添付資料 21 ケーススタディ(給水)(テトン語版)

Dizenya ba Fornesementu Bee iha Area Rural : Estudu Kazu (1)

1. **Servisu iha Area ho Ezezensia Bee)**
2. **Bee Matan**
3. **Transmission Main (Transmisaun Prinsipal)**
4. **Reservoir (Tank) Tanki Rezervoir**
5. **Distribution Main (Distribusaun Prisipal)**
6. **Stand Pipe(Pipa hamrik)**

PDID	CHECKLIST C-3-1 (1/4)			Verified by	Approved by
Type of Project	Water Supply – spring/river bed water	Objective	Planning and Design		

Contract/Project No.		Date of Submission	/ , 201 (dd / mm , yyyy)
Project Name		Stage	Verification of Draft Contract Documents
Implementing Agency			

Check Item	Check Point	Date Checked	Tick	Remarks
Project concept	Is the project proposed in accordance with Government Strategy (rural and urban water supply development strategy)?			
Coordination	Was all coordination made between the relevant agencies?			
Project area	Are data/information available, including: ☐ number of present population and households, ☐ major income sources, ☐ development history of the villages/towns, ☐ rainfalls?			
	Are the area frequently affected by natural disaster like ☐ floods or ☐ landslides?			
Project target	Target year: _____			
	Number of households to be served: _____			

PDID	CHECKLIST C-3-1 (2/4)			Verified by	Approved by
Type of Project	Water Supply – spring/river bed water	Objective	Planning and Design		

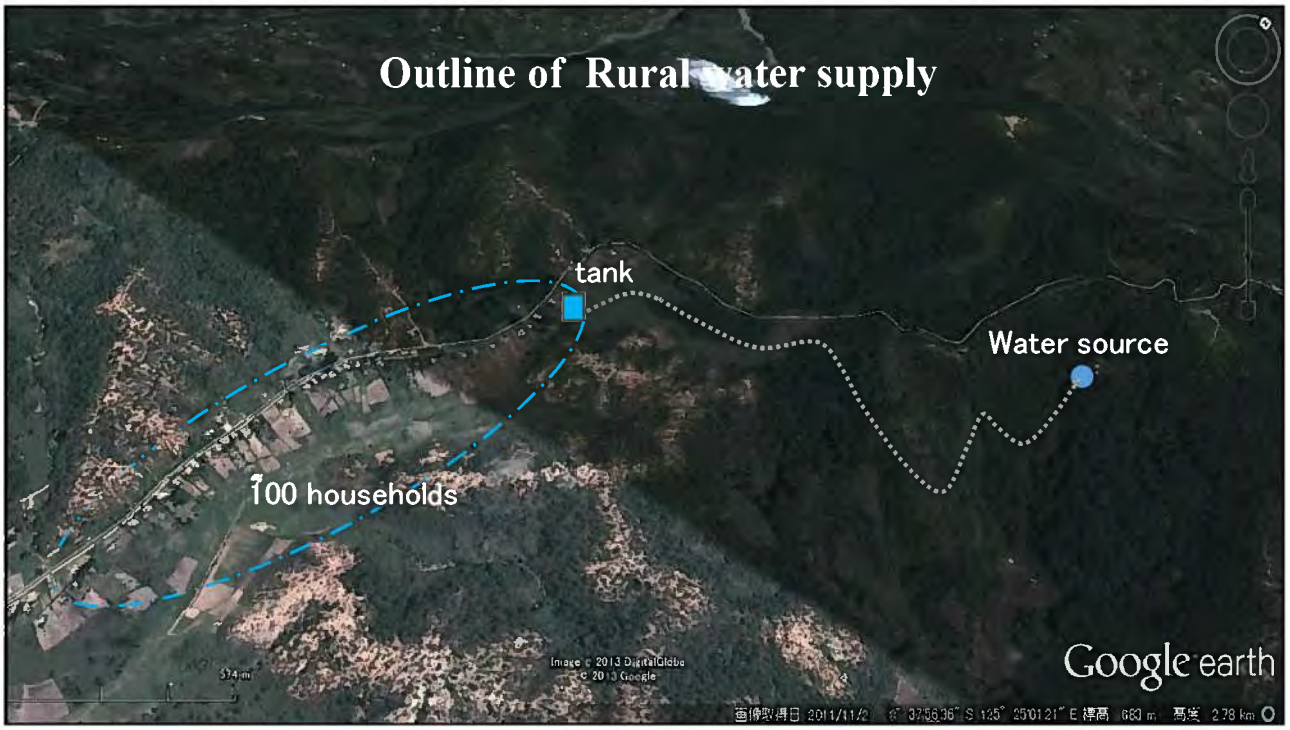
Check Item	Check Point	Date Checked	Tick	Remarks
Existing condition	Are data are available on:			
	☐ What are the present water sources for people's daily lives?			
	☐ What are their major problems (☐quantity, ☐quality, ☐distance)?			
	☐ What are health condition of the people? (morbidity rate of water borne diseases)			
Planned water source	Is water source sufficient in quantity and quality? Quantity: _____ L/sec, Quality: ☐ turbid, ☐ not turbid			See Annex: Planned water source No.1
	Is its yield stable throughout the year? ☐ yes, ☐ no			
	Is gravity flow system applied for water transmission? ☐ yes, ☐ no			
	Is catchment area of the source sufficient? ☐ yes, ☐ no			See Annex: Planned water source No.4
Future water demand	Supply water to the people via ☐ house taps or ☐ public taps?			
	Design value of unit water consumption per capita per day: _____L/c/d			
	Is calculation for future water demand by the service population made or not? ☐ yes, ☐ no			

PDID	CHECKLIST C-3-1 (3/4)			Verified by	Approved by
Type of Project	Water Supply – spring/river bed water	Objective	Planning and Design		

Check Item	Check Point	Date Checked	Tick	Remarks
Pipeline design	Is pipe diameter estimated using pipe-flow formula with variables of distance, height and flow rate? ☐ yes, ☐ no			See Annex: Pipeline design No.1
	Are drawings of hydraulic profile based on field survey attached? ☐ yes, ☐ no			See Annex: Pipeline design No.2
	Are pipe accessories such as gate valves, air valves, wash-outs properly designed? ☐ yes, ☐ no			See Annex: Pipeline design No.3
Service reservoir design	Is the reservoir equipped with ☐ inlet valves, ☐ outlet valves, ☐ drain pipes, ☐ overflow pipes, ☐ air ventilator.			See Annex: Service reservoir design No.1
	Is concrete structure with reinforcement bars normally designed: ☐ yes, ☐ no			
Public taps	Number of faucets equipped at a tap: ___ faucets			
	Number of households to be served by one tap: _____ households			
	Are concrete apron properly designed: ☐ yes, ☐ no			
	Are drain pipes equipped at the concrete apron: ☐ yes, ☐ no			

PDID	CHECKLIST C-3-1 (4/4)			Verified by	Approved by
Type of Project	Water Supply – spring/river bed water	Objective	Planning and Design		

Check Item	Check Point	Date Checked	Tick	Remarks
Operation & maintenance after construction	Is water user committee planned to organize in the village/town: ☐ yes, ☐ no			
	Is an operation plan (cleaning, valve control, etc.) prepared: ☐ yes, ☐ no			
	Will fixed amount of fees for O&M be collected from the households: US$_____ /month/household			
People's awareness	Do people have an awareness to pay for O&M fees: ☐ yes, ☐ no			
	Do people have a willingness to be serviced: _____ households out of _____ households			



1. Area Servisu ho Ezezensia Bee

(1) Area Servisu
2 Ezezensia Bee

Uma kain (HHs) = 100, medio 1 HH = ba ema nai' n 6
Total ba populasaun nebe konsume= 100 x 6 = ba ema nai' n 600
Mediu ba Ezezensia bee = 600 x [50] lpcd = [30] l/d

NRW (Relasaun ho kuak) = 15 %
Distibusaun hamutuk ho kanu nebe kuak ka suli sai(estraga)
= [30.000] l/d / (1 – 0.15) / 86400 sec/d = [0.41] l/sec

Maxsimum ba Ezezensia bee
= Medio ba Ezezensia bee (inclui NRW) x 1.30
= [0.41] l/sec x 1.30 = [0.53] l/sec

quote from Multi-Village Pooling Project in Indonesia
Handbook for Community-Based Water Supply Organizations

2. Bee Matan

Metodu Volume :Fatin nebe fornese bee nian(Inteik). Husi fatin bee Matan

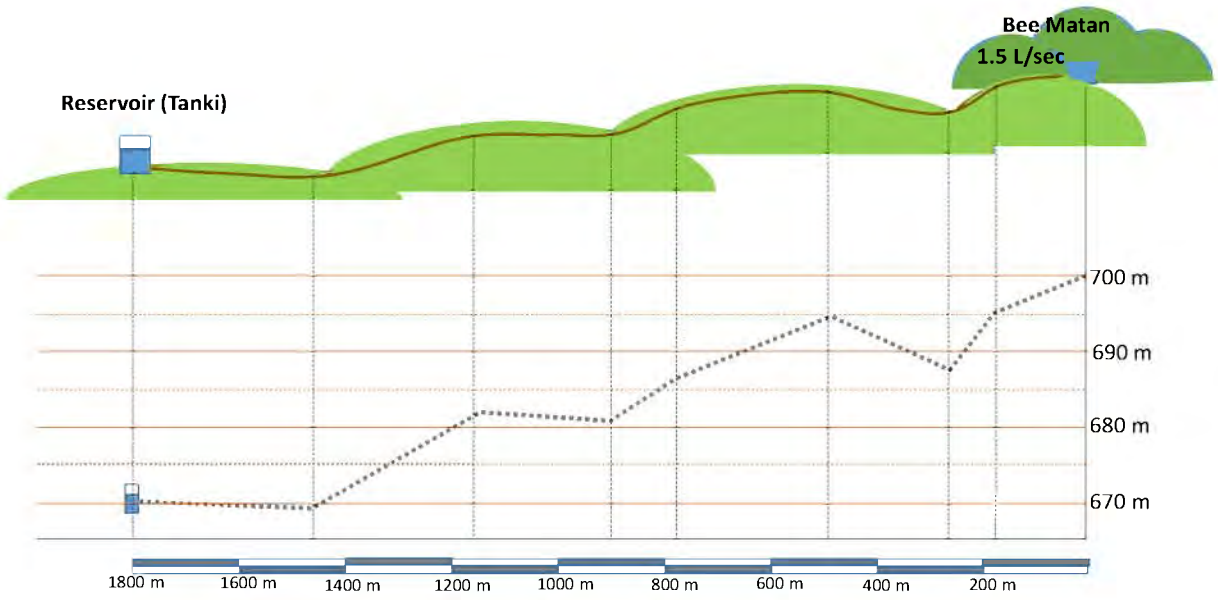
Ita presiza mos : 1. Rezervador ho volume nebe iha
2. Para ita nia observasaun ida ne (hare)
3. Halo Notadu ba rezultadu iha kraik ne

Bee Matan = 1.5 L/sec

Etapa 1. Fatin Rezervador iha pontu bee sulin nian
2. halo Recordtime nomos foti desizaun
3. Repete ita nia tempu itoan hodi halo rezultadu nebe diak
4. kalkula ho kuantidade ba *Bee suli nian tuir formula iha kraik ho kada exprementasaun*
5. Foti medio ho kuantidade kada be nia sulin

Formula Q = V / T
Q : kuantidade ba be sulin
V : volume ba rezervador (kada litru)
T : Foti mos tempu atu prense Kontainer (Per menit)

3. Transmisaun Prinsipal



4. Rezervador (Tanki)

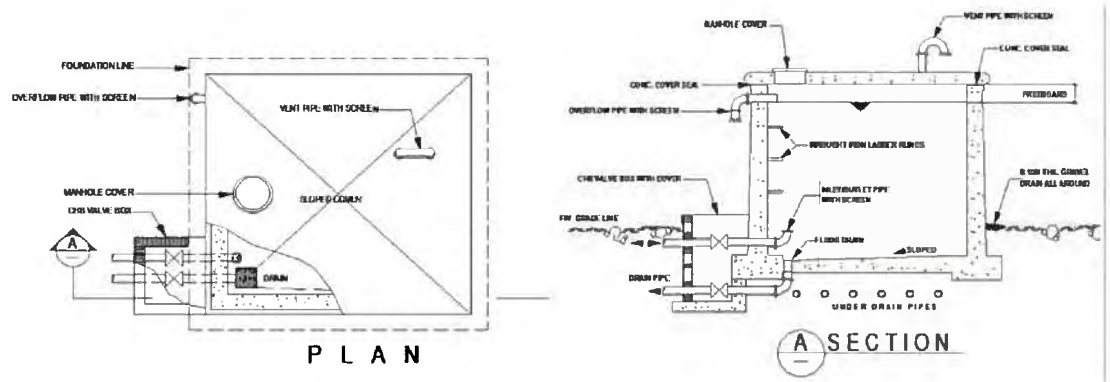
Capasidade

Cr = (1/4) (ADD)

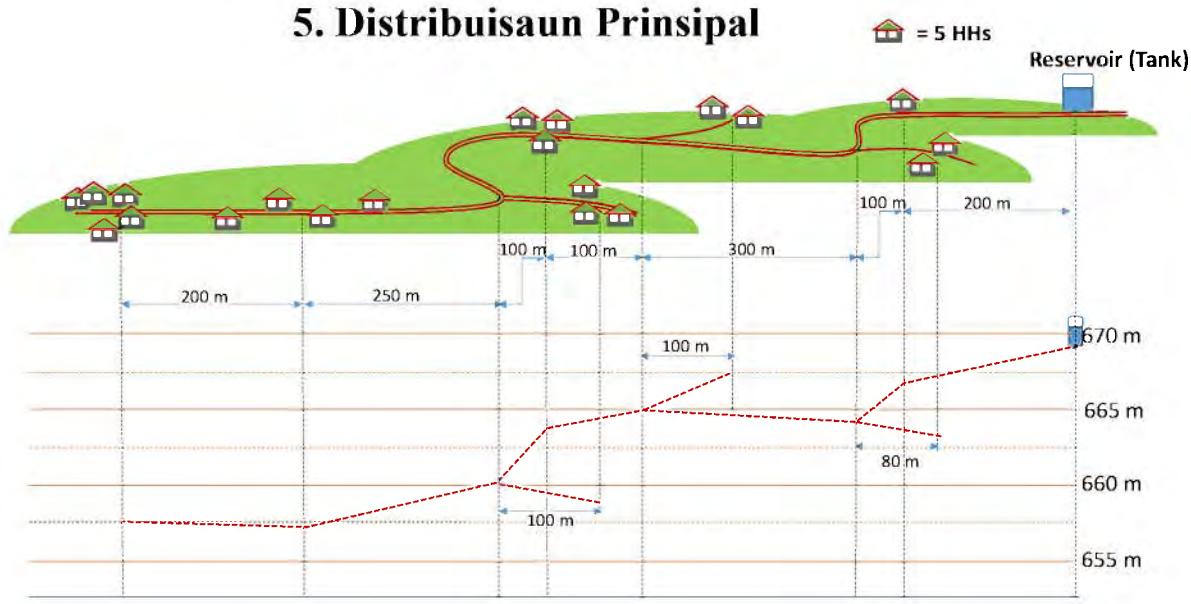
Iha nebe:

Cr = kapasidade ba Reservoir kada litru

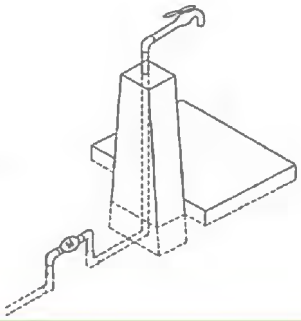
ADD = Medio ba Ezezensia bee kada litrus por dia



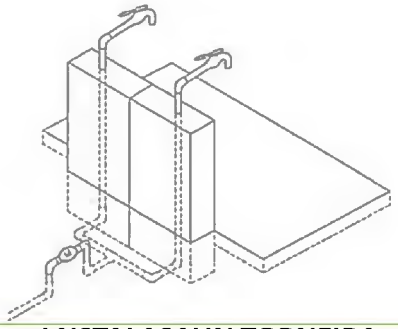
5. Distribuisaun Prinsipal



6. Pipa Hamrik

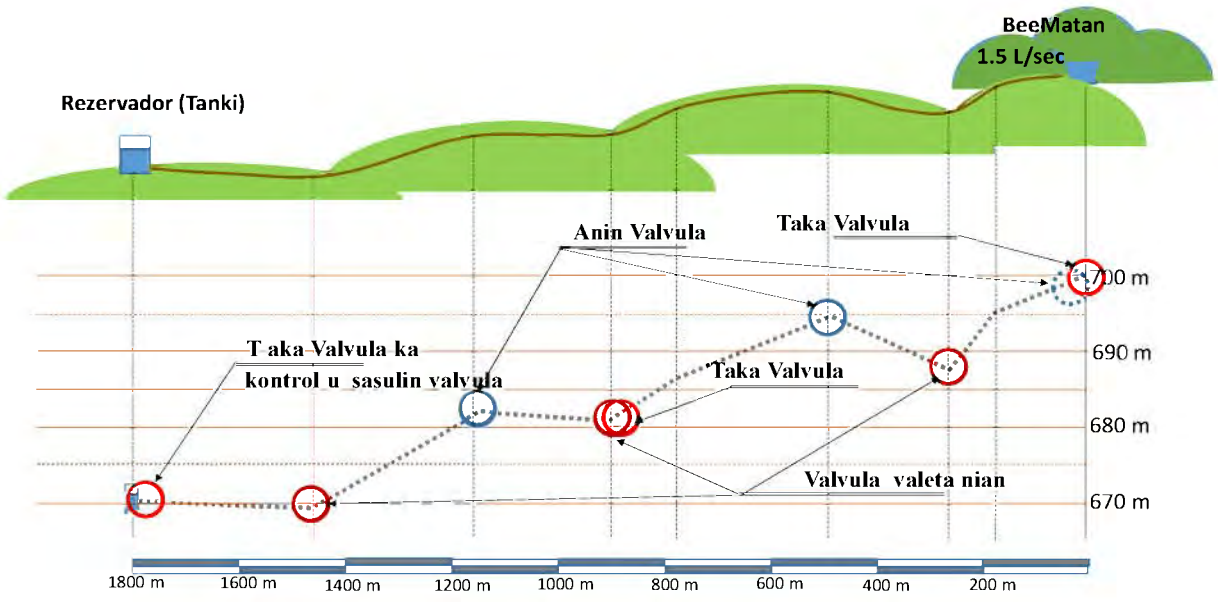


INSTALASUN TORNEIRA PUBLIKU
HO TIPU RIN IDA

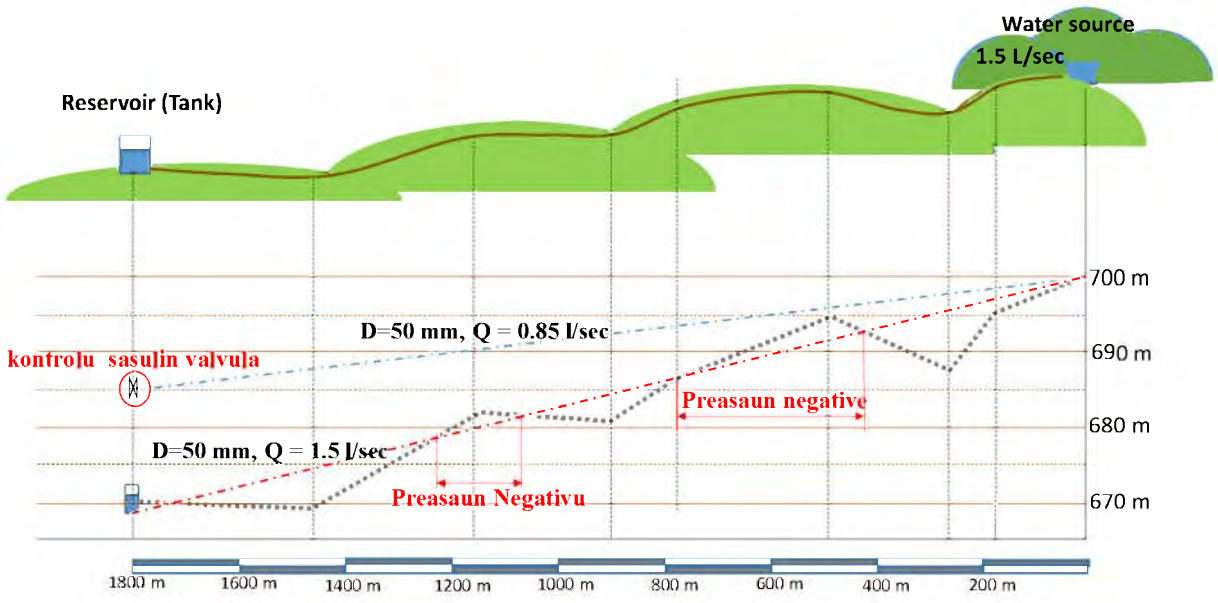


I NSTALASAUN TORNEIRA
PUBLIKU
HO TIPU RIN KADUAK

Pontu Revista (1)



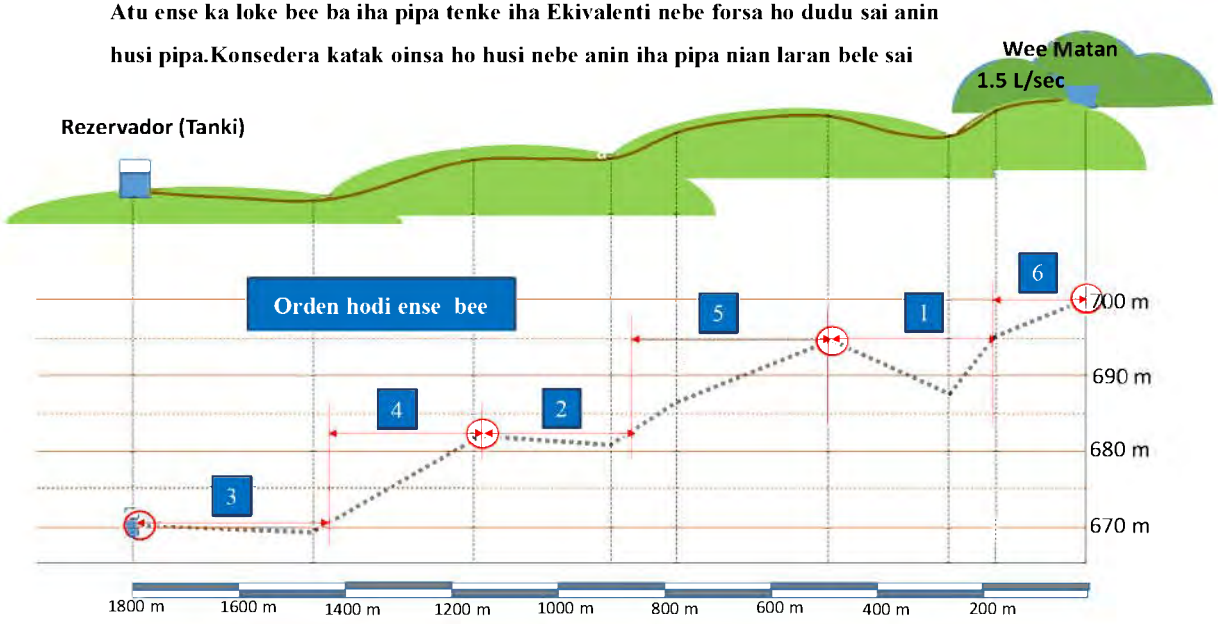
Pontu Revista (2)



Knowhow: filling of water

Oinsa atu ense ka loke bee ba lina pipa nian depois de konstrusaun

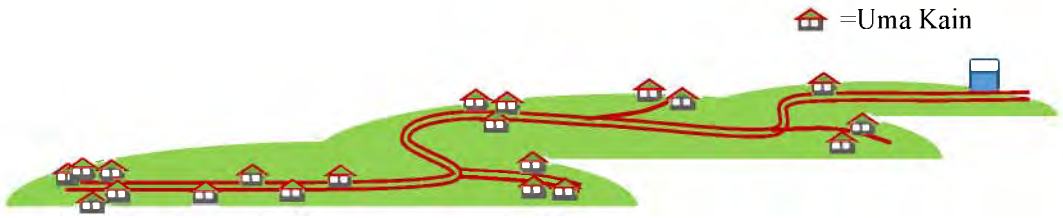
Atu ense ka loke bee ba iha pipa tenke iha Ekivalenti nebe forsa ho dudu sai anin husi pipa.Konsedera katak oinsa ho husi nebe anin iha pipa nian laran bele sai



WORKSHEET : Dezeńu Water supply ih Rural –**Estudu Kazu (1)** –

1.Area Projetu

Numeru de Populasaun ho Umakain



Populasun nebe iha = HHs x Ema/HH

HH: Uma kain

2.Target Projetu

Targetu Tinan: 10

Numeru ba Uma kain atu fornese : _____

Numeru ba populasaun atu fornese :

3. Planu ba Bee Matan

a. Karik Bee Matan Sufsiente duni, iha Kuantidade ho Kualidae ?

a-1. Quantidade: 1.5 L/sec

a-2. Qualidade: □ diak (turbid), □ la diak (not turbid)

b. Iha Rezultadu diak ba mudansa tinan nian? □ Los, □ Lae

c. Sistema Gravitasaun bee matan bele aplika ba bee nia transmisaun? ☐

Sim, ☐ Lae

d. Zona bee matan suli: ____m naruk x _____ m luan

4. Ezezensia Bee(Water demand) ba Futuru

a. Bee Moos ba komunidade liu husi

☐ Torneira Pribadu ☐ Torneira públiku ?

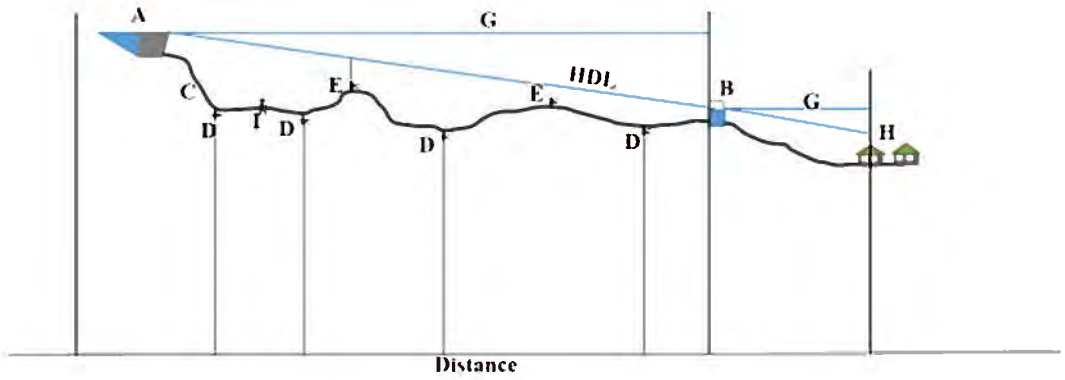
b. Dezeñu valor unidade konsumadór bee loron ida: 3800X45=171.000 L/c/d

c. Kalkulasaun ba ezijénsia bee iha futuru husi serbi populasaun halo tiha ona ka lae?

☐Sim, ☐Lae

5. Dezeńu kanu(Pipe line)

a. Asesoriu sira tubulasaun, Valvula ár, fase liur nian projetadu tiha ona tuir Dezeńu? ☐ Sim, ☐ Lae



A = Intake structure
B = Storage reservoir
C = Pipeline
D = Blow-off valve
E = Air valve

HDL = Hydraulic grade line
G = Static head
H = Rural town or Village
I = Sectioning valve (every 1.5 km)

b. Dezenu perfil hidrauliku bazeia ba levantamentude dadus?

☐ Sim, ☐Lae

c. Dezenu perfil hidrauliku bazeia ba levantamentude dadus EPANET?

