13. The Result of Water Quality Test

Although supplemental water quality analysis was made which is shown below under the Study, the more comprehensive results conducted during JICA M/P and F/S are used for determination of water treatment process.

Appendix Table 22 The Result of Water quality Test in this B/D survey

Parameter		K3	K4	G1		G2		D6
		JICA Well	Intake	JICA Well	Shallow Well	JICA Well	House Connection	Existing Well
Temperature	℃	25.4	24.7	26.8	26.0	26.0	27.0	25.9
pH		7.1	6.7	7.2	5.3	5.4	5.5	7.4
Conductivity	μs/cm	—	72	—	15	101	112	173
	ms/cm	0.7	—	0.21	—	—	—	—
Color		Non	Non	Non	Non	Non	Non	Non
Odor		Non	Non	Non	Non	Non	Non	Non
Hardness	mg/L	247	19.9	17.9	22.1	12.8	12.5	40.1
Ammonium (NH_4^+)	mg/L	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite (NO_2^-)	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate (NO_3^-)	mg/L	0.58	0.6	1.25	0.77	16.6	17.1	1.72
Chloride (Cl^-)	mg/L	1.98	1.28	1.13	0.78	7.09	8.51	1.12
Sulfate (SO_4^{2-})	mg/L	109	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phosphate (PO_4^{3-})	mg/L	0.08	0.12	0.08	0.09	0.2	0.12	0.09
Sodium (Na)	mg/L	5.5	4.84	9.41	10.2	6.04	7.57	23.9
Total Iron (Fe)	mg/L	0.03	6.57	0.11	0.05	0.04	0.03	<0.03
Manganese (Mn)	mg/L	0.18	0.49	<0.03	<0.03	<0.03	0.03	<0.03
Aluminum (Al)	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Dissolved Solids	mg/L	425	58.4	68.2	83.5	62.5	61.5	151
Total coliform	MPN/100mL	0	2200	0	1100	0	0	0
Thermo tolerant coliform	MPN/100mL	0	170	0	40	0	0	0
Escherichia coli	MPN/100mL	0	210	0	110	0	0	0

Appendix Table 23 The Result of Water quality Test in Master Plan

Parameter		K3-1	G1	G2	D2	D4-1
		Dak Ui	Kong Tang	Nhon Hoa	Ea Drang	Ea Drong
pH		7.19	7.32	7.00	6.42	7.85
Total Iron (Fe)	mg/L	3.49	0.82	0.21	0.39	3.76
Manganese (Mn)	mg/L	0.1211	0.0013	0.1950	0.0410	0.039

14. Environmental and Social Consideration

(1) Drop Down of Groundwater Level of Existing Wells

In the JICA Feasibility Study, the 24 hours water pumping tests were carried out for the JICA test wells in 14 communes. During the water pumping tests, the monitoring in the neighboring dug wells which are located 22 to 100 meters away from the JICA test wells, was also carried out whether or not their water levels are lowered. The results indicate that there was no drop down of water level except the monitoring well K3-1. The only drop down at K3-1 is assumed that non-pressured groundwater in the shallow layer was pumped up from JICA well different from other JICA wells where pressured groundwater were pumped up. As the counter measure for this problem, in case that there is strong influence to the dug well in the dry season, it is adequate to shift the water source from this dug well to the newly constructed water supply service.

Concerning the other monitoring wells, although they were located relatively near to JICA wells, there was no groundwater level drop down observed. It is assumed because the dug wells utilize groundwater from the shallow layer while JICA wells utilize groundwater from the deep layer of the basalt zone (excluding K2).

(2) Water Utilization Right

As mentioned in the paragraph (1), there is almost no possibility of the JICA wells to lower the water level of the existing wells. In the stakeholder meeting of each commune during the Basic Study, the explanation was made to the inhabitants that the JICA wells and the existing wells utilized the different water sources of the shallow aquifer and the deep aquifer respectively, and the understanding of the inhabitants was obtained.

Even if the water levels of existing wells drop down and it becomes difficult for inhabitants to intake water due to the JICA wells, the new water supply system can alternatively supply safe water to each household and this concept was overwhelmingly welcomed in the stakeholder meeting.

(3) Monitoring System for Well Water Quality

In the JICA Feasibility Study Report, it is stated that the monitoring has been carried out for 73 monitoring wells in Dak Lak, Gia Lai and Kon Tum Provinces since 1993 in accordance with "National Program of Groundwater Monitoring in the Central Highlands under the Ministry of Industry".

According to the hearings from Sub-divisions No.701 and 704, the following matters were confirmed:

- The Ministry in charge has been changed to Ministry of Resources and Environment since 3 years ago.
- The number of target province has been extended to 5 provinces by adding Dak Nong and Lam Dong Provinces.
- The monitoring has been implemented periodically for groundwater level and water quality (112 monitoring items)
- The interval of monitoring is basically as follows:

  Groundwater Level: each 3 days in the rainy season
  each 5 ~ 6 days in the dry season

  Water Quality: Twice/year each for rainy season and dry season

  The monitoring wells in the target communes are as follows:

Commune/ town	Monitoring Well	Aquifer	Screen(m)	Constructed Year	Location
G2,Nhon Hoa	LK67T	Basalt(βN_2-Q_1)	0-20	1993	SSE 1.4 km from JICA Well
G5,Nghia Hoa	C2a	Basalt(βN_2-Q_1)	0-22.7	1995	SE 1.5 km from JICA Well
	C2b	Basalt(βN_2-Q_1)	33-58.5		
	C2c	Basalt(βN_2-Q_1)	62-75		
	C2o	Basalt(βN_2-Q_1)	89.6-190.8		

(4) Land Acquisition

In order to decide the locations of new well construction, the physical detection was carried out in the area with high potentiality of groundwater development where the proposal was made in the JICA Development Study and, at the same time, the consultations were held with CERWASS in each province and the representatives of People's Committee in Communes and Districts. Accordingly, the planned lands for water treatment plants, that require large area for land acquisition, are secured in the public lands excluding one site. However, the planned lands for water intake points, that require small area for land acquisition, include some private lands.

Appendix Table 24 List of the Land Owner (Planned Site for Water Treatment Plant)

Commune		Owner		Remark
K2-3	Dak Su	Public Land (CPC)		CPC（Commune People's Committee）
K3-1	Dak Ui	Public Land (CPC)		
K4-1	Dak Hring	Public Land (CPC)		
G1	Kong Tang	Public Land (CPC)		
G2	Nhon Hoa	Public Land (CPC)		
G3	Chu Ty	Public Land (CPC)		
G4-1	Thang Hung	Public Land (CPC)		
G5-1	Nghia Hoa	Public Land (CPC)		
D1	Krong Nang	Public Land (CPC)		
D2	Ea Drang	Public Land (Army)		Approved by army
D3-1	Krong Buk		Private Land (YNHOEN)	Cornfield
D4-1	Ea Drong	Public Land (CPC)		
D6-1	Kien Duc	Public Land (CPC)		

Appendix Table 25 List of the Land Owner (Planned Site for Well)

Commune		No.	Owner	
K2-3	Dak Su	No.1		Private Land (A.Chem)
		No.2		Private Land (A.Vu)
		No.3		Private Land (A.Ang)
K3-1	Dak Ui	-	None	
K4-1	Dak Hring	-	None	
G1	Kong Tang	No.1		Private Land (Nhan)
G2	Nhon Hoa	No.1	Public Land (CPC)	
		No.2	Public Land (Elementary school)	
		No.3		Private Land (Mane)
		No.4		Private Land (Lu Thi Dong)
		No.5		Private Land (O.Tro)
		No.6	Public Land (Elementary school)	
G3	Chu Ty	No.1	Public Land (CPC)	
G4-1	Thang Hung	No.1	Public Land (CPC)	
G5-1	Nghia Hoa	No.1		Private Land (Do Mot)
D1	Krong Nang	No.1	Public Land (CPC)	
		No.2	Public Land (CPC)	
D2	Ea Drang	No.1	Public Land (Elementary school)	
		No.2		Private Land (Phan Van Sy)
		No.3		Private Land (Mable)
		No.4		Private Land (Ngoc)
		No.5	Public Land (Army, Coffee Company)	
		No.6	Public Land (CPC)	

Commune		No.	Owner	
		No.7	Public Land (CPC)	
D3-1	Krong Buk	No.1	Public Land (CPC)	
D4-1	Ea Drong	No.1		Private Land (Y Yot Nie)
		No.2		Private Land (Y Vin Qtla)
D6-1	Kien Duc	No.1	Public Land (CPC)	
		No.2		Private Land (Uy)
		No.3	Public Land (Elementary school)	

(5) Concerning Drainage and Sewage

Since the groundwater source planned in the Basic Study is all the pressurized aquifer (deep wells), there is no chance of the organic matters of the drainage and wastewater from the daily living to infiltrate into deep aquifer and worsen water quality.

(6) Others

It is stated in the EIA of the JICA F/S and it is also confirmed in this Basic Study that the Project has no negative influence to the poverty class and the culture & life style of minority ethnic groups. The Government of Vietnam is making efforts for improving the dwelling environment for the minority ethnic groups especially in the Central Highlands area through the subsidization, the improvement of water supply facilities and roads, etc.

Concerning the gender, since the water draw up work is not limited to women in the target area of the Basic Study and the water supply service to each individual household is the basic plan of the Project, there is no factor to be influenced by the Project.

15. Necessity for Construction of Facilities and Provision of Equipment

(1) Improvement of Facilities

For the selected 5 communes in 3 provinces of Kon Tum, Gia Lai and Dak Lak, the basic design is formulated to construct water supply facilities with distribution system for the target year of 2010. The per capita demand is 60 liter per day, same as the target of NRWSS. The water source is deep wells in order to secure sufficient water volume. Although iron and manganese are not harmful to the health they are troublesome to the daily life. Therefore, if iron and/or manganese are present or acidity is observed in the water, required water treatment facilities should be constructed. Moreover, the disinfection facility should be provided to all the facilities.

1) Necessity for Improvement of Facilities

In the past, the invested budget has been only half of the required budget in achieving NRWSS target. If this tendency continues, NRWSS target would be difficult to achieve. In order to achieve the target, it is necessary to increase the amount of the Government fund and, at the same time, there should be increased assistance from the donors.

The water supply system in future will be mainly the central water supply system instead of present system of small scale water supply. The central system of water suply consists of the securing of water source, the water treatment according to the raw water quality and the water distribution facilities.

The lists of the existing central water supply systems in the Central Highlands are shown in the Tables below. Each system serve one village with the size of service population less than 1,000 persons (service household under 200 houses). A village in general has the area of 500m square at the most that is topographically uniform and therefore, its water supply system is technically a simple one.

Nevertheless, their operation and maintenances are not adequate in general. In order to strengthen the system of the operation and maintenance (CPC and P-CERWASS), it is necessary to develop the central water supply system at the commune level (population served: 10,000 persons) which is high-ranking administrative unit of a village (a commune consists of 10 to 15 villages) instead of the conventional water supply system at village level (population served: 1,000 persons).

MARD and its executing agency CERWASS, who are in charge of rural water supply, have less experience of the central system. As for the proportion of CERWASS staff, since they have been making efforts to increase water supply service ratio mainly by the small-scale water supply system, there are many geology experts but few water supply experts. The present situation is that CERWASS has just started to employ new water supply engineers.

Therefore, the assistance of Japan to strengthen CERWASS is effective. The service area of central water supply system is one commune for which the areal extent is vast and topographic conditions are complicated. Thus, the technology for complicated topographic conditions is required (such as the water hammer pressure control when pumps are started and stopped, protection of pipe joints from slip off that might cause water leakage, techniques to balance water demand and water supply, etc.). P-CERWASS, after receiving adequate technology and skill through the Project, can continue to construct the central water supply system in the communes, other than six communes, where the well will be drilled using the drilling equipment supplied by the Project.

The capability of staff responsible for operation and maintenance of the completed facilities will be strengthened by the establishment of management organization with the guidance of PCERWASS through the soft-component, cooperation as advisors from the Ministry of Construction or the urban water supply entities with sufficient experience of large-scale central system and the training for staff of P-CERWASS at the vocational school in Da Nang City.

Appendix Table 26 The Constructed Water Supply Systems in Kon Tum province (2000)

No.	Commune	District/City	Population Served (person)	Total Population (person)	No. of wells	Depth (m)	Year of Construction
1	Ya Chim	KonTum	500	9,936	1	72	2000
	Total		500		1		

Appendix Table 27 The Constructed Water Supply Systems in Gia Lai province (2003-05)

No.	Commune	District/City	Population Served (person)	Total Population (person)	No. of wells	Depth (m)	Year of Construction
1	Ia Rsuom	Krông Pa	5,343	5,343	4	100 - 180 (JICA well)	2004
2	Ia Rsai	Krông Pa	1,420	3,674	2	100	2005
3	Uar	Krông Pa	2,500	3,624	3	100	2005
4	Chu Drang	Krông Pa	2,210	4,993	2	100	2005
5	Ia Rmok	Krông Pa	2,230	4,626	3	100	2005
6	Ia Dreh	Krông Pa	1,500	3,450	1	100	2005
7	Kon Thup	Mang Yang	350	2,623	1	120	2003
8	De Ar	Mang Yang	320	2,586	1	110	2004
9	Dak Tro I	Mang Yang	300	1,958	1	120	2005
10	Ia Der	Ia Grai	1,450	7,011	1	160	2004

No.	Commune	District/City	Population Served (person)	Total Population (person)	No. of wells	Depth (m)	Year of Construction
11	Ia O	Ia Grai	1,520	6,063	2	120	2005
12	Phu Hoa	Chu Pah	1,850	3,915	4	150	2003
13	Dak So Mei	Dak Doa	560	8,028	1	140	2003
14	Kong Yang	Kong Chro	1,620	2,759	1	160	2005
	Total		23,173	60,653	27		

Appendix Table 28 The Constructed Water Supply Systems in Dak Lak province (2003-05)

No.	Village	Commune	District/City	Population Served (person)	Total Population (person)	No. of wells	Depth (m)	Year of Construction
1	Thôn 3	Hòa Xuân	Buôn Ma Thuột	440	440	1	60	2004
2	Thôn 5	Hòa Xuân	Buôn Ma Thuột	300	300	1	58	2004
3	Buôn ĐrayHlinh	Hòa Xuân	Buôn Ma Thuột	700	700	1	65	2004
4	Thôn 1	Hòa Xuân	Buôn Ma Thuột	396	396	1	60	2005
5	Thôn 2&4	Hòa Xuân	Buôn Ma Thuột	850	950	1	65	2003
6	Buôn Buôr	Hòa Xuân	Buôn Ma Thuột	920	1,230	1	56	2005
7	Buôn CưĐluê	Hòa Xuân	Buôn Ma Thuột	740	850	2	84	2005
8	Thôn 2	Hòa Xuân	Buôn Ma Thuột	480	590	1	62	2005
9	Thôn 4	Hòa Phú	Buôn Ma Thuột	700	820	1	63	2004
10	Thôn 11	Hòa Phú	Buôn Ma Thuột	650	800	1	60	2005
11	Buôn Tuôr	Hòa Phú	Buôn Ma Thuột	460	550	1	56	2005
12	Thôn 7	Hòa Phú	Buôn Ma Thuột	750	850	1	65	2005
13	Buôn Kbu	Hòa Khánh	Buôn Ma Thuột	1,100	1,475	1	51	2005
14	Cụm thôn 6	YaTờMot	EaSup	310	310	1	68	2005
15	Cụm thôn 8	YaTờMot	EaSup	1,100	1,600	1	75	2005
16	EaPôk	EaPôk	CưMga	3,450	3,450	1	80	2005
17	Thôn An Bình	EaPôk	CưMga	500	615	1	80	2005
18	CTCN Đông tân giang	Buôn tría	Lăk	900	1,190	1	61	2005
19	CTCN Hòa Bình 1,2&Cam	Đăk Liêng	Lăk	1,460	1,500	1	52	2005
20	CTCN Thôn Hòa Bình 3	Đăk Liêng	Lăk	880	900	1	58	2005
21	CTCN Thôn Đoàn kết 1,2	Buôn Triết	Lăk	1,150	1,550	1	55	2005
22	CTCN EaYiêng	EaYiêng	KrôngPăc	2,650	4,485	2	60	2005
	Total			20,886		24		

2) Selection of the 5 Communes

Considering the factors mentioned below, 5 communes are selected from requested 13 communes to implement the Project activities on priority basis.

Appendix Table 29 The Selected 5 Communes

Province	District	Commune	System	Population served in 2010 (person)	No. of Required Wells (( ); no. of new drilling wells in total)
Kon Tum	Dak Ha	Dak Ui	K3-1	2,757	1 (0)
Gia Lai	Mang Yang	Kong Tang	G1	6,797	2 (1)
	Chu Se	Nhon Hoa	G2	11,493	7 (6)
Dak Lak	Ea Hleo	Ea Drang	D2	16,795	7 (7)
	Cu M Gar	Ea Drong	D4-1	7,132	3 (2)
			Total	*44,974*	*20(16)*

a) Priority of Communes in JICA Development Study

The 13 systems requested are considered to be of the high priority among the 46 systems of 20 communes according to the JICA Development Study. Eight evaluation criteria have been used to rank the communes in the study including urgency, population density, improvement conditions of related infrastructure, potential of groundwater, poverty degree, financial affordability, potential of operation and maintenance, gender and environmental assessment.

The weight of environmental assessment is 3 points and all other 7 items have 10 points weight, respectively. Each system has been scored in terms of all eight factors with scores such as A class 3 points, Ba class 2.5 points, B class 2 points, Bc class 1.5 points and C class 1 point. Therefore, the score ranged from the maximum of 219 points (7 items x 10 points x 3 points + 1 item x 3 points x 3 points) to minimum of 73 points (7 items x 10 points x 1 point + 1 item x 3 points x 1 point).

If the average of each item is Ba class, the score is 182.5 points, and if it is B class, the score is 146.0 points. All the 10 communes of Gia Lai, Dak Lak and Dak Nong Provinces are included between Ba and B. The score of each commune is D6（189.0）, D2（184.0）, G3（184.0）, G2（179.0）, D4（174.0）, G1（164.0）, D3-1（164.0）, G4-1（159.0）, G5-1, (159.0), D1（159.0）.

On the other hand, the 3 communes of Kon Tum Province are included between B class (146.0 points) and Bc class (109.5 points). The score of each commune is K3-1 (131.0), K2-3（127.5）, and K4-1（121.0）. This means that, in comparison to the other provinces, the priority is low in the items such as population density, potential of groundwater, poverty degree, financial affordability and environmental assessment. However, considering the geological and political balances the three communes in Kon Tum province was selected to have high priority.

Appendix Table 30 Project Prioritization in Development Study

System	Commune	Urgency	Population Density and Infrastructure	Groundwater Potential	Poverty	Financial Affordability	O&M Potential	Gender	Environment	Total Score	Rank
	Weight	10	10	10	10	10	10	10	3		
K2-3	Dak Su	Ba	B	Bc	Bc	B	Bc	C	Ba	127.5	17
K3-1	Dak Ui	B	B	B	Bc	C	B	B	B	131.0	16
K4-1	Dak Hring	Bc	A	Bc	C	C	B	Bc	B	121.0	18
G1	Kong Tang	C	A	Ba	B	Ba	B	Ba	A	164.0	7
G2	Nhon Hoa	A	A	Bc	A	Ba	B	B	A	179.0	4
G3	Chu Ty	Ba	A	Ba	Ba	A	B	B	A	184.0	2
G4-1	Thang Hung	B	A	Ba	Bc	Ba	B	Bc	A	159.0	9
G5-1	Nghia Hoa	B	A	B	Bc	Ba	B	B	A	159.0	9
D1	Krong Nang	C	A	A	B	Ba	B	Bc	A	159.0	9
D2	Ea Drang	A	A	B	B	A	A	Bc	A	184.0	2
D3-1	Krong Buk	Bc	A	A	Ba	B	B	Bc	A	164.0	7
D4-1	Ea Drong	A	A	B	A	B	B	Bc	A	174.0	6
D6	Kien Duc	A	A	Ba	Bc	A	A	B	A	189.0	1

G6 (Ia Rsion Commune) excluded from the request was ranked as No. 4.
Communes from rank 12 to 15 are not excluded.

b) Priority Communes in Basic Design Study

In the Basic Design Study, it is assessed that the priority decided 3 years ago in the Development Study is still appropriate in 2005.

The level of poverty reflects the same affects as financial affordability, that is to say, a lower value of financial affordability implies higher level of poverty. Therefore, the level of poverty is excluded while carrying our assessment in Basic Design Study to avoid repeated evaluation in terms of similar factors. With respect to the financial affordability, for all the provinces except Kon Tum province, the evaluations in this Study are almost same as in the previous Development Study, an increase in the financial affordability has been observed in Kon Tum province.

In this Basic Design Study, three new evaluation criteria have been added. These are continuity of pilot project, willingness to construct the water supply system and distance between adjoining communes.

In terms of continuity of pilot project, 2 communes (K3 and G2) are evaluated as “A” , because it is appropriate that pilot project is expanded to full facilities in these two communes. The other communes have been evaluated as “C” with respect to continuity of pilot project.

Willing to construct the water supply system overlaps with ability to pay or urgency (amount of water supply and water quality) in Developing Study. However, it is important criteria and is evaluated as high rank, if willing to construct the water supply system is high. (Refer to Appendix)

Distance between adjoining communes becomes evaluation criteria from viewpoint of efficiency of implementation and cost required for implementation. The Study 13 communes are located in 4 provinces, and these communes are separated from each other. If the distance between considered communes is more than 40km, the implementation cost will be higher in comparison, because staff and office for construction and supervision will be required separately for both communes. However, if the distance between considered communes is less than 40km, the implementation cost will be low, because staff and office for construction and supervision could be shared by these communes. Therefore, only D6 commune is evaluated as "C" due to being located at long distance (3 hrs) from D3 or D4. The other communes being located within a distance of 40km from each other, these have been evaluated as "A".

Appendix Table 31 The Evaluation Items for Project Prioritization

Evaluation Item	Comment
Overlap of request with other donors	No
Urgency	In G1, inhabitants complain of the smell of oil in dug well as existing water source. Accordingly, urgency is higher. Urgency in other communes are same as Development Study.
Willing to construct the water supply system	Urgency is evaluated in terms of water volume and quality. Relating to this, basic study survey of willing to construct the water supply system is reflected in evaluation.（weight is 10 points as same as other items. If more than ９０% of households expect: A, more than ８０%: Ba, more than７０%: B, more than６０%: Bc, less than６０%: C）
Population density & improvement conditions of related infrastructure	District center or semi-center. Population density is high. Town has been developed as a base town faced with national road for cultivation of plantation for coffee, rubber and pepper. High potential of development in future. Power supply conditions have been improved greatly and power failure occurs frequently.
Groundwater potential	Potential of water source in 2 communes of Kon Tum Province is low. It is proposed to use surface water for K4 and, for K2, to utilize water supply from water in neighboring town. Concerning water quality, treatment facilities are constructed in many communes where iron and manganese are contained. Concerning D2 and D6 where water yield was assumed from neighboring wells, and G3 where existing well may be utilized, pumping test was conducted.
Poverty Level and financial affordability	Poverty level (ethnic minority group) and Soundness of financial basis are contrary items. If former is high, latter is low. Communes of low financial soundness are receiving Government financial assistance for development of minority ethnic group, etc. Since target in Central Highlands is area with relatively high poverty degree, in Basic Study, poverty degree is excluded from priority items by placing importance on self-supporting development after completion of facility construction. Willingness to pay survey was carried out in Basic Study. Result of Kon Tum Province was changed. Relating to financial soundness, financial survey of communes was also carried out this time. Although financial soundness of communes in Kon Tum is low as same as result of Development Study, financial size has been increased.
Operation & maintenance	This evaluation item is important in terms of sustainability. On the other hand, commune's volition, support system of province including P-CERWASS and efforts by people's committee are also essential in future. In North, WSU was established in each commune, under support from province such as training at vocational school, and WSU has been managing water supply service and are successful in general. It is also expected to encourage self-supporting development of water supply facilities through utilization of soft component and promotion of IEC activities. In Dak Lak Province, a plan is under progress that P-CERWASS will directly manage operation and maintenance of facilities that is of relatively large scale. Therefore, there is no difference of management capability in each commune for operation and maintenance of facilities as evaluated in JICA Development Study.
Gender and environmental assessment	There is no difference between communes as evaluated in JICA Development Study.
Continuity of pilot	Pilot projects were carried out in K3 and G2. In respect of study continuity, it is expected to

Evaluation Item	Comment
project	continue them in Basic Study.
Land Acquisition	Except 1 commune, it is possible to acquire public lands for water treatment plants that require vast land. Half number of lands for well drillings, that require small lands, are private lands. These sites were selected by attendance of people's committee and therefore lands acquisition will be smoothly carried out.

Appendix Table 32 Project Prioritization in Basic Design

System	Commune	Urgency	Population Density and Infrastructure	Groundwater Potential	Financial Affordability	O&M Potential	Pilot Project	Willing to construct the water supply system	Distance between adjoining communes	Total Score	Rank	Selected Commune
	Weight	10	10	10	10	10	10	10	10			
K2-3	Dak Su	Ba	B	Bc	C.	Bc	C	A	A	155	13	
K3-1	Dak Ui	B	B	B	Ba	B	A	B	A	185	4	○
K4-1	Dak Hring	Bc	A	Bc	Ba	B	C	Bc	A	160	12	
G1	Kong Tang	**A**	A	Ba	Ba	B	C	B	A	190	3	○
G2	Nhon Hoa	A	A	Bc	Ba	B	A	A	A	210	1	○
G3	Chu Ty	Ba	A	Ba	A	B	C	Bc	A	185	4	
G4-1	Thang Hung	B	A	Ba	Ba	B	C	Bc	A	175	9	
G5-1	Nghia Hoa	B	A	B	Ba	B	C	Ba	A	180	8	
D1	Krong Nang	C	A	A	Ba	B	C	B	A	175	9	
D2	Ea Drang	A	A	*B*	A	A	C	Bc	A	195	2	○
D3-1	Krong Buk	Bc	A	A	B	B	C	C	A	165	11	
D4-1	Ea Drong	A	A	B	B	B	C	Ba	A	185	4	○
D6	Kien Duc	A	A	*Ba*	A	A	C	B	C	185	4	

Parts of Master Plan are revised.

