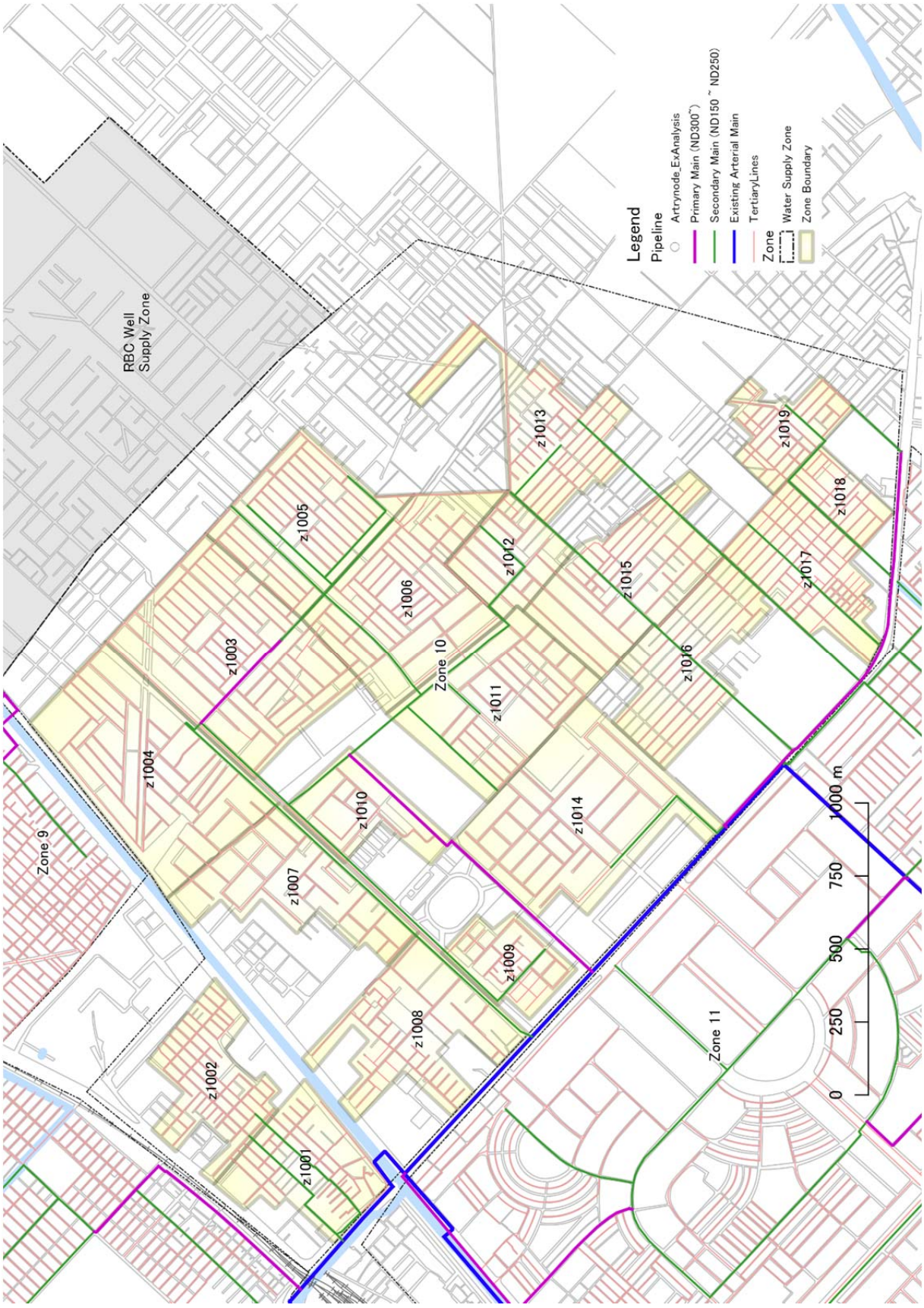



**Fig. A.1.10 Distribution Zone 10**

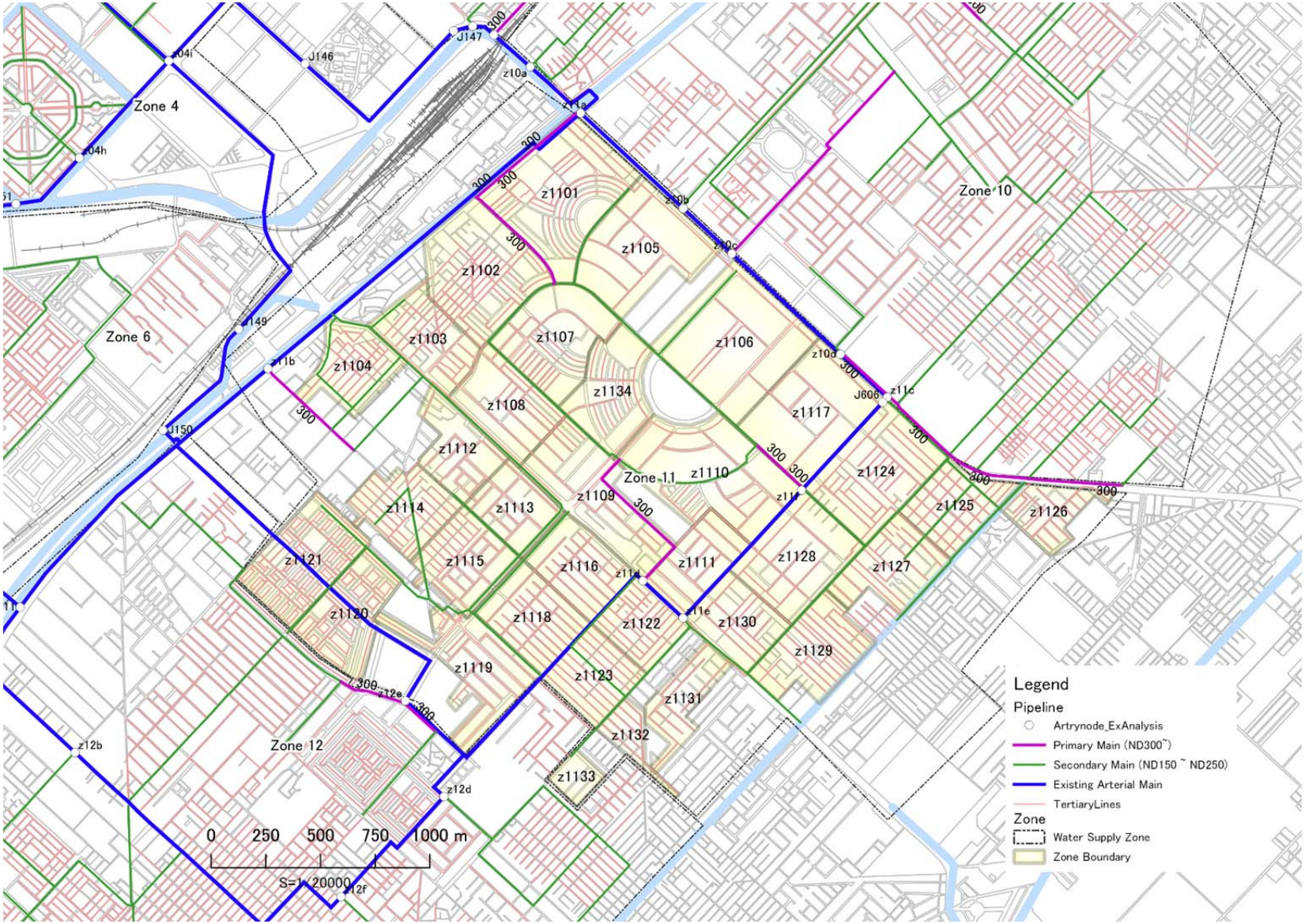



**Fig. A.1.11 Distribution Zone 11**

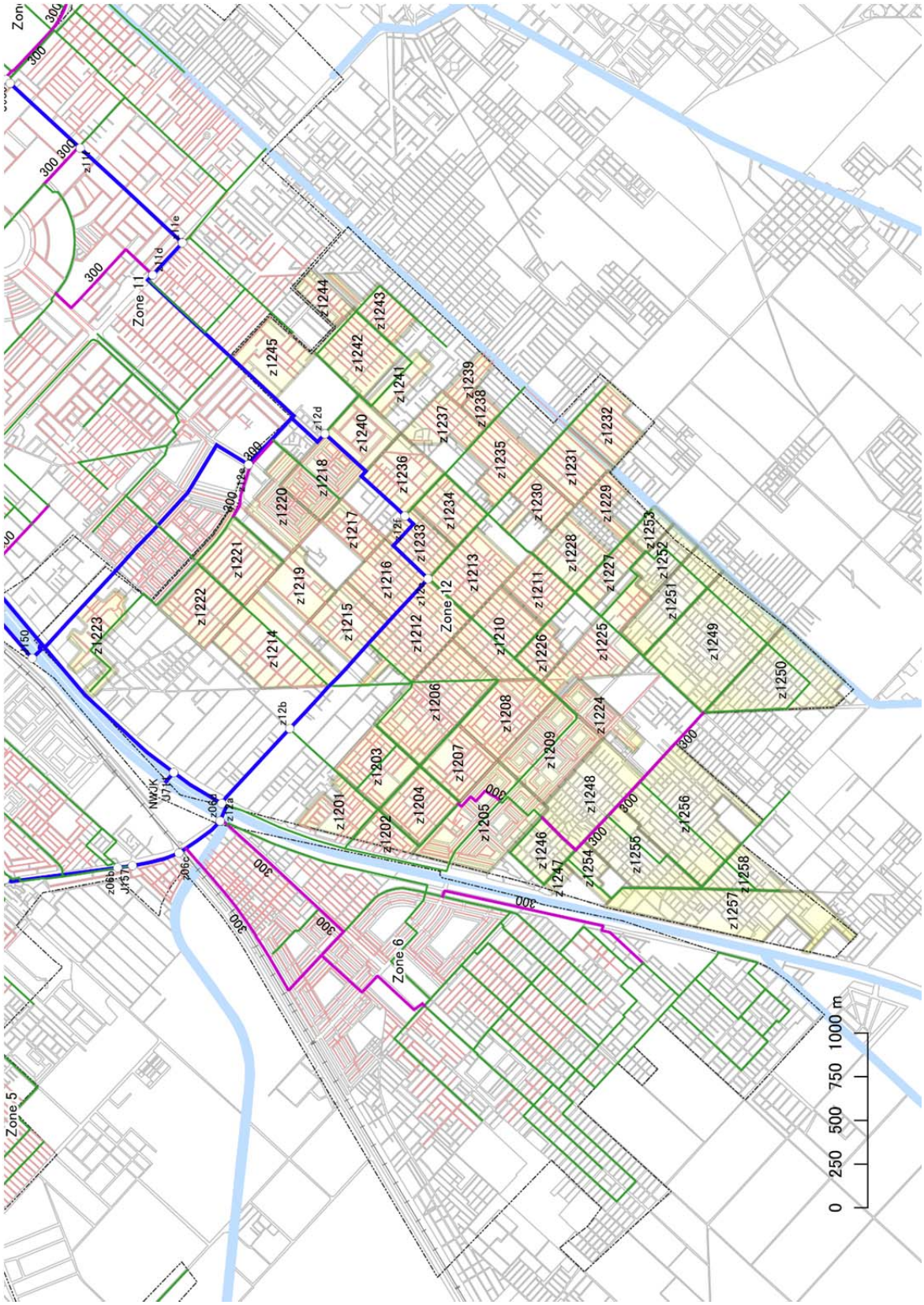



**Fig. A.1.12 Distribution Zone 12**

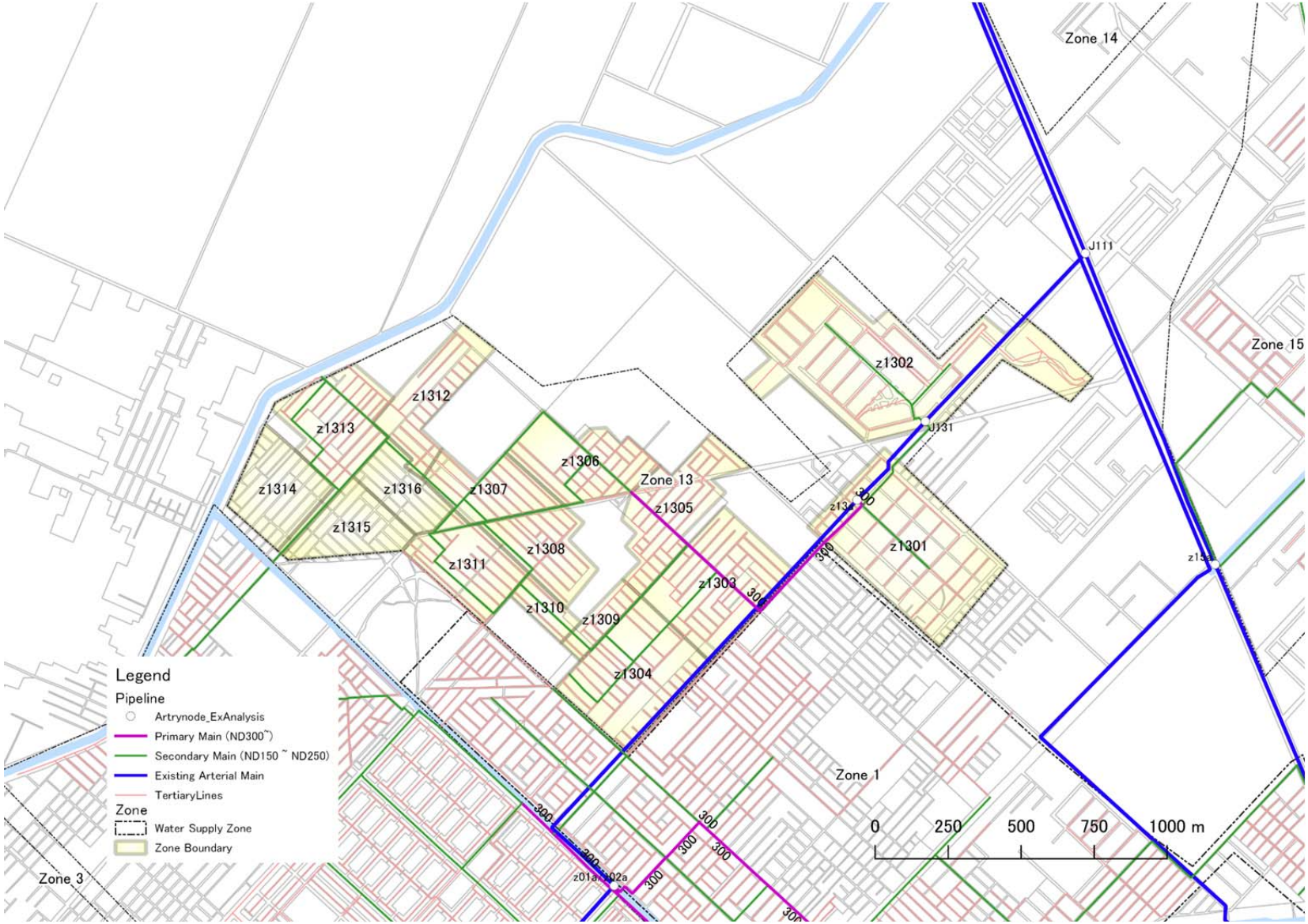



**Fig. A.1.13 Distribution Zone 13**

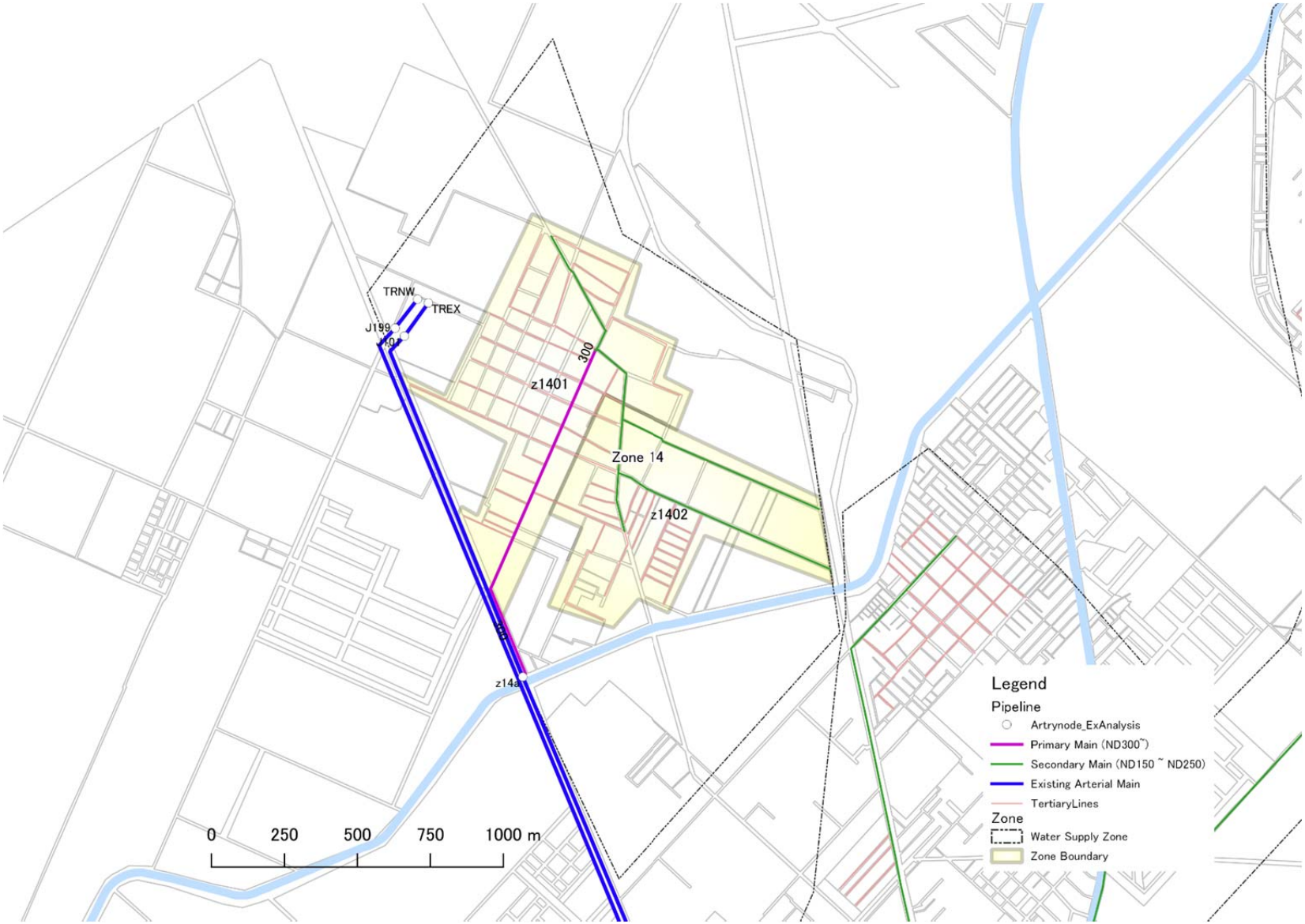



**Fig. A.1.14 Distribution Zone 14**

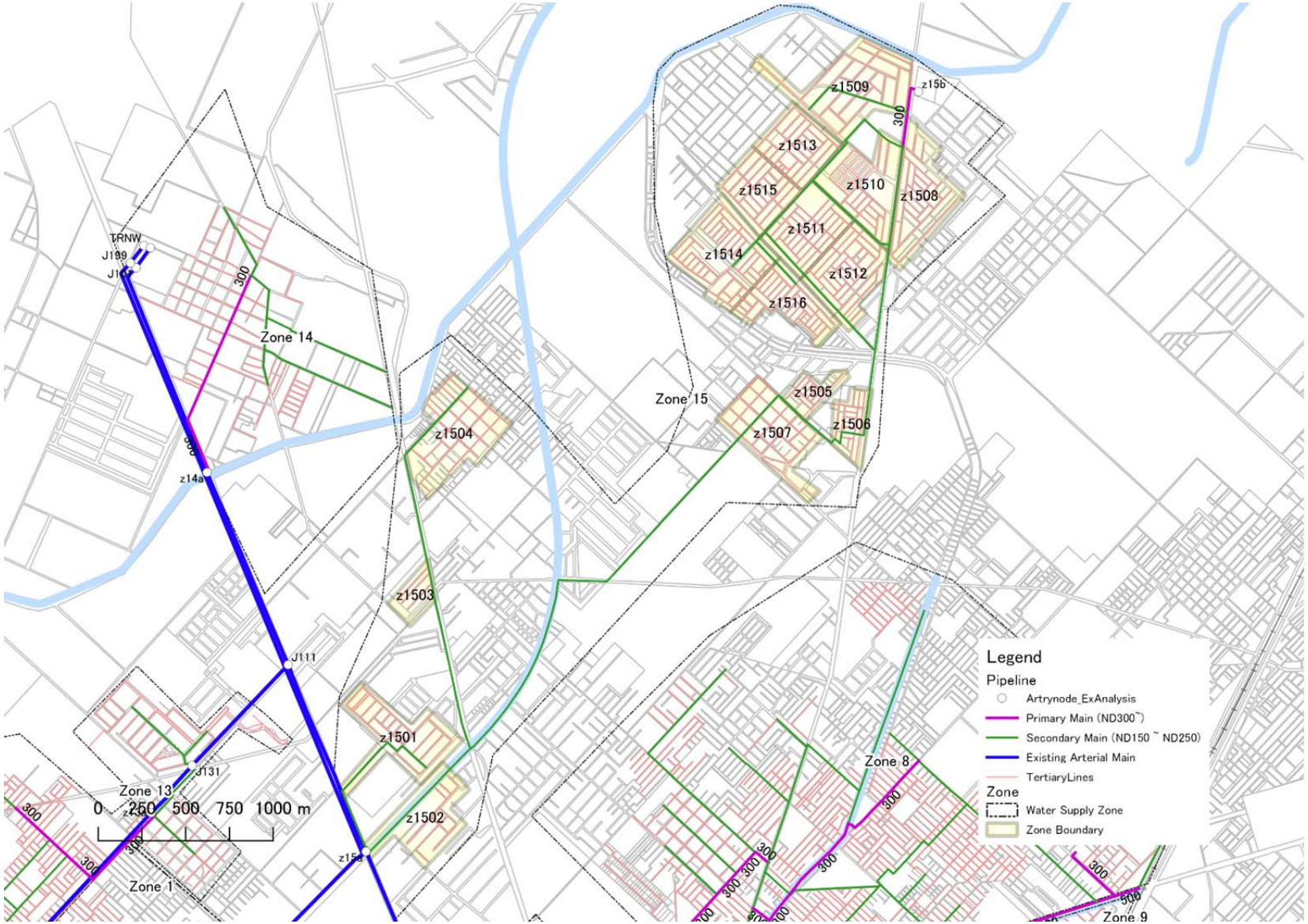



**Fig. A.1.15 Distribution Zone 15**

# ATTACHMENT 2

# Arterial MAIN Network

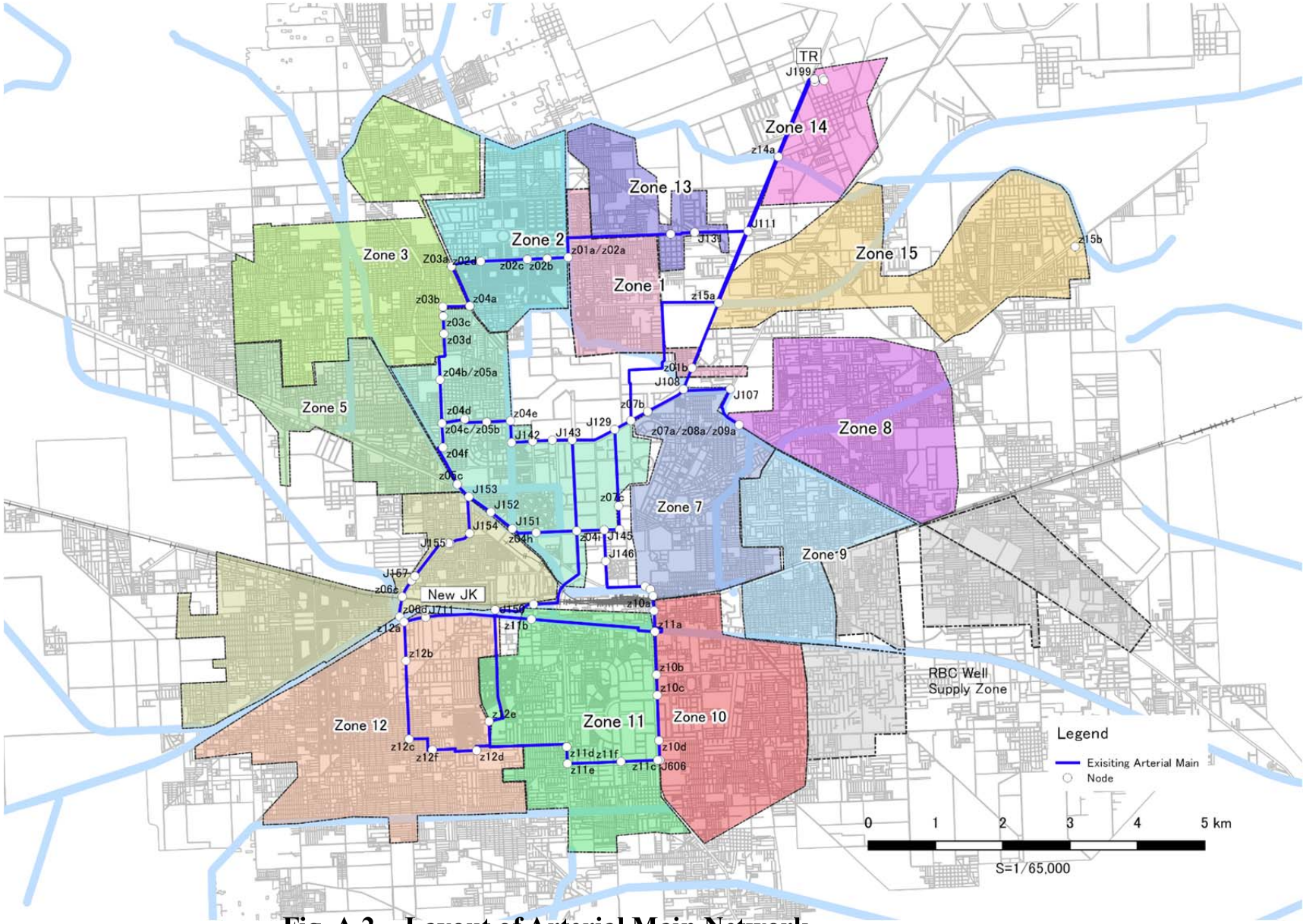



**Fig. A.2 Layout of Arterial Main Network**

# ATTACHMENT 2.1

## NETWORK ANALYSIS OF ARTERIAL MAIN -1

**Node Data**

| Node No. | Discharge | | WL | GL | Eff. Head |
|---|---|---|---|---|---|
| | CMD | l/s | m | m | m |
| TREx[*1] | -329,290 | -3,811.2 | 233.00 | 188 | 45.00 |
| TRNw[*2] | -78,483 | -908.4 | 233.00 | 188 | 45.00 |
| NJK WTP[*3] | -52,168 | -603.8 | 214.20 | 187 | 27.20 |
| z01a/z02a | 23,401 | 270.8 | 223.29 | 183 | 40.29 |
| z01b | 4,965 | 57.5 | 224.56 | 184 | 40.56 |
| z02b | 3,210 | 37.2 | 222.19 | 185 | 37.19 |
| z02c | 12,115 | 140.2 | 221.61 | 185 | 36.61 |
| z02d | 5,434 | 62.9 | 220.55 | 185 | 35.55 |
| z03a | 24,279 | 281.0 | 219.96 | 183 | 36.96 |
| z03b | 3,741 | 43.3 | 218.10 | 186 | 32.10 |
| z03c | 12,854 | 148.8 | 217.94 | 186 | 31.94 |
| z03d | 13,609 | 157.5 | 217.81 | 186 | 31.81 |
| z04a | 4,948 | 57.3 | 218.73 | 183 | 35.73 |
| z04b/z05a | 14,767 | 170.9 | 217.64 | 186 | 31.64 |
| z04c/z05b | 12,483 | 144.5 | 217.64 | 185 | 32.64 |
| z04d | 6,063 | 70.2 | 217.89 | 186 | 31.89 |
| z04e | 3,246 | 37.6 | 218.42 | 186 | 32.42 |
| z04f | 4,337 | 50.2 | 217.42 | 189 | 28.42 |
| z04g | 0 | 0.0 | 219.09 | 186 | 33.09 |
| z04h | 7,849 | 90.8 | 217.41 | 190 | 27.41 |
| z04i | 11,167 | 129.2 | 217.50 | 187 | 30.50 |
| z04j | 2,722 | 31.5 | 222.81 | 185 | 37.81 |
| z05c | 4,192 | 48.5 | 217.10 | 185 | 32.10 |
| z06a | 3,231 | 37.4 | 214.44 | 188 | 26.44 |
| z06b | 7,448 | 86.2 | 213.80 | 186 | 27.80 |
| z06c | 7,388 | 85.5 | 213.68 | 188 | 25.68 |
| z06d | 15,353 | 177.7 | 213.65 | 186 | 27.65 |
| z07/08/09a | 64,949 | 751.7 | 222.25 | 185 | 37.25 |
| z07b | 5,359 | 62.0 | 223.08 | 185 | 38.08 |
| z07c | 2,486 | 28.8 | 219.30 | 187 | 32.30 |
| z07d | 2,722 | 31.5 | 214.73 | 186 | 28.73 |
| z07e | 2,062 | 23.9 | 214.54 | 187 | 27.54 |
| z10a | 12,897 | 149.3 | 214.20 | 187 | 27.20 |
| z10b | 916 | 10.6 | 213.19 | 185 | 28.19 |
| z10c | 7,424 | 85.9 | 212.70 | 186 | 26.70 |
| z10d | 10,394 | 120.3 | 212.00 | 186 | 26.00 |
| z11a | 7,176 | 83.1 | 213.85 | 188 | 25.85 |
| z11b | 14,161 | 163.9 | 213.95 | 190 | 23.95 |
| z11c | 3,855 | 44.6 | 211.85 | 183 | 28.85 |
| z11d | 4,275 | 49.5 | 211.08 | 186 | 25.08 |
| z11e | 6,623 | 76.7 | 211.03 | 185 | 26.03 |
| z11f | 9,123 | 105.6 | 211.10 | 186 | 25.10 |
| z12a | 11,706 | 135.5 | 213.66 | 182 | 31.66 |
| z12b | 13,174 | 152.5 | 212.20 | 184 | 28.20 |
| z12c | 13,517 | 156.4 | 211.21 | 184 | 27.21 |
| z12d | 3,983 | 46.1 | 211.56 | 186 | 25.56 |
| z12e | 8,027 | 92.9 | 211.99 | 185 | 26.99 |

| Node No. | Discharge | | WL | GL | Eff. Head |
|---|---|---|---|---|---|
| | CMD | l/s | m | m | m |
| z12f | 8,354 | 96.7 | 211.21 | 185 | 26.21 |
| z13a | 14,386 | 166.5 | 225.67 | 185 | 40.67 |
| z14a | 8,104 | 93.8 | 229.97 | 182 | 47.97 |
| z15a | 15,466 | 179.0 | 225.86 | 185 | 40.86 |
| J101 | 0 | 0.0 | 232.70 | 185 | 47.70 |
| J107 | 0 | 0.0 | 222.97 | 185 | 37.97 |
| J108 | 0 | 0.0 | 223.71 | 182 | 41.71 |
| J111 | 0 | 0.0 | 227.54 | 182 | 45.54 |
| J128 | 0 | 0.0 | 218.45 | 190 | 28.45 |
| J129 | 0 | 0.0 | 222.08 | 187 | 35.08 |
| J131 | 0 | 0.0 | 226.26 | 183 | 43.26 |
| J140 | 0 | 0.0 | 218.10 | 187 | 31.10 |
| J142 | 0 | 0.0 | 218.76 | 185 | 33.76 |
| J143 | 0 | 0.0 | 219.40 | 187 | 32.40 |
| J144 | 0 | 0.0 | 219.71 | 187 | 32.71 |
| J145 | 0 | 0.0 | 218.13 | 189 | 29.13 |
| J146 | 0 | 0.0 | 217.09 | 193 | 24.09 |
| J147 | 0 | 0.0 | 214.94 | 186 | 28.94 |
| J149 | 0 | 0.0 | 215.65 | 190 | 25.65 |
| J150 | 0 | 0.0 | 214.27 | 190 | 24.27 |
| J151 | 0 | 0.0 | 217.28 | 189 | 28.28 |
| J152 | 0 | 0.0 | 217.15 | 185 | 32.15 |
| J153 | 0 | 0.0 | 217.02 | 186 | 31.02 |
| J154 | 0 | 0.0 | 215.54 | 189 | 26.54 |
| J155 | 0 | 0.0 | 214.64 | 187 | 27.64 |
| J156 | 0 | 0.0 | 214.59 | 186 | 28.59 |
| J157 | 0 | 0.0 | 213.75 | 183 | 30.75 |
| J180 | 0 | 0.0 | 212.19 | 184 | 28.19 |
| J199 | 0 | 0.0 | 232.81 | 185 | 47.81 |
| J401 | 0 | 0.0 | 211.84 | 186 | 25.84 |
| J402 | 0 | 0.0 | 211.80 | 186 | 25.80 |
| J405 | 0 | 0.0 | 212.35 | 185 | 27.35 |
| J406 | 0 | 0.0 | 211.62 | 186 | 25.62 |
| J408 | 0 | 0.0 | 211.41 | 187 | 24.41 |
| J409 | 0 | 0.0 | 211.39 | 187 | 24.39 |
| J606 | 0 | 0.0 | 211.78 | 183 | 28.78 |
| J701 | 0 | 0.0 | 214.15 | 190 | 24.15 |
| J702 | 0 | 0.0 | 214.13 | 190 | 24.13 |
| J703 | 0 | 0.0 | 214.07 | 190 | 24.07 |
| J705 | 0 | 0.0 | 213.89 | 185 | 28.89 |
| J706 | 0 | 0.0 | 213.88 | 188 | 25.88 |
| J708 | 0 | 0.0 | 213.25 | 184 | 29.25 |
| J709 | 0 | 0.0 | 213.22 | 184 | 29.22 |
| J710 | 0 | 0.0 | 213.20 | 184 | 29.20 |
| J711 | 0 | 0.0 | 214.18 | 187 | 27.18 |
| J713 | 0 | 0.0 | 212.22 | 184 | 28.22 |
| J716 | 0 | 0.0 | 211.87 | 184 | 27.87 |