☐ Sim, ☐Lae

6. Dezeñu Rezervatoriu Servisu

a.karik Kapasidade ba Rezervador nian Sufsiente ?_____ m^3

Cr = (1/4) (ADD)

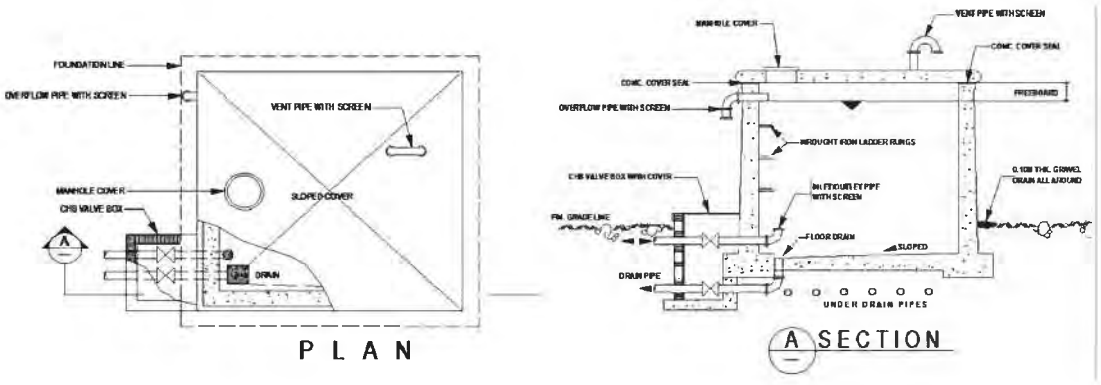
Iha nebe :

Cr = Kapasidade Rezervador kada litrus

ADD = Medio ba ezezensia loron, kada liturs por dia

b. Rezervatoriu halo kompletu tiha ona ho ☐ Valvula de entrada/tama, ☐ Valvula sai nian, ☐ Kanu drenejen/ penguras pipa, ☐Kanu transbordamentu, ☐ ár Ventiladór

c. Estrutura konkretu ho baras de reforsu normalmente projetadu tiha ona? : ☐ Sim, ☐Lae



7. Torneira Publik

a. Numeru torneira sira kompletu ho keran : 1…….. torneira

a. Torneira ida sei instala ba total uma kain hira: _____ uma kain

b. Abental konkretu projeta tiha ona: ☐ Sim, ☐Lae

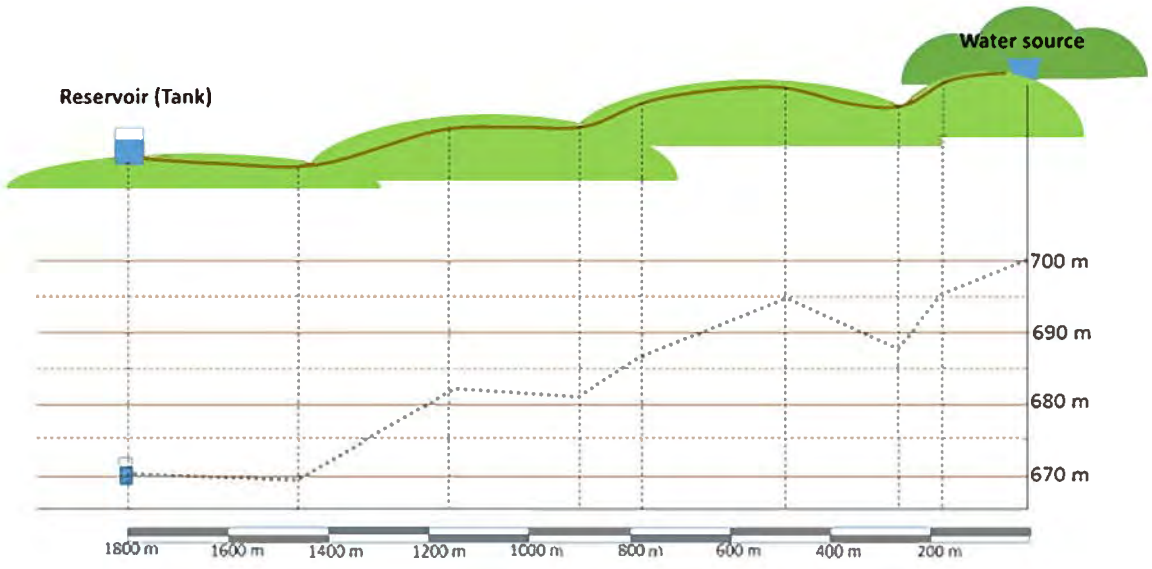
d. Kanu drenajen halo kompletu ona ho avental konkretu: ☐Sim, ☐Lae

☐ Sim, ☐ Lae

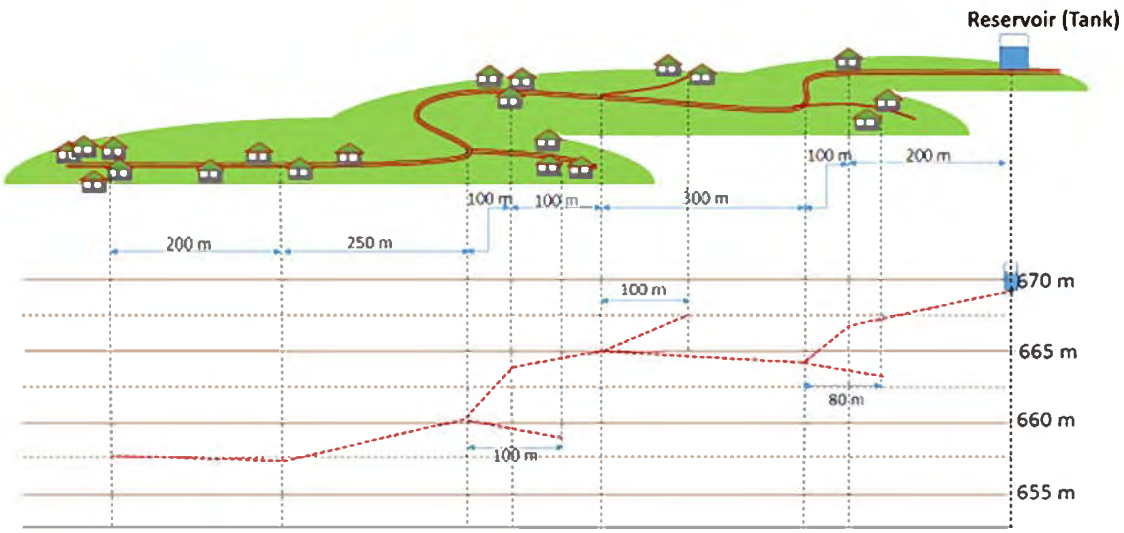
Kalkulasaun Hydraulic

1. Pipa Transmisaun

ns

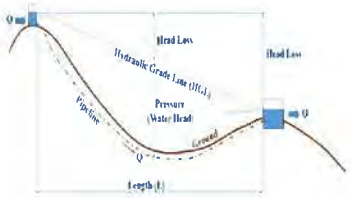


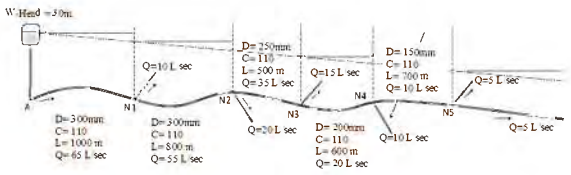
2. Pipa Distribuisaun

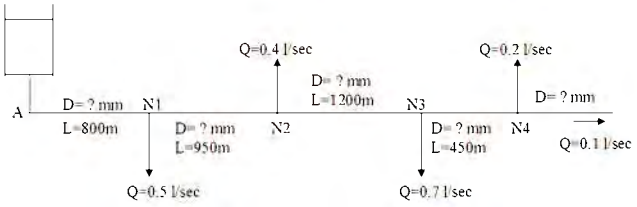


添付資料 22 PIPECAL(給水)(英語版)

How to use PIPECAL







Hazen–Williams Formula

- Darcy-Weisbach formula
- **Hazen-Williams formula**
- Mannings formula
- Combined Darcy-Weisback and Colebrook-White equation.

$$Q = 0.25783C \cdot (D/1000)^{2.63} \cdot (h/L)^{0.54} \cdot 1000$$

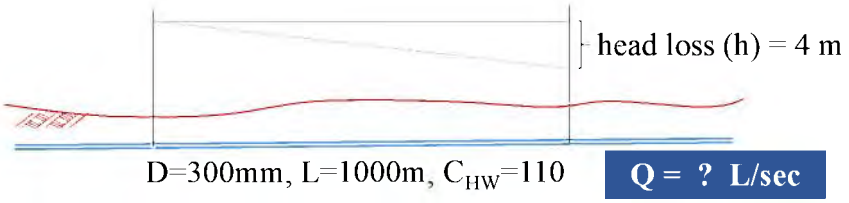
$$D = 1.6258C^{-0.38} \cdot (Q/1000)^{0.38} \cdot (h/L)^{-0.205} \cdot 1000$$

$$h = 10.666C^{-1.85} \cdot (D/1000)^{-4.87} \cdot (Q/1000)^{1.85} \cdot L$$

$$C = (Q/1000)/(D/1000)^{2.63}/(h/L)^{0.54}/0.27853$$

h: Head Loss(m)
C: Flow(Roughness) coefficient
D: Pipe diameter(mm)
Q: Flow rate(l/s)
L: Pipe Length(m)

1. To Calculate the flow rate (Q)

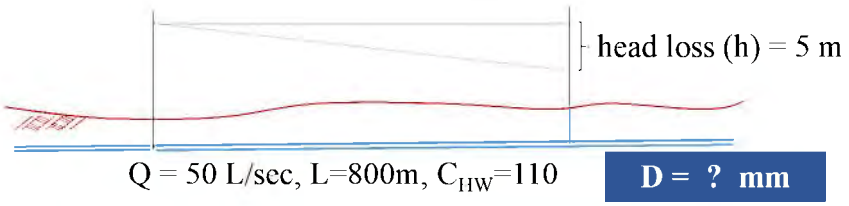


$$Q = 0.25783C \cdot (D/1000)^{2.63} \cdot (h/L)^{0.54} \cdot 1000$$

D(mm)= ?	h(m)= ?	L(m)= ?	C= ?	Q (l/sec)
300	4	1000	110	

Input → Output

2. To calculate pipe-diameter (D)

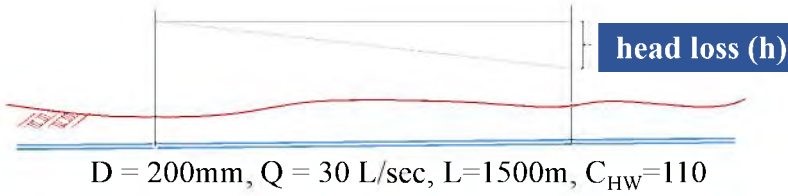


$$D = 1.6258C^{-0.38} \cdot (Q/1000)^{0.38} \cdot (h/L)^{-0.205} \cdot 1000$$

Q(l/sec)=?	h(m)= ?	L(m)= ?	C= ?	D (mm)
50	5	800	110	

Input → Output

3. To calculate the head-loss (h)

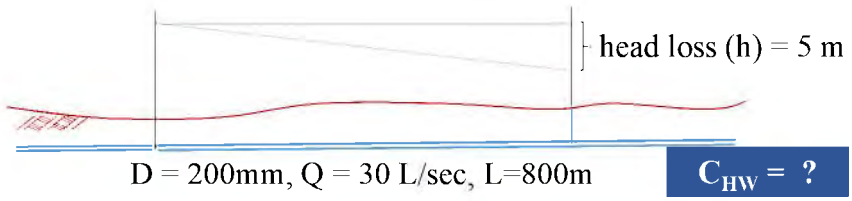


$$h = 10.666C^{-1.85} \cdot (D/1000)^{-4.87} \cdot (Q/1000)^{1.85} \cdot L$$

Q(l/sec)=?	D(mm)= ?	L(m)= ?	C= ?	h (m)
30	200	1500	110	

Input → Output

4. To calculate the flow coefficient



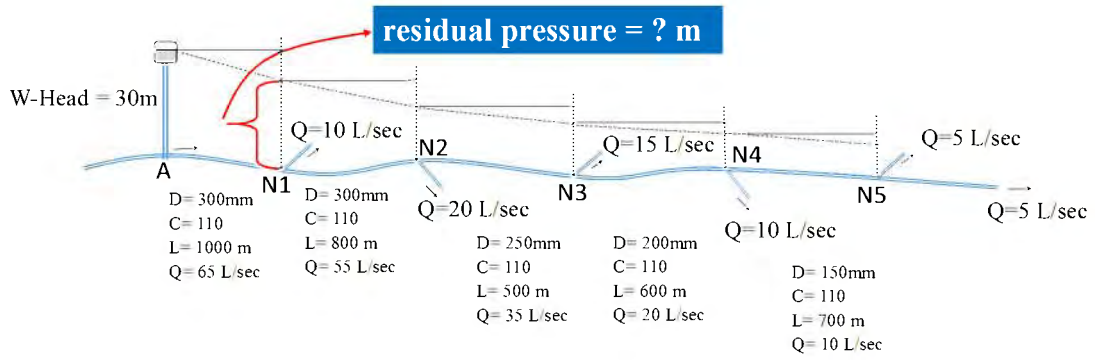
$$C = (Q/1000) / (D/1000)^{2.63} / (h/L)^{0.54} / 0.27853$$

Q(l/sec)=?	D(mm)= ?	h(m)= ?	L(m)= ?	C
30	200	5	800	

Input → Output

5. Hydraulics of a pipeline with branches

5-1. To calculate the residual pressure at each node of a pipeline



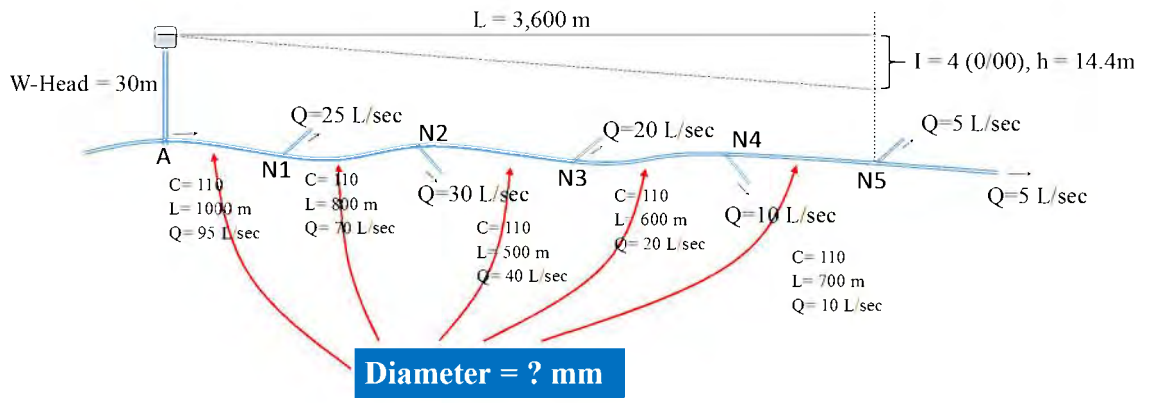
Node	GL(m)	Qout	W-Head	Pipeline	D(mm)	L(m)	C	Qflow	loss (m)
A	GLA= 10	-	30.00		-	-	-	-	-
Node- 1	GL1= 10	10	WH1	A - N1	300	1000	110	65	h1
Node- 2	GL2= 12	20	WH2	N1 - N2	300	800	110	55	h2
Node- 3	GL3= 8	15	WH3	N2 - N3	250	500	110	35	h3
Node- 4	GL4= 7	10	WH4	N3 - N4	200	600	110	20	h4
Node- 5	GL5= 5	5	WH5	N4 - N5	150	700	110	10	h5
To Down	-	5	-	N5 -	100	-	-	5	-

Step -2: To calculate

WH1 = GLA + WHA – GL1 – h1
WH2 = GL1 + WH1 – GL2 – h2
WH3 = GL2 + WH2 – GL3 – h3
-- -- -- -- -- -- -- -- -- -- --

Step -1: To calculate using PIPECAL

5-2. To calculate the efficient diameter of each section



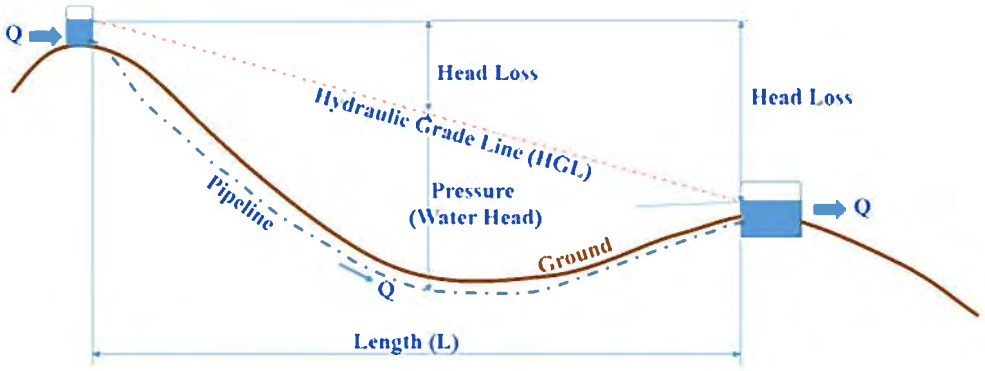
Node	GL(m)	Qout	W-Head	Pipeline	D(mm)	L(m)	C	Qflow	I(0/00)	loss (m)
A	10	-	30.00		-	-	-	-	-	-
Node- 1	10	25	26.0	A - N1		1000	110	95	4	4.0
Node- 2	12	30	20.8	N1 - N2		800	110	70	4	3.2
Node- 3	8	20	22.8	N2 - N3		500	110	40	4	2.0
Node- 4	7	10	21.4	N3 - N4		600	110	20	4	2.4
Node- 5	5	5	20.6	N4 - N5		700	110	10	4	2.8
To Down	-	5	-	N5 -	-	-	-	5		-

To calculate

Basic Hydraulics for Water Supply Engineers

The flow in a water main has some relation with roughness of pipe inside (friction). As a result of the friction loss, the difference of water heads between at an upper-point and at the lower point occurs.

Several formulas are used to calculate the flow in a water main by applying a roughness or friction coefficient as a factor.



1. Hydraulic Formulas

There are several formulas on pressured pipeline hydraulics, which express the relation between flow rate and head loss. They are shown below. A well-known formula is Hazen-Williams Formula.

a. Hazen-Williams Formula

$Q = 0.25783C \cdot (D/1000)^{2.63} \cdot (h/L)^{0.54} \cdot 1000$

$D = 1.6258C^{-0.38} \cdot (Q/1000)^{0.38} \cdot (h/L)^{-0.205} \cdot 1000$

$h = 10.666C^{-1.85} \cdot (D/1000)^{-4.87} \cdot (Q/1000)^{1.85} \cdot L$

$C = 3.9503(Q/1000) \cdot (D/1000)^{-2.63} \cdot (h/L)^{-0.54}$

b. Takakuwa Formula

$Q = C \cdot (D/1000)^{2.495} \cdot (h/L)^{0.512} \cdot 1000$

$D = C^{-0.401} \cdot (Q/1000)^{0.401} \cdot (h/L)^{-0.205} \cdot 1000$

$h = C^{-1.952} \cdot (D/1000)^{-4.87} \cdot (Q/1000)^{1.952} \cdot L$

$C = (Q/1000) \cdot (D/1000)^{-2.495} \cdot (h/L)^{-0.512}$

c. Manning Formula

$Q = 0.31168C \cdot (D/1000)^{2.667} \cdot (h/L)^{0.5} \cdot 1000$

$D = 1.566C^{-0.375} \cdot (Q/1000)^{0.375} \cdot (h/L)^{-0.1875} \cdot 1000$

$h = 10.294C^{-2} \cdot (D/1000)^{-5.33333} \cdot (Q/1000)^{2} \cdot L$

$C = 3.2084(Q/1000) \cdot (D/1000)^{-2.6667} \cdot (h/L)^{-0.5}$

The comparison of flow-coefficient between Hazen-Williams Formula, Takakuwa Formula and Manning Formula: at D=250mm, Q=40 L/sec

Hazen-Williams	80	90	100	110	120	130	140
Takakuwa	19.5	21.8	24.1	26.4	28.6	30.9	33.1
Manning	60.6	67.5	74.4	81.3	88.1	94.9	101.6

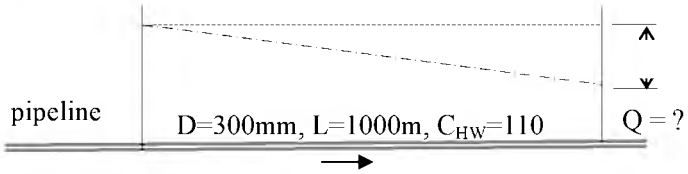
2. Calculation of Using MS-Excel (Spreadsheet Software)

Calculations of pipeline hydraulics can be done easily by using a spreadsheet software such as MS-Excel. Followings are examples of pipeline calculation. In these examples Hazen-Williams Formula are used.

2-1. Calculation of a simple pipeline hydraulics (using Sheet 'Simple-Pipeline' of Excel file "PIPE-CAL.xlsx")

(1) To Calculate the flow rate (using Formula-1 of Sheet 'Simple-Pipeline')

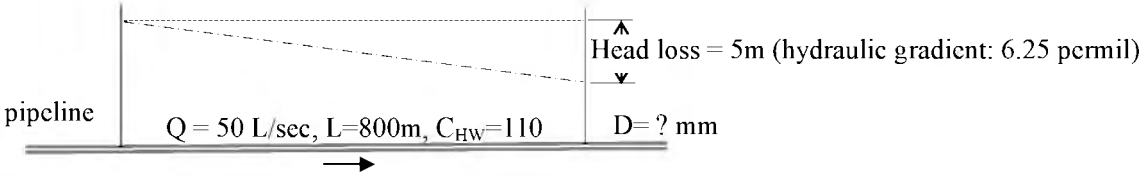
This is an example how to get the flow rate (Q) when pipe diameter (D), pi pe length (L), head loss (h) and flow coefficient (C_{HW}) are given.



$$Q = 0.25783 C_{HW} \cdot (D/1000)^{2.63} \cdot (h/L)^{0.54} \cdot 1000$$
$$= 0.25783 \times 110 \times (0.3)^{2.63} \times (0.004)^{0.54} \times 1000$$
$$= 65.5 \text{ L/sec}$$

(2) To calculate the pipe-diameter (using Formula-2 of Sheet 'Simple-Pipeline')

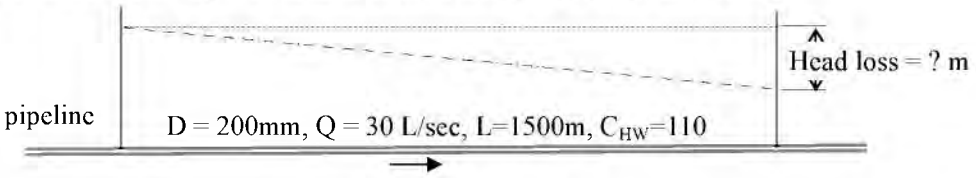
This is an example how to get the pipe-diameter (D) when Q, L, h, C_{HW} are given.



$$D = 1.6258 C_{HW}^{-0.38} \cdot (Q/1000)^{0.38} \cdot (h/L)^{-0.205} \cdot 1000$$
$$= 1.6258 \times (110)^{-0.38} \times (0.05)^{0.38} \times (0.00625)^{-0.205} \times 1000$$
$$= 247 \text{ mm} \quad (\Rightarrow 250 \text{ mm})$$

(3) To calculate the head-loss (using Formula-3 of Sheet 'Simple-Pipeline')

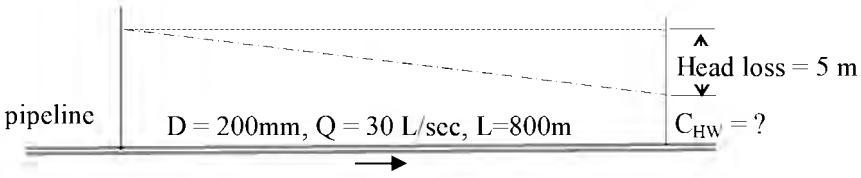
This is an example how to get the head-loss (h) when Q, D, L, C_{HW} are given.



$$h = 10.666 C_{HW}^{-1.85} \cdot (D/1000)^{-4.87} \cdot (Q/1000)^{1.85} \cdot L$$
$$= 10.666 \times (110)^{-1.85} \times (0.02)^{-4.87} \times (0.030)^{1.85} \times 1500$$
$$= 10.33 \text{ m}$$

(4) To calculate the flow coefficient (using Formula-4 of Sheet 'Simple-Pipeline')

This is an example how to get the flow coefficient (C_{HW}) when Q, D, L, h are given.

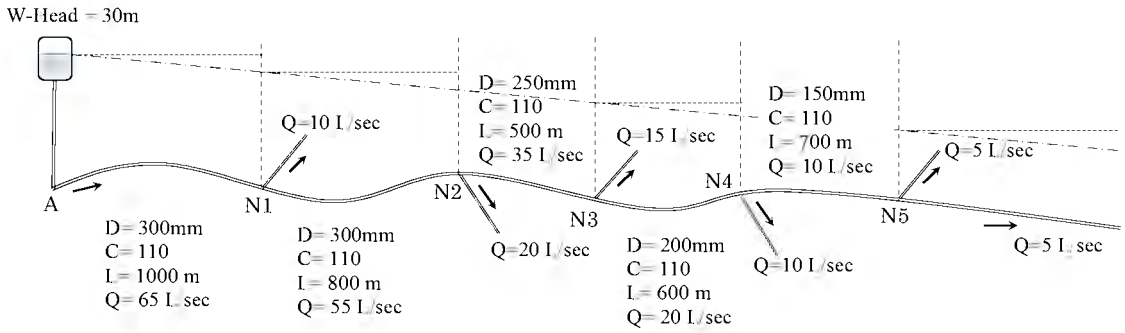


$$C = 3.9503(Q/1000) \cdot (D/1000)^{-2.63} \cdot (h/L)^{-0.54}$$
$$= 3.9503 \times (0.03) \times (0.2)^{-2.63} \times (5/800)^{-0.54}$$
$$= 115$$

2-2. Hydraulics of a pipeline with branches (using Sheet 'with Branch' of Excel file "PIPECAL.xlsl")

(1) To calculate the residual pressure at each node of a pipeline with several branches (using case-1 of Sheet 'with Branch').

This is an example how to get the head loss (h) between each two nodes and the water head (w-H) at each node when water head at the base (A in here), GL of nodes, water amount discharged from the nodes (consumption), pipe diameters (D), pipe lengths (L), and flow coefficients (C_{HW}) are given.

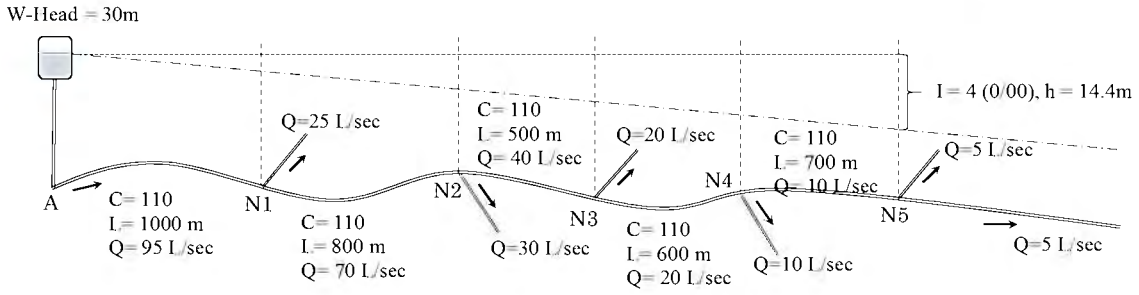


Put the given data into the table of case-1 of Sheet 'with Branch'. You will get the answer at column 'W-head' and column 'loss(m)' of the same table.

Node	GL (m)	Qout	W-Head	Pipeline	D(mm)	L(m)	C	Qflow	loss (m)
A	10	-	30.00		-	-	-	-	-
Node- 1	10	10	**26.00**	A - N1	300	1000	110	65	**4.00**
Node- 2	12	20	**21.65**	N1 - N2	300	800	110	55	**2.35**
Node- 3	8	15	**24.10**	N2 - N3	250	500	110	35	**1.55**
Node- 4	7	10	**23.15**	N3 - N4	200	600	110	20	**1.95**
Node- 5	5	5	**22.59**	N4 - N5	150	700	110	10	**2.56**
To Down	-	5	-	N5 -	100	-	-	5	-

(2) To calculate the efficient diameter of each section of a pipeline with several branches (using case-2 of Sheet 'with Branch').

This is an example how to decide the pipe diameters (D) of each section when water head at the base (A in here), GL of nodes, water amount discharged from the nodes (consumption), pipe lengths (L), and flow coefficients (C_{HW}) are given. You have to assume the reasonable pipeline hydrau-gradient (h/L).

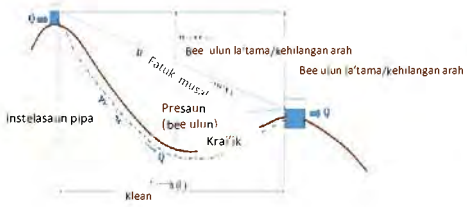


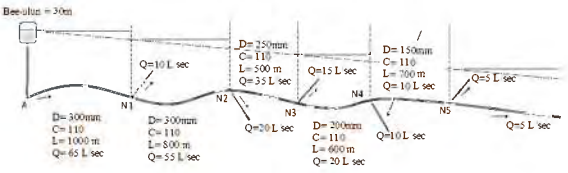
Put the given data into the table of case-2 of Sheet 'with Branch'. you will get the answer at column 'D(mm)' of the same table.