The nomination of the priority communes have been carried out considering the Total Score that has been estimated using weighted score. For example, the Full Score has been calculated as 279 assuming that for all the 10 evaluated factors, grade "A" has been awarded (Full Score = 3 point X weighting factor 10 point X 7 items = 240). After calculation of the Total Score for each commune, those communes that have scored more than 75% of full score (i.e. score higher than 180) have been evaluated as priority communes. Thereby, there are 7 communes that could be considered as priority communes and included 1 commune in Kon Tum province, 3 in Gia Lai province, 3 in Dak Lak and Dak Nong provinces.

On the other hand, it has also been considered that CERWASS should conduct the water supply plan in other communes on their own after building up their skills through experience of planning and construction for large scale water supply facility in this project, and through operation and maintenance after construction.

For this reason, considering the scale of population, communes of distribution are decreased to 2 communes from 3 communes in Kon Tum province and therefore total number of considered communes decreased to 5 from 7.

Dak Nong province separated from Dak Lak province in 2004 and has strong relationship with Dak Lak province. Therefore, based on the project implementation experiences in Dak Lak province, project activities could be carried out similarly in Dak Nong province, and therefore, D6 Kien Duc is excluded. At present, the staffs in Dak Nong province have been assigned from Dak Lak province.

(2) Supply of Equipment

1) Solar Power Generation System

In the 4 communes, the introduction of Solar Power Generation System had been requested, but the Government of Vietnam agreed to delete it from the request because the electric power supply conditions has improved since 2002 when the request was presented, and the power supply has been stable with infrequent power failure.

2) Well Drilling Equipment

a) Objective of Equipment Supply and Coordination with the Sector

The objectives of equipment supply are as follows:

- To construct the water production well (deep well) for the Project by using the equipment (well drilling)
- To transfer the technology to the CERWASS in order to level up the Vietnamese technology for construction of wells and contribute to the projects of NRWSS after the completion of the Project.

b) Necessity for Supply of Equipment

During the last 5 years (2000~2004), total 164 deep wells were drilled in 4 provinces and about a half of them (86 wells) was drilled directly by P-CERWASS. The 3 provinces (excluding Dak Nong Province which was separated from Dak Lak Province in 2004) have respectively one unit of well drilling equipment that is basically a core boring machine made in China (diameter 46mm) and therefore the drilling depth is shallow (usually less than 100m), the drilling diameter is small (intake water volume is small) and a long drilling time is required. The remaining 78 wells were drilled by drilling companies. There are 8 drilling companies at least and they own total 40 boring machines. However, their drilling equipment are boring machines and have the same problem as the P-CERWASS machine.

In the future, the equipment used exclusively for well drilling will be required that is able to drill the large size wells (diameter 300mm), (intake of sufficient water volume) in the deep and hard ground layer (drilling depth 200m) because rock layer appears at the depth of 5~20m in Central Highland.

Japan has supplied the well drilling equipment for exclusive use in the northern provinces as the grant aid cooperation and it has drilled 16 wells by the year 2005. From now on, the equipment will be used to drill 8 wells annually in the northern provinces of dry area and it is planned to improve water supply service ratio in the northern areas. The supplied equipment is operated and maintained by the staff of 9 persons of CERWASS and they use the equipment fully and effectively.

It is judged that the equipment supplied in the central highlands will be also used effectively through the measures such as the equipment center to be established in the central highlands, the new employment of staff of 9 persons similar to the north, accumulating experiences through the grant aid cooperation in the central highlands and receiving the training from the staff of the North. It is judged that it is possible to secure the budget for the projects mentioned above.

The necessity for the equipment supply is summarized in the table below.

Appendix Table 33 Necessity for Equipment Supply

Item	Comment
1. Contribution to NRWSS Strategy 2020	Contribution to achievement of service ratio (85% in 2010 and 100% in 2020) Expectation to growth of the population served by water supply as percent of total population (6.4%)
2. Securing Stable Water Source	Although the service ratio is improved to above 50% in each province, most of the water source is dug wells. Dug wells are unstable water source due to risks of infiltration of muddy water and organically polluted water in the rainy season and due to water shortage problem in the dry season (for 5~6 months) resulted from lower water level. On the other hand, deep wells are good water source with stable water volume and good water quality all year round.
3. Result of Utilization of Equipment Supplied to the North	16 wells were drilled from 2003 to 2004 (including unsuccessful wells). Drilling diameter is 275mm and drilling depths are from 75m to 122m.
4. Schedule of Utilization of Equipment Supplied to the North	7 wells will be drilled from October 2005 to December 2006 in Ha Tay Province neighboring to Hanoi City. Afterwards, 8 wells in every year will be drilled in the dry areas of the North.
5. Existing Equipment in Each CERWASS	There are equipments (XY-1) made in 1993 in Kon Tum, Gia Lai and Dak Lak Province. Drilling diameter is as small as 46~100mm and drilling depth is as shallow as 100m(in case of diameter 46mm). Gia Lai Province also owns an equipment made in Canada 1985 (small diameter and 100m of drilling depth). These equipments were modified from boring machines for geological survey and, are used for drilling of deep wells. But since diameter is small, it takes long time and labor to enlarge the drilled diameter. Too long time of drilling works cause bad influence such as difficulty of maintenance of hole wall, stuffing vein of water.
6. Result of Drilling by	It is confirmed that 8 companies are active in Central Highlands (4 state

Item	Comment
Local Companies	companies under Ministry of Science, Technology and Environment and 4 private companies). A company owns on average 5 machines made in former Soviet and China and has result of 40 wells annually. Deepest drilling depth is 180m. Drilling period per well is from 1 to 3 months. Spare parts are available in market. Drilling machines are modified ones from boring machines for geological survey and therefore the same problems mentioned above exist.
7. Comparison of Drilling Costs	¥15,000～20,000 per meter by these companies in item 6 ¥7,000 per meter directly by CERWASS (example of North)
8. Schedule of Utilization of Equipment Supplied to the Central Vietnam	Drilling result for last 5 years is 164 wells in 4 target provinces. Drilling schedule for next 5 years will be 400 wells that is a big increase.
9. Management Method of Equipment Supplied to the Central Vietnam	In order to manage supplied equipment to North, North center has been established in Hanoi City. Staff consists of 2 engineers, 2 technicians and 5 operators (they are also drivers). Central center will be established in Gia Lai Province in order to manage equipment to be supplied to Central Vietnam. 9 persons of staff for Central center will be employed and positioned after receiving training in North center.
10. Limitation of Construction Period	After confirming existence of underground water and considering location of well, locations of ground facilities (pipeline, water treatment plant and reservoir) are decided. Accordingly, existing drilling machines of inferior capacity of drilling (drilling period of 1~3 months) will shorten period of construction for ground facilities and therefore cause difficulty to complete all facilities within the limited construction period.

<u>Supplement to the Table above</u>

a) Result of utilization and Schedule of utilization of the equipment supplied to the North in items 3 and 4

The equipment was utilized until 2004 for the projects in the North. In 2006, the equipment will be utilized for the well drilling of water projects in 9 communes of Ha Tay Province neighboring to Hanoi City. (15.9 billion VND of National budget (¥115 million) and almost the same amount of Provincial budget) In October 2005, the well drilling in a commune has been commenced.

Appendix Table 34 The Plan for Water Supply and Sanitation of Ha Tay province in 2006

Population	2.39 million
Budget	38.8 billion VND（approx 242 million JPY）
The Details of Plan	✓ <u>Water Supply facilities（including drilling deep well and laying distribution pipe）</u> 9 schemes Total budget: 15,85 billion VND (approx 115 million JPY) ✓ <u>Individual systems</u> Shallow Well: 11,852 wells Dug Well: 2,100 wells Rain – Water Storage Tank: 1,000 ✓ <u>Sanitation Plan</u> Small Sewerage facilities: 2 Toilet Installation

b) 6. Result of Local Companies

There are at least 8 drilling companies in Central Highlands. A company owns on average 5 machines and has experience of drilling about 30 ~ 50 wells annually. Most of their machines are supplied by the former Soviet Union in the eighties or purchased from China in the nineties. Since these drilling machines are modified ones from boring machines for geological survey originally, it takes a long time for drilling that requires time for reaming works to enlarge drilled diameter. Although these machines have faced many troubles frequently, the spare parts are available in the markets.

c) 8. Schedule of Utilization of Equipment Supplied

According to the Central CERWASS, the result of drilling for the last 5 years is shown in the table below. In Kon Tum Province, the number of drilled wells has been low, (3 wells per year maximum), because of the small size of province (the population of 360,000 persons in 2005). In Gia Lai Province, the number of wells drilled for the last 3 years is about 15 to 21 wells per year. Reflecting the geological conditions, the drilling depth is as deep as from 100 to 180m. In Dak Lak Province (including the present Dak Nong Province), the result of drilling for the last 2 years is 34 ~ 35 wells annually that are more wells in comparison to Gia Lai Province but the depth is as shallow as 45 ~ 85m. About a-half the number of all wells drilled during 2000 ~2004 has been drilled directly by CERWASS.

Appendix Table 35 Number of Drilling Wells (2000-2004)

Year / Province	2000	2001	2002	2003	2004	Total	Depth (Max/Ave/Min)	Number of Constructed Wells by CERWASS
Kon Tum	1	1	0	3	3	8	NA	NA
Gia Lai	8	13	16	21	15	73	180/140/100	43
Dak Lak	1	4	4	20	15	44	85/55/45	24
Dak Nong	0	0	5	14	20	39	70/55/45	18
Total	10	18	25	58	53	164	180/100/45	85

(source：CERWASS)

The schedule of drilling wells in the next 5 years in each province is shown in the table below. From 10 wells annually (Gia Lai Province) to 50 wells annually (Dak Lak and Dak Nong Provinces), 400 wells in total are scheduled to be drilled. The schedule of drilling in Gia Lai Province has the same pace as in the last 5 years, but the schedules of the other provinces require to be 6 ~ 8 times more than the number of drilling during the last 5 years. Therefore, the equipment with higher level of capacity is required in order to realize the shorter drilling time and the deeper drilling depth. It is supposed that the water production will be 80m3 per day per well and, in total, the water supply of 45,000m3 per day will be possible, that is, equivalent to one third of the required increase in water volume of 126,000m3 per day.

The budget arrangement is also shown in the table below that occupies reasonably 10 ~ 20 % of the annual investment budget of all CERWASS for the last 3 years mentioned previously (12 billion VND of Kon Tum Province, 18 billion VND of Gia Lai Province and 32 billion VND of Dak Lak Province). The investment budget of past years was used mainly in the construction of dug wells, but in the future, it will be used for the construction of deep wells. If the budget for well construction covers 10 ~ 20 %, the remaining amount of budget for the relating water supply facilities (reservoir, distribution pump, distribution pipes) will be reasonable and feasible in terms of budget estimation. It is possible to drill 10 wells annually (50 wells for 5 years) by the equipment owned by CERWASS of 3 provinces except Dak Nong Province. The remaining wells will be drilled economically by the supplied equipment and, at the same time, consigned to the local drilling companies.

Appendix Table 36 Number of Drilling Wells (2006-2010)

Year / Province		2006	2007	2008	2009	2010	Total
Kon Tum	No. of Wells	11	14	14	14	14	67
	Budget (million VND)	1,650	2,100	2,100	2,100	2,100	10,050
Gia Lai	No. of Wells	13	13	10	8	6	50
	Budget (million VND)	2,600	2,600	2,000	1,600	1,200	10,000
Dak Lak	No. of Wells	16	38	39	38	39	170
	Budget (million VND)	1,920	4,560	4,680	4,560	4,680	20.400
Dak Nong	No. of Wells	25	23	20	25	20	113
	Budget (million VND)	3,500	3,220	2,800	3,500	2,380	15,400
Total	No. of Wells	65	88	83	85	79	400
	Budget (million VND)	9,670	12,480	11,580	11,760	10,360	55,850
No. of wells	by Direct Drilling	30	30	30	30	30	150
	by Sub-Contract	35	43	38	40	34	190
	by Supplied Equipment	-	15	15	15	15	60

（source ： CERWASS）

Appendix Table 37 Planned Communes where Well Drilled by Supplied Drilling Equipment

No.	Province	District	Commune	Population (Person)	No. of Existing Water Supply Systems	No. of Proposed Water Supply Systems	No. of Proposed Wells	Existing Population Served (Person)
1	Dak Lak	Ea Kar	Ea Nop	12,140	-	1	3	
2	Dak Lak	Cu Mga	Quanh Hiep	11,330	-	1	2	
3	Gia Lai	Ia Pa	Ia Trok	8,373	-	1	3	
4	Gia Lai	Ayun Pa	Phu Thien	15,410	-	1	5	
5	Gia Lai	Ia Grai	Ia Sao	17,656	-	1	6	
6	Gia Lai	Ia Grai	Ia To	10,856	-	1	3	
7	Kon Tum	Dak Ha	Dak La	6,302	-	1	2	
8	Kon Tum	Kon Tum	Ya Chim	9,936	-	2	2	
9	Dak Nong	Dak R'Lap	Nhan Co	13,795	1	1	4	500
10	Dak Nong	Dak Mill	Duc Minh	12,625	1	1	5	475
			Sub-total	118,423		11	35	
11	Gia Lai	Duc Co	Chu Ty	8,713	1	1	1	500
12	Gia Lai	Chu Prong	Thang Hung	4,645	-	1	1	
13	Gia Lai	Chu Pah	Nghia Hoa	4,013	-	1	1	
14	Dak Lak	Krong Nang	Krong Nang	11,497	-	1	2	
15	Dak Lak	Krong Pac	Krong Buk	7,465	-	1	1	
16	Dak Lak	Dak R' lap	Kien Duc	9,970	1	1	3	
			Sub-total	46,303		6	7	
			Total	164,726			44	

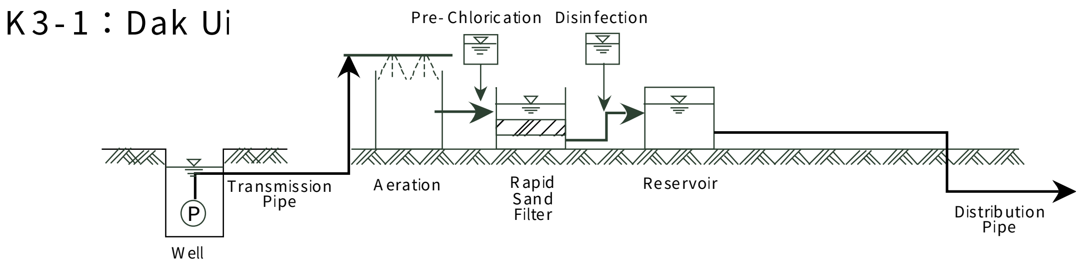
Remark: Depending on hydro geological survey, number of proposed wells may differ.

d) 9. The Systems of Operation and Maintenance of Equipment Supplied to Central Highlands

9 persons including 2 engineers and 2 technicians will be employed and On-the-Job training will be implemented for them in the equipment center of northern and central parts. The equipment center of Central Vietnam will be established in Pleiku City of Gia Lai Province.

16. Outline of Water Supply Facilities

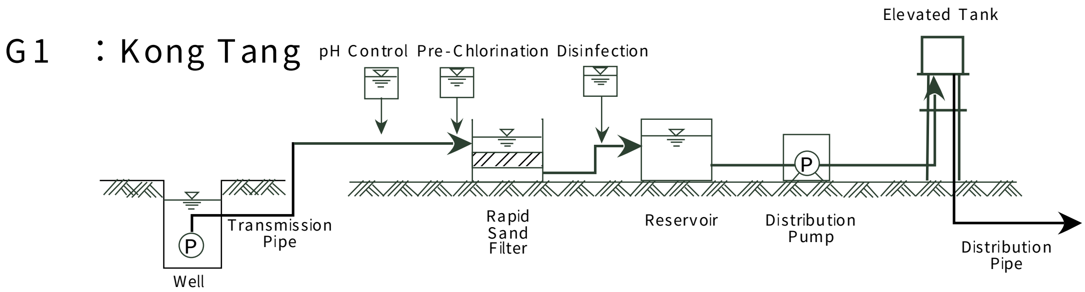
(1) Outline of Water Supply Facilities in K3-1 Dak Ui



Appendix Table 38 Outline of Water Supply Facilities

Facility/Equipment		Dimension & Specification
Well Pump		$0.18m^3$/min×88m×5.5kw (J1)
Transmission Pipe	Diameter (mm)	Φ100 (Existing)
	Length (km)	0.8(Existing)
Aeration Facility		Capacity: $259m^3$/day W1.5m×L1.0m×H3.5m×1 (Existing)
Sedimentation Basin		W1.0m×L1.0m×1 (Existing)
Filtration Basin		W2.8m×L5.6m×2 A=$15.68m^2$
Chemical Feeding Facility	pH Control	—
	Disinfection	○
Distribution Reservoir		W3.0m×5.0m×H3.0m×2 Capacity: $90m^3$ Reinforced concrete
Distribution Pump		—
Elevated Tank		—
Distribution Pipe	Diameter (mm)	φ50～100
	Length (km)	5.0
Service Pipe	Household	624
	Pipe (m)	12,480
	Water Meter	624

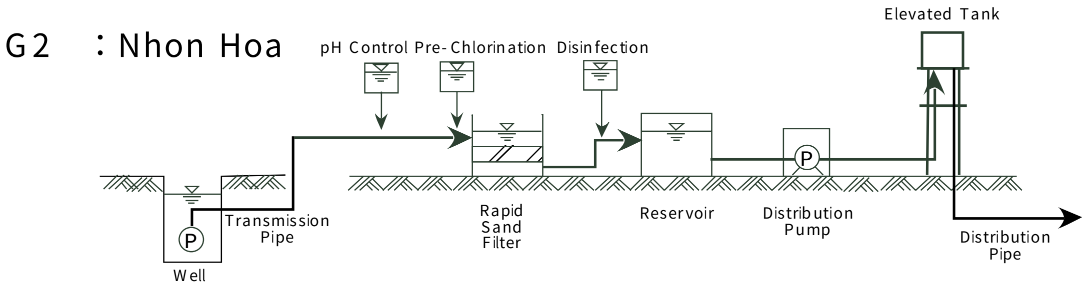
(2) Outline of Water Supply Facilities in G1 Kong Tang



Appendix Table 39 Outline of Water Supply Facilities

Facility/Equipment		Dimension & Specification
Well Pump		0.23m^3/min×73m×5.5kw (J1)
		0.23m^3/min×82m×5.5kw (N1)
Transmission Pipe	Diameter (mm)	φ100～150
	Length (km)	2.2
Aeration Facility		—
Filtration Basin		W1.4m×L1.9m×2 A=2.66m^2/basin
Surface washing pump		80mm×Q0.4m^3/min×H17m×3.7kw×1 unit Backwashing; Washing by treated water from elevated tank
Chemical Feeding Facility	pH Control	○
	Disinfection	○
Distribution Reservoir		W4.0m×9.0m×H3.0m×2 Capacity: 216m^3 Reinforced concrete
Distribution Pump		100mm×Q0.88m^3/min×H15.0m×7.5kw×2 (1 unit is Stand-by)
Elevated Tank		W4.4m×4.4m×H2.0m×1 Capacity: 38.7m^3 Reinforced concrete L.W.L.+752.0m
Distribution Pipe	Diameter (mm)	φ50～200
	Length (km)	26.5
Service Pipe	Household	1,738
	Pipe (m)	34,760
	Water Meter	1,738

(3) Outline of Water Supply Facilities in G2 Nhon Hoa

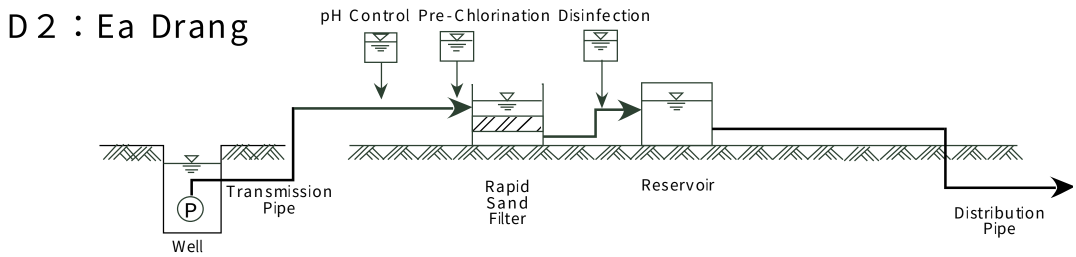


Appendix Table 40 Outline of Water Supply Facilities

Facility/Equipment		Dimension & Specification
Well Pump		0.12m^3/min×87m×3.7kw (J1)
		0.12m^3/min×87m×3.7kw (N1)
		0.12m^3/min×88m×3.7kw (N2)
		0.12m^3/min×118m×5.5kw(N3)
		0.12m^3/min×86m×3.7kw (N4)
		0.12m^3/min×85m×3.7kw (N5)
		0.12m^3/min×116m×5.5kw(N6)
Transmission Pipe	Diameter (mm)	φ80～250
	Length (km)	7.9
Aeration Facility		—
Filtration Basin		W2.0m×L2.3m×2 A=4.60m^2/basin Manganese sand
Surface washing pump		80mm×Q0.69m^3/min×H17m×3.7kw×1 unit Backwashing; Washing by treated water from elevated tank
Chemical Feeding Facility	pH Control	○
	Disinfection	○

Distribution Reservoir		W4.0m×15.0m×H3.0m×2 Capacity: 360m^3 Reinforced concrete
Distribution Pump		150mm×Q1.49m^3/min×H17.0m×11.0kw×2 (1 unit is Stand-by)
Elevated Tank		W5.0m×5.0m×H2.0m×1 Capacity: 50.0m^3 Reinforced concrete L.W.L.+432.0
Distribution Pipe	Diameter (mm)	Φ40～250
	Length (km)	38.6
Service Pipe	Household	2,181
	Pipe (m)	43,620
	Water Meter	2,181

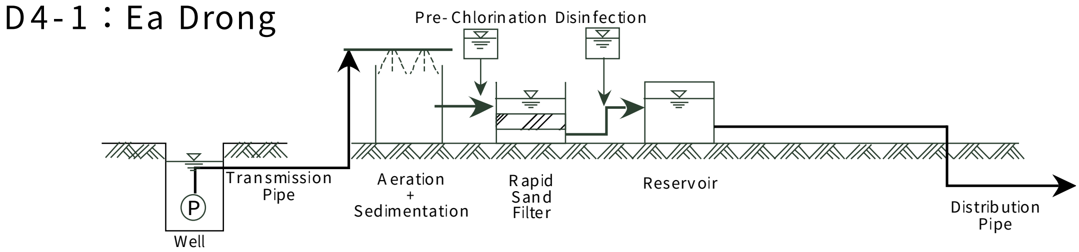
(4) Outline of Water Supply Facilities in D2 Ea Drang



Appendix Table 41 Outline of Water Supply Facilities

Facility/Equipment		Dimension & Specification
Well Pump		0.16m^3/min×141m×7.5kw (N1)
		0.16m^3/min×150m×7.5kw (N2)
		0.16m^3/min×150m×7.5kw (N3)
		0.16m^3/min×161m×7.5kw (N4)
		0.16m^3/min×165m×11kw (N5)
		0.16m^3/min×167m×11kw (N6)
		0.16m^3/min×144m×7.5kw (N7)
Transmission Pipe	Diameter (mm)	φ125～φ150
	Length (km)	5.0
Aeration Facility		—
Filtration Basin		W2.9m×L2.3m×2 A=6.67m^2/basin
Surface and backwashing pump		200mm×150mm×Q5.0m^3/min×H25m×45kw×2 units (1 unit is stand-by)
Chemical Feeding Facility	pH Control	○
	Disinfection	○
Distribution Reservoir		W6.0m×15.0m×H3.0m×2 Capacity: 540m^3 Reinforced concrete
Distribution Pump		—
Elevated Tank		—
Distribution Pipe	Diameter (mm)	φ50～300
	Length (km)	51.8
Service Pipe	Household	3,874
	Pipe (m)	77,480
	Water Meter	3,874

(5) Outline of Water Supply Facilities in D4-1 Ea Drong



Appendix Table 42 Outline of Water Supply Facilities

Facility/Equipment		Dimension & Specification
Well Pump		$0.19m^3$/min×117m×7.5kw (J1)
		$0.19m^3$/min×112m×7.5kw (N1)
		$0.19m^3$/min×139m×7.5kw (N2)
Transmission Pipe	Diameter (mm)	φ100～125
	Length (km)	4.9
Sedimentation Basin		W5.2m×L2.6m×H4.15×2
Aeration Facility		Capacity: $668m^3$/day W5.2m×L2.6m×H4.0m×2
Filtration Basin		W1.4m×L2.0m×2 A=$2.8m^2$/basin
Surface and backwashing pump		125mm×100mm×Q$2.1m^3$/min×H25m×15kw×2 units(1 unit is stand-by)
Chemical Feeding Facility	pH Control	—
	Disinfection	○
Distribution Reservoir		W4.0m×9.5m×H3.0m×2 Capacity: $228m^3$ Reinforced concrete
Distribution Pump		—
Elevated Tank		—
Distribution Pipe	Diameter (mm)	φ50～200
	Length (km)	27.2
Service Pipe	Household	1,583
	Pipe (m)	31,660
	Water Meter	1,583

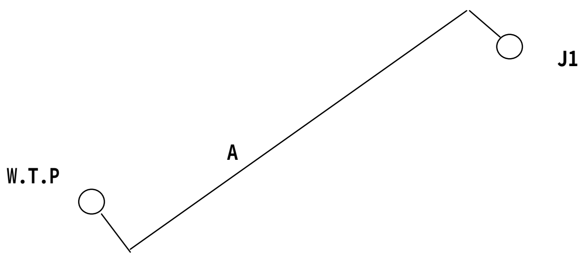
17. Capacity Calculation

Hydraulic analysis for transmission pipe

K3-1 Dak Ui

Daily maximum supply(m3/day)								259
Item of well	Well Name	Required Amount (m3/day)	Dynamic Water Level (Elevation:m)	Pump Head (m)	Pipe Loss (m)	Pump Loss (m)	Required Pump Head (m)	Remark
	J1	259	647	73	2.7	3.0	78.7	A
	計	259						