# ATTACHMENT 2.2.1

## NETWORK ANALYSIS OF ARTERIAL MAIN - 2.1

**Pipeline Data -1**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | $m^3/d$ | l/s | m/s | ‰ |
| TREx | J101 | 1,600 | 140.4 | 110 | 0.30 | 329,290 | 3,811.2 | 1.90 | 2.13 |
| TRNw | J199 | 1,000 | 125.7 | 110 | 0.19 | 78,483 | 908.4 | 1.16 | 1.48 |
| NJK WTP*3 | J711 | 800 | 10.0 | 110 | 0.02 | 52,168 | 603.8 | 1.20 | 2.06 |
| z03b | z04a | 800 | 399.1 | 110 | -0.62 | -44,974 | -520.5 | -1.04 | 1.56 |
| J101 | z14a | 1600 | 1,278.4 | 110 | 2.72 | 329,290 | 3,811.2 | 1.90 | 2.13 |
| z04a | z03a | 800 | 650.0 | 110 | -1.24 | -49,922 | -577.8 | -1.15 | 1.90 |
| z04f | z05c | 800 | 698.6 | 110 | 0.32 | 23,214 | 268.7 | 0.53 | 0.46 |
| J146 | J147 | 800 | 958.7 | 110 | 2.16 | 54,668 | 632.7 | 1.26 | 2.25 |
| z11a | z10b | 800 | 699.9 | 110 | 0.66 | 34,451 | 398.7 | 0.79 | 0.95 |
| z12d | J408 | 500 | 323.5 | 110 | 0.15 | 6,732 | 77.9 | 0.40 | 0.46 |
| J711 | J702 | 800 | 990.8 | 110 | -0.05 | 6,935 | 80.3 | 0.16 | 0.05 |
| z13a | z01a/z02a | 1,200 | 1,927.3 | 110 | 2.51 | 118,361 | 1,369.9 | 1.21 | 1.30 |
| z02b | z01a/z02a | 900 | 313.1 | 110 | -1.10 | -94,960 | -1,099.1 | -1.73 | 3.52 |
| z03a | z02d | 1,000 | 439.8 | 110 | -0.58 | -74,201 | -858.8 | -1.09 | 1.33 |
| z-4b/z05/a | z03d | 800 | 834.9 | 110 | -0.17 | -14,770 | -171.0 | -0.34 | 0.20 |
| z04e | L140 | 900 | 353.8 | 110 | 0.33 | 46,093 | 533.5 | 0.84 | 0.92 |
| J142 | z04e | 900 | 325.7 | 110 | 0.34 | 49,339 | 571.1 | 0.90 | 1.05 |
| J129 | J144 | 900 | 671.0 | 110 | 2.38 | 95,317 | 1,103.2 | 1.74 | 3.54 |
| J108 | z07b | 1,200 | 627.6 | 110 | 0.63 | 103,059 | 1,192.8 | 1.06 | 1.01 |
| z151 | z01b | 1,400 | 1,044.0 | 110 | 1.29 | 172,973 | 2,002.0 | 1.30 | 1.24 |
| J111 | z15a | 1,400 | 1,156.0 | 110 | 1.68 | 188,439 | 2,181.0 | 1.42 | 1.45 |
| J129 | z07c | 900 | 1,136.6 | 110 | 2.78 | 78,144 | 904.4 | 1.42 | 2.45 |
| z04h | J151 | 600 | 383.7 | 110 | 0.13 | 9,184 | 106.3 | 0.38 | 0.34 |
| z04c/z05b | z041 | 800 | 359.6 | 110 | 0.23 | 27,551 | 318.9 | 0.63 | 0.63 |
| J154 | J153 | 600 | 550.1 | 110 | -1.47 | -28,206 | -326.5 | -1.16 | 2.68 |
| J155 | J154 | 600 | 337.6 | 110 | -0.90 | -28,206 | -326.5 | -1.16 | 2.68 |
| z06b | z06a | 700 | 639.3 | 110 | -0.65 | -24,975 | -289.1 | -0.75 | 1.01 |
| z06c | J157 | 800 | 276.8 | 110 | -0.07 | -17,527 | -202.9 | -0.40 | 0.27 |
| z06d | z06c | 800 | 299.7 | 110 | -0.03 | -10,139 | -117.4 | -0.23 | 0.10 |
| J713 | z12a | 600 | 534.9 | 110 | -1.44 | -28,313 | -327.7 | -1.16 | 2.70 |
| z12f | z12c | 600 | 454.0 | 110 | -0.00 | -1,622 | -18.8 | -0.07 | 0.01 |
| J409 | z12f | 500 | 401.6 | 110 | 0.18 | 6,732 | 77.9 | 0.40 | 0.46 |
| J401 | J406 | 500 | 199.8 | 110 | 0.22 | 10,715 | 124.0 | 0.63 | 1.08 |
| z11d | J402 | 500 | 1,140.8 | 110 | -0.74 | -8,159 | -94.4 | -0.48 | 0.65 |
| z11e | z11d | 500 | 299.7 | 110 | -0.05 | -3,884 | -45.0 | -0.23 | 0.17 |
| J606 | z11f | 500 | 521.2 | 110 | 0.68 | 11,862 | 137.3 | 0.70 | 1.31 |
| z10a | z11a | 800 | 317.8 | 110 | 0.35 | 36,987 | 428.1 | 0.85 | 1.09 |
| z07d | z07e | 800 | 92.0 | 110 | 0.19 | 51,946 | 601.2 | 1.20 | 2.04 |
| J107 | z07/08/09a | 1,000 | 694.4 | 110 | 0.72 | 64,949 | 751.7 | 0.96 | 1.04 |
| z10c | z10d | 700 | 633.8 | 110 | 0.70 | 26,111 | 302.2 | 0.79 | 1.10 |
| J706 | J705 | 700 | 355.4 | 110 | 0.01 | -4,640 | -53.7 | -0.14 | 0.04 |
| J408 | J409 | 500 | 36.6 | 110 | 0.02 | 6,732 | 77.9 | 0.40 | 0.46 |
| J140 | z04d | 1,000 | 376.5 | 110 | 0.21 | 46,093 | 533.5 | 0.68 | 0.55 |
| z04d | z04c/z05b | 900 | 344.9 | 110 | 0.24 | 40,030 | 463.3 | 0.73 | 0.71 |
| J131 | J111 | 1,200 | 795.0 | 110 | -1.28 | -132,747 | -1,536.4 | -1.36 | 1.61 |
| z13a | J131 | 1,200 | 363.7 | 110 | -0.59 | -132,747 | -1,536.4 | -1.36 | 1.61 |
| J152 | J151 | 600 | 404.5 | 110 | -0.14 | -9,184 | -106.3 | -0.38 | 0.34 |
| z05c | J153 | 800 | 255.4 | 110 | 0.08 | 19,022 | 220.2 | 0.44 | 0.32 |
| J145 | J128 | 1,000 | 230.1 | 110 | 0.32 | -75,658 | -875.7 | -1.12 | 1.38 |
| J145 | J146 | 800 | 465.5 | 110 | 1.05 | 54,668 | 632.7 | 1.26 | 2.25 |

# ATTACHMENT 2.2.2

## NETWORK ANALYSIS OF ARTERIAL MAIN - 2.2

**Pipeline Data -2**

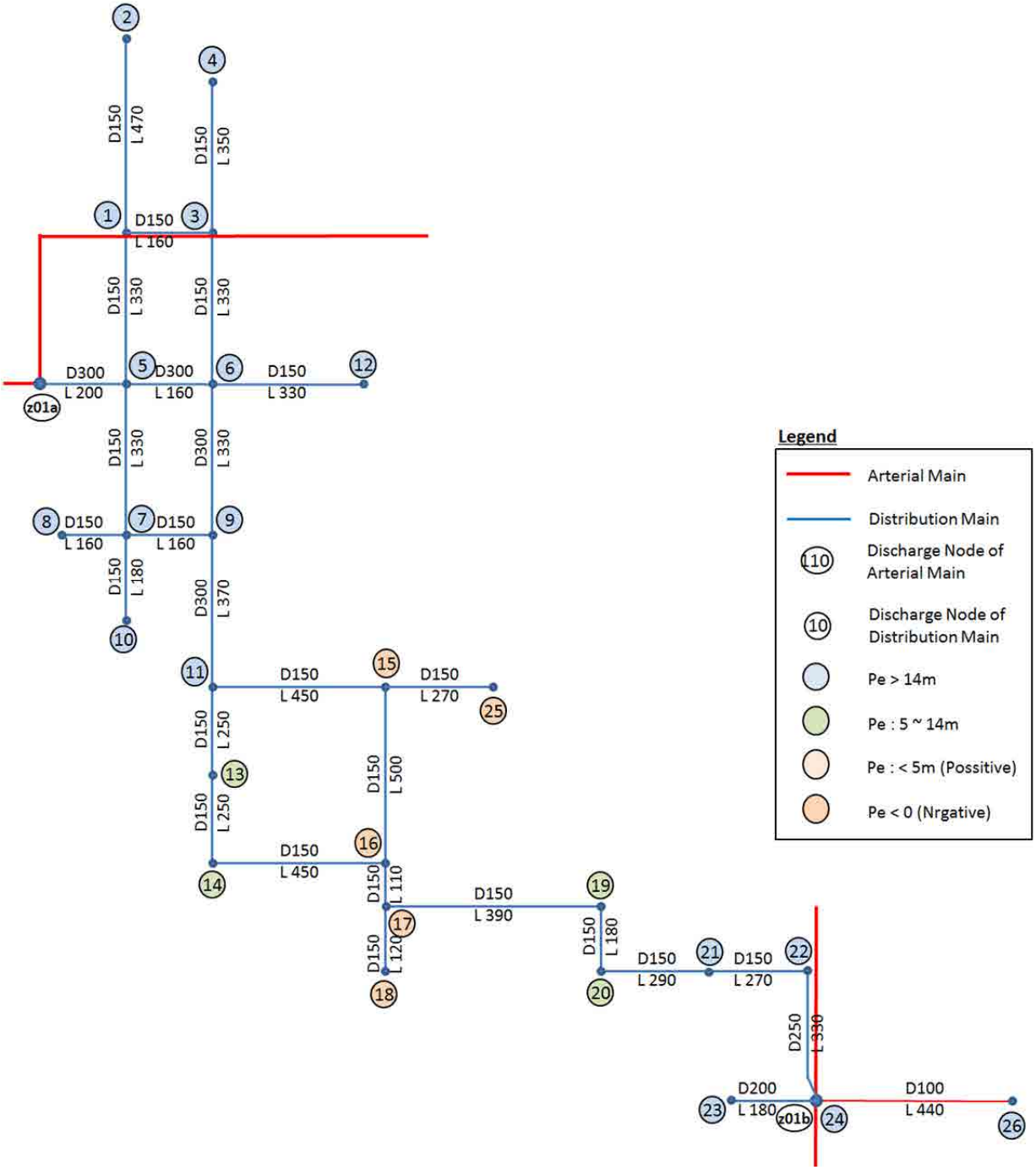
| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | $m^3/d$ | l/s | m/s | ‰ |
| z11b | J705 | 700 | 1,245.4 | 110 | -0.05 | 4,640 | 53.7 | 0.14 | 0.04 |
| J702 | J703 | 800 | 206.2 | 110 | 0.06 | 18,801 | 217.6 | 0.43 | 0.31 |
| J406 | z12d | 500 | 57.8 | 110 | 0.06 | 10,715 | 124.0 | 0.63 | 1.08 |
| z01b | J108 | 1,200 | 343.3 | 110 | 0.85 | 168,008 | 1,944.5 | 1.72 | 2.49 |
| J716 | J180 | 600 | 378.9 | 110 | -0.32 | -15,139 | -175.2 | -0.62 | 0.85 |
| J199 | z04j | 1,000 | 6,760.3 | 110 | 10.01 | 78,483 | 908.4 | 1.16 | 1.48 |
| z04j | J129 | 1,200 | 275.5 | 110 | 0.73 | 173,461 | 2,007.6 | 1.78 | 2.64 |
| J405 | J710 | 700 | 732.7 | 110 | -0.85 | -26,901 | -311.4 | -0.81 | 1.16 |
| z04i | J149 | 800 | 1,557.5 | 110 | 1.85 | 38,767 | 448.7 | 0.89 | 1.19 |
| J150 | J149 | 700 | 605.3 | 110 | -1.38 | -38,767 | -448.7 | -1.17 | 2.28 |
| J701 | J702 | 700 | 76.2 | 110 | 0.02 | 11,866 | 137.3 | 0.36 | 0.25 |
| J143 | z04g | 900 | 297.4 | 110 | 0.31 | 49,339 | 571.1 | 0.90 | 1.05 |
| z12a | J171 | 800 | 326.2 | 110 | -0.52 | -45,233 | -523.5 | -1.04 | 1.58 |
| J716 | z12c | 600 | 773.2 | 110 | 0.66 | 15,139 | 175.2 | 0.62 | 0.85 |
| J701 | J708 | 700 | 780.3 | 110 | 0.91 | 26,901 | 311.4 | 0.81 | 1.16 |
| z14a | J111 | 1,600 | 1,193.0 | 110 | 2.43 | 321,186 | 3,717.4 | 1.85 | 2.04 |
| J152 | J153 | 600 | 397.6 | 110 | 0.14 | 9,184 | 106.3 | 0.38 | 0.34 |
| J143 | J144 | 900 | 294.4 | 110 | -0.31 | -49,339 | -571.1 | -0.90 | 1.05 |
| z12e | J401 | 700 | 253.0 | 110 | 0.15 | 18,874 | 218.5 | 0.57 | 0.60 |
| J405 | z12e | 700 | 314.7 | 110 | 0.37 | 26,901 | 311.4 | 0.81 | 1.16 |
| J708 | J709 | 700 | 20.3 | 110 | 0.02 | 26,901 | 311.4 | 0.81 | 1.16 |
| J713 | z12b | 700 | 20.3 | 110 | 0.03 | 28,313 | 327.7 | 0.85 | 1.27 |
| J108 | J107 | 1,000 | 707.1 | 110 | 0.74 | 64,949 | 751.7 | 0.96 | 1.04 |
| J706 | z11a | 700 | 525.3 | 110 | -0.02 | 4,640 | 53.7 | 0.14 | 0.04 |
| z11c | J606 | 500 | 51.9 | 110 | 0.07 | 11,862 | 137.3 | 0.70 | 1.31 |
| J710 | J709 | 700 | 20.8 | 110 | -0.02 | -26,901 | -311.4 | -0.81 | 1.16 |
| J401 | J402 | 500 | 13.3 | 110 | 0.01 | 8,159 | 94.4 | 0.48 | 0.65 |
| z12b | J180 | 700 | 20.4 | 110 | 0.01 | 15,139 | 175.2 | 0.46 | 0.40 |
| J703 | z11b | 800 | 379.0 | 110 | 0.12 | 18,801 | 217.6 | 0.43 | 0.31 |
| J155 | J156 | 600 | 20.1 | 110 | 0.05 | 28,206 | 326.5 | 1.16 | 2.68 |
| J144 | z04i | 800 | 1,355.5 | 110 | 2.21 | 45,977 | 532.1 | 1.06 | 1.63 |
| J145 | z04i | 600 | 408.9 | 110 | 0.63 | 20,990 | 242.9 | 0.86 | 1.55 |
| z06d | z12a | 600 | 124.0 | 110 | 0.01 | -5,214 | -60.3 | -0.21 | 0.12 |
| J147 | z07d | 800 | 90.8 | 110 | 0.20 | 54,668 | 632.7 | 1.26 | 2.25 |
| J150 | J701 | 700 | 53.2 | 110 | 0.12 | 38,767 | 448.7 | 1.17 | 2.28 |
| z02b | z02c | 1,000 | 293.5 | 110 | 0.58 | 91,750 | 1,061.9 | 1.35 | 1.98 |
| z02c | z02d | 1,000 | 700.6 | 110 | 1.06 | 79,635 | 921.7 | 1.17 | 1.52 |
| z03b | z03c | 800 | 121.6 | 110 | 0.16 | 41,233 | 477.2 | 0.95 | 1.33 |
| z03c | z03d | 800 | 196.2 | 110 | 0.13 | 28,379 | 328.5 | 0.65 | 0.67 |
| z04b/z05a | z04c/z05b | 800 | 669.0 | 110 | 0.00 | 3 | 0.0 | 0.00 | 0.00 |
| z04g | J142 | 900 | 310.5 | 110 | 0.33 | 49,339 | 571.1 | 0.90 | 1.05 |
| z04i | z04h | 900 | 596.4 | 110 | 0.09 | 17,033 | 197.1 | 0.31 | 0.15 |
| J156 | z06a | 700 | 112.9 | 110 | 0.14 | 28,206 | 326.5 | 0.85 | 1.26 |
| z06b | J157 | 700 | 83.4 | 110 | 0.04 | 17,527 | 202.9 | 0.53 | 0.52 |
| z07b | z04j | 1,200 | 286.5 | 110 | 0.26 | 97,700 | 1,130.8 | 1.00 | 0.91 |
| z07c | J128 | 900 | 367.0 | 110 | 0.85 | 75,658 | 875.7 | 1.38 | 2.31 |
| z07e | z10a | 800 | 181.2 | 110 | 0.34 | 49,884 | 577.4 | 1.15 | 1.90 |
| z10b | z10c | 700 | 281.2 | 110 | 0.49 | 33,535 | 388.1 | 1.01 | 1.74 |
| z10d | z11c | 700 | 355.5 | 110 | 0.15 | 15,717 | 181.9 | 0.47 | 0.43 |
| z11f | z11e | 500 | 802.2 | 110 | 0.07 | 2,739 | 31.7 | 0.16 | 0.09 |