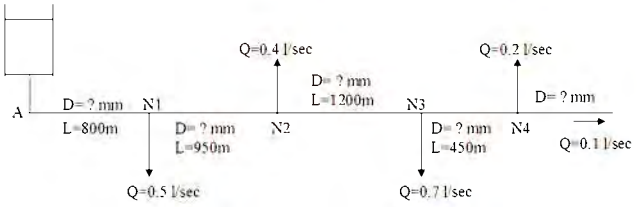
Node	GL (m)	Qout	W-Head	Pipeline	D(mm)	L (m)	C	Qflow	I(0/00)	loss (m)
A	10	-	30.00		-	-	-	-	-	-
Node- 1	10	25	26.0	A - N1	**345.5**	1000	110	95	4	4.0
Node- 2	12	30	20.8	N1 - N2	**307.6**	800	110	70	4	3.2
Node- 3	8	20	22.8	N2 - N3	**248.7**	500	110	40	4	2.0
Node- 4	7	10	21.4	N3 - N4	**191.1**	600	110	20	4	2.4
Node- 5	5	5	20.6	N4 - N5	**146.9**	700	110	10	4	2.8
To Down	-	5	-	N5 -	-	-	-	5		-

添付資料 23 PIPECAL(給水)(テトン語版)

Oinsa atu uza tubu pipa(Pipecal)







Formula husi Hazen–Williams

- Darcy-Weisbach formula
- **Formula Hazen-Williams**
- Mannings formula
- Kombinasi Darcy-Weisback ho Colebrook-Mutin iguala.

$$Q = 0.25783C \cdot (D/1000)^{2.63} \cdot (h/L)^{0.54} \cdot 1000$$

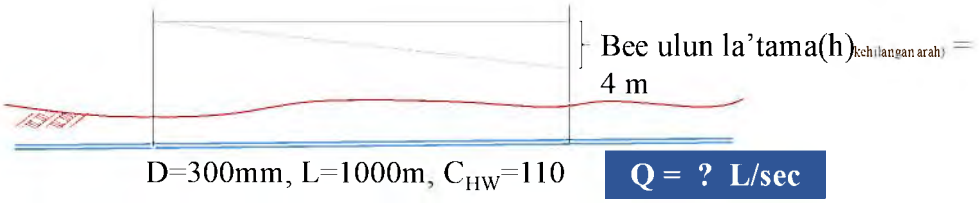
$$D = 1.6258C^{-0.38} \cdot (Q/1000)^{0.38} \cdot (h/L)^{-0.205} \cdot 1000$$

$$h = 10.666C^{-1.85} \cdot (D/1000)^{-4.87} \cdot (Q/1000)^{1.85} \cdot L$$

$$C = (Q/1000)/(D/1000)^{2.63}/(h/L)^{0.54}/0.27853$$

h: bee ulun la'tama(kehilangan arah)s
C: bee suli groseiru(kekasaran) koeficiente
D: Pipa diametru(mm)
Q: Media bee suli(l/s)

1. Atu kalkula media bee suli (Q)

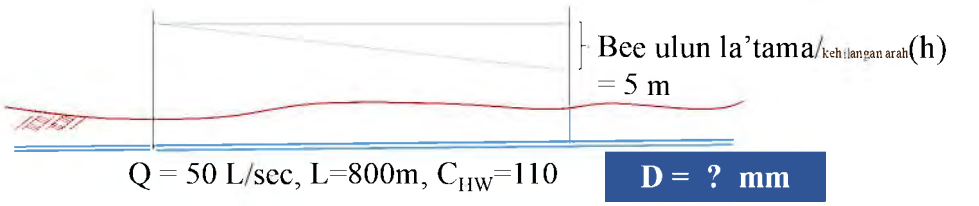


$$Q = 0.25783C \cdot (D/1000)^{2.63} \cdot (h/L)^{0.54} \cdot 1000$$

D(mm)= ?	h(m)= ?	L(m)= ?	C= ?	Q (l/sec)
300	4	1000	110	

Bee tama → Bee sai

2. Atu kalkula pipa diametru(D)

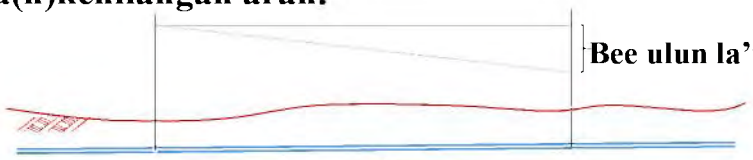


$$D = 1.6258C^{-0.38} \cdot (Q/1000)^{0.38} \cdot (h/L)^{-0.205} \cdot 1000$$

Q(l/sec)=?	h(m)= ?	L(m)= ?	C= ?	D (mm)
50	5	800	110	

Bee tama → Bee sai

3. Atu kalkula bee ulun la'tama(h)kehilangan arah.



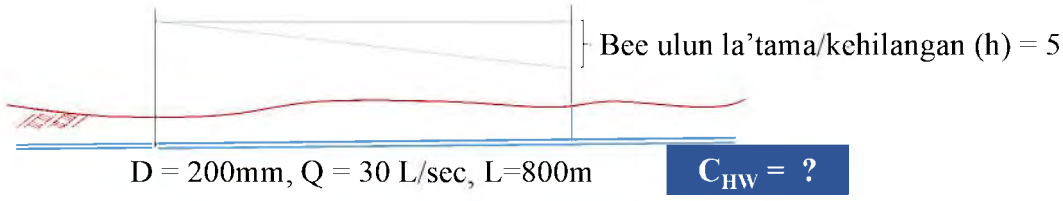
D = 200mm, Q = 30 L/sec, L=1500m, C_{HW}=110

$$h = 10.666C^{-1.85} \cdot (D/1000)^{-4.87} \cdot (Q/1000)^{1.85} \cdot L$$

Q(l/sec)=?	D(mm)= ?	L(m)= ?	C= ?	h (m)
30	200	1500	110	

Bee tama → Bee sai

4. Atu kalkula koeficiente bee suli



D = 200mm, Q = 30 L/sec, L=800m C_{HW} = ?

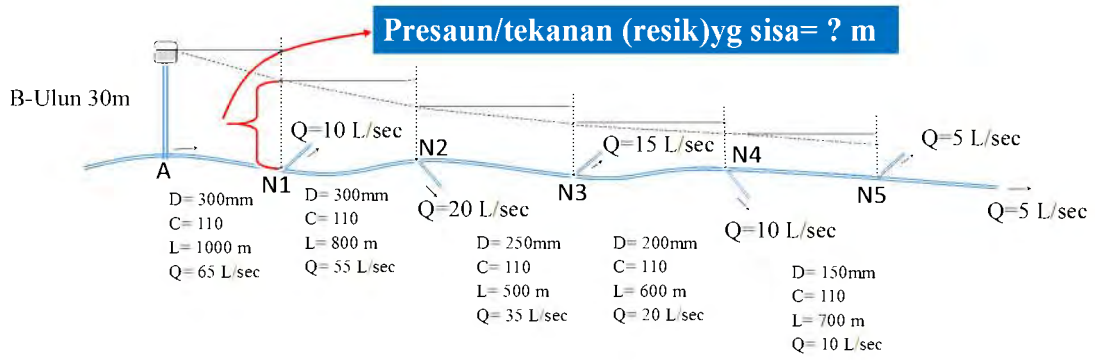
$$C = (Q/1000) / (D/1000)^{2.63} / (h/L)^{0.54} / 0.27853$$

Q(l/sec)=?	D(mm)= ?	h(m)= ?	L(m)= ?	C
30	200	5	800	

Bee tama → Bee sai

5. Hydraulics of a pipeline with branches

5-1. Atu presaun resik ba nodo id-idak kona-ba instelasaun pipa



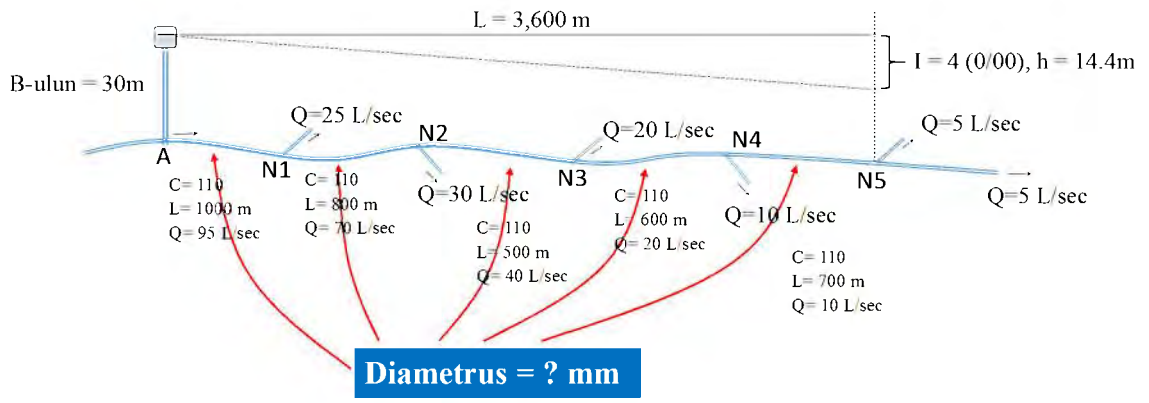
Nodo	GL(m)	Q sai	W(B-ulun)	Instelasaun pipa	D(mm)	L(m)	C	Qbee suli	Bee latama/kehi langan arah (m)
A	GLA= 10	-	30.00		-	-	-	-	-
Nodo- 1	GL1= 10	10	WH1	A - N1	300	1000	110	65	h1
Nodo 2	GL2= 12	20	WH2	N1 - N2	300	800	110	55	h2
Nodo- 3	GL3= 8	15	WH3	N2 - N3	250	500	110	35	h3
Nodo- 4	GL4= 7	10	WH4	N3 - N4	200	600	110	20	h4
Nodo- 5	GL5= 5	5	WH5	N4 - N5	150	700	110	10	h5
Ba krai'ik	-	5	-	N5 -	100	-	-	5	-

Pasu -2: atu kalkula

WH1 = GLA + WHA – GL1 – h1
WH2 = GL1 + WH1 – GL2 – h2
WH3 = GL2 + WH2 – GL3 – h3
-- -- -- -- -- -- -- -- -- -- --

Pasu -1: Atu kalkula uza tubu pipa

5-2. Atu kalkula eficiente diametru kona-ba seksaun



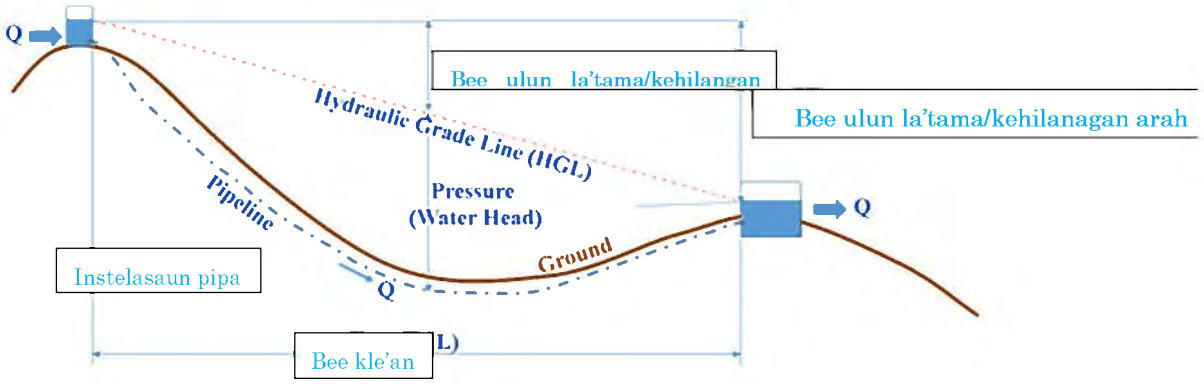
Nodo	GL(m)	Qsai	B-ulun	Instelasaun pipa	D(mm)	L(m)	C	Qbee suli	I(0/00)	Bee la'tama /kehilangan arah (m)
A	10	-	30.00		-	-	-	-	-	-
Nodo- 1	10	25	26.0	A - N1		1000	110	95	4	4.0
Nodo- 2	12	30	20.8	N1 - N2		800	110	70	4	3.2
Nodo- 3	8	20	22.8	N2 - N3		500	110	40	4	2.0
Nodo- 4	7	10	21.4	N3 - N4		600	110	20	4	2.4
Nodo- 5	5	5	20.6	N4 - N5		700	110	10	4	2.8
Ba krai'ik	-	5	-	N5 -	-	-	-	5		-

Atu kalkula

Base Hydraulics fo ba Engineru sira fornese bee mos.

Bee suli dala ruma relasaun ho pipa/kanu laran ladun kaber friksaun/gesekan. Nudar resultadu friksaun/gesekan lakon diferensa ba bee ulun no iha pontu bee leten ho nebe akontese iha krai'ik liu.

Formula hirak nee atu uza hodi kalkula bee ulun tuir mai husi aplikasaun kanu laran ladun kaber ka nudar faktor friksaun koefisiente**(koefisien)** .



1. Formula Hydraulic

Formula hirak nebe hanesan iha leten atu hanehan pipa hydraulics,nebe expresa relasaun entre media bee suli ho bee ulun la'tama. Harc iha krai'ik . Hatene formula diak kona-ba formula Hazen Willians nian.

a. Formula Hazen-Williams

$Q = 0.25783C \cdot (D/1000)^{2.63} \cdot (h/L)^{0.54} \cdot 1000$

$D = 1.6258C^{-0.38} \cdot (Q/1000)^{0.38} \cdot (h/L)^{-0.205} \cdot 1000$

$h = 10.666C^{-1.85} \cdot (D/1000)^{-4.87} \cdot (Q/1000)^{1.85} \cdot L$

$C = 3.9503(Q/1000) \cdot (D/1000)^{-2.63} \cdot (h/L)^{-0.54}$

b. Formula Takakuwa

$Q = C \cdot (D/1000)^{2.495} \cdot (h/L)^{0.512} \cdot 1000$

$D = C^{-0.401} \cdot (Q/1000)^{0.401} \cdot (h/L)^{-0.205} \cdot 1000$

$h = C^{-1.952} \cdot (D/1000)^{-4.87} \cdot (Q/1000)^{1.952} \cdot L$

$C = (Q/1000) \cdot (D/1000)^{-2.495} \cdot (h/L)^{-0.512}$

c. Formula Manning

$Q = 0.31168C \cdot (D/1000)^{2.667} \cdot (h/L)^{0.5} \cdot 1000$

$D = 1.566C^{-0.375} \cdot (Q/1000)^{0.375} \cdot (h/L)^{-0.1875} \cdot 1000$

$h = 10.294C^{-2} \cdot (D/1000)^{-5.33333} \cdot (Q/1000)^{2} \cdot L$

$C = 3.2084(Q/1000) \cdot (D/1000)^{-2.6667} \cdot (h/L)^{-0.5}$

Komparasaun kona-ba koeficiente-bee suli entre Formula Hazen-Williams, Formula Takakuwa ho Formula Manning: iha sD=250mm, Q=40 L/sec

Hazen-Williams	80	90	100	110	120	130	140
Takakuwa	19.5	21.8	24.1	26.4	28.6	30.9	33.1
Manning	60.6	67.5	74.4	81.3	88.1	94.9	101.6

2. Uza kalkulasaun MS-Excel (surat tahan matrix Komputer/ Spreadsheet Software)

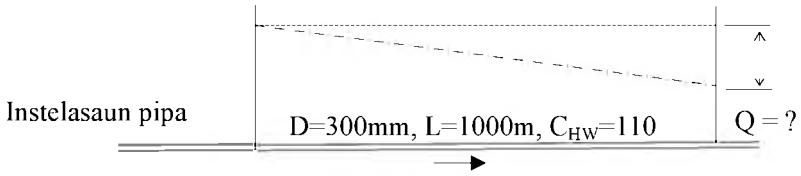
Kalkulasaun kona-ba instelasaun pipa hydraulics fasil liu uza husi surat tahan matrix komputer /spreadsheet software hanesan MS-Excel.

Tuir mai exemplo kona-ba instelasaun pipa. Exemplo hirak nee uza Formula Hazen-Williams.

2-1. Kalkulasaun simples liu ba instelasaun pipa hydraulics (uza Sheet ' simples liu-Instelasaun' ba Excel arquivo"PIPA-CAL.xlsx")

(1) At u kalkula bee suli(uza Formula-1 ba Sheet 'Simples liu-instelasaun pipa')

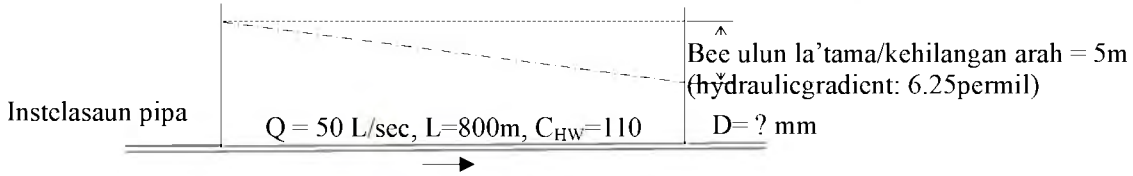
Nee exemplo ida oinsa atu hetan media bee suli nian(Q) Wainhira pipadiametru (D), Pipa nia klc'an (L), bee ulun la'tama(Kehilangan arah) (h)ho koesficient bee suli(C_{HW}) nee mak iha.



$$Q = 0.25783 C_{HW} \cdot (D/1000)^{2.63} \cdot (h/L)^{0.54} \cdot 1000$$
$$= 0.25783 \times 110 \times (0.3)^{2.63} \times (0.004)^{0.54} \times 1000$$
$$= 65.5 \text{ L/sec}$$

(2)Atu kalkula pipadiametru (uza Formula-2 ba Sheet 'simples liu-Instelasaun pipa')

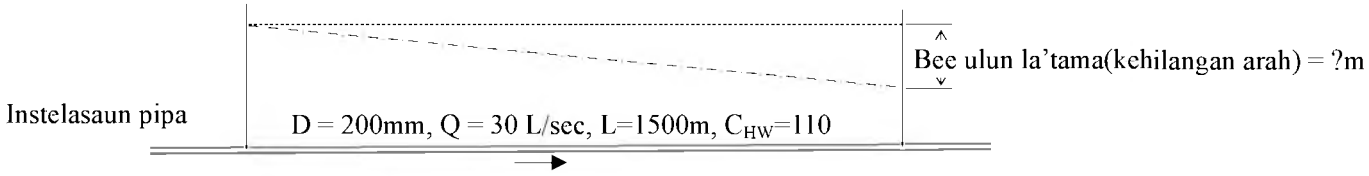
Nee exemplo ida oinsa atu hetan pipa-diametru (D) wainhira Q, L, h, C_{HW} mak iha.



$$D = 1.6258 C_{HW}^{-0.38} \cdot (Q/1000)^{0.38} \cdot (h/L)^{-0.205} \cdot 1000$$
$$= 1.6258 \times (110)^{-0.38} \times (0.05)^{0.38} \times (0.00625)^{-0.205} \times 1000$$
$$= 247 \text{ mm} \quad (\Rightarrow 250 \text{ mm})$$

(3)Atu kalkula bee ulun la'tama(kehilangan arah) (uza Formula-3 ba Sheet 'Simples liu-instelasaun pipa')

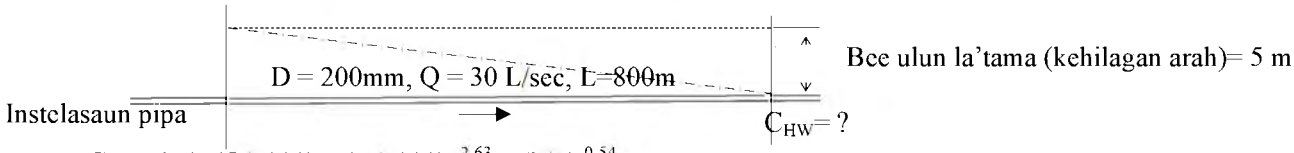
Nee exemplo ida oinsa atu hetan bee ulun la'tama(kehilanagan arah) (h) wainhira Q, D, L, C_{HW} mak iha.



$$h = 10.666C_{HW}^{-1.85} \cdot (D/1000)^{-4.87} \cdot (Q/1000)^{1.85} \cdot L$$
$$= 10.666 \times (110)^{-1.85} \times (0.02)^{-4.87} \times (0.030)^{1.85} \times 1500$$
$$= 10.33 \text{ m}$$

(4)Atu kalkula koeficiente bee suli (uza Formula-4 ba Sheet 'Simples liu-instelasaun pipa')

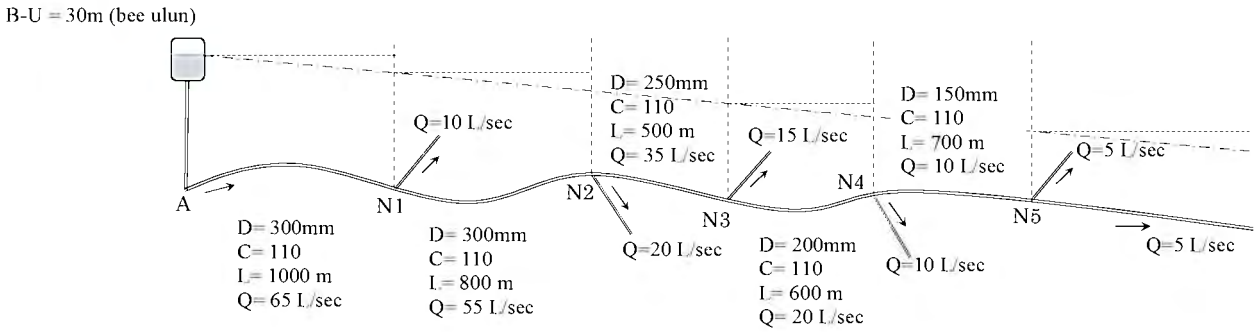
Nee exemplo ida oinsa atu hetan koeficiente bee suli (C_{HW}) wainhira Q, D, L, h mak iha.



$$C = 3.9503(Q/1000) \cdot (D/1000)^{-2.63} \cdot (h/L)^{-0.54}$$
$$= 3.9503 \times (0.03) \times (0.2)^{-2.63} \times (5/800)^{-0.54}$$
$$= 115$$

2-2. Hydraulics kona-ba instelasaun pipa ho sanak-sanak/ brancheses (uza Sheet 'ho sanak' ba Excel arquivo "PIPACAL.xlsl")

(1) Atu kalkula residuales/kuantitas hanehan node id-idak kona-ba instelasaun pipa ho pipa sanak hirak nee (uza Nee exemplo ida how kona-ba oinsa atu bee ulun la'tama (kehilanagan arah)(h) entre nodos rua id-idak ho bee ulun (w-H) nee nodo id-idak bainhira bee ulun iha hu'un (A iha nee), GL of nodos, bee uitoan deit mak sai husi nodos (konsumidor), pipadiametrus (D), pipa nia klean (L), ho koeficiente bee suli (C_{HW}) mak iha.

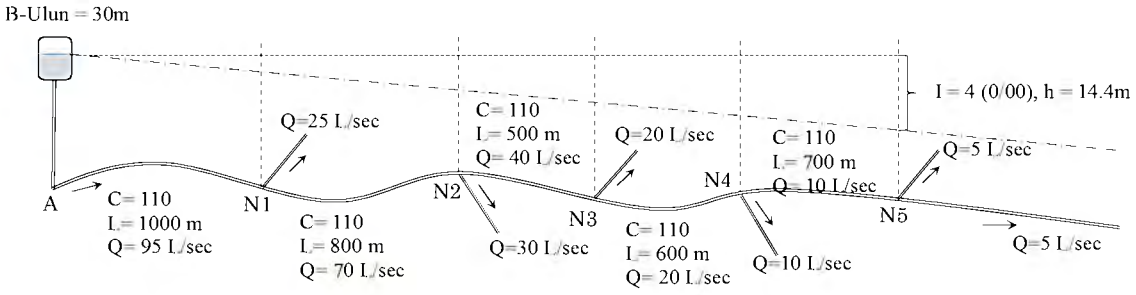


Dadus nebe hatama iha tabela kona-ba kazu-1 ba Sheet 'ho nia pipa sanak. Ita boot sei hetan resposta iha" kolum 'B-ulun' ho kolun'la'tama(kehilangan arah)(m)' ba tabela hanesan..

Nodo	GL.(m)	Qsae	W-ulun	Instelasaun pipa	D(mm)	L(m)	C	Q bee suli	La'tama(kehilangan arah (m)
A	10	-	30.00		-	-	-	-	-
Nodo- 1	10	10	**26.00**	A - N1	300	1000	110	65	**4.00**
Nodo- 2	12	20	**21.65**	N1 - N2	300	800	110	55	**2.35**
Nodo- 3	8	15	**24.10**	N2 - N3	250	500	110	35	**1.55**
Nodo- 4	7	10	**23.15**	N3 - N4	200	600	110	20	**1.95**
Nodo- 5	5	5	**22.59**	N4 - N5	150	700	110	10	**2.56**
Ba kri'ik	-	5	-	N5-	100	-	-	5	-

(2) Atu kalkula efficiente diametru kona-ba seksaun id-idak ba instelasaun pipa ho pipa sanak hirak nee (uza kazu-2 ba Sheet 'ho pipa sanak(bercabang).

Nee exemplo ida bee uitoan husi nodos (konsumidor), pipa kle'an (L), ho koeficiente bee suli (C_{HW}) mak iha. Ita boot nia asume lolos duni instelasaun pipa hydrau-gradient (h/L).



Dadus nebe hatama iha tabela kona-ba kazu-2 ba Sheet ho pipa sanak(bercabang)'. Ita boot sei hetan resposta iha kolum 'D(mm)' hanesan iha tabela.

Nodo	GI (m)	Qsai	B-Ulun	Instelasaun Pipa	D(mm)	L (m)	C	Qsuli	I(0/00)	La'tama/kehilangan arah (m)
A	10	-	30.00		-	-	-	-	-	-
Nodo- 1	10	25	26.0	A - N1	**345.5**	1000	110	95	4	4.0
Nodo- 2	12	30	20.8	N1 - N2	**307.6**	800	110	70	4	3.2
Nodo- 3	8	20	22.8	N2 - N3	**248.7**	500	110	40	4	2.0
Nodo- 4	7	10	21.4	N3 - N4	**191.1**	600	110	20	4	2.4
Nodo- 5	5	5	20.6	N4 - N5	**146.9**	700	110	10	4	2.8
Tu'un	-	5	-	N5-	-	-	-	5		-

添付資料 24 EPANET(給水)(英語版)

at the beginning "Why EPANET, but not EPANET"

1. EPANET is a worldwide used free software introduced in:
   "RURAL WATER SUPPLY DESIGN MANUAL" published by World Bank Manila Office
   "Among the current software available in the internet and from proprietary sources, the EPANET is highly recommended. EPANET is public domain software developed by the US Environmental Protection Agency that can be downloaded free on the internet."

   "Handbook for Community-Based Water Supply Organizations" published by Ministry of Public Works, Indonesia
   "There are now available computer supported design systems, such as '**EPANET**,' a public domain software developed by the US Environmental Protection Authority, to help hydraulic analysis and modeling."

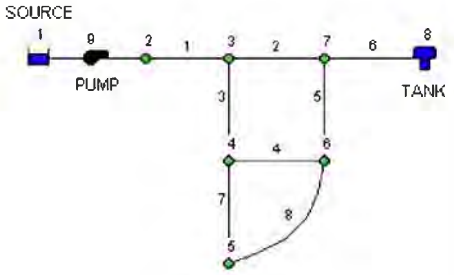
2. Hydraulics of pipeline is one of core components in a small water supply system.
   - ◆ Water source (intake) facilities
   - ◆ Transmission and Distribution pipelines
   - ◆ Storage tank (Reservoir)
   - ◆ Public tap

   But pipelines must be designed one by one, there is not a reference drawings to be quoted from the other projects.

3. **But,** EPANET is not the best tool in all cases. Excel (PIPECAL) is sometimes better than EPANET. Case by case.