Elevation at inflow of WTP (Elevation:m)								720
No. of Transmission Pipe	Roughness	Diameter (mm)	Flow (m3/day)	Hydraulic Gradient (m/km)	Velocity (m3/sec)	Length (m)	Head Loss (m)	Remark
A	100	100	259	3.4	0.38	800	2.7	

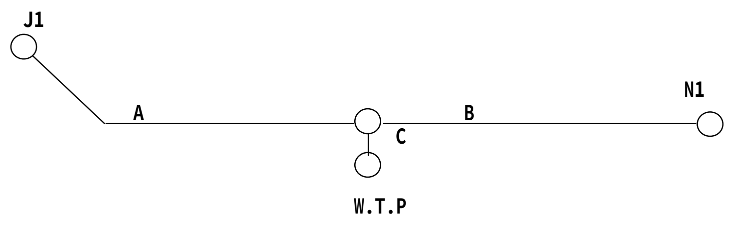


Hydraulic analysis for transmission pipe

G1 Kong Tang

Daily maximum supply(m3/day)								636
Item of well	Well Name	Required Amount (m3/day)	Dynamic Water Level (Elevation:m)	Pump Head (m)	Pipe Loss (m)	Pump Loss (m)	Required Pump Head (m)	Remark
	J1	322	679	68	2.3	3.0	73.3	A+C
	N1	322	675	72	7.2	3.0	82.2	B+C
	計	644						

Elevation at inflow of WTP (Elevation:m)								747
No. of Transmission Pipe	Roughness	Diameter (mm)	Flow (m3/day)	Hydraulic Gradient (m/km)	Velocity (m3/sec)	Length (m)	Head Loss (m)	Remark
A	110	100	322	4.3	0.47	520	2.2	
B	110	100	322	4.3	0.47	1,640	7.1	
C	110	150	644	2.1	0.42	30	0.1	

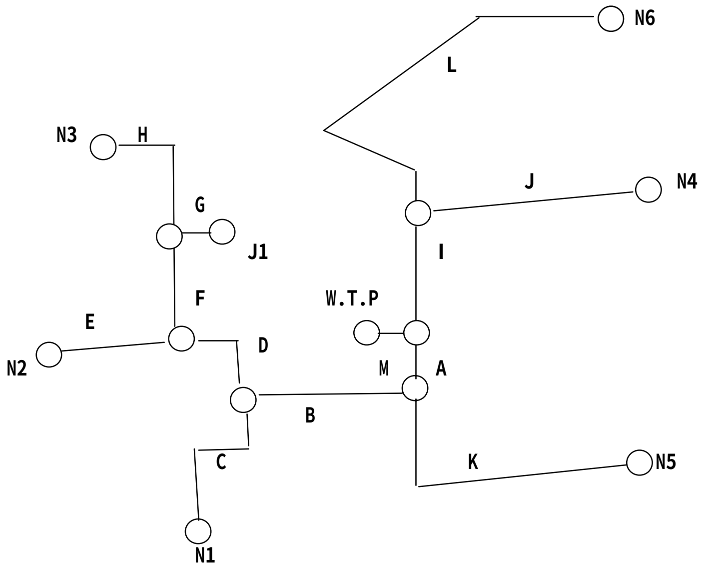


Hydraulic analysis for transmission pipe

G2 Nhon Hoa

Daily maximum supply(m3/day)								950
Item of well	Well Name	Required Amount (m3/day)	Dynamic Water Level (Elevation:m)	Pump Head (m)	Pipe Loss (m)	Pump Loss (m)	Required Pump Head (m)	Remark
	J1	173	347	78	5.6	3.0	86.6	M+A+B+D+F+G
	N1	173	347	78	5.5	3.0	86.5	M+A+B+C
	N2	173	347	78	7.2	3.0	88.2	M+A+B+D+E
	N3	173	320	105	9.5	3.0	117.5	M+A+B+D+F+H
	N4	173	346	79	3.9	3.0	85.9	M+I+J
	N5	173	350	75	7.1	3.0	85.1	M+A+K
	N6	173	323	102	10.6	3.0	115.6	M+I+L
	計	1211						

Elevation at inflow of WTP (Elevation:m)								425
No. of Transmission Pipe	Roughness	Diameter (mm)	Flow (m3/day)	Hydraulic Gradient (m/km)	Velocity (m3/sec)	Length (m)	Head Loss (m)	Remark
A	110	150	865	3.7	0.57	500	1.9	
B	110	150	692	2.4	0.45	420	1.0	
C	110	80	173	4.0	0.40	650	2.6	
D	110	125	519	3.5	0.49	330	1.2	
E	110	80	173	4.0	0.40	770	3.1	
F	110	100	346	4.9	0.51	300	1.5	
G	110	80	173	4.0	0.40	10	0.0	
H	110	80	173	4.0	0.40	980	3.9	
I	110	100	346	4.9	0.51	300	1.5	
J	110	80	173	4.0	0.40	610	2.4	
K	110	80	173	4.0	0.40	1,290	5.2	
L	110	80	173	4.0	0.40	2,280	9.1	
M	110	200	1211	1.7	0.45	20	0.0	

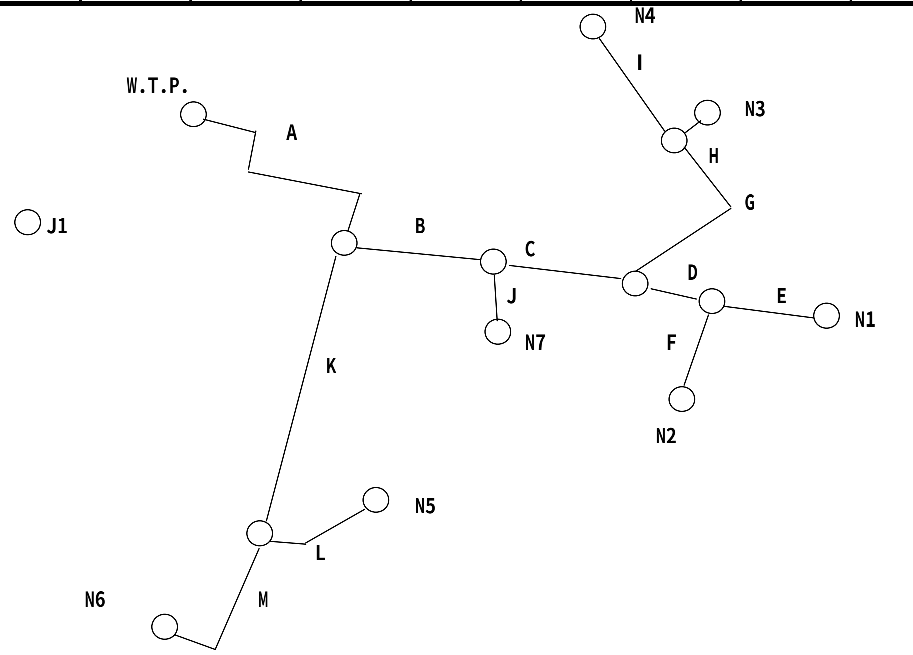


Hydraulic analysis for transmission pipe

D2 Ea Drang

Daily maximum supply(m3/day)								1,572
Item of well	Well Name	Required Amount (m3/day)	Dynamic Water Level (Elevation:m)	Pump Head (m)	Pipe Loss (m)	Pump Loss (m)	Required Pump Head (m)	Remark
	J1	-	576	-	-	-	-	
	N1	225	523	133	4.8	3.0	140.8	A+B+C+D+E
	N2	225	515	141	5.0	3.0	149.0	A+B+C+D+F
	N3	225	515	141	5.7	3.0	149.7	A+B+C+G+H
	N4	225	505	151	6.8	3.0	160.8	A+B+C+G+I
	N5	225	500	156	5.8	3.0	164.8	A+K+L
	N6	225	497	159	5.3	3.0	167.3	A+K+M
	N7	225	518	138	2.7	3.0	143.7	A+B+J
	計	1,575						

Elevation at inflow of WTP (Elevation:m)								656
No. of Transmission Pipe	Roughness	Diameter (mm)	Flow (m3/day)	Hydraulic Gradient (m/km)	Velocity (m3/sec)	Length (m)	Head Loss (m)	Remark
A	110	200	1,575	2.7	0.58	690	1.9	
B	110	200	1,125	1.5	0.41	320	0.5	
C	110	150	900	4.0	0.59	390	1.6	
D	110	125	450	2.7	0.42	120	0.3	
E	110	100	225	2.2	0.33	210	0.5	
F	110	100	225	2.2	0.33	320	0.7	
G	110	125	450	2.7	0.42	630	1.7	
H	110	100	225	2.2	0.33	10	0.0	
I	110	100	225	2.2	0.33	520	1.1	
J	110	100	225	2.2	0.33	120	0.3	
K	110	125	450	2.7	0.42	1,200	3.2	
L	110	100	225	2.2	0.33	300	0.7	
M	110	100	225	2.2	0.33	100	0.2	

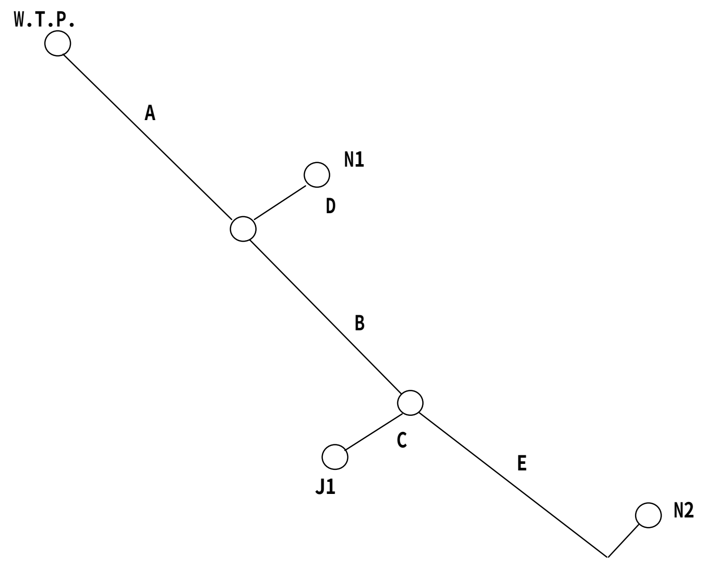


Hydraulic analysis for transmission pipe

D4-1 Ea Drong

Daily maximum supply(m3/day)								668
Item of well	Well Name	Required Amount (m3/day)	Dynamic Water Level (Elevation:m)	Pump Head (m)	Pipe Loss (m)	Pump Loss (m)	Required Pump Head (m)	Remark
	J1	268	563	106	8.0	3.0	117.0	A+B+C
	N1	268	565	104	4.8	3.0	111.8	A+D
	N2	268	545	124	11.8	3.0	138.8	A+B+E
	計	804						

Elevation at inflow of WTP (Elevation:m)								669
No. of Transmission Pipe	Roughness	Diameter (mm)	Flow (m3/day)	Hydraulic Gradient (m/km)	Velocity (m3/sec)	Length (m)	Head Loss (m)	Remark
A	110	150	804	3.2	0.53	1,240	4.0	
B	110	125	536	3.7	0.51	1,010	3.7	
C	110	100	268	3.0	0.39	100	0.3	
D	110	100	268	3.0	0.39	250	0.8	
E	110	100	268	3.0	0.39	1,360	4.1	



Appendix Table 43 Rapid sand filter, Reservoir, Elevated Tank, Drain Pit, Aeration Equipment and sedimentation Tank

Commune Name			Unit	G1 Kong Tang	G2 Nhon Hoa	D2 Ea Drang	D4-1 Ea Drong
Treatment Process				Sand Filter + Disinfection	(Manganese) Sand Filter + Disinfection		Aeration + Sand Filter + Disinfection
1	Design Basis						
		Water Quantity	m³/day	636	1075	1572	668
			m³/h	26.5	44.8	65.5	27.8
			m³/min	0.44	0.75	1.09	0.46
		No. of Series	No.	2	2	2	2
		Water Quantity per Series	m³/day	318	537.5	786	334
			m³/h	13.25	22.4	32.75	13.92
			m³/min	0.22	0.37	0.55	0.23
2	Rapid Sand Filter						
		Water Quantity per Series	m³/day	318	537.5	786	334
			m³/min	0.22	0.37	0.55	0.23
		Required Filtration Speed	m/day	120	120	120	120
		Required Area	m²/filter	2.65	4.48	6.55	2.78
		Filter Size					
		Width	m	1.4	2	2.9	1.4
		Length	m	1.9	2.3	2.3	2
		Height	m	1.84	1.84	1.84	1.84
		Filter Area	m²/filter	2.66	4.6	6.67	2.8
		Filter Area	m/day	119.5	116.8	117.8	119.3
3	Reservoir						
		Water Quantity per Series	m³/day	318	537.5	786	334
			m³/h	13.25	22.4	32.75	13.92
		Reservoir Size					
		Width	m	4	4	6	4
		Length	m	9	13.5	15	9.5
		Height	m	3	3	3	3
		Volume	m³	108	162	270	114
		No. of Reservoir	No.	2	2	2	2
		Material		RC	RC	RC	RC
		Retention Time	hour	8.15	7.23	8.24	8.19
4	Elevated Tank						
		Wash Speed					
		Back Wash	m/min	0.6	0.6		0.6
		Surface Wash	m/min	0.15	0.15		0.15
		Washing Time					
		Back Wash	min	6	6		6
		Surface Wash	min	4	4		4
		Filter Area	m²/basin	2.66	4.6		2.8
		Back Washed Water Quantity per Minute	m³/min	1.596	2.76	0	1.68
		Surface Washed Water Quantity per Minute	m³/min	0.4	0.69	0	0.42
		Back Washed Water Quantity	m³	9.58	16.56	0	10.08
		Surface Washed Water Quantity	m³	1.6	2.76	0	1.68
		Total Washed Water Quantity	m³	11.18	19.32	0	11.76
			m³	12	20	29	12
		Tank Size					
		Width	m	4.4	5		
		Length	m	4.4	5		
		Effective Height	m	2	2		
		Effective Volume	m³	38.72	50		
		No. of Tank	No.	1	1		
		Material		RC	RC		
5	Drain Pit						
		Washed Water Quantity	m³	12	20	29	12

Commune Name				Unit	G1 Kong Tang	G2 Nhon Hoa	D2 Ea Drang	D4-1 Ea Drong
Treatment Process					Sand Filter + Disinfection	(Manganese) Sand Filter + Disinfection		Aeration + Sand Filter + Disinfection
		Drained Water Quantity from Filter		m^3	4.37	4.6	6.3	4.37
		Required Volume		m^3	16.37	24.6	35.3	16.37
		Pit Size						
		Width		m	3	3	4	3
		Length		m	3	5	5	3.5
		Effective Height		m	2	2	2	2
		Height		m	2.5	2.5	2.5	2.5
		Effective Volume		m^3	18	30	40	21
6	Aeration Equipment							
		Aeration Area Load		$m^3/m^2/h$				0.88
		Required Aeration Area		m^2 per Series				15.82
		Size						
		Width		m				5.2
		Length		m				2.6
		Effective Height		m				3.3
		Height		m				4
		Effective Aeration Area		m^2				13.52
		Load of Aeration		$m^3/m^2/h$				1.03
		No. of Equipment		No.				2
		Material						RC
7	Sedimentation Tank							
		Water Quantity per Series		m^3/day				334
				m^3/min				0.23
		Surface Load		mm/min				40
		Required Surface Area		m^2				5.75
		Size						
		Width		m				3
		Length		m				2.5
		Effective Height		m				3.4
		Height		m				4.5
		Effective Area		m^2				7.5
		Effective Volume		m^3				25.5
		Surface Load		mm/min				30.67
		No. of Tank		No.				2
		Material						RC

●K3-1 Dak Ui　Verification of filter (Existing)

Filtration bed area: 5.6m×2.8m＝15.68m^2

Maximum daily supply: 259m^3/day

Filtration rate: 259m^3/day÷15.68m^2＝16.5m

Therefore, this existing filter will be utilized as medium speed filter.

Appendix Table 44 Calculation for Filter Trough

System Name	Commune Name	Daily Maximum Demand (m^3/d)	Washed Water Quantity (Back Washing + Surface Washing) (m3/min)	Washed Water Quantity X 1.2 (m3/min)	Washed Water Quantity X 1.2 (m3/s)
G1	Kong Tang	636	2	2.4	0.04
G2	Nhon Hoa	1075	3.45	4.14	0.069
D2	Ea Drang	1572	5	6	0.1
D4-1	Ea Drong	668	2.1	2.52	0.042
D6	Kien Duc	933	3	3.6	0.06

Appendix Table 45 Various size of Filter Trough

System Name	Q (m3/s)	B Trough Width (m)	h0 Water Depth at Upstream Trough (m)	L Trough Length (m)	I Angle	No. of Trough
G1	0.08	0.4	0.3	1.4	1	1
G2	0.08	0.4	0.3	2.3	1	1
D2	0.16	0.4	0.3	2.3	1	2
D4-1	0.08	0.4	0.3	1.4	1	1
D6	0.08	0.4	0.3	2.3	1	1

Miller’s Formula Q=1.05B（ｈ０＋Ltani）^1.5

Appendix Table 46 Calculation for dosing amount

System Name	Commune Name	T-Fe (mg/l) (2002)	T-Fe (mg/l) (2005)	After Aeration (T-Fe× 1/2)	Design T-Fe	Mn^{2+} (mg/l) (2002)	Mn^{2+} (mg/l) (2005)	Design Mn	NH^{4+} (mg/l) (2002)	NH^{4+} (mg/l) (2005)	Design NH4+	pH (2002)	Process	Theoretical Pre-chlorination (mg/L)
K3-1	Dak Ui	3.49	0.03	1.745	1.8	0.1211	0.1800	0.2	0.1211	<0.0100	0.2	7.19	A(Modification to Existing Slow Sand Filter)	none
G1	Kong Tang	0.82	0.11		0.9	0.0130	<0.0300	0.1	0.0130	<0.0100	0.1	5.30	B+pH Adjustment	1.6
G2	Nhon Hoa	0.21	0.04		0.3	0.1950	<0.0300	0.2	0.1950	<0.0100	0.2	5.40	B (Manganese Sand) +pH Adjustment	2.1
D2	Ea Drang	0.39			0.4	0.0410		0.1	0.0410		0.1	6.42	B+pH Adjustment	2.3
D4-1	Ea Drong	3.76		1.88	1.9	0.0390		0.1	0.0390		0.1	7.85	C	2.3

A. Chlorination Dosing Amount

1)Design Basis

①Required Chlorination Amount to oxidize 1mg/l Ion

	Theoretical Value	Design Value
Fe	0.63 mg/L	0.7 mg/L
Mn	1.29 mg/L	1.3 mg/L
NH4+	7.6 mg/L	8 mg/L

②Required Chlorination Amount for Disinfection

1 mg/L

③Raw Water Quality

Cut out two place of decimals of maximum data

Taget iron concentrate is half in case of flow which has aeration.

④Chemical

7% Sodium hypochlorite

Sample Calculation : D2 Ea Drang

●Pre-chlorination	Raw Water Quality	Unit Required Chlorination Amount	Required Chlorination Amount
Fe	0.4 mg/L×	0.7 =	0.28 mg/L
Mn	0.1 mg/L×	1.3 =	0.13 mg/L
NH4+	0.1 mg/L×	8 =	0.8 mg/L
		Theoretical Value	1.21 mg/L
		Designed Value	2 mg/L

●Post-Chlorination

For Disinfection

Sub-total	1 mg/L

Water Quantity 1572 m^3/d

Liquid or Solid Liquid Sodium hypochlorite
Effective 7%

Water Quantity 1,572 m^3/day
Dosing rate

Pre-chlorination	2 mg/L as Cl_2	→Injection ratio of pre-chloronation should be integrate 3mg/L.
chlorination	1 mg/L as Cl_2	
Total	3 mg/L as Cl_2	

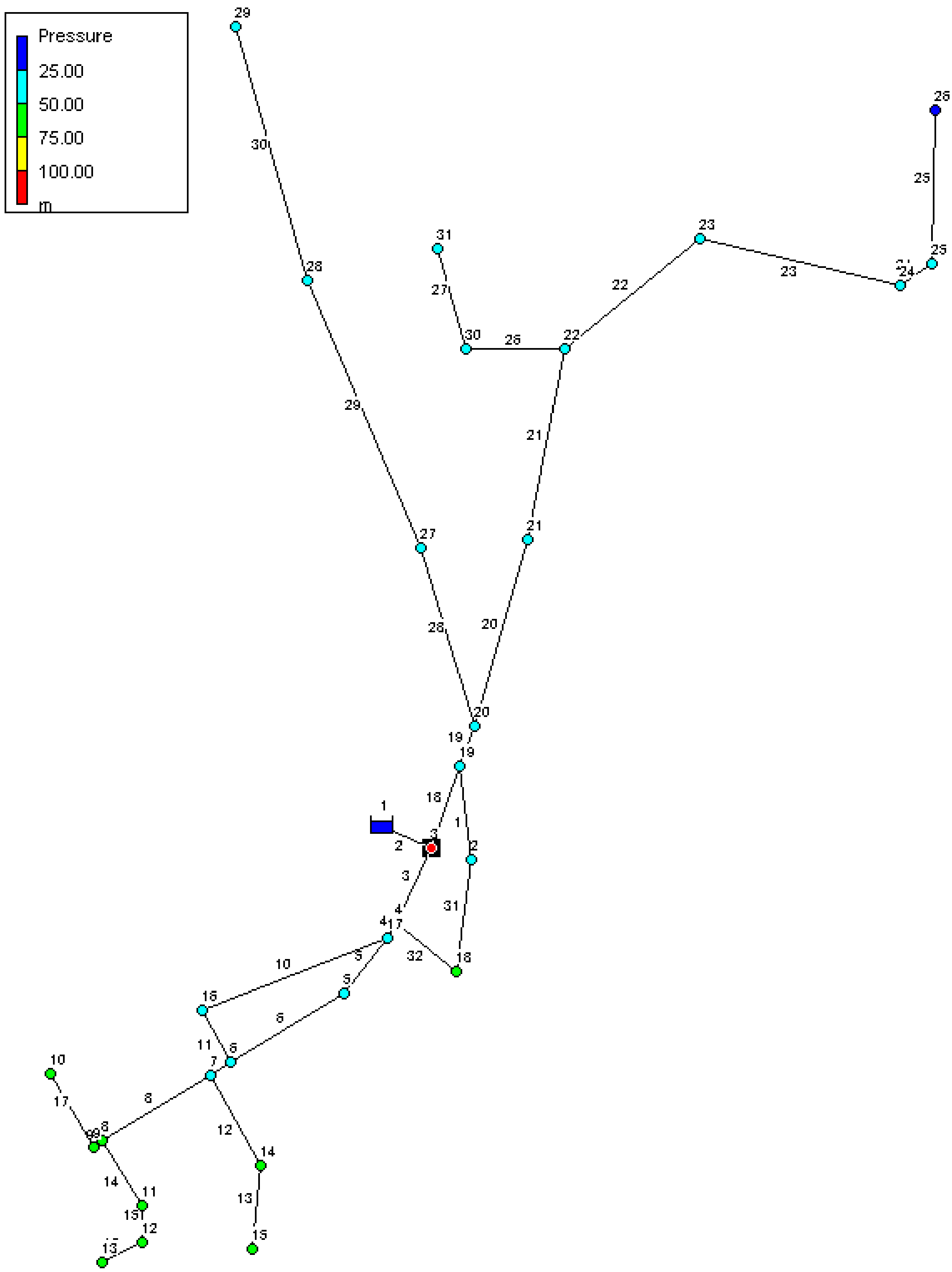
Chloride Dosing Amount	4.72 kg/day	as Cl_2
Effective	7 %	
	67.4 kg/day	7% NaClO required
Specific Gravity	1.11 kg/L	
Liquid Amount		
V=	61 L/day	
Pre-Chlorination	40 L/day	
Post-	20 L/day	
Storage Tank		
Storage Period	5 days equivalent	
Storage Volume foe Pre-chlorination	0.20 m^3	
	0.2 m^3	Minimum Tank Volume
Storage Period	5 days equivalent	
Storage Volume foe Post-	0.10 m^3	
	0.2 m^3	Minimum Tank Volume
Storage Tank Volume		
Volume	0.2 m^3	
No. of Tank	2 No.	
Material	PVC	