# ATTACHMENT 3

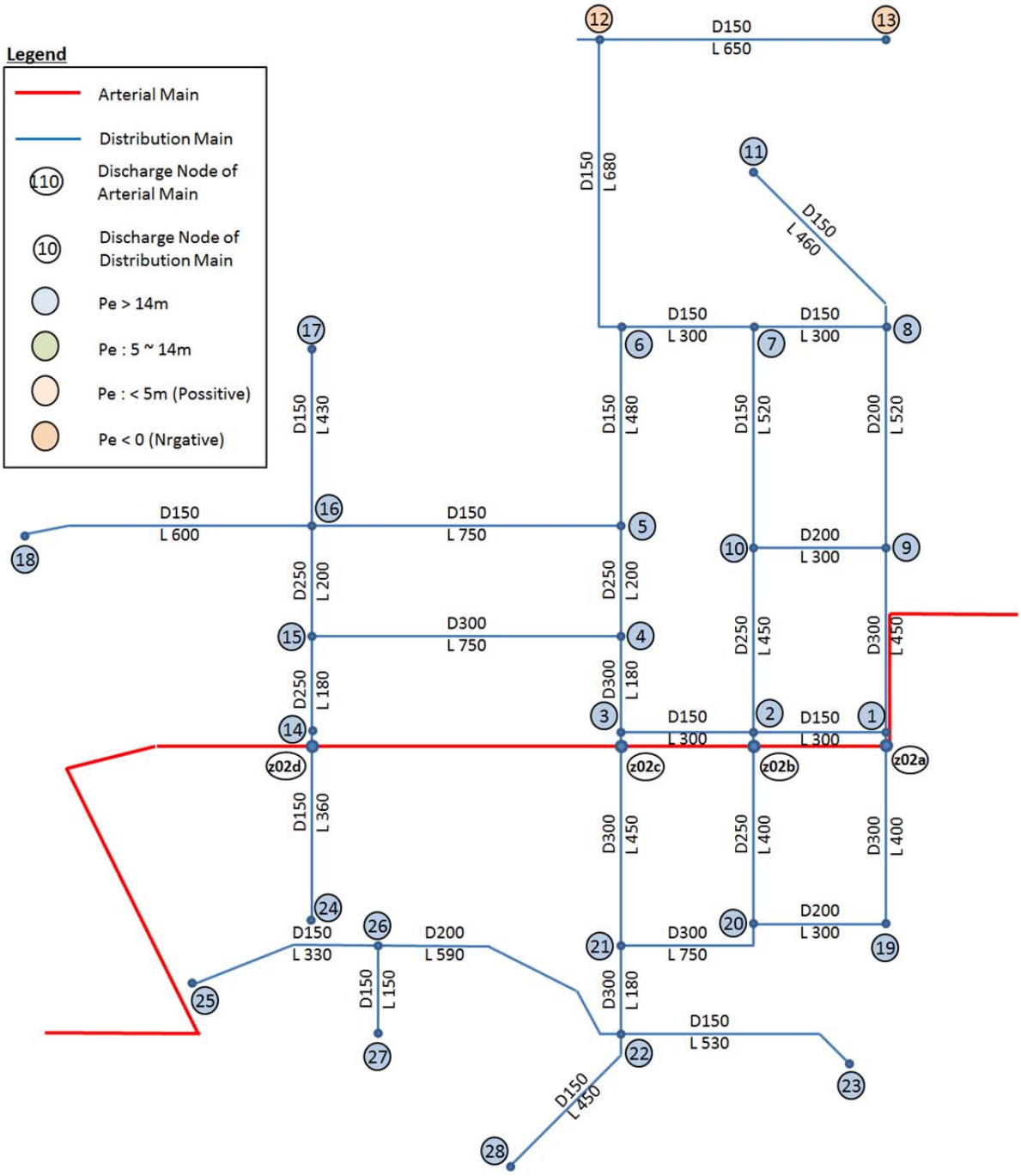
# Distribution Network of DZ

# ATTACHMENT 3.1

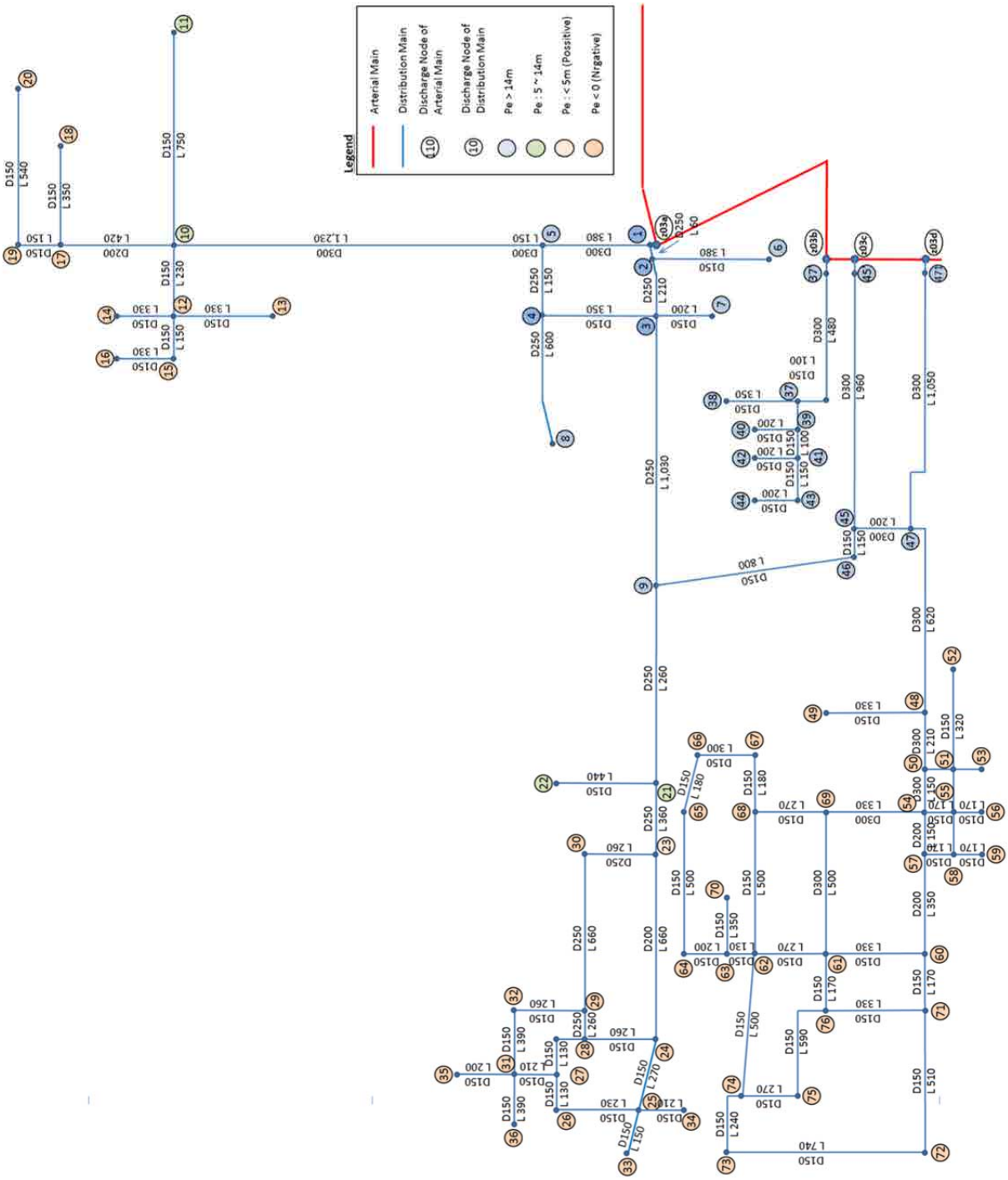
## Layout of Distribution Network



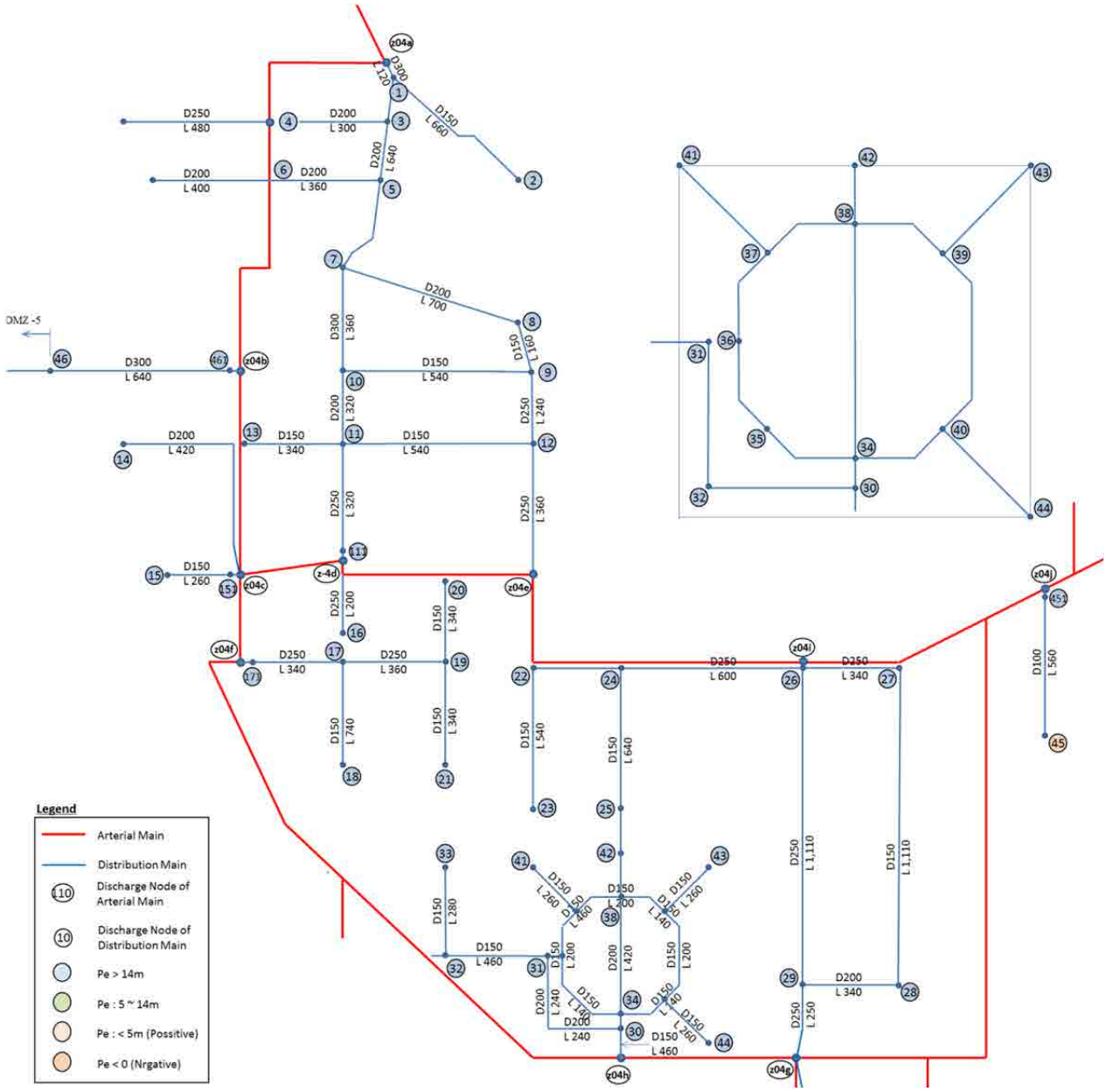

**Distribution Zone - 01**



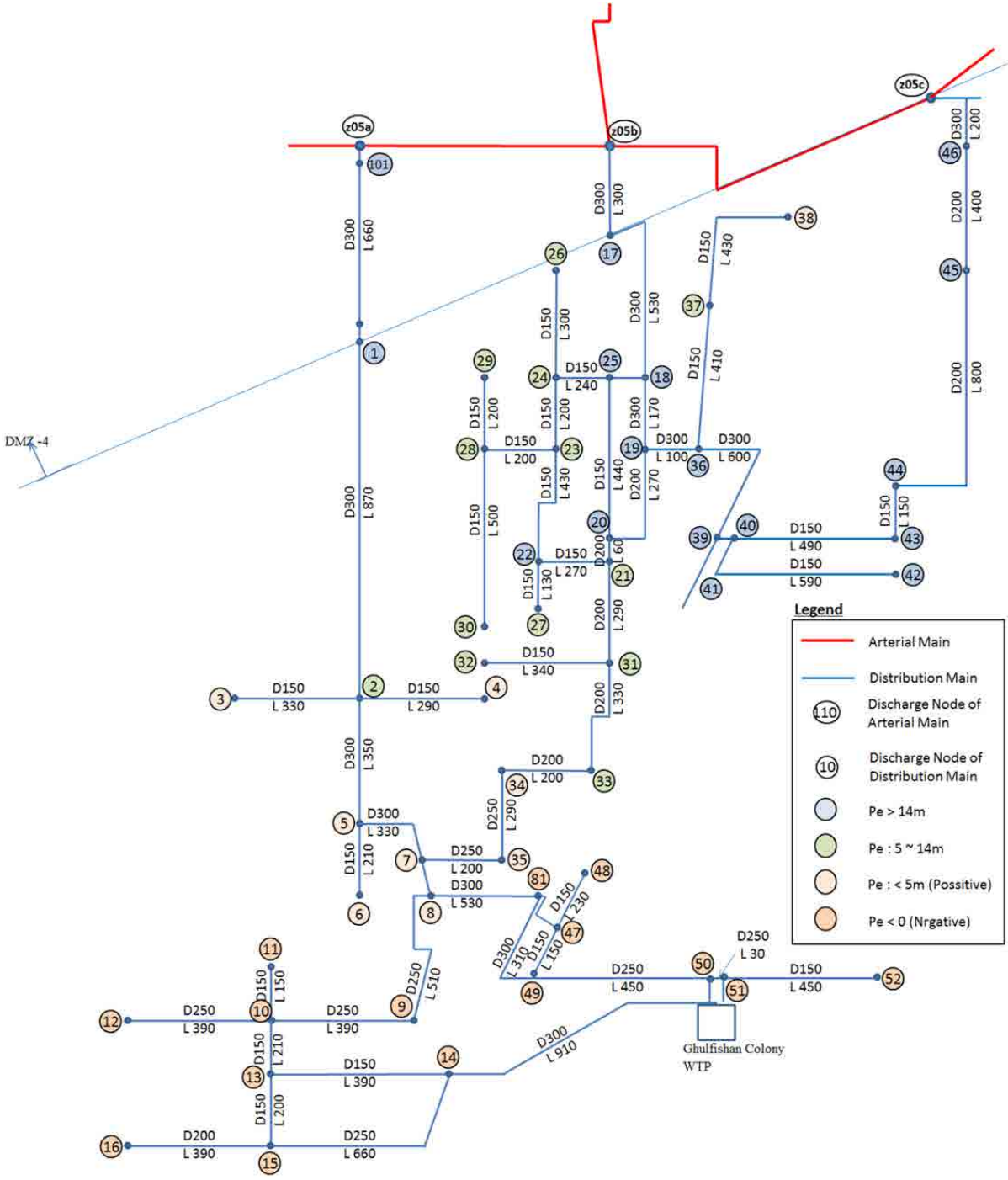

**Distribution Zone - 02**



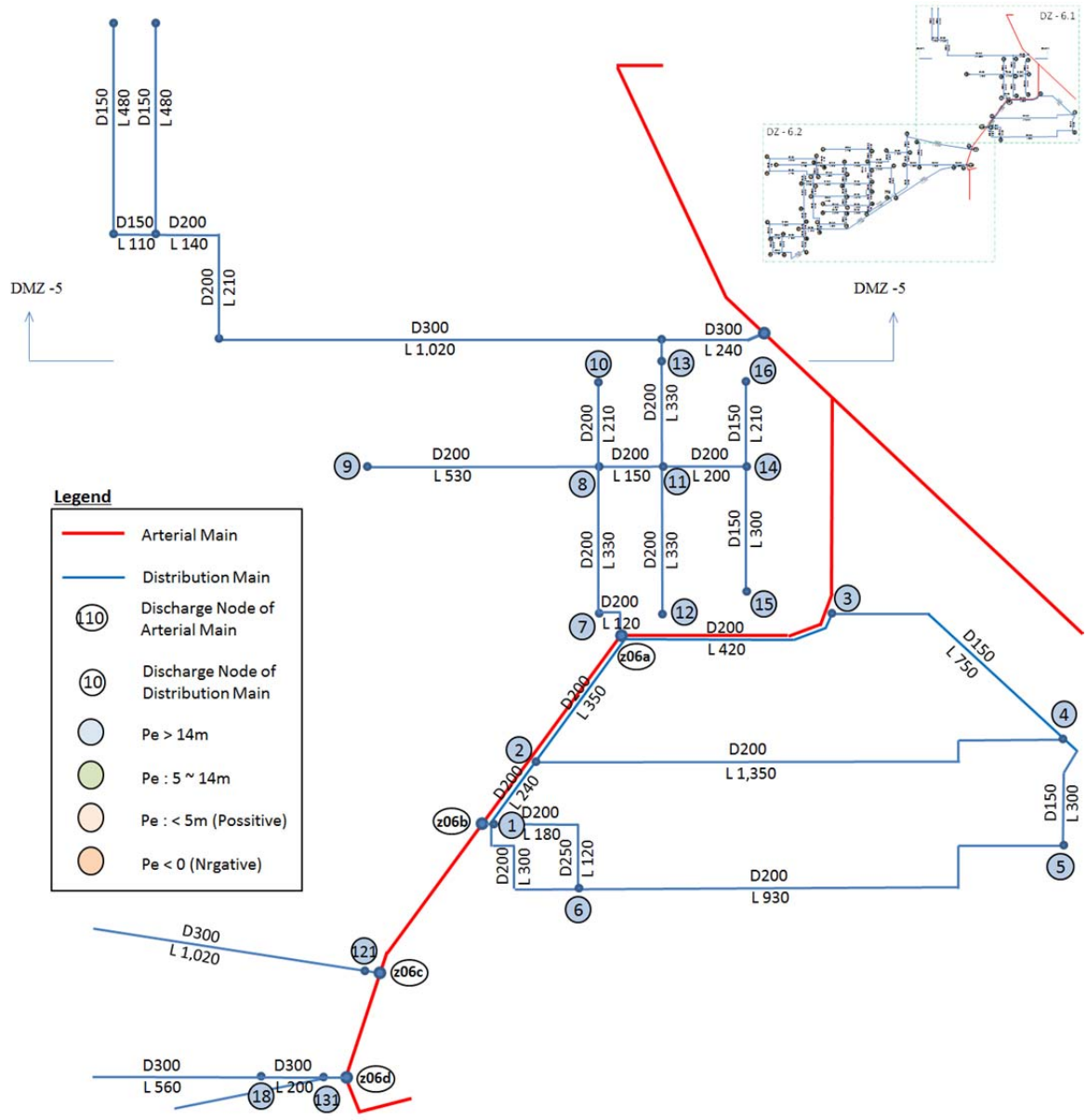

**Distribution Zone - 03**



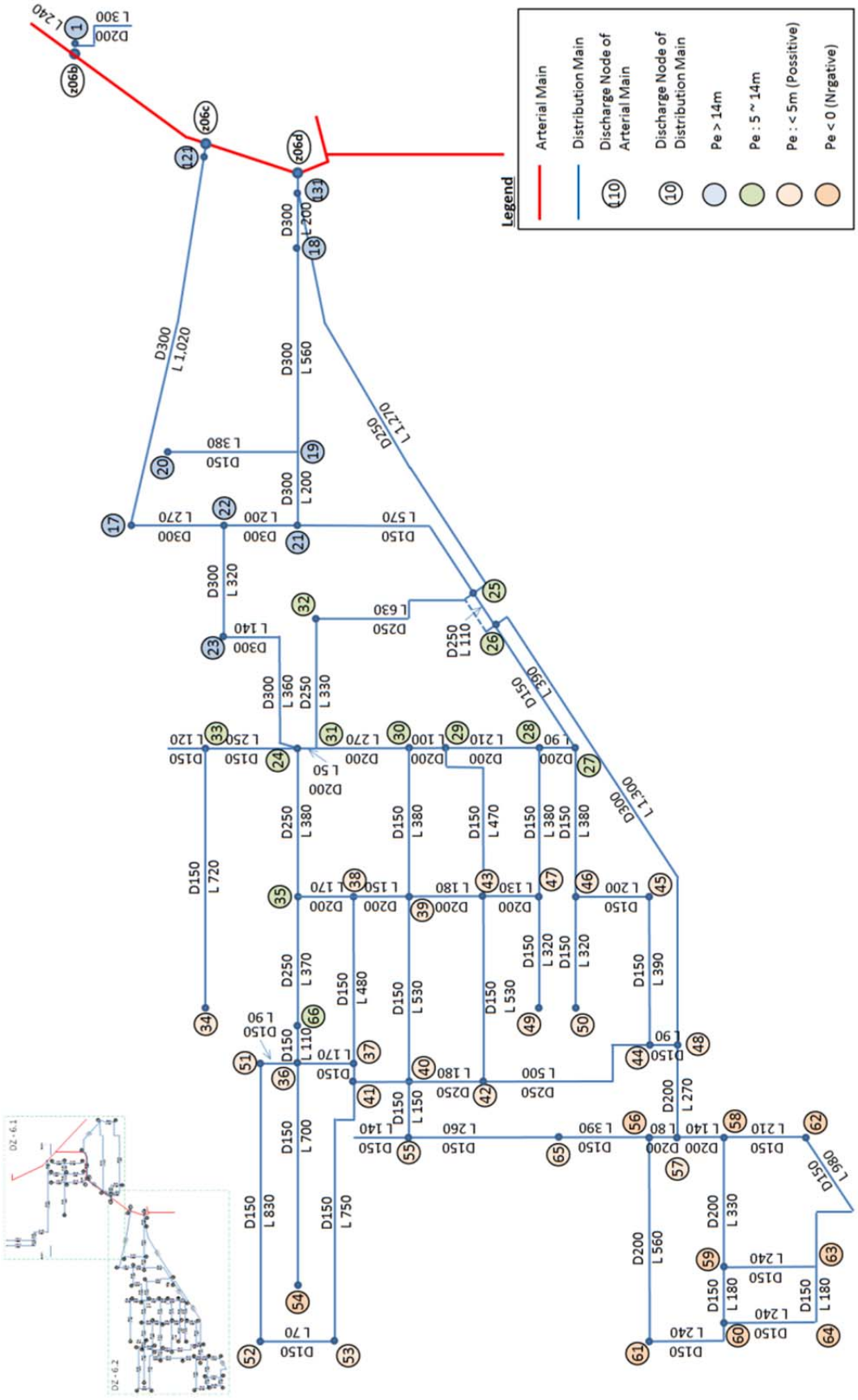

**Distribution Zone - 04**



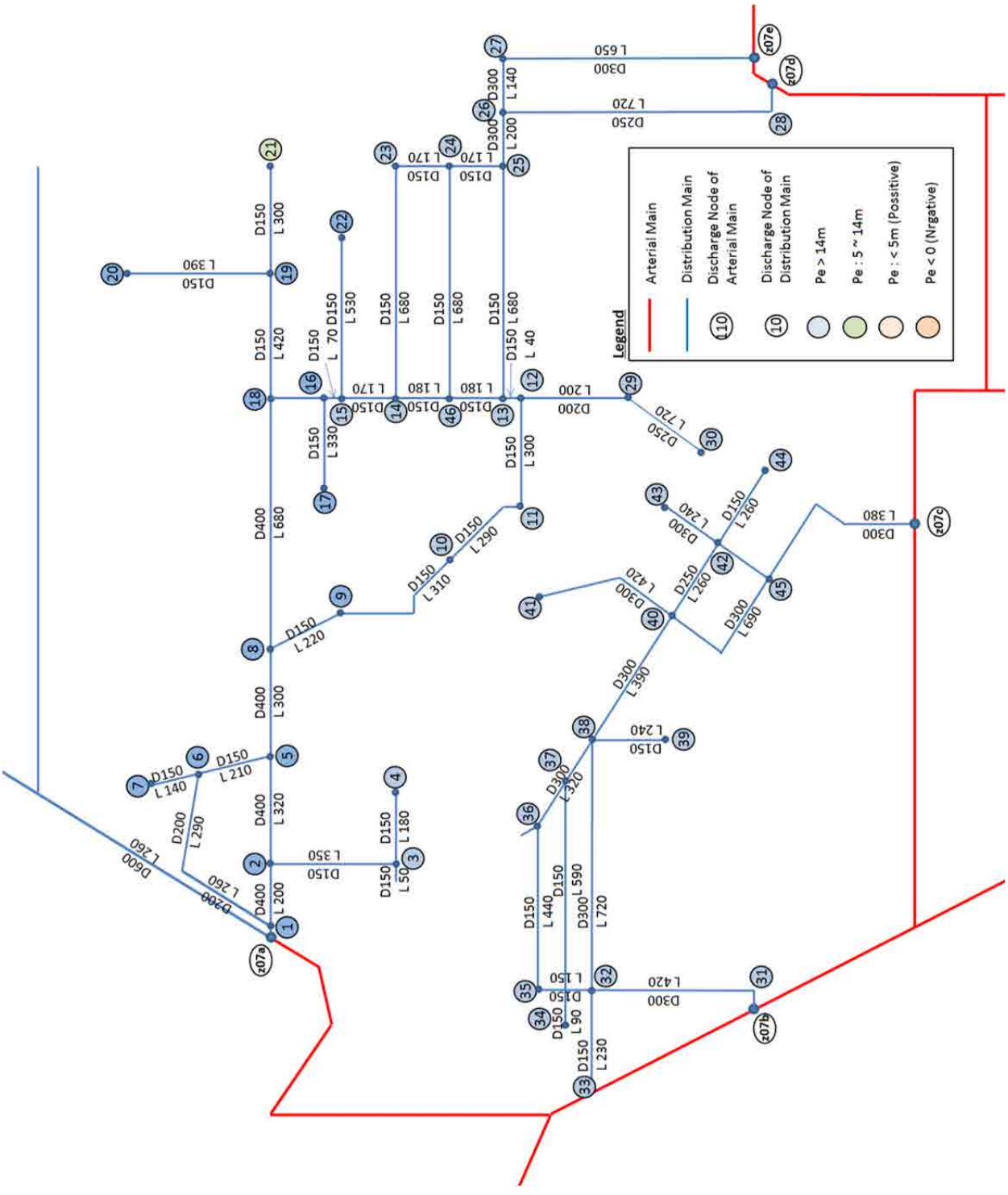

**Distribution Zone - 05**



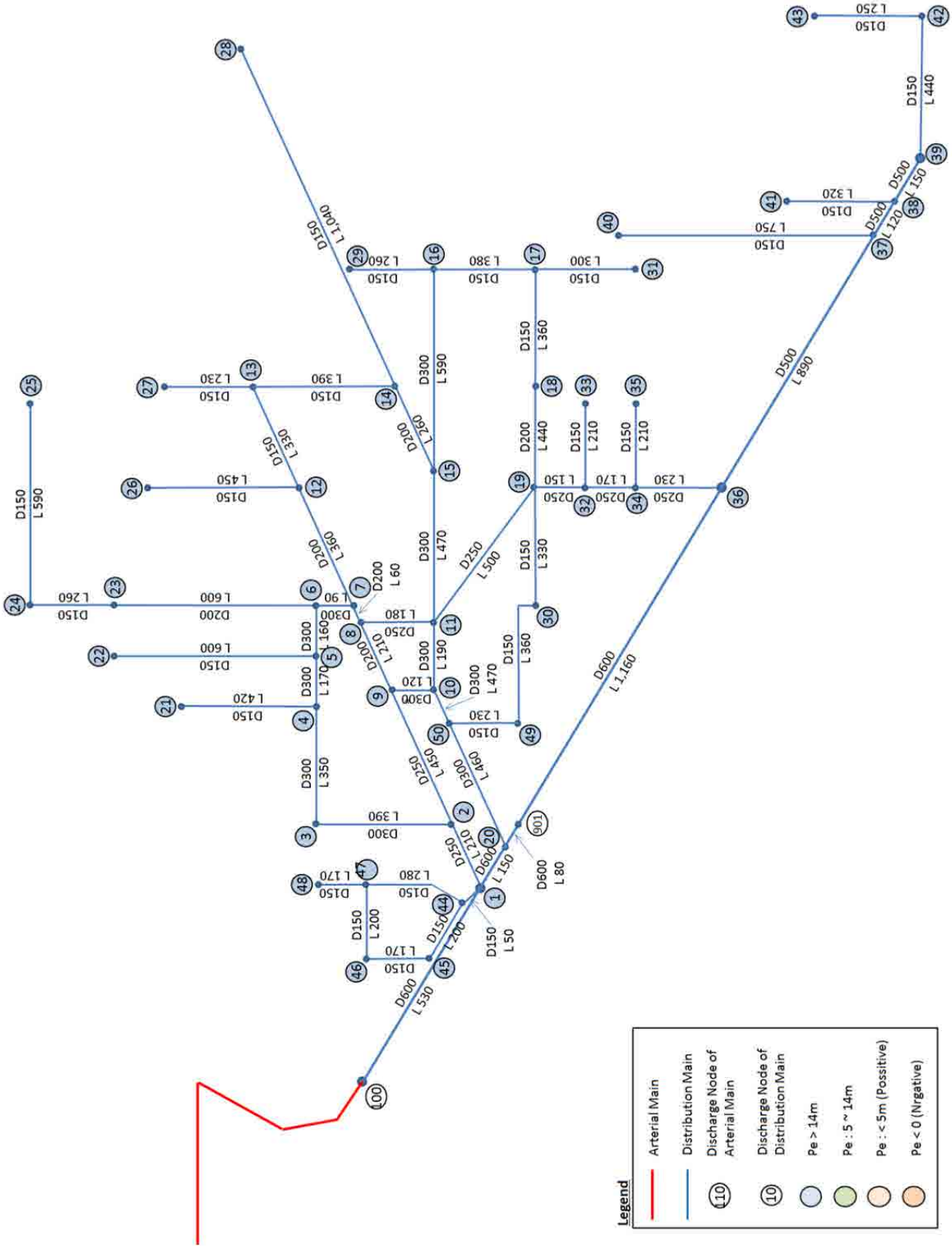

**Distribution Zone – 06.1**



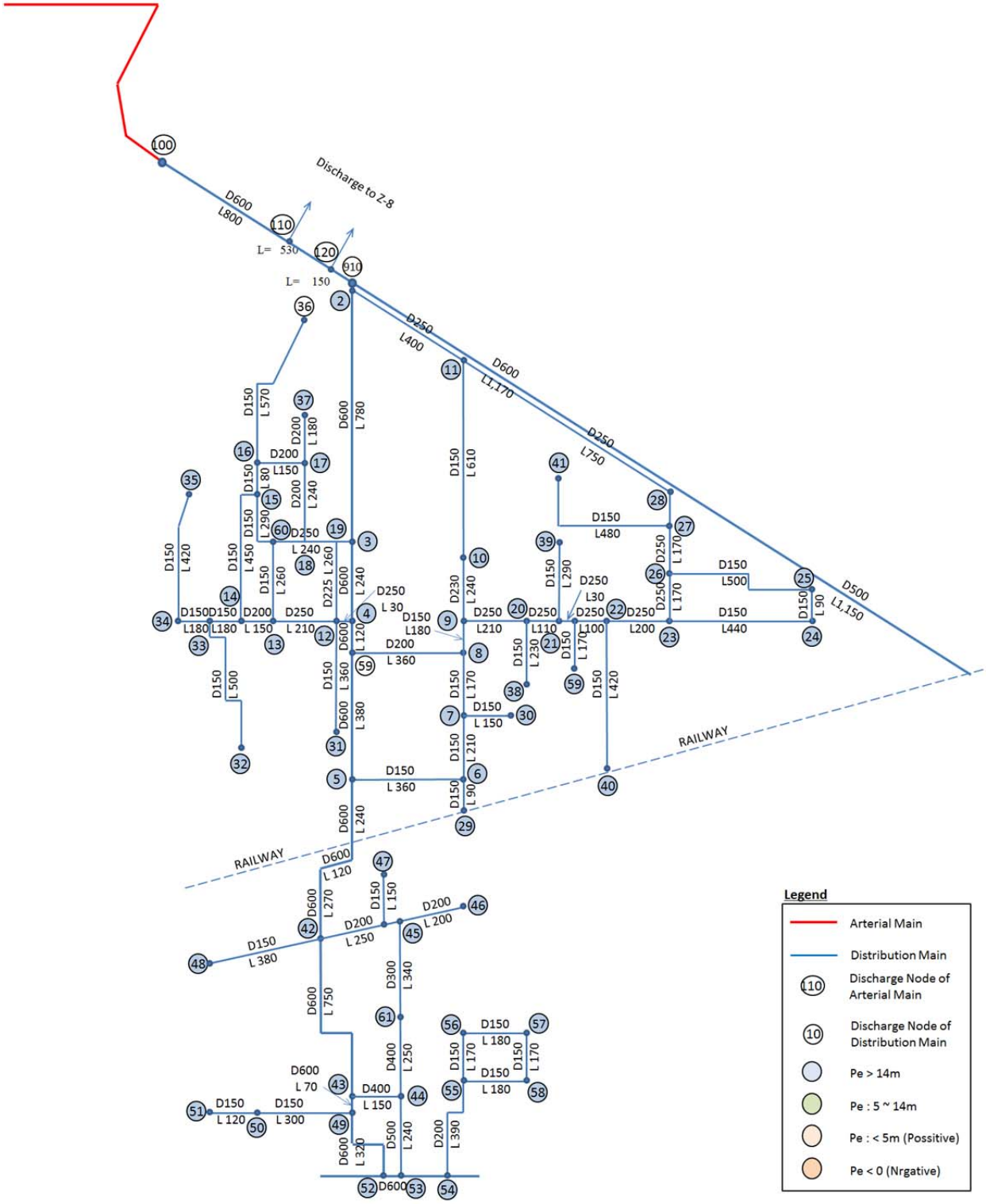

**Distribution Zone – 06.2**



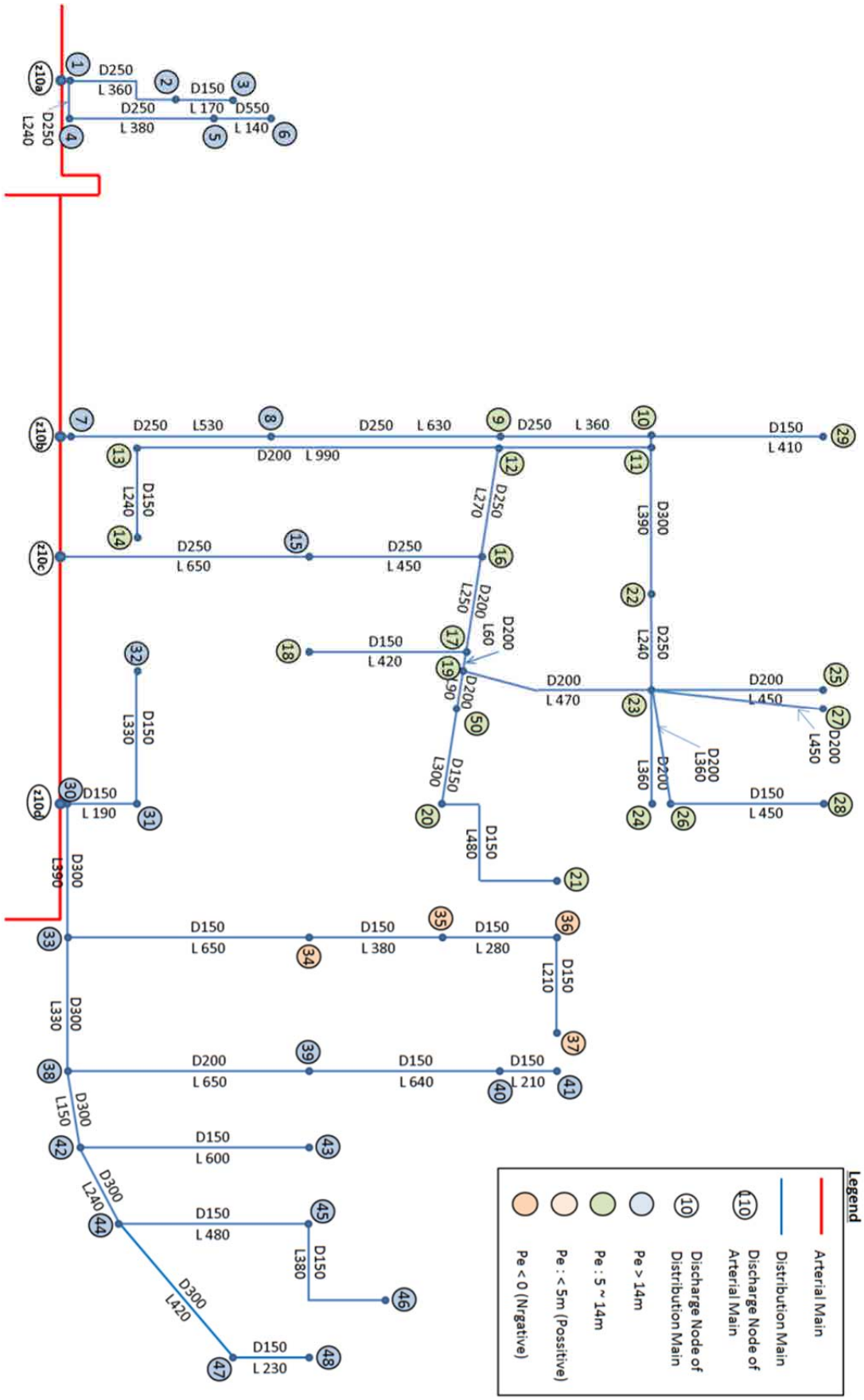

**Distribution Zone – 07**



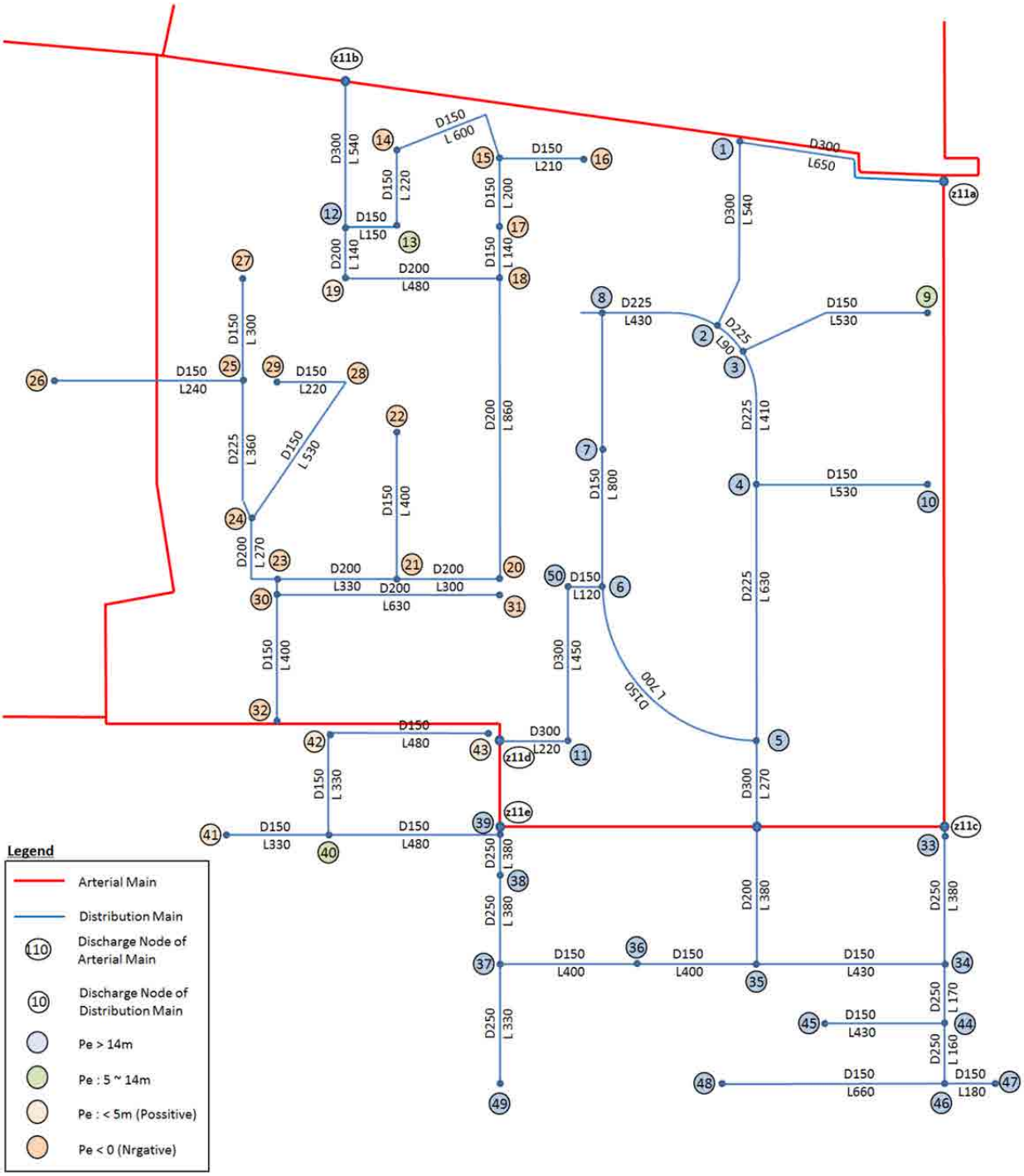

**Distribution Zone – 08**



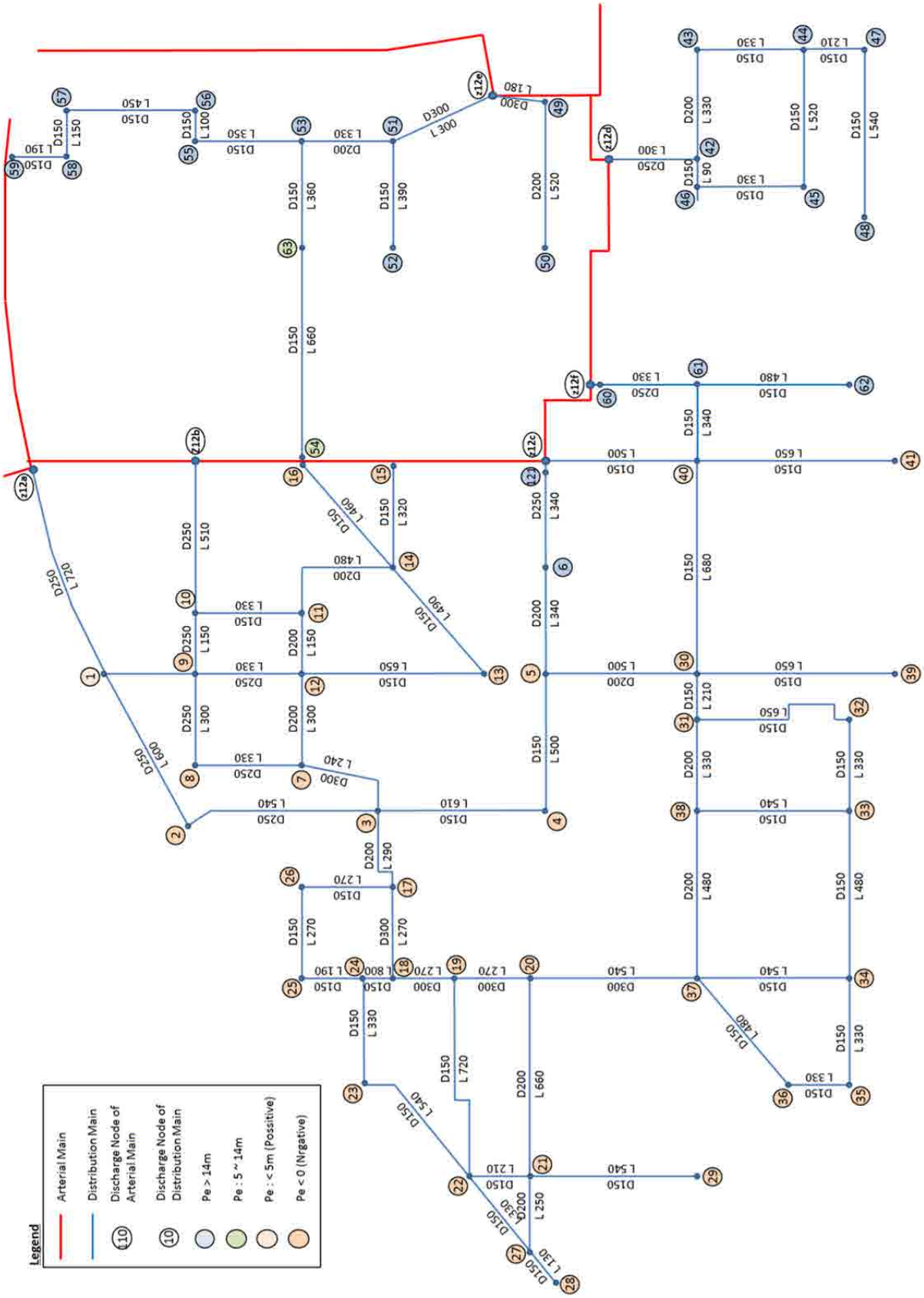

**Distribution Zone – 09**



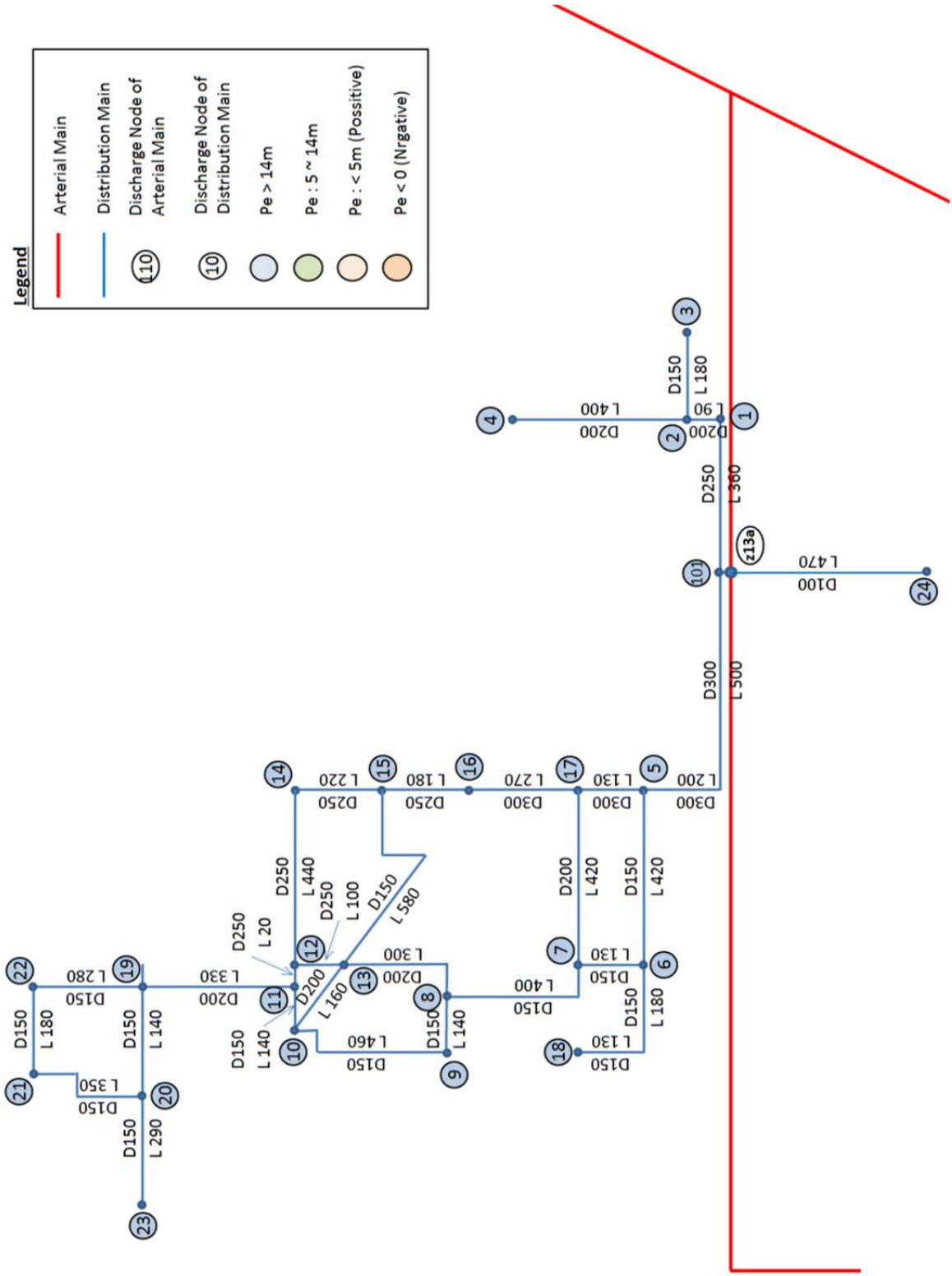

**Distribution Zone – 10**



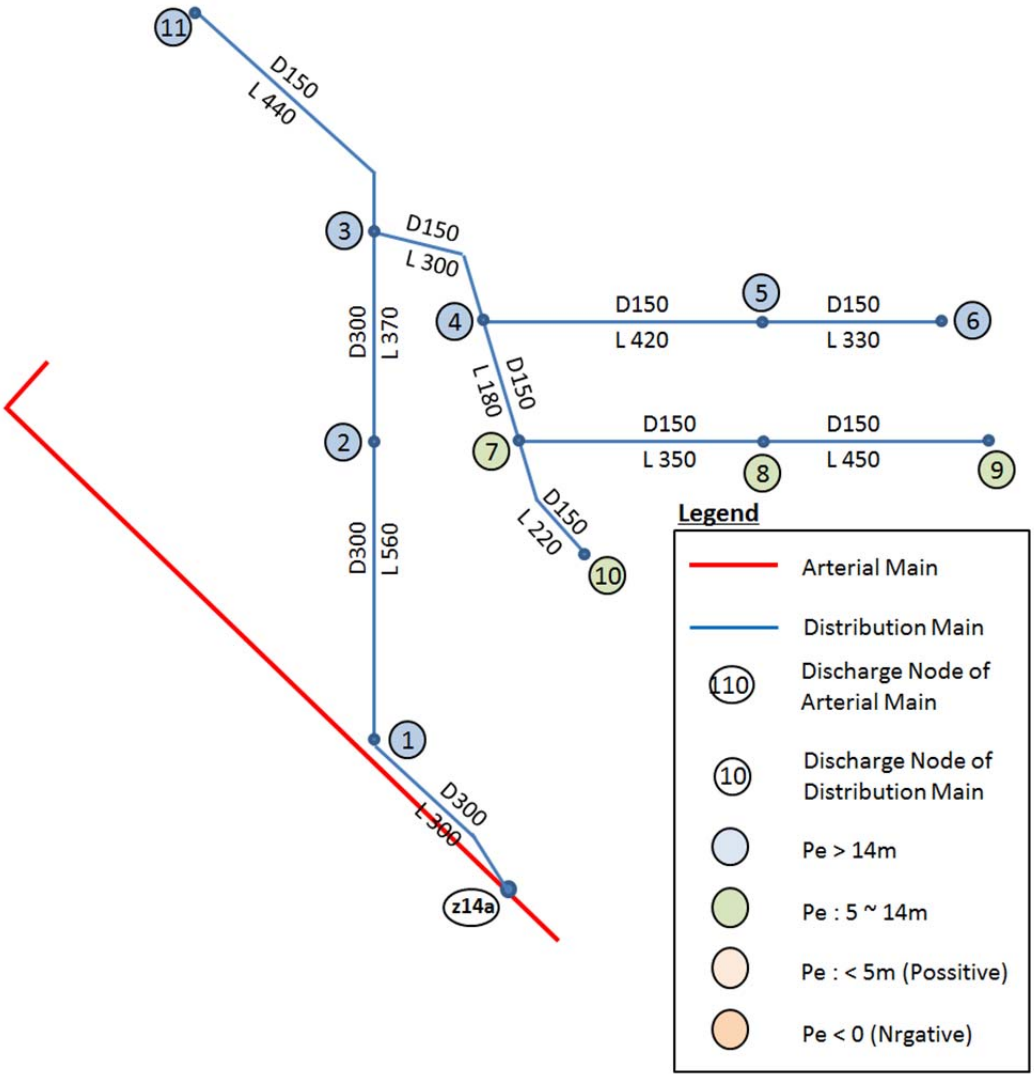

**Distribution Zone – 11**



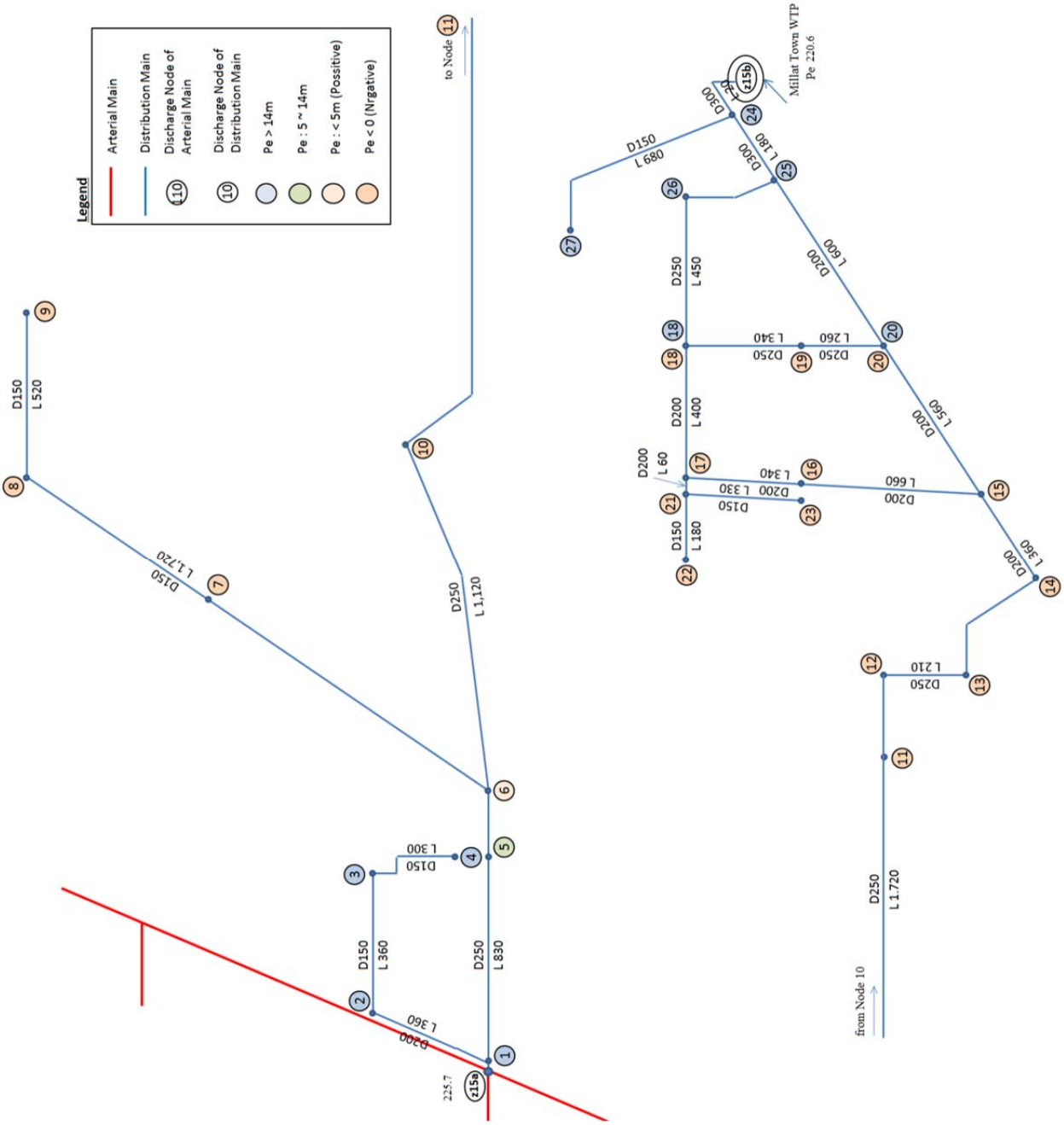

**Distribution Zone – 12**




**Distribution Zone – 13**




**Distribution Zone – 14**




**Distribution Zone – 15**

# ATTACHMENT 3.2

# DISTRIBUTION NETWORK ANALYSIS

# Distribution Network Analysis for Zone 01

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z01a | -150.66 | 223.29 | 188 | 35.29 |
| z01b | -57.64 | 224.56 | 188 | 36.56 |
| 1 | 13.8 | 209.60 | 188 | 21.60 |
| 2 | 9.9 | 207.94 | 188 | 19.94 |
| 3 | 4.5 | 209.24 | 188 | 21.24 |
| 4 | 3.3 | 209.08 | 188 | 21.08 |
| 5 | 8.3 | 219.55 | 188 | 31.55 |
| 6 | 11.2 | 218.23 | 188 | 30.23 |
| 7 | 5.3 | 217.27 | 188 | 29.27 |
| 8 | 1.4 | 217.26 | 188 | 29.26 |
| 9 | 2.7 | 217.19 | 188 | 29.19 |
| 10 | 4.1 | 217.15 | 188 | 29.15 |
| 11 | 10.4 | 216.00 | 188 | 28.00 |
| 12 | 27.8 | 210.34 | 188 | 22.34 |
| 13 | 17.80 | 199.58 | 188 | 11.56 |
| 14 | 9.00 | 192.63 | 188 | 4.61 |
| 15 | 14.40 | 178.70 | 188 | -9.32 |
| 16 | 11.70 | 186.13 | 188 | -1.88 |
| 17 | 6.80 | 186.69 | 188 | -1.33 |
| 18 | 4.00 | 186.61 | 188 | -1.41 |
| 19 | 9.50 | 193.17 | 188 | 5.16 |
| 20 | 4.10 | 198.87 | 188 | 10.86 |
| 21 | 3.60 | 210.32 | 188 | 22.31 |
| 22 | 3.60 | 223.02 | 188 | 35.01 |
| 23 | 3.70 | 224.50 | 188 | 36.49 |
| 24 | 3.60 | 224.53 | 188 | 36.52 |
| 25 | 7.10 | 178.18 | 188 | -9.83 |
| 26 | 6.70 | 219.09 | 188 | 31.08 |

**Pipeline Data**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z01a | 5 | 300 | 200 | 110 | 3.74 | 150.66 | 2.13 | 18.70 |
| z01b | 24 | 300 | 10 | 110 | 0.03 | 57.64 | 0.82 | 3.16 |
| 5 | 6 | 300 | 160 | 110 | 1.31 | 96.65 | 1.37 | 8.22 |
| 6 | 9 | 300 | 330 | 110 | 1.04 | 57.65 | 0.82 | 3.16 |
| 9 | 11 | 300 | 370 | 110 | 1.19 | 58.36 | 0.83 | 3.23 |
| 5 | 1 | 150 | 330 | 110 | 9.95 | 31.50 | 1.78 | 30.15 |
| 1 | 2 | 150 | 470 | 110 | 1.66 | 9.90 | 0.56 | 3.53 |
| 1 | 3 | 150 | 160 | 110 | 0.36 | 7.80 | 0.44 | 2.27 |
| 3 | 4 | 150 | 350 | 110 | 0.16 | 3.30 | 0.19 | 0.46 |
| 5 | 7 | 150 | 330 | 110 | 2.28 | 14.21 | 0.80 | 6.90 |
| 7 | 8 | 150 | 160 | 110 | 0.02 | 1.40 | 0.08 | 0.09 |
| 7 | 9 | 150 | 160 | 110 | 0.08 | 3.41 | 0.19 | 0.49 |
| 7 | 10 | 150 | 180 | 110 | 0.12 | 4.10 | 0.23 | 0.69 |
| 6 | 12 | 150 | 330 | 110 | 7.89 | 27.80 | 1.57 | 23.92 |
| 11 | 13 | 150 | 250 | 110 | 16.42 | 47.96 | 2.72 | 65.67 |
| 13 | 14 | 150 | 250 | 110 | 6.96 | 30.16 | 1.71 | 27.82 |
| 14 | 16 | 150 | 450 | 110 | 6.50 | 21.16 | 1.20 | 14.43 |
| 16 | 15 | 150 | 500 | 110 | 7.43 | 21.50 | 1.22 | 14.86 |
| 15 | 25 | 150 | 270 | 110 | 0.52 | 7.10 | 0.40 | 1.91 |
| 16 | 17 | 150 | 110 | 110 | -0.56 | -12.04 | -0.68 | -5.08 |
| 17 | 18 | 150 | 120 | 110 | 0.08 | 4.00 | 0.23 | 0.66 |
| 17 | 19 | 150 | 390 | 110 | -6.48 | -22.84 | -1.29 | -16.63 |
| 19 | 20 | 150 | 180 | 110 | -5.70 | -32.34 | -1.83 | -31.66 |
| 20 | 21 | 150 | 290 | 110 | -11.45 | -36.44 | -2.06 | -39.49 |
| 21 | 22 | 150 | 270 | 110 | -12.69 | -40.04 | -2.27 | -47.01 |
| 22 | 24 | 250 | 330 | 110 | -1.51 | -43.64 | -0.89 | -4.58 |
| 24 | 23 | 200 | 180 | 110 | 0.03 | 3.70 | 0.12 | 0.14 |
| 24 | 26 | 100 | 440 | 110 | 5.44 | 6.70 | 0.85 | 12.36 |