How to use EPANET

1. What is EPANET
2. Installing EPANET
3. Steps for EPANET Analysis
4. Practice



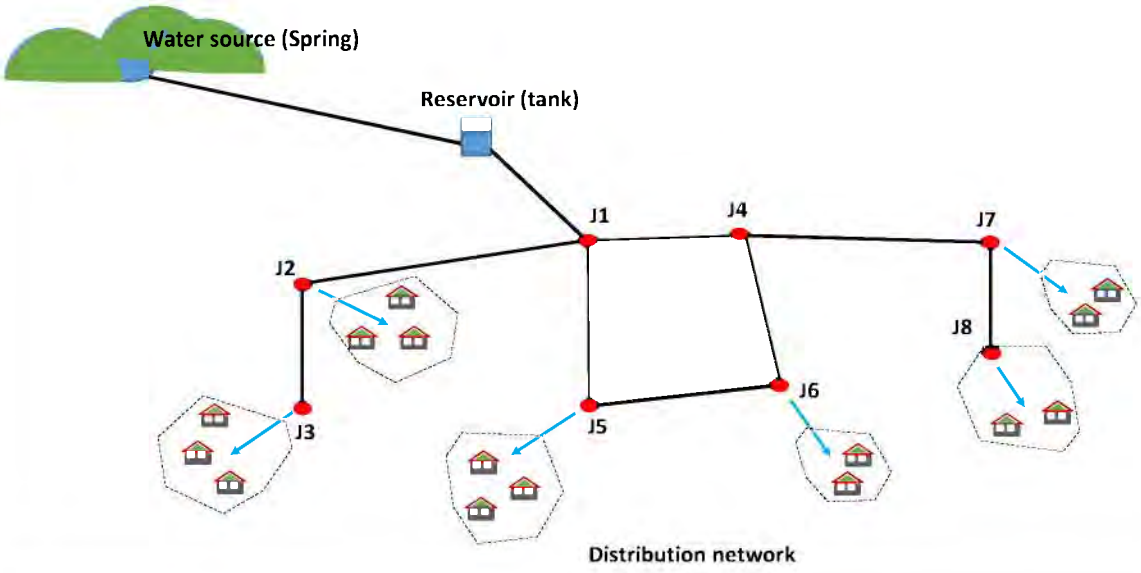
What is EPANET

Provided by the U.S. Environmental Protection Agency (EPA)

EPANET: A computer program for simulation of
(1) Hydraulic
(2) Water quality behavior
within pressurized pipe networks

Network: pipes, nodes (pipe junctions), pumps, valves, storage tanks, reservoirs

Layout of Water Supply System



Steps for EPANET Analysis

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

1. Open EPANET 2.0 Program
2. Set-Up a New Projects
3. Create the Project Scenario
4. Analyze the Network
5. View Results of Analysis

1. Open EPANET 2.0 Program

- To Run EPANET program, simply select this item off of the Start Menu
- Select EPANET 2.0 from the submenu
- Click to Run:

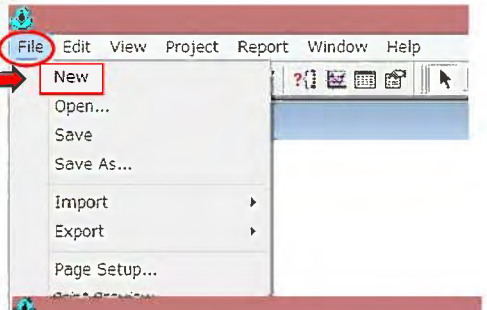
Epanet2w.exe

2. Set up a New Project

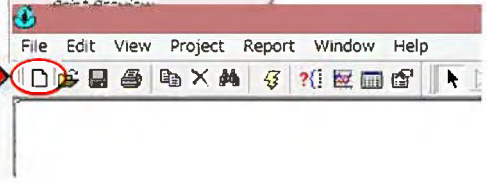
a. Create a New Project
b. Set Project Preferences
c. Set Project Defaults
d. Set Map Options

a. Create a New Project

- From Main Toolbars select: File >> New
- A new, unnamed project is created with all options set to default values

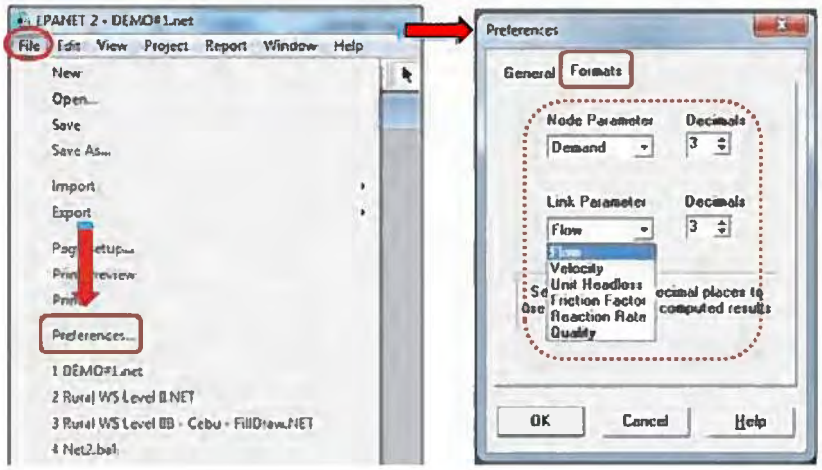


- Or, click New Project from Standard Toolbars
- Prompted to save the existing project before the new project is created



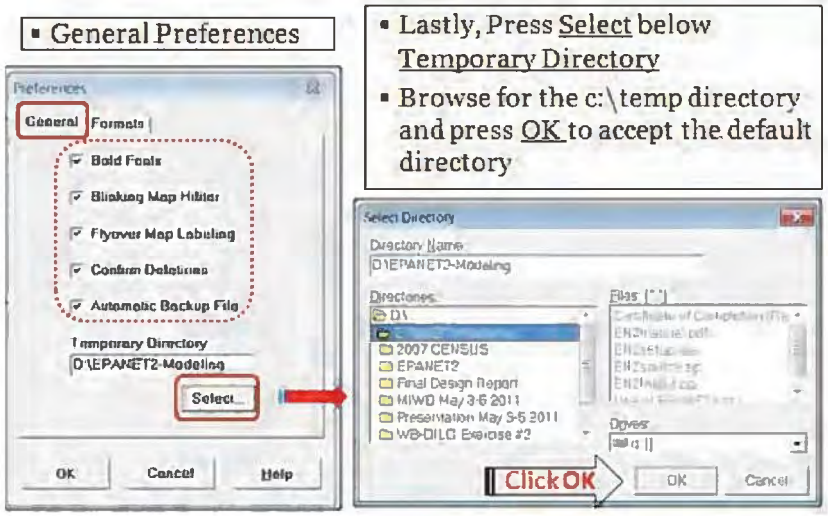
b. Set Project Preferences: File>>Preferences

- From Main Toolbars select: File >> Preferences
- Formats Preferences



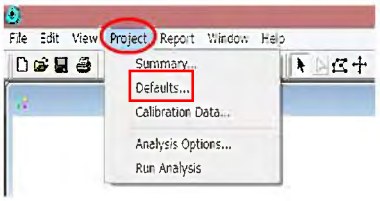
b. Set Project Preferences: File>>Preferences

- General Preferences
- Lastly, Press Select below Temporary Directory
- Browse for the c:\temp directory and press OK to accept the default directory

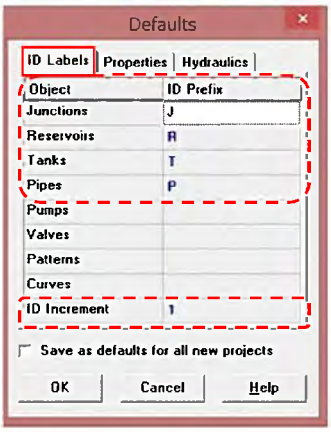


c. Set Project Defaults: Project>>Defaults

- From General Toolbar select: Project >> Defaults

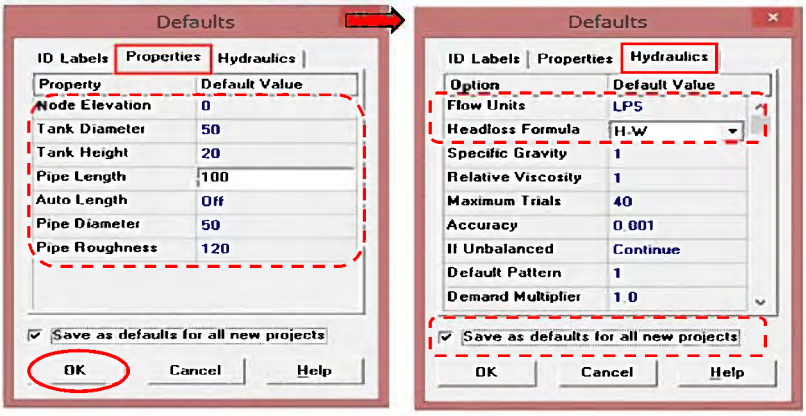


- ID Labels Defaults



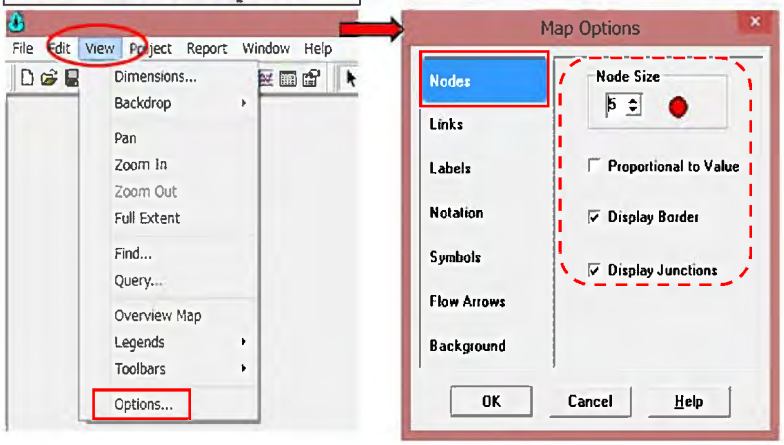
c. Set Project Defaults: Project>>Defaults

- Properties Defaults
  - Make sure Auto Length is off
  - For Pipe Diameter = 50
  - For Pipe Roughness = 120
- Hydraulics Defaults
  - Select appropriate flow units >> LPS
  - Select headloss formula >> H-W



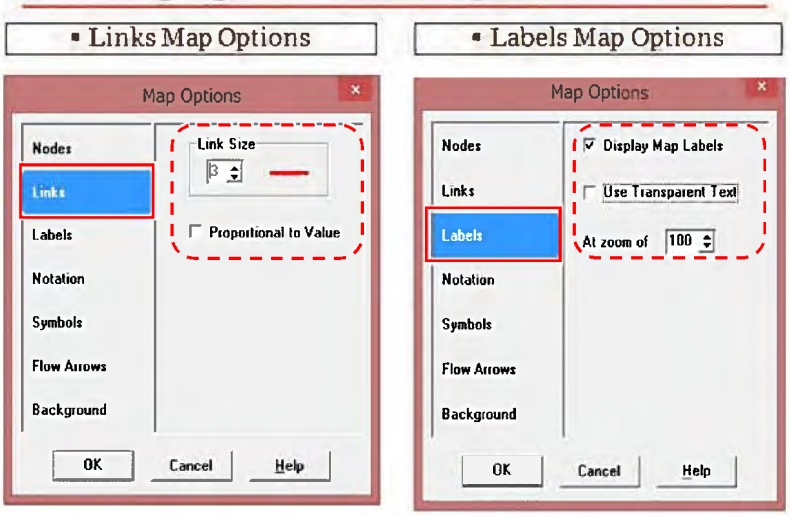
c. Set Map Options: View>>Options

- From Main Toolbar select: View >> Options
- Nodes Map Options



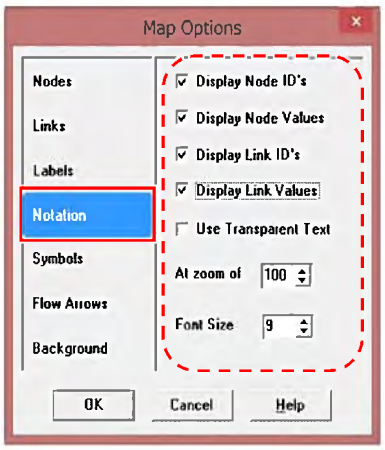
c. Set Map Options: View>>Options

- Links Map Options
- Labels Map Options

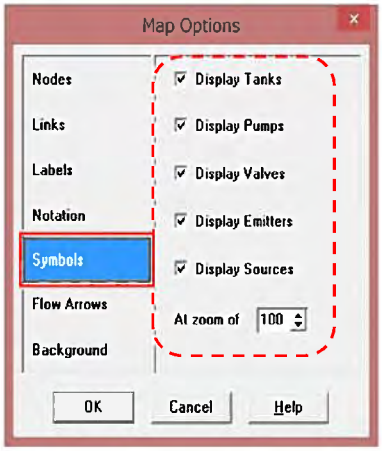


c. Set Map Options: View>>Options

▪ Notation Map Options

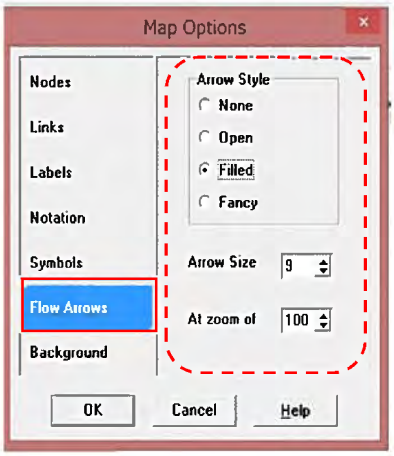


▪ Symbols Map Options

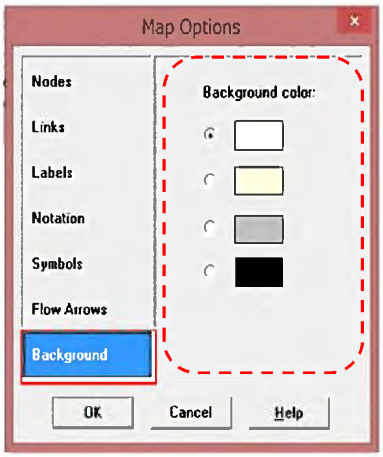


c. Set Map Options: View>>Options

▪ Flow Arrows Map Options



▪ Background Map Options



3. Create the Project Scenario

a. Draw the Network
- Nodes (including reservoirs, tanks)
- Pipes connecting nodes
- Pumps
- Control Valves

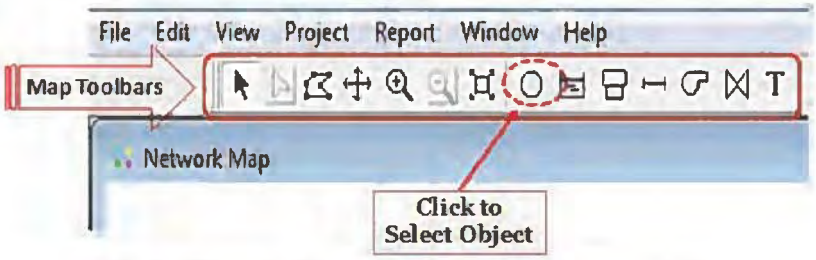
b. Specify Network Properties
- Nodes {demands, elevations}
- Pipe properties {L, D, C}
- Pump Curves {H vs. Q}

c. Run a Simulation
- Single period (snapshot) Analysis

d. Saving and Opening a Project
- Save As a Project
- Open a Project

a. Draw the network

- We are now ready to begin drawing our network by making use of Buttons contained on the Map Toolbar shown below.
  - Use Object Selection Button

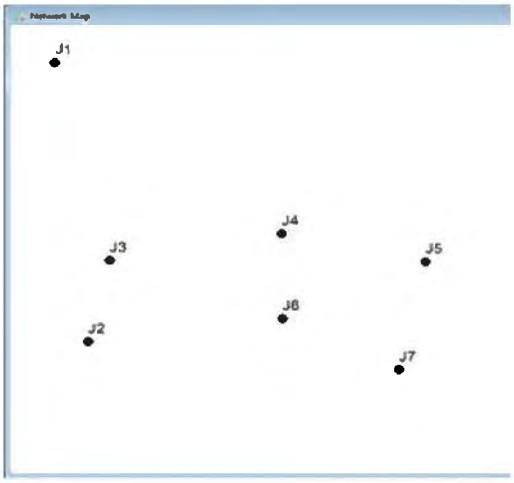


- If the Map Toolbars are not visible then select:
  View >> Toolbars >> Map

a. Draw the network

▪Adding Junctions

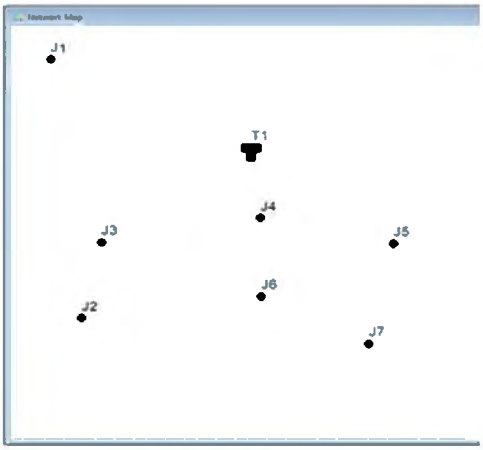
- First, we will add the junction nodes.
- Click the Junction button and then click on the map at the locations of nodes 1 through 7,
- ALWAYS start a project by putting at least two (2) junctions on the map. You can add all junctions at this time, or add additional junctions later.



a. Draw the network

▪Adding Tank

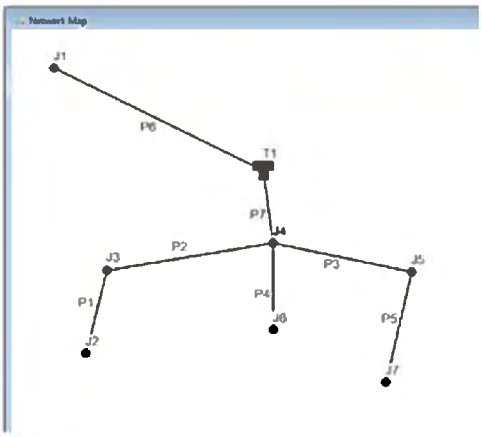
- Finally, add the tank by clicking the Tank button and clicking the map where the tank is located,
- At this point the Network Map should look something like the drawing in attached figure.



a. Draw the network

▪Adding Links

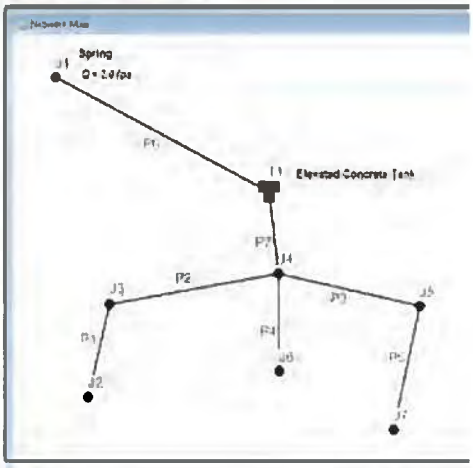
- Next we will add the pipes. Let's begin with Pipe 1 connecting J2 to J3
- First click the Pipe button on the Map Toolbar
- Then click the mouse on J2 on the map and then on J3
- Repeat this procedure for Pipes P2 through P7



a. Draw the network

▪Adding Labels

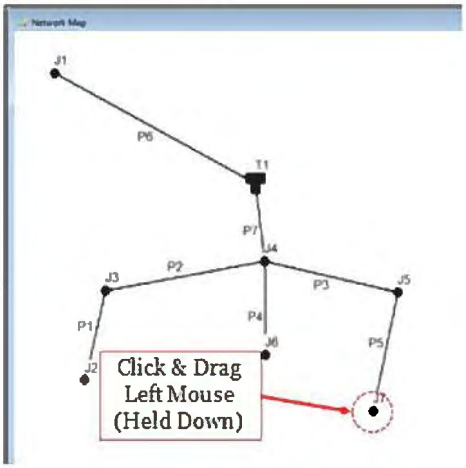
- Next we will label the spring and tank
- Select the Text button on the Map Toolbar and click somewhere close to the spring (Node J1)
- An edit box will appear. Type in the word "Spring" and then hit the Enter key.
- Click next to the Tank and enter its label.



a. Draw the network

▪ Moving an Object

- If the Nodes are out of position you can move them around by clicking the node to select it
- Drag it with the left mouse button held down to its new position
- Labels can be repositioned in similar procedure



b. Specify Network Properties

- Editing an Object is Adding Information to:
  - Links
  - Nodes
- To select an object on the map using the Select Object button:
  - Click the Select Object button (Arrow) on the Map Toolbar
  - Double-Click the mouse over the desired object on the map
- To select an object using the Browser:
  - Select the type of object from the Object listbox of the Database Browser
  - Select the desired object from the Item listbox

b. Specify Network Properties

▪Editing Junction Properties:

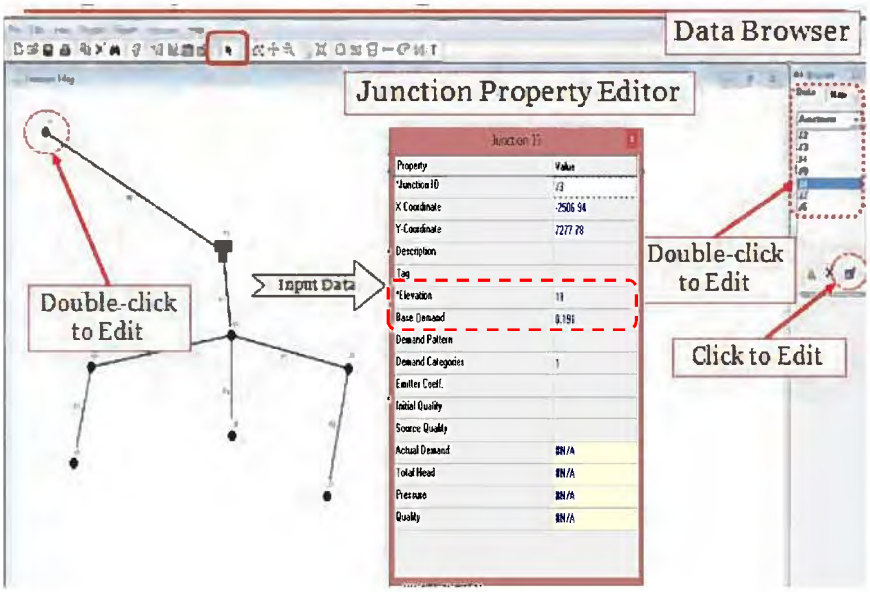
- The nodes in our example network are assumed to have the following properties:

Input Data → Base Demand → Elevation

Network Table - Nodes

Node ID	HHs	Pop1	PF	NRW (%)	Water Demand (lps)		Elevation
					ADD	MDD	m
Junc J1	Spring Source				-2.50		40
Junc J2	14	77	3	30%	0.076	0.099	10
Junc J3	35	193	7	30%	0.191	0.248	11
Junc J4	53	292	11	30%	0.290	0.377	13
Junc J5	67	369	13	30%	0.366	0.476	14
Junc J6	32	176	6	30%	0.175	0.228	12
Junc J7	35	193	7	30%	0.191	0.248	13
Tank1							
Total	236	1300	47		1.289	1.676	

b. Specify Network Properties



b. Specify Network Properties

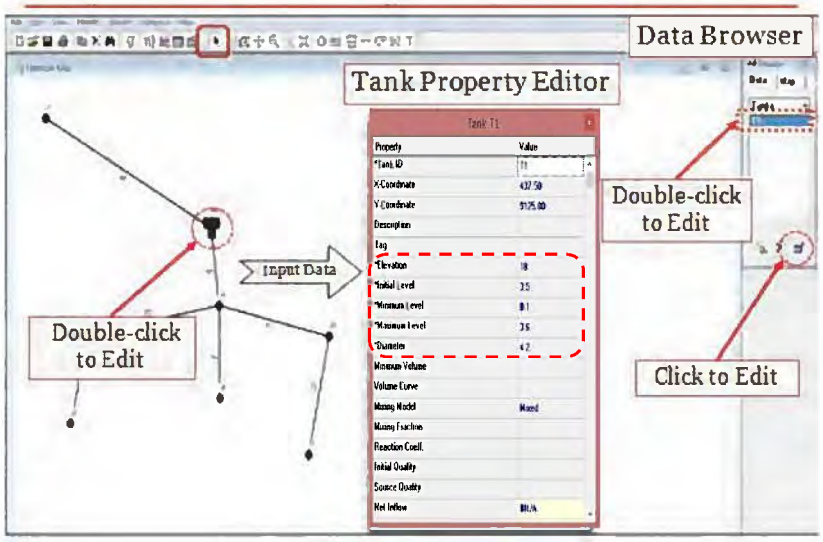
▪Editing Tank Property:

- The Tank in our example network is assumed to have the following properties:

Input Data

Tank Node Data :	T1
Tank Bottom Elev. :	18.00
Initial Level :	3.50
Minimum Level :	0.10
Maximum Level :	3.60
Diameter :	4.20

b. Specify Network Properties



b. Specify Network Properties

▪Editing Pipe Properties:

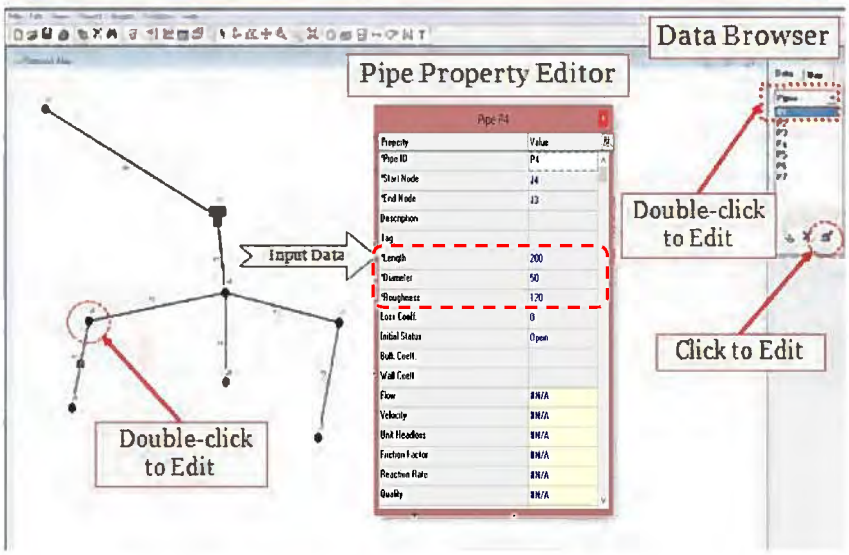
- The Pipes in our example network are assumed to have the following properties:

Input Data → **Length** | **Diameter** | **Roughness**

Network Table - Links

Link ID	Node Number		Length	Diameter	"C"
	From	To	m	mm	
Pipe P1	J2	J3	**200**	**50**	**120**
Pipe P2	J3	J4	**300**	**75**	**120**
Pipe P3	J4	J5	**250**	**75**	**120**
Pipe P4	J4	J6	**200**	**75**	**120**
Pipe P5	J5	J7	**250**	**50**	**120**
Pipe P6	J1	T1	**3000**	**100**	**120**
Pipe P7	T1	J4	**30**	**100**	**120**

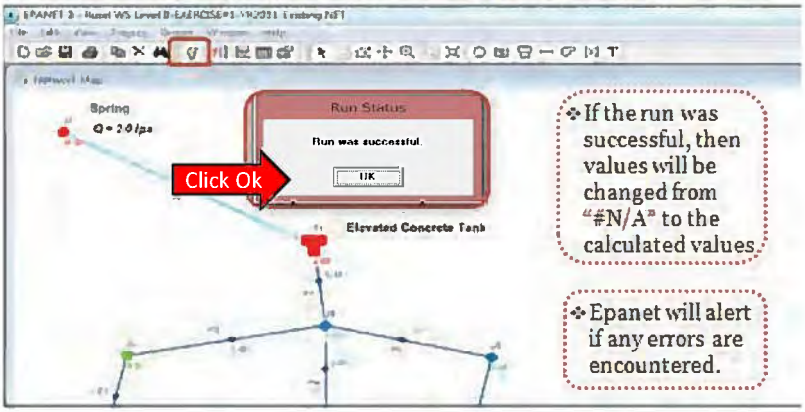
b. Specify Network Properties



c. Run a Simulation

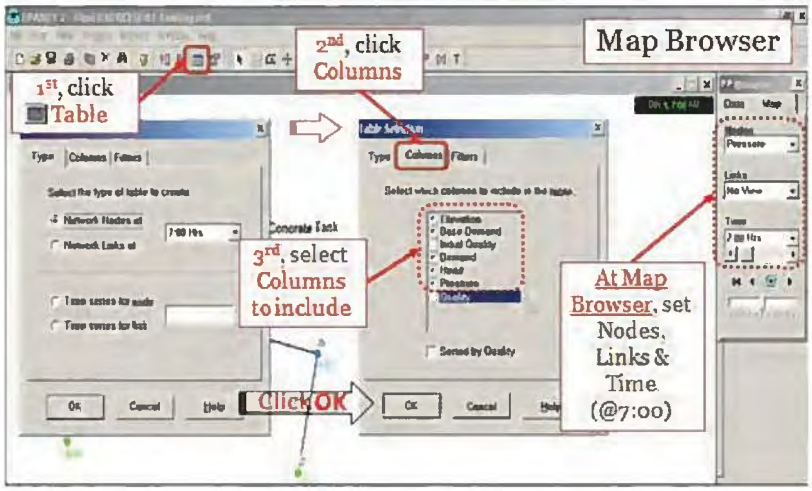
- Run a Single period (steady-state) Analysis