B. Dosing Amount

1)Design Basis
①ppm

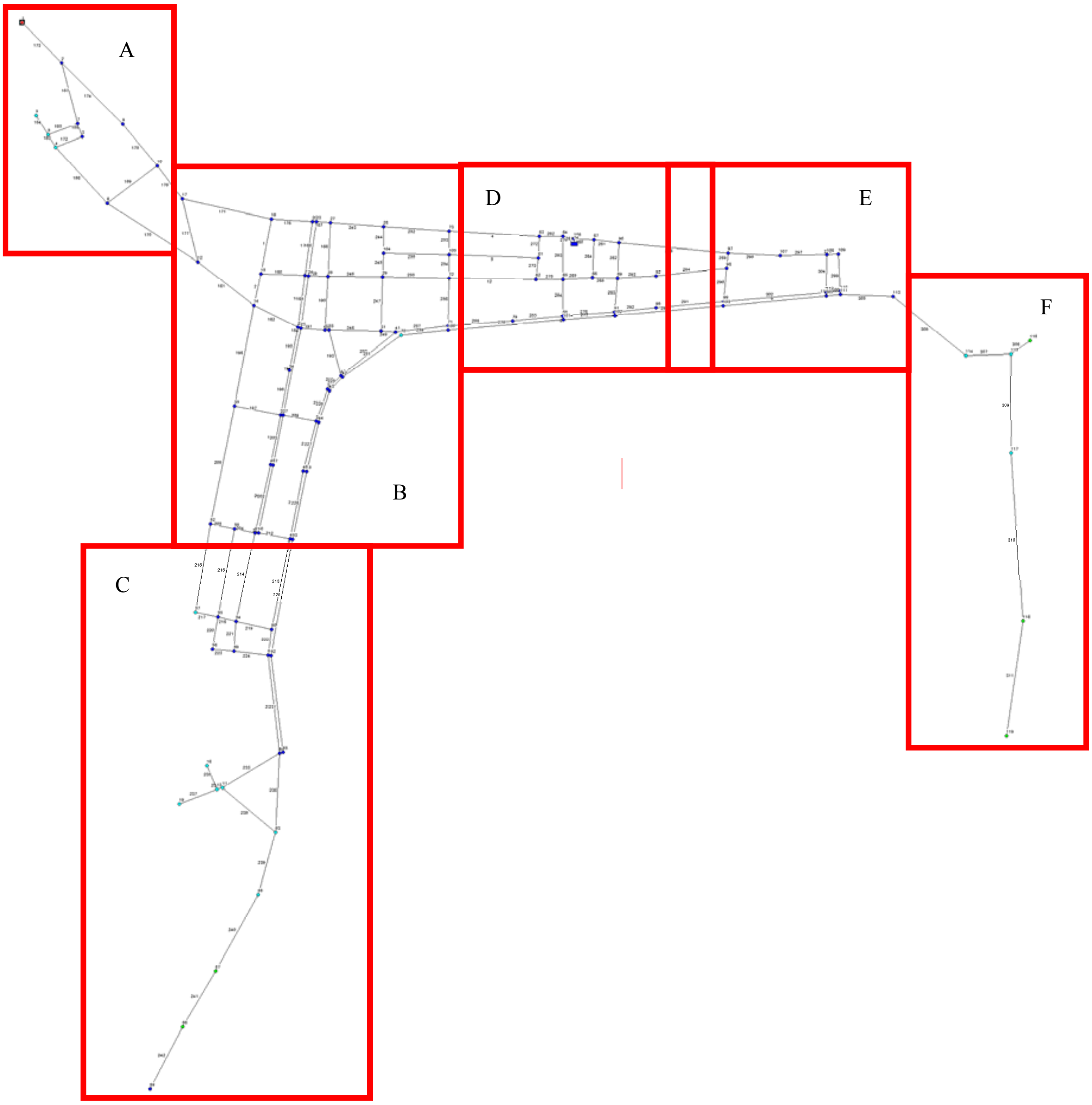
Sample Calculation : D2 Ea Drang

Water Quantity	1572	m^3/d	
Liquid or Solid	Liquid	Sodium hydrate	
Effective	32%		
Water Quantity	1,572	m^3/day	
Dosing Ratio			
		10 mg/L	
Dosing Amount	15.72	kg/day	
Effective	32	%	
32% NaOH Required Amount	49.1	kg/day	
Specific Gravity	1.35	kg/L	
Liquid Amount V=	36	L/day	
Tank			
Storage Period	5	days equivalent	This is diluted as needed, in this case, storage days will be short.
Storage Volume	0.18	m^3	
	0.2	m^3	Minimum Tank Volume
Storage Volume			
Volume	0.2	m^3	
No. of Tank	1	No.	
Material	PVC		

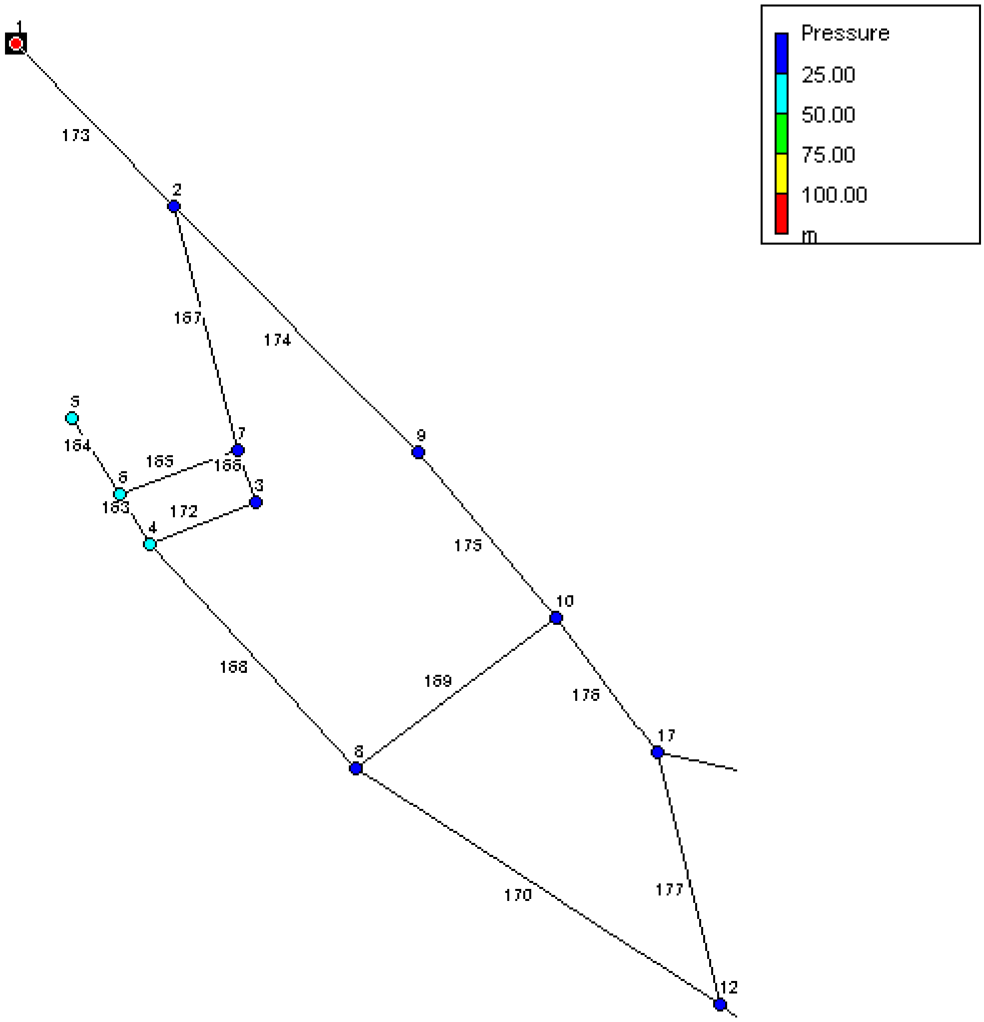


K3-1 Dak Ui Distribution Network

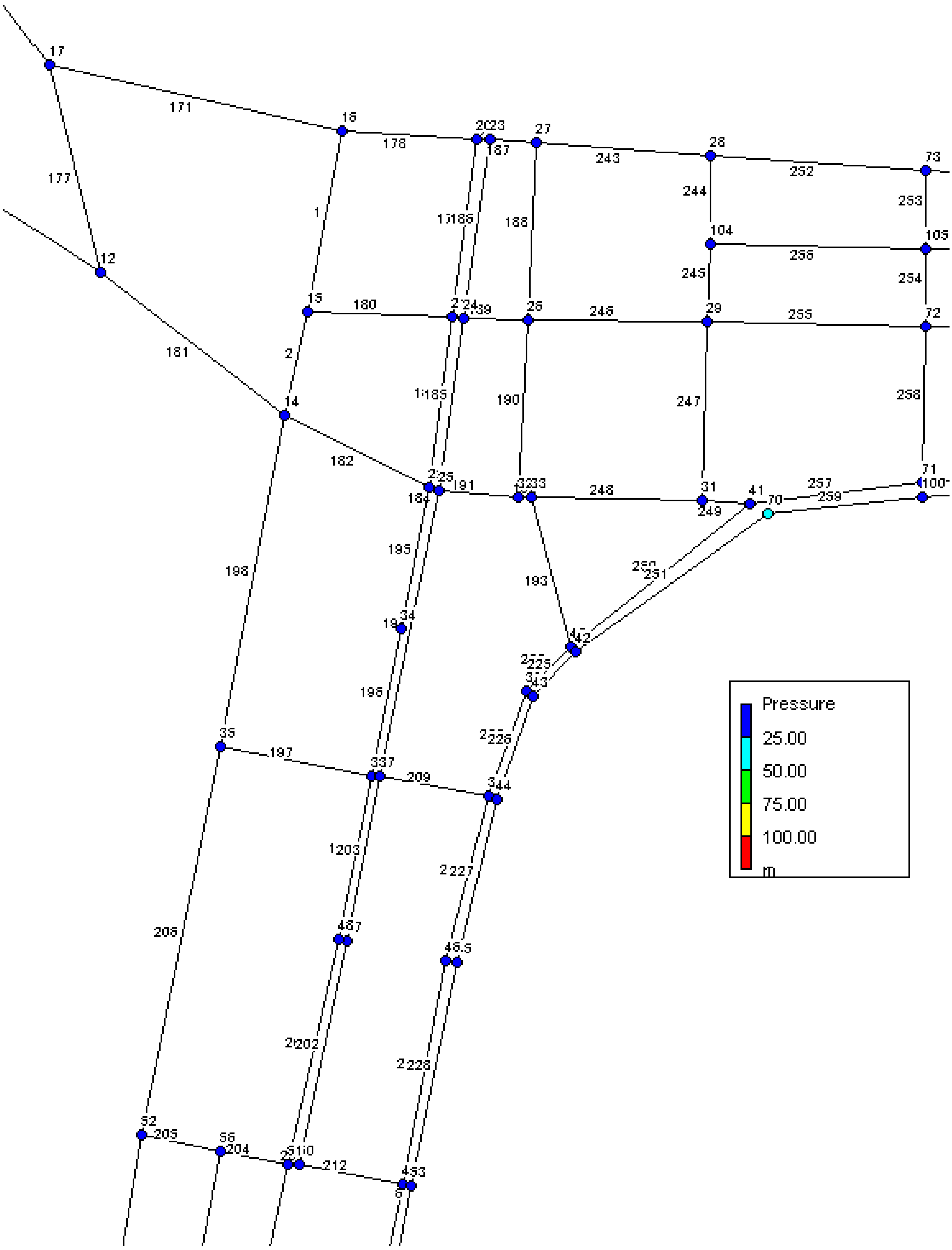
Network Table - Nodes				Network Table - Links			
Node ID	Demand m^3/d	Head m	Pressure m	Link ID	Flow m^3/d	Velocity m/s	Head loss m/km
Junc 3	34.4	714.9	29.9	Pipe 2	515.6	0.3	1.15
Junc 4	27.2	714.5	37.5	Pipe 3	226.6	0.3	1.90
Junc 5	17.2	714.1	42.1	Pipe 4	169.2	0.3	1.09
Junc 6	17.2	713.7	44.2	Pipe 5	109.9	0.3	2.09
Junc 7	17.2	713.6	44.6	Pipe 6	92.7	0.2	1.51
Junc 8	17.2	712.9	59.9	Pipe 7	90.4	0.2	1.44
Junc 9	0.0	712.9	63.9	Pipe 8	38.8	0.2	2.32
Junc 10	7.2	712.9	62.9	Pipe 9	7.2	0.0	0.05
Junc 11	7.2	712.9	56.9	Pipe 10	32.1	0.2	1.62
Junc 12	0.0	712.9	57.9	Pipe 11	14.9	0.1	0.39
Junc 13	7.2	712.9	59.9	Pipe 12	34.4	0.2	1.85
Junc 14	17.2	713.2	56.2	Pipe 13	17.2	0.1	0.51
Junc 15	17.2	713.1	58.6	Pipe 14	14.4	0.1	0.37
Junc 16	17.2	713.7	29.9	Pipe 15	7.2	0.0	0.06
Junc 17	27.2	714.5	38.5	Pipe 16	7.2	0.0	0.06
Junc 18	25.6	714.3	57.3	Pipe 17	7.2	0.0	0.06
Junc 19	27.2	714.4	42.4	Pipe 18	254.6	0.4	2.38
Junc 20	27.2	714.2	45.7	Pipe 19	206.4	0.3	1.59
Junc 21	17.2	713.9	47.9	Pipe 20	137.6	0.2	0.73
Junc 22	17.2	713.7	43.7	Pipe 21	120.4	0.2	0.57
Junc 23	17.2	713.0	37.0	Pipe 22	68.8	0.2	1.79
Junc 24	17.2	712.5	38.5	Pipe 23	51.6	0.2	1.04
Junc 25	17.2	712.3	37.8	Pipe 24	34.4	0.2	1.85
Junc 26	17.2	712.1	24.1	Pipe 25	17.2	0.1	0.51
Junc 27	17.2	713.1	43.1	Pipe 26	34.4	0.2	1.85
Junc 28	17.2	712.5	38.5	Pipe 27	17.2	0.1	0.51
Junc 29	7.2	712.5	26.5	Pipe 28	41.6	0.3	2.65
Junc 30	17.2	713.3	45.3	Pipe 29	24.4	0.1	0.97
Junc 31	17.2	713.1	36.1	Pipe 30	7.2	0.0	0.06
Junc 2	25.6	714.2	44.2	Pipe 1	21.0	0.1	0.74
Resvr 1		715.0		Pipe 31	-4.6	0.0	0.04
				Pipe 32	30.2	0.2	1.44



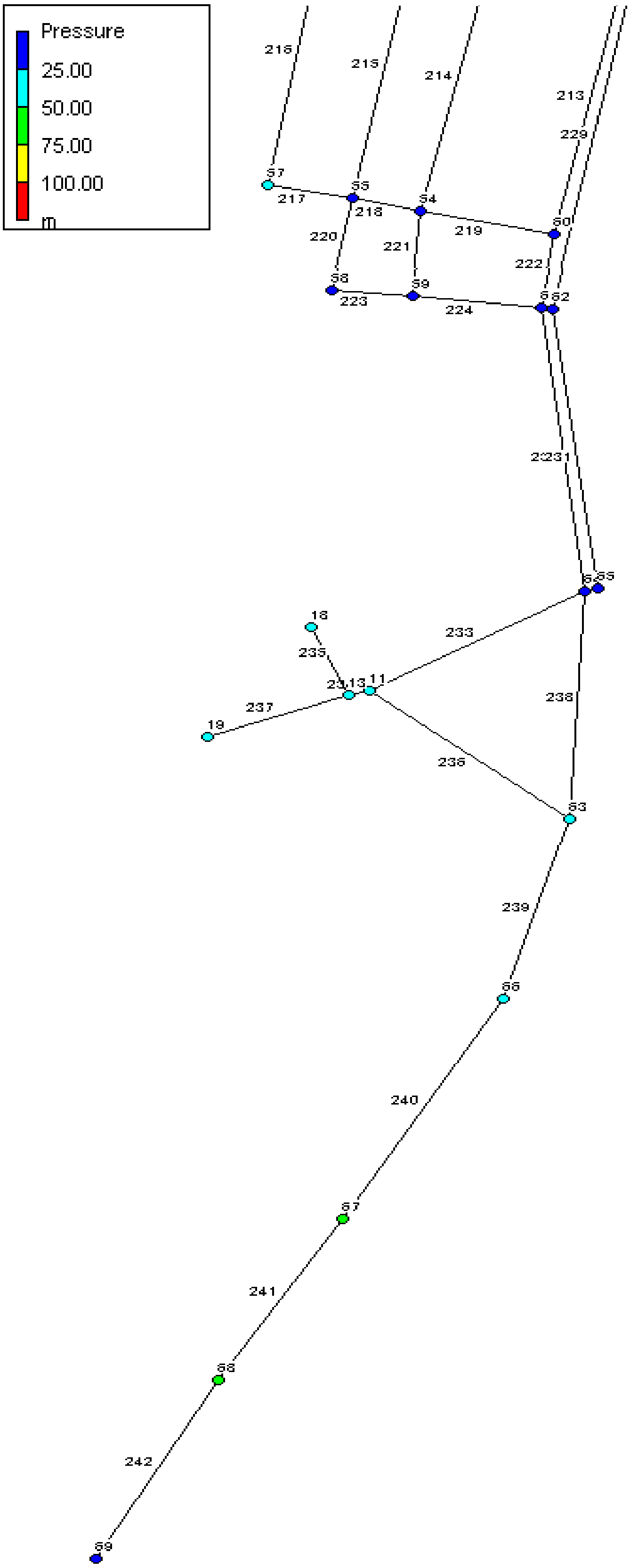
G1 Kong Tang Key Map



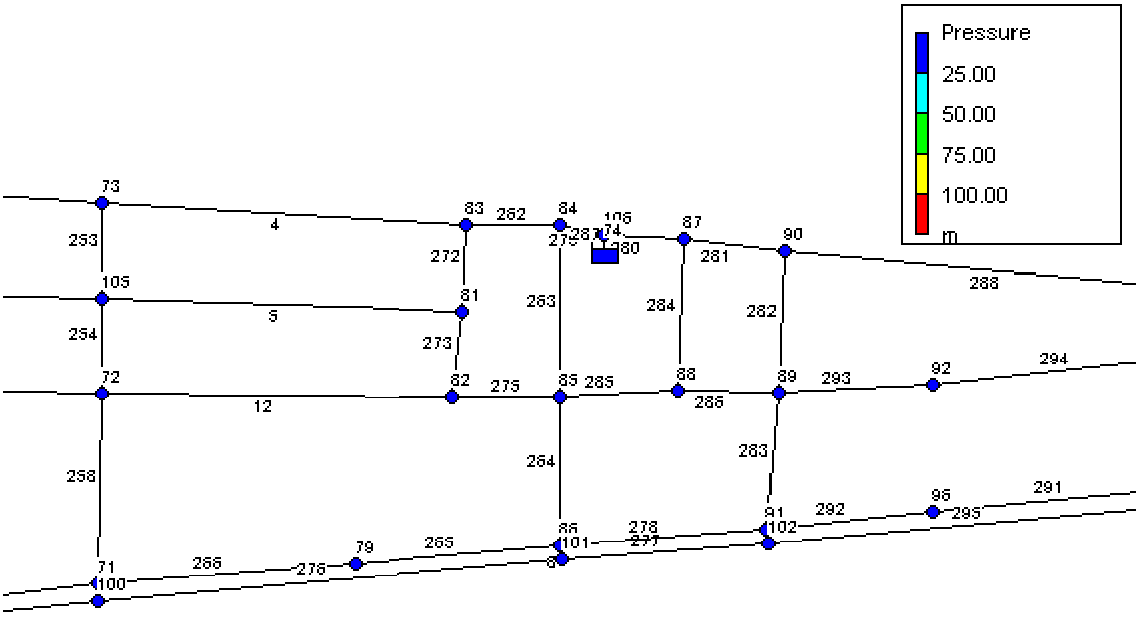
G1 Kong Tang Distribution Network (A)



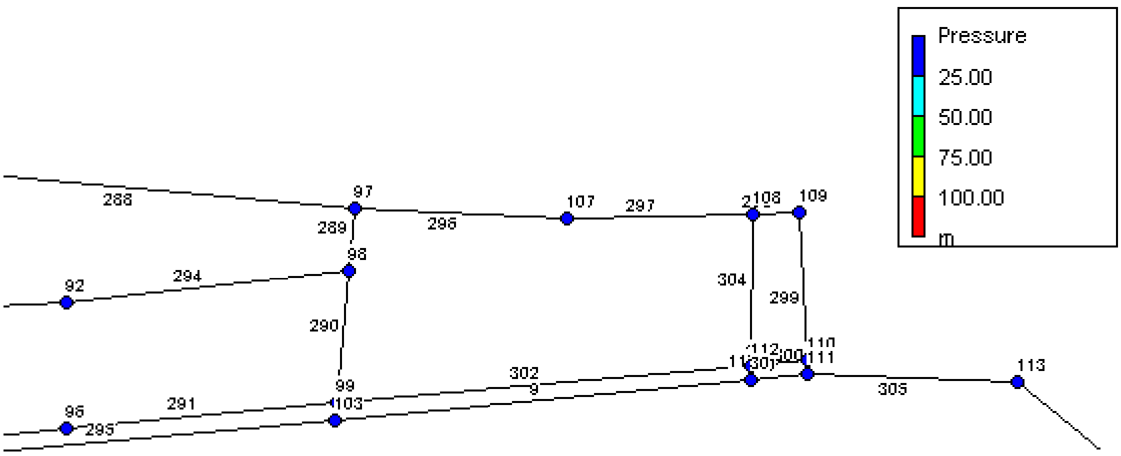
G1 Kong Tang Distribution Network (B)



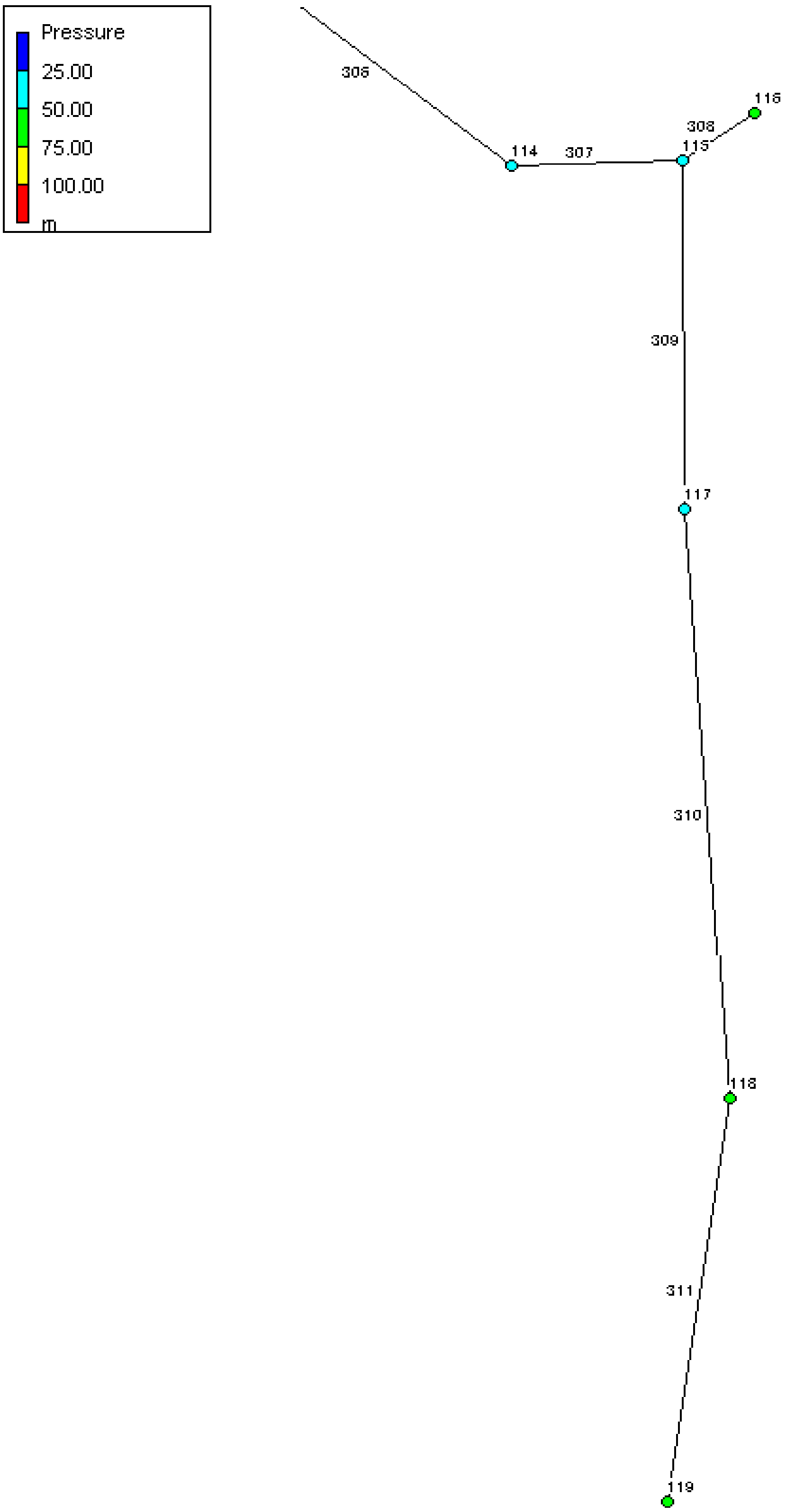
G1 Kong Tang Distribution Network (C)



G1 Kong Tang Distribution Network (D)



G1 Kong Tang Distribution Network (E)



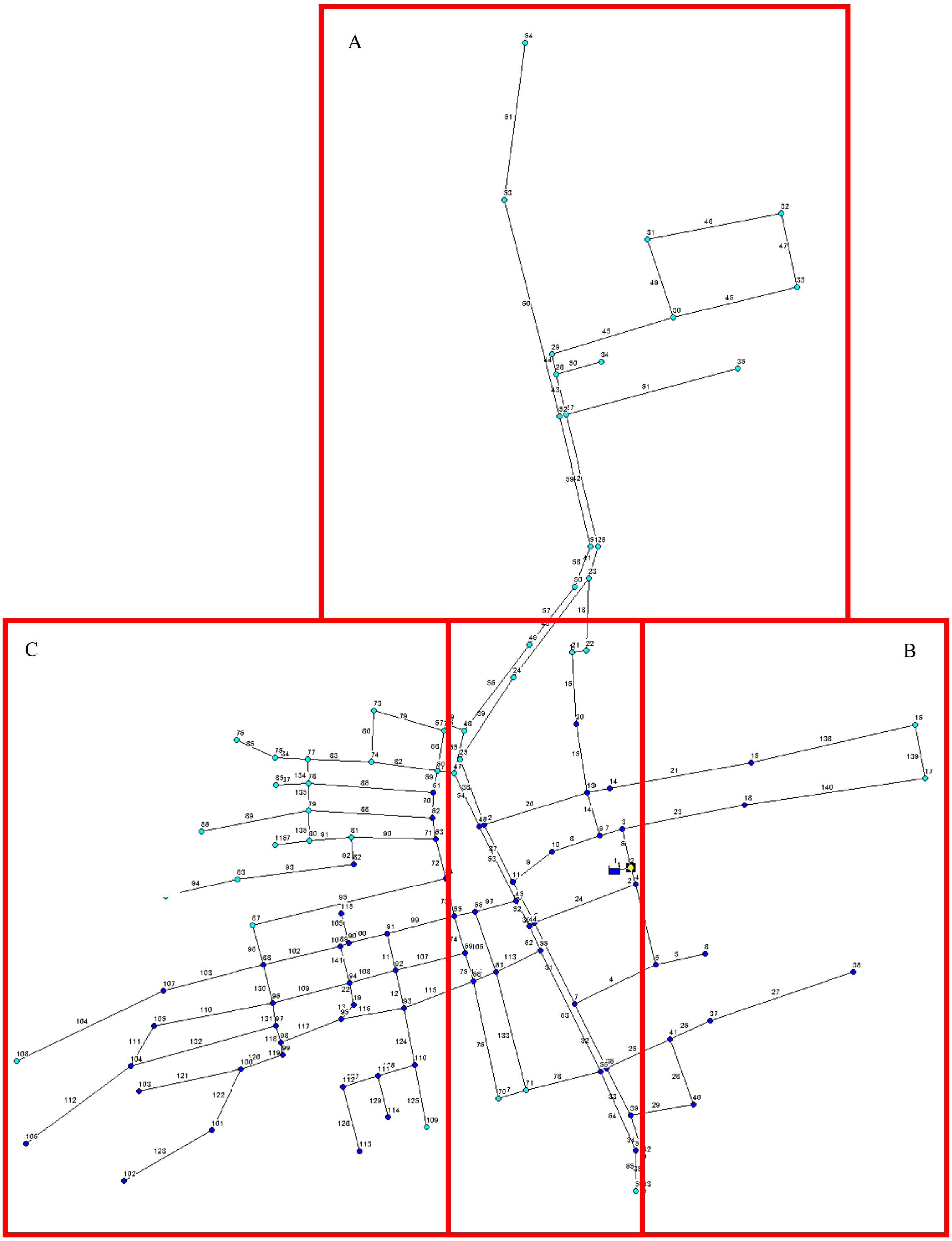
G1 Kong Tang Distribution Network (F)