# Distribution Network Analysis for Zone 02

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z02a | -120.19 | 223.29 | 184 | 39.29 |
| z02b | -37.51 | 222.19 | 185 | 37.69 |
| z02c | -140.22 | 221.61 | 185 | 36.61 |
| z02d | -62.89 | 220.55 | 185 | 35.55 |
| 1 | 3.50 | 223.22 | 184 | 39.22 |
| 2 | 18.30 | 222.18 | 185 | 37.68 |
| 3 | 16.00 | 221.52 | 185 | 36.52 |
| 4 | 8.40 | 220.19 | 185 | 35.19 |
| 5 | 11.00 | 219.02 | 185 | 34.02 |
| 6 | 10.90 | 203.12 | 185 | 18.12 |
| 7 | 7.10 | 204.99 | 185 | 19.99 |
| 8 | 15.00 | 209.10 | 185 | 24.10 |
| 9 | 7.10 | 220.71 | 184 | 37.21 |
| 10 | 14.20 | 220.20 | 183 | 37.20 |
| 11 | 21.50 | 202.26 | 185 | 17.26 |
| 12 | 25.00 | 177.26 | 185 | -7.74 |
| 13 | 10.70 | 174.61 | 185.000 | -10.39 |
| 14 | 20.70 | 219.14 | 185.000 | 34.14 |
| 15 | 12.80 | 219.35 | 185.000 | 34.35 |
| 16 | 25.30 | 218.05 | 185.000 | 33.05 |
| 17 | 16.30 | 214.22 | 185.000 | 29.22 |
| 18 | 17.00 | 212.27 | 185.000 | 27.27 |
| 19 | 5.60 | 222.95 | 185.000 | 37.95 |
| 20 | 11.40 | 221.70 | 185.000 | 36.70 |
| 21 | 2.00 | 220.87 | 185.000 | 35.87 |
| 22 | 11.70 | 220.02 | 185.000 | 35.02 |
| 23 | 4.30 | 219.62 | 185.000 | 34.62 |
| 24 | 9.50 | 219.37 | 185.000 | 34.37 |
| 25 | 13.60 | 206.91 | 185.000 | 21.91 |
| 26 | 15.40 | 209.01 | 185.000 | 24.01 |
| 27 | 22.80 | 206.52 | 185.000 | 21.52 |
| 28 | 3.70 | 219.76 | 185.000 | 34.76 |

**Pipeline Data**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z02a | 1 | 300 | 10 | 110 | 0.07 | 91.62 | 1.30 | 7.45 |
| z02b | 2 | 250 | 10 | 110 | 0.01 | 16.20 | 0.33 | 0.73 |
| z02c | 3 | 300 | 10 | 110 | 0.09 | 99.59 | 1.41 | 8.69 |
| z02d | 15 | 250 | 180 | 110 | 1.20 | 53.39 | 1.09 | 6.66 |
| z02d | 15 | 250 | 180 | 110 | 1.20 | 53.39 | 1.09 | 6.66 |
| z02d | 24 | 150 | 360 | 110 | 1.18 | 9.50 | 0.54 | 3.28 |
| z02a | 19 | 300 | 400 | 110 | 0.34 | 28.57 | 0.40 | 0.86 |
| z02b | 20 | 250 | 400 | 110 | 0.49 | 21.31 | 0.43 | 1.22 |
| z02c | 21 | 300 | 450 | 110 | 0.74 | 40.62 | 0.57 | 1.65 |
| 1 | 2 | 150 | 300 | 110 | 1.03 | 9.76 | 0.55 | 3.44 |
| 2 | 3 | 150 | 300 | 110 | 0.66 | 7.66 | 0.43 | 2.20 |
| 3 | 4 | 300 | 180 | 110 | 1.33 | 91.25 | 1.29 | 7.39 |
| 4 | 5 | 250 | 200 | 110 | 1.17 | 49.90 | 1.02 | 5.87 |
| 5 | 6 | 150 | 480 | 110 | 15.90 | 33.14 | 1.88 | 33.13 |
| 6 | 7 | 150 | 300 | 110 | -1.87 | -13.46 | -0.76 | -6.25 |
| 7 | 8 | 150 | 300 | 110 | -4.11 | -20.56 | -1.16 | -13.68 |
| 8 | 9 | 200 | 520 | 110 | -11.61 | -57.06 | -1.82 | -22.33 |
| 9 | 1 | 300 | 450 | 110 | -2.51 | -78.36 | -1.11 | -5.58 |
| 9 | 10 | 200 | 300 | 110 | 0.51 | 14.20 | 0.45 | 1.70 |
| 8 | 11 | 150 | 460 | 110 | 6.84 | 21.50 | 1.22 | 14.87 |
| 6 | 12 | 150 | 680 | 110 | 25.85 | 35.70 | 2.02 | 38.02 |
| 12 | 13 | 150 | 650 | 110 | 2.65 | 10.70 | 0.61 | 4.08 |
| 14 | 15 | 250 | 180 | 110 | -0.21 | -20.70 | -0.42 | -1.15 |
| 15 | 14 | 250 | 180 | 110 | 0.21 | 20.70 | 0.42 | 1.15 |
| 15 | 4 | 300 | 750 | 110 | -0.84 | -32.95 | -0.47 | -1.12 |
| 15 | 16 | 250 | 200 | 110 | 1.31 | 52.84 | 1.08 | 6.53 |
| 16 | 5 | 150 | 750 | 110 | -0.97 | -5.76 | -0.33 | -1.30 |
| 16 | 17 | 150 | 430 | 110 | 3.83 | 16.30 | 0.92 | 8.90 |
| 16 | 18 | 150 | 600 | 110 | 5.77 | 17.00 | 0.96 | 9.62 |
| 19 | 20 | 200 | 300 | 110 | 1.24 | 22.97 | 0.73 | 4.14 |
| 20 | 21 | 300 | 750 | 110 | 0.84 | 32.88 | 0.47 | 1.12 |
| 21 | 22 | 300 | 180 | 110 | 0.85 | 71.50 | 1.01 | 4.70 |
| 22 | 23 | 150 | 530 | 110 | 0.40 | 4.30 | 0.24 | 0.75 |
| 22 | 28 | 150 | 450 | 110 | 0.26 | 3.70 | 0.21 | 0.57 |
| 22 | 26 | 200 | 590 | 110 | 11.01 | 51.80 | 1.65 | 18.66 |
| 26 | 25 | 150 | 330 | 110 | 2.10 | 13.60 | 0.77 | 6.37 |
| 26 | 27 | 150 | 150 | 110 | 2.49 | 22.80 | 1.29 | 16.57 |

# Distribution Network Analysis for Zone 03

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z03a | -281.02 | 219.96 | 183 | 36.96 |
| z03b | -43.30 | 218.10 | 186 | 32.10 |
| z03c | -148.77 | 217.94 | 186 | 31.94 |
| z03d | -157.51 | 217.81 | 186 | 31.81 |
| 1 | 0.00 | 219.90 | 183 | 36.90 |
| 2 | 13.60 | 217.95 | 183 | 34.95 |
| 3 | 10.50 | 213.16 | 183 | 30.16 |
| 4 | 8.20 | 212.09 | 183 | 29.09 |
| 5 | 0.00 | 212.39 | 183 | 29.39 |
| 6 | 8.40 | 216.96 | 183 | 33.96 |
| 7 | 1.90 | 213.13 | 183 | 30.13 |
| 8 | 29.00 | 210.80 | 183 | 27.80 |
| 9 | 7.10 | 197.91 | 183 | 14.91 |
| 10 | 0.00 | 193.52 | 186 | 7.52 |
| 11 | 8.20 | 191.65 | 186 | 5.65 |
| 12 | 14.40 | 167.44 | 186 | -18.56 |
| 13 | 9.70 | 166.32 | 186 | -19.68 |
| 14 | 17.80 | 163.98 | 186 | -22.02 |
| 15 | 4.80 | 165.02 | 186 | -20.98 |
| 16 | 17.70 | 161.59 | 186 | -24.41 |
| 17 | 17.60 | 184.88 | 186 | -1.12 |
| 18 | 13.20 | 182.77 | 186 | -3.23 |
| 19 | 14.20 | 182.19 | 186 | -3.81 |
| 20 | 9.60 | 180.38 | 186 | -5.62 |
| 21 | 12.30 | 193.86 | 186 | 7.86 |
| 22 | 9.20 | 192.50 | 186 | 6.50 |
| 23 | 4.30 | 190.60 | 186 | 4.60 |
| 24 | 8.70 | 175.08 | 186 | -10.92 |
| 25 | 1.60 | 170.36 | 186 | -15.64 |
| 26 | 0.80 | 169.79 | 186 | -16.21 |
| 27 | 3.70 | 169.29 | 186 | -16.71 |
| 28 | 5.30 | 169.37 | 186 | -16.63 |
| 29 | 3.90 | 169.15 | 186 | -16.85 |
| 30 | 4.40 | 169.10 | 186 | -16.90 |
| 31 | 3.10 | 168.47 | 186 | -17.53 |
| 32 | 11.70 | 168.35 | 186 | -17.65 |
| 33 | 3.50 | 170.28 | 186 | -15.72 |
| 34 | 7.20 | 169.95 | 186 | -16.05 |
| 35 | 2.40 | 168.41 | 186 | -17.59 |
| 36 | 2.40 | 168.37 | 186 | -17.63 |
| 371 | 5.60 | 218.10 | 186 | 32.10 |

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| 37 | 10.30 | 217.26 | 186 | 31.26 |
| 38 | 5.70 | 216.82 | 186 | 30.82 |
| 39 | 2.00 | 215.00 | 186 | 29.00 |
| 40 | 2.10 | 214.96 | 186 | 28.96 |
| 41 | 2.00 | 213.97 | 186 | 27.97 |
| 42 | 2.10 | 213.93 | 186 | 27.93 |
| 43 | 12.10 | 213.03 | 186 | 27.03 |
| 44 | 1.40 | 213.01 | 186 | 27.01 |
| 451 | 8.80 | 217.92 | 186 | 31.92 |
| 45 | 11.50 | 202.26 | 186 | 16.26 |
| 46 | 9.70 | 200.47 | 186 | 14.47 |
| 471 | 15.50 | 217.79 | 186 | 31.79 |
| 47 | 30.60 | 200.19 | 186 | 14.19 |
| 48 | 4.90 | 176.65 | 186 | -9.35 |
| 49 | 5.00 | 176.32 | 186 | -9.68 |
| 50 | 11.60 | 169.33 | 186 | -16.67 |
| 51 | 5.00 | 166.13 | 186 | -19.87 |
| 52 | 3.80 | 165.94 | 186 | -20.06 |
| 53 | 1.90 | 166.10 | 186 | -19.90 |
| 54 | 9.60 | 165.63 | 186 | -20.37 |
| 55 | 2.40 | 165.16 | 186 | -20.84 |
| 56 | 1.40 | 165.14 | 186 | -20.86 |
| 57 | 3.70 | 163.63 | 186 | -22.37 |
| 58 | 7.50 | 163.44 | 186 | -22.56 |
| 59 | 16.40 | 161.91 | 186 | -24.09 |
| 60 | 6.00 | 160.59 | 186 | -25.41 |
| 61 | 11.00 | 160.21 | 186 | -25.79 |
| 62 | 9.00 | 150.74 | 186 | -35.26 |
| 63 | 2.10 | 148.80 | 186 | -37.20 |
| 64 | 1.70 | 147.65 | 186 | -38.35 |
| 65 | 9.10 | 145.46 | 186 | -40.54 |
| 66 | 10.00 | 145.42 | 186 | -40.58 |
| 67 | 19.90 | 146.13 | 186 | -39.87 |
| 68 | 13.80 | 150.46 | 186 | -35.54 |
| 69 | 13.80 | 161.99 | 186 | -24.01 |
| 70 | 6.60 | 148.21 | 186 | -37.79 |
| 71 | 6.70 | 157.76 | 186 | -28.24 |
| 72 | 4.80 | 154.76 | 186 | -31.24 |
| 73 | 9.10 | 152.89 | 186 | -33.11 |
| 74 | 11.70 | 152.90 | 186 | -33.10 |
| 75 | 12.30 | 157.63 | 186 | -28.37 |

**Pipeline Data -DZ-3.1**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z03a | 1 | 300 | 1 | 110 | 0.06 | 281.02 | 3.98 | 59.35 |
| 1 | 2 | 250 | 60 | 110 | 1.95 | 125.79 | 2.56 | 32.55 |
| 2 | 3 | 250 | 210 | 110 | 4.79 | 103.79 | 2.12 | 22.80 |
| 3 | 4 | 150 | 350 | 110 | 1.07 | 9.17 | 0.52 | 3.07 |
| 4 | 5 | 250 | 150 | 110 | -0.30 | -28.03 | -0.57 | -2.02 |
| 5 | 1 | 300 | 380 | 110 | -7.51 | -155.23 | -2.20 | -19.77 |
| 2 | 6 | 150 | 380 | 110 | 0.99 | 8.40 | 0.48 | 2.61 |
| 3 | 7 | 150 | 200 | 110 | 0.03 | 1.90 | 0.11 | 0.17 |
| 9 | 3 | 250 | 1030 | 110 | -15.25 | -82.22 | -1.68 | -14.81 |
| 4 | 8 | 250 | 600 | 110 | 1.29 | 29.00 | 0.59 | 2.15 |
| 5 | 10 | 300 | 1380 | 110 | 18.87 | 127.20 | 1.80 | 13.67 |
| 10 | 11 | 150 | 750 | 110 | 1.87 | 8.20 | 0.46 | 2.49 |
| 10 | 12 | 150 | 230 | 110 | 26.08 | 64.40 | 3.65 | 113.37 |
| 12 | 13 | 150 | 330 | 110 | 1.12 | 9.70 | 0.55 | 3.40 |
| 12 | 14 | 150 | 330 | 110 | 3.46 | 17.80 | 1.01 | 10.48 |
| 12 | 15 | 150 | 150 | 110 | 2.43 | 22.50 | 1.27 | 16.17 |
| 15 | 16 | 150 | 330 | 110 | 3.42 | 17.70 | 1.00 | 10.37 |
| 10 | 17 | 200 | 420 | 110 | 8.64 | 54.60 | 1.74 | 20.57 |
| 17 | 18 | 150 | 350 | 110 | 2.11 | 13.20 | 0.75 | 6.02 |
| 17 | 19 | 150 | 150 | 110 | 2.69 | 23.80 | 1.35 | 17.94 |
| 19 | 20 | 150 | 540 | 110 | 1.80 | 9.60 | 0.54 | 3.34 |
| 9 | 21 | 250 | 260 | 110 | 4.05 | 84.50 | 1.72 | 15.58 |
| 21 | 22 | 150 | 440 | 110 | 1.36 | 9.20 | 0.52 | 3.09 |
| 21 | 23 | 250 | 360 | 110 | 3.26 | 63.00 | 1.28 | 9.04 |
| 23 | 24 | 200 | 660 | 110 | 15.52 | 58.70 | 1.87 | 23.52 |
| 24 | 25 | 150 | 270 | 110 | 4.72 | 23.46 | 1.33 | 17.47 |
| 25 | 26 | 150 | 130 | 110 | 0.57 | 11.16 | 0.63 | 4.41 |
| 26 | 27 | 150 | 130 | 110 | 0.50 | 10.36 | 0.59 | 3.84 |
| 27 | 28 | 150 | 130 | 110 | -0.08 | -3.80 | -0.22 | -0.60 |
| 28 | 24 | 150 | 260 | 110 | -5.71 | -26.54 | -1.50 | -21.96 |
| 28 | 29 | 250 | 260 | 110 | 0.22 | 17.44 | 0.36 | 0.84 |
| 29 | 30 | 250 | 660 | 110 | 0.04 | 4.40 | 0.09 | 0.07 |
| 27 | 31 | 150 | 210 | 110 | 0.82 | 10.46 | 0.59 | 3.91 |
| 31 | 32 | 150 | 390 | 110 | 0.11 | 2.56 | 0.14 | 0.29 |
| 32 | 29 | 150 | 260 | 110 | -0.79 | -9.14 | -0.52 | -3.05 |
| 25 | 33 | 150 | 150 | 110 | 0.08 | 3.50 | 0.20 | 0.52 |
| 25 | 34 | 150 | 210 | 110 | 0.41 | 7.20 | 0.41 | 1.96 |
| 31 | 36 | 150 | 390 | 110 | 0.10 | 2.40 | 0.14 | 0.26 |
| 31 | 35 | 150 | 200 | 110 | 0.05 | 2.40 | 0.14 | 0.26 |
| z03b | 371 | 300 | 1 | 110 | 0.00 | 43.30 | 0.61 | 1.86 |
| 371 | 37 | 300 | 580 | 110 | 0.83 | 37.70 | 0.53 | 1.44 |
| 37 | 38 | 150 | 350 | 110 | 0.45 | 5.70 | 0.32 | 1.27 |
| 37 | 39 | 150 | 150 | 110 | 2.27 | 21.70 | 1.23 | 15.12 |
| 39 | 40 | 150 | 200 | 110 | 0.04 | 2.10 | 0.12 | 0.20 |
| 39 | 41 | 150 | 100 | 110 | 1.03 | 17.60 | 1.00 | 10.26 |

**Pipeline Data -DZ-3.2**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| 41 | 42 | 150 | 200 | 110 | 0.04 | 2.10 | 0.12 | 0.20 |
| 41 | 43 | 150 | 150 | 110 | 0.94 | 13.50 | 0.76 | 6.28 |
| 43 | 44 | 150 | 200 | 110 | 0.02 | 1.40 | 0.08 | 0.09 |
| z03c | 451 | 300 | 1 | 110 | 0.02 | 148.77 | 2.11 | 18.28 |
| 451 | 45 | 300 | 960 | 110 | 15.67 | 139.97 | 1.98 | 16.32 |
| 45 | 46 | 150 | 150 | 110 | 1.79 | 19.08 | 1.08 | 11.91 |
| 46 | 9 | 150 | 800 | 110 | 2.56 | 9.38 | 0.53 | 3.20 |
| z03d | 471 | 300 | 1 | 110 | 0.02 | 157.51 | 2.23 | 20.32 |
| 471 | 47 | 300 | 1050 | 110 | 17.60 | 142.01 | 2.01 | 16.76 |
| 47 | 45 | 300 | 200 | 110 | -2.07 | -109.39 | -1.55 | -10.34 |
| 47 | 48 | 300 | 620 | 110 | 23.54 | 220.80 | 3.13 | 37.96 |
| 48 | 49 | 150 | 330 | 110 | 0.33 | 5.00 | 0.28 | 1.00 |
| 48 | 50 | 300 | 210 | 110 | 7.32 | 210.90 | 2.99 | 34.87 |
| 50 | 51 | 150 | 170 | 110 | 3.20 | 24.43 | 1.38 | 18.83 |
| 51 | 52 | 150 | 320 | 110 | 0.19 | 3.80 | 0.22 | 0.60 |
| 51 | 53 | 150 | 170 | 110 | 0.03 | 1.90 | 0.11 | 0.17 |
| 50 | 54 | 300 | 150 | 110 | 3.70 | 174.87 | 2.48 | 24.65 |
| 54 | 55 | 150 | 170 | 110 | 0.48 | 8.72 | 0.49 | 2.79 |
| 55 | 51 | 150 | 150 | 110 | -0.97 | -13.73 | -0.78 | -6.48 |
| 55 | 58 | 150 | 150 | 110 | 1.71 | 18.65 | 1.06 | 11.42 |
| 55 | 56 | 150 | 170 | 110 | 0.02 | 1.40 | 0.08 | 0.09 |
| 54 | 57 | 200 | 150 | 110 | 2.00 | 43.22 | 1.38 | 13.35 |
| 57 | 58 | 150 | 170 | 110 | 0.19 | 5.25 | 0.30 | 1.09 |
| 58 | 59 | 150 | 170 | 110 | 1.53 | 16.40 | 0.93 | 9.00 |
| 57 | 60 | 200 | 350 | 110 | 3.04 | 34.27 | 1.09 | 8.68 |
| 60 | 61 | 150 | 330 | 110 | 0.38 | 5.42 | 0.31 | 1.16 |
| 61 | 62 | 150 | 270 | 110 | 9.47 | 34.18 | 1.94 | 35.09 |
| 62 | 63 | 150 | 130 | 110 | 1.94 | 21.53 | 1.22 | 14.91 |
| 63 | 64 | 150 | 200 | 110 | 1.14 | 12.83 | 0.73 | 5.72 |
| 64 | 65 | 150 | 500 | 110 | 2.20 | 11.13 | 0.63 | 4.40 |
| 65 | 66 | 150 | 180 | 110 | 0.03 | 2.03 | 0.12 | 0.19 |
| 66 | 67 | 150 | 300 | 110 | -0.71 | -7.97 | -0.45 | -2.36 |
| 67 | 68 | 150 | 180 | 110 | -4.33 | -27.87 | -1.58 | -24.03 |
| 68 | 62 | 150 | 500 | 110 | -0.28 | -3.65 | -0.21 | -0.56 |
| 68 | 69 | 150 | 270 | 110 | -11.53 | -38.02 | -2.15 | -42.71 |
| 69 | 61 | 300 | 500 | 110 | 1.78 | 61.52 | 0.87 | 3.56 |
| 69 | 54 | 300 | 330 | 110 | -3.64 | -113.33 | -1.60 | -11.04 |
| 63 | 70 | 150 | 350 | 110 | 0.58 | 6.60 | 0.37 | 1.67 |
| 60 | 71 | 150 | 170 | 110 | 2.83 | 22.85 | 1.29 | 16.64 |
| 71 | 72 | 150 | 510 | 110 | 3.00 | 13.04 | 0.74 | 5.89 |
| 72 | 73 | 150 | 740 | 110 | 1.86 | 8.24 | 0.47 | 2.52 |
| 73 | 74 | 150 | 240 | 110 | -0.01 | -0.86 | -0.05 | -0.04 |
| 74 | 75 | 150 | 860 | 110 | -4.72 | -12.56 | -0.71 | -5.49 |
| 75 | 71 | 150 | 330 | 110 | -0.14 | -3.11 | -0.18 | -0.41 |
| 75 | 61 | 150 | 170 | 110 | -2.58 | -21.75 | -1.23 | -15.19 |

# Distribution Network Analysis for Zone 04

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z04a | -57.28 | 218.73 | 183 | 35.73 |
| z04b | -11.80 | 217.64 | 186 | 31.64 |
| z04c | -19.30 | 217.64 | 186 | 31.64 |
| z04d | -70.16 | 217.89 | 186 | 31.89 |
| z04e | -37.56 | 218.42 | 186 | 32.42 |
| z04f | -50.20 | 217.42 | 186 | 31.42 |
| z04g | 0.00 | 219.09 | 186 | 33.09 |
| z04h | -90.84 | 217.41 | 190 | 27.41 |
| z04i | -129.26 | 217.50 | 187 | 30.50 |
| z04j | -31.50 | 222.81 | 185 | 37.81 |
| 1 | 10.00 | 218.36 | 186 | 32.36 |
| 2 | 6.70 | 217.22 | 186 | 31.22 |
| 3 | 5.80 | 218.24 | 186 | 32.24 |
| 4 | 5.80 | 218.14 | 186 | 32.14 |
| 5 | 5.80 | 216.58 | 186 | 30.58 |
| 6 | 5.80 | 215.07 | 186 | 29.07 |
| 7 | 14.10 | 214.94 | 186 | 28.94 |
| 8 | 12.60 | 214.86 | 186 | 28.86 |
| 9 | 8.30 | 215.37 | 186 | 29.37 |
| 10 | 18.20 | 215.54 | 186 | 29.54 |
| 11 | 19.60 | 216.66 | 186 | 30.66 |
| 12 | 17.80 | 217.17 | 186 | 31.17 |
| 13 | 3.90 | 216.44 | 188 | 28.44 |
| 14 | 6.60 | 217.18 | 186 | 31.18 |
| 15 | 6.40 | 217.23 | 186 | 31.23 |
| 151 | 6.30 | 217.64 | 186 | 31.64 |
| 111 | 25.50 | 217.88 | 186 | 31.88 |
| 16 | 5.10 | 217.86 | 186 | 31.86 |
| 461 | 5.90 | 217.64 | 186 | 31.64 |
| 46 | 5.90 | 217.61 | 186 | 31.61 |
| 171 | 8.90 | 217.41 | 186 | 31.41 |

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| 17 | 5.90 | 216.01 | 186 | 30.01 |
| 18 | 8.80 | 215.04 | 186 | 29.04 |
| 19 | 16.40 | 215.35 | 186 | 29.35 |
| 20 | 5.10 | 215.00 | 186 | 29.00 |
| 21 | 5.10 | 215.00 | 186 | 29.00 |
| 22 | 5.40 | 214.29 | 186 | 28.29 |
| 23 | 11.60 | 211.73 | 186 | 25.73 |
| 24 | 12.50 | 214.55 | 186 | 28.55 |
| 25 | 16.70 | 209.32 | 186 | 23.32 |
| 26 | 5.40 | 217.47 | 186 | 31.47 |
| 27 | 29.20 | 215.96 | 186 | 29.96 |
| 28 | 35.10 | 208.87 | 186 | 22.87 |
| 29 | 14.50 | 213.91 | 186 | 27.91 |
| 30 | 0.00 | 212.13 | 190 | 22.13 |
| 31 | 8.70 | 209.77 | 190 | 19.77 |
| 32 | 7.00 | 205.58 | 190 | 15.58 |
| 33 | 9.50 | 204.66 | 190 | 14.66 |
| 34 | 6.50 | 211.26 | 190 | 21.26 |
| 35 | 5.20 | 210.00 | 190 | 20.00 |
| 36 | 3.60 | 209.44 | 190 | 19.44 |
| 37 | 6.40 | 209.21 | 190 | 19.21 |
| 38 | 2.90 | 209.34 | 190 | 19.34 |
| 39 | 8.10 | 208.34 | 190 | 18.34 |
| 40 | 8.00 | 209.02 | 190 | 19.02 |
| 41 | 4.00 | 209.03 | 190 | 19.03 |
| 42 | 2.70 | 209.32 | 190 | 19.32 |
| 43 | 12.20 | 206.99 | 190 | 16.99 |
| 44 | 4.90 | 208.77 | 190 | 18.77 |
| 451 | 6.30 | 222.59 | 185 | 37.59 |
| 45 | 25.20 | 142.11 | 185 | -42.89 |

**Pipeline Data -DZ-4**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z04a | 1 | 300 | 120 | 110 | 0.37 | 57.28 | 0.81 | 3.12 |
| 1 | 2 | 150 | 660 | 110 | 1.13 | 6.70 | 0.38 | 1.72 |
| 1 | 3 | 200 | 10 | 110 | 0.12 | 40.58 | 1.29 | 11.88 |
| 3 | 4 | 200 | 300 | 110 | 0.10 | 5.80 | 0.18 | 0.32 |
| 3 | 5 | 200 | 260 | 110 | 1.66 | 28.98 | 0.92 | 6.37 |
| 5 | 6 | 200 | 360 | 110 | 1.52 | 23.18 | 0.74 | 4.21 |
| 6 | 7 | 300 | 370 | 110 | 0.13 | 17.38 | 0.25 | 0.34 |
| 7 | 8 | 200 | 700 | 110 | 0.08 | 3.28 | 0.10 | 0.11 |
| 8 | 9 | 150 | 160 | 110 | -0.51 | -9.32 | -0.53 | -3.16 |
| 9 | 10 | 150 | 540 | 110 | -0.18 | -2.73 | -0.15 | -0.33 |
| 10 | 11 | 200 | 320 | 110 | -1.12 | -20.93 | -0.67 | -3.49 |
| 11 | 12 | 150 | 540 | 110 | -0.51 | -4.87 | -0.28 | -0.95 |
| 12 | 9 | 150 | 240 | 110 | 1.81 | 14.88 | 0.84 | 7.52 |
| 12 | z04c | 250 | 360 | 110 | -1.25 | -37.56 | -0.77 | -3.47 |
| 11 | 111 | 250 | 320 | 110 | -1.22 | -39.56 | -0.81 | -3.82 |
| 111 | z04d | 250 | 1 | 110 | -0.01 | -70.16 | -1.43 | -11.04 |
| 11 | 13 | 150 | 340 | 110 | 0.21 | 3.90 | 0.22 | 0.63 |
| z04b | 461 | 300 | 1 | 110 | 0.00 | 11.80 | 0.17 | 0.17 |
| 461 | 46 | 300 | 640 | 110 | 0.03 | 5.90 | 0.08 | 0.05 |
| z04c | 151 | 200 | 1 | 110 | 0.00 | 19.30 | 0.61 | 3.00 |
| 151 | 14 | 200 | 1100 | 110 | 0.45 | 6.60 | 0.21 | 0.41 |
| 151 | 15 | 150 | 260 | 110 | 0.41 | 6.40 | 0.36 | 1.58 |
| 111 | 16 | 250 | 200 | 110 | 0.02 | 5.10 | 0.10 | 0.09 |
| z04f | 171 | 250 | 1 | 110 | 0.01 | 50.20 | 1.02 | 5.94 |
| 171 | 17 | 250 | 340 | 110 | 1.41 | 41.30 | 0.84 | 4.14 |
| 17 | 18 | 150 | 340 | 110 | 0.97 | 8.80 | 0.50 | 2.84 |
| 17 | 19 | 250 | 360 | 110 | 0.66 | 26.60 | 0.54 | 1.83 |
| 19 | 20 | 150 | 340 | 110 | 0.35 | 5.10 | 0.29 | 1.04 |
| 19 | 21 | 150 | 340 | 110 | 0.35 | 5.10 | 0.29 | 1.04 |
| 22 | 24 | 250 | 320 | 110 | -0.26 | -17.00 | -0.35 | -0.80 |
| 22 | 23 | 150 | 540 | 110 | 2.56 | 11.60 | 0.66 | 4.74 |
| 24 | 26 | 250 | 600 | 110 | -2.92 | -45.06 | -0.92 | -4.86 |
| 26 | 27 | 250 | 340 | 110 | 1.50 | 42.83 | 0.87 | 4.43 |
| 27 | 28 | 150 | 1110 | 110 | 7.09 | 13.63 | 0.77 | 6.39 |
| 28 | 29 | 150 | 340 | 110 | -5.04 | -21.47 | -1.22 | -14.83 |
| 29 | 26 | 250 | 1110 | 110 | -3.56 | -35.97 | -0.73 | -3.20 |
| 26 | 180 | 250 | 1 | 110 | -0.03 | -129.26 | -2.63 | -34.24 |
| z04h | 30 | 200 | 100 | 110 | 5.28 | 90.84 | 2.89 | 52.81 |
| 30 | 31 | 200 | 480 | 110 | 2.36 | 25.20 | 0.80 | 4.91 |
| 31 | 32 | 150 | 460 | 110 | 4.19 | 16.50 | 0.93 | 9.11 |
| 32 | 33 | 150 | 280 | 110 | 0.92 | 9.50 | 0.54 | 3.28 |
| 30 | 34 | 200 | 30 | 110 | 0.87 | 65.64 | 2.09 | 28.93 |
| 34 | 38 | 200 | 420 | 110 | 1.92 | 24.23 | 0.77 | 4.57 |
| 38 | 42 | 200 | 150 | 110 | 0.02 | 3.84 | 0.12 | 0.15 |
| 42 | 25 | 200 | 150 | 110 | 0.00 | 1.14 | 0.04 | 0.02 |
| 25 | 24 | 150 | 640 | 110 | -5.23 | -15.56 | -0.88 | -8.17 |
| 34 | 35 | 150 | 170 | 110 | 1.26 | 14.75 | 0.84 | 7.40 |
| 35 | 36 | 150 | 170 | 110 | 0.56 | 9.55 | 0.54 | 3.31 |
| 36 | 37 | 150 | 170 | 110 | 0.23 | 5.95 | 0.34 | 1.38 |
| 37 | 38 | 150 | 170 | 110 | -0.14 | -4.45 | -0.25 | -0.80 |
| 38 | 39 | 150 | 170 | 110 | 1.00 | 13.04 | 0.74 | 5.89 |
| 39 | 40 | 150 | 340 | 110 | -0.68 | -7.26 | -0.41 | -1.99 |
| 40 | 34 | 150 | 170 | 110 | -2.24 | -20.16 | -1.14 | -13.19 |
| 40 | 44 | 150 | 260 | 110 | 0.25 | 4.90 | 0.28 | 0.96 |
| 39 | 43 | 150 | 260 | 110 | 1.35 | 12.20 | 0.69 | 5.21 |
| 37 | 41 | 150 | 260 | 110 | 0.17 | 4.00 | 0.23 | 0.66 |
| z04j | 451 | 100 | 1 | 110 | 0.22 | 31.50 | 4.01 | 217.34 |
| 451 | 45 | 100 | 560 | 110 | 80.49 | 25.20 | 3.21 | 143.72 |

# Distribution Network Analysis for Zone 05

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z05a | -159.11 | 217.64 | 186 | 31.64 |
| z05b | -125.17 | 217.64 | 186 | 31.64 |
| z05c | -48.52 | 217.10 | 188 | 29.10 |
| 101 | 5.90 | 203.98 | 186 | 17.98 |
| 1 | 32.00 | 203.96 | 188 | 15.96 |
| 2 | 26.50 | 193.08 | 188 | 5.08 |
| 3 | 6.80 | 192.50 | 188 | 4.50 |
| 4 | 5.30 | 192.76 | 188 | 4.76 |
| 5 | 5.50 | 190.93 | 188 | 2.93 |
| 6 | 1.30 | 190.91 | 188 | 2.91 |
| 7 | 0.70 | 189.20 | 188 | 1.20 |
| 8 | 4.10 | 188.22 | 188 | 0.22 |
| 9 | 9.00 | 183.65 | 188 | -4.35 |
| 10 | 13.60 | 181.02 | 186 | -4.98 |
| 11 | 3.80 | 180.93 | 186 | -5.07 |
| 12 | 7.20 | 180.96 | 186 | -5.04 |
| 13 | 8.50 | 175.55 | 186 | -10.45 |
| 14 | 7.70 | 174.52 | 186 | -11.48 |
| 15 | 8.10 | 174.52 | 186 | -11.48 |
| 16 | 4.80 | 174.43 | 186 | -11.57 |
| 17 | 0.00 | 213.66 | 186 | 27.66 |
| 18 | 6.80 | 206.63 | 186 | 20.63 |
| 19 | 0.00 | 205.51 | 186 | 19.51 |
| 20 | 3.40 | 200.60 | 186 | 14.60 |
| 21 | 1.60 | 199.31 | 186 | 13.31 |
| 22 | 3.10 | 198.78 | 186 | 12.78 |
| 23 | 3.40 | 198.61 | 186 | 12.61 |
| 24 | 5.80 | 199.01 | 186 | 13.01 |
| 25 | 5.80 | 201.75 | 186 | 15.75 |
| 26 | 5.50 | 198.65 | 186 | 12.65 |
| 27 | 1.00 | 198.77 | 186 | 12.77 |
| 28 | 2.40 | 198.23 | 186 | 12.23 |
| 29 | 3.20 | 198.15 | 186 | 12.15 |
| 30 | 1.40 | 198.19 | 186 | 12.19 |
| 31 | 6.40 | 194.73 | 186 | 8.73 |
| 32 | 6.40 | 194.20 | 186 | 8.20 |
| 33 | 0.00 | 191.83 | 186 | 5.83 |
| 34 | 5.30 | 190.08 | 188 | 2.08 |
| 35 | 7.80 | 189.45 | 188 | 1.45 |
| 36 | 0.00 | 205.39 | 188 | 17.39 |
| 37 | 17.60 | 193.10 | 188 | 5.10 |
| 38 | 13.80 | 190.28 | 188 | 2.28 |
| 39 | 0.00 | 205.38 | 188 | 17.38 |
| 40 | 2.60 | 205.37 | 188 | 17.37 |
| 41 | 2.50 | 205.26 | 188 | 17.26 |
| 42 | 3.50 | 204.95 | 188 | 16.95 |
| 43 | 4.10 | 205.96 | 188 | 17.96 |
| 44 | 18.30 | 206.46 | 188 | 18.46 |
| 45 | 15.70 | 211.21 | 188 | 23.21 |
| 46 | 4.90 | 216.64 | 188 | 28.64 |
| 47 | 4.00 | 186.22 | 188 | -1.78 |
| 48 | 2.60 | 186.15 | 188 | -1.85 |
| 49 | 12.20 | 185.44 | 188 | -2.56 |
| 50 | 3.30 | 187.46 | 188 | -0.54 |
| 51 | 3.80 | 187.46 | 188 | -0.54 |
| 52 | 3.80 | 187.19 | 188 | -0.81 |
| 81 | 0.00 | 187.73 | 188 | -0.27 |