- You now have enough information to run a Single Period (or steady-state) hydraulic analysis
- To run the analysis select Project >> Run Analysis (or click the button)



c. View Results

- View Results - Tables



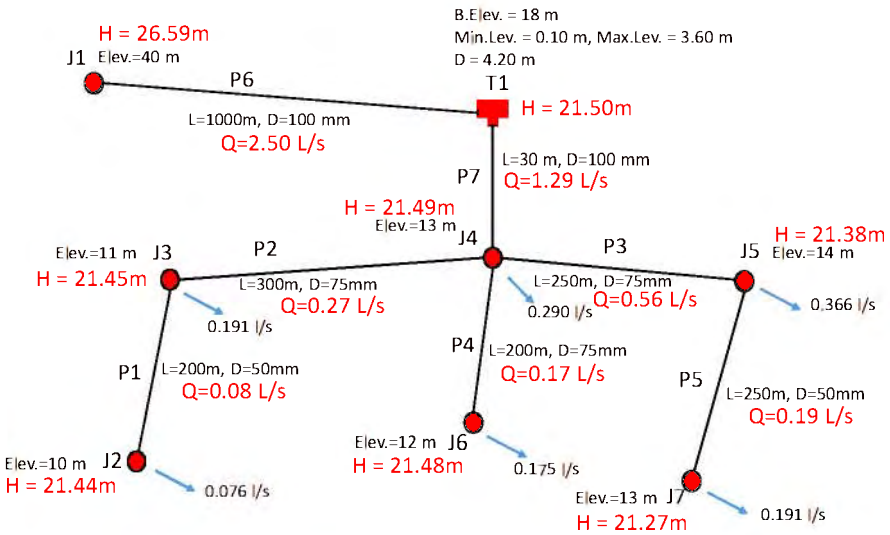
c. View Results: Tables

- EPANET allows you to view selected project data and analysis results in a tabular format
- Tables can be printed, copied to the Windows clipboard, or saved as a data file or Windows metafile
- Network Link sign on flow (+/-) is relative to the way the pipe (link) was initially drawn on the network map

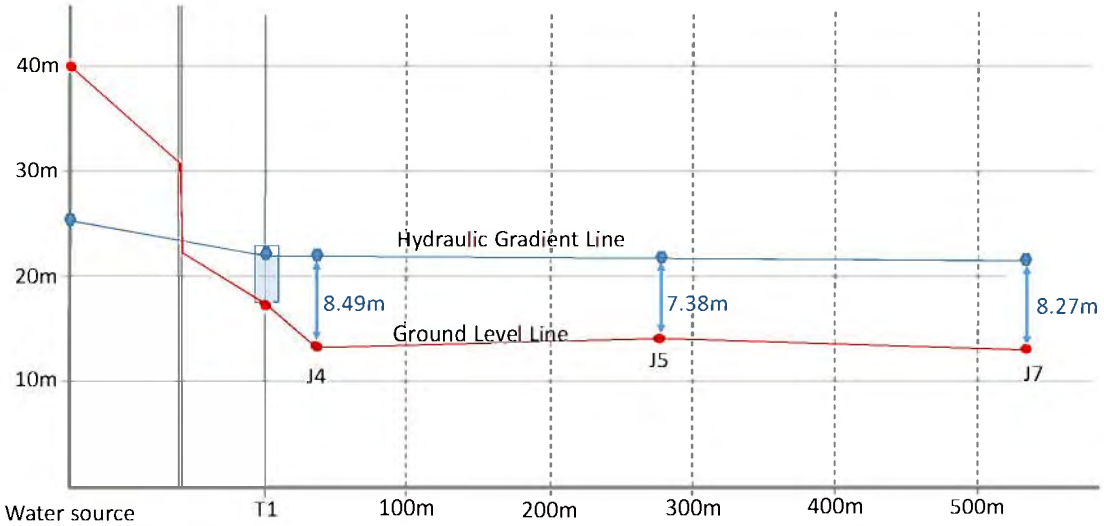
Network Table - Nodes at 7:00 Hrs

Node ID	Elevation m	Base Demand	Demand LPS	Head m	Pressure m
Junc J2	10	0.071	0.14	19.90	9.90
Junc J3	11	0.179	0.36	19.95	8.95
Junc J4	13	0.270	0.54	20.71	7.71
Junc J5	14	0.342	0.68	20.37	6.37
Junc J1	40	-2.00	-2.00	34.42	-5.58
Junc J7	13	0.179	0.36	20.03	7.03
Junc J6	12	0.163	0.33	20.48	8.48
Tank T1	18	#N/A	-0.41	20.76	2.76

Results of Calculation



Profile of Pipeline from Source to Distribution System

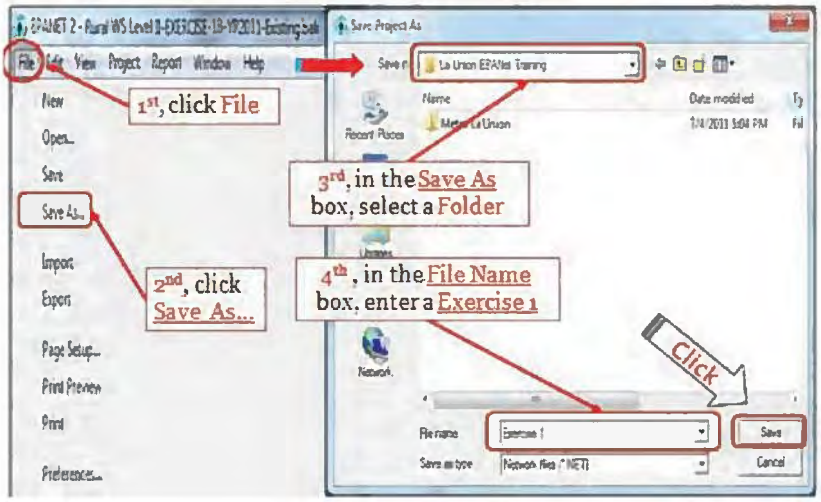


d. Saving &Opening Project

- Having completed the initial design of our network it is a good idea to save our work to a file at this point
  1. From the File menu select the Save As option
  2. In the Save As dialog that appears, select a folder and file name under which to save this project. We suggest naming the file Exercise 1. (An extension of ".net" will be added to the file name if one is not supplied)
  3. Click Save to save the project to file
- The project data is saved to the file in a special binary format. If you wanted to save the network data to file as readable text, use the File >> Export >> Network command instead
- To open our project at some later time, we would select the Open command from the File menu.

d. Saving &Opening Project

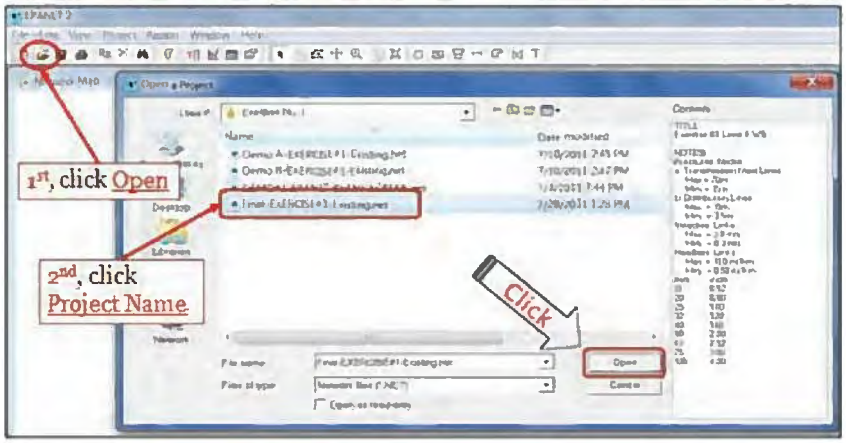
- Saving As a Project

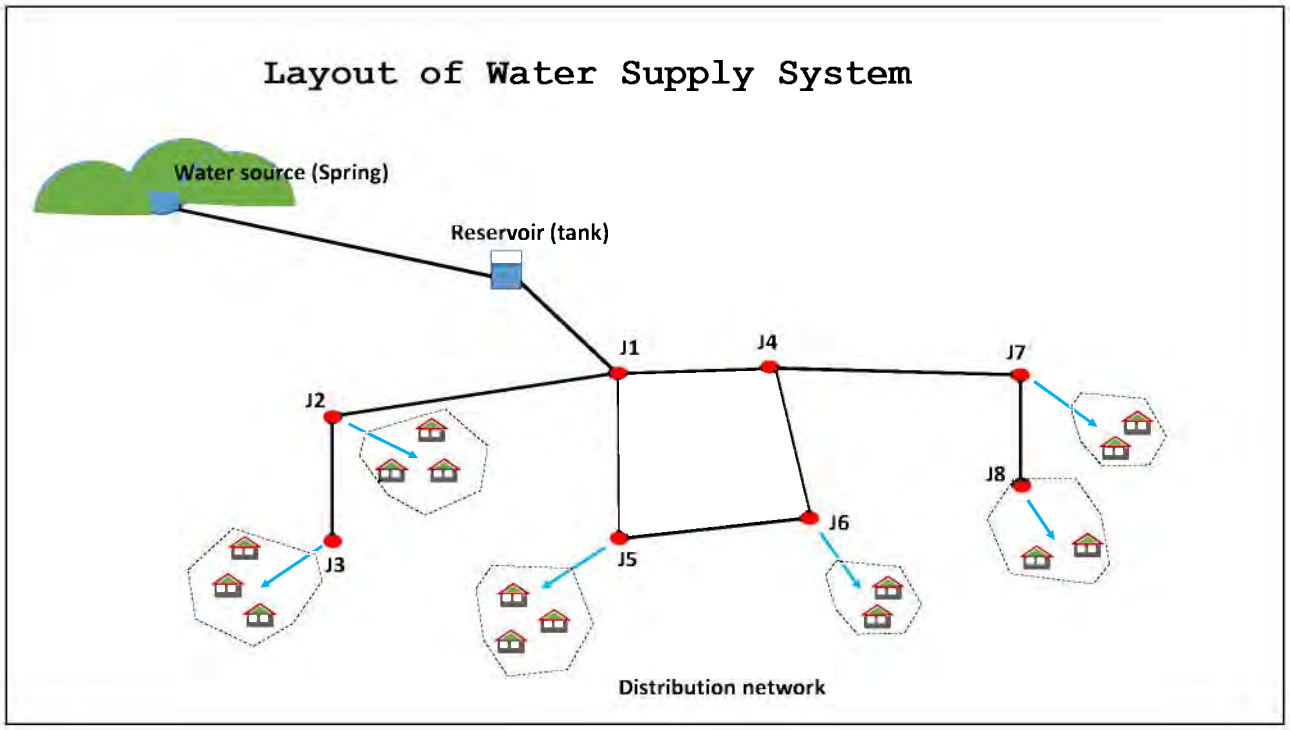


d. Saving &Opening Project

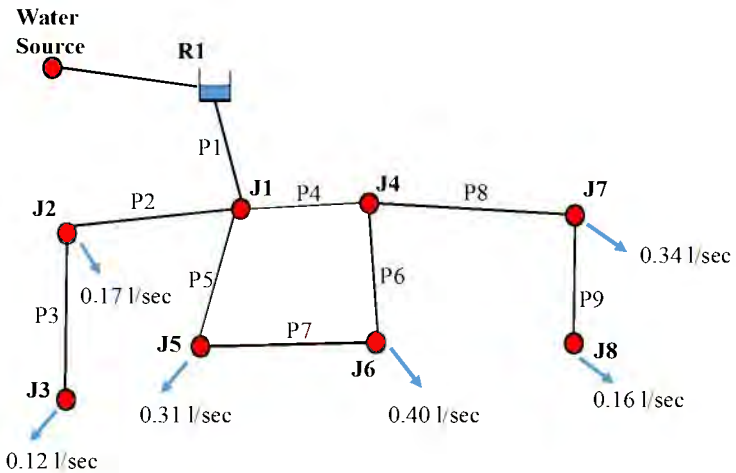
- Opening a Project

- To open our project at some later time, select the Open command from the File menu (File>>Open), or click the Open button from the map toolbar.





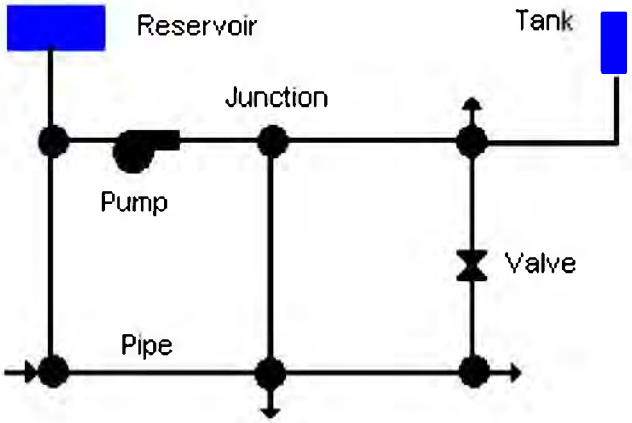
Practice of EPANET



No	Diameter (mm)	Length (m)
P1		50
P2		200
P3		250
P4		100
P5		150
P6		130
P7		175
P8		330
P9		150

No	Q (l/sec)	Elevation (m)
R1		30
J1	0.00	22
J2	0.17	20
J3	0.12	16
J4	0.00	20
J5	0.31	18
J6	0.40	15
J7	0.34	18
J8	0.16	14

Physical Components



Physical Components in a Water Distribution System

Junctions

Reservoirs

Tanks

Pipes

Pumps

Valves

Junctions

Junctions are points in the network where links join together and where water enters or leaves the network.

The basic input data required for junctions are:

- elevation above some reference (usually mean sea level)
- water demand (rate of withdrawal from the network)
- initial water quality.

The output results computed for junctions at all time periods of a simulation are:

- hydraulic head (internal energy per unit weight of fluid)
- pressure
- water quality.

Reservoirs

Reservoirs are nodes that represent an infinite external source or sink of water to the network. They are used to model such things as lakes, rivers, groundwater aquifers, and tie-ins to other systems.

The basic input data required for junctions are:

- elevation above some reference (usually mean sea level)
- water demand (rate of withdrawal from the network)
- initial water quality.

The output results computed for junctions at all time periods of a simulation are:

- hydraulic head (internal energy per unit weight of fluid)
- pressure
- water quality.

Tanks

Tanks are nodes with storage capacity, where the volume of stored water can vary with time during a simulation.

The primary input properties for tanks are:

- bottom elevation (where water level is zero)
- diameter (or shape if non-cylindrical)
- initial, minimum and maximum water levels
- initial water quality.

The principal outputs computed over time are:

- hydraulic head (water surface elevation)
- water quality.

Tanks are required to operate within their minimum and maximum levels. EPANET stops outflow if a tank is at its minimum level and stops inflow if it is at its maximum level.

Pipes

Pipes are links that convey water from one point in the network to another. EPANET assumes that all pipes are full at all times. Flow direction is from the end at higher hydraulic head (internal energy per weight of water) to that at lower head.

The principal hydraulic input parameters for pipes are:

- start and end nodes
- diameter
- length
- roughness coefficient (for determining headloss)
- status (open, closed, or contains a check valve).

Computed outputs for pipes include:

- flow rate
- velocity
- headloss

Practices of EPANET

Analyze the distribution systems below by EPANET. Modify the system (pipe diameter etc.) when there are something wrong in a result of EPANET.

Timor Leste Rural Water Supply Guideline (DENSA of MPW): Standards of GFC design

1. Max static Pressure in network: <= 100m unless topographical constraints
2. Minimum static pressure in network: 5 – 10m
3. max-min static pressure at taps: 5 – 15m
4. Diameter between intake and sedimentation tank: >= 50mm
5. Diameter between tanks: Per hydraulic calculation
6. Diameter at tap stands: 3/4inch GS
7. Velocity of pipe in diameter (min – max)
   (1) 20 – 40mm: 0.3 – 2m/sec
   (2) 50 – 75mm: 1 – 3m/sec

Practice-1

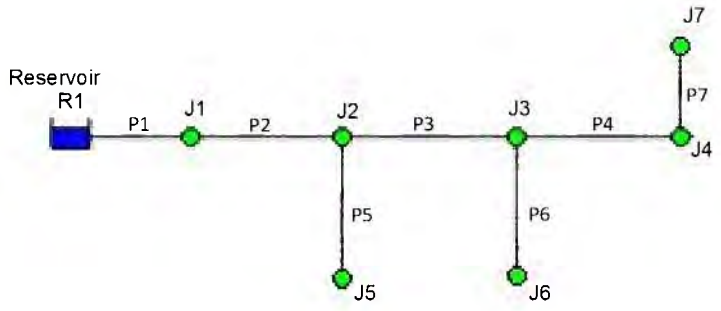


Table 1: Network Node Properties

Node	Elevation (m)	Demand (L/s)
R1	100	0.00
J1	85	0.09
J2	82	0.00
J3	78	0.00
J4	77	0.00
J5	82	0.10
J6	78	0.07
J7	76	0.05

Table 2: Network Pipe Properties

Pipe	Length (m)	Diameter (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	50	120
P5	40	20	120
P6	25	20	120
P7	50	20	120

Practice-2

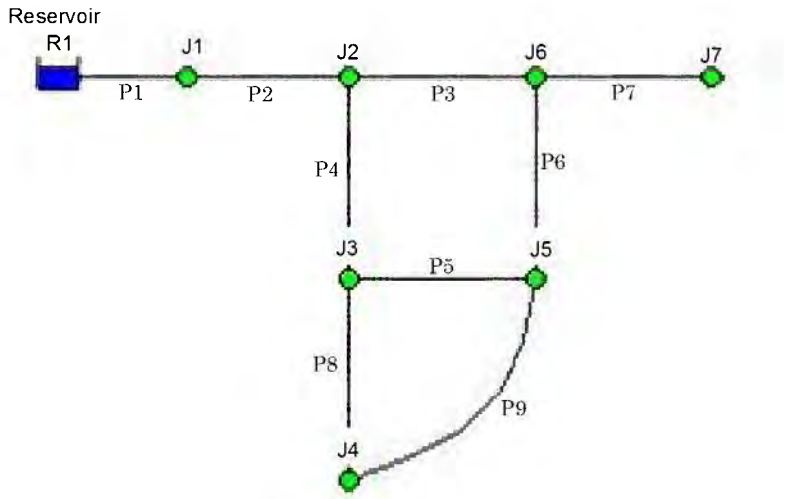


Table 1: Network Node Properties

Node	Elevation (m)	Demand (L/s)
R1	100	0.00
J1	86	0.09
J2	77	0.09
J3	68	0.13
J4	58	005
J5	70	0.10
J6	75	0.07
J7	80	0.05

Table 2: Network Pipe Properties

Pipe	Length (m)	Diameter (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	40	120
P5	400	40	120
P6	250	40	120
P7	500	40	120
P8	350	40	120
P9	800	40	120

Practice-3

Analyze the case of Practice-2 with a time pattern below into consideration.

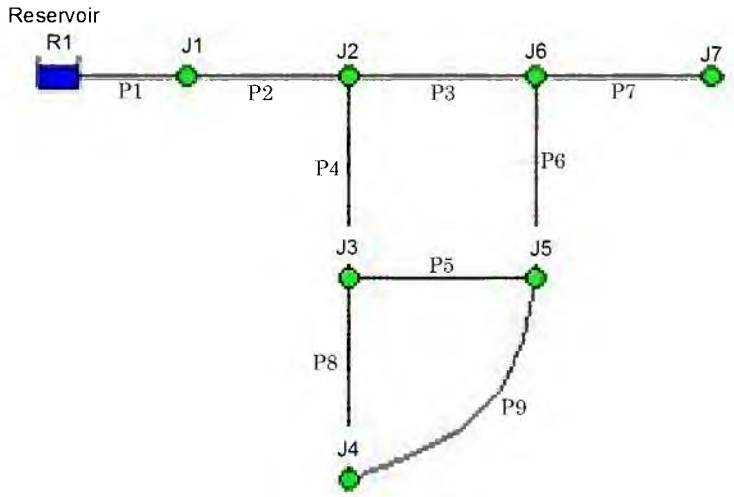


Table 1: Network Node Properties

Node	Elevation (m)	Demand (L/s)
R1	100	0.00
J1	86	0.09
J2	77	0.09
J3	68	0.13
J4	58	005
J5	70	0.10
J6	75	0.07
J7	80	0.05

Table 2: Network Pipe Properties

Pipe	Length (m)	Diameter (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	40	120
P5	400	40	120
P6	250	40	120
P7	500	40	120
P8	350	40	120
P9	800	40	120

Table 3: Time Pattern

Time	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Time Factor	0.60	0.40	0.30	0.25	0.25	0.30	0.75	1.55	1.80	1.75	1.50	1.20

Time	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
Time Factor	1.00	0.90	0.80	0.75	0.80	0.90	1.20	1.50	1.55	1.50	1.35	1.10

EPANET 2 USERS MANUAL P.21-P.23

2.8 Running an Extended Period Analysis

To make our network more realistic for analyzing an extended period of operation we will create a Time Pattern that makes demands at the nodes vary in a periodic way over the course of a day. For this simple example we will use a pattern time step of 6 hours thus making demands change at four

different times of the day. (A 1-hour pattern time step is a more typical number and is the default assigned to new projects.) We set the pattern time step by selecting Options-Times from the Data Browser, clicking the Browser's Edit button to make the Property Editor appear (if its not already visible), and entering 6 for the value of the Pattern Time Step (as shown in Figure 2.8 below). While we have the Time Options available we can also set the duration for which we want the extended period to run. Let's use a 3-day period of time (enter 72 hours for the Duration property).

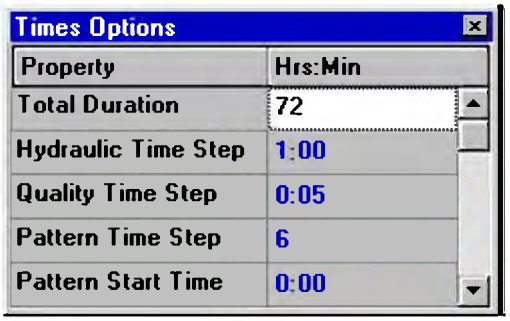


Figure 2.8 Times Options

To create the pattern, select the Patterns category in the Browser and then click the Add button . A new Pattern 1 will be created and the Pattern Editor dialog should appear (see Figure 2.9). Enter the multiplier values 0.5, 1.3, 1.0, 1.2 for the time periods 1 to 4 that will give our pattern a duration of 24 hours. The multipliers are used to modify the demand from its base level in each time period. Since we are making a run of 72 hours, the pattern will wrap around to the start after each 24-hour interval of time.

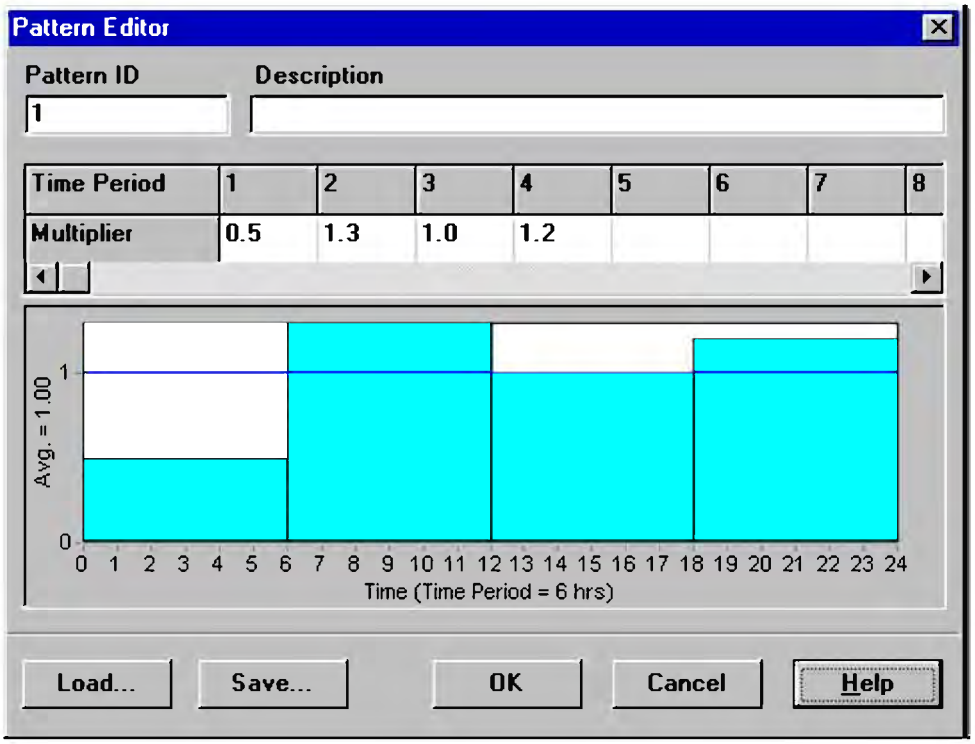


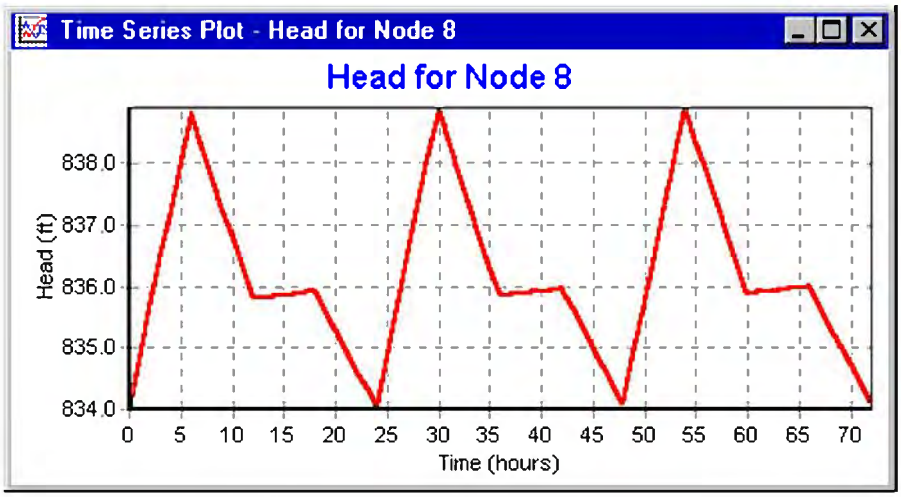
Figure 2.9 Pattern Editor

We now need to assign Pattern 1 to the Demand Pattern property of all of the junctions in our network. We can utilize one of EPANET's Hydraulic Options to avoid having to edit each junction individually.

If you bring up the Hydraulic Options in the Property Editor you will see that there is an item called Default Pattern. Setting its value equal to 1 will make the Demand Pattern at each junction equal Pattern 1, as long as no other pattern is assigned to the junction.

Next run the analysis (select **Project >> Run Analysis** or click the button on the Standard Toolbar). For extended period analysis you have several more ways in which to view results:

- The scrollbar in the Browser's Time controls is used to display the network map at different points in time. Try doing this with Pressure selected as the node parameter and Flow as the link parameter.
- The VCR-style buttons in the Browser can animate the map through time. Click the Forward button to start the animation and the Stop button to stop it.
- Add flow direction arrows to the map (select **View >> Options**, select the Flow Arrows page from the Map Options dialog, and check a style of arrow that you wish to use). Then begin the animation again and note the change in flow direction through the pipe connected to the tank as the tank fills and empties over time.
- Create a time series plot for any node or link. For example, to see how the water elevation in the tank changes with time:
    1. Click on the tank.
    2. Select **Report >> Graph** (or click the Graph button on the Standard Toolbar) which will display a Graph Selection dialog box.
    3. Select the Time Series button on the dialog.
    4. Select Head as the parameter to plot.
    5. Click **OK** to accept your choice of graph.



Note the periodic behavior of the water elevation in the tank over time (Figure 2.10).

Figure 2.10 Example Time Series Plot

Practice-4

Analyze the system distributed by a pump.

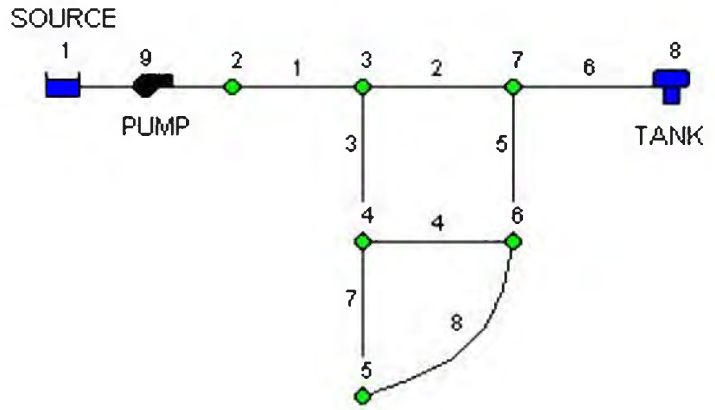


Table 1: Network Node Properties

Node	Elevation (m)	Demand (L/s)
1	100	0.00
2	100	0.00
3	103	9.46
4	100	9.46
5	85	12.62
6	100	9.46
7	100	0.00
8	140	0.00

Table 2: Network Pipe Properties

Pipe	Length (m)	Diameter (mm)	C
1	900	350	100
2	1,500	300	100
3	1,500	200	100
4	1,500	200	100
5	1,500	200	100
6	2,100	250	100
7	1,500	150	100
8	2,200	150	100

Node 8: The tank (Node 8) has a 18-m diameter, a 1.5-m water level, and a maximum level of 6 m.

Link 9: The pump (Link 9) can deliver 46 m of head at a flow of 38 L/sec.

Head = 60.00-0.0097 〔Flow〕 ^2.00

EPANET 2 USERS MANUAL P.19

2.5 Setting Object Properties

For the pump, we need to assign it a pump curve (head versus flow relationship). Enter the ID label 1 in the Pump Curve field.

Next we will create Pump Curve 1. From the Data page of the Browser window, select Curves from the dropdown list box and then click the Add button . A new Curve 1 will be added to the database and the Curve Editor dialog form will appear (see Figure 2.6). Enter the pump's design flow (600) and head (150) into this form. EPANET automatically creates a complete pump curve from this single point. The curve's equation is shown along with its shape. Click **OK** to close the Editor.