Network Table - Nodes				Network Table - Links			
	Demand	Head	Pressure		Flow	Velocity	Head loss
Node ID	m^3/d	m	m	Link ID	m^3/d	m/s	m/km
Junc 1	5.2	749.4	29.4	Pipe 163	8.0	0.1	0.07
Junc 2	5.2	749.4	24.2	Pipe 164	5.2	0.0	0.04
Junc 3	5.2	749.3	24.3	Pipe 165	-2.4	0.0	0.02
Junc 4	5.2	749.4	29.4	Pipe 166	-2.3	0.0	0.02
Junc 5	5.2	749.3	34.1	Pipe 167	-9.9	0.1	0.12
Junc 6	5.2	749.3	33.8	Pipe 168	-16.1	0.1	0.45
Junc 7	5.2	749.3	24.2	Pipe 169	-8.1	0.1	0.07
Junc 8	5.2	749.5	23.6	Pipe 170	-13.2	0.1	0.31
Junc 9	5.2	749.4	14.0	Pipe 171	-69.2	0.2	0.63
Junc 10	11.2	749.5	9.5	Pipe 172	2.9	0.0	0.02
Junc 12	11.2	749.6	14.4	Pipe 173	-5.2	0.0	0.04
Junc 14	11.2	749.6	14.6	Pipe 174	-20.3	0.1	0.19
Junc 15	11.2	749.6	9.4	Pipe 175	-25.5	0.1	0.28
Junc 16	11.2	749.8	7.0	Pipe 176	-44.8	0.2	0.80
Junc 17	11.2	749.6	10.7	Pipe 177	13.2	0.1	0.06
Junc 20	11.2	749.9	8.0	Pipe 178	-100.9	0.2	1.28
Junc 21	11.2	749.7	8.5	Pipe 179	31.8	0.2	1.59
Junc 22	11.2	749.6	10.7	Pipe 180	9.3	0.1	0.10
Junc 23	11.2	750.0	7.2	Pipe 181	-11.2	0.0	0.04
Junc 24	11.2	749.9	8.7	Pipe 182	-45.4	0.1	0.29
Junc 25	11.2	749.6	10.7	Pipe 183	-11.3	0.1	0.18
Junc 26	11.2	749.9	8.7	Pipe 184	-74.9	0.2	0.72
Junc 27	11.2	750.1	7.3	Pipe 185	-29.1	0.2	1.35
Junc 28	11.2	750.4	9.4	Pipe 186	-18.4	0.1	0.58
Junc 29	5.2	750.2	12.2	Pipe 187	-173.5	0.4	3.60
Junc 31	5.2	749.8	18.8	Pipe 188	28.0	0.2	1.25
Junc 32	5.2	749.7	14.7	Pipe 189	21.9	0.1	0.79
Junc 33	5.2	749.7	14.7	Pipe 190	28.4	0.2	1.29
Junc 34	11.2	749.4	14.4	Pipe 191	74.7	0.2	0.72
Junc 35	11.2	749.3	12.3	Pipe 192	-51.5	0.1	0.36
Junc 36	11.2	749.3	14.3	Pipe 193	16.6	0.0	0.01
Junc 37	11.2	749.5	14.5	Pipe 194	17.7	0.1	0.54
Junc 38	11.2	749.5	21.5	Pipe 195	29.6	0.2	1.39
Junc 39	11.2	749.6	21.6	Pipe 196	18.4	0.1	0.58
Junc 40	11.2	749.7	21.7	Pipe 197	-6.0	0.0	0.05
Junc 41	11.2	749.9	19.9	Pipe 198	41.6	0.1	0.69
Junc 42	17.2	750.2	22.2	Pipe 199	13.2	0.1	0.31
Junc 43	17.2	750.1	22.1	Pipe 200	2.0	0.0	0.02
Junc 44	17.2	749.9	21.9	Pipe 201	-67.9	0.2	1.74
Junc 45	11.2	749.8	19.8	Pipe 202	-10.9	0.1	0.17
Junc 46	11.2	749.5	19.5	Pipe 203	-22.1	0.1	0.80
Junc 47	11.2	749.3	14.3	Pipe 204	37.1	0.1	0.56
Junc 48	11.2	749.3	14.3	Pipe 205	6.2	0.0	0.02
Junc 49	11.2	749.5	19.5	Pipe 206	-24.3	0.1	0.26

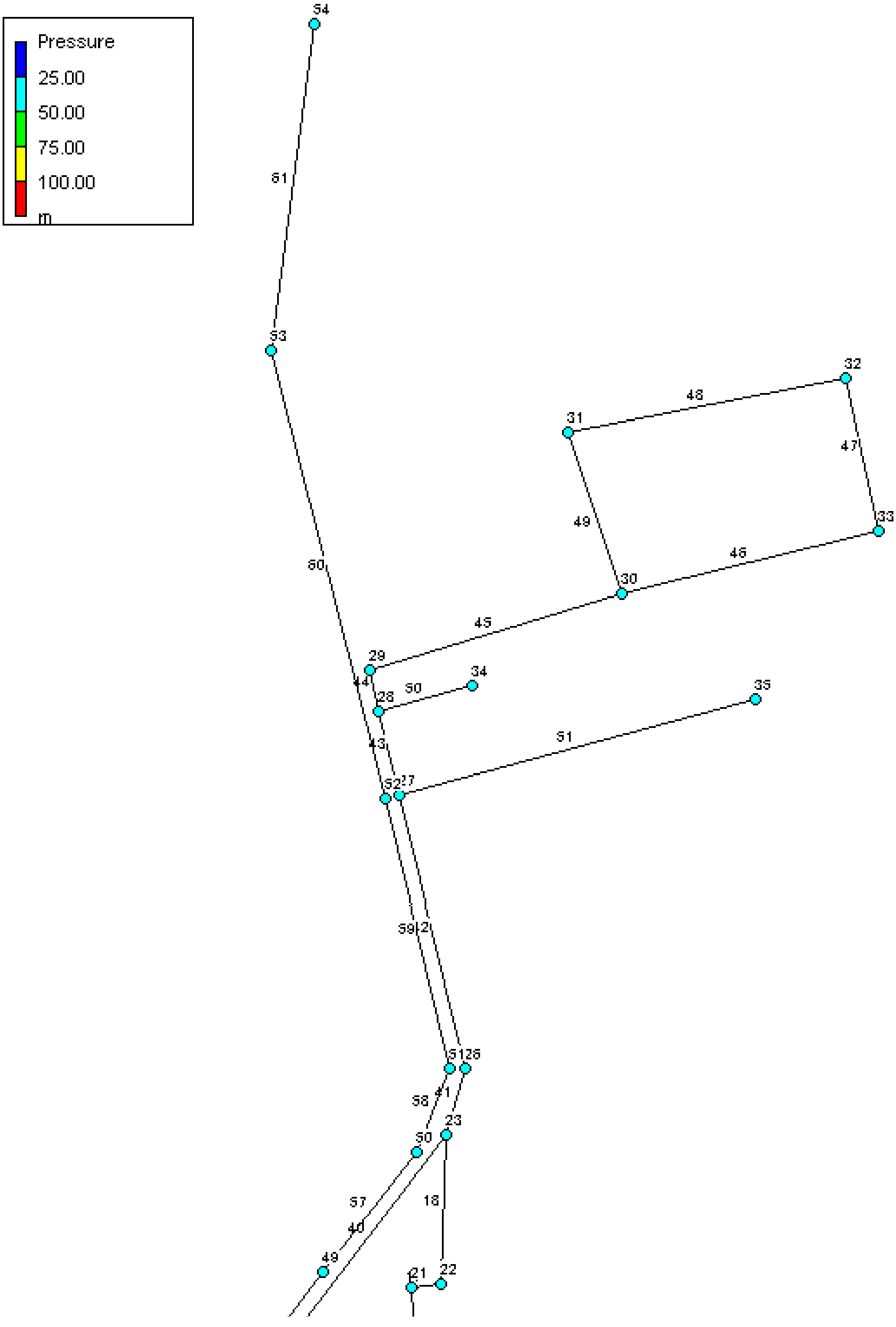
Network Table - Nodes				Network Table - Links			
	Demand	Head	Pressure		Flow	Velocity	Head loss
Node ID	m^3/d	m	m	Link ID	m^3/d	m/s	m/km
Junc 50	11.2	749.3	16.3	Pipe 207	56.9	0.2	1.25
Junc 51	11.2	749.3	16.3	Pipe 208	45.7	0.2	0.83
Junc 52	11.2	749.2	14.2	Pipe 209	15.5	0.1	0.42
Junc 53	11.2	749.5	19.5	Pipe 210	19.0	0.1	0.17
Junc 54	11.2	749.1	23.1	Pipe 211	7.8	0.0	0.02
Junc 55	11.2	749.1	23.1	Pipe 212	68.2	0.2	1.76
Junc 56	11.2	749.2	14.2	Pipe 213	57.8	0.2	1.28
Junc 57	11.2	749.1	25.1	Pipe 214	21.6	0.1	0.77
Junc 58	11.2	749.0	25.0	Pipe 215	19.7	0.1	0.66
Junc 59	11.2	749.0	23.0	Pipe 216	19.3	0.1	0.63
Junc 60	5.2	749.1	22.1	Pipe 217	8.1	0.1	0.07
Junc 61	5.2	748.9	21.3	Pipe 218	-3.1	0.0	0.02
Junc 62	11.2	749.5	21.9	Pipe 219	-14.6	0.1	0.38
Junc 64	5.2	748.8	23.8	Pipe 220	19.7	0.1	0.66
Junc 65	5.2	749.5	24.5	Pipe 221	21.9	0.1	0.79
Junc 11	5.2	748.7	35.7	Pipe 222	38.0	0.2	2.23
Junc 13	5.2	748.7	35.7	Pipe 223	8.5	0.1	0.08
Junc 18	5.2	748.7	35.7	Pipe 224	19.2	0.1	0.62
Junc 19	5.2	748.7	44.2	Pipe 225	202.6	0.3	1.53
Junc 63	5.2	748.7	35.7	Pipe 226	185.4	0.3	1.29
Junc 66	5.2	748.6	43.6	Pipe 227	168.2	0.3	1.07
Junc 67	5.2	748.4	56.4	Pipe 228	157.0	0.2	0.94
Junc 68	5.2	748.4	66.5	Pipe 229	16.4	0.1	0.12
Junc 69	5.2	748.4	23.4	Pipe 230	52.0	0.1	0.37
Junc 70	17.2	750.6	25.1	Pipe 231	5.2	0.0	0.01
Junc 71	11.2	750.6	14.6	Pipe 233	16.8	0.1	0.49
Junc 72	5.2	750.7	11.8	Pipe 234	15.6	0.1	0.43
Junc 73	11.2	750.9	10.9	Pipe 235	5.2	0.0	0.04
Junc 79	11.2	751.2	12.2	Pipe 236	-4.1	0.0	0.03
Junc 81	11.2	751.5	9.6	Pipe 237	5.2	0.0	0.04
Junc 82	5.2	751.5	10.5	Pipe 238	30.1	0.1	0.38
Junc 83	11.2	751.7	9.7	Pipe 239	20.8	0.1	0.72
Junc 84	17.2	751.9	9.9	Pipe 240	15.6	0.1	0.43
Junc 85	23.2	751.9	10.9	Pipe 241	10.4	0.1	0.15
Junc 86	23.2	751.8	12.3	Pipe 242	5.2	0.0	0.04
Junc 87	17.2	751.9	9.9	Pipe 243	-212.7	0.3	1.68
Junc 88	23.2	751.8	10.8	Pipe 244	11.2	0.1	0.19
Junc 89	17.2	751.7	11.7	Pipe 245	39.5	0.2	2.40
Junc 90	17.2	751.8	10.8	Pipe 246	33.5	0.2	1.76
Junc 91	23.2	751.7	12.8	Pipe 247	39.0	0.2	2.34
Junc 92	11.2	751.6	12.7	Pipe 248	73.3	0.2	0.70
Junc 96	23.2	751.6	13.7	Pipe 249	-39.4	0.2	2.39
Junc 97	11.2	751.6	16.1	Pipe 250	-51.5	0.2	1.03
Junc 98	11.2	751.6	13.7	Pipe 251	-219.8	0.3	1.79

Network Table - Nodes				Network Table - Links			
	Demand	Head	Pressure		Flow	Velocity	Head loss
Node ID	m^3/d	m	m	Link ID	m^3/d	m/s	m/km
Junc 99	17.2	751.6	18.6	Pipe 252	-235.1	0.4	2.04
Junc 100	23.2	750.9	14.9	Pipe 253	24.2	0.1	0.95
Junc 101	35.2	751.8	12.3	Pipe 254	24.3	0.1	0.97
Junc 102	29.2	751.8	12.9	Pipe 255	38.2	0.2	2.25
Junc 103	17.2	751.7	18.7	Pipe 256	-33.6	0.2	1.76
Junc 104	5.2	750.4	10.4	Pipe 257	-102.2	0.4	3.80
Junc 105	5.2	750.8	11.3	Pipe 258	-22.8	0.1	0.86
Junc 106	17.2	752.0	10.0	Pipe 259	-237.0	0.4	2.07
Junc 107	11.2	750.8	17.8	Pipe 262	-323.1	0.5	3.77
Junc 108	11.2	750.3	22.1	Pipe 263	667.8	0.3	0.43
Junc 109	11.2	750.3	22.1	Pipe 264	564.3	0.2	0.31
Junc 110	11.2	750.2	17.2	Pipe 265	101.8	0.4	3.77
Junc 111	11.2	750.2	17.2	Pipe 266	90.6	0.3	3.02
Junc 112	11.2	750.3	15.3	Pipe 272	41.5	0.2	2.63
Junc 113	11.2	750.2	22.9	Pipe 273	-8.7	0.1	0.08
Junc 114	11.2	750.1	36.1	Pipe 275	-55.8	0.3	4.63
Junc 115	11.2	750.1	48.1	Pipe 276	-260.2	0.4	2.48
Junc 116	11.2	750.1	54.1	Pipe 277	98.2	0.1	0.39
Junc 117	11.2	749.9	49.9	Pipe 278	45.7	0.2	0.83
Junc 118	11.2	749.5	53.5	Pipe 279	-1008.1	0.4	0.95
Junc 119	11.2	749.4	51.4	Pipe 280	206.7	0.3	1.59
Junc 30	11.2	750.3	15.3	Pipe 281	169.1	0.3	1.09
Resvr 74		752.0		Pipe 282	36.0	0.1	0.53
				Pipe 283	18.9	0.1	0.16
				Pipe 284	20.4	0.1	0.70
				Pipe 285	24.6	0.1	0.99
				Pipe 286	21.8	0.1	0.79
				Pipe 287	-1232.0	0.5	1.40
				Pipe 288	115.9	0.2	0.53
				Pipe 289	49.0	0.1	0.11
				Pipe 290	48.4	0.1	0.11
				Pipe 291	-18.2	0.1	0.15
				Pipe 292	-41.4	0.1	0.69
				Pipe 293	21.7	0.1	0.78
				Pipe 294	10.5	0.1	0.15
				Pipe 295	69.0	0.1	0.20
				Pipe 296	55.7	0.3	4.61
				Pipe 297	44.5	0.3	3.00
				Pipe 298	28.5	0.2	1.30
				Pipe 299	17.3	0.1	0.51
				Pipe 300	44.9	0.3	3.05
				Pipe 302	49.3	0.3	3.66
				Pipe 303	38.8	0.2	2.32
				Pipe 304	4.8	0.0	0.04

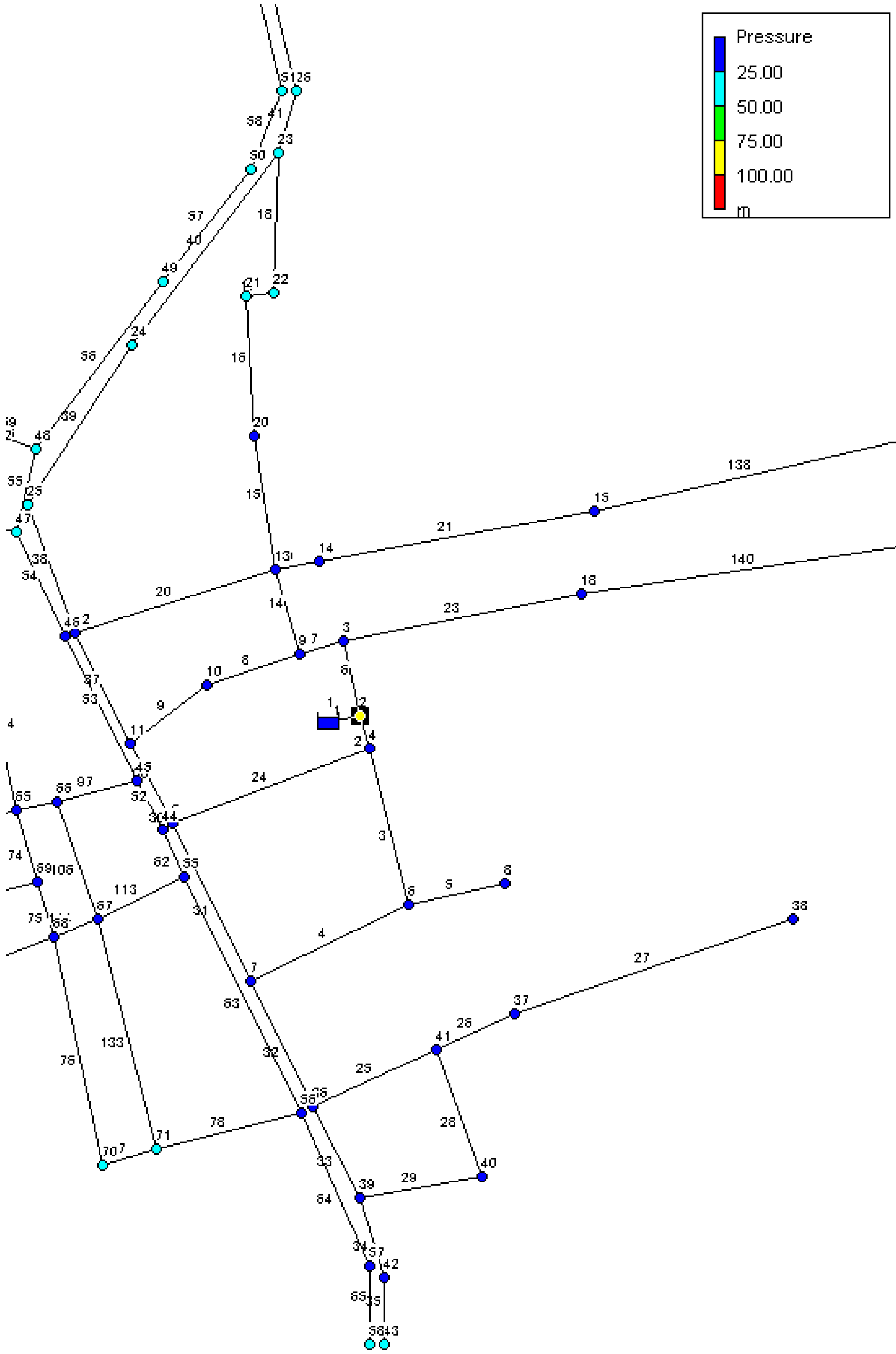
Network Table - Nodes				Network Table - Links			
	Demand	Head	Pressure		Flow	Velocity	Head loss
Node ID	m^3/d	m	m	Link ID	m^3/d	m/s	m/km
				Pipe 305	78.4	0.1	0.26
				Pipe 306	67.2	0.1	0.19
				Pipe 307	56.0	0.1	0.14
				Pipe 308	11.2	0.1	0.19
				Pipe 309	33.6	0.1	0.47
				Pipe 310	22.4	0.1	0.83
				Pipe 311	11.2	0.1	0.19
				Pipe 1	20.5	0.1	0.71
				Pipe 2	18.6	0.1	0.59
				Pipe 6	-129.4	0.5	6.00
				Pipe 7	143.9	0.3	2.51
				Pipe 8	393.6	0.2	0.16
				Pipe 9	51.8	0.3	4.02
				Pipe 10	44.8	0.3	3.04
				Pipe 11	4.1	0.0	0.04
				Pipe 4	-270.4	0.4	2.67
				Pipe 5	-38.9	0.2	2.33
				Pipe 12	-41.9	0.3	2.68



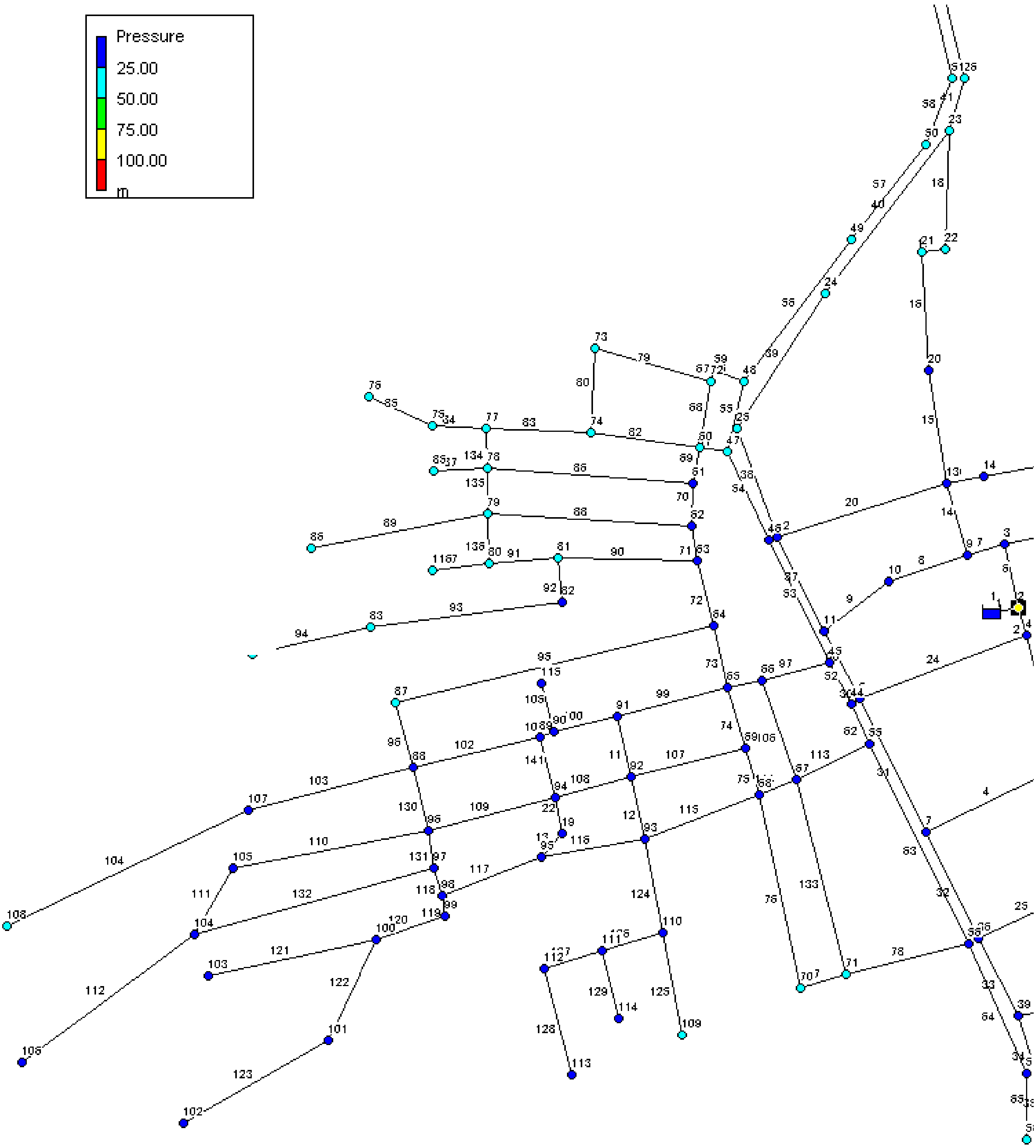
G2 Nhon Hoa Key Map



G2 Nhon Hoa Distribution Network (A)



G2 Nhon Hoa Distribution Network (B)