**Pipeline Data -DZ-5**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z05a | 101 | 300 | 660 | 110 | 13.66 | 159.11 | 2.25 | 20.70 |
| 101 | 1 | 300 | 1 | 110 | 0.02 | 153.21 | 2.17 | 19.30 |
| 1 | 2 | 300 | 870 | 110 | 10.88 | 121.21 | 1.72 | 12.50 |
| 2 | 3 | 150 | 330 | 110 | 0.58 | 6.80 | 0.38 | 1.76 |
| 2 | 4 | 150 | 290 | 110 | 0.32 | 5.30 | 0.30 | 1.11 |
| 2 | 5 | 300 | 350 | 110 | 2.15 | 82.61 | 1.17 | 6.15 |
| 5 | 6 | 150 | 210 | 110 | 0.02 | 1.30 | 0.07 | 0.08 |
| 5 | 7 | 300 | 330 | 110 | 1.73 | 75.81 | 1.07 | 5.24 |
| 7 | 8 | 300 | 120 | 110 | 0.98 | 96.50 | 1.37 | 8.20 |
| 8 | 9 | 250 | 510 | 110 | 4.57 | 62.70 | 1.28 | 8.96 |
| 9 | 10 | 250 | 390 | 110 | 2.62 | 53.70 | 1.09 | 6.73 |
| 10 | 11 | 150 | 150 | 110 | 0.09 | 3.80 | 0.22 | 0.60 |
| 10 | 12 | 250 | 390 | 110 | 0.06 | 7.20 | 0.15 | 0.16 |
| 10 | 13 | 150 | 210 | 110 | 5.47 | 29.10 | 1.65 | 26.04 |
| 13 | 14 | 150 | 390 | 110 | 1.03 | 8.46 | 0.48 | 2.64 |
| 14 | 15 | 250 | 660 | 110 | 0.00 | 0.76 | 0.02 | 0.00 |
| 15 | 13 | 150 | 200 | 110 | -1.03 | -12.14 | -0.69 | -5.16 |
| 15 | 16 | 200 | 390 | 110 | 0.09 | 4.80 | 0.15 | 0.23 |
| z05b | 17 | 300 | 300 | 110 | 3.98 | 125.17 | 1.77 | 13.27 |
| 17 | 18 | 300 | 530 | 110 | 7.03 | 125.17 | 1.77 | 13.27 |
| 18 | 19 | 300 | 170 | 110 | 1.11 | 85.55 | 1.21 | 6.56 |
| 19 | 20 | 200 | 270 | 110 | 4.91 | 51.07 | 1.63 | 18.18 |
| 20 | 21 | 200 | 60 | 110 | 1.30 | 56.06 | 1.79 | 21.60 |
| 21 | 22 | 150 | 270 | 110 | 0.53 | 7.17 | 0.41 | 1.95 |
| 22 | 23 | 150 | 430 | 110 | 0.17 | 3.07 | 0.17 | 0.41 |
| 23 | 24 | 150 | 200 | 110 | -0.40 | -7.33 | -0.41 | -2.02 |
| 24 | 25 | 150 | 240 | 110 | -2.74 | -18.63 | -1.05 | -11.40 |
| 25 | 18 | 150 | 150 | 110 | -4.88 | -32.81 | -1.86 | -32.53 |
| 25 | 20 | 150 | 440 | 110 | 1.14 | 8.39 | 0.47 | 2.60 |
| 24 | 26 | 150 | 300 | 110 | 0.36 | 5.50 | 0.31 | 1.19 |
| 22 | 27 | 150 | 130 | 110 | 0.01 | 1.00 | 0.06 | 0.05 |
| 23 | 28 | 150 | 200 | 110 | 0.37 | 7.00 | 0.40 | 1.86 |
| 28 | 29 | 150 | 200 | 110 | 0.09 | 3.20 | 0.18 | 0.44 |
| 28 | 30 | 150 | 500 | 110 | 0.05 | 1.40 | 0.08 | 0.09 |
| 21 | 31 | 200 | 290 | 110 | 4.57 | 47.29 | 1.51 | 15.76 |
| 31 | 32 | 150 | 340 | 110 | 0.54 | 6.40 | 0.36 | 1.58 |
| 31 | 33 | 200 | 330 | 110 | 2.90 | 34.49 | 1.10 | 8.79 |
| 33 | 34 | 200 | 200 | 110 | 1.76 | 34.49 | 1.10 | 8.79 |
| 34 | 35 | 250 | 290 | 110 | 0.63 | 29.19 | 0.59 | 2.18 |
| 35 | 7 | 250 | 200 | 110 | 0.24 | 21.39 | 0.44 | 1.22 |
| 19 | 36 | 300 | 100 | 110 | 0.12 | 34.48 | 0.49 | 1.22 |
| 36 | 37 | 150 | 410 | 110 | 12.29 | 31.40 | 1.78 | 29.98 |
| 37 | 38 | 150 | 430 | 110 | 2.81 | 13.80 | 0.78 | 6.54 |
| 36 | 39 | 300 | 600 | 110 | 0.01 | 3.08 | 0.04 | 0.01 |
| 39 | 40 | 150 | 30 | 110 | 0.01 | 3.08 | 0.17 | 0.41 |
| 40 | 41 | 150 | 80 | 110 | 0.11 | 6.00 | 0.34 | 1.40 |
| 41 | 42 | 150 | 590 | 110 | 0.30 | 3.50 | 0.20 | 0.52 |
| 40 | 43 | 150 | 490 | 110 | -0.59 | -5.52 | -0.31 | -1.20 |
| 43 | 44 | 150 | 150 | 110 | -0.50 | -9.62 | -0.54 | -3.35 |
| 44 | 45 | 200 | 800 | 110 | -4.75 | -27.92 | -0.89 | -5.94 |
| 45 | 46 | 200 | 400 | 110 | -5.43 | -43.62 | -1.39 | -13.57 |
| 46 | z05c | 300 | 200 | 110 | -0.46 | -48.52 | -0.69 | -2.30 |
| 8 | 81 | 300 | 530 | 110 | 0.49 | 29.70 | 0.42 | 0.92 |
| 81 | 47 | 150 | 130 | 110 | 1.51 | 18.80 | 1.06 | 11.60 |
| 47 | 48 | 150 | 230 | 110 | 0.07 | 2.60 | 0.15 | 0.30 |
| 47 | 49 | 150 | 150 | 110 | 0.78 | 12.20 | 0.69 | 5.21 |
| 81 | 50 | 250 | 760 | 110 | 0.27 | 10.90 | 0.22 | 0.35 |
| 50 | 51 | 250 | 30 | 110 | 0.01 | 7.60 | 0.15 | 0.18 |
| 51 | 52 | 150 | 450 | 110 | 0.27 | 3.80 | 0.22 | 0.60 |

# Distribution Network Analysis for Zone 06

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z06a | -37.40 | 214.44 | 188 | 26.44 |
| z06b | -86.20 | 213.80 | 187 | 26.80 |
| z06c | -84.38 | 213.68 | 187 | 26.68 |
| z06d | -178.82 | 213.65 | 186 | 27.65 |
| 1 | 10.80 | 213.75 | 187 | 26.75 |
| 2 | 15.40 | 210.45 | 188 | 22.95 |
| 3 | 10.00 | 209.03 | 188 | 21.03 |
| 4 | 17.70 | 208.32 | 188 | 20.32 |
| 5 | 26.40 | 208.31 | 188 | 20.31 |
| 6 | 5.90 | 213.00 | 188 | 25.00 |
| 7 | 2.70 | 213.21 | 188 | 25.21 |
| 8 | 7.00 | 210.28 | 188 | 22.28 |
| 9 | 5.00 | 210.15 | 188 | 22.15 |
| 10 | 3.60 | 210.25 | 188 | 22.25 |
| 11 | 6.90 | 209.84 | 188 | 21.84 |
| 12 | 0.90 | 209.84 | 188 | 21.84 |
| 13 | 1.00 | 209.84 | 188 | 21.84 |
| 14 | 4.20 | 209.65 | 188 | 21.65 |
| 15 | 6.10 | 209.22 | 188 | 21.22 |
| 16 | 0.00 | 209.65 | 188 | 21.65 |
| 121 | 2.10 | 213.67 | 187 | 26.67 |
| 17 | 4.40 | 207.45 | 186 | 21.45 |
| 18 | 8.60 | 211.85 | 186 | 25.85 |
| 19 | 6.10 | 207.63 | 186 | 21.63 |
| 20 | 4.60 | 207.30 | 186 | 21.30 |
| 21 | 9.10 | 206.43 | 186 | 20.43 |
| 22 | 6.10 | 205.96 | 186 | 19.96 |
| 23 | 10.30 | 201.98 | 186 | 15.98 |
| 24 | 2.20 | 196.71 | 186 | 10.71 |
| 25 | 6.80 | 196.56 | 186 | 10.56 |
| 26 | 0.00 | 194.99 | 186 | 8.99 |
| 27 | 5.20 | 193.11 | 186 | 7.11 |
| 28 | 0.90 | 193.08 | 186 | 7.08 |
| 29 | 2.60 | 193.01 | 186 | 7.01 |
| 30 | 4.60 | 193.18 | 186 | 7.18 |
| 31 | 4.60 | 196.18 | 186 | 10.18 |

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| 32 | 8.80 | 196.21 | 186 | 10.21 |
| 33 | 15.70 | 191.47 | 186 | 5.47 |
| 34 | 10.20 | 188.78 | 186 | 2.78 |
| 35 | 1.70 | 194.95 | 186 | 8.95 |
| 36 | 9.30 | 187.63 | 186 | 1.63 |
| 37 | 6.60 | 187.55 | 186 | 1.55 |
| 38 | 4.10 | 187.70 | 186 | 1.70 |
| 39 | 8.30 | 188.04 | 186 | 2.04 |
| 40 | 4.20 | 187.43 | 186 | 1.43 |
| 41 | 0.00 | 187.44 | 186 | 1.44 |
| 42 | 10.90 | 187.47 | 186 | 1.47 |
| 43 | 6.60 | 188.44 | 186 | 2.44 |
| 44 | 4.80 | 187.70 | 186 | 1.70 |
| 45 | 2.10 | 187.06 | 186 | 1.06 |
| 46 | 3.30 | 186.91 | 186 | 0.91 |
| 47 | 1.80 | 188.42 | 186 | 2.42 |
| 48 | 4.30 | 189.30 | 186 | 3.30 |
| 49 | 1.80 | 188.37 | 186 | 2.37 |
| 50 | 1.10 | 186.89 | 186 | 0.89 |
| 51 | 6.50 | 187.14 | 186 | 1.14 |
| 52 | 8.80 | 186.02 | 186 | 0.02 |
| 53 | 4.00 | 186.08 | 186 | 0.08 |
| 54 | 7.90 | 186.00 | 186 | -0.00 |
| 55 | 3.30 | 186.74 | 186 | 0.74 |
| 56 | 6.30 | 185.91 | 186 | -0.09 |
| 57 | 3.30 | 186.06 | 186 | 0.06 |
| 58 | 5.70 | 185.25 | 186 | -0.75 |
| 59 | 6.10 | 184.88 | 186 | -1.12 |
| 60 | 4.90 | 184.84 | 186 | -1.16 |
| 61 | 6.80 | 185.15 | 186 | -0.85 |
| 62 | 2.50 | 185.04 | 186 | -0.96 |
| 63 | 4.60 | 184.77 | 186 | -1.23 |
| 64 | 4.10 | 184.75 | 186 | -1.25 |
| 65 | 4.60 | 186.11 | 186 | 0.11 |
| 66 | 0.00 | 193.35 | 186 | 7.35 |
| 131 | 0.00 | 213.62 | 186 | 27.62 |

**Pipeline Data -DZ6.1**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z06b | 1 | 200 | 1 | 110 | 0.05 | 86.20 | 2.75 | 47.93 |
| 1 | 2 | 200 | 240 | 110 | 3.30 | 43.93 | 1.40 | 13.75 |
| 2 | 3 | 200 | 770 | 110 | 1.42 | 14.86 | 0.47 | 1.85 |
| 3 | 4 | 150 | 750 | 110 | 0.71 | 4.86 | 0.28 | 0.95 |
| 4 | 2 | 200 | 1350 | 110 | -2.14 | -13.66 | -0.44 | -1.58 |
| 4 | 5 | 150 | 300 | 110 | 0.01 | 0.83 | 0.05 | 0.04 |
| 5 | 6 | 200 | 930 | 110 | -4.70 | -25.57 | -0.81 | -5.05 |
| 6 | 1 | 250 | 300 | 110 | -0.75 | -31.47 | -0.64 | -2.50 |
| z06a | 7 | 200 | 120 | 110 | 1.23 | 37.40 | 1.19 | 10.21 |
| 7 | 8 | 200 | 330 | 110 | 2.93 | 34.70 | 1.11 | 8.89 |
| 8 | 9 | 200 | 530 | 110 | 0.13 | 5.00 | 0.16 | 0.25 |
| 8 | 10 | 200 | 210 | 110 | 0.03 | 3.60 | 0.11 | 0.13 |
| 8 | 11 | 200 | 150 | 110 | 0.44 | 19.10 | 0.61 | 2.94 |
| 11 | 12 | 200 | 330 | 110 | 0.00 | 0.90 | 0.03 | 0.01 |
| 11 | 13 | 200 | 330 | 110 | 0.00 | 1.00 | 0.03 | 0.01 |
| 11 | 14 | 200 | 200 | 110 | 0.19 | 10.30 | 0.33 | 0.94 |
| 14 | 15 | 150 | 300 | 110 | 0.43 | 6.10 | 0.35 | 1.44 |
| 14 | 16 | 150 | 210 | 110 | 0.00 | 0.00 | 0.00 | 0.00 |
| z06c | 121 | 300 | 1 | 110 | 0.01 | 84.38 | 1.19 | 6.39 |
| 121 | 17 | 300 | 1020 | 110 | 6.22 | 82.28 | 1.16 | 6.10 |
| z06d | 131 | 300 | 1 | 110 | 0.03 | 178.82 | 2.53 | 25.70 |
| 131 | 18 | 300 | 200 | 110 | 1.78 | 100.80 | 1.43 | 8.89 |
| 18 | 19 | 300 | 560 | 110 | 4.22 | 92.20 | 1.31 | 7.53 |
| 19 | 20 | 150 | 380 | 110 | 0.32 | 4.60 | 0.26 | 0.86 |
| 19 | 21 | 300 | 200 | 110 | 1.20 | 81.50 | 1.15 | 6.00 |
| 21 | 22 | 300 | 200 | 110 | 0.47 | 49.05 | 0.69 | 2.34 |
| 22 | 17 | 300 | 270 | 110 | -1.49 | -77.88 | -1.10 | -5.51 |
| 22 | 23 | 300 | 320 | 110 | 3.98 | 120.84 | 1.71 | 12.43 |
| 23 | 24 | 300 | 500 | 110 | 5.27 | 110.54 | 1.56 | 10.54 |
| 131 | 25 | 250 | 1270 | 110 | 17.06 | 78.02 | 1.59 | 13.44 |
| 25 | 26 | 250 | 110 | 110 | 1.57 | 80.50 | 1.64 | 14.24 |
| 26 | 27 | 150 | 390 | 110 | 1.88 | 11.71 | 0.66 | 4.82 |
| 27 | 28 | 200 | 90 | 110 | 0.04 | 6.51 | 0.21 | 0.40 |
| 28 | 29 | 200 | 210 | 110 | 0.06 | 5.61 | 0.18 | 0.30 |
| 29 | 30 | 200 | 100 | 110 | -0.17 | -14.10 | -0.45 | -1.68 |
| 30 | 31 | 200 | 270 | 110 | -3.00 | -39.12 | -1.25 | -11.10 |
| 30 | 39 | 150 | 380 | 110 | 5.14 | 20.42 | 1.16 | 13.52 |
| 31 | 24 | 200 | 50 | 110 | -0.54 | -38.46 | -1.22 | -10.75 |
| 31 | 32 | 250 | 330 | 110 | -0.03 | -5.26 | -0.11 | -0.09 |
| 32 | 25 | 250 | 630 | 110 | -0.35 | -14.06 | -0.29 | -0.56 |
| 25 | 21 | 150 | 570 | 110 | -9.87 | -23.35 | -1.32 | -17.32 |
| 24 | 33 | 150 | 250 | 110 | 5.25 | 25.90 | 1.47 | 20.99 |

**Pipeline Data -DZ6.2**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| 33 | 34 | 150 | 720 | 110 | 2.69 | 10.20 | 0.58 | 3.74 |
| 24 | 35 | 250 | 380 | 110 | 1.77 | 43.98 | 0.90 | 4.65 |
| 35 | 66 | 250 | 370 | 110 | 1.60 | 42.28 | 0.86 | 4.32 |
| 66 | 36 | 150 | 110 | 110 | 5.72 | 42.28 | 2.39 | 52.00 |
| 36 | 37 | 250 | 170 | 110 | 0.08 | 12.67 | 0.26 | 0.46 |
| 37 | 38 | 150 | 480 | 110 | -0.15 | -2.64 | -0.15 | -0.31 |
| 38 | 39 | 150 | 200 | 110 | -0.35 | -6.74 | -0.38 | -1.73 |
| 39 | 40 | 150 | 530 | 110 | 0.61 | 5.39 | 0.30 | 1.15 |
| 40 | 41 | 250 | 170 | 110 | -0.00 | -1.82 | -0.04 | -0.01 |
| 41 | 37 | 150 | 40 | 110 | -0.11 | -8.71 | -0.49 | -2.79 |
| 40 | 42 | 250 | 180 | 110 | -0.04 | -8.41 | -0.17 | -0.22 |
| 42 | 43 | 150 | 530 | 110 | -0.96 | -6.91 | -0.39 | -1.82 |
| 43 | 29 | 150 | 470 | 110 | -4.58 | -17.11 | -0.97 | -9.74 |
| 43 | 47 | 200 | 130 | 110 | 0.02 | 3.60 | 0.11 | 0.13 |
| 42 | 44 | 250 | 500 | 110 | -0.22 | -12.40 | -0.25 | -0.45 |
| 44 | 45 | 150 | 390 | 110 | 0.63 | 6.50 | 0.37 | 1.62 |
| 45 | 46 | 150 | 200 | 110 | 0.16 | 4.40 | 0.25 | 0.79 |
| 47 | 49 | 150 | 320 | 110 | 0.05 | 1.80 | 0.10 | 0.15 |
| 46 | 50 | 150 | 320 | 110 | 0.02 | 1.10 | 0.06 | 0.06 |
| 44 | 48 | 150 | 90 | 110 | -1.60 | -23.70 | -1.34 | -17.81 |
| 48 | 26 | 300 | 1300 | 110 | -5.69 | -68.79 | -0.97 | -4.38 |
| 36 | 51 | 150 | 90 | 110 | 0.48 | 12.40 | 0.70 | 5.37 |
| 36 | 54 | 150 | 700 | 110 | 1.63 | 7.90 | 0.45 | 2.33 |
| 51 | 52 | 150 | 830 | 110 | 1.13 | 5.90 | 0.33 | 1.36 |
| 41 | 53 | 150 | 750 | 110 | 1.36 | 6.90 | 0.39 | 1.81 |
| 53 | 52 | 150 | 170 | 110 | 0.06 | 2.90 | 0.16 | 0.36 |
| 40 | 55 | 150 | 150 | 110 | 0.69 | 11.41 | 0.65 | 4.60 |
| 55 | 65 | 150 | 260 | 110 | 0.64 | 8.11 | 0.46 | 2.45 |
| 65 | 56 | 150 | 390 | 110 | 0.20 | 3.51 | 0.20 | 0.52 |
| 56 | 57 | 200 | 80 | 110 | -0.16 | -15.33 | -0.49 | -1.96 |
| 57 | 48 | 200 | 270 | 110 | -3.24 | -40.79 | -1.30 | -11.99 |
| 57 | 58 | 200 | 210 | 110 | 0.81 | 22.15 | 0.71 | 3.87 |
| 58 | 59 | 200 | 330 | 110 | 0.38 | 11.44 | 0.36 | 1.14 |
| 59 | 60 | 150 | 180 | 110 | 0.03 | 2.06 | 0.12 | 0.19 |
| 60 | 61 | 150 | 240 | 110 | -0.31 | -5.75 | -0.33 | -1.29 |
| 61 | 56 | 200 | 560 | 110 | -0.76 | -12.55 | -0.40 | -1.35 |
| 58 | 62 | 150 | 210 | 110 | 0.21 | 5.02 | 0.28 | 1.00 |
| 62 | 63 | 150 | 980 | 110 | 0.27 | 2.52 | 0.14 | 0.28 |
| 63 | 64 | 150 | 180 | 110 | 0.01 | 1.20 | 0.07 | 0.07 |
| 64 | 60 | 150 | 240 | 110 | -0.09 | -2.90 | -0.16 | -0.37 |
| 63 | 59 | 150 | 240 | 110 | -0.11 | -3.28 | -0.19 | -0.46 |

# Distribution Network Analysis for Zone 07

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z07a | -164.76 | 222.25 | 185 | 37.25 |
| z07b | -62.07 | 223.08 | 185 | 38.08 |
| z07c | -28.73 | 219.30 | 186 | 33.30 |
| z07d | -31.50 | 214.73 | 187 | 27.73 |
| z07e | -23.84 | 214.54 | 187 | 27.54 |
| 1 | 0.00 | 222.24 | 185 | 37.24 |
| 2 | 11.40 | 221.16 | 185 | 36.16 |
| 3 | 15.00 | 213.86 | 185 | 28.86 |
| 4 | 10.80 | 213.12 | 185 | 28.12 |
| 5 | 4.30 | 220.07 | 185 | 35.07 |
| 6 | 4.40 | 218.20 | 185 | 33.20 |
| 7 | 11.90 | 217.51 | 185 | 32.51 |
| 8 | 4.20 | 219.34 | 185 | 34.34 |
| 9 | 11.40 | 213.68 | 186 | 27.68 |
| 10 | 12.30 | 210.53 | 186 | 24.53 |
| 11 | 7.50 | 210.22 | 186 | 24.22 |
| 12 | 1.60 | 210.29 | 186 | 24.29 |
| 13 | 0.00 | 210.56 | 186 | 24.56 |
| 14 | 5.60 | 210.92 | 186 | 24.92 |
| 15 | 3.60 | 211.35 | 186 | 25.35 |
| 16 | 11.60 | 211.76 | 186 | 25.76 |
| 17 | 9.90 | 210.56 | 186 | 24.56 |
| 18 | 1.80 | 218.50 | 186 | 32.50 |
| 19 | 5.90 | 205.84 | 186 | 19.84 |
| 20 | 4.80 | 205.48 | 186 | 19.48 |
| 21 | 20.80 | 201.64 | 186 | 15.64 |
| 22 | 6.00 | 211.02 | 186 | 25.02 |
| 23 | 3.20 | 211.30 | 186 | 25.30 |
| 24 | 12.90 | 211.33 | 186 | 25.33 |
| 25 | 2.50 | 213.27 | 187 | 26.27 |
| 26 | 4.50 | 213.48 | 187 | 26.48 |
| 27 | 0.00 | 213.57 | 187 | 26.57 |
| 28 | 19.10 | 214.43 | 187 | 27.43 |
| 29 | 4.20 | 210.04 | 185 | 25.04 |
| 30 | 5.80 | 209.98 | 185 | 24.98 |
| 31 | 5.20 | 222.97 | 185 | 37.97 |
| 32 | 6.00 | 221.68 | 185 | 36.68 |
| 33 | 1.30 | 221.66 | 185 | 36.66 |
| 34 | 1.50 | 218.60 | 185 | 33.60 |
| 35 | 26.70 | 216.59 | 185 | 31.59 |
| 36 | 8.70 | 216.52 | 185 | 31.52 |
| 37 | 3.00 | 216.53 | 185 | 31.53 |
| 38 | 7.70 | 218.60 | 185 | 33.60 |
| 39 | 3.60 | 218.47 | 185 | 33.47 |
| 40 | 5.20 | 218.60 | 185 | 33.60 |
| 41 | 1.40 | 218.53 | 185 | 33.53 |
| 42 | 4.30 | 218.44 | 185 | 33.44 |
| 43 | 2.20 | 218.44 | 185 | 33.44 |
| 44 | 11.90 | 217.15 | 185 | 32.15 |
| 45 | 2.10 | 218.78 | 185 | 33.78 |
| 46 | 3.10 | 210.63 | 186 | 24.63 |

**Pipeline Data -DZ07**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z07a | 1 | 400 | 1 | 110 | 0.01 | 164.76 | 1.31 | 5.44 |
| 1 | 2 | 400 | 200 | 110 | 1.09 | 164.76 | 1.31 | 5.44 |
| 2 | 3 | 150 | 350 | 110 | 7.29 | 25.80 | 1.46 | 20.84 |
| 3 | 4 | 150 | 180 | 110 | 0.75 | 10.80 | 0.61 | 4.15 |
| 2 | 5 | 400 | 320 | 110 | 1.08 | 127.56 | 1.02 | 3.39 |
| 5 | 6 | 150 | 210 | 110 | 1.87 | 16.30 | 0.92 | 8.90 |
| 6 | 7 | 150 | 140 | 110 | 0.70 | 11.90 | 0.67 | 4.97 |
| 5 | 8 | 400 | 300 | 110 | 0.73 | 106.96 | 0.85 | 2.44 |
| 8 | 9 | 150 | 220 | 110 | 5.66 | 28.90 | 1.64 | 25.72 |
| 9 | 10 | 150 | 310 | 110 | 3.15 | 17.50 | 0.99 | 10.16 |
| 10 | 11 | 150 | 290 | 110 | 0.31 | 5.20 | 0.29 | 1.07 |
| 11 | 12 | 150 | 300 | 110 | -0.07 | -2.30 | -0.13 | -0.24 |
| 12 | 29 | 200 | 290 | 110 | 0.26 | 10.00 | 0.32 | 0.89 |
| 29 | 30 | 200 | 170 | 110 | 0.06 | 5.80 | 0.18 | 0.32 |
| 8 | 18 | 400 | 680 | 110 | 0.84 | 73.86 | 0.59 | 1.23 |
| 18 | 16 | 150 | 140 | 110 | 6.74 | 40.56 | 2.30 | 48.17 |
| 17 | 16 | 150 | 340 | 110 | -1.20 | -9.90 | -0.56 | -3.54 |
| 16 | 15 | 150 | 70 | 110 | 0.41 | 13.06 | 0.74 | 5.91 |
| 15 | 14 | 150 | 170 | 110 | 0.43 | 8.23 | 0.47 | 2.51 |
| 14 | 46 | 150 | 180 | 110 | 0.29 | 6.43 | 0.36 | 1.59 |
| 46 | 13 | 150 | 160 | 110 | 0.08 | 3.33 | 0.19 | 0.47 |
| 13 | 12 | 150 | 40 | 110 | 0.27 | 13.90 | 0.79 | 6.63 |
| 18 | 19 | 150 | 420 | 110 | 12.67 | 31.50 | 1.78 | 30.16 |
| 19 | 20 | 150 | 390 | 110 | 0.36 | 4.80 | 0.27 | 0.93 |
| 19 | 21 | 150 | 300 | 110 | 4.20 | 20.80 | 1.18 | 13.98 |
| 22 | 16 | 150 | 530 | 110 | -0.74 | -6.00 | -0.34 | -1.40 |
| 23 | 15 | 150 | 680 | 110 | -0.05 | -1.23 | -0.07 | -0.07 |
| 23 | 24 | 150 | 170 | 110 | -0.03 | -1.97 | -0.11 | -0.18 |
| 24 | 14 | 150 | 680 | 110 | 0.41 | 3.80 | 0.21 | 0.60 |
| 24 | 25 | 150 | 170 | 110 | -1.95 | -18.67 | -1.06 | -11.45 |
| 25 | 13 | 150 | 680 | 110 | 2.71 | 10.57 | 0.60 | 3.99 |
| 25 | 26 | 300 | 200 | 110 | -0.21 | -31.74 | -0.45 | -1.05 |
| 26 | 27 | 300 | 140 | 110 | -0.09 | -23.84 | -0.34 | -0.62 |
| 27 | z07e | 250 | 650 | 110 | -0.97 | -23.84 | -0.49 | -1.50 |
| 26 | 28 | 200 | 720 | 110 | -0.95 | -12.40 | -0.39 | -1.32 |
| 28 | z07d | 200 | 40 | 110 | -0.30 | -31.50 | -1.00 | -7.43 |
| z07b | 31 | 300 | 30 | 110 | 0.11 | 62.07 | 0.88 | 3.62 |
| 31 | 32 | 300 | 420 | 110 | 1.29 | 56.87 | 0.80 | 3.08 |
| 32 | 33 | 150 | 230 | 110 | 0.02 | 1.30 | 0.07 | 0.08 |
| 32 | 34 | 150 | 70 | 110 | 3.08 | 38.61 | 2.19 | 43.96 |
| 34 | 35 | 150 | 80 | 110 | 2.01 | 28.54 | 1.62 | 25.13 |
| 35 | 36 | 150 | 440 | 110 | 0.07 | 1.84 | 0.10 | 0.16 |
| 36 | 37 | 300 | 160 | 110 | -0.01 | -6.86 | -0.10 | -0.06 |
| 37 | 34 | 150 | 590 | 110 | -2.07 | -9.86 | -0.56 | -3.51 |
| 34 | 38 | 300 | 160 | 110 | -0.00 | -1.29 | -0.02 | -0.00 |
| 38 | 32 | 150 | 720 | 110 | -3.08 | -10.97 | -0.62 | -4.27 |
| 38 | 39 | 150 | 240 | 110 | 0.13 | 3.60 | 0.20 | 0.54 |
| 38 | 40 | 300 | 390 | 110 | -0.00 | -1.63 | -0.02 | -0.00 |
| 40 | 41 | 300 | 420 | 110 | 0.07 | 12.06 | 0.17 | 0.17 |
| 41 | 42 | 250 | 260 | 110 | 0.09 | 10.66 | 0.22 | 0.34 |
| 42 | 43 | 300 | 240 | 110 | 0.00 | 2.20 | 0.03 | 0.01 |
| 42 | 44 | 150 | 260 | 110 | 1.29 | 11.90 | 0.67 | 4.97 |
| 42 | 45 | 150 | 150 | 110 | -0.34 | -7.74 | -0.44 | -2.24 |
| 45 | z07c | 300 | 600 | 110 | -0.52 | -28.73 | -0.41 | -0.87 |
| 45 | 40 | 300 | 440 | 110 | 0.18 | 18.88 | 0.27 | 0.40 |

# Distribution Network Analysis for Zone 08

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z08a | -587.00 | 222.25 | 185 | 37.25 |
| 1 | 0.00 | 218.04 | 185 | 33.04 |
| 2 | 3.70 | 215.61 | 185 | 30.61 |
| 3 | 9.90 | 213.92 | 185 | 28.92 |
| 4 | 10.70 | 212.79 | 185 | 27.79 |
| 5 | 4.50 | 212.50 | 185 | 27.50 |
| 6 | 3.00 | 212.32 | 185 | 27.32 |
| 7 | 1.40 | 212.31 | 185 | 27.31 |
| 8 | 3.50 | 212.36 | 185 | 27.36 |
| 9 | 5.30 | 212.77 | 185 | 27.77 |
| 10 | 3.60 | 212.87 | 185 | 27.87 |
| 11 | 1.40 | 212.35 | 185 | 27.35 |
| 12 | 10.40 | 211.28 | 185 | 26.28 |
| 13 | 1.70 | 211.10 | 185 | 26.10 |
| 14 | 4.10 | 211.12 | 185 | 26.12 |
| 15 | 10.00 | 211.58 | 185 | 26.58 |
| 16 | 8.90 | 211.40 | 185 | 26.40 |
| 17 | 3.40 | 211.37 | 185 | 26.37 |
| 18 | 6.50 | 211.64 | 185 | 26.64 |
| 19 | 5.80 | 212.08 | 185 | 27.08 |
| 20 | 0.00 | 217.17 | 185 | 32.17 |
| 21 | 6.00 | 212.20 | 185 | 27.20 |
| 22 | 4.80 | 211.94 | 185 | 26.94 |
| 23 | 5.40 | 210.64 | 185 | 25.64 |
| 24 | 7.50 | 209.08 | 185 | 24.08 |
| 25 | 5.70 | 208.33 | 185 | 23.33 |
| 26 | 4.70 | 210.88 | 185 | 25.88 |
| 27 | 3.00 | 211.01 | 185 | 26.01 |
| 28 | 9.40 | 207.78 | 185 | 22.78 |
| 29 | 5.80 | 211.06 | 185 | 26.06 |
| 30 | 12.00 | 210.69 | 185 | 25.69 |
| 31 | 2.20 | 211.31 | 185 | 26.31 |
| 32 | 2.70 | 213.05 | 185 | 28.05 |
| 33 | 5.00 | 212.84 | 185 | 27.84 |
| 34 | 11.60 | 215.56 | 185 | 30.56 |
| 35 | 12.30 | 214.45 | 185 | 29.45 |
| 36 | 0.00 | 216.69 | 185 | 31.69 |
| 37 | 2.10 | 216.65 | 185 | 31.65 |
| 38 | 4.50 | 216.65 | 185 | 31.65 |
| 39 | 0.00 | 216.65 | 185 | 31.65 |
| 40 | 7.80 | 214.94 | 185 | 29.94 |
| 41 | 4.60 | 216.37 | 185 | 31.37 |
| 42 | 1.90 | 216.37 | 185 | 31.37 |
| 43 | 2.00 | 216.32 | 185 | 31.32 |
| 44 | 4.90 | 217.42 | 185 | 32.42 |
| 45 | 1.40 | 215.97 | 185 | 30.97 |
| 46 | 1.40 | 214.95 | 185 | 29.95 |
| 47 | 8.30 | 213.97 | 185 | 28.97 |
| 48 | 3.50 | 213.88 | 185 | 28.88 |
| 49 | 17.80 | 210.72 | 185 | 25.72 |
| 50 | 0.00 | 213.41 | 185 | 28.41 |
| 901 | 330.90 | 216.86 | 185 | 31.86 |