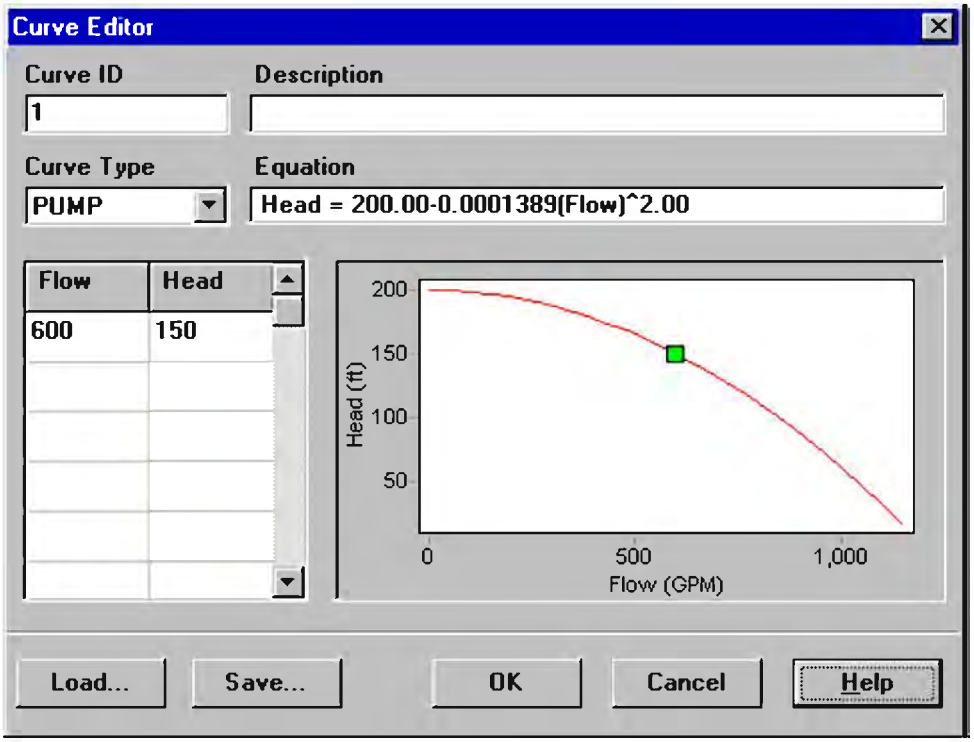


Figure 2.6 Curve Editor

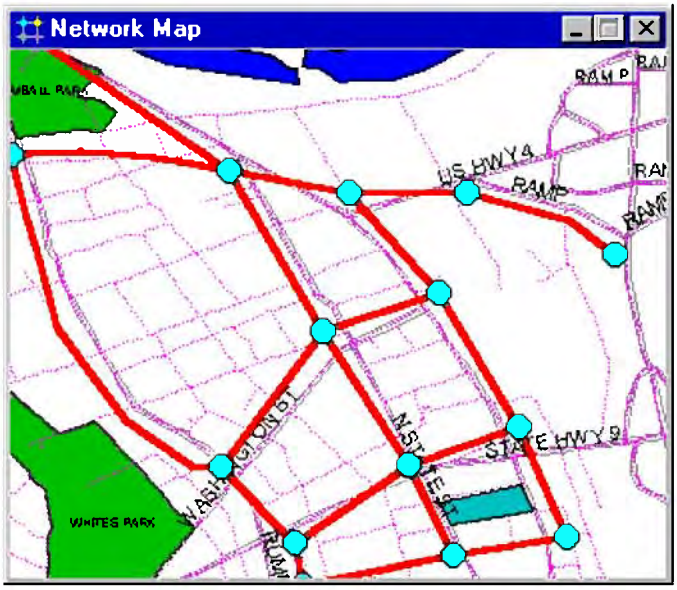
Practice-5

Draw pipe network on a backdrop map.

EPANET 2 USERS MANUAL P.85 – P.86

7.3 Utilizing a Backdrop Map

EPANET can display a backdrop map behind the pipe network map. The backdrop map might be a street map, utility map, topographic map, site development plan, or any other picture or drawing that might be useful. For example, using a street map would simplify the process of adding pipes to the network since one could essentially digitize the network's nodes and links directly on top of it.



The backdrop map must be a Windows enhanced metafile or bitmap created outside of EPANET. Once imported, its features cannot be edited, although its scale and extent will change as the map window is zoomed and panned. For this reason metafiles work better than bitmaps since they will not loose resolution when rescaled. Most CAD and GIS programs have the ability to save their drawings and maps as metafiles.

Selecting **View >> Backdrop** from the Menu Bar will display a sub-menu with the following commands:

- **Load** (loads a backdrop map file into the project)
- **Unload** (unloads the backdrop map from the project)
- **Align** (aligns the pipe network with the backdrop)
- **Show/Hide** (toggles the display of the backdrop on and off)

When first loaded, the backdrop image is placed with its upper left corner coinciding with that of the network's bounding rectangle. The backdrop can be re-positioned relative to the network map by

selecting **View >> Backdrop >> Align**. This allows an outline of the pipe network to be moved across the backdrop (by moving the mouse with the left button held down) until one decides that it lines up properly with the backdrop. The name of the backdrop file and its current alignment are save along with the rest of a project's data whenever the project is saved to file.

For best results in using a backdrop map:

- Use a metafile, not a bitmap.
- Dimension the network map so that its bounding rectangle has the same aspect ratio (width-to-height ratio) as the backdrop.

at the beginning "Why EPANET, but not EPANET"

1. EPANET is a worldwide used free software introduced in:
   "RURAL WATER SUPPLY DESIGN MANUAL" published by World Bank Manila Office
   "Among the current software available in the internet and from proprietary sources, the EPANET is highly recommended. EPANET is public domain software developed by the US Environmental Protection Agency that can be downloaded free on the internet."

   "Handbook for Community-Based Water Supply Organizations" published by Ministry of Public Works, Indonesia
   "There are now available computer supported design systems, such as '**EPANET**,' a public domain software developed by the US Environmental Protection Authority, to help hydraulic analysis and modeling."

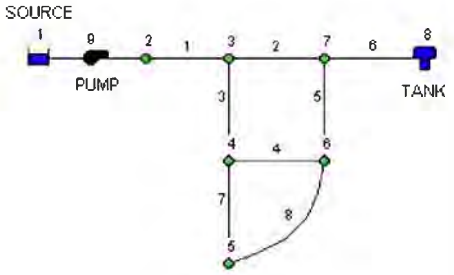
2. Hydraulics of pipeline is one of core components in a small water supply system.
   - ◆ Water source (intake) facilities
   - ◆ Transmission and Distribution pipelines
   - ◆ Storage tank (Reservoir)
   - ◆ Public tap

   But pipelines must be designed one by one, there is not a reference drawings to be quoted from the other projects.

3. **But,** EPANET is not the best tool in all cases. Excel (PIPECAL) is sometimes better than EPANET. Case by case.

How to use EPANET

1. What is EPANET
2. Installing EPANET
3. Steps for EPANET Analysis
4. Practice



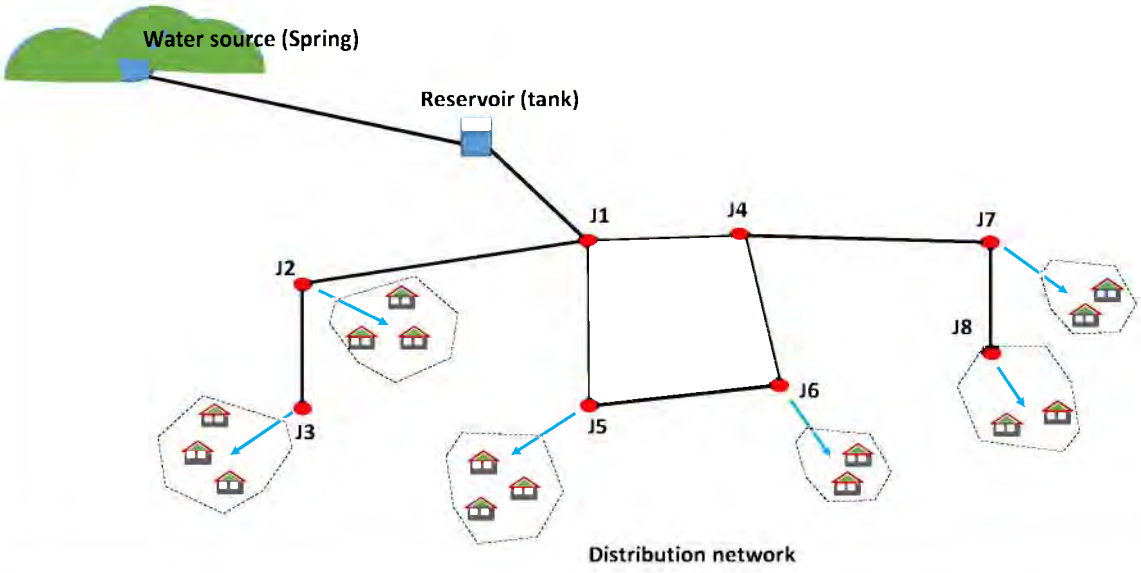
What is EPANET

Provided by the U.S. Environmental Protection Agency (EPA)

EPANET: A computer program for simulation of
(1) Hydraulic
(2) Water quality behavior
within pressurized pipe networks

Network: pipes, nodes (pipe junctions), pumps, valves, storage tanks, reservoirs

Layout of Water Supply System



Steps for EPANET Analysis

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

1. Open EPANET 2.0 Program
2. Set-Up a New Projects
3. Create the Project Scenario
4. Analyze the Network
5. View Results of Analysis

1. Open EPANET 2.0 Program

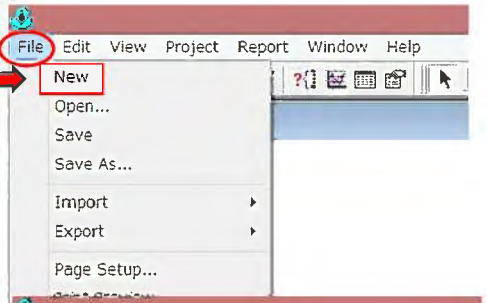
- To Run EPANET program, simply select this item off of the Start Menu
- Select EPANET 2.0 from the submenu
- Click to Run:

2. Set up a New Project

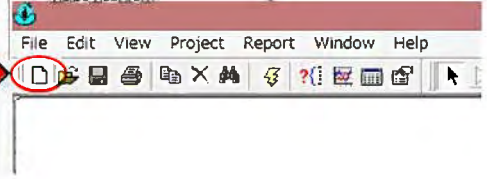
a. Create a New Project
b. Set Project Preferences
c. Set Project Defaults
d. Set Map Options

a. Create a New Project

- From Main Toolbars select: File >> New
- A new, unnamed project is created with all options set to default values

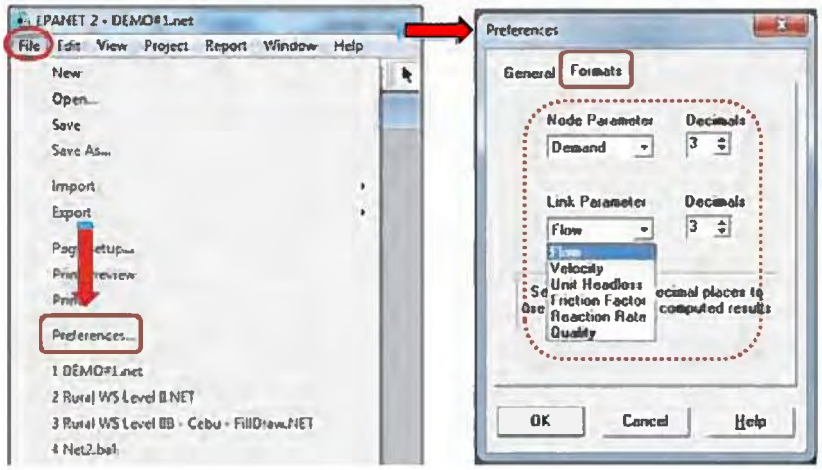


- Or, click New Project from Standard Toolbars
- Prompted to save the existing project before the new project is created



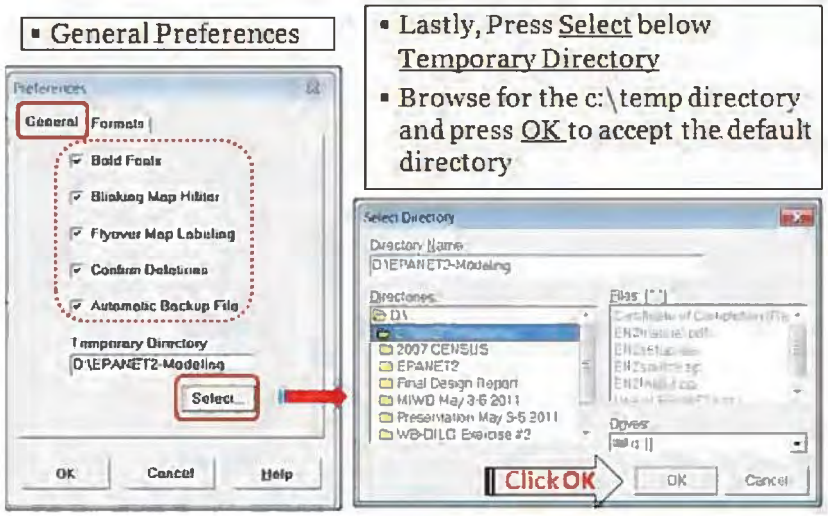
b. Set Project Preferences: File>>Preferences

- From Main Toolbars select: File >> Preferences
- Formats Preferences



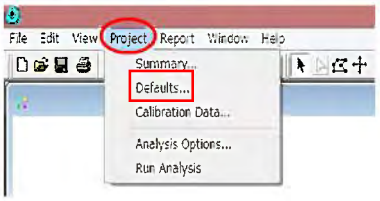
b. Set Project Preferences: File>>Preferences

- General Preferences
- Lastly, Press Select below Temporary Directory
- Browse for the c:\temp directory and press OK to accept the default directory

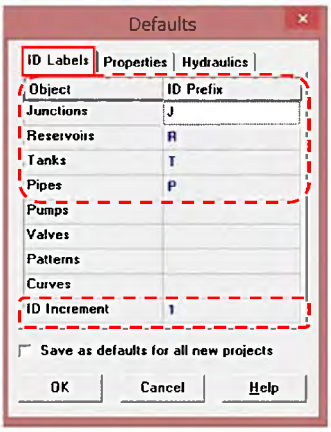


c. Set Project Defaults: Project>>Defaults

- From General Toolbar select: Project >> Defaults

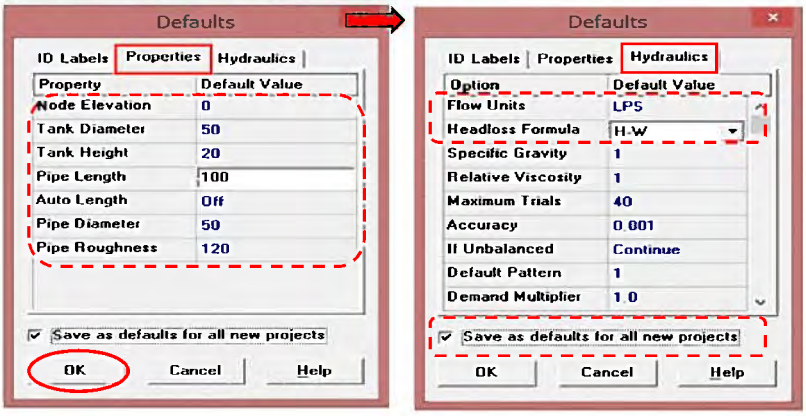


- ID Labels Defaults



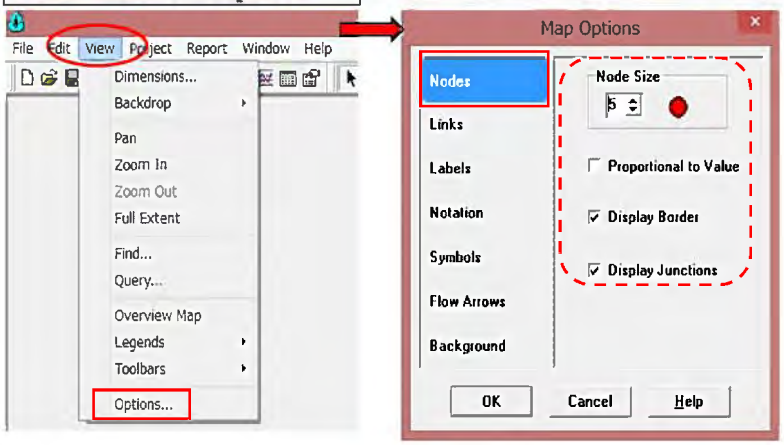
c. Set Project Defaults: Project>>Defaults

- Properties Defaults
  - Make sure Auto Length is off
  - For Pipe Diameter = 50
  - For Pipe Roughness = 120
- Hydraulics Defaults
  - Select appropriate flow units >> LPS
  - Select headloss formula >> H-W



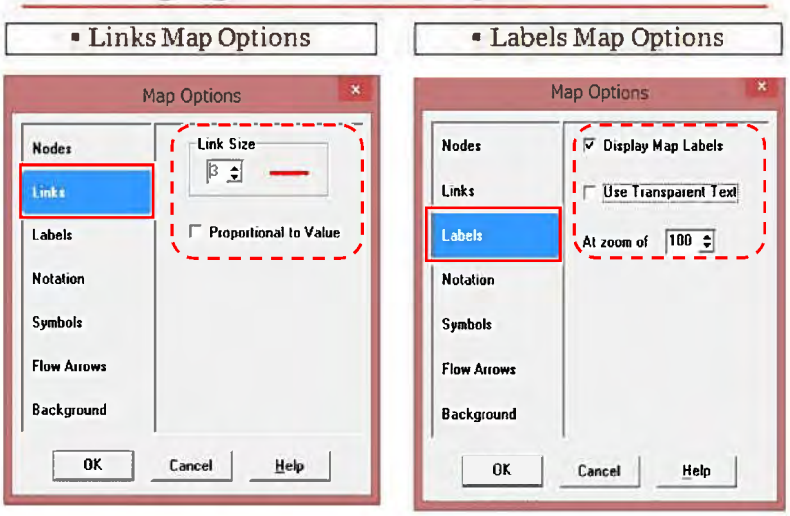
c. Set Map Options: View>>Options

- From Main Toolbar select: View >> Options
- Nodes Map Options



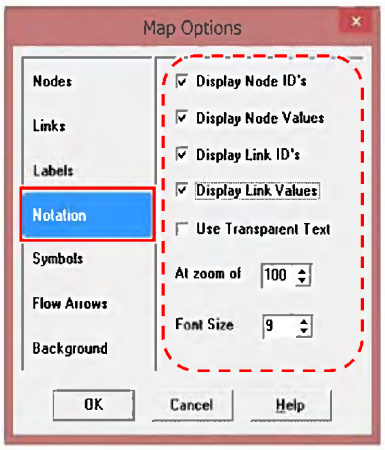
c. Set Map Options: View>>Options

- Links Map Options
- Labels Map Options

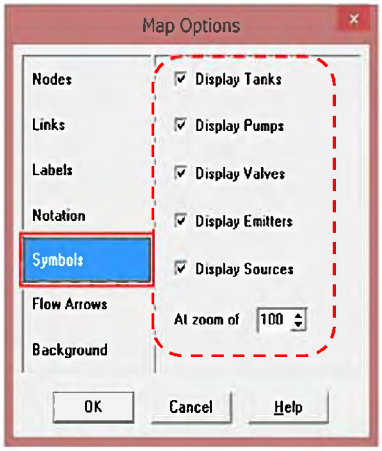


c. Set Map Options: View>>Options

- Notation Map Options

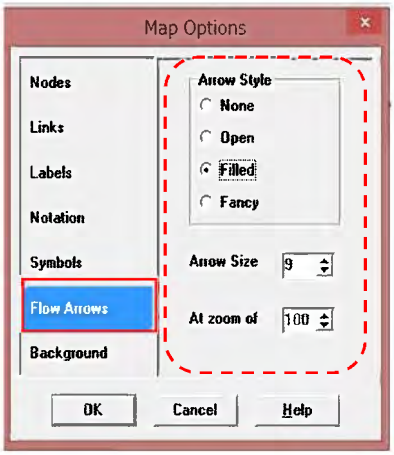


- Symbols Map Options

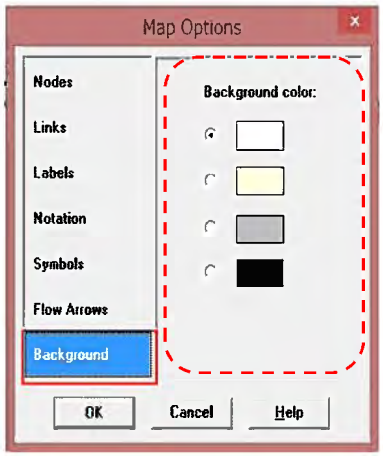


c. Set Map Options: View>>Options

- Flow Arrows Map Options



- Background Map Options



3. Create the Project Scenario

a. Draw the Network
- Nodes (including reservoirs, tanks)
- Pipes connecting nodes
- Pumps
- Control Valves

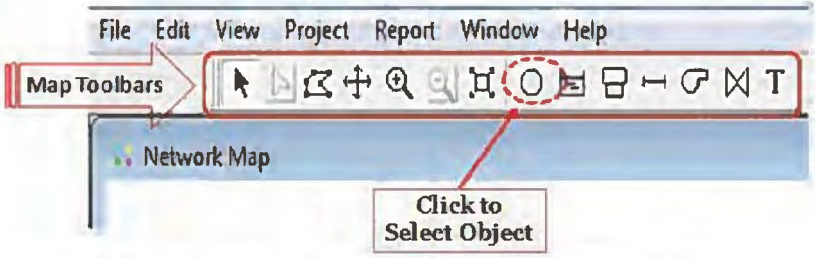
b. Specify Network Properties
- Nodes {demands, elevations}
- Pipe properties {L, D, C}
- Pump Curves {H vs. Q}

c. Run a Simulation
- Single period (snapshot) Analysis

d. Saving and Opening a Project
- Save As a Project
- Open a Project

a. Draw the network

- We are now ready to begin drawing our network by making use of Buttons contained on the Map Toolbar shown below.
  - Use Object Selection Button

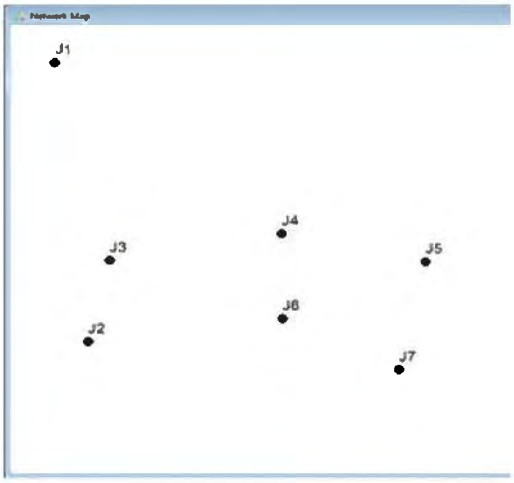


- If the Map Toolbars are not visible then select:
  View >> Toolbars >> Map

a. Draw the network

▪Adding Junctions

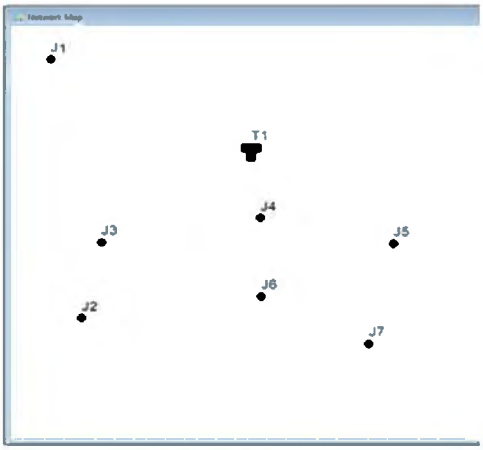
- First, we will add the junction nodes.
- Click the Junction button and then click on the map at the locations of nodes 1 through 7,
- ALWAYS start a project by putting at least two (2) junctions on the map. You can add all junctions at this time, or add additional junctions later.



a. Draw the network

▪Adding Tank

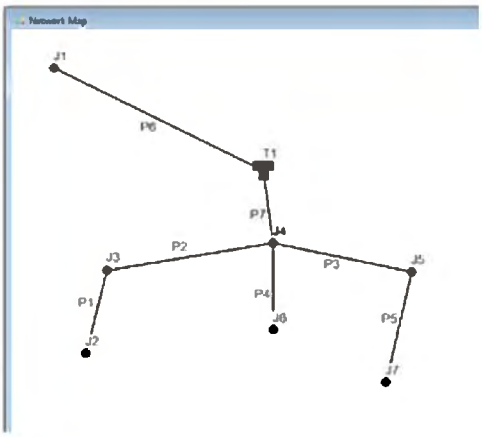
- Finally, add the tank by clicking the Tank button and clicking the map where the tank is located,
- At this point the Network Map should look something like the drawing in attached figure.



a. Draw the network

▪Adding Links

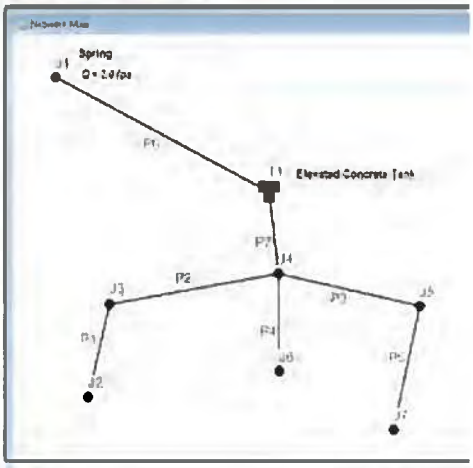
- Next we will add the pipes. Let's begin with Pipe 1 connecting J2 to J3
- First click the Pipe button on the Map Toolbar
- Then click the mouse on J2 on the map and then on J3
- Repeat this procedure for Pipes P2 through P7



a. Draw the network

▪Adding Labels

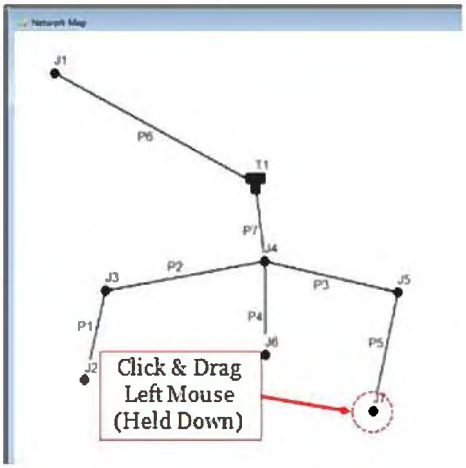
- Next we will label the spring and tank
- Select the Text button on the Map Toolbar and click somewhere close to the spring (Node J1)
- An edit box will appear. Type in the word "Spring" and then hit the Enter key.
- Click next to the Tank and enter its label.



a. Draw the network

▪ Moving an Object

- If the Nodes are out of position you can move them around by clicking the node to select it
- Drag it with the left mouse button held down to its new position
- Labels can be repositioned in similar procedure



b. Specify Network Properties

- Editing an Object is Adding Information to:
  - Links
  - Nodes
- To select an object on the map using the Select Object button:
  - Click the Select Object button (Arrow) on the Map Toolbar
  - Double-Click the mouse over the desired object on the map
- To select an object using the Browser:
  - Select the type of object from the Object listbox of the Database Browser
  - Select the desired object from the Item listbox

b. Specify Network Properties

▪Editing Junction Properties:

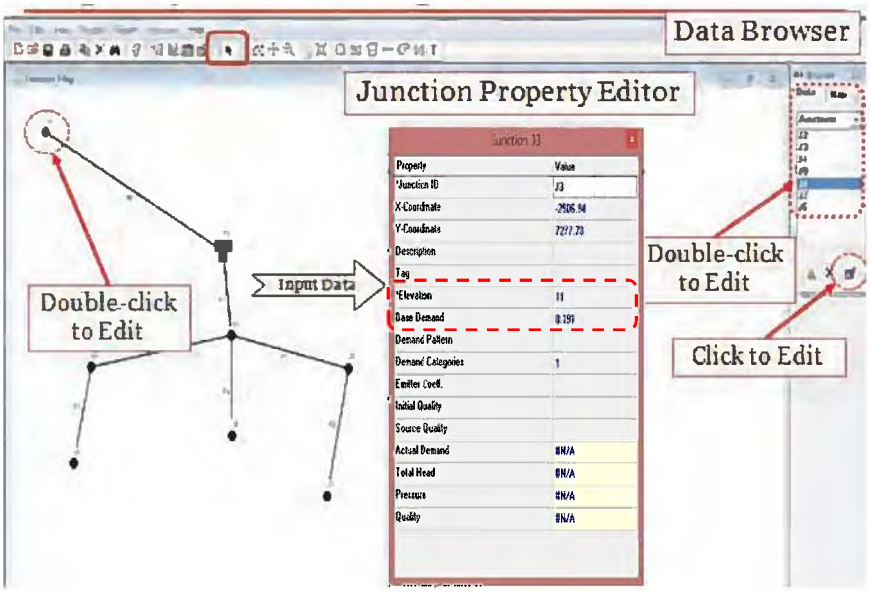
- The nodes in our example network are assumed to have the following properties:

Input Data → Base Demand → Elevation

Network Table - Nodes

Node ID	HHs	Pop1	PF	NRW (%)	Water Demand (lps)		Elevation
					ADD	MDD	m
Junc J1	Spring Source				-2.50		40
Junc J2	14	77	3	30%	0.076	0.099	10
Junc J3	35	193	7	30%	0.191	0.248	11
Junc J4	53	292	11	30%	0.290	0.377	13
Junc J5	67	369	13	30%	0.366	0.476	14
Junc J6	32	176	6	30%	0.175	0.228	12
Junc J7	35	193	7	30%	0.191	0.248	13
Tank1							
Total	236	1300	47		1.289	1.676	

b. Specify Network Properties



b. Specify Network Properties

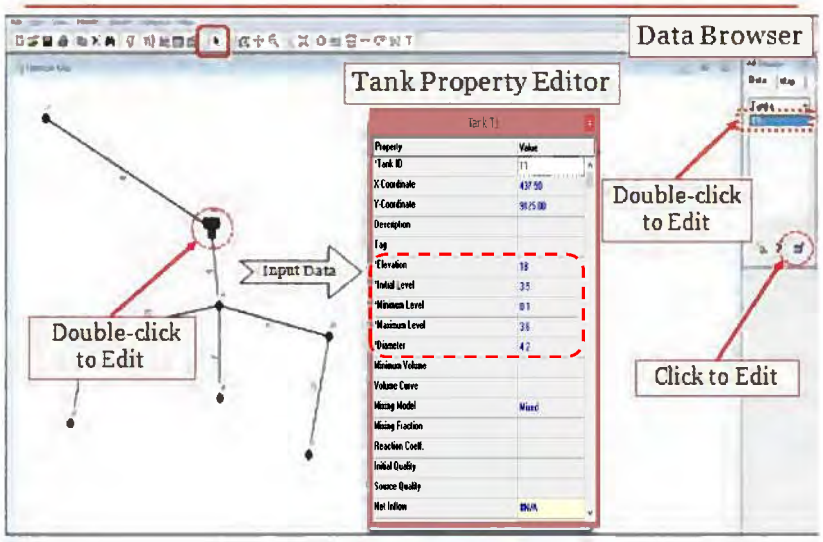
▪Editing Tank Property:

- The Tank in our example network is assumed to have the following properties:

Input Data

Tank Node Data :	T1
Tank Bottom Elev. :	18.00
Initial Level :	3.50
Minimum Level :	0.10
Maximum Level :	3.60
Diameter :	4.20

b. Specify Network Properties



b. Specify Network Properties

▪Editing Pipe Properties:

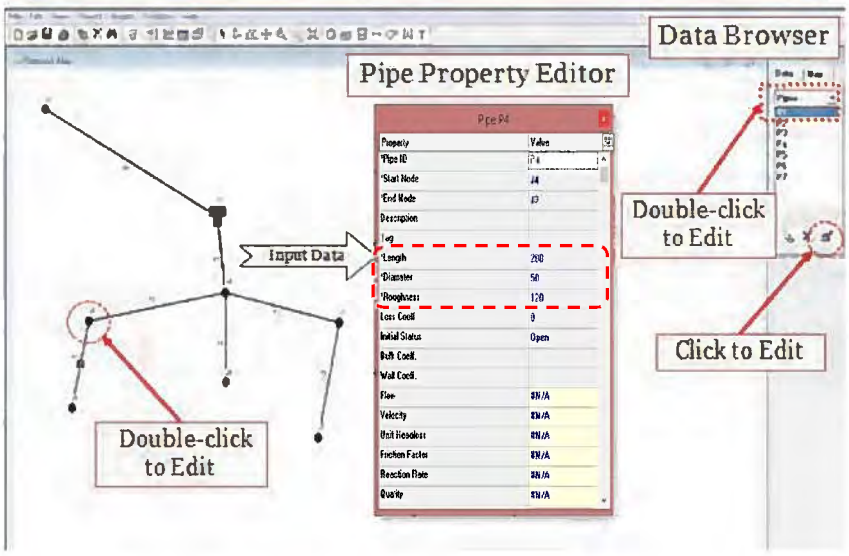
- The Pipes in our example network are assumed to have the following properties:

Input Data → **Length** | **Diameter** | **Roughness**

Network Table - Links

Link ID	Node Number		Length	Diameter	"C"
	From	To	m	mm	
Pipe P1	J2	J3	**200**	**50**	**120**
Pipe P2	J3	J4	**300**	**75**	**120**
Pipe P3	J4	J5	**250**	**75**	**120**
Pipe P4	J4	J6	**200**	**75**	**120**
Pipe P5	J5	J7	**250**	**50**	**120**
Pipe P6	J1	T1	**3000**	**100**	**120**
Pipe P7	T1	J4	**30**	**100**	**120**

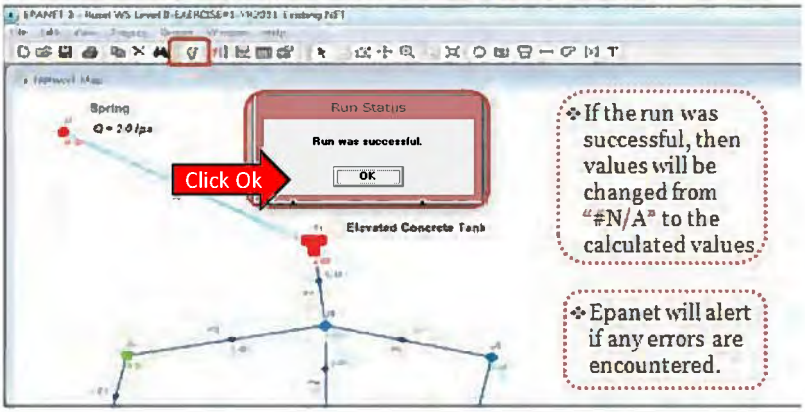
b. Specify Network Properties



c. Run a Simulation

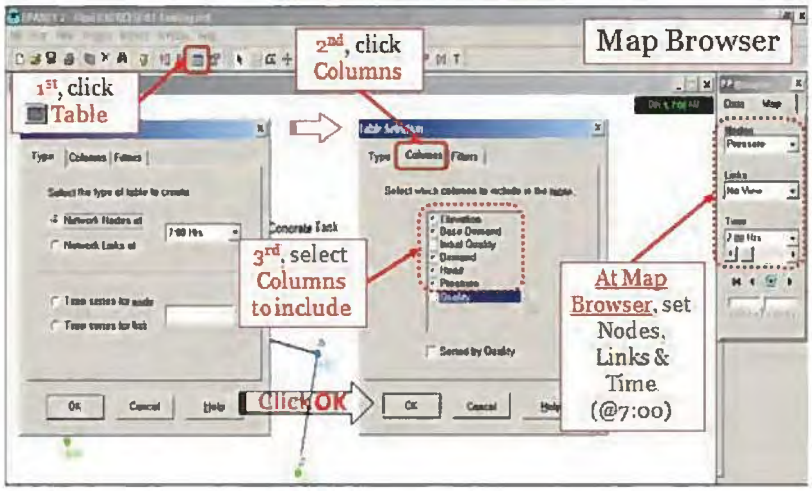
- Run a Single period (steady-state) Analysis

- You now have enough information to run a Single Period (or steady-state) hydraulic analysis
- To run the analysis select Project >> Run Analysis (or click the button)



c. View Results

- View Results - Tables



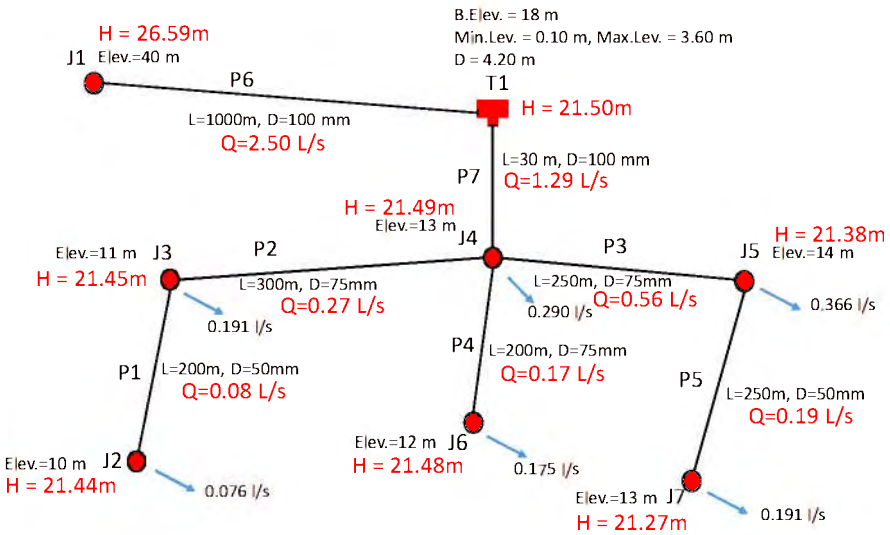
c. View Results: Tables

- EPANET allows you to view selected project data and analysis results in a tabular format
- Tables can be printed, copied to the Windows clipboard, or saved as a data file or Windows metafile
- Network Link sign on flow (+/-) is relative to the way the pipe (link) was initially drawn on the network map

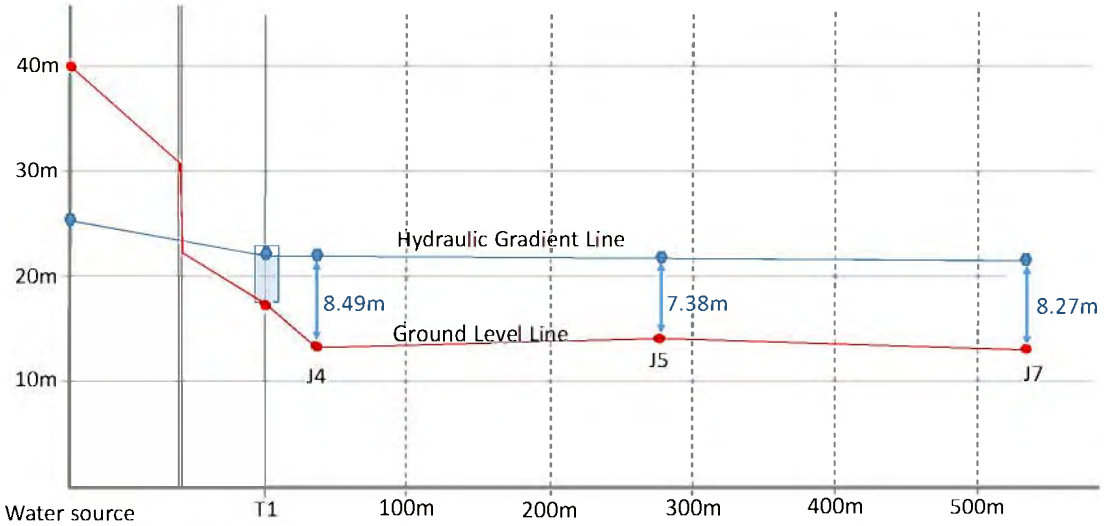
Network Table - Nodes at 7:00 Hrs

Node ID	Elevation m	Base Demand	Demand LPS	Head m	Pressure m
Junc J2	10	0.071	0.14	19.90	9.90
Junc J3	11	0.179	0.36	19.95	8.95
Junc J4	13	0.270	0.54	20.71	7.71
Junc J5	14	0.342	0.68	20.37	6.37
Junc J1	40	-2.00	-2.00	34.42	-5.58
Junc J7	13	0.179	0.36	20.03	7.03
Junc J6	12	0.163	0.33	20.48	8.48
Tank T1	18	#N/A	-0.41	20.76	2.76

Results of Calculation



Profile of Pipeline from Source to Distribution System

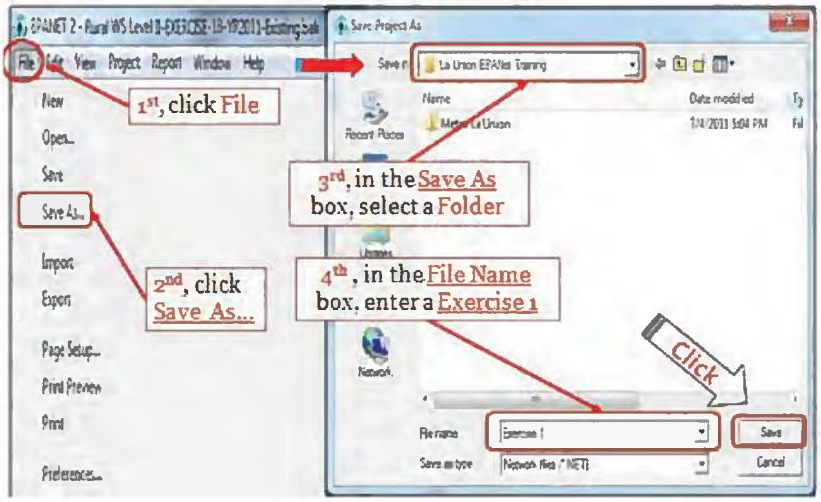


d. Saving &Opening Project

- Having completed the initial design of our network it is a good idea to save our work to a file at this point
  1. From the File menu select the Save As option
  2. In the Save As dialog that appears, select a folder and file name under which to save this project. We suggest naming the file Exercise 1. (An extension of ".net" will be added to the file name if one is not supplied)
  3. Click Save to save the project to file
- The project data is saved to the file in a special binary format. If you wanted to save the network data to file as readable text, use the File >> Export >> Network command instead
- To open our project at some later time, we would select the Open command from the File menu.

d. Saving &Opening Project

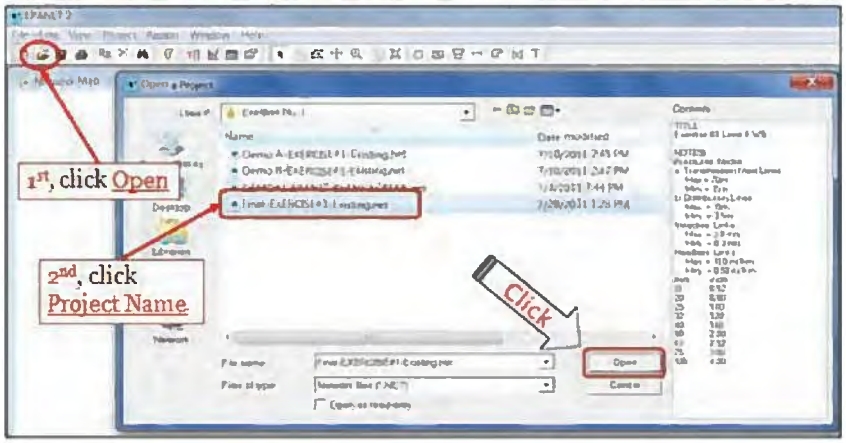
- Saving As a Project

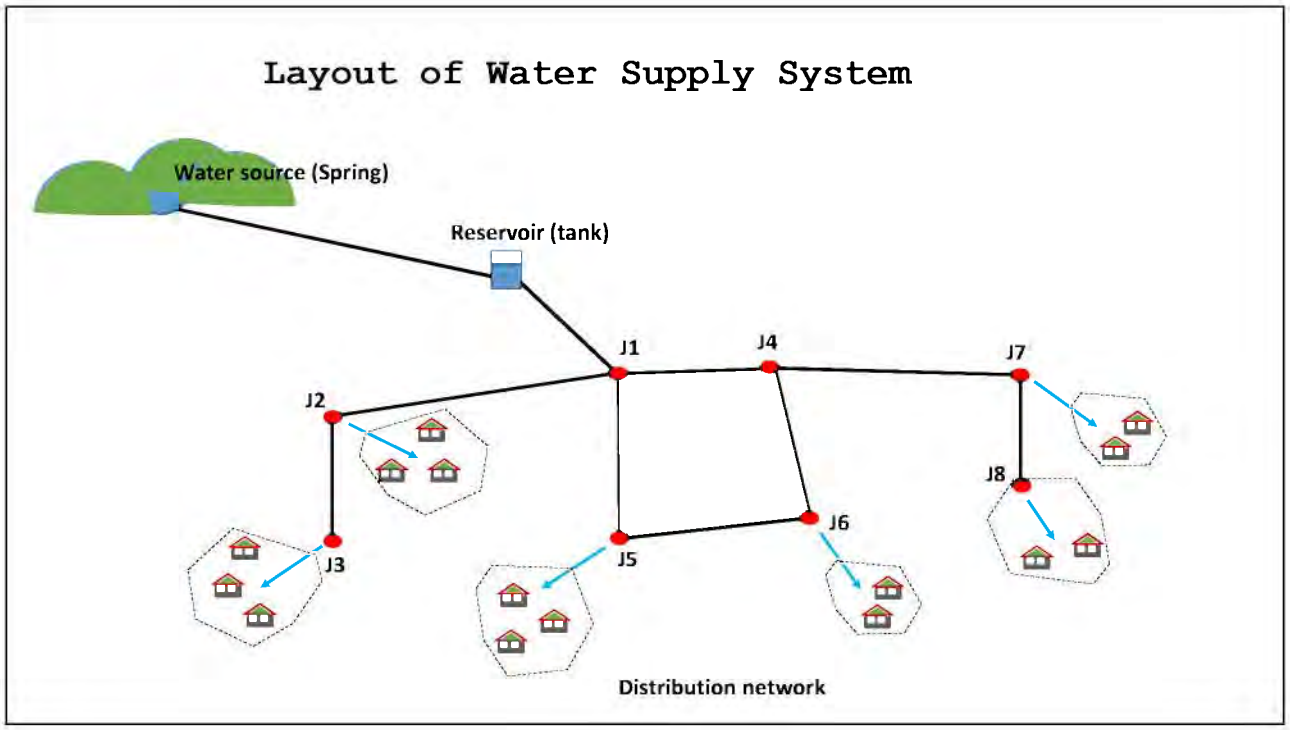


d. Saving &Opening Project

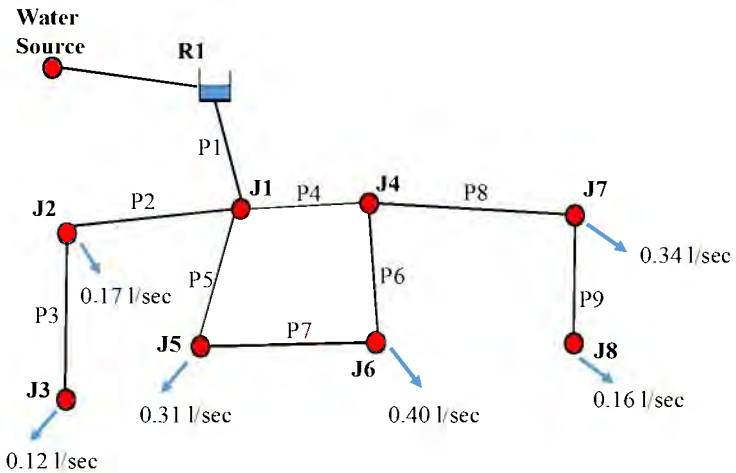
- Opening a Project

- To open our project at some later time, select the Open command from the File menu (File>>Open), or click the Open button from the map toolbar.





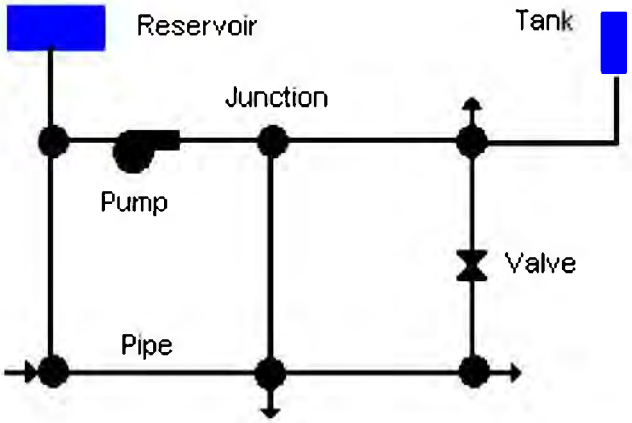
Practice of EPANET



No	Diameter (mm)	Length (m)
P1		50
P2		200
P3		250
P4		100
P5		150
P6		130
P7		175
P8		330
P9		150

No	Q (l/sec)	Elevation (m)
R1		30
J1	0.00	22
J2	0.17	20
J3	0.12	16
J4	0.00	20
J5	0.31	18
J6	0.40	15
J7	0.34	18
J8	0.16	14

Physical Components



Physical Components in a Water Distribution System

- Junctions
- Reservoirs
- Tanks
- Pipes
- Pumps
- Valves

Junctions

Junctions are points in the network where links join together and where water enters or leaves the network.

The basic input data required for junctions are:

- elevation above some reference (usually mean sea level)
- water demand (rate of withdrawal from the network)
- initial water quality.

The output results computed for junctions at all time periods of a simulation are:

- hydraulic head (internal energy per unit weight of fluid)
- pressure
- water quality.

Reservoirs

Reservoirs are nodes that represent an infinite external source or sink of water to the network. They are used to model such things as lakes, rivers, groundwater aquifers, and tie-ins to other systems.

The basic input data required for junctions are:

- elevation above some reference (usually mean sea level)
- water demand (rate of withdrawal from the network)
- initial water quality.

The output results computed for junctions at all time periods of a simulation are:

- hydraulic head (internal energy per unit weight of fluid)
- pressure
- water quality.

Tanks

Tanks are nodes with storage capacity, where the volume of stored water can vary with time during a simulation.

The primary input properties for tanks are:

- bottom elevation (where water level is zero)
- diameter (or shape if non-cylindrical)
- initial, minimum and maximum water levels
- initial water quality.

The principal outputs computed over time are:

- hydraulic head (water surface elevation)
- water quality.

Tanks are required to operate within their minimum and maximum levels. EPANET stops outflow if a tank is at its minimum level and stops inflow if it is at its maximum level.

Pipes

Pipes are links that convey water from one point in the network to another. EPANET assumes that all pipes are full at all times. Flow direction is from the end at higher hydraulic head (internal energy per weight of water) to that at lower head.

The principal hydraulic input parameters for pipes are:

- start and end nodes
- diameter
- length
- roughness coefficient (for determining headloss)
- status (open, closed, or contains a check valve).

Computed outputs for pipes include:

- flow rate
- velocity
- headloss

Practices of EPANET

Analyze the distribution systems below by EPANET. Modify the system (pipe diameter etc.) when there are something wrong in a result of EPANET.

Timor Leste Rural Water Supply Guideline (DENSA of MPW): Standards of GFC design

1. Max static Pressure in network: <= 100m unless topographical constraints
2. Minimum static pressure in network: 5 – 10m
3. max-min static pressure at taps: 5 – 15m
4. Diameter between intake and sedimentation tank: >= 50mm
5. Diameter between tanks: Per hydraulic calculation
6. Diameter at tap stands: 3/4inch GS
7. Velocity of pipe in diameter (min – max)
   (1) 20 – 40mm: 0.3 – 2m/sec
   (2) 50 – 75mm: 1 – 3m/sec

Practice-1

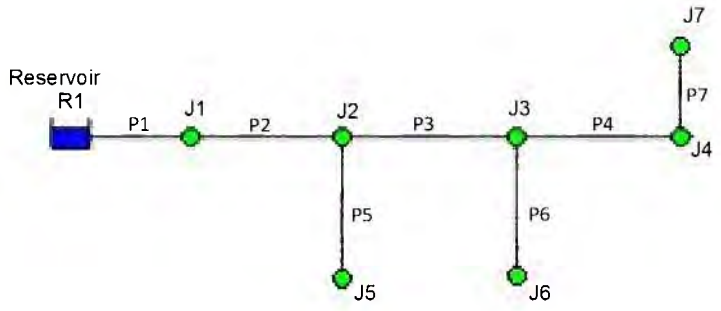


Table 1: Network Node Properties

Node	Elevation (m)	Demand (L/s)
R1	100	0.00
J1	85	0.09
J2	82	0.00
J3	78	0.00
J4	77	0.00
J5	82	0.10
J6	78	0.07
J7	76	0.05

Table 2: Network Pipe Properties

Pipe	Length (m)	Diameter (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	50	120
P5	40	20	120
P6	25	20	120
P7	50	20	120

Practice-2

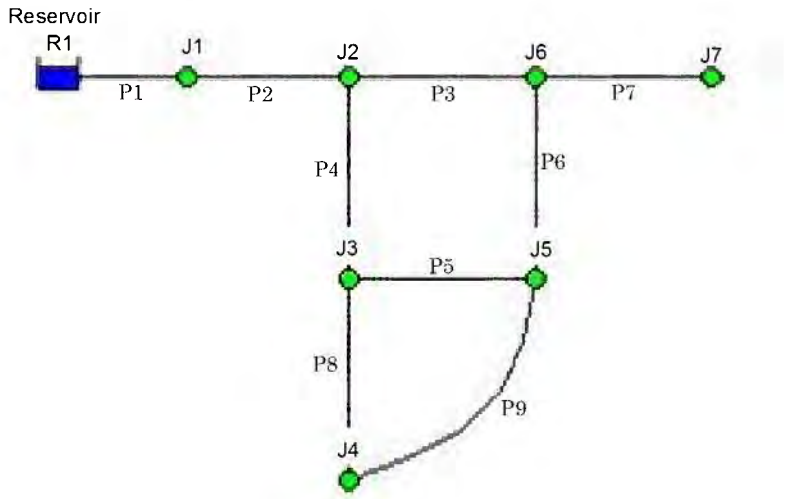


Table 1: Network Node Properties

Node	Elevation (m)	Demand (L/s)
R1	100	0.00
J1	86	0.09
J2	77	0.09
J3	68	0.13
J4	58	005
J5	70	0.10
J6	75	0.07
J7	80	0.05

Table 2: Network Pipe Properties

Pipe	Length (m)	Diameter (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	40	120
P5	400	40	120
P6	250	40	120
P7	500	40	120
P8	350	40	120
P9	800	40	120

Practice-3

Analyze the case of Practice-2 with a time pattern below into consideration.

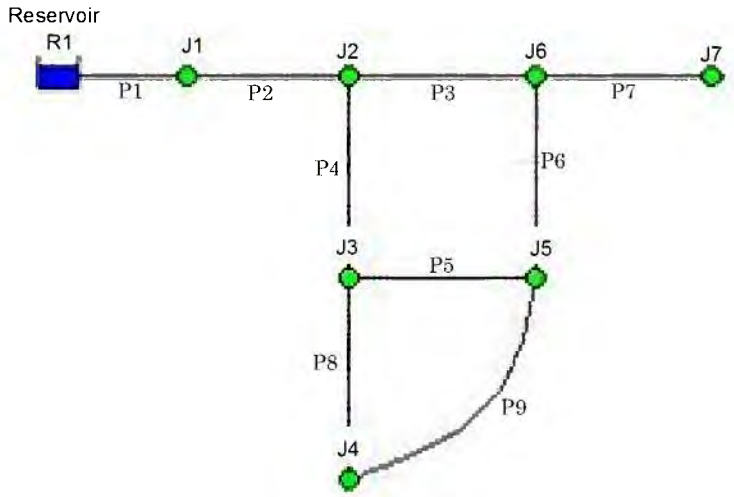


Table 1: Network Node Properties

Node	Elevation (m)	Demand (L/s)
R1	100	0.00
J1	86	0.09
J2	77	0.09
J3	68	0.13
J4	58	005
J5	70	0.10
J6	75	0.07
J7	80	0.05

Table 2: Network Pipe Properties

Pipe	Length (m)	Diameter (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	40	120
P5	400	40	120
P6	250	40	120
P7	500	40	120
P8	350	40	120
P9	800	40	120

Table 3: Time Pattern

Time	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Time Factor	0.60	0.40	0.30	0.25	0.25	0.30	0.75	1.55	1.80	1.75	1.50	1.20

Time	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
Time Factor	1.00	0.90	0.80	0.75	0.80	0.90	1.20	1.50	1.55	1.50	1.35	1.10

EPANET 2 USERS MANUAL P.21-P.23

2.8 Running an Extended Period Analysis

To make our network more realistic for analyzing an extended period of operation we will create a Time Pattern that makes demands at the nodes vary in a periodic way over the course of a day. For this simple example we will use a pattern time step of 6 hours thus making demands change at four

different times of the day. (A 1-hour pattern time step is a more typical number and is the default assigned to new projects.) We set the pattern time step by selecting Options-Times from the Data Browser, clicking the Browser's Edit button to make the Property Editor appear (if its not already visible), and entering 6 for the value of the Pattern Time Step (as shown in Figure 2.8 below). While we have the Time Options available we can also set the duration for which we want the extended period to run. Let's use a 3-day period of time (enter 72 hours for the Duration property).