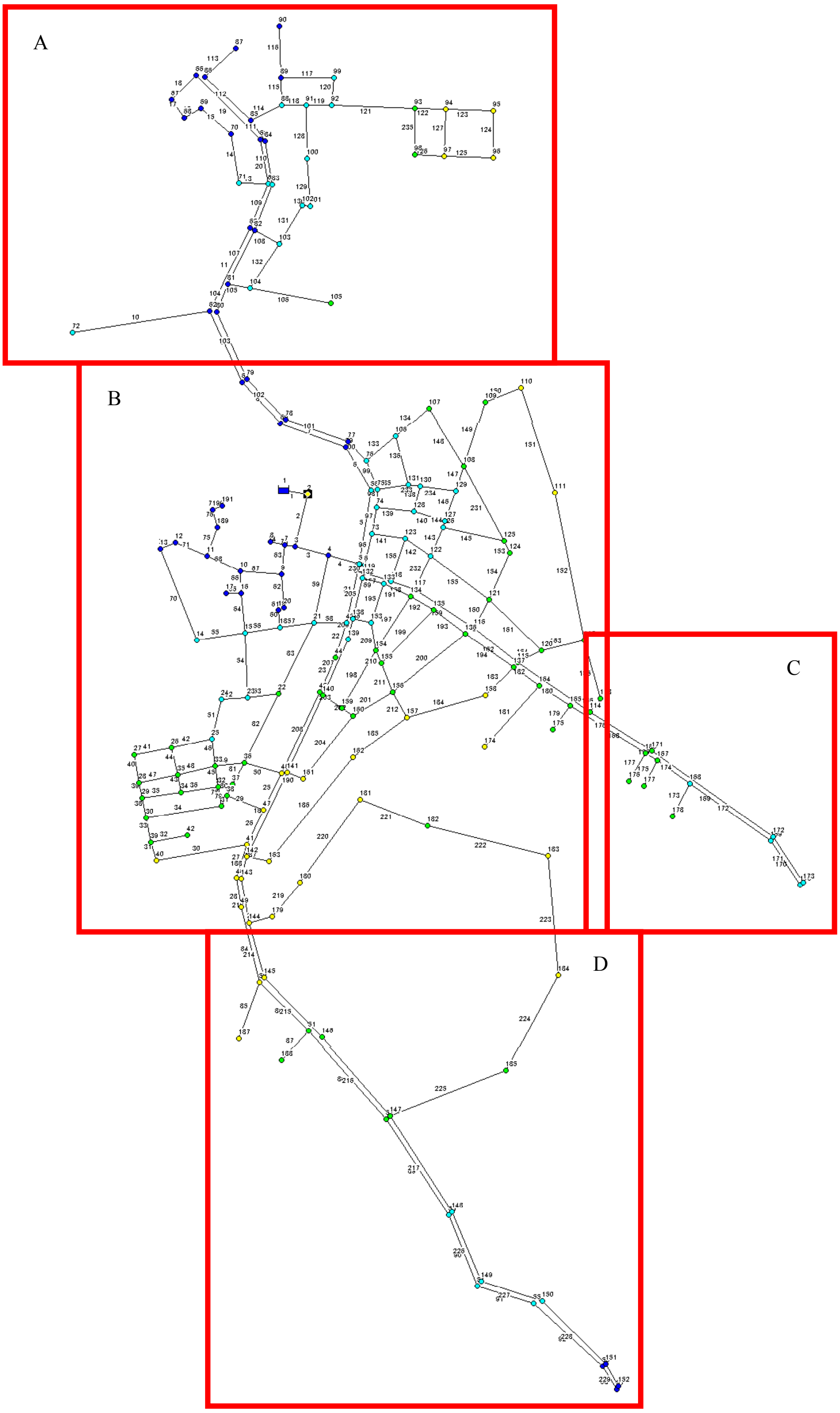
G2 Nhon Hoa Distribution Network (C)

Network Table - Nodes				Network Table - Links			
Node ID	Demand m^3/d	Head m	Pressure m	Link ID	Flow m^3/d	Velocity m/s	Head loss m/km
Junc 2	16.6	431.9	11.9	Pipe 1	1908.4	0.5	1.04
Junc 3	16.6	431.9	14.9	Pipe 2	1683.2	0.4	0.81
Junc 4	16.6	431.9	11.9	Pipe 3	85.9	0.2	0.94
Junc 5	16.6	431.6	14.6	Pipe 4	52.7	0.1	0.38
Junc 6	16.6	431.6	9.6	Pipe 5	16.6	0.1	0.48
Junc 7	16.6	431.5	15.5	Pipe 6	208.6	0.1	0.21
Junc 8	16.6	431.5	8.3	Pipe 7	148.2	0.5	7.81
Junc 9	16.6	431.3	14.3	Pipe 8	13.4	0.1	0.06
Junc 10	16.6	431.2	15.2	Pipe 9	-3.3	0.0	0.01
Junc 11	16.6	431.3	15.8	Pipe 14	118.3	0.4	5.04
Junc 12	16.6	430.8	20.3	Pipe 15	87.4	0.3	2.82
Junc 13	16.6	430.4	16.4	Pipe 16	70.8	0.3	1.89
Junc 14	16.6	430.2	16.2	Pipe 17	54.2	0.2	1.14
Junc 15	16.6	429.8	21.3	Pipe 18	37.6	0.1	0.57
Junc 16	16.6	429.8	31.3	Pipe 19	-39.2	0.2	2.37
Junc 17	16.6	429.8	27.8	Pipe 20	-24.9	0.2	1.01
Junc 18	16.6	430.6	15.6	Pipe 21	22.6	0.1	0.84
Junc 20	16.6	429.7	24.2	Pipe 23	-43.8	0.3	2.92
Junc 21	16.6	429.2	33.2	Pipe 24	1580.7	0.4	0.72
Junc 22	16.6	429.2	33.2	Pipe 25	55.3	0.2	1.18
Junc 23	16.6	429.0	43.0	Pipe 26	33.2	0.2	1.73
Junc 24	16.6	430.2	35.2	Pipe 27	16.6	0.1	0.48
Junc 25	16.6	430.5	26.5	Pipe 28	5.5	0.0	0.04
Junc 26	16.6	428.6	45.6	Pipe 29	-11.1	0.1	0.18
Junc 27	16.6	427.4	44.4	Pipe 30	1227.8	0.3	0.44
Junc 28	16.6	426.6	40.6	Pipe 31	96.7	0.1	0.38
Junc 29	16.6	426.5	39.5	Pipe 32	132.8	0.3	2.15
Junc 30	16.6	425.7	44.7	Pipe 33	60.9	0.2	1.42
Junc 31	16.6	425.3	44.3	Pipe 34	33.2	0.1	0.46
Junc 32	16.6	425.3	48.3	Pipe 35	16.6	0.1	0.12
Junc 33	16.6	425.3	46.5	Pipe 36	239.6	0.4	2.12
Junc 34	16.6	426.6	45.6	Pipe 37	219.7	0.3	1.79
Junc 35	16.6	427.1	49.1	Pipe 38	178.2	0.3	1.20
Junc 36	16.6	430.9	18.9	Pipe 39	161.6	0.2	1.00
Junc 37	16.6	430.3	7.3	Pipe 40	145.0	0.3	2.55
Junc 38	16.6	430.1	12.1	Pipe 41	166.0	0.4	3.31
Junc 39	16.6	430.7	19.2	Pipe 42	149.4	0.3	2.70
Junc 40	16.6	430.6	14.1	Pipe 43	116.2	0.4	4.87
Junc 41	16.6	430.6	11.1	Pipe 44	83.0	0.3	2.55
Junc 42	16.6	430.6	21.6	Pipe 45	66.4	0.2	1.67
Junc 43	16.6	430.6	27.1	Pipe 46	22.9	0.1	0.86
Junc 44	16.6	431.6	14.6	Pipe 47	6.3	0.0	0.05
Junc 45	16.6	431.4	14.4	Pipe 48	-10.3	0.1	0.14
Junc 46	16.6	430.7	20.2	Pipe 49	-26.9	0.2	1.16

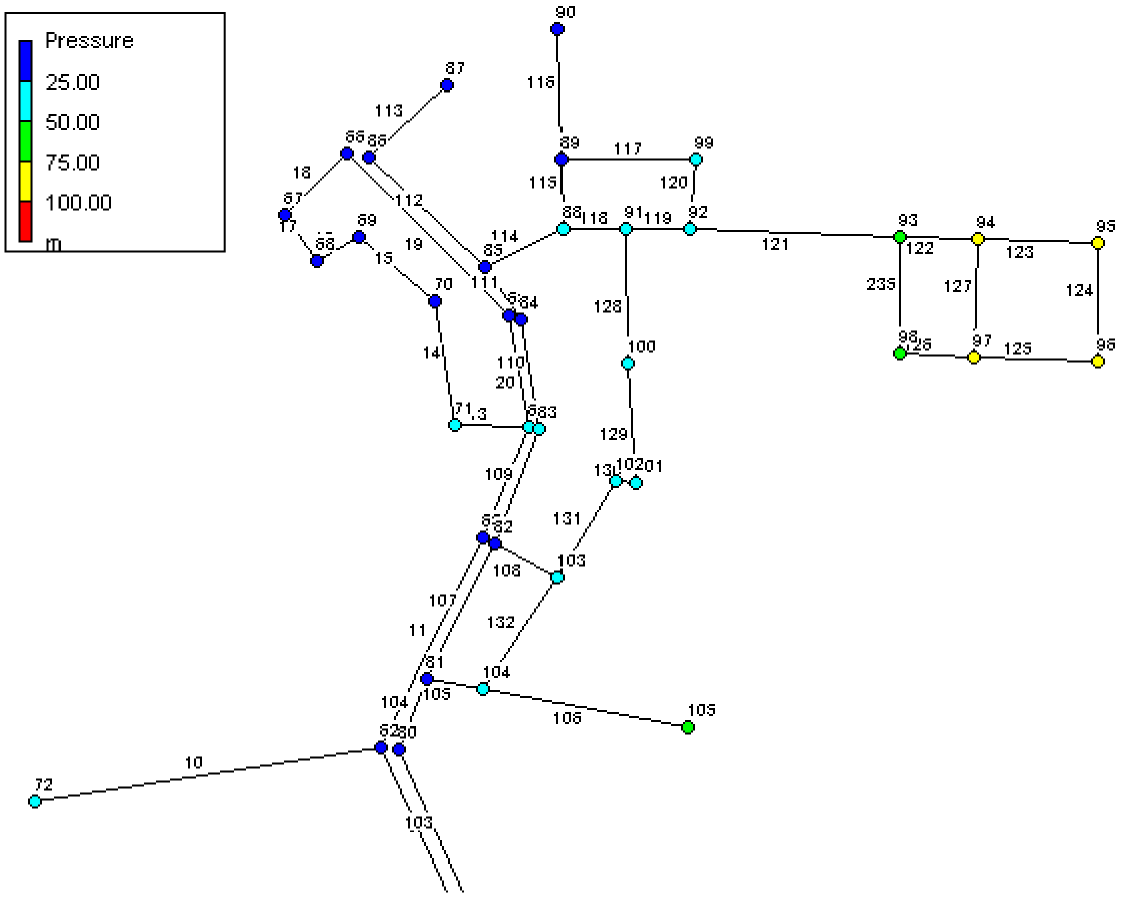
Network Table - Nodes				Network Table - Links			
Node ID	Demand m^3/d	Head m	Pressure m	Link ID	Flow m^3/d	Velocity m/s	Head loss m/km
Junc 47	16.6	430.3	25.8	Pipe 50	16.6	0.1	0.48
Junc 48	16.6	429.9	30.9	Pipe 51	16.6	0.1	0.48
Junc 49	16.6	429.5	40.0	Pipe 52	757.0	0.5	2.41
Junc 50	16.6	429.2	41.7	Pipe 53	241.8	0.4	2.15
Junc 51	16.6	429.1	46.6	Pipe 54	225.2	0.3	1.88
Junc 52	16.6	429.0	46.0	Pipe 55	136.6	0.3	2.27
Junc 53	16.6	428.6	43.1	Pipe 56	99.6	0.2	1.24
Junc 54	16.6	428.3	49.3	Pipe 57	83.0	0.2	0.88
Junc 55	16.6	431.5	14.0	Pipe 58	66.4	0.2	0.58
Junc 56	16.6	431.3	19.3	Pipe 59	49.8	0.1	0.34
Junc 57	16.6	431.1	22.1	Pipe 60	33.2	0.1	0.46
Junc 58	16.6	431.1	28.6	Pipe 61	16.6	0.1	0.48
Junc 59	16.6	429.9	31.4	Pipe 62	454.2	0.3	0.90
Junc 60	16.6	430.2	27.2	Pipe 63	59.1	0.1	0.47
Junc 61	16.6	430.2	24.7	Pipe 64	33.2	0.1	0.46
Junc 62	16.6	430.2	23.7	Pipe 65	16.6	0.1	0.12
Junc 63	16.6	430.3	22.8	Pipe 66	20.4	0.1	0.70
Junc 64	16.6	430.7	20.2	Pipe 67	3.8	0.0	0.03
Junc 65	16.6	431.1	17.6	Pipe 68	-35.7	0.2	1.98
Junc 66	16.6	431.2	17.7	Pipe 69	-56.8	0.1	0.14
Junc 67	16.6	431.4	16.4	Pipe 70	-112.0	0.2	0.50
Junc 68	16.6	431.4	18.4	Pipe 71	-173.0	0.3	1.13
Junc 69	16.6	431.1	17.1	Pipe 72	-256.2	0.4	2.41
Junc 70	16.6	431.3	28.8	Pipe 73	-286.3	0.4	2.99
Junc 71	16.6	431.3	26.3	Pipe 74	7.4	0.0	0.06
Junc 72	16.6	429.9	30.9	Pipe 75	-40.0	0.2	2.46
Junc 73	16.6	429.7	35.7	Pipe 76	11.3	0.1	0.19
Junc 74	16.6	429.7	31.2	Pipe 77	-5.3	0.0	0.04
Junc 75	16.6	429.2	40.3	Pipe 78	-9.3	0.0	0.03
Junc 76	16.6	429.1	42.6	Pipe 79	23.0	0.1	0.87
Junc 77	16.6	429.3	35.3	Pipe 80	6.4	0.0	0.05
Junc 78	16.6	429.2	35.2	Pipe 81	71.9	0.3	1.94
Junc 79	16.6	428.9	32.9	Pipe 82	76.4	0.3	2.18
Junc 80	16.6	428.3	29.8	Pipe 83	66.1	0.2	1.66
Junc 81	16.6	428.3	25.8	Pipe 84	33.2	0.1	0.46
Junc 82	16.6	428.0	25.0	Pipe 85	16.6	0.1	0.48
Junc 83	16.6	425.6	29.6	Pipe 86	38.7	0.2	2.31
Junc 84	16.6	425.3	30.8	Pipe 87	16.6	0.2	1.47
Junc 85	16.6	429.0	39.0	Pipe 88	44.3	0.3	2.98
Junc 86	16.6	428.3	38.8	Pipe 89	16.6	0.2	1.47
Junc 87	16.6	430.4	27.9	Pipe 90	66.7	0.4	6.53
Junc 88	16.6	430.4	22.9	Pipe 91	0.3	0.0	0.01
Junc 89	16.6	430.6	20.8	Pipe 92	49.8	0.3	3.73
Junc 90	16.6	430.6	20.8	Pipe 93	33.2	0.3	5.45

Network Table - Nodes				Network Table - Links			
Node ID	Demand m^3/d	Head m	Pressure m	Link ID	Flow m^3/d	Velocity m/s	Head loss m/km
Junc 91	16.6	430.7	20.9	Pipe 94	16.6	0.2	1.47
Junc 92	16.0	430.7	19.2	Pipe 95	13.5	0.1	0.33
Junc 93	16.6	430.7	17.7	Pipe 96	-3.1	0.0	0.02
Junc 94	16.6	430.5	19.0	Pipe 97	498.6	0.3	1.08
Junc 95	16.6	430.5	19.5	Pipe 98	505.8	0.3	1.11
Junc 96	16.6	430.4	19.4	Pipe 99	195.5	0.3	1.43
Junc 97	16.6	430.4	18.4	Pipe 100	166.3	0.3	1.05
Junc 98	16.6	430.4	17.9	Pipe 101	133.1	0.2	0.69
Junc 99	16.6	430.4	17.9	Pipe 102	102.4	0.2	0.42
Junc 100	16.6	430.1	17.1	Pipe 103	33.2	0.1	0.05
Junc 101	16.6	429.7	14.0	Pipe 104	16.6	0.0	0.01
Junc 102	16.6	429.5	15.5	Pipe 105	16.6	0.2	1.47
Junc 103	16.6	429.9	16.9	Pipe 106	-23.8	0.1	0.92
Junc 104	16.6	430.2	18.2	Pipe 107	30.8	0.2	1.50
Junc 105	16.6	430.2	20.7	Pipe 108	25.7	0.2	1.07
Junc 106	16.6	429.9	19.9	Pipe 109	15.3	0.1	0.41
Junc 107	16.6	430.4	24.4	Pipe 110	17.9	0.1	0.55
Junc 108	16.6	430.4	26.9	Pipe 111	1.3	0.0	0.01
Junc 109	16.6	429.8	30.8	Pipe 112	16.6	0.1	0.48
Junc 110	16.6	430.0	23.0	Pipe 113	378.5	0.3	0.63
Junc 111	16.6	429.0	21.5	Pipe 114	325.5	0.2	0.48
Junc 112	16.6	428.8	20.3	Pipe 115	257.6	0.4	2.43
Junc 113	16.6	428.7	22.3	Pipe 116	143.2	0.2	0.79
Junc 114	16.6	429.0	23.5	Pipe 117	117.8	0.2	0.55
Junc 115	16.6	430.4	24.4	Pipe 118	-18.2	0.0	0.05
Junc 116	16.6	428.1	32.6	Pipe 119	83.0	0.2	0.88
Junc 19	16.6	430.5	19.5	Pipe 120	66.4	0.2	1.67
Resvr 1		432.0		Pipe 121	16.6	0.1	0.48
				Pipe 122	33.2	0.2	1.73
				Pipe 123	16.6	0.1	0.48
				Pipe 124	99.6	0.4	3.62
				Pipe 125	16.6	0.1	0.48
				Pipe 126	66.4	0.4	6.47
				Pipe 127	33.2	0.2	1.73
				Pipe 128	16.6	0.1	0.48
				Pipe 129	16.6	0.1	0.48
				Pipe 130	49.5	0.1	0.34
				Pipe 131	30.3	0.1	0.14
				Pipe 132	31.9	0.1	0.42
				Pipe 133	12.6	0.1	0.27
				Pipe 134	16.3	0.2	1.43
				Pipe 135	21.8	0.2	2.46
				Pipe 136	32.9	0.3	5.37
				Pipe 137	16.6	0.2	1.47

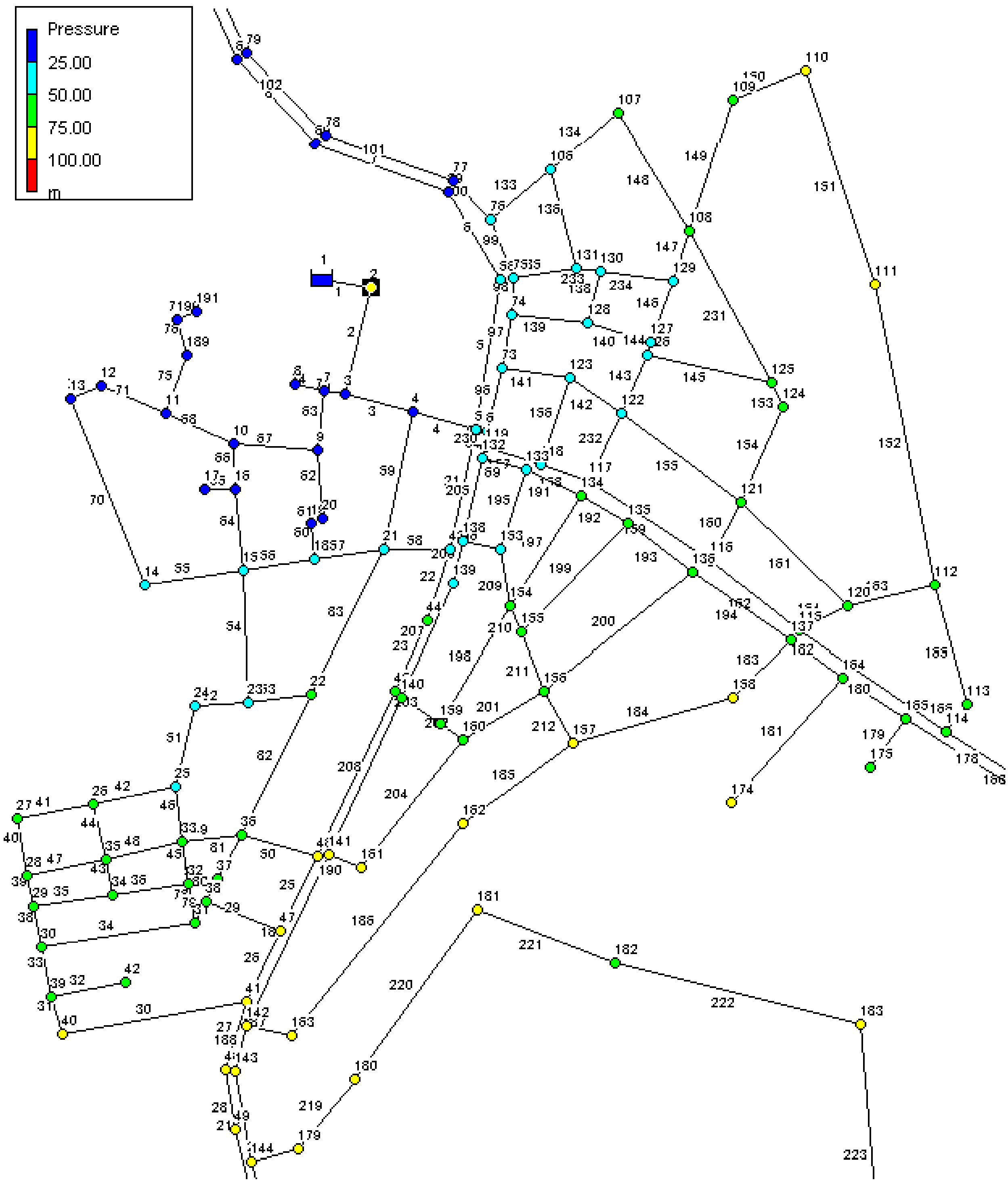
Network Table - Nodes				Network Table - Links			
Node ID	Demand m^3/d	Head m	Pressure m	Link ID	Flow m^3/d	Velocity m/s	Head loss m/km
				Pipe 138	6.0	0.0	0.05
				Pipe 139	-10.6	0.1	0.15
				Pipe 140	-27.2	0.2	1.19
				Pipe 11	12.6	0.1	0.28
				Pipe 12	1.8	0.0	0.01
				Pipe 13	8.8	0.1	0.08
				Pipe 22	-7.8	0.1	0.06
				Pipe 141	-14.1	0.1	0.35



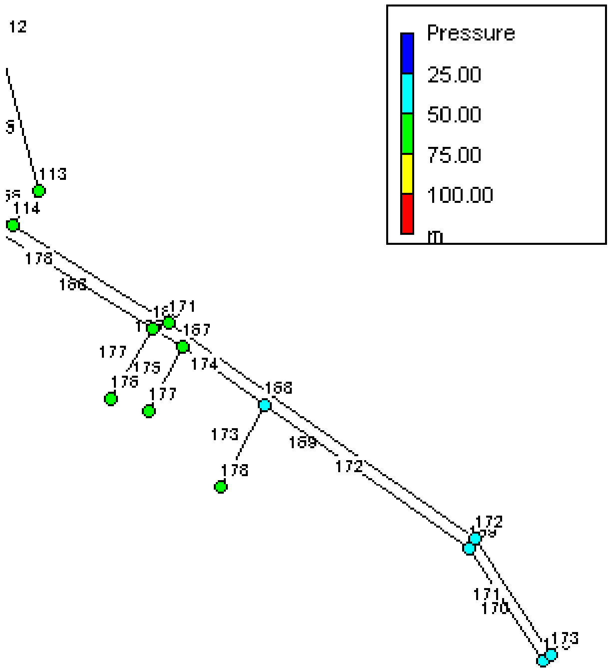
D2 Ea Drang Key Map



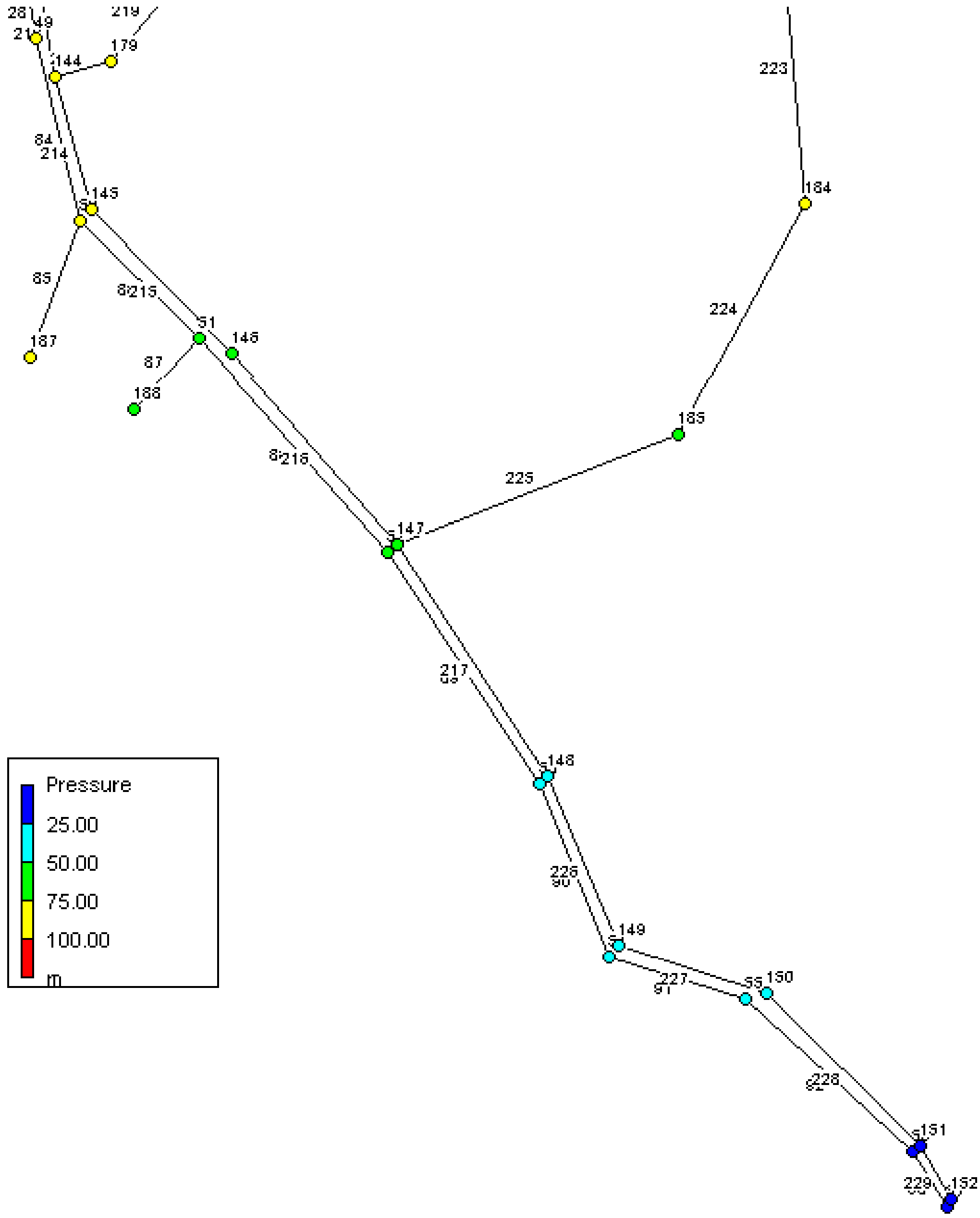
D2 Ea Drang Distribution Network (A)