**Pipeline Data -DZ08**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z08a | 1 | 600 | 530 | 110 | 4.21 | 587.00 | 2.08 | 7.94 |
| 1 | 2 | 250 | 210 | 110 | 2.43 | 72.02 | 1.47 | 11.58 |
| 2 | 3 | 300 | 390 | 110 | 1.69 | 68.32 | 0.97 | 4.32 |
| 3 | 4 | 300 | 350 | 110 | 1.13 | 58.42 | 0.83 | 3.24 |
| 4 | 5 | 300 | 170 | 110 | 0.29 | 41.72 | 0.59 | 1.73 |
| 5 | 6 | 300 | 160 | 110 | 0.17 | 32.42 | 0.46 | 1.09 |
| 6 | 7 | 300 | 90 | 110 | 0.01 | 10.82 | 0.15 | 0.14 |
| 7 | 8 | 200 | 60 | 110 | -0.05 | -9.35 | -0.30 | -0.78 |
| 8 | 9 | 200 | 210 | 110 | -0.41 | -15.37 | -0.49 | -1.97 |
| 9 | 10 | 300 | 210 | 110 | -0.10 | -20.67 | -0.29 | -0.47 |
| 10 | 11 | 300 | 190 | 110 | 0.52 | 53.17 | 0.75 | 2.72 |
| 11 | 8 | 250 | 180 | 110 | -0.00 | -2.52 | -0.05 | -0.02 |
| 7 | 12 | 200 | 360 | 110 | 1.03 | 18.78 | 0.60 | 2.85 |
| 12 | 13 | 150 | 330 | 110 | 0.19 | 3.68 | 0.21 | 0.56 |
| 13 | 14 | 150 | 390 | 110 | -0.02 | -1.02 | -0.06 | -0.05 |
| 14 | 15 | 200 | 260 | 110 | -0.46 | -14.52 | -0.46 | -1.77 |
| 11 | 15 | 300 | 470 | 110 | 0.77 | 40.57 | 0.57 | 1.65 |
| 15 | 16 | 300 | 590 | 110 | 0.17 | 16.05 | 0.23 | 0.30 |
| 16 | 17 | 150 | 380 | 110 | 0.03 | 1.35 | 0.08 | 0.09 |
| 17 | 18 | 150 | 360 | 110 | -0.27 | -4.25 | -0.24 | -0.74 |
| 18 | 19 | 200 | 440 | 110 | -0.45 | -10.75 | -0.34 | -1.01 |
| 19 | 11 | 250 | 500 | 110 | -0.27 | -13.72 | -0.28 | -0.54 |
| 19 | 30 | 150 | 330 | 110 | 1.39 | 10.88 | 0.62 | 4.21 |
| 30 | 49 | 150 | 360 | 110 | -0.02 | -1.12 | -0.06 | -0.06 |
| 49 | 50 | 150 | 230 | 110 | -2.70 | -18.92 | -1.07 | -11.73 |
| 50 | 10 | 300 | 100 | 110 | 0.55 | 77.44 | 1.10 | 5.45 |
| 50 | 20 | 300 | 460 | 110 | -3.76 | -96.36 | -1.36 | -8.17 |
| 20 | 1 | 600 | 150 | 110 | -0.87 | -495.48 | -1.75 | -5.80 |
| 4 | 21 | 150 | 420 | 110 | 0.59 | 6.00 | 0.34 | 1.40 |
| 5 | 22 | 150 | 600 | 110 | 0.56 | 4.80 | 0.27 | 0.93 |
| 6 | 23 | 200 | 600 | 110 | 1.68 | 18.60 | 0.59 | 2.80 |
| 23 | 24 | 150 | 260 | 110 | 1.57 | 13.20 | 0.75 | 6.02 |
| 24 | 25 | 150 | 590 | 110 | 0.75 | 5.70 | 0.32 | 1.27 |
| 12 | 26 | 150 | 450 | 110 | 0.40 | 4.70 | 0.27 | 0.89 |
| 13 | 27 | 150 | 230 | 110 | 0.09 | 3.00 | 0.17 | 0.39 |
| 14 | 28 | 150 | 1040 | 110 | 3.34 | 9.40 | 0.53 | 3.21 |
| 16 | 29 | 150 | 260 | 110 | 0.34 | 5.80 | 0.33 | 1.31 |
| 17 | 31 | 150 | 300 | 110 | 0.07 | 2.20 | 0.12 | 0.22 |
| 19 | 32 | 150 | 150 | 110 | -0.97 | -13.72 | -0.78 | -6.47 |
| 32 | 33 | 150 | 210 | 110 | 0.21 | 5.00 | 0.28 | 1.00 |
| 32 | 34 | 150 | 170 | 110 | -2.51 | -21.42 | -1.21 | -14.75 |
| 34 | 35 | 150 | 210 | 110 | 1.11 | 12.30 | 0.70 | 5.28 |
| 34 | 36 | 250 | 230 | 110 | -1.13 | -45.32 | -0.92 | -4.91 |
| 36 | 901 | 600 | 1160 | 110 | -0.17 | -68.22 | -0.24 | -0.15 |
| 36 | 37 | 500 | 890 | 110 | 0.04 | 22.90 | 0.12 | 0.05 |
| 37 | 38 | 500 | 120 | 110 | 0.00 | 13.00 | 0.07 | 0.02 |
| 38 | 39 | 500 | 150 | 110 | 0.00 | 3.90 | 0.02 | 0.00 |
| 37 | 40 | 150 | 750 | 110 | 1.70 | 7.80 | 0.44 | 2.27 |
| 38 | 41 | 150 | 320 | 110 | 0.27 | 4.60 | 0.26 | 0.85 |
| 39 | 42 | 150 | 440 | 110 | 0.28 | 3.90 | 0.22 | 0.63 |
| 42 | 43 | 150 | 250 | 110 | 0.05 | 2.00 | 0.11 | 0.18 |
| 1 | 44 | 150 | 50 | 110 | 0.62 | 19.50 | 1.10 | 12.40 |
| 44 | 45 | 150 | 200 | 110 | 1.45 | 14.60 | 0.83 | 7.26 |
| 45 | 46 | 150 | 170 | 110 | 1.02 | 13.20 | 0.75 | 6.02 |
| 46 | 47 | 150 | 200 | 110 | 0.98 | 11.80 | 0.67 | 4.89 |
| 47 | 48 | 150 | 170 | 110 | 0.09 | 3.50 | 0.20 | 0.52 |
| 20 | 901 | 600 | 80 | 110 | 0.31 | 399.12 | 1.41 | 3.88 |

# Distribution Network Analysis for Zone 09

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| 109 | -330.90 | 216.86 | 185 | 31.86 |
| 2 | 0.00 | 216.86 | 185 | 31.86 |
| 3 | 0.00 | 215.48 | 185 | 30.48 |
| 4 | 0.00 | 215.19 | 185 | 30.19 |
| 5 | 5.30 | 214.88 | 185 | 29.88 |
| 6 | 3.70 | 210.77 | 185 | 25.77 |
| 7 | 10.10 | 209.28 | 185 | 24.28 |
| 8 | 8.40 | 209.28 | 185 | 24.28 |
| 9 | 7.60 | 204.61 | 185 | 19.61 |
| 10 | 20.00 | 204.61 | 185 | 19.61 |
| 11 | 12.60 | 212.42 | 185 | 27.42 |
| 12 | 7.40 | 215.13 | 185 | 30.13 |
| 13 | 2.40 | 214.79 | 185 | 29.79 |
| 14 | 3.70 | 214.07 | 185 | 29.07 |
| 15 | 4.80 | 214.07 | 185 | 29.07 |
| 16 | 4.60 | 214.04 | 185 | 29.04 |
| 17 | 5.00 | 214.21 | 185 | 29.21 |
| 18 | 2.60 | 214.91 | 185 | 29.91 |
| 19 | 2.40 | 215.27 | 185 | 30.27 |
| 20 | 2.10 | 204.07 | 185 | 19.07 |
| 21 | 4.80 | 203.85 | 185 | 18.85 |
| 22 | 3.90 | 203.74 | 185 | 18.74 |
| 23 | 6.80 | 203.69 | 185 | 18.69 |
| 24 | 11.70 | 203.57 | 185 | 18.57 |
| 25 | 8.60 | 203.85 | 185 | 18.85 |
| 26 | 3.80 | 209.08 | 185 | 24.08 |
| 27 | 7.80 | 209.29 | 185 | 24.29 |
| 28 | 0.00 | 209.78 | 185 | 24.78 |
| 29 | 0.50 | 210.77 | 185 | 25.77 |
| 30 | 3.90 | 209.19 | 185 | 24.19 |
| 31 | 5.00 | 214.77 | 185 | 29.77 |
| 32 | 6.10 | 211.40 | 185 | 26.40 |
| 33 | 6.70 | 210.54 | 185 | 25.54 |
| 34 | 2.60 | 210.89 | 185 | 25.89 |
| 35 | 6.10 | 210.25 | 185 | 25.25 |
| 36 | 10.20 | 211.91 | 185 | 26.91 |
| 37 | 2.60 | 214.19 | 185 | 29.19 |
| 38 | 2.20 | 204.02 | 185 | 19.02 |
| 39 | 3.10 | 203.78 | 185 | 18.78 |
| 40 | 6.70 | 203.02 | 185 | 18.02 |
| 41 | 8.50 | 208.01 | 185 | 23.01 |
| 42 | 16.00 | 214.65 | 185 | 29.65 |
| 43 | 0.00 | 214.55 | 185 | 29.55 |
| 44 | 0.00 | 214.53 | 185 | 29.53 |
| 45 | 5.60 | 214.31 | 185 | 29.31 |
| 46 | 15.80 | 213.90 | 185 | 28.90 |
| 47 | 11.60 | 213.60 | 185 | 28.60 |
| 48 | 17.80 | 210.67 | 185 | 25.67 |
| 49 | 6.20 | 214.54 | 185 | 29.54 |
| 50 | 10.60 | 211.00 | 185 | 26.00 |
| 51 | 8.40 | 210.68 | 185 | 25.68 |
| 52 | 0.00 | 214.54 | 185 | 29.54 |
| 53 | 0.00 | 214.54 | 185 | 29.54 |
| 54 | 0.00 | 214.54 | 185 | 29.54 |
| 55 | 3.90 | 214.23 | 185 | 29.23 |
| 56 | 2.60 | 214.17 | 185 | 29.17 |
| 57 | 1.40 | 214.17 | 185 | 29.17 |
| 58 | 1.40 | 214.18 | 185 | 29.18 |
| 59 | 2.90 | 215.08 | 185 | 30.08 |
| 60 | 2.40 | 214.85 | 185 | 29.85 |
| 61 | 10.00 | 214.47 | 185 | 29.47 |

**Pipeline Data -DZ09.1**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| 109 | 2 | 600 | 1 | 110 | 0.00 | 330.90 | 1.17 | 2.75 |
| 2 | 3 | 600 | 780 | 110 | 1.38 | 260.58 | 0.92 | 1.76 |
| 3 | 4 | 600 | 240 | 110 | 0.29 | 213.18 | 0.75 | 1.22 |
| 4 | 59 | 600 | 120 | 110 | 0.11 | 185.98 | 0.66 | 0.94 |
| 59 | 5 | 600 | 380 | 110 | 0.20 | 135.23 | 0.48 | 0.52 |
| 5 | 6 | 150 | 360 | 110 | 4.10 | 18.63 | 1.05 | 11.40 |
| 6 | 7 | 150 | 210 | 110 | 1.49 | 14.43 | 0.82 | 7.10 |
| 7 | 8 | 150 | 170 | 110 | 0.00 | 0.43 | 0.02 | 0.01 |
| 8 | 9 | 150 | 100 | 110 | 4.67 | 39.88 | 2.26 | 46.65 |
| 8 | 59 | 200 | 360 | 110 | -5.80 | -47.84 | -1.52 | -16.10 |
| 9 | 10 | 230 | 240 | 110 | 0.00 | 0.16 | 0.00 | 0.00 |
| 10 | 11 | 150 | 610 | 110 | -7.81 | -19.84 | -1.12 | -12.80 |
| 11 | 2 | 250 | 400 | 110 | -4.43 | -70.32 | -1.43 | -11.08 |
| 4 | 12 | 250 | 30 | 110 | 0.06 | 27.20 | 0.55 | 1.91 |
| 12 | 13 | 250 | 210 | 110 | 0.34 | 25.02 | 0.51 | 1.64 |
| 13 | 14 | 200 | 150 | 110 | 0.72 | 24.86 | 0.79 | 4.79 |
| 14 | 15 | 150 | 450 | 110 | -0.00 | -0.34 | -0.02 | -0.01 |
| 15 | 16 | 150 | 80 | 110 | 0.04 | 3.37 | 0.19 | 0.48 |
| 16 | 17 | 200 | 150 | 110 | -0.17 | -11.43 | -0.36 | -1.14 |
| 17 | 18 | 200 | 240 | 110 | -0.70 | -19.03 | -0.61 | -2.92 |
| 18 | 60 | 250 | 120 | 110 | 0.06 | 13.14 | 0.27 | 0.50 |
| 60 | 13 | 150 | 260 | 110 | 0.06 | 2.24 | 0.13 | 0.22 |
| 60 | 15 | 150 | 290 | 110 | 0.77 | 8.51 | 0.48 | 2.67 |
| 18 | 19 | 250 | 120 | 110 | -0.36 | -34.78 | -0.71 | -3.01 |
| 19 | 3 | 250 | 40 | 110 | -0.21 | -47.40 | -0.97 | -5.34 |
| 19 | 12 | 225 | 260 | 110 | 0.14 | 10.23 | 0.26 | 0.52 |
| 9 | 20 | 250 | 210 | 110 | 0.55 | 32.11 | 0.65 | 2.60 |
| 20 | 21 | 250 | 110 | 110 | 0.22 | 27.81 | 0.57 | 1.99 |
| 21 | 22 | 250 | 100 | 110 | 0.11 | 19.91 | 0.41 | 1.07 |
| 22 | 23 | 250 | 200 | 110 | 0.05 | 9.31 | 0.19 | 0.26 |
| 23 | 24 | 150 | 440 | 110 | 0.12 | 2.51 | 0.14 | 0.28 |
| 24 | 25 | 150 | 90 | 110 | -0.28 | -9.19 | -0.52 | -3.08 |
| 25 | 26 | 150 | 500 | 110 | -5.23 | -17.79 | -1.01 | -10.46 |
| 26 | 27 | 250 | 170 | 110 | -0.21 | -21.59 | -0.44 | -1.24 |
| 27 | 28 | 250 | 140 | 110 | -0.49 | -37.89 | -0.77 | -3.53 |

**Pipeline Data -DZ09.2**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| 28 | 11 | 250 | 750 | 110 | -2.64 | -37.89 | -0.77 | -3.53 |
| 6 | 29 | 150 | 190 | 110 | 0.00 | 0.50 | 0.03 | 0.01 |
| 7 | 30 | 150 | 150 | 110 | 0.09 | 3.90 | 0.22 | 0.63 |
| 12 | 31 | 150 | 360 | 110 | 0.36 | 5.00 | 0.28 | 1.00 |
| 14 | 32 | 150 | 180 | 110 | 2.68 | 21.50 | 1.22 | 14.86 |
| 32 | 33 | 150 | 500 | 110 | 0.86 | 6.70 | 0.38 | 1.72 |
| 32 | 34 | 150 | 180 | 110 | 0.50 | 8.70 | 0.49 | 2.78 |
| 34 | 35 | 150 | 450 | 110 | 0.65 | 6.10 | 0.35 | 1.44 |
| 16 | 36 | 150 | 570 | 110 | 2.13 | 10.20 | 0.58 | 3.74 |
| 17 | 37 | 200 | 180 | 110 | 0.01 | 2.60 | 0.08 | 0.07 |
| 20 | 38 | 150 | 230 | 110 | 0.05 | 2.20 | 0.12 | 0.22 |
| 21 | 39 | 150 | 170 | 110 | 0.07 | 3.10 | 0.18 | 0.41 |
| 22 | 40 | 150 | 420 | 110 | 0.72 | 6.70 | 0.38 | 1.72 |
| 27 | 41 | 150 | 480 | 110 | 1.28 | 8.50 | 0.48 | 2.67 |
| 5 | 42 | 600 | 630 | 110 | 0.23 | 111.30 | 0.39 | 0.36 |
| 42 | 43 | 600 | 750 | 110 | 0.10 | 65.03 | 0.23 | 0.13 |
| 43 | 44 | 400 | 150 | 110 | 0.01 | 18.42 | 0.15 | 0.09 |
| 44 | 61 | 400 | 250 | 110 | 0.06 | 30.53 | 0.24 | 0.24 |
| 61 | 45 | 300 | 340 | 110 | 0.16 | 20.53 | 0.29 | 0.47 |
| 45 | 42 | 200 | 250 | 110 | -0.33 | -12.47 | -0.40 | -1.34 |
| 45 | 46 | 200 | 200 | 110 | 0.41 | 15.80 | 0.50 | 2.07 |
| 45 | 47 | 150 | 150 | 110 | 0.71 | 11.60 | 0.66 | 4.74 |
| 42 | 48 | 150 | 380 | 110 | 3.98 | 17.80 | 1.01 | 10.48 |
| 43 | 49 | 600 | 70 | 110 | 0.01 | 46.61 | 0.16 | 0.07 |
| 49 | 50 | 150 | 300 | 110 | 3.55 | 19.00 | 1.08 | 11.82 |
| 50 | 51 | 150 | 120 | 110 | 0.31 | 8.40 | 0.48 | 2.61 |
| 49 | 52 | 600 | 250 | 110 | 0.00 | 21.41 | 0.08 | 0.02 |
| 52 | 53 | 600 | 70 | 110 | 0.00 | 21.41 | 0.08 | 0.02 |
| 53 | 44 | 500 | 240 | 110 | 0.00 | 12.11 | 0.06 | 0.01 |
| 53 | 54 | 600 | 140 | 110 | 0.00 | 9.30 | 0.03 | 0.00 |
| 54 | 55 | 200 | 390 | 110 | 0.30 | 9.30 | 0.30 | 0.78 |
| 55 | 56 | 150 | 170 | 110 | 0.06 | 2.87 | 0.16 | 0.36 |
| 56 | 57 | 150 | 180 | 110 | 0.00 | 0.27 | 0.02 | 0.00 |
| 57 | 58 | 150 | 170 | 110 | -0.01 | -1.13 | -0.06 | -0.06 |
| 58 | 55 | 150 | 180 | 110 | -0.05 | -2.53 | -0.14 | -0.28 |

# Distribution Network Analysis for Zone 10

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z10a | -149.27 | 214.20 | 186 | 28.20 |
| z10b | -10.60 | 213.19 | 186 | 27.19 |
| z10c | -85.93 | 212.70 | 186 | 26.70 |
| z10d | -120.30 | 212.00 | 186 | 26.00 |
| 1 | 9.00 | 213.75 | 186 | 27.75 |
| 2 | 9.00 | 213.49 | 186 | 27.49 |
| 3 | 7.30 | 213.14 | 186 | 27.14 |
| 4 | 9.00 | 213.57 | 186 | 27.57 |
| 5 | 9.00 | 213.28 | 186 | 27.28 |
| 6 | 7.40 | 213.00 | 186 | 27.00 |
| 7 | 10.60 | 213.19 | 186 | 27.19 |
| 8 | 20.20 | 202.77 | 186 | 16.77 |
| 9 | 16.60 | 194.24 | 186 | 8.24 |
| 10 | 15.90 | 191.10 | 186 | 5.10 |
| 11 | 17.80 | 191.07 | 186 | 5.07 |
| 12 | 6.90 | 193.95 | 186 | 7.95 |
| 13 | 5.20 | 193.24 | 186 | 7.24 |
| 14 | 3.70 | 193.10 | 186 | 7.10 |
| 15 | 2.00 | 202.25 | 186 | 16.25 |
| 16 | 3.60 | 195.33 | 186 | 9.33 |
| 17 | 4.20 | 193.19 | 186 | 7.19 |
| 18 | 6.60 | 192.49 | 186 | 6.49 |
| 19 | 5.60 | 192.94 | 186 | 6.94 |
| 20 | 12.50 | 189.63 | 186 | 3.63 |
| 21 | 5.10 | 189.14 | 186 | 3.14 |
| 22 | 0.00 | 190.22 | 186 | 4.22 |
| 23 | 26.10 | 188.94 | 186 | 2.94 |
| 24 | 6.40 | 188.80 | 186 | 2.80 |
| 25 | 2.70 | 188.90 | 186 | 2.90 |
| 26 | 4.10 | 188.72 | 186 | 2.72 |
| 27 | 4.10 | 188.86 | 186 | 2.86 |
| 28 | 4.00 | 188.42 | 186 | 2.42 |
| 29 | 11.20 | 189.28 | 186 | 3.28 |
| 30 | 0.00 | 211.88 | 186 | 25.88 |
| 31 | 10.00 | 207.66 | 186 | 21.66 |
| 32 | 16.70 | 204.59 | 186 | 18.59 |
| 33 | 0.00 | 208.86 | 186 | 22.86 |
| 34 | 17.40 | 174.57 | 186 | -11.43 |
| 35 | 11.60 | 166.99 | 186 | -19.01 |
| 36 | 7.00 | 165.21 | 186 | -20.79 |
| 37 | 6.60 | 164.86 | 186 | -21.14 |
| 38 | 2.00 | 208.03 | 186 | 22.03 |
| 39 | 12.10 | 205.62 | 186 | 19.62 |
| 40 | 5.00 | 205.26 | 186 | 19.26 |
| 41 | 4.50 | 205.09 | 186 | 19.09 |
| 42 | 4.10 | 207.91 | 186 | 21.91 |
| 43 | 4.20 | 207.47 | 186 | 21.47 |
| 44 | 4.20 | 207.81 | 186 | 21.81 |
| 45 | 5.90 | 204.96 | 186 | 18.96 |
| 46 | 7.20 | 204.21 | 186 | 18.21 |
| 47 | 0.00 | 207.81 | 186 | 21.81 |
| 48 | 1.80 | 207.77 | 186 | 21.77 |
| 50 | 0.00 | 192.71 | 186 | 6.71 |

**Pipeline Data -DZ10**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z10a | 1 | 250 | 10 | 110 | 0.45 | 149.27 | 3.04 | 44.69 |
| 1 | 2 | 250 | 360 | 110 | 0.27 | 16.30 | 0.33 | 0.74 |
| 2 | 3 | 150 | 170 | 110 | 0.34 | 7.30 | 0.41 | 2.01 |
| 1 | 4 | 250 | 110 | 110 | 0.19 | 25.40 | 0.52 | 1.68 |
| 4 | 5 | 250 | 380 | 110 | 0.28 | 16.40 | 0.33 | 0.75 |
| 5 | 6 | 150 | 140 | 110 | 0.29 | 7.40 | 0.42 | 2.06 |
| z10b | 7 | 250 | 1 | 110 | 0.00 | 10.60 | 0.22 | 0.33 |
| 1 | 8 | 250 | 530 | 110 | 10.98 | 98.57 | 2.01 | 20.72 |
| 8 | 9 | 250 | 630 | 110 | 8.54 | 78.37 | 1.60 | 13.55 |
| 9 | 10 | 250 | 360 | 110 | 3.14 | 61.77 | 1.26 | 8.72 |
| 10 | 11 | 300 | 20 | 110 | 0.02 | 34.67 | 0.49 | 1.23 |
| 11 | 12 | 200 | 410 | 110 | -2.87 | -30.53 | -0.97 | -7.01 |
| 12 | 13 | 200 | 990 | 110 | 0.71 | 8.90 | 0.28 | 0.72 |
| 13 | 14 | 150 | 240 | 110 | 0.14 | 3.70 | 0.21 | 0.57 |
| z10c | 15 | 250 | 650 | 110 | 10.45 | 85.93 | 1.75 | 16.07 |
| 15 | 16 | 250 | 450 | 110 | 6.92 | 83.93 | 1.71 | 15.38 |
| 16 | 12 | 250 | 270 | 110 | 1.38 | 46.33 | 0.94 | 5.12 |
| 16 | 17 | 200 | 250 | 110 | 2.14 | 34.00 | 1.08 | 8.56 |
| 17 | 18 | 150 | 420 | 110 | 0.70 | 6.60 | 0.37 | 1.67 |
| 17 | 19 | 200 | 60 | 110 | 0.25 | 23.20 | 0.74 | 4.22 |
| 19 | 50 | 200 | 90 | 110 | 0.23 | 17.60 | 0.56 | 2.53 |
| 50 | 20 | 150 | 300 | 110 | 3.08 | 17.60 | 1.00 | 10.26 |
| 20 | 21 | 150 | 480 | 110 | 0.50 | 5.10 | 0.29 | 1.04 |
| 10 | 11 | 300 | 20 | 110 | 0.02 | 34.67 | 0.49 | 1.23 |
| 11 | 22 | 300 | 390 | 110 | 0.86 | 47.40 | 0.67 | 2.20 |
| 22 | 23 | 250 | 240 | 110 | 1.28 | 47.40 | 0.97 | 5.34 |
| 23 | 24 | 200 | 360 | 110 | 0.14 | 6.40 | 0.20 | 0.39 |
| 23 | 25 | 200 | 450 | 110 | 0.04 | 2.70 | 0.09 | 0.08 |
| 23 | 26 | 200 | 360 | 110 | 0.22 | 8.10 | 0.26 | 0.60 |
| 23 | 27 | 200 | 450 | 110 | 0.08 | 4.10 | 0.13 | 0.17 |
| 26 | 28 | 150 | 450 | 110 | 0.30 | 4.00 | 0.23 | 0.66 |
| 10 | 29 | 150 | 410 | 110 | 1.82 | 11.20 | 0.63 | 4.44 |
| z10d | 30 | 300 | 10 | 110 | 0.12 | 120.30 | 1.70 | 12.33 |
| 30 | 31 | 150 | 190 | 110 | 4.22 | 26.70 | 1.51 | 22.20 |
| 31 | 32 | 150 | 330 | 110 | 3.07 | 16.70 | 0.95 | 9.31 |
| 30 | 33 | 300 | 390 | 110 | 3.02 | 93.60 | 1.32 | 7.75 |
| 33 | 34 | 150 | 650 | 110 | 34.28 | 42.60 | 2.41 | 52.74 |
| 34 | 35 | 150 | 380 | 110 | 7.58 | 25.20 | 1.43 | 19.95 |
| 35 | 36 | 150 | 280 | 110 | 1.78 | 13.60 | 0.77 | 6.37 |
| 36 | 37 | 150 | 210 | 110 | 0.35 | 6.60 | 0.37 | 1.67 |
| 33 | 38 | 300 | 330 | 110 | 0.83 | 51.00 | 0.72 | 2.52 |
| 38 | 39 | 200 | 650 | 110 | 2.40 | 21.60 | 0.69 | 3.69 |
| 39 | 40 | 200 | 450 | 110 | 0.36 | 9.50 | 0.30 | 0.81 |
| 40 | 41 | 150 | 210 | 110 | 0.17 | 4.50 | 0.25 | 0.82 |
| 38 | 42 | 300 | 150 | 110 | 0.12 | 27.40 | 0.39 | 0.80 |
| 42 | 43 | 150 | 600 | 110 | 0.43 | 4.20 | 0.24 | 0.72 |
| 42 | 44 | 300 | 240 | 110 | 0.10 | 19.10 | 0.27 | 0.41 |
| 44 | 45 | 150 | 480 | 110 | 2.85 | 13.10 | 0.74 | 5.94 |
| 45 | 46 | 150 | 380 | 110 | 0.75 | 7.20 | 0.41 | 1.96 |
| 44 | 47 | 300 | 420 | 110 | 0.00 | 1.80 | 0.03 | 0.01 |
| 47 | 48 | 150 | 230 | 110 | 0.03 | 1.80 | 0.10 | 0.15 |

# Distribution Network Analysis for Zone 11

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z11a | -83.06 | 213.85 | 186 | 27.85 |
| z11b | -163.90 | 213.95 | 186 | 27.95 |
| z11c | -44.62 | 211.85 | 186 | 25.85 |
| z11d | -49.48 | 211.08 | 186 | 25.08 |
| z11e | -76.65 | 211.03 | 186 | 25.03 |
| z11f | -105.59 | 211.10 | 186 | 25.10 |
| 1 | 0.00 | 209.81 | 186 | 23.81 |
| 2 | 12.80 | 206.46 | 186 | 20.46 |
| 3 | 25.00 | 205.79 | 186 | 19.79 |
| 4 | 14.70 | 205.89 | 186 | 19.89 |
| 5 | 36.80 | 209.35 | 186 | 23.35 |
| 6 | 32.90 | 205.91 | 186 | 19.91 |
| 7 | 22.80 | 203.56 | 186 | 17.56 |
| 8 | 17.00 | 205.10 | 186 | 19.10 |
| 9 | 25.20 | 195.22 | 186 | 9.22 |
| 10 | 14.70 | 202.00 | 186 | 16.00 |
| 11 | 15.70 | 210.56 | 186 | 24.56 |
| 12 | 0.00 | 202.14 | 186 | 16.14 |
| 13 | 3.00 | 193.00 | 186 | 7.00 |
| 14 | 3.00 | 181.17 | 186 | -4.83 |
| 15 | 6.20 | 152.93 | 186 | -33.07 |
| 16 | 12.10 | 151.86 | 186 | -34.14 |
| 17 | 9.50 | 149.89 | 186 | -36.11 |
| 18 | 16.70 | 149.16 | 186 | -36.84 |
| 19 | 0.00 | 190.18 | 186 | 4.18 |
| 20 | 9.20 | 80.70 | 186 | -105.30 |
| 21 | 5.90 | 74.69 | 186 | -111.31 |
| 22 | 12.90 | 72.38 | 186 | -113.62 |
| 23 | 0.00 | 71.71 | 186 | -114.29 |
| 24 | 6.50 | 66.79 | 186 | -119.21 |
| 25 | 11.90 | 65.17 | 186 | -120.83 |
| 26 | 14.10 | 61.70 | 186 | -124.30 |
| 27 | 6.80 | 64.59 | 186 | -121.41 |
| 28 | 8.30 | 64.20 | 186 | -121.80 |
| 29 | 3.50 | 64.09 | 186 | -121.91 |
| 30 | 15.50 | 71.75 | 186 | -114.25 |
| 31 | 6.60 | 80.35 | 186 | -105.65 |
| 32 | 12.20 | 69.67 | 186 | -116.33 |
| 33 | 5.30 | 211.85 | 186 | 25.85 |
| 34 | 9.30 | 210.41 | 186 | 24.41 |
| 35 | 14.80 | 209.82 | 186 | 23.82 |
| 36 | 24.80 | 207.91 | 186 | 21.91 |
| 37 | 10.50 | 210.31 | 186 | 24.31 |
| 38 | 9.30 | 210.69 | 186 | 24.69 |
| 39 | 6.90 | 211.02 | 186 | 25.02 |
| 40 | 8.70 | 191.72 | 186 | 5.72 |
| 41 | 10.10 | 190.51 | 186 | 4.51 |
| 42 | 8.90 | 188.19 | 186 | 2.19 |
| 43 | 9.10 | 186.74 | 186 | 0.74 |
| 44 | 3.10 | 210.15 | 186 | 24.15 |
| 45 | 3.10 | 210.00 | 186 | 24.00 |
| 46 | 8.00 | 210.01 | 186 | 24.01 |
| 47 | 4.10 | 209.89 | 186 | 23.89 |
| 48 | 5.80 | 209.14 | 186 | 23.14 |
| 49 | 0.00 | 210.31 | 186 | 24.31 |
| 50 | 0.00 | 210.03 | 186 | 24.03 |

**Pipeline Data -DZ11**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z14a | 1 | 300 | 650 | 110 | 4.04 | 83.06 | 1.18 | 6.21 |
| 1 | 2 | 300 | 540 | 110 | 3.35 | 83.06 | 1.18 | 6.21 |
| 2 | 3 | 225 | 90 | 110 | 0.67 | 43.15 | 1.09 | 7.50 |
| 3 | 4 | 225 | 410 | 110 | -0.11 | -7.05 | -0.18 | -0.26 |
| 4 | 5 | 225 | 630 | 110 | -3.45 | -36.45 | -0.92 | -5.48 |
| 5 | 6 | 150 | 700 | 110 | 3.44 | 11.82 | 0.67 | 4.91 |
| 6 | 7 | 150 | 420 | 110 | 2.35 | 12.70 | 0.72 | 5.60 |
| 7 | 8 | 150 | 420 | 110 | -1.54 | -10.10 | -0.57 | -3.67 |
| 8 | 2 | 225 | 430 | 110 | -1.36 | -27.10 | -0.68 | -3.17 |
| 3 | 9 | 150 | 530 | 110 | 10.57 | 25.20 | 1.43 | 19.94 |
| 4 | 10 | 150 | 530 | 110 | 3.90 | 14.70 | 0.83 | 7.35 |
| 5 | z11f | 300 | 270 | 110 | -1.75 | -85.07 | -1.20 | -6.49 |
| z11d | 11 | 300 | 220 | 110 | 0.52 | 49.48 | 0.70 | 2.38 |
| 11 | 50 | 300 | 450 | 110 | 0.53 | 33.78 | 0.48 | 1.17 |
| 50 | 6 | 150 | 120 | 110 | 4.12 | 33.78 | 1.91 | 34.31 |
| z11b | 12 | 300 | 540 | 110 | 11.81 | 163.90 | 2.32 | 21.87 |
| 12 | 13 | 150 | 150 | 110 | 9.14 | 46.06 | 2.61 | 60.94 |
| 13 | 14 | 150 | 220 | 110 | 11.83 | 43.06 | 2.44 | 53.79 |
| 14 | 15 | 150 | 600 | 110 | 28.24 | 40.06 | 2.27 | 47.06 |
| 15 | 16 | 150 | 210 | 110 | 1.08 | 12.10 | 0.69 | 5.13 |
| 15 | 17 | 150 | 200 | 110 | 3.04 | 21.76 | 1.23 | 15.20 |
| 17 | 18 | 150 | 140 | 110 | 0.74 | 12.26 | 0.69 | 5.26 |
| 18 | 19 | 200 | 480 | 110 | -41.02 | -117.84 | -3.75 | -85.46 |
| 19 | 12 | 200 | 140 | 110 | -11.96 | -117.84 | -3.75 | -85.46 |
| 18 | 20 | 200 | 860 | 110 | 68.45 | 113.40 | 3.61 | 79.60 |
| 20 | 21 | 200 | 300 | 110 | 6.01 | 53.84 | 1.71 | 20.04 |
| 21 | 22 | 150 | 400 | 110 | 2.31 | 12.90 | 0.73 | 5.77 |
| 21 | 23 | 200 | 330 | 110 | 2.98 | 35.04 | 1.12 | 9.04 |
| 23 | 24 | 200 | 270 | 110 | 4.91 | 51.10 | 1.63 | 18.19 |
| 24 | 25 | 225 | 360 | 110 | 1.62 | 32.80 | 0.83 | 4.51 |
| 25 | 26 | 150 | 510 | 110 | 3.47 | 14.10 | 0.80 | 6.80 |
| 25 | 27 | 150 | 330 | 110 | 0.58 | 6.80 | 0.38 | 1.76 |
| 24 | 28 | 150 | 530 | 110 | 2.59 | 11.80 | 0.67 | 4.89 |
| 28 | 29 | 150 | 220 | 110 | 0.11 | 3.50 | 0.20 | 0.52 |
| 23 | 30 | 200 | 20 | 110 | -0.04 | -16.06 | -0.51 | -2.13 |
| 30 | 31 | 200 | 630 | 110 | -8.60 | -43.76 | -1.39 | -13.65 |
| 31 | 20 | 200 | 20 | 110 | -0.35 | -50.36 | -1.60 | -17.71 |
| 30 | 32 | 150 | 400 | 110 | 2.08 | 12.20 | 0.69 | 5.20 |
| z11c | 33 | 250 | 1 | 110 | 0.00 | 44.62 | 0.91 | 4.78 |
| 33 | 34 | 250 | 380 | 110 | 1.44 | 39.32 | 0.80 | 3.78 |
| 34 | 35 | 150 | 430 | 110 | 0.59 | 5.92 | 0.34 | 1.36 |
| 35 | 36 | 150 | 400 | 110 | 1.91 | 11.65 | 0.66 | 4.78 |
| 35 | z11f | 200 | 380 | 110 | -1.28 | -20.53 | -0.65 | -3.36 |
| 36 | 37 | 150 | 400 | 110 | -2.39 | -13.15 | -0.74 | -5.99 |
| 37 | 38 | 250 | 260 | 110 | -0.38 | -23.65 | -0.48 | -1.47 |
| 38 | 39 | 250 | 120 | 110 | -0.33 | -32.95 | -0.67 | -2.72 |
| 39 | z11e | 250 | 1 | 110 | -0.01 | -76.65 | -1.56 | -13.01 |
| 39 | 40 | 150 | 480 | 110 | 19.30 | 36.80 | 2.08 | 40.21 |
| 40 | 41 | 150 | 330 | 110 | 1.21 | 10.10 | 0.57 | 3.67 |
| 40 | 42 | 150 | 330 | 110 | 3.53 | 18.00 | 1.02 | 10.69 |
| 42 | 43 | 150 | 480 | 110 | 1.45 | 9.10 | 0.52 | 3.02 |
| 34 | 44 | 250 | 170 | 110 | 0.26 | 24.10 | 0.49 | 1.53 |
| 44 | 45 | 150 | 360 | 110 | 0.15 | 3.10 | 0.18 | 0.41 |
| 44 | 46 | 250 | 160 | 110 | 0.14 | 17.90 | 0.36 | 0.88 |
| 46 | 47 | 150 | 180 | 110 | 0.12 | 4.10 | 0.23 | 0.69 |
| 46 | 48 | 150 | 660 | 110 | 0.87 | 5.80 | 0.33 | 1.31 |
| 37 | 49 | 250 | 330 | 110 | 0.00 | 0.00 | 0.00 | 0.00 |

# Distribution Network Analysis for Zone 12

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z12a | -135.49 | 213.66 | 186 | 27.66 |
| z12b | -152.48 | 212.20 | 186 | 26.20 |
| z12c | -156.45 | 211.21 | 186 | 25.21 |
| z12d | -46.10 | 211.56 | 186 | 25.56 |
| z12e | -92.90 | 211.99 | 186 | 25.99 |
| z12f | -96.68 | 211.21 | 186 | 25.21 |
| 1 | 0.00 | 186.77 | 186 | 0.77 |
| 2 | 4.80 | 174.64 | 186 | -11.36 |
| 3 | 20.50 | 164.70 | 186 | -21.30 |
| 4 | 28.00 | 165.95 | 186 | -20.05 |
| 5 | 14.40 | 184.65 | 186 | -1.35 |
| 6 | 15.90 | 202.90 | 186 | 16.90 |
| 7 | 2.50 | 166.60 | 186 | -19.40 |
| 8 | 4.90 | 176.24 | 186 | -9.76 |
| 9 | 7.80 | 185.69 | 186 | -0.31 |
| 10 | 9.90 | 188.49 | 186 | 2.49 |
| 11 | 9.40 | 165.57 | 186 | -20.43 |
| 12 | 16.20 | 165.49 | 186 | -20.51 |
| 13 | 11.40 | 161.81 | 186 | -24.19 |
| 14 | 13.30 | 161.76 | 186 | -24.24 |
| 15 | 15.30 | 159.23 | 186 | -26.77 |
| 16 | 5.40 | 161.23 | 186 | -24.77 |
| 17 | 6.70 | 113.70 | 186 | -72.30 |
| 18 | 14.50 | 109.23 | 186 | -76.77 |
| 19 | 5.80 | 105.58 | 186 | -80.42 |
| 20 | 24.40 | 103.03 | 186 | -82.97 |
| 21 | 7.60 | 100.02 | 186 | -85.98 |
| 22 | 18.80 | 98.95 | 186 | -87.05 |
| 23 | 8.60 | 99.93 | 186 | -86.07 |
| 24 | 2.00 | 102.60 | 186 | -83.40 |
| 25 | 2.00 | 104.53 | 186 | -81.47 |
| 26 | 6.80 | 107.87 | 186 | -78.13 |
| 27 | 5.10 | 95.88 | 186 | -90.12 |
| 28 | 11.60 | 95.26 | 186 | -90.74 |
| 29 | 5.90 | 99.28 | 186 | -86.72 |
| 30 | 23.90 | 159.13 | 186 | -26.87 |
| 31 | 13.60 | 142.21 | 186 | -43.79 |
| 32 | 8.60 | 111.77 | 186 | -74.23 |
| 33 | 14.00 | 101.90 | 186 | -84.10 |
| 34 | 12.90 | 100.71 | 186 | -85.29 |
| 35 | 3.40 | 100.66 | 186 | -85.34 |
| 36 | 5.10 | 100.69 | 186 | -85.31 |
| 37 | 24.00 | 101.51 | 186 | -84.49 |
| 38 | 26.10 | 100.35 | 186 | -85.65 |
| 39 | 3.30 | 158.83 | 186 | -27.17 |
| 40 | 25.40 | 189.44 | 186 | 3.44 |
| 41 | 16.70 | 183.38 | 186 | -2.62 |
| 42 | 0.00 | 210.04 | 186 | 24.04 |
| 43 | 14.40 | 208.47 | 186 | 22.47 |
| 44 | 9.70 | 207.20 | 186 | 21.20 |
| 45 | 7.80 | 207.38 | 186 | 21.38 |
| 46 | 10.70 | 208.72 | 186 | 22.72 |
| 47 | 1.70 | 207.09 | 186 | 21.09 |
| 48 | 1.80 | 207.05 | 186 | 21.05 |
| 49 | 3.00 | 211.92 | 186 | 25.92 |
| 50 | 15.00 | 210.94 | 186 | 24.94 |
| 51 | 3.40 | 210.82 | 186 | 24.82 |
| 52 | 13.60 | 208.34 | 186 | 22.34 |
| 53 | 7.90 | 205.59 | 186 | 19.59 |
| 54 | 10.70 | 195.45 | 186 | 9.45 |
| 55 | 4.40 | 203.30 | 186 | 17.30 |
| 56 | 3.10 | 202.98 | 186 | 16.98 |
| 57 | 3.10 | 202.29 | 186 | 16.29 |
| 58 | 1.60 | 202.23 | 186 | 16.23 |
| 59 | 1.60 | 202.21 | 186 | 16.21 |
| 60 | 24.60 | 211.19 | 186 | 25.19 |
| 61 | 20.60 | 207.36 | 186 | 21.36 |
| 62 | 8.90 | 205.97 | 186 | 19.97 |
| 63 | 15.00 | 198.15 | 186 | 12.15 |
| 121 | 10.50 | 211.18 | 186 | 25.18 |
| 141 | 10.50 | 211.98 | 186 | 25.98 |