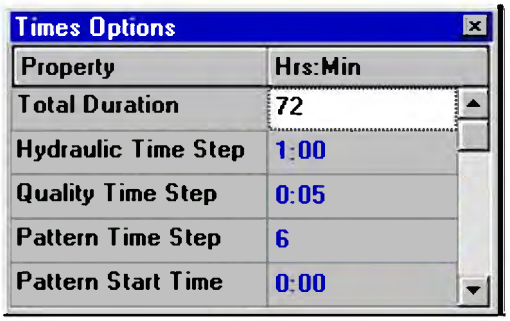


Figure 2.8 Times Options

To create the pattern, select the Patterns category in the Browser and then click the Add button . A new Pattern 1 will be created and the Pattern Editor dialog should appear (see Figure 2.9). Enter the multiplier values 0.5, 1.3, 1.0, 1.2 for the time periods 1 to 4 that will give our pattern a duration of 24 hours. The multipliers are used to modify the demand from its base level in each time period. Since we are making a run of 72 hours, the pattern will wrap around to the start after each 24-hour interval of time.

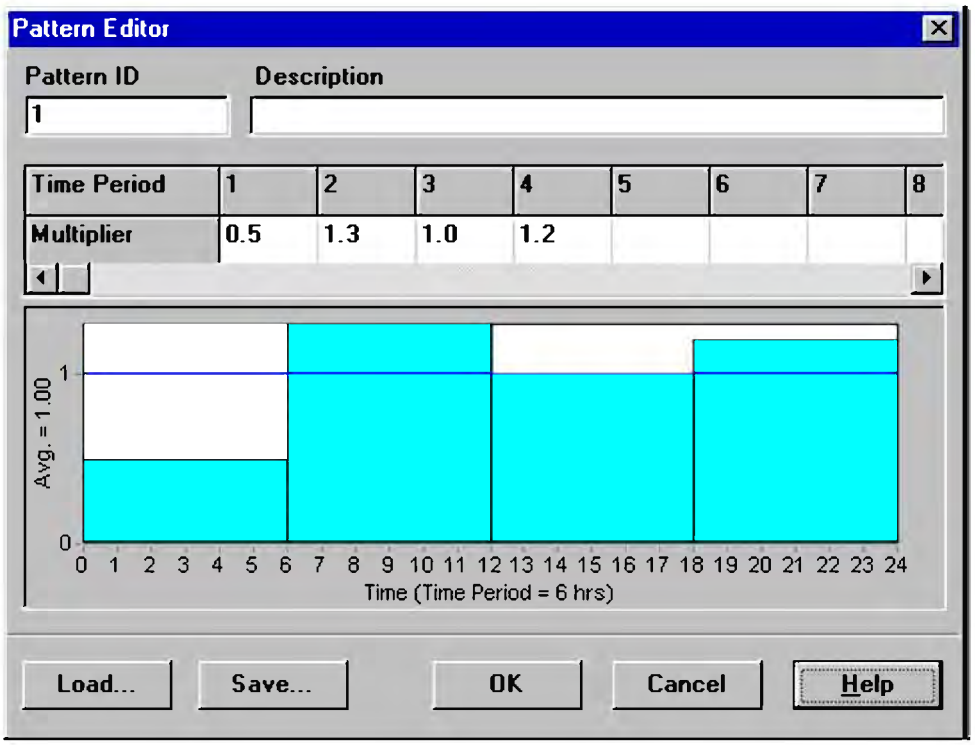


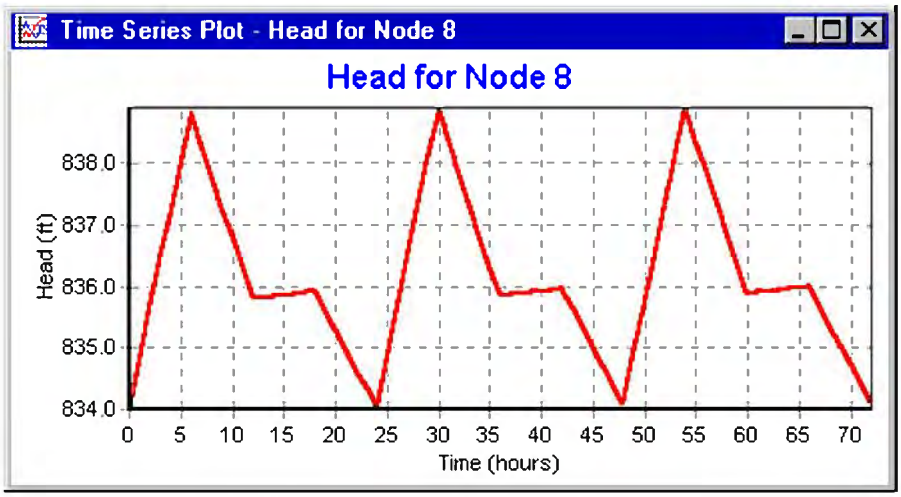
Figure 2.9 Pattern Editor

We now need to assign Pattern 1 to the Demand Pattern property of all of the junctions in our network. We can utilize one of EPANET's Hydraulic Options to avoid having to edit each junction individually.

If you bring up the Hydraulic Options in the Property Editor you will see that there is an item called Default Pattern. Setting its value equal to 1 will make the Demand Pattern at each junction equal Pattern 1, as long as no other pattern is assigned to the junction.

Next run the analysis (select **Project >> Run Analysis** or click the button on the Standard Toolbar). For extended period analysis you have several more ways in which to view results:

- The scrollbar in the Browser's Time controls is used to display the network map at different points in time. Try doing this with Pressure selected as the node parameter and Flow as the link parameter.
- The VCR-style buttons in the Browser can animate the map through time. Click the Forward button to start the animation and the Stop button to stop it.
- Add flow direction arrows to the map (select **View >> Options**, select the Flow Arrows page from the Map Options dialog, and check a style of arrow that you wish to use). Then begin the animation again and note the change in flow direction through the pipe connected to the tank as the tank fills and empties over time.
- Create a time series plot for any node or link. For example, to see how the water elevation in the tank changes with time:
    1. Click on the tank.
    2. Select **Report >> Graph** (or click the Graph button on the Standard Toolbar) which will display a Graph Selection dialog box.
    3. Select the Time Series button on the dialog.
    4. Select Head as the parameter to plot.
    5. Click **OK** to accept your choice of graph.



Note the periodic behavior of the water elevation in the tank over time (Figure 2.10).

Figure 2.10 Example Time Series Plot

Practice-4

Analyze the system distributed by a pump.

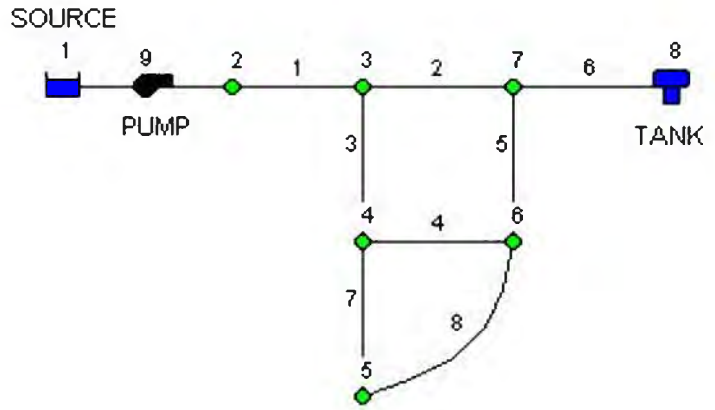


Table 1: Network Node Properties

Node	Elevation (m)	Demand (L/s)
1	100	0.00
2	100	0.00
3	103	9.46
4	100	9.46
5	85	12.62
6	100	9.46
7	100	0.00
8	140	0.00

Table 2: Network Pipe Properties

Pipe	Length (m)	Diameter (mm)	C
1	900	350	100
2	1,500	300	100
3	1,500	200	100
4	1,500	200	100
5	1,500	200	100
6	2,100	250	100
7	1,500	150	100
8	2,200	150	100

Node 8: The tank (Node 8) has a 18-m diameter, a 1.5-m water level, and a maximum level of 6 m.

Link 9: The pump (Link 9) can deliver 46 m of head at a flow of 38 L/sec.

Head = 60.00-0.0097〔Flow〕^2.00

EPANET 2 USERS MANUAL P.19

2.5 Setting Object Properties

For the pump, we need to assign it a pump curve (head versus flow relationship). Enter the ID label 1 in the Pump Curve field.

Next we will create Pump Curve 1. From the Data page of the Browser window, select Curves from the dropdown list box and then click the Add button . A new Curve 1 will be added to the database and the Curve Editor dialog form will appear (see Figure 2.6). Enter the pump's design flow (600) and head (150) into this form. EPANET automatically creates a complete pump curve from this single point. The curve's equation is shown along with its shape. Click **OK** to close the Editor.

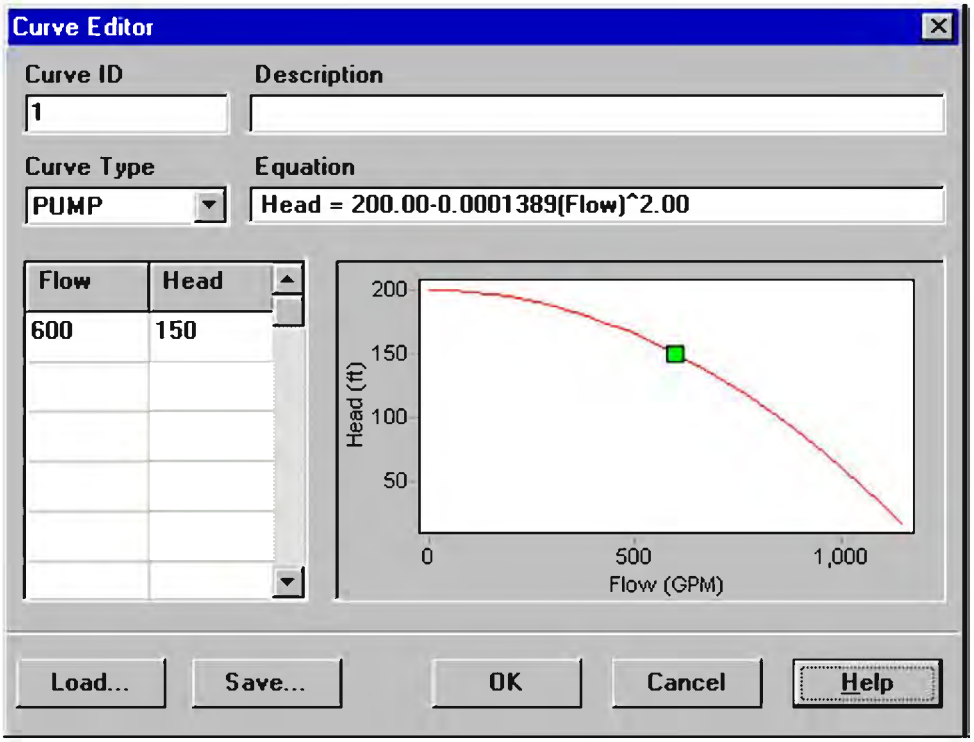


Figure 2.6 Curve Editor

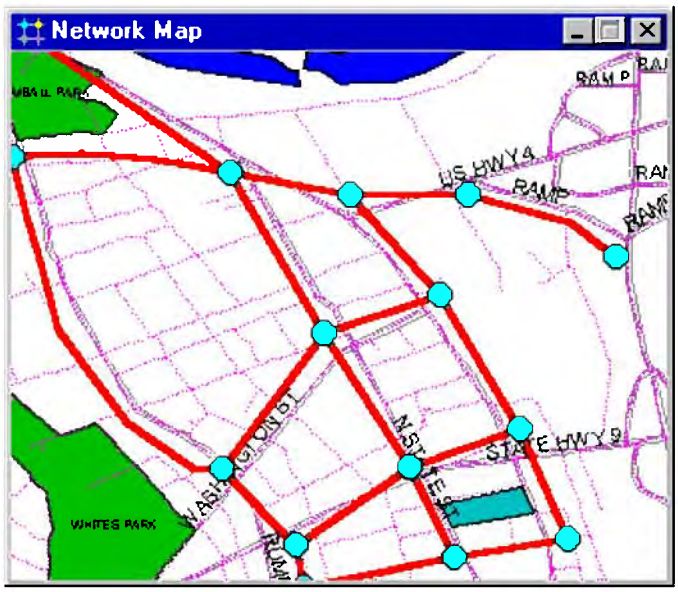
Practice-5

Draw pipe network on a backdrop map.

EPANET 2 USERS MANUAL P.85 – P.86

7.3 Utilizing a Backdrop Map

EPANET can display a backdrop map behind the pipe network map. The backdrop map might be a street map, utility map, topographic map, site development plan, or any other picture or drawing that might be useful. For example, using a street map would simplify the process of adding pipes to the network since one could essentially digitize the network's nodes and links directly on top of it.



The backdrop map must be a Windows enhanced metafile or bitmap created outside of EPANET. Once imported, its features cannot be edited, although its scale and extent will change as the map window is zoomed and panned. For this reason metafiles work better than bitmaps since they will not loose resolution when rescaled. Most CAD and GIS programs have the ability to save their drawings and maps as metafiles.

Selecting **View >> Backdrop** from the Menu Bar will display a sub-menu with the following commands:

- **Load** (loads a backdrop map file into the project)
- **Unload** (unloads the backdrop map from the project)
- **Align** (aligns the pipe network with the backdrop)
- **Show/Hide** (toggles the display of the backdrop on and off)

When first loaded, the backdrop image is placed with its upper left corner coinciding with that of the network's bounding rectangle. The backdrop can be re-positioned relative to the network map by

selecting **View >> Backdrop >> Align**. This allows an outline of the pipe network to be moved across the backdrop (by moving the mouse with the left button held down) until one decides that it lines up properly with the backdrop. The name of the backdrop file and its current alignment are save along with the rest of a project's data whenever the project is saved to file.

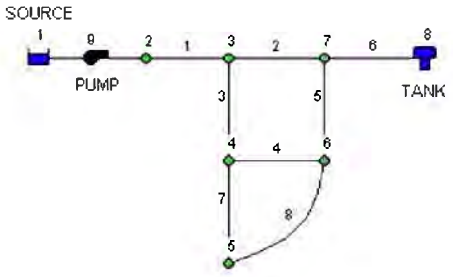
For best results in using a backdrop map:

- Use a metafile, not a bitmap.
- Dimension the network map so that its bounding rectangle has the same aspect ratio (width-to-height ratio) as the backdrop.

添付資料 25 EPANET(給水)(テトン語版)

Oinsa atu uza EPANET

1. Saida mak EPANET
2. Etapa Analiza ba EPANET
3. Pratik a



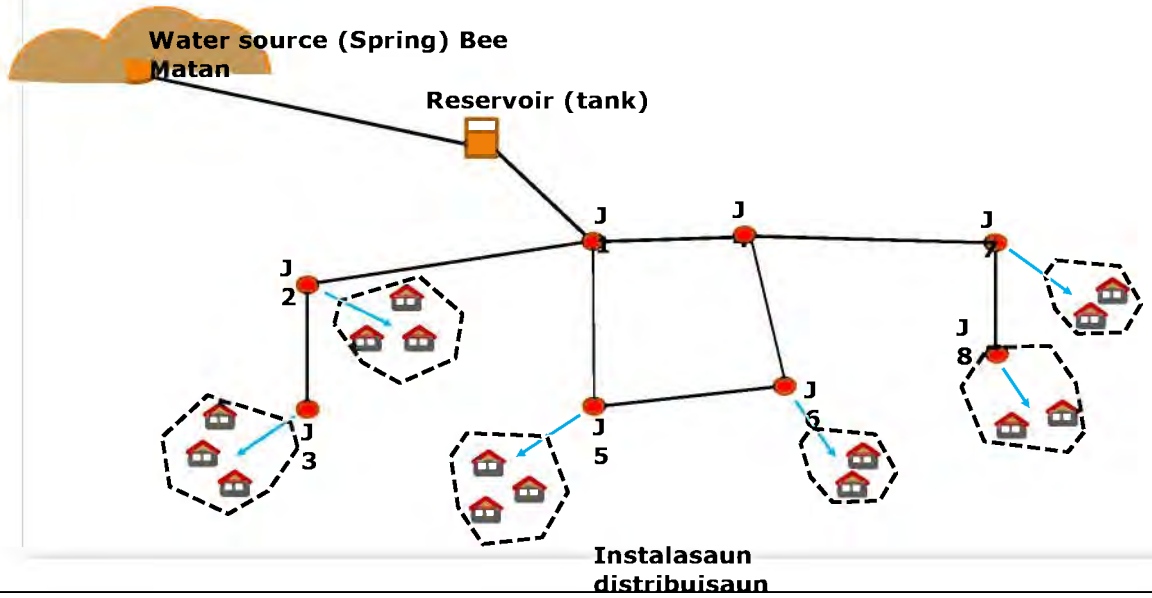
Saida mak EPANET

Prepara husi U.S. Agensia Protesaun Ambiente (EPA)

EPANET: Programa komputer ba simulasaun hosi
(1) Hydroliku
(2) Kualidade Bee ho Preasaun redi pipa nian

Redi Instalasaun: pipa, nodu (pipa sentral), bomba, valvula, tanki rezervador, rezervoirs

Dizenu husi sistema fornese Bee Mos



Etapa analis ba EPANET

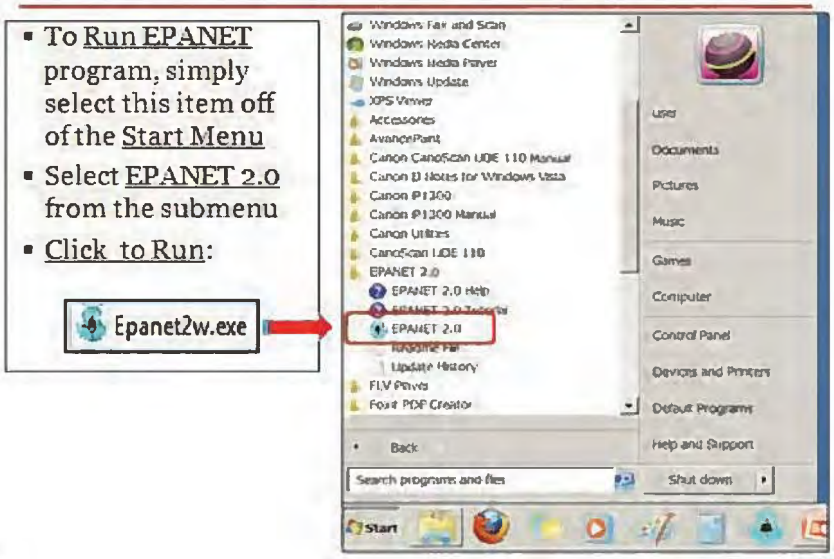
Tipu hodi hala'o tuir etapa wainhira :

uza EPANET ba iha modelu ho sistema distribuisaun:

1. Loke programa EPANET 2.0
2. Set-up ka hatur ba New project
3. Kria skenario ba projetu
4. Analiza ba Network
5. Hare hikas rezultadu ba Analiza

1. Loke programa EPANET 2.0

- To Run EPANET program, simply select this item off of the Start Menu
- Select EPANET 2.0 from the submenu
- Click to Run:

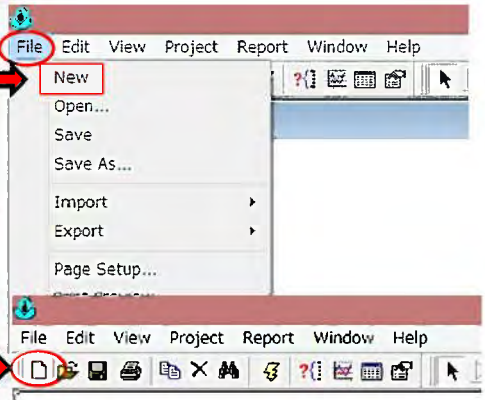


2.Hatur (Set up)Projetu foun

a. Kria projetu foun
b. Hatur (Set) ba iha Projetu Preferences
c. Hatur (Set)ba iha Projetu Difaoults
d. Hatur (Set) ba iha Mapa Opsaun

a. Kria projetu foun

•Husi Main Toolbars
Select :file >> New
•Select New, Laiha naran file, kria ho opsaun hirak ne depois set iha Default values

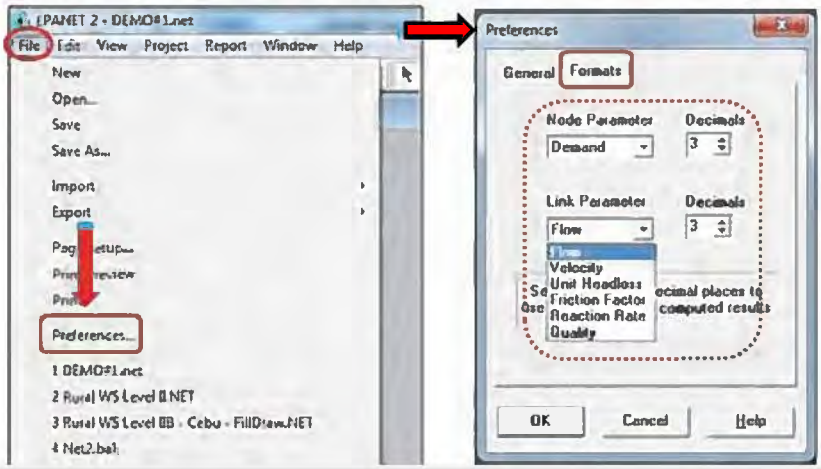


•Ou,klik New Project
Husi Standard Toolbars
▪Propoint mos ba iha Save I exiting project nebe iha , antes atu kria new Project

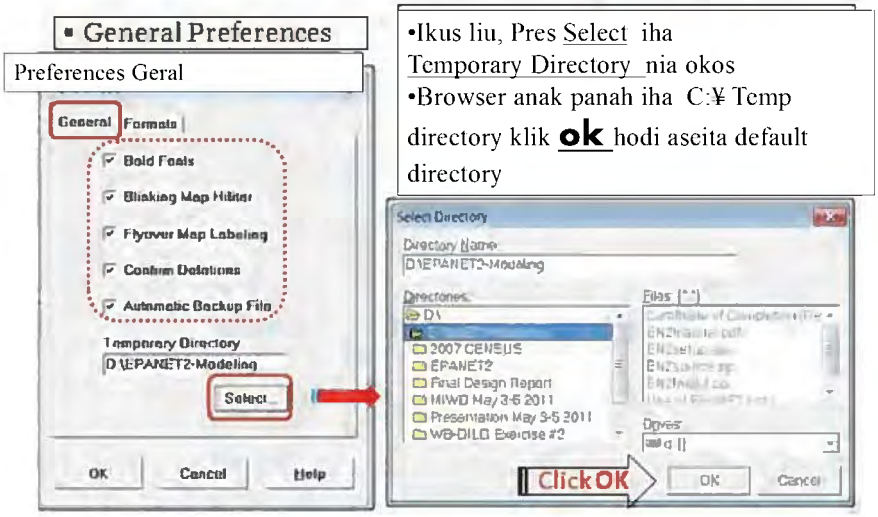
b. Hatur (Set) Project Preferences nian: File>>Preferences

•Husi Main Toolbars
Select :file >> Preferences

• Formats Preferences



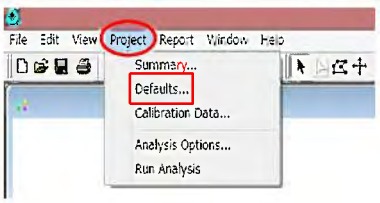
b. Set ba Project Preferences: File>>Preferences



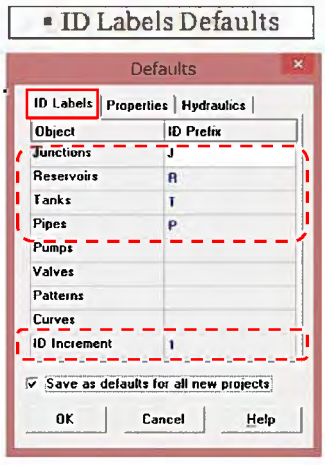
•Ikus liu, Pres Select iha Temporary Directory nia okos
•Browser anak panah iha C:¥ Temp directory klik **ok** hodi aseita default directory

c. Set Project Defaults: Project>>Defaults

•Husi Toolbars Geral
Select :Project>> Defaults



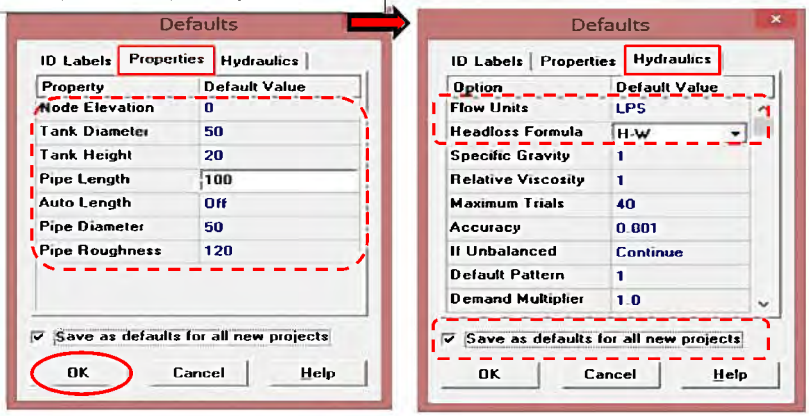
•Husi Main Toolbars
Select :file >> Preferences



c.Hatur (Set) Projetu Defaults: Project>>Defaults

▪Properties Defaults
•Konsedera Auto length ho keadaan Off
•Ba Diameter Pipa =50
•Pipa roughness =120
Select :file >> Preferences

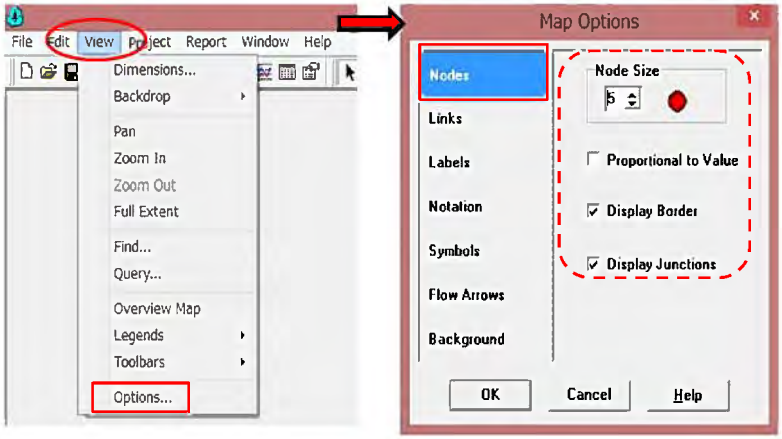
•Hydraulics Defaults
•Select Flow Unit >>LPS
•Select headloss formula >>H-W



c. Hatur (Set) ba Map Options: View>>Options

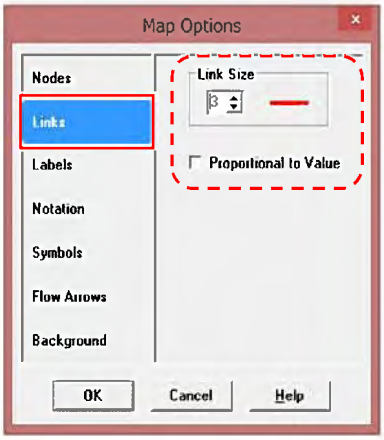
•Husi Main Toolbars
Select :View >> Option

•Opsaun Nodes Map

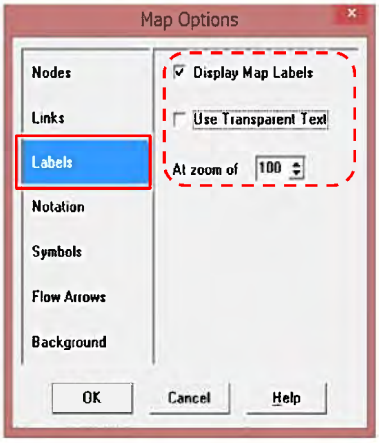


c. Marka ba Map Options: View>>Options

- Links Map Options

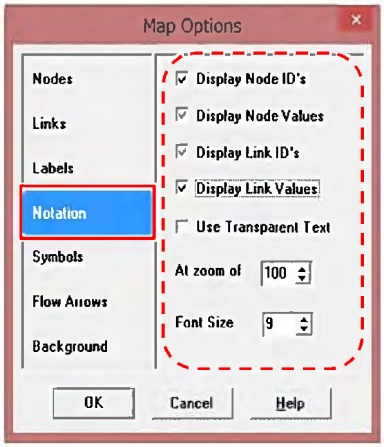


- Labels Map Options

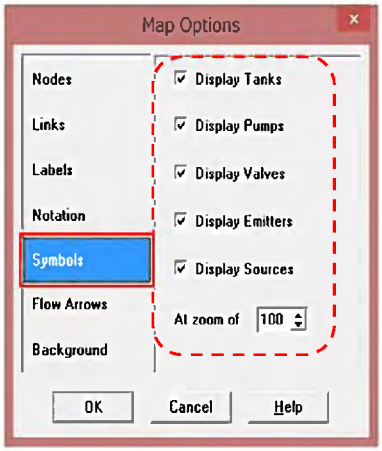


c. Hatur (Set) ba Map Options: View>>Options

- Notation Map Options