D2 Ea Drang Distribution Network (B)



D2 Ea Drang Distribution Network (C)



D2 Ea Drang Distribution Network (D)

Network Table - Nodes				Network Table - Links			
	Demand	Head	Pressure		Flow	Velocity	Head loss
Node ID	m^3/d	m	m	Link ID	m^3/d	m/s	m/km
Junc 2	0.0	649.4	4.4	Pipe 1	3137.4	0.5	1.07
Junc 3	25.2	649.2	9.7	Pipe 2	3137.4	0.5	1.07
Junc 4	26.6	649.0	22.5	Pipe 3	2920.9	0.5	0.93
Junc 5	30.6	648.9	36.9	Pipe 4	2684.3	0.4	0.79
Junc 6	30.6	648.9	36.9	Pipe 5	259.0	0.4	2.46
Junc 7	24.6	649.0	7.0	Pipe 6	232.4	0.3	2.00
Junc 8	8.6	649.0	5.0	Pipe 7	215.8	0.3	1.73
Junc 9	24.6	648.6	13.6	Pipe 8	199.2	0.3	1.48
Junc 10	16.6	648.4	8.4	Pipe 9	182.6	0.3	1.26
Junc 11	29.8	648.3	8.3	Pipe 10	16.6	0.1	0.48
Junc 12	16.6	648.3	15.3	Pipe 11	149.4	0.3	2.70
Junc 13	16.6	648.3	21.8	Pipe 12	132.8	0.3	2.15
Junc 14	16.6	648.3	26.3	Pipe 13	50.6	0.3	3.84
Junc 15	16.6	648.3	28.8	Pipe 14	34.0	0.2	1.81
Junc 16	16.6	648.3	14.3	Pipe 15	17.4	0.1	0.52
Junc 17	16.6	648.3	14.3	Pipe 16	0.8	0.0	0.01
Junc 18	16.6	648.4	31.4	Pipe 17	-15.8	0.1	0.44
Junc 19	16.6	648.4	23.4	Pipe 18	-32.4	0.2	1.65
Junc 20	16.6	648.4	23.4	Pipe 19	-49.0	0.2	0.94
Junc 21	26.6	648.6	35.6	Pipe 20	-65.6	0.2	1.63
Junc 22	16.6	648.3	53.8	Pipe 21	489.7	0.3	1.04
Junc 23	16.6	648.2	45.2	Pipe 22	384.3	0.3	0.65
Junc 24	16.6	648.1	45.6	Pipe 23	357.7	0.2	0.57
Junc 25	16.6	648.0	48.0	Pipe 24	331.1	0.2	0.49
Junc 26	16.6	647.9	51.4	Pipe 25	222.7	0.3	1.84
Junc 27	16.6	647.8	62.8	Pipe 26	182.8	0.3	1.26
Junc 28	16.6	647.8	65.8	Pipe 27	145.2	0.3	2.56
Junc 29	16.6	647.8	65.8	Pipe 28	128.6	0.3	2.02
Junc 30	16.6	647.8	67.8	Pipe 30	21.0	0.1	0.07
Junc 31	16.6	648.0	70.0	Pipe 31	4.4	0.0	0.01
Junc 32	16.6	648.0	63.0	Pipe 32	16.6	0.1	0.48
Junc 33	16.6	648.0	56.0	Pipe 33	-28.8	0.1	0.12
Junc 34	16.6	647.8	60.8	Pipe 34	-58.1	0.1	0.45
Junc 35	16.6	647.8	55.8	Pipe 35	-8.8	0.1	0.08
Junc 36	16.6	648.2	64.7	Pipe 36	-21.3	0.1	0.76
Junc 37	16.6	648.0	68.0	Pipe 37	-29.3	0.2	1.37
Junc 38	16.6	648.0	70.0	Pipe 38	12.8	0.0	0.05
Junc 39	16.6	647.8	72.3	Pipe 39	5.0	0.0	0.01
Junc 40	16.6	647.8	78.3	Pipe 40	-2.2	0.0	0.01
Junc 41	16.6	647.9	91.9	Pipe 41	-18.8	0.1	0.16
Junc 42	16.6	647.8	72.3	Pipe 42	-44.1	0.2	0.77
Junc 43	26.6	648.7	42.7	Pipe 43	-4.1	0.0	0.03
Junc 44	26.6	648.6	51.6	Pipe 44	-8.6	0.1	0.08
Junc 45	26.6	648.5	58.5	Pipe 45	-8.5	0.1	0.08

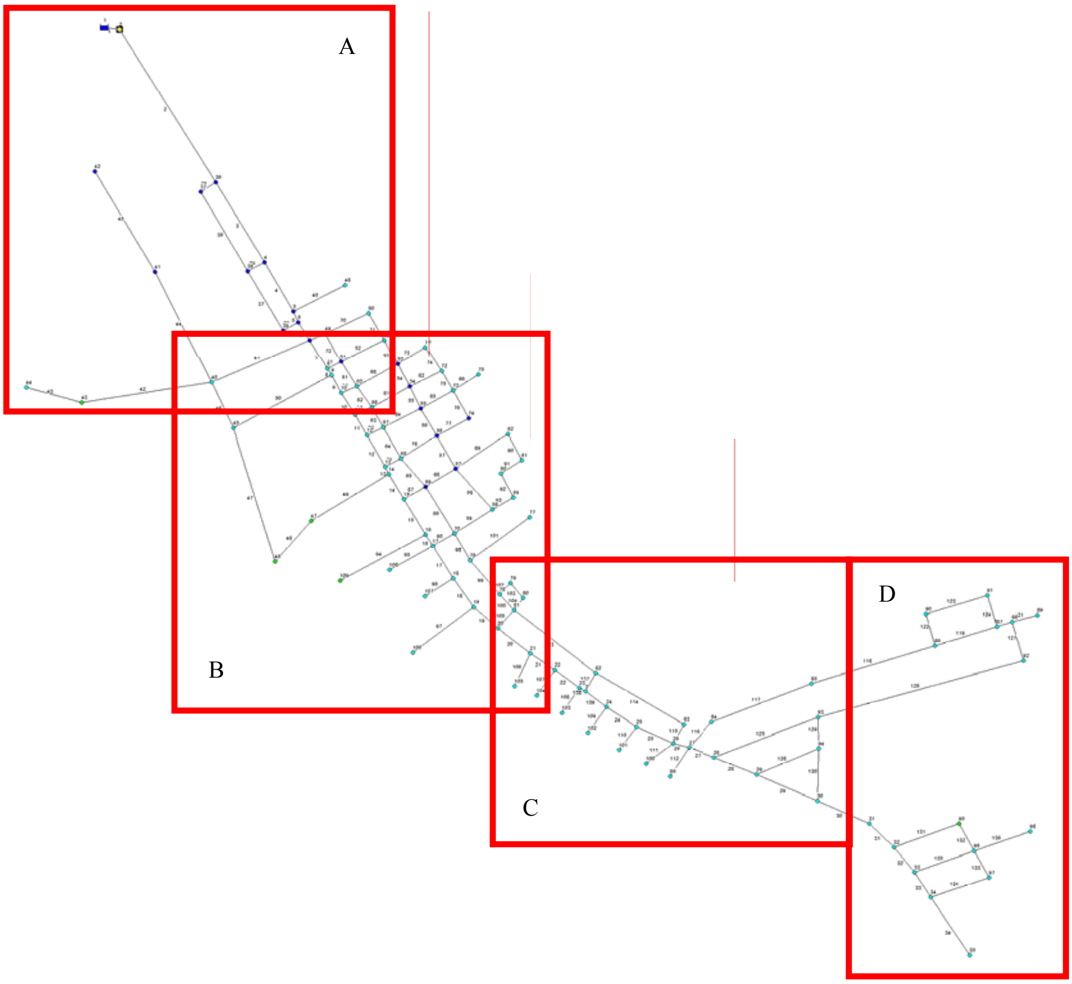
Network Table - Nodes				Network Table - Links			
	Demand	Head	Pressure		Flow	Velocity	Head loss
Node ID	m^3/d	m	m	Link ID	m^3/d	m/s	m/km
Junc 46	20.6	648.3	78.3	Pipe 46	-10.9	0.1	0.17
Junc 47	16.6	648.0	85.5	Pipe 47	-9.4	0.1	0.10
Junc 48	16.6	647.5	93.5	Pipe 48	-21.4	0.1	0.76
Junc 49	16.6	647.3	93.3	Pipe 49	-35.6	0.2	1.97
Junc 50	16.6	646.8	78.8	Pipe 50	-87.8	0.2	0.98
Junc 51	16.6	646.6	71.6	Pipe 51	-71.5	0.2	0.67
Junc 52	16.6	646.2	51.2	Pipe 52	-88.1	0.2	0.99
Junc 53	6.6	646.0	44.0	Pipe 53	-69.6	0.2	0.63
Junc 54	6.6	645.8	38.8	Pipe 54	-35.1	0.1	0.51
Junc 55	6.6	645.7	25.7	Pipe 55	19.5	0.1	0.17
Junc 56	7.2	645.6	9.6	Pipe 56	-78.1	0.2	0.78
Junc 57	2.0	645.6	6.1	Pipe 57	-97.5	0.2	1.19
Junc 58	26.6	648.2	26.2	Pipe 58	-78.8	0.2	0.80
Junc 59	16.6	647.8	20.8	Pipe 59	-210.0	0.3	1.64
Junc 60	16.6	647.3	19.3	Pipe 60	2.8	0.0	0.02
Junc 61	16.6	647.0	17.5	Pipe 61	-13.8	0.1	0.34
Junc 62	16.6	646.6	17.1	Pipe 62	-30.4	0.2	1.46
Junc 63	16.6	645.6	19.1	Pipe 63	-158.1	0.4	3.01
Junc 64	16.6	645.2	25.7	Pipe 64	6.8	0.0	0.05
Junc 65	16.6	644.9	20.9	Pipe 65	16.6	0.1	0.48
Junc 66	16.6	644.6	12.6	Pipe 66	-26.4	0.2	1.12
Junc 67	16.6	644.4	16.4	Pipe 67	103.1	0.2	1.33
Junc 68	16.6	644.3	24.3	Pipe 68	60.1	0.1	0.48
Junc 69	16.6	644.3	21.3	Pipe 70	-2.9	0.0	0.01
Junc 70	16.6	644.4	21.9	Pipe 71	30.3	0.1	0.39
Junc 71	16.6	644.8	30.8	Pipe 72	13.7	0.1	0.07
Junc 72	16.6	646.4	36.4	Pipe 73	191.3	0.4	4.35
Junc 73	30.6	648.7	32.7	Pipe 74	8.6	0.1	0.08
Junc 74	26.6	648.5	29.5	Pipe 75	0.0	0.0	0.00
Junc 75	26.6	648.5	26.5	Pipe 76	0.0	0.0	0.00
Junc 76	16.6	648.3	25.3	Pipe 77	0.0	0.0	0.00
Junc 77	16.6	648.2	21.2	Pipe 78	0.1	0.0	0.20
Junc 78	16.6	648.0	20.0	Pipe 79	-74.9	0.2	0.72
Junc 79	16.6	647.8	18.3	Pipe 80	-68.2	0.2	0.61
Junc 80	16.6	647.5	18.0	Pipe 81	-114.2	0.3	1.61
Junc 81	16.6	647.5	18.0	Pipe 82	-78.6	0.1	0.26
Junc 82	16.6	647.3	20.8	Pipe 83	-164.8	0.2	1.03
Junc 83	16.6	646.8	27.3	Pipe 84	112.0	0.3	1.55
Junc 84	16.6	646.4	24.4	Pipe 85	16.6	0.1	0.48
Junc 85	16.6	646.2	20.2	Pipe 86	78.8	0.2	0.80
Junc 86	16.6	645.8	13.8	Pipe 87	-16.6	0.1	0.48
Junc 87	16.6	645.7	10.7	Pipe 88	45.6	0.2	0.82
Junc 88	16.6	645.7	26.2	Pipe 89	29.0	0.1	0.36
Junc 89	16.6	645.3	22.8	Pipe 90	22.4	0.1	0.83

Network Table - Nodes				Network Table - Links			
	Demand	Head	Pressure		Flow	Velocity	Head loss
Node ID	m^3/d	m	m	Link ID	m^3/d	m/s	m/km
Junc 90	16.6	645.2	24.2	Pipe 91	15.8	0.1	0.44
Junc 91	16.6	645.5	37.5	Pipe 92	9.2	0.1	0.10
Junc 92	16.6	645.3	40.8	Pipe 93	2.0	0.0	0.02
Junc 93	16.6	644.9	62.9	Pipe 94	-780.6	0.5	2.56
Junc 94	16.6	644.7	78.2	Pipe 95	-1221.4	0.8	6.13
Junc 95	16.6	644.7	97.7	Pipe 96	653.0	0.4	1.81
Junc 96	16.6	644.7	99.7	Pipe 97	598.8	0.4	1.53
Junc 97	16.6	644.7	79.7	Pipe 98	545.9	0.4	1.28
Junc 98	16.6	644.7	66.7	Pipe 99	496.3	0.3	1.07
Junc 99	16.6	645.3	33.8	Pipe 100	481.4	0.3	1.00
Junc 100	16.6	645.5	29.5	Pipe 101	464.8	0.3	0.94
Junc 101	16.6	645.8	40.8	Pipe 102	448.2	0.3	0.88
Junc 102	16.6	645.9	37.9	Pipe 103	431.6	0.3	0.81
Junc 103	16.6	647.0	25.5	Pipe 104	415.0	0.3	0.76
Junc 104	16.6	647.3	27.3	Pipe 105	65.6	0.2	1.63
Junc 105	16.6	647.1	52.1	Pipe 106	16.6	0.1	0.48
Junc 106	16.6	648.3	38.3	Pipe 107	332.8	0.2	0.50
Junc 107	16.6	648.3	55.3	Pipe 108	47.6	0.3	3.42
Junc 108	16.6	648.3	53.8	Pipe 109	268.6	0.4	2.64
Junc 109	16.6	648.0	70.5	Pipe 110	252.0	0.4	2.33
Junc 110	16.6	648.0	90.0	Pipe 111	235.4	0.4	2.05
Junc 111	16.6	648.0	83.5	Pipe 112	33.2	0.2	1.73
Junc 112	16.6	648.1	73.6	Pipe 113	16.6	0.1	0.48
Junc 113	16.6	648.1	65.6	Pipe 114	185.6	0.4	4.10
Junc 114	16.6	648.1	65.1	Pipe 115	44.5	0.3	3.00
Junc 115	16.6	648.4	71.4	Pipe 116	16.6	0.1	0.48
Junc 116	16.6	648.5	71.0	Pipe 117	11.3	0.1	0.19
Junc 117	33.2	648.6	54.6	Pipe 118	124.5	0.3	1.90
Junc 118	26.6	648.7	46.7	Pipe 119	121.6	0.3	1.82
Junc 119	20.6	648.7	37.2	Pipe 120	5.4	0.0	0.04
Junc 120	16.6	648.3	71.3	Pipe 121	99.6	0.2	1.24
Junc 121	16.6	648.4	62.4	Pipe 122	56.7	0.2	1.24
Junc 122	16.6	648.5	45.5	Pipe 123	26.1	0.1	0.29
Junc 123	16.6	648.6	38.6	Pipe 124	9.5	0.1	0.11
Junc 124	16.6	648.3	59.8	Pipe 125	-7.1	0.0	0.06
Junc 125	16.6	648.3	58.3	Pipe 126	-9.8	0.1	0.12
Junc 126	16.6	648.4	43.9	Pipe 127	13.9	0.1	0.35
Junc 127	16.6	648.4	43.9	Pipe 128	-13.6	0.1	0.33
Junc 128	16.6	648.4	36.4	Pipe 129	-30.2	0.2	1.45
Junc 129	16.6	648.4	48.9	Pipe 130	-46.8	0.3	3.31
Junc 130	16.6	648.3	39.3	Pipe 131	-63.4	0.4	5.92
Junc 131	16.6	648.3	36.3	Pipe 132	-32.4	0.2	1.65
Junc 132	20.6	648.7	37.2	Pipe 133	-1.7	0.0	0.00
Junc 133	26.6	648.4	45.4	Pipe 134	-9.1	0.0	0.00

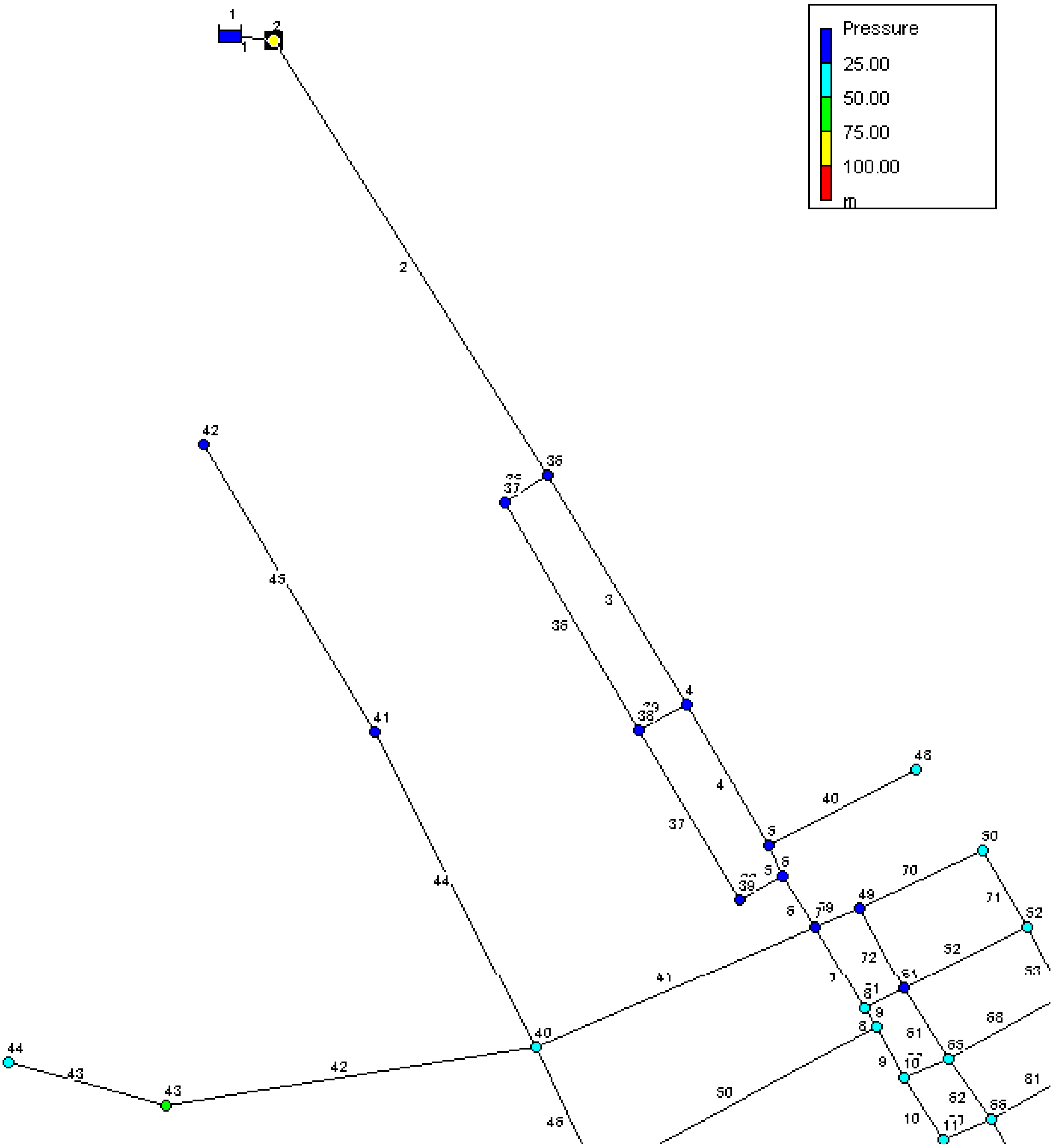
Network Table - Nodes				Network Table - Links			
	Demand	Head	Pressure		Flow	Velocity	Head loss
Node ID	m^3/d	m	m	Link ID	m^3/d	m/s	m/km
Junc 134	16.6	648.1	54.1	Pipe 135	23.1	0.1	0.87
Junc 135	16.6	648.0	62.0	Pipe 136	9.2	0.1	0.10
Junc 136	36.6	647.8	70.3	Pipe 138	-14.4	0.1	0.37
Junc 137	16.6	646.9	69.9	Pipe 139	26.2	0.2	1.11
Junc 138	26.6	648.5	42.5	Pipe 140	-4.7	0.0	0.04
Junc 139	26.6	648.5	46.0	Pipe 141	23.7	0.1	0.92
Junc 140	16.6	648.3	58.3	Pipe 142	22.4	0.1	0.83
Junc 141	20.6	648.2	78.2	Pipe 143	133.4	0.2	0.69
Junc 142	16.6	647.5	93.0	Pipe 144	104.9	0.2	0.44
Junc 143	16.6	647.4	93.4	Pipe 145	11.9	0.1	0.23
Junc 144	16.6	647.3	89.3	Pipe 146	83.5	0.1	0.29
Junc 145	16.6	646.7	78.7	Pipe 147	61.9	0.1	0.17
Junc 146	16.6	646.2	69.2	Pipe 148	-25.7	0.0	0.03
Junc 147	16.6	645.7	50.7	Pipe 149	27.2	0.2	1.19
Junc 148	6.6	645.6	43.6	Pipe 150	10.6	0.1	0.16
Junc 149	6.6	645.3	38.3	Pipe 151	-6.0	0.0	0.02
Junc 150	6.6	645.2	25.2	Pipe 152	-22.6	0.1	0.23
Junc 151	7.2	645.2	9.2	Pipe 153	-12.3	0.0	0.05
Junc 152	2.0	645.2	5.7	Pipe 154	-28.9	0.1	0.35
Junc 153	16.6	648.3	48.3	Pipe 155	12.1	0.1	0.24
Junc 154	16.6	648.1	55.1	Pipe 156	-15.3	0.1	0.41
Junc 155	16.6	648.0	60.0	Pipe 157	420.2	0.3	0.77
Junc 156	16.6	647.8	70.9	Pipe 158	378.3	0.3	0.63
Junc 157	16.6	647.3	82.3	Pipe 159	205.4	0.1	0.20
Junc 158	16.6	646.9	81.9	Pipe 160	49.7	0.2	0.96
Junc 159	16.6	648.1	68.1	Pipe 161	16.3	0.1	0.46
Junc 160	16.6	648.0	73.0	Pipe 162	139.1	0.2	0.75
Junc 161	16.6	648.1	82.6	Pipe 163	46.8	0.2	0.86
Junc 162	16.6	647.3	90.3	Pipe 164	-47.2	0.2	0.88
Junc 163	16.6	647.4	93.4	Pipe 165	7.7	0.1	0.06
Junc 164	16.6	646.3	66.3	Pipe 166	-8.9	0.1	0.09
Junc 165	16.6	645.8	63.3	Pipe 167	75.3	0.2	0.73
Junc 166	16.6	643.6	55.6	Pipe 168	49.8	0.3	3.73
Junc 167	16.6	643.4	51.9	Pipe 169	33.2	0.2	1.73
Junc 168	16.6	643.1	45.1	Pipe 170	16.6	0.1	0.48
Junc 169	16.6	642.4	39.4	Pipe 171	-16.6	0.1	0.48
Junc 170	16.6	642.3	39.3	Pipe 172	-33.2	0.2	1.73
Junc 171	16.6	647.0	59.0	Pipe 173	16.6	0.1	0.48
Junc 172	16.6	646.0	43.0	Pipe 174	-66.4	0.2	1.67
Junc 173	16.6	645.9	42.9	Pipe 175	16.6	0.1	0.48
Junc 174	16.6	646.1	81.1	Pipe 176	-99.6	0.4	3.62
Junc 175	16.6	645.7	65.7	Pipe 177	16.6	0.1	0.48
Junc 176	16.6	643.5	60.5	Pipe 178	-132.8	0.5	6.31
Junc 177	16.6	643.3	55.3	Pipe 179	16.6	0.1	0.48