**Pipeline Data -DZ12.1**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z12a | 1 | 250 | 720 | 110 | 26.89 | 135.49 | 2.76 | 37.35 |
| 1 | 2 | 250 | 600 | 110 | 12.13 | 97.26 | 1.98 | 20.21 |
| 2 | 3 | 250 | 540 | 110 | 9.94 | 92.46 | 1.88 | 18.40 |
| 3 | 4 | 150 | 610 | 110 | -1.25 | -7.38 | -0.42 | -2.05 |
| 4 | 5 | 150 | 500 | 110 | -18.70 | -35.38 | -2.00 | -37.40 |
| 5 | 6 | 200 | 340 | 110 | -18.25 | -91.64 | -2.92 | -53.67 |
| 6 | 121 | 250 | 340 | 110 | -8.28 | -107.54 | -2.19 | -24.35 |
| z12c | 121 | 250 | 1 | 110 | 0.03 | 118.04 | 2.41 | 28.94 |
| 3 | 7 | 300 | 240 | 110 | -1.90 | -94.61 | -1.34 | -7.90 |
| 7 | 8 | 250 | 330 | 110 | -9.64 | -118.68 | -2.42 | -29.22 |
| 8 | 9 | 250 | 300 | 110 | -9.45 | -123.58 | -2.52 | -31.50 |
| 9 | 10 | 250 | 150 | 110 | -2.80 | -93.16 | -1.90 | -18.66 |
| 9 | 1 | 250 | 300 | 110 | -1.08 | -38.23 | -0.78 | -3.59 |
| 10 | z12b | 250 | 510 | 110 | -23.71 | -152.48 | -3.11 | -46.49 |
| 10 | 11 | 150 | 330 | 110 | 22.92 | 49.43 | 2.80 | 69.46 |
| 11 | 12 | 200 | 150 | 110 | 0.08 | 7.40 | 0.24 | 0.51 |
| 12 | 7 | 200 | 300 | 110 | -1.11 | -21.57 | -0.69 | -3.69 |
| 12 | 13 | 150 | 650 | 110 | 3.68 | 12.77 | 0.72 | 5.67 |
| 13 | 14 | 150 | 490 | 110 | 0.04 | 1.37 | 0.08 | 0.09 |
| 14 | 11 | 200 | 480 | 110 | -3.81 | -32.63 | -1.04 | -7.93 |
| 14 | 15 | 150 | 320 | 110 | 2.53 | 15.30 | 0.87 | 7.92 |
| 14 | 16 | 150 | 460 | 110 | 0.53 | 5.40 | 0.31 | 1.15 |
| 3 | 17 | 200 | 290 | 110 | 51.01 | 173.95 | 5.54 | 175.88 |
| 17 | 18 | 300 | 270 | 110 | 4.47 | 140.96 | 2.00 | 16.54 |
| 18 | 19 | 300 | 270 | 110 | 3.65 | 126.46 | 1.79 | 13.53 |
| 19 | 20 | 300 | 270 | 110 | 2.55 | 104.07 | 1.47 | 9.43 |
| 20 | 21 | 200 | 600 | 110 | 3.02 | 25.52 | 0.81 | 5.03 |
| 21 | 22 | 150 | 210 | 110 | 1.06 | 12.02 | 0.68 | 5.06 |
| 22 | 23 | 150 | 540 | 110 | -0.97 | -6.89 | -0.39 | -1.81 |
| 23 | 24 | 150 | 330 | 110 | -2.67 | -15.49 | -0.88 | -8.10 |
| 24 | 25 | 150 | 190 | 110 | -1.93 | -17.49 | -0.99 | -10.14 |
| 25 | 26 | 150 | 270 | 110 | -3.35 | -19.49 | -1.10 | -12.39 |
| 26 | 17 | 150 | 270 | 110 | -5.82 | -26.29 | -1.49 | -21.57 |
| 22 | 19 | 150 | 720 | 110 | -6.63 | -16.60 | -0.94 | -9.20 |
| 22 | 27 | 150 | 330 | 110 | 3.07 | 16.70 | 0.95 | 9.31 |
| 27 | 28 | 150 | 130 | 110 | 0.62 | 11.60 | 0.66 | 4.74 |
| 21 | 29 | 150 | 540 | 110 | 0.73 | 5.90 | 0.33 | 1.36 |
| 30 | 31 | 150 | 210 | 110 | 16.92 | 53.55 | 3.03 | 80.57 |
| 31 | 32 | 150 | 650 | 110 | 30.44 | 39.95 | 2.26 | 46.83 |

**Pipeline Data -DZ12.2**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| 32 | 33 | 150 | 330 | 110 | 9.87 | 31.35 | 1.77 | 29.89 |
| 33 | 34 | 150 | 450 | 110 | 1.20 | 8.49 | 0.48 | 2.66 |
| 34 | 35 | 150 | 330 | 110 | 0.05 | 1.81 | 0.10 | 0.15 |
| 35 | 36 | 150 | 330 | 110 | -0.04 | -1.59 | -0.09 | -0.12 |
| 36 | 37 | 150 | 480 | 110 | -0.82 | -6.69 | -0.38 | -1.71 |
| 37 | 38 | 200 | 480 | 110 | 1.17 | 17.24 | 0.55 | 2.43 |
| 37 | 34 | 150 | 540 | 110 | 0.81 | 6.23 | 0.35 | 1.50 |
| 37 | 20 | 300 | 540 | 110 | -1.52 | -54.15 | -0.77 | -2.81 |
| 33 | 38 | 150 | 540 | 110 | 1.56 | 8.86 | 0.50 | 2.88 |
| 5 | 30 | 150 | 500 | 110 | 25.53 | 41.85 | 2.37 | 51.05 |
| 30 | 39 | 150 | 650 | 110 | 0.30 | 3.30 | 0.19 | 0.46 |
| z12c | 40 | 150 | 500 | 110 | 21.77 | 38.41 | 2.17 | 43.55 |
| 40 | 30 | 150 | 680 | 110 | 30.31 | 38.90 | 2.20 | 44.57 |
| 40 | 41 | 150 | 650 | 110 | 6.05 | 16.70 | 0.95 | 9.31 |
| z12d | 42 | 250 | 300 | 110 | 1.52 | 46.10 | 0.94 | 5.07 |
| 42 | 43 | 200 | 330 | 110 | 1.57 | 24.76 | 0.79 | 4.76 |
| 43 | 44 | 150 | 330 | 110 | 1.27 | 10.36 | 0.59 | 3.84 |
| 44 | 45 | 150 | 520 | 110 | -0.18 | -2.84 | -0.16 | -0.35 |
| 45 | 46 | 150 | 330 | 110 | -1.33 | -10.64 | -0.60 | -4.04 |
| 46 | 42 | 150 | 90 | 110 | -1.32 | -21.34 | -1.21 | -14.67 |
| 44 | 47 | 150 | 210 | 110 | 0.11 | 3.50 | 0.20 | 0.52 |
| 47 | 48 | 150 | 300 | 110 | 0.05 | 1.80 | 0.10 | 0.15 |
| z12e | 141 | 300 | 1 | 110 | 0.01 | 92.90 | 1.31 | 7.64 |
| 141 | 49 | 300 | 180 | 110 | 0.07 | 18.00 | 0.25 | 0.37 |
| 49 | 50 | 200 | 520 | 110 | 0.98 | 15.00 | 0.48 | 1.88 |
| 141 | 51 | 300 | 300 | 110 | 1.16 | 64.40 | 0.91 | 3.88 |
| 51 | 52 | 150 | 390 | 110 | 2.48 | 13.60 | 0.77 | 6.37 |
| 51 | 53 | 200 | 330 | 110 | 5.23 | 47.40 | 1.51 | 15.83 |
| 53 | 63 | 150 | 360 | 110 | 7.45 | 25.70 | 1.46 | 20.69 |
| 63 | 54 | 150 | 660 | 110 | 2.70 | 10.70 | 0.61 | 4.08 |
| 53 | 55 | 150 | 350 | 110 | 2.29 | 13.80 | 0.78 | 6.54 |
| 55 | 56 | 150 | 100 | 110 | 0.32 | 9.40 | 0.53 | 3.21 |
| 56 | 57 | 150 | 450 | 110 | 0.69 | 6.30 | 0.36 | 1.53 |
| 57 | 58 | 150 | 150 | 110 | 0.07 | 3.20 | 0.18 | 0.44 |
| 58 | 59 | 150 | 190 | 110 | 0.02 | 1.60 | 0.09 | 0.12 |
| z12f | 60 | 250 | 1 | 110 | 0.02 | 96.68 | 1.97 | 20.00 |
| 60 | 61 | 250 | 330 | 110 | 3.83 | 72.08 | 1.47 | 11.61 |
| 61 | 62 | 150 | 480 | 110 | 1.39 | 8.90 | 0.50 | 2.90 |
| 61 | 40 | 150 | 340 | 110 | 17.92 | 42.58 | 2.41 | 52.72 |

# Distribution Network Analysis for Zone 13

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z13a | -166.50 | 225.67 | 184 | 40.10 |
| 101 | 10.90 | 225.65 | 184 | 40.08 |
| 1 | 0.00 | 224.28 | 184 | 38.71 |
| 2 | 19.10 | 223.26 | 184 | 37.69 |
| 3 | 10.20 | 220.83 | 184 | 35.26 |
| 4 | 10.20 | 220.46 | 184 | 34.89 |
| 5 | 13.10 | 218.92 | 184 | 33.35 |
| 6 | 8.80 | 216.90 | 184 | 31.33 |
| 7 | 3.30 | 216.90 | 184 | 31.33 |
| 8 | 6.70 | 213.17 | 188 | 23.60 |
| 9 | 2.00 | 213.09 | 184 | 27.52 |
| 10 | 4.30 | 213.02 | 184 | 27.45 |
| 11 | 2.10 | 212.99 | 184 | 27.42 |
| 12 | 1.40 | 213.06 | 184 | 27.49 |
| 13 | 6.40 | 213.06 | 184 | 27.49 |
| 14 | 1.90 | 215.14 | 184 | 29.57 |
| 15 | 3.90 | 216.26 | 184 | 30.69 |
| 16 | 7.00 | 217.32 | 184 | 31.75 |
| 17 | 4.00 | 218.16 | 184 | 32.59 |
| 18 | 2.20 | 216.86 | 184 | 31.29 |
| 19 | 13.10 | 209.51 | 184 | 23.94 |
| 20 | 10.70 | 208.33 | 184 | 22.76 |
| 21 | 5.60 | 208.35 | 184 | 22.78 |
| 22 | 2.60 | 208.65 | 184 | 23.08 |
| 23 | 6.10 | 207.91 | 184 | 22.34 |
| 24 | 10.90 | 211.34 | 184 | 25.77 |

**Pipeline Data**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z13a | 101 | 300 | 1 | 110 | 0.02 | 166.50 | 2.36 | 22.52 |
| 101 | 1 | 250 | 360 | 110 | 1.37 | 39.50 | 0.81 | 3.81 |
| 1 | 2 | 200 | 90 | 110 | 1.02 | 39.50 | 1.26 | 11.29 |
| 2 | 3 | 150 | 180 | 110 | 2.43 | 20.40 | 1.15 | 13.48 |
| 3 | 4 | 200 | 400 | 110 | 0.37 | 10.20 | 0.32 | 0.92 |
| 101 | 5 | 300 | 700 | 110 | 6.73 | 105.20 | 1.49 | 9.61 |
| 5 | 6 | 150 | 420 | 110 | 2.02 | 11.69 | 0.66 | 4.81 |
| 6 | 7 | 150 | 130 | 110 | 0.00 | 0.69 | 0.04 | 0.03 |
| 6 | 18 | 150 | 180 | 110 | 0.04 | 2.20 | 0.12 | 0.22 |
| 7 | 8 | 150 | 400 | 110 | 3.73 | 16.71 | 0.95 | 9.32 |
| 8 | 9 | 150 | 140 | 110 | 0.08 | 3.74 | 0.21 | 0.58 |
| 9 | 10 | 150 | 460 | 110 | 0.07 | 1.74 | 0.10 | 0.14 |
| 10 | 11 | 150 | 140 | 110 | 0.03 | 2.12 | 0.12 | 0.20 |
| 11 | 12 | 250 | 20 | 110 | -0.07 | -38.08 | -0.78 | -3.56 |
| 12 | 13 | 250 | 100 | 110 | 0.01 | 4.82 | 0.10 | 0.08 |
| 13 | 10 | 200 | 160 | 110 | 0.03 | 4.68 | 0.15 | 0.22 |
| 13 | 8 | 200 | 300 | 110 | -0.11 | -6.27 | -0.20 | -0.37 |
| 12 | 14 | 250 | 440 | 110 | -2.07 | -44.29 | -0.90 | -4.71 |
| 14 | 15 | 250 | 220 | 110 | -1.12 | -46.19 | -0.94 | -5.09 |
| 15 | 16 | 250 | 180 | 110 | -1.06 | -50.09 | -1.02 | -5.91 |
| 16 | 17 | 300 | 270 | 110 | -0.84 | -57.09 | -0.81 | -3.10 |
| 17 | 7 | 200 | 420 | 110 | 1.26 | 19.32 | 0.62 | 3.00 |
| 17 | 5 | 300 | 130 | 110 | -0.76 | -80.41 | -1.14 | -5.85 |
| 11 | 19 | 200 | 330 | 110 | 3.49 | 38.10 | 1.21 | 10.56 |
| 19 | 20 | 150 | 140 | 110 | 1.18 | 15.81 | 0.90 | 8.41 |
| 20 | 21 | 150 | 350 | 110 | -0.02 | -0.99 | -0.06 | -0.05 |
| 21 | 22 | 150 | 180 | 110 | -0.30 | -6.59 | -0.37 | -1.66 |
| 22 | 19 | 150 | 280 | 110 | -0.86 | -9.19 | -0.52 | -3.08 |
| 20 | 23 | 150 | 290 | 110 | 0.42 | 6.10 | 0.35 | 1.44 |
| 101 | 24 | 100 | 470 | 110 | 14.30 | 10.90 | 1.39 | 30.43 |

# Distribution Network Analysis for Zone 14

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z14a | -93.80 | 229.97 | 185 | 44.97 |
| 1 | 5.50 | 227.64 | 185 | 42.64 |
| 2 | 14.70 | 223.74 | 185 | 38.74 |
| 3 | 20.50 | 221.91 | 185 | 36.91 |
| 4 | 6.90 | 203.82 | 185 | 18.82 |
| 5 | 5.00 | 203.00 | 185 | 18.00 |

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| 6 | 2.20 | 202.92 | 185 | 17.92 |
| 7 | 7.00 | 198.33 | 185 | 13.33 |
| 8 | 7.40 | 191.60 | 185 | 6.60 |
| 9 | 2.50 | 191.48 | 185 | 6.48 |
| 10 | 14.80 | 189.97 | 185 | 4.97 |
| 11 | 7.30 | 221.02 | 185 | 36.02 |

**Pipeline Data**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z14a | 1 | 300 | 300 | 110 | 2.33 | 93.80 | 1.33 | 7.78 |
| 1 | 2 | 300 | 560 | 110 | 3.89 | 88.30 | 1.25 | 6.95 |
| 2 | 3 | 300 | 370 | 110 | 1.84 | 73.60 | 1.04 | 4.96 |
| 3 | 4 | 150 | 300 | 110 | 18.09 | 45.80 | 2.59 | 60.29 |
| 4 | 5 | 150 | 420 | 110 | 0.82 | 7.20 | 0.41 | 1.96 |
| 5 | 6 | 150 | 330 | 110 | 0.07 | 2.20 | 0.12 | 0.22 |
| 4 | 7 | 150 | 180 | 110 | 5.49 | 31.70 | 1.79 | 30.50 |
| 7 | 8 | 150 | 350 | 110 | 6.73 | 24.70 | 1.40 | 19.22 |
| 8 | 9 | 150 | 450 | 110 | 0.12 | 2.50 | 0.14 | 0.28 |
| 8 | 10 | 150 | 220 | 110 | 1.64 | 14.80 | 0.84 | 7.44 |
| 3 | 11 | 150 | 440 | 110 | 0.88 | 7.30 | 0.41 | 2.01 |

# Distribution Network Analysis for Zone 15-1
# (Arterial System)

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z15a | -179.00 | 225.86 | 185 | 40.86 |
| 1 | 8.20 | 225.80 | 185 | 40.80 |
| 2 | 0.00 | 224.77 | 185 | 39.77 |
| 3 | 13.10 | 220.60 | 185 | 35.60 |
| 4 | 5.70 | 220.22 | 185 | 35.22 |
| 5 | 8.30 | 198.08 | 185 | 13.08 |
| 6 | 0.00 | 188.51 | 185 | 3.51 |
| 7 | 5.30 | 166.91 | 185 | -18.09 |
| 8 | 9.50 | 155.51 | 185 | -29.49 |
| 9 | 12.10 | 152.85 | 185 | -32.15 |
| 10 | 0.00 | 156.75 | 185 | -28.25 |
| 11 | 6.10 | 117.05 | 185 | -67.95 |
| 12 | 8.80 | 108.83 | 185 | -76.17 |
| 13 | 9.70 | 104.20 | 185 | -80.80 |
| 14 | 7.40 | 83.04 | 185 | -101.96 |
| 15 | 4.10 | 66.31 | 185 | -118.69 |
| 16 | 7.80 | 59.14 | 185 | -125.86 |
| 17 | 10.00 | 56.71 | 185 | -128.29 |
| 18 | 16.50 | 56.92 | 185 | -128.08 |
| 19 | 7.70 | 58.31 | 185 | -126.69 |
| 20 | 4.10 | 59.23 | 185 | -125.77 |
| 21 | 0.00 | 56.00 | 185 | -129.00 |
| 22 | 21.60 | 53.30 | 185 | -131.70 |
| 23 | 13.00 | 54.07 | 185 | -130.93 |

**Pipeline Data**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z15a | 1 | 250 | 1 | 110 | 0.06 | 179.00 | 3.65 | 62.57 |
| 1 | 2 | 200 | 360 | 110 | 1.03 | 18.80 | 0.60 | 2.86 |
| 2 | 3 | 150 | 360 | 110 | 4.17 | 18.80 | 1.06 | 11.59 |
| 3 | 4 | 150 | 300 | 110 | 0.38 | 5.70 | 0.32 | 1.27 |
| 1 | 5 | 250 | 600 | 110 | 27.71 | 152.00 | 3.10 | 46.19 |
| 5 | 6 | 250 | 230 | 110 | 9.57 | 143.70 | 2.93 | 41.63 |
| 6 | 7 | 150 | 960 | 110 | 21.60 | 26.90 | 1.52 | 22.50 |
| 7 | 8 | 150 | 760 | 110 | 11.39 | 21.60 | 1.22 | 14.99 |
| 8 | 9 | 150 | 520 | 110 | 2.67 | 12.10 | 0.69 | 5.13 |
| 6 | 10 | 250 | 1120 | 110 | 31.76 | 116.80 | 2.38 | 28.36 |
| 10 | 11 | 250 | 1400 | 110 | 39.70 | 116.80 | 2.38 | 28.36 |
| 11 | 12 | 250 | 320 | 110 | 8.22 | 110.70 | 2.26 | 25.68 |
| 12 | 13 | 250 | 210 | 110 | 4.63 | 101.90 | 2.08 | 22.03 |
| 13 | 14 | 200 | 390 | 110 | 21.16 | 92.20 | 2.94 | 54.26 |
| 14 | 15 | 200 | 360 | 110 | 16.73 | 84.80 | 2.70 | 46.47 |
| 15 | 16 | 200 | 660 | 110 | 7.17 | 38.69 | 1.23 | 10.87 |
| 16 | 17 | 200 | 340 | 110 | 2.44 | 30.89 | 0.98 | 7.16 |
| 17 | 18 | 250 | 400 | 110 | -0.21 | -13.71 | -0.28 | -0.54 |
| 18 | 19 | 250 | 600 | 110 | -1.39 | -30.21 | -0.62 | -2.32 |
| 19 | 20 | 250 | 260 | 110 | -0.92 | -37.91 | -0.77 | -3.53 |
| 20 | 15 | 200 | 560 | 110 | -7.09 | -42.01 | -1.34 | -12.65 |
| 17 | 21 | 200 | 80 | 110 | 0.71 | 34.60 | 1.10 | 8.84 |
| 21 | 22 | 150 | 180 | 110 | 2.70 | 21.60 | 1.22 | 14.99 |
| 21 | 23 | 150 | 330 | 110 | 1.93 | 13.00 | 0.74 | 5.85 |

# Distribution Network Analysis for Zone 15-2
# (Millat Town WTP System)

**Node Data**

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| z15b | -69.10 | 220.60 | 185.00 | 35.60 |
| 24 | 12.70 | 220.07 | 185.00 | 35.07 |
| 25 | 21.90 | 219.73 | 185.00 | 34.73 |
| 26 | 9.60 | 219.60 | 185.00 | 34.60 |

| Node No. | Discharge l/s | WL m | GL m | Eff. Head m |
|---|---|---|---|---|
| 27 | 12.70 | 216.26 | 185.00 | 31.26 |
| 18 | 6.10 | 219.53 | 185.00 | 34.53 |
| 20 | 6.10 | 219.53 | 185.00 | 34.53 |
| 19 | 0.00 | 219.53 | 185.00 | 34.53 |

**Pipeline Data**

| Node Number | | Dia | Length | Friction L. | Head Loss | Flow | Velocity | H Gradient |
|---|---|---|---|---|---|---|---|---|
| Up-stream | Dn-stream | mm | m | Co-efficient | m | l/s | m/s | ‰ |
| z15b | 24 | 300 | 120 | 110 | 0.53 | 69.10 | 0.98 | 4.42 |
| 24 | 25 | 300 | 180 | 110 | 0.34 | 43.70 | 0.62 | 1.89 |
| 24 | 27 | 150 | 680 | 110 | 3.81 | 12.70 | 0.72 | 5.61 |
| 25 | 26 | 250 | 180 | 110 | 0.13 | 15.94 | 0.32 | 0.71 |
| 26 | 18 | 250 | 540 | 110 | 0.07 | 6.34 | 0.13 | 0.13 |
| 25 | 20 | 200 | 600 | 110 | 0.20 | 5.86 | 0.19 | 0.33 |
| 18 | 19 | 250 | 340 | 110 | 0.00 | 0.24 | 0.00 | 0.00 |
| 19 | 20 | 250 | 260 | 110 | 0.00 | 0.24 | 0.00 | 0.00 |

# Service Pipe Connection and Customer Water Meter Installation Manual in WASA-F

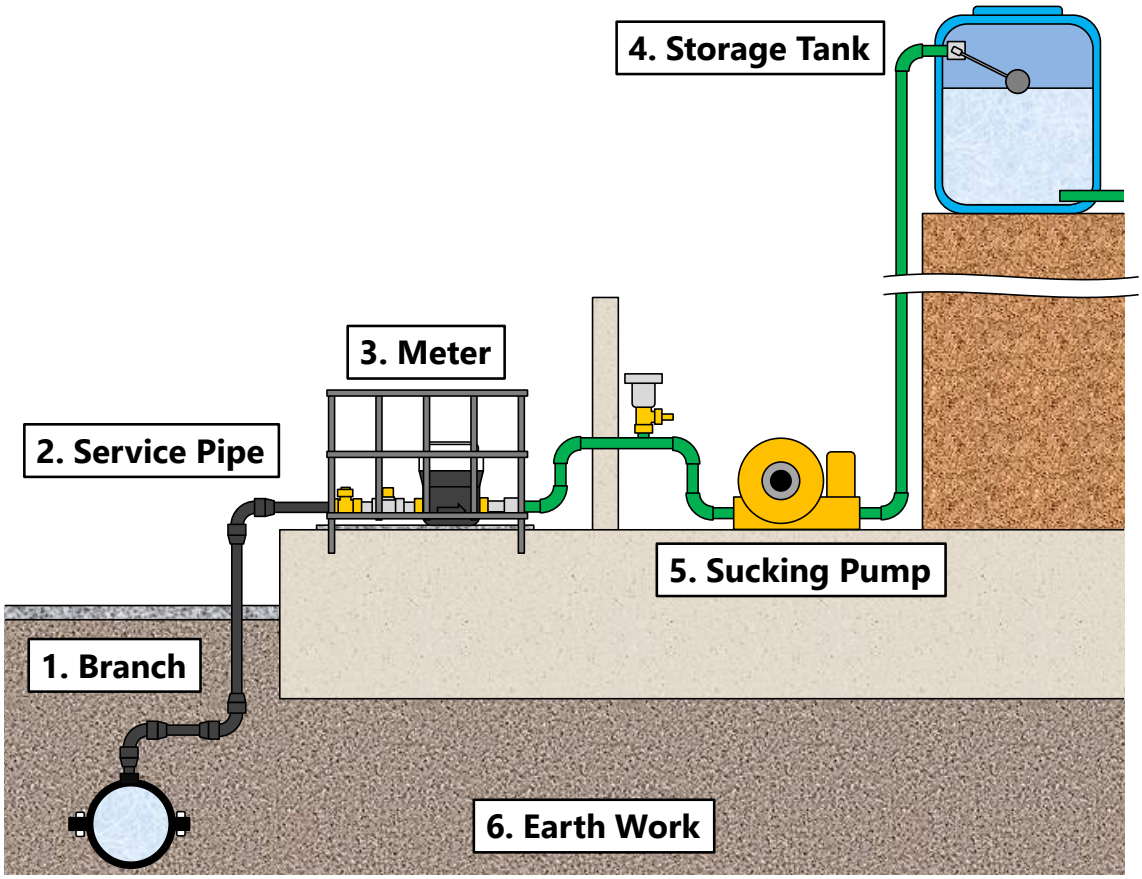
## 1. General

### (1) Scope and Applicability

This manual describes procedures for service pipe connection and water meter installation. It is possible to grasp the amount of water consumption of customer use. And sustainability is guaranteed by proper construction. This manual is applicable for the water supply area of WASA-F.

### (2) Overall figure of coverage

The following figure is a conceptual diagram from the branch distribution pipe to the customer's water property. The first letter of the name will be explained in the next section.




The definition in the above figure is described below. A to F are collectively referred to as a water supply Equipment.

1. Branch is point of branch from distribution pipe to services pipe.

2. Services pipe is water supply pipes from branch to customer tap or storage tank
3. Water meter is installed in services pipe for measure the amount of water used by customers
4. Sucking Pump is water sucking from distribution pipe and pressurizing water for supply water to house or storage tank.
5. Storage tank is installed in rooftop of customer for water storage and supply to house.
6. Earth work is excavating and buck filling for installed water supply equipment.

**(3) Principle**

A. The construction method is based on WASA-F standards.

B. The construction material is based on WASA-F standards

C. The constructor must submit a water supply construction (as-built) drawing and completion report to WASA-F later.

D. The constructor should coordinate with WASA-F when it is necessary to cut off water supply by construction.

E. WASA-F needs to supervise as necessary

F. When the constructor finds an unknown pipe or inappropriate remaining pipe at the time of construction, it reports to WASA-F.

G. The customer's water equipment must be able to withstand the specified water pressure and construction of WASA - F.

## 2. Work Flow of Installation

In order to implement water service pipe/equipment installation construction, work flow is shown below.

| | |
|---|---|
| 1. | Preparatory Work |
| | Grasp of existing situation (Site place, Road surface pavement, Private pump) |
| | Check of other enterprise pipe/canal (Gus, Telephone, Cable Network, etc.) |
| | Selection of construction method |
| | Planning of construction schedule |
| | Planning of water cut-off (if necessary) |
| 2. | Adjustment before construction |
| | Explanation to customers |
| | Negotiate with customers |
| | Application for road permission |
| 3. | Construction work |
| | Implementation of construction work by Manual and SOP |
| | Supervise by WASA-F |
| 4. | After construction work |
| | Check of completion (Meter counting, Leakage, Water pressure, Water quality) |
| | As-built drawing |
| | Completion report |
| 5. | After completion |
| | Submit completion report to WASA-F |
| | Inspection of completion by WASA-F(if necessary) |

## 3. Construction Work

### (1) Branch

In branch construction, it is necessary to pay attention to breakage of the water distribution pipe. And in order not to cause water leakage, the construction worker must properly install. During construction, the construction contractor must be particularly careful about the following.

A. New branch should be 0.3m or more away from other branches.

B. Construction of new branch must be done from directly above pipe.

C. New branch must be constructed from the straight pipe section of the distribution branch pipe.

D. New branch shall not be made from the non-straight pipe (Bend pipe or T-shape pipe) and coupling pipe.

E. The diameter of new branch pipe shall be two ranks or less of the diameter of the water distribution pipe. (Distribution pipe: 100mm → Service pipe: Less than 50mm)

**(2) Service Pipe Installation**

The water supply pipe shall be installed at an appropriate depth and position in order to avoid damage to the pipe due to the load from the road. And in the case of exposed piping, it shall be installed at a place not external damaged. During construction, the construction contractor must be particularly careful about the following.

A. When installing water service pipe under the road, it shall be buried at a depth of 30cm or more.

B. In a place where the load from the road is not applied to the water service pipe, it may be buried at a depth of 10cm or more.

C. In the case of exposed piping, the water service pipe shall be GIP.

D. For connection between water service pipes, hose pipe shall not be used.

E. For connection between PE pipe and stopcock, check valve and water meter, the socket must be used.

F. If the angle of PE pipe is less than the minimum bending radius, the bend pipe must be placed in that location. For the minimum bending radius, see Table 1.

Table-1 Minimum Bending Radius

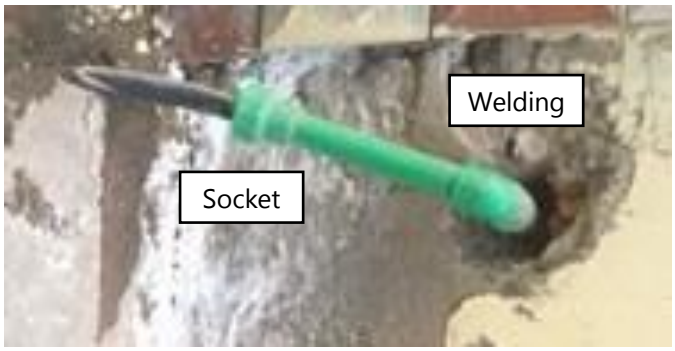
| PE Pipe Diameter | 1/2 inch 13 mm | 3/4 inch 20 mm | 1 inch 25 mm | 1 1/2 inch 40 mm | 2 inch 50 mm |
|---|---|---|---|---|---|
| 1st Grade | 45 mm | 55 mm | 70 mm | 100 mm | 120 mm |
| 2nd Grade | 65 mm | 85 mm | 105 mm | 145 mm | 180 mm |

**[Reference]**

PVC: Polyvinyl Chloride

PE: Polyethylene

GP: Galvanized Pipe

| | |
|---|---|
|  |  |
| Connection by socket and welding | Connection by hose clump |

**(3) Meter Installation**

**1) Location of Meter Installation**

Installation of the water meter shall be prescribed by WASA-F. The installation conditions shall be as follows.

A. The water meter should be place that can easily be surveyed by meter reader.

B. The water meter should be installed outside the customer premises.

C. The water meter should be installed in location that does not impede traffic.

D. The water meter should be installed on sidewalk concrete.

E. In order to ensure the precision of the water meter, it must be installed horizontally using leveling instrument.

F. Since the water meter needs to measure the total amount of water consumption of the customer used, it must be confirmed that there is no branch upstream of the its water meter.

G. Since the direction in which the water meter is installed must coincide with the direction of flowing water, the arrow on the side of the water meter body must be confirmed.

H. As a countermeasure to theft, the water meter must be stored in the iron cage water meter box. The design of the meter box is as follows.

**2) Meter Box**

In principle, the water meter box must be installed on the ground using iron grill.

A. Cage of the iron grating

Except in special cases, the water meter box must be installed using iron gratings.

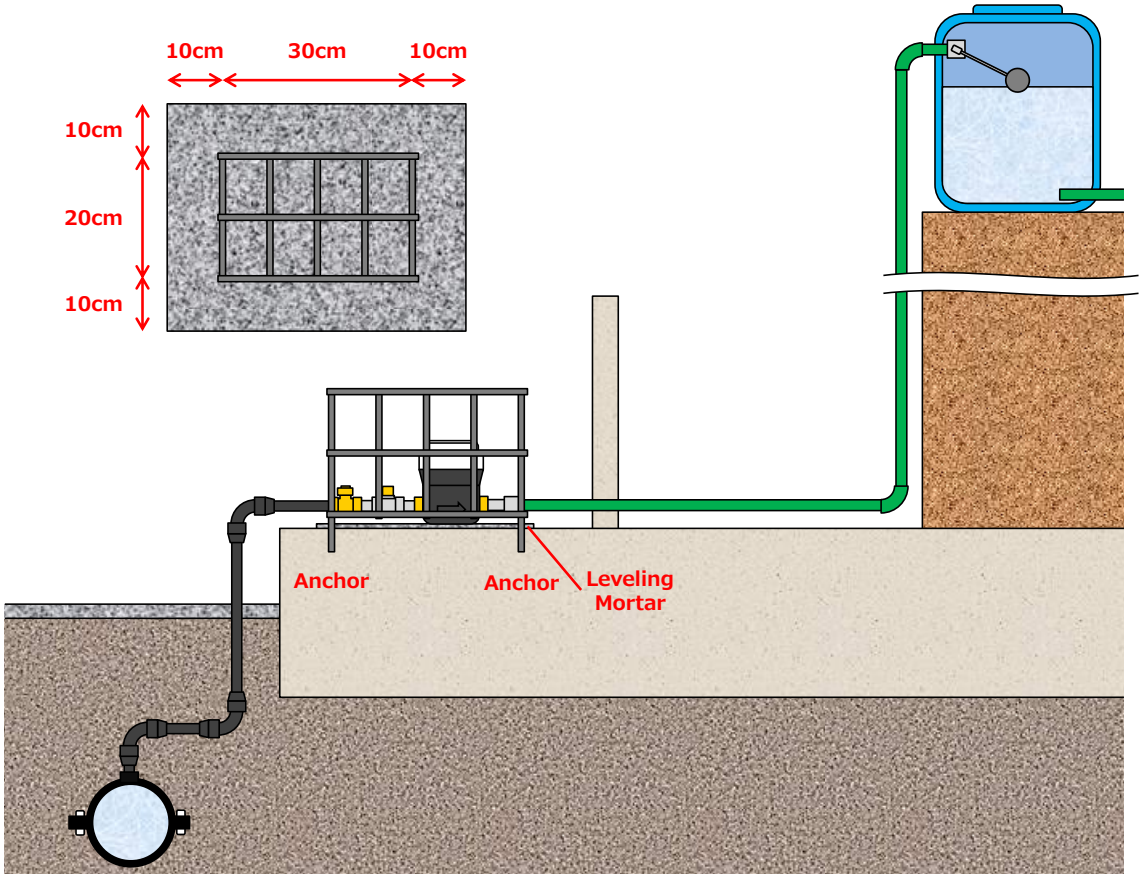
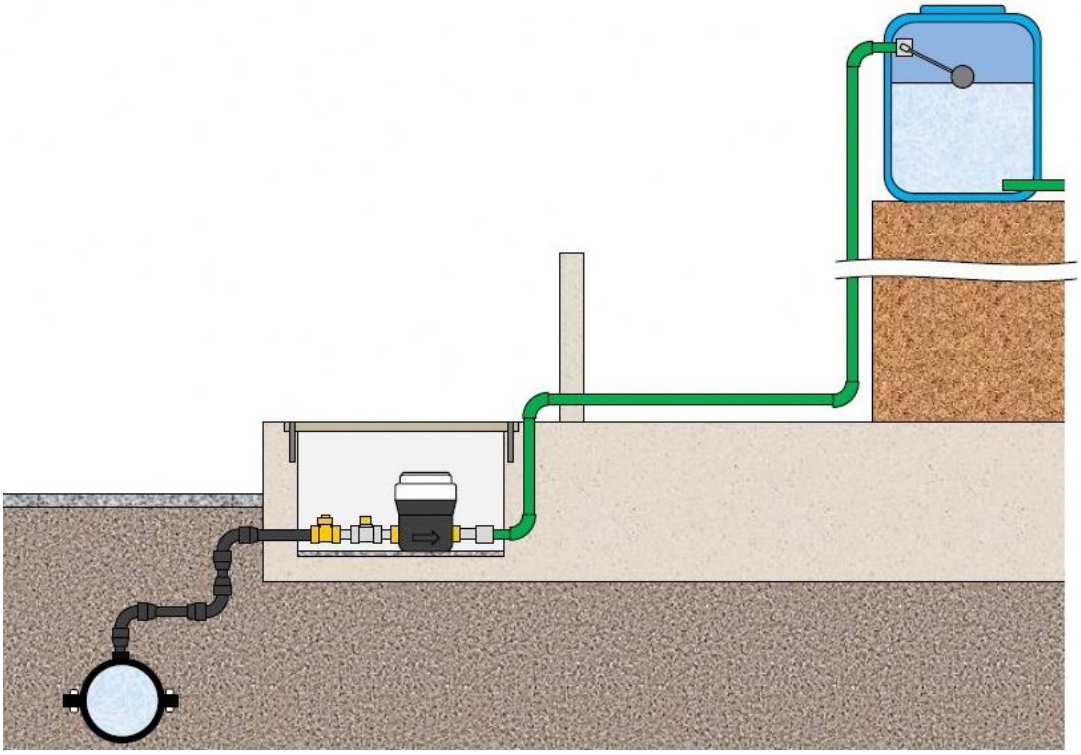



Fig. 1 Cage of Iron Grating

B. Lid type

When iron grating cannot be installed on the ground. It is a form to install at a place where the possibility of theft or external damage is high.