Network Table - Nodes				Network Table - Links			
	Demand	Head	Pressure		Flow	Velocity	Head loss
Node ID	m^3/d	m	m	Link ID	m^3/d	m/s	m/km
Junc 178	16.6	643.0	53.0	Pipe 180	-166.0	0.4	3.31
Junc 179	6.6	647.0	89.0	Pipe 181	-16.6	0.1	0.48
Junc 180	6.6	646.7	88.7	Pipe 182	-199.2	0.5	4.70
Junc 181	6.6	646.2	86.2	Pipe 183	34.5	0.1	0.49
Junc 182	6.6	646.0	75.0	Pipe 184	-51.1	0.2	1.02
Junc 183	6.6	645.8	82.8	Pipe 185	-10.8	0.0	0.03
Junc 184	6.6	645.7	77.7	Pipe 186	-27.4	0.1	0.32
Junc 185	6.6	645.7	68.7	Pipe 187	-44.0	0.2	0.77
Junc 187	16.6	646.7	89.7	Pipe 188	158.2	0.2	0.96
Junc 188	16.6	646.5	71.5	Pipe 189	-218.8	0.3	1.78
Junc 189	0.0	648.3	4.3	Pipe 190	76.4	0.2	0.75
Junc 190	0.0	648.3	4.3	Pipe 69	291.0	0.4	3.08
Junc 191	0.0	648.3	3.3	Pipe 191	249.2	0.4	2.28
Resvr 1		649.5		Pipe 192	208.2	0.3	1.62
				Pipe 193	186.2	0.3	1.30
				Pipe 194	181.3	0.4	3.92
				Pipe 195	15.2	0.1	0.41
				Pipe 196	-40.7	0.2	2.54
				Pipe 197	24.4	0.1	0.26
				Pipe 198	9.1	0.0	0.03
				Pipe 199	5.5	0.0	0.04
				Pipe 200	-31.7	0.1	0.15
				Pipe 201	-78.5	0.2	0.79
				Pipe 202	-35.3	0.2	1.94
				Pipe 203	-42.8	0.3	2.79
				Pipe 204	-59.8	0.1	0.48
				Pipe 205	469.0	0.3	0.96
				Pipe 206	401.7	0.3	0.71
				Pipe 207	375.1	0.3	0.62
				Pipe 208	315.8	0.2	0.45
				Pipe 209	39.3	0.2	2.38
				Pipe 210	38.0	0.2	2.22
				Pipe 211	26.8	0.2	1.16
				Pipe 212	56.9	0.3	4.82
				Pipe 213	141.6	0.2	0.77
				Pipe 214	83.5	0.3	2.59
				Pipe 215	66.9	0.2	1.69
				Pipe 216	50.3	0.2	0.99
				Pipe 217	29.0	0.1	0.36
				Pipe 218	41.5	0.2	2.63
				Pipe 219	34.9	0.2	1.89
				Pipe 220	28.3	0.2	1.28
				Pipe 221	21.7	0.1	0.78
				Pipe 222	15.1	0.1	0.40

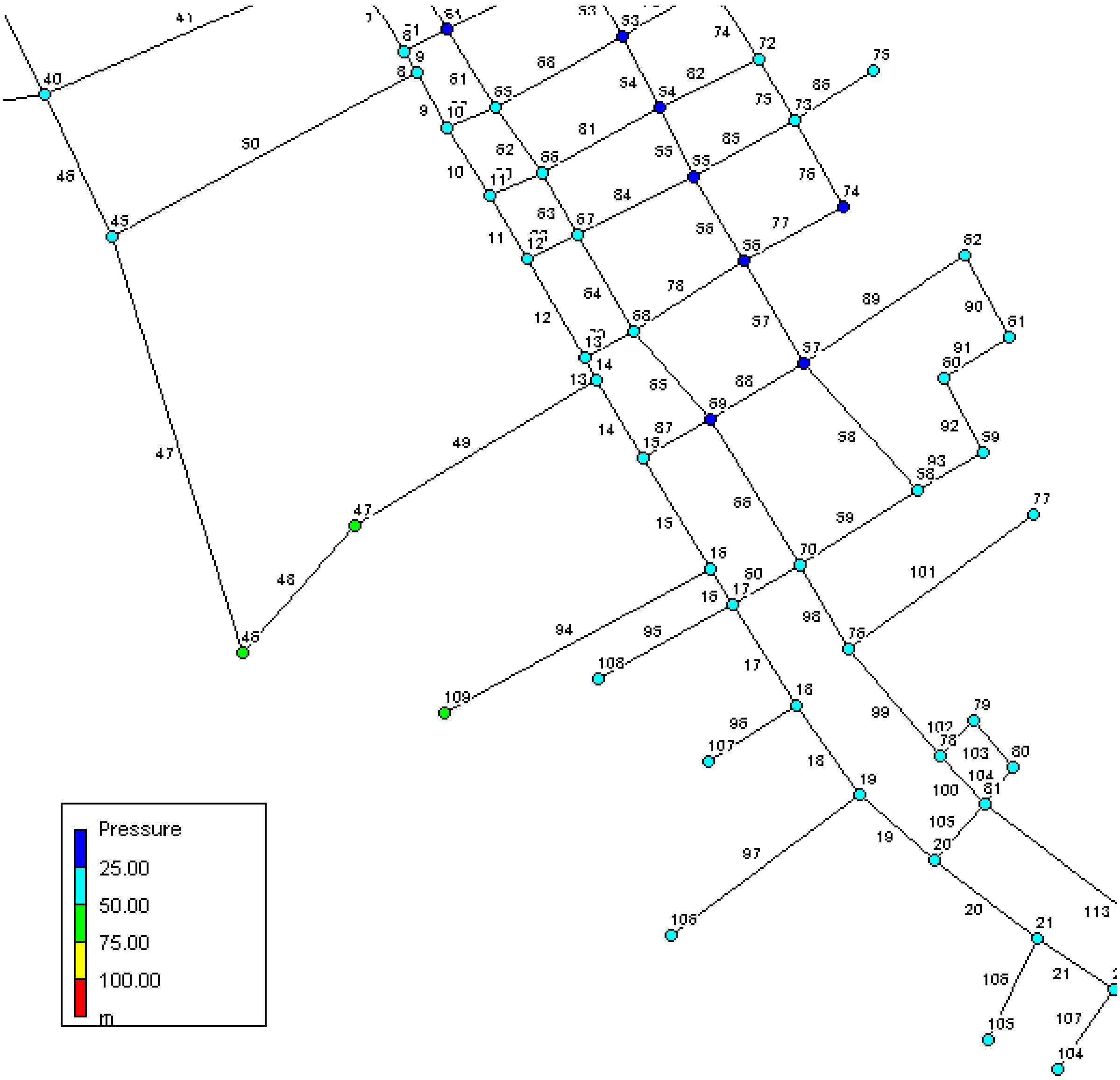
Network Table - Nodes				Network Table - Links			
	Demand	Head	Pressure		Flow	Velocity	Head loss
Node ID	m^3/d	m	m	Link ID	m^3/d	m/s	m/km
				Pipe 223	8.5	0.1	0.08
				Pipe 224	1.9	0.0	0.01
				Pipe 225	-4.7	0.0	0.04
				Pipe 226	22.4	0.1	0.83
				Pipe 227	15.8	0.1	0.44
				Pipe 228	9.2	0.1	0.10
				Pipe 229	2.0	0.0	0.02
				Pipe 29	23.3	0.1	0.24
				Pipe 230	1905.0	0.3	0.41
				Pipe 231	-7.6	0.0	0.02
				Pipe 232	139.7	0.2	0.76
				Pipe 233	-2.8	0.0	0.02
				Pipe 234	-5.0	0.0	0.04
				Pipe 235	26.4	0.2	1.12



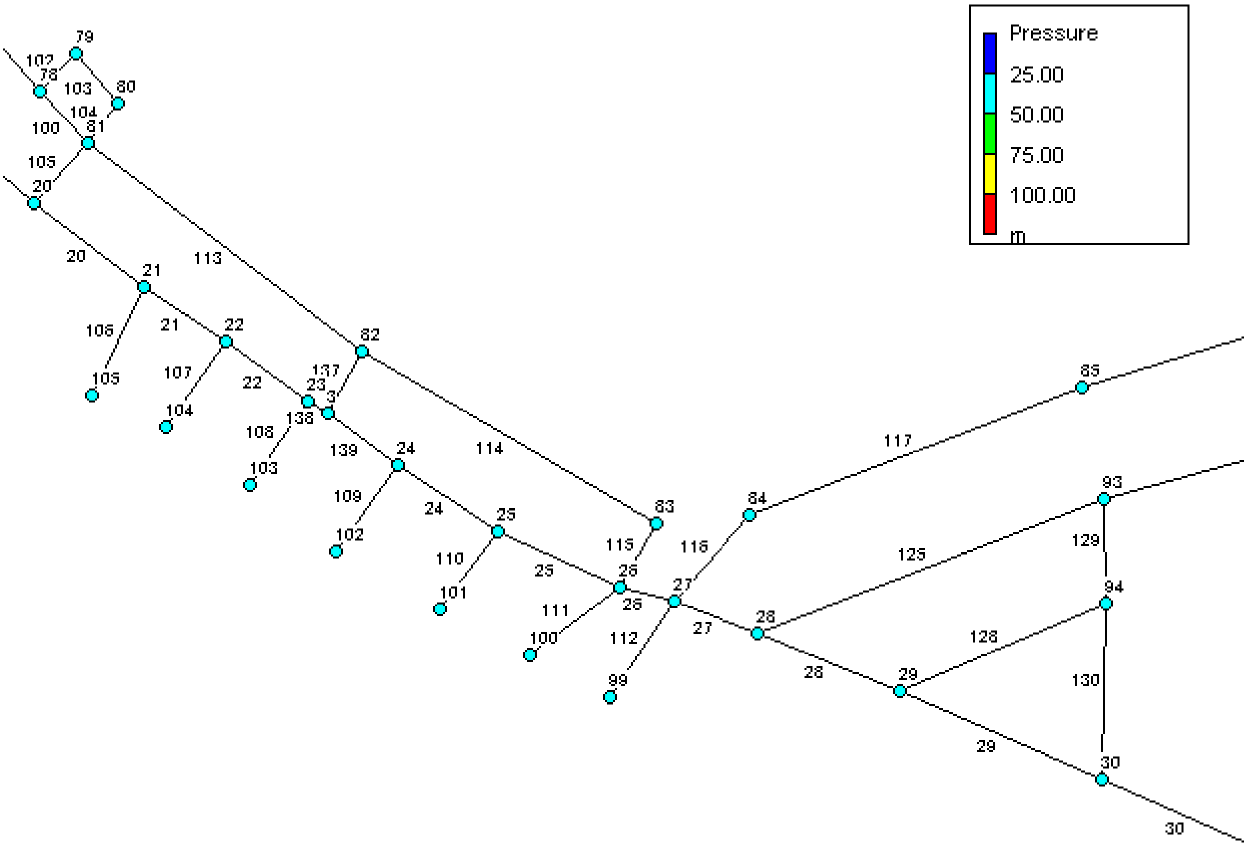
D4-1 Ea Drong Key Map



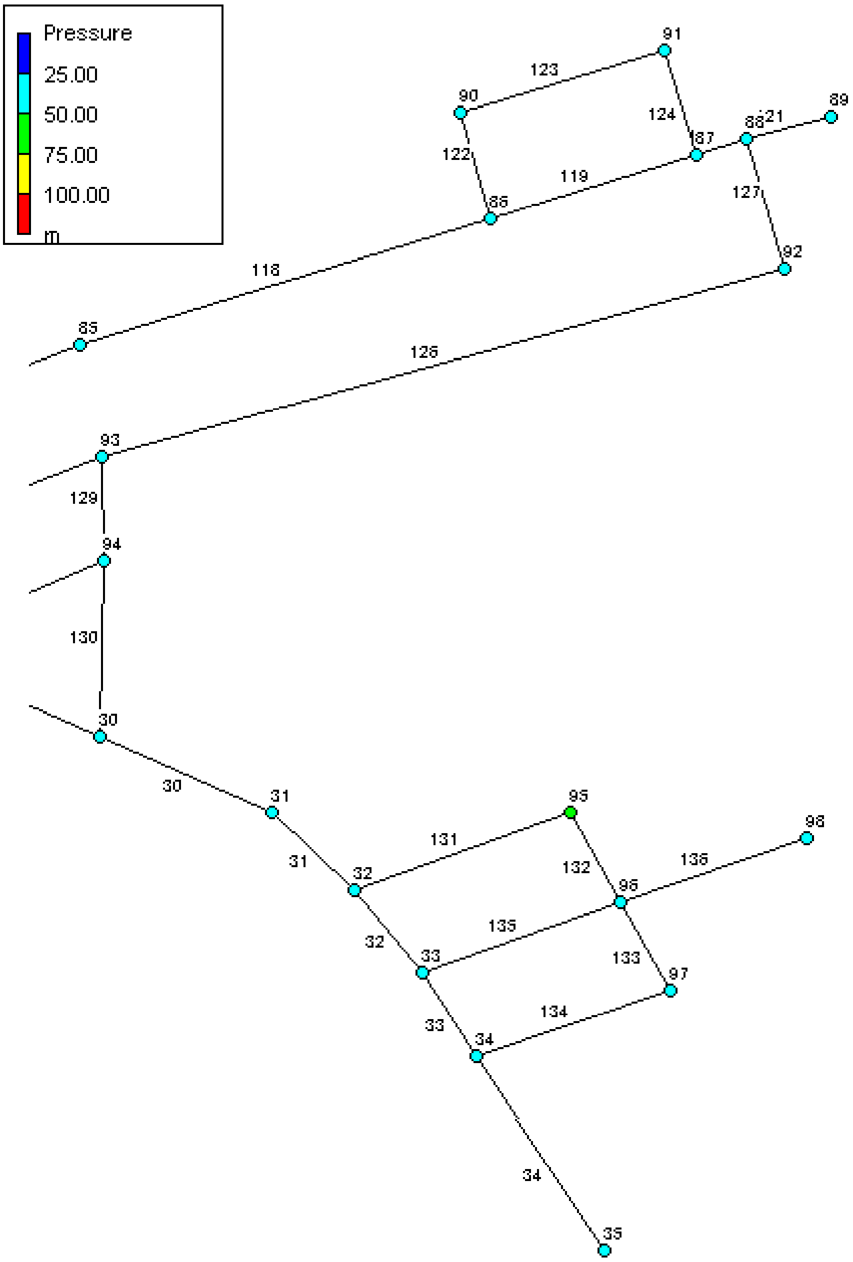
D4-1 Ea Drong Distribution Network (A)



D4-1 Ea Drong Distribution Network (B)



D4-1 Ea Drong Distribution Network (C)



D4-1 Ea Drong Distribution Network (D)

Network Table - Nodes				Network Table - Links			
Node ID	Demand m^3/d	Head m	Pressure m	Link ID	Flow m^3/d	Velocity m/s	Head loss m/km
Junc 2	12.6	658.4	1.4	Pipe 1	1335.6	0.5	1.64
Junc 4	12.6	656.8	18.8	Pipe 2	1323.0	0.5	1.61
Junc 5	12.6	656.5	19.5	Pipe 3	1271.4	0.5	1.49
Junc 6	12.6	656.4	20.4	Pipe 4	1244.9	0.5	1.43
Junc 7	12.6	656.3	24.3	Pipe 5	1219.7	0.5	1.38
Junc 8	12.6	655.9	25.9	Pipe 6	1222.2	0.5	1.38
Junc 9	12.6	655.8	27.8	Pipe 7	936.4	0.6	3.65
Junc 10	12.6	655.6	30.1	Pipe 8	886.5	0.6	3.28
Junc 11	12.6	655.3	32.3	Pipe 9	859.7	0.6	3.09
Junc 12	12.6	655.1	32.6	Pipe 10	816.4	0.5	2.79
Junc 13	12.6	654.8	30.8	Pipe 11	773.2	0.5	2.51
Junc 14	12.6	654.7	30.7	Pipe 12	730.8	0.5	2.25
Junc 15	12.6	654.5	29.5	Pipe 13	692.9	0.5	2.03
Junc 16	12.6	654.2	31.2	Pipe 14	686.4	0.5	1.99
Junc 17	12.6	654.1	30.1	Pipe 15	647.0	0.4	1.78
Junc 18	12.6	652.7	29.2	Pipe 16	621.8	0.4	1.65
Junc 19	12.6	651.5	32.5	Pipe 17	535.7	0.8	10.11
Junc 20	12.6	650.6	36.1	Pipe 18	510.5	0.8	9.20
Junc 21	12.6	649.5	35.5	Pipe 19	485.3	0.7	8.33
Junc 22	12.6	648.9	35.4	Pipe 20	439.9	0.7	6.88
Junc 23	12.6	648.3	35.3	Pipe 21	414.7	0.6	6.13
Junc 24	12.6	647.7	35.2	Pipe 22	389.5	0.6	5.43
Junc 25	12.6	647.2	38.2	Pipe 24	330.0	0.5	3.93
Junc 26	12.6	646.7	40.7	Pipe 25	304.8	0.5	3.37
Junc 27	12.6	646.5	41.0	Pipe 26	315.0	0.5	3.59
Junc 28	12.6	646.3	44.8	Pipe 27	208.0	0.3	1.61
Junc 29	12.6	646.2	43.2	Pipe 28	153.2	0.2	0.90
Junc 30	12.6	646.0	46.0	Pipe 29	122.6	0.2	0.59
Junc 31	12.6	645.7	48.9	Pipe 30	113.4	0.3	1.59
Junc 32	12.6	645.5	47.5	Pipe 31	100.8	0.2	1.27
Junc 33	12.6	645.3	43.8	Pipe 32	63.8	0.2	1.55
Junc 34	12.6	645.3	45.3	Pipe 33	36.1	0.1	0.53
Junc 35	12.6	645.2	46.2	Pipe 34	12.6	0.1	0.27
Junc 36	12.6	657.3	9.3	Pipe 35	39.0	0.2	2.35
Junc 37	12.6	657.2	9.2	Pipe 36	26.4	0.2	1.13
Junc 38	12.6	656.8	14.8	Pipe 37	27.7	0.2	1.23
Junc 39	12.6	656.5	20.5	Pipe 38	15.1	0.1	0.40
Junc 40	12.6	655.9	34.4	Pipe 39	-13.8	0.1	0.34
Junc 41	12.6	655.8	17.8	Pipe 40	12.6	0.1	0.27
Junc 42	12.6	655.7	13.7	Pipe 41	92.7	0.2	1.09
Junc 43	12.6	655.8	54.8	Pipe 42	25.2	0.1	0.28
Junc 44	12.6	655.8	35.8	Pipe 43	12.6	0.0	0.05
Junc 45	12.6	655.6	37.6	Pipe 44	25.2	0.1	0.28
Junc 46	12.6	654.8	56.6	Pipe 45	12.6	0.1	0.27

Network Table - Nodes				Network Table - Links			
Node ID	Demand m^3/d	Head m	Pressure m	Link ID	Flow m^3/d	Velocity m/s	Head loss m/km
Junc 47	12.6	654.7	52.7	Pipe 46	29.7	0.2	1.40
Junc 48	12.6	656.4	31.4	Pipe 47	31.3	0.2	1.55
Junc 49	12.6	656.1	23.1	Pipe 48	18.7	0.1	0.59
Junc 50	12.6	655.8	31.8	Pipe 49	6.1	0.0	0.05
Junc 51	12.6	655.8	24.8	Pipe 50	14.2	0.1	0.36
Junc 52	12.6	655.6	26.6	Pipe 51	37.4	0.2	2.16
Junc 53	12.6	655.4	23.4	Pipe 52	25.4	0.2	1.05
Junc 54	12.6	655.1	22.6	Pipe 53	125.4	0.3	1.93
Junc 55	12.6	654.9	22.4	Pipe 54	91.4	0.3	3.07
Junc 56	12.6	654.7	21.7	Pipe 55	77.9	0.3	2.26
Junc 57	12.6	654.3	22.3	Pipe 56	69.9	0.2	1.84
Junc 58	12.6	654.1	28.6	Pipe 57	81.8	0.3	2.48
Junc 59	12.6	654.0	29.0	Pipe 58	58.6	0.2	1.32
Junc 60	12.6	654.0	27.0	Pipe 59	24.0	0.1	0.25
Junc 61	12.6	654.0	30.5	Pipe 60	-60.9	0.2	1.42
Junc 62	12.6	654.0	34.0	Pipe 61	42.1	0.3	2.70
Junc 65	12.6	655.5	26.5	Pipe 62	43.0	0.3	2.81
Junc 66	12.6	655.2	28.7	Pipe 63	40.3	0.2	2.49
Junc 67	12.6	655.0	28.5	Pipe 64	37.3	0.2	2.15
Junc 68	12.6	654.7	26.7	Pipe 65	38.3	0.2	2.26
Junc 69	12.6	654.4	22.9	Pipe 66	34.6	0.2	1.87
Junc 70	12.6	654.0	26.0	Pipe 67	30.7	0.2	1.49
Junc 71	12.6	655.1	26.6	Pipe 68	17.2	0.1	0.51
Junc 72	12.6	655.0	28.0	Pipe 69	180.5	0.4	3.88
Junc 73	12.6	654.8	27.8	Pipe 70	125.2	0.3	1.92
Junc 74	12.6	654.7	22.7	Pipe 71	112.6	0.3	1.57
Junc 75	12.6	654.8	34.8	Pipe 72	42.7	0.3	2.78
Junc 76	12.6	652.2	28.2	Pipe 73	38.5	0.2	2.29
Junc 77	12.6	652.1	32.1	Pipe 74	25.9	0.2	1.09
Junc 78	12.6	650.6	29.6	Pipe 75	34.8	0.2	1.89
Junc 79	12.6	650.5	32.5	Pipe 76	25.2	0.2	1.03
Junc 80	12.6	650.4	32.4	Pipe 77	12.6	0.1	0.28
Junc 81	12.6	650.4	33.4	Pipe 78	-11.8	0.1	0.23
Junc 82	12.6	648.1	35.6	Pipe 79	-25.4	0.2	1.04
Junc 83	12.6	646.8	43.8	Pipe 80	30.6	0.2	1.48
Junc 84	12.6	646.1	42.1	Pipe 81	20.6	0.1	0.71
Junc 85	12.6	645.4	38.4	Pipe 82	21.5	0.1	0.77
Junc 86	12.6	644.9	36.9	Pipe 83	29.8	0.2	1.41
Junc 87	12.6	644.7	37.2	Pipe 84	20.2	0.1	0.68
Junc 88	12.6	644.7	37.7	Pipe 85	15.6	0.1	0.42
Junc 89	12.6	644.7	38.7	Pipe 86	12.6	0.1	0.27
Junc 90	12.6	644.7	35.7	Pipe 87	26.8	0.2	1.15
Junc 91	12.6	644.7	30.7	Pipe 88	17.9	0.1	0.54
Junc 92	12.6	644.8	43.8	Pipe 89	28.5	0.2	1.29

Network Table - Nodes				Network Table - Links			
Node ID	Demand m^3/d	Head m	Pressure m	Link ID	Flow m^3/d	Velocity m/s	Head loss m/km
Junc 93	12.6	646.0	41.5	Pipe 90	15.9	0.1	0.44
Junc 94	12.6	646.0	40.5	Pipe 91	3.3	0.0	0.02
Junc 95	12.6	645.3	52.3	Pipe 92	-9.4	0.1	0.10
Junc 96	12.6	645.2	47.2	Pipe 93	-22.0	0.1	0.80
Junc 97	12.6	645.2	44.7	Pipe 94	12.6	0.1	0.27
Junc 98	12.6	645.2	47.7	Pipe 95	12.6	0.1	0.27
Junc 99	12.6	646.4	41.4	Pipe 96	12.6	0.1	0.27
Junc 100	12.6	646.6	41.1	Pipe 97	12.6	0.1	0.27
Junc 101	12.6	647.2	40.2	Pipe 98	106.9	0.6	16.31
Junc 102	12.6	647.7	37.7	Pipe 99	81.7	0.5	9.67
Junc 103	12.6	648.2	38.2	Pipe 100	35.8	0.2	1.99
Junc 104	12.6	648.8	41.8	Pipe 101	12.6	0.1	0.27
Junc 105	12.6	649.5	48.7	Pipe 102	33.3	0.2	1.74
Junc 106	12.6	651.5	48.5	Pipe 103	20.7	0.1	0.72
Junc 107	12.6	652.7	36.2	Pipe 104	8.1	0.1	0.07
Junc 108	12.6	654.1	46.1	Pipe 105	-32.7	0.2	1.68
Junc 109	12.6	654.1	53.1	Pipe 106	12.6	0.1	0.27
Junc 3	12.6	648.1	35.1	Pipe 107	12.6	0.1	0.27
Resvr 1		658.5		Pipe 108	12.6	0.1	0.27
				Pipe 109	12.6	0.1	0.27
				Pipe 110	12.6	0.1	0.27
				Pipe 111	12.6	0.1	0.27
				Pipe 112	12.6	0.1	0.27
				Pipe 113	64.1	0.4	6.04
				Pipe 114	48.0	0.3	3.47
				Pipe 115	35.4	0.2	1.95
				Pipe 116	81.8	0.3	2.48
				Pipe 117	69.2	0.2	1.81
				Pipe 118	56.6	0.2	1.23
				Pipe 119	20.0	0.1	0.67
				Pipe 120	6.2	0.0	0.05
				Pipe 121	12.6	0.1	0.27
				Pipe 122	24.0	0.1	0.94
				Pipe 123	11.4	0.1	0.20
				Pipe 124	-1.2	0.0	0.01
				Pipe 125	42.2	0.2	0.71
				Pipe 126	31.6	0.2	1.57
				Pipe 127	19.0	0.1	0.61
				Pipe 128	18.0	0.1	0.56
				Pipe 129	2.0	0.0	0.01
				Pipe 130	-3.4	0.0	0.03
				Pipe 131	24.4	0.1	0.97
				Pipe 132	11.8	0.1	0.23
				Pipe 133	1.7	0.0	0.00

Network Table - Nodes				Network Table - Links			
Node ID	Demand m^3/d	Head m	Pressure m	Link ID	Flow m^3/d	Velocity m/s	Head loss m/km
				Pipe 134	-10.9	0.1	0.14
				Pipe 135	15.1	0.1	0.39
				Pipe 136	12.6	0.1	0.27
				Pipe 137	3.5	0.0	0.03
				Pipe 138	364.3	0.5	4.76
				Pipe 139	355.2	0.5	4.54