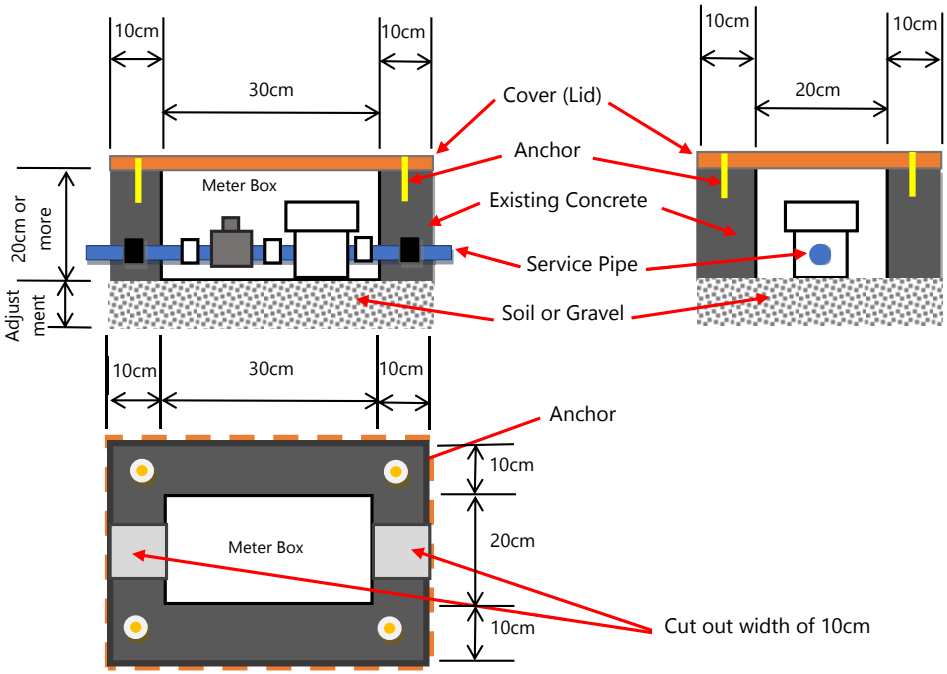
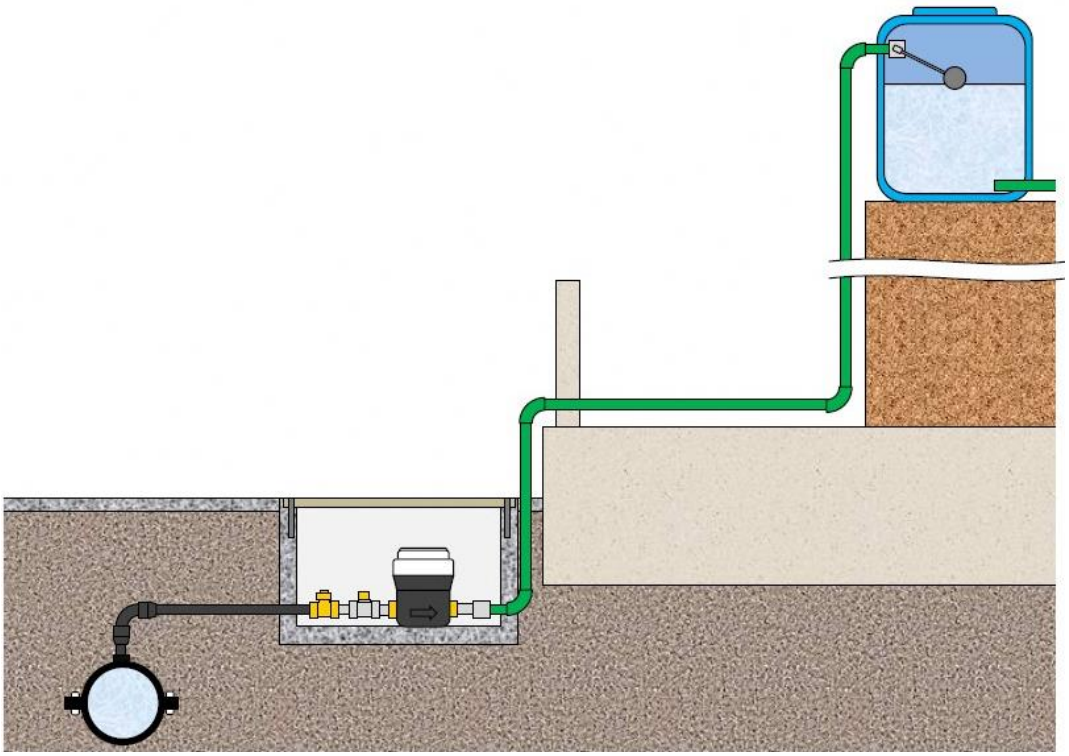



Fig. 2 Lid Type

C. Concrete Box type

This underground type should be installed where there is a high possibility of theft or external damage.



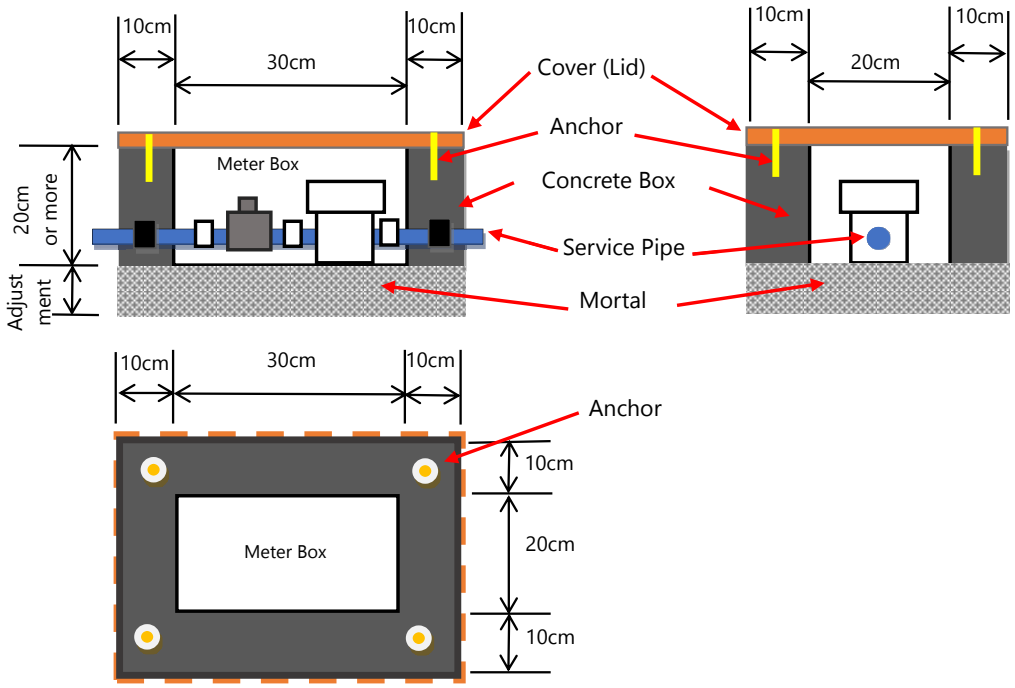



Fig. 3 Case that cannot be handled with iron grating and lid type

**3) Installation of Magnetic Valve**

When installing the meter, it is better to install the magnetic valve on the upstream side of the meter. This is used when exchanging meters or when stopping unpaid customers.

**4) Installation of Check Valve**

A. Case that new water meter is installed in existing water service pipe

Since check valve is not always installed properly when branching construction of starting of water supply, check valve should be installed upstream of the water meters.

B. Case that new water meter is installed in new water service pipe

Since check valve is installed at the branch point of the water supply, there is no need to install check valve around new water meter. In the case that water meter has the function of check valve, installation of check valve can be omitted.

**(4) Approval Materials**

Regulations on materials used are as follows

**1) Pipe and Joint/Fitting**

Pipes and joints/fittings that make up the water supply system must be used that is considered to be the most appropriate. Details are shown in Table-2.

**2) Valve (Main cock, Magnetic valve, Check valve, etc.)**

Valves that make up the water supply system must be used that is considered to be the most appropriate. Details are shown in Table-2.

**3) Water Meter**

It is based on specification of Panjab Government. Details are【Government of Punjab Housing, Urban Development & Public Health Engineering Department. / Notification No. SO (UD) 10-26/2015】

Table-2 List of material specification

| Material name | Standard | Diameter | Symbol | Remark |
|---|---|---|---|---|
| Saddle clump | | 1/2 inch | | |
| Check valve | | 1/2 inch | | |
| Magnetic valve | | 1/2 inch | | |
| Adopter | | 1/2 inch | | |
| Main cock | | 1/2 inch | | |
| Short pipe for connecting meter | | 1/2 inch | | |
| Meter | | 1/2 inch | | |
| Meter cage | | | | |
| Meter cover | | | | |
| Meter box | | | | |
| GP Pipe | | 1/2 inch | | |
| Nipple for GP pipe | | 1/2 inch | | |
| Bend pipe for GP pipe | | 1/2 inch | | |
| PVC Pipe | | 1/2 inch | | |
| Nipple for PVC Pipe | | 1/2 inch | | |
| Bend pipe for PVC pipe | | 1/2 inch | | |
| Polyethylene pipe | | 1/2 inch | | |
| Plug for Polyethylene pipe | | 1/2 inch | | |
| Collar Joint for Polyethylene pipe | | 1/2 inch | | |
| Male Joint for Polyethylene pipe | | 1/2 inch | | |
| Female Joint for Polyethylene pipe | | 1/2 inch | | |
| Bend pipe for Polyethylene pipe | | 1/2 inch | | |
| T-Pipe for Polyethylene pipe | | 1/2 inch | | |

**(5) Installation of Float Valve at Individual Tank**

Based on article 90; Wastage of Drinking Water of "WATER SUPPLY FAISALABAD REGULATIONS - 2015"; WASA-F can ask customers to install float valve at individual tank in order to prevent overflow from their tanks.

When installing new service connection or installing meter to existing service pipe, WASA-F should check whether or not the float valve is installed at their individual tank.

**(6) Removal of Illegal Sucking Pump**

Based on article 33; Pump Directly Connected of "WATER SUPPLY FAISALABAD REGULATIONS - 2015"; WASA-F can force the customers to remove the illegal sucking pumps.

When installing new service connection or installing water meter to existing service pipe, WASA-F should check whether the sucking pump is connected directly to WASA-F system or not.

If the sufficient water pressure for water to flow into the tank is secured, WASA-F orders the customer to remove their sucking pump or stop supplying water to this customer.

If the sufficient water pressure cannot be secured, WASA-F orders to the customer to install the intermediate tank or stop supplying water to this customer.

It is illegal to directly connect customers' pumps to WASA-F's water distribution system, as it may reduce the water pressure of WASA-F's water distribution system and cause foreign matter to enter the water distribution pipe. Therefore, measures to remove illegal pumps are necessary.

**(7) Earth Work**

**1) Excavation**

A. During excavation, the construction worker must be careful not to damage the surrounding structures, other enterprise pipes and existing water pipes.

B. When installing a water supply pipe, it is necessary to excavate both sides more than 10cm from pipe center.

C. When installing a water supply pipe, it is necessary to excavate 10cm downward from pipe center.

D. The surroundings of installed pipes must be backfilled with fine material from 10cm downward to 10cm above them. For example, Fine material is sand.

**2) Back filling**

A. Do not use large stones or bricks as backfilling material.

B. Do not backfill other than small gravel

**3) Road surface restoration**

A. Recovery of road surface should be restored to the state before construction as much as possible.

B. If it is difficult to restore to the above, the construction worker must consult with WASA-F and follow the results.

**(8) Inspection of service connection inside the customer's property**

Based on article 9; Inspection of Premises of "WATER SUPPLY FAISALABAD REGULATIONS - 2015"; WASA-F can enter the customer's property and inspect and test the customer's piping and equipment when new installation of service connection.

When installing new service connection, WASA-F should check the in-hoe piping whether it is suitable or not, and if not, WASA-F stop supplying water to this customer.

**1) Completion inspection**

After completion of construction, completion inspection must be carried out before backfilling. The completion inspection refers to the following.

A. Water flow inspection

It is necessary to let water flow through the installed water service pipe and check water leakage and construction failure.

B. Water quality inspection

It is necessary to sample with tap and confirm the Residual Chlorine reaction.

C. Water meter setting inspection

It is necessary to confirm whether the water meter is properly installed by the water meter setting check sheet.

**(9) Submission of As-built Drawings and Material List (Completion Report)**

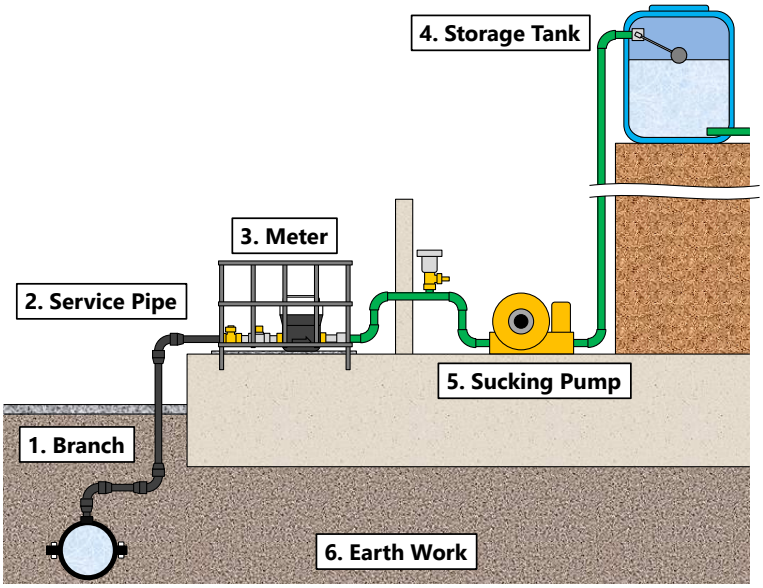
A. The construction contractor shall submit completed documents after completion of the completion inspection.

B. The format of Table 2 designated by WASA-F must be used for completed documents.

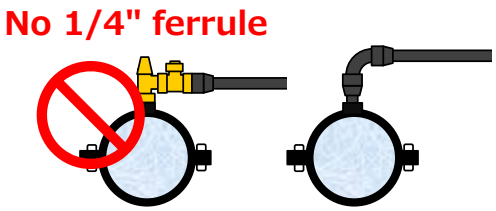
C. WASA-F supervises before and after construction, if there is doubt; WASA-F conducts construction attendance and completion inspection

# Meter Installation SOP in WASA-F

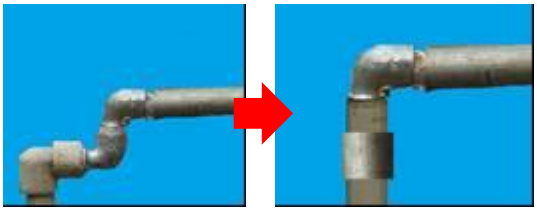
**Overall Figure of coverage**




**1. Branch**

| | |
|---|---|
|  | It should be confirmed that rubber is set at branch point. |
|  | Service connection should be branched directly from water distribution pipe by 1/2" and 90° of bent pipe is used instead of 1/4" ferrule. |

## 2. Service Pipe

| | |
|---|---|
|  | When improving existing service pipe, it is necessary to confirm that pipe comes from WASA-F's system. |
| | GI should be selected if pipe is installed above ground. If pipe is installed underground, UPVC/HDPE or non-corrosive pipe & fittings shall be used. |
|  | The pipe should be cut with suitable equipment. |
|  | The cut of the polyethylene pipe must be straight. |
|  | Use of meaningless bend pipe should be avoided. |

## 3. Meter

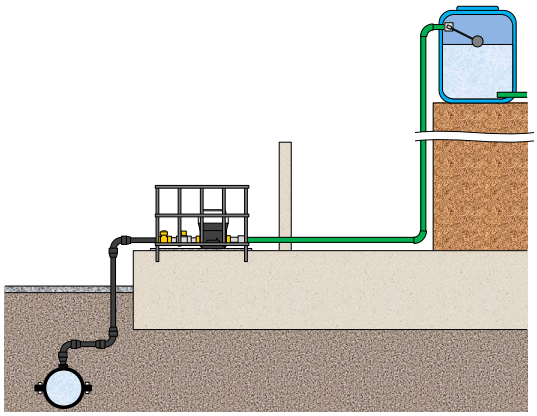
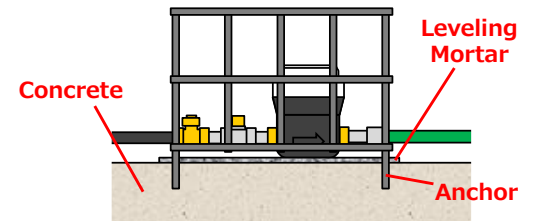
### 3-1. Location of Meter Installation

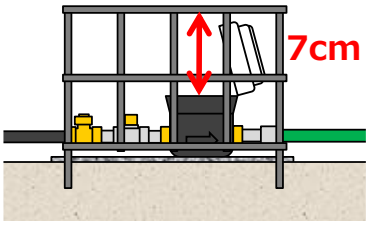
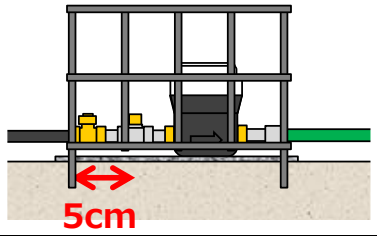
| | |
|---|---|
|  | Meter should be installed outside of customer's premises within 50cm from boundary and without vehicle load.<br>(If meter is installed inside the customer's premises, it is difficult to read the meter for meter readers because of gate lock or customer absence) |

### 3-2. Three types of meter cage for thief prevention measure of meter

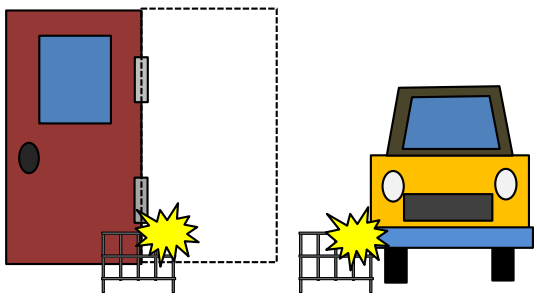
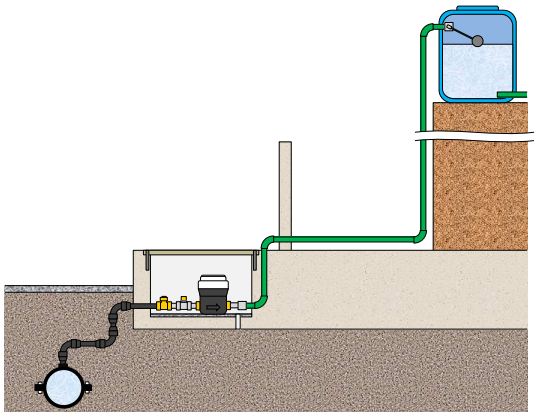
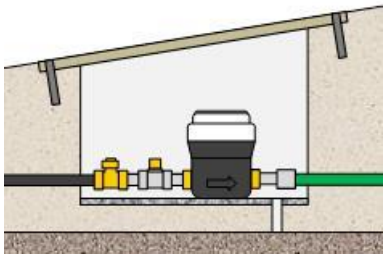
Measures to prevent theft of the meter are selected depending on the site situation, but in principle, installation of **(1) MS cage** should be adopted. Under difficult circumstances for various reasons, underground installation such as **(2) Steel lid** or **(3) Concrete Box** will be considered.

### (1) MS Cage type

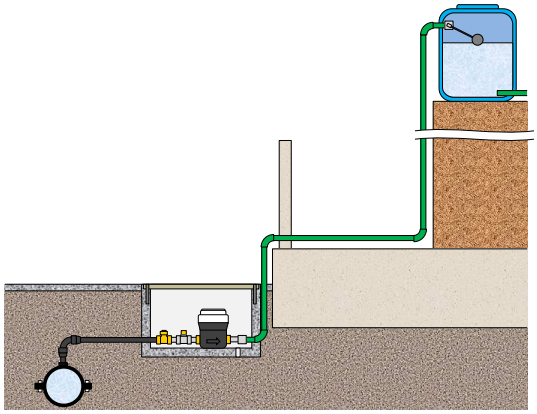
| | |
|---|---|
|  | In principle, MS cage should be selected with concrete base and meter should be installed on the ground. |
|  | MS cage should be installed as left figure. |

| | |
|---|---|
|  | For opening the meter cover, 7cm or more of interval is required at the top. At the site, meter cover should be opened and ease of meter reading should be confirmed. |
|  | For opening/closing the magnetic valve, 5cm or more of interval is required around magnetic valve. At the site, valve operation should be carried out and confirmed. |

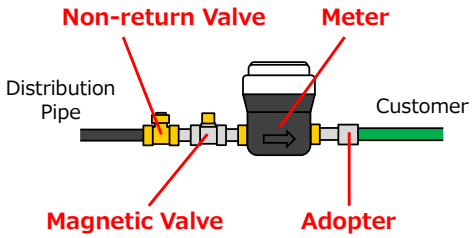
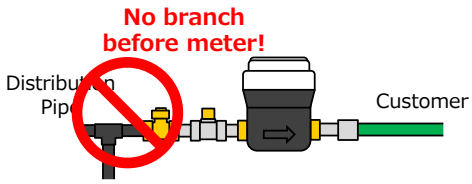
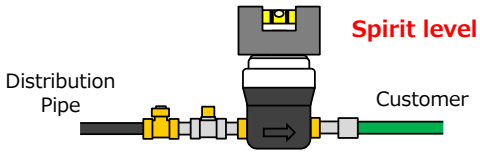
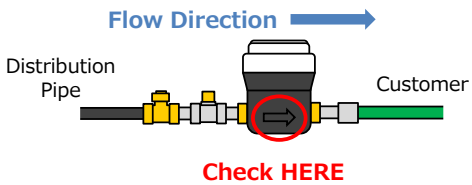
**(2) Steel lid type**

| | |
|---|---|
|  | When the cage installed on the ground interferes with the opening and closing of the door or the passage of the vehicle, or when the space cannot be secured on the ground, underground installation should be selected for thief prevention measure of meter. |
|  | If there is a concrete part where the lid can be fixed with the anchor, **(2) Steel lid type** should be selected instead of **(1) MS cage type**.<br>The meter installation place is excavated.<br>**Excavation range:**<br>Width20cm x Length30cm x Depth20cm or more.<br>Drainage function should be considered. |
|  | Even on a slope, the lid can be installed as the left figure. However, it is necessary to pay attention to the lid installation location so that the anchor does not penetrate. |

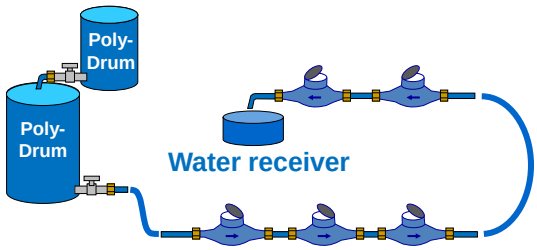
### (3) Concrete Box type

| | |
|---|---|
|  | If there is no concrete to fix the lid with anchor, **(3) Concrete Box Type** should be selected for thief prevention measure of meter instead of **(2) Steel Lid type**.<br>Drainage function should be considered.<br><br>(Installation of (1) and (2) is considered as much as possible, because (3) is expensive) |

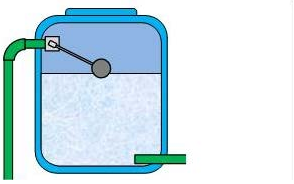
### 3-3. Basics for Meter Installation

| | |
|---|---|
|  | Piping around the meter consists of non-return valve, magnetic valve, meter and adopter. |
|  | All water consumption should be captured.<br>It is necessary to confirm that there is no water supply branch upstream of the meter. |
|  | Meter should be installed horizontally, therefore horizontal should be confirmed using spirit level etc. |
|  | It should be confirmed that the arrow on the side of the meter body with water flow direction. |

### 3-4. Reuse of existing meter

| | |
|---|---|
|  | Whether there is existing meter should be confirmed. |
|  | If customer already has existing meter, meter should be read and recorded and this value should be reported to IT section. |
|  | Removed meter should be brought the meter test yard and checked the accuracy. If meter has good accuracy, WASA-F can reuse it. |
|  | If test meter is available, you can utilize it. |

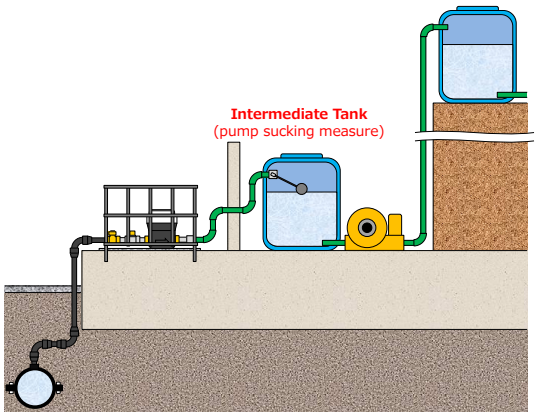
### 4. Storage Tank

| | |
|---|---|
|  | It should be confirmed whether the customer has a storage tank. If customer has tank, it should be confirmed that the float valve is installed. If not, WASA-F should instruct customer to install it. |

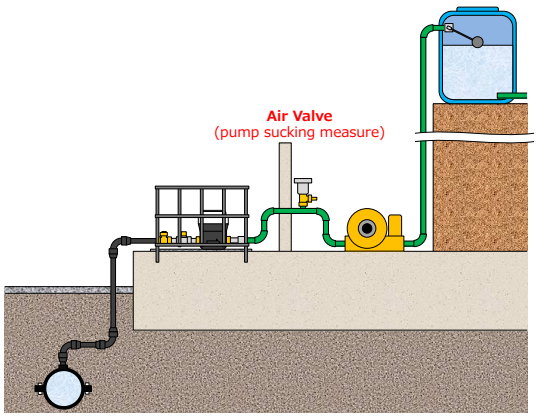
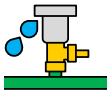
### 5. Sucking Pump

In principle, illegal sucking pump must be removed. If WASA-F cannot ensure the proper water pressure or customer denies removing it, for countermeasure of illegal pump sucking, **(1) Intermediate Tank** or **(2) Air Valve** should be installed.

#### (1) Intermediate Tank

| | |
|---|---|
|  | For one of the countermeasure of sucking pump, intermediate storage tank should be installed between meter and pump. When installing intermediate tank, float valve should be installed. |

#### (2) Air Valve

| | |
|---|---|
|  | For another countermeasure of sucking pump, air valve should be installed between meter and pump, and it should be installed at higher position than meter. |
|  | It is confirmed that water does not come out from the air valve. |

# Water Meter Installation Check Sheet

| No. | Check items | Check |
|---|---|---|
| 1 | Meter is checked for proper functioning of low-flow dial before installing it. | |
| 2 | Meter is horizontally installed with correct flow direction. | |
| 3 | Magnetic valve is installed upstream and non-return valve is installed downstream of meter with no branches upstream of meter. | |
| 4 | Illegal sucking pump is not installed*1 and there are no suspected, illegal connections around customer's premises*2. | |
| 5 | If customer has storage tank, float valve is installed*3. | |
| 6 | Proper water pressure is secured at customer's tap. | |
| 7 | Meter is easy to read and remove by WASA-F maintenance workers. | |
| 8 | Meter is not an obstacle to traffic and has theft prevention. | |

*1 If not, WASA-F should instruct and ask the customer to improve the situations (removal of pump/installation of intermediate tank/installation of air valve), and reconfirm later.

*2 If not, WASA-F should instruct and ask the customer to improve the situations (disconnect the connections) and reconfirm later.

*3 If not, WASA-F should instruct and ask the customer to improve the situations (installation of float valve) and reconfirm at later date.

Book No: _____ Meter reading date: _____

# METER READING BOOK


# WASA-F

Section: _____

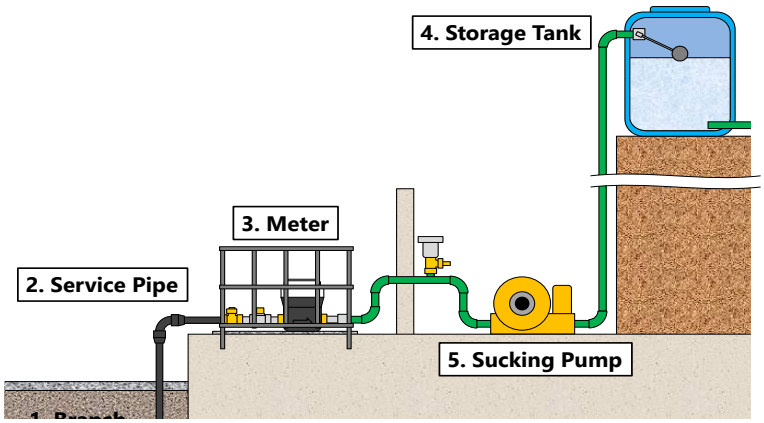
In-charge: _____

Water Distribution Area: _____

# Meter Reading and Inspection SOP for WASA-F

Apart from meter reading, the staff has three other responsibilities. The ability to understand the situation at hand is required in them.

- Inspection of a water meter.
- Discovery of a leakage or illegal connection and grasping any unique case.
- Providing means for effective conversation between WASA-F and consumers.




Meter installation scheme

## Meter Reading:

The meter reader must have a thorough understanding of water meters and meter reading book. Each page of the book belongs to one customer and only his/her data would be mentioned there every month. Staff should follow these steps:

- Check meter number and open respective page on book.
- Meter consists of 8 digits and meter reading column in book is divided in two. Black digits on meter will be recorded on left column and red digits in right column.
- Staff will inspect the meter and add remarks in “Remarks” column.
- Date will be marked in “Date” column.
- After completing meter reading of all houses in one book, reader will check the map at the end of book before handing it over to the IT section.

Meter readers need to take care of following issues when recording consumption volume as it is of substantial importance.

### 1. Inspection of water meter:

| | |
|---|---|
|  | Meter readers need to check the meter and report if the dial isn’t moving smoothly or the glass is broken. Staff should measure reading and record it precisely. Meter reading should be done after regular time intervals to ensure uniformity in data. |

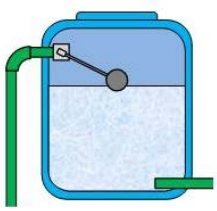
## 2. Discovering leakage/illegal or some unique case:

| | |
|---|---|
|  | When improving existing service pipe, it is necessary to confirm that pipe comes from WASA-F's system.<br>If installation is above ground, use GI pipes and use UPVC/HDPE or non-corrosive pipes underground. |

## 3. Providing means for effective conversation between WASA-F and consumers:

- Delivering new messages from WASA-F to customers door-to-door. Providing information to them about meter installation distance and proper conditions.
- Informing WASA-F and CRC in case of any complaints or requests from consumers.
- Selection of appropriate measures for preventing meter theft. If circumstances are not feasible for MS cage, adopt steel lid or concrete box.

### 3.1 Storage Tank:

| | |
|---|---|
|  | Check if the customer has storage tank present and float valve installed in it or not. If not present, instruct customer to install it. |

### 3.2 Sucking Pump:

Use of sucking pumps is prohibited because:

- Its vibrations damage the meter.
- It increases chances of water contamination.
- Pressure created reduces water supply for those who do not use sucking pump.

WASA-F needs to educate consumers about these drawbacks of sucking pumps through bills or pamphlets. If WASA-F cannot ensure the proper water pressure or customer denies removing it, then Intermediate tank or Air valve might be used as countermeasure of illegal pump sucking.

# METER READING CHECKLIST

| | | | |
|---|---|---|---|
| Parcel ID: | | Account No: | |
| Meter No: | | Connection classification: | |
| Consumer Name: | | Property area: | |
| Address: | | | |

| Reading Date | Meter Reading | Remarks | Action required |
|---|---|---|---|
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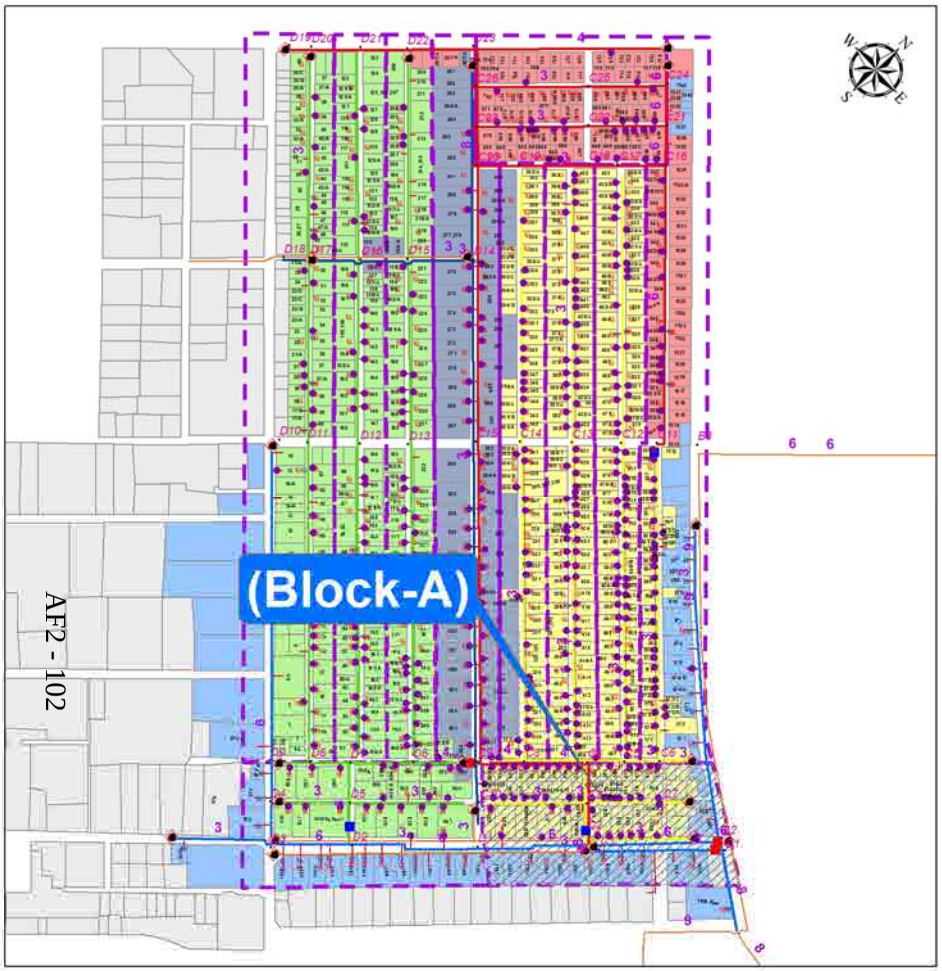
|---|---|
| Meter reader: | |

# Pilot Area Map Sarfraz Colony (Block-A)





## Legend

- Water Meter
- Reference Points
- Pipe End
- Existing Valve
- Proposed Valve
- Red Pump
- Sucking Pumps

**Water Supply Lines**

**Zones**

- Blue
- Dark Blue
- Green
- Red
- Yellow
- Water Connection

- Block_Maping

**Sarfraz Colony Zones**

- Blue (69)

- Dark Blue (81)
- Green (329)
- Red (164)
- Yellow (367)

**Block-A Zones**

- Gray 01)
- Blue 18)
- Yellow (56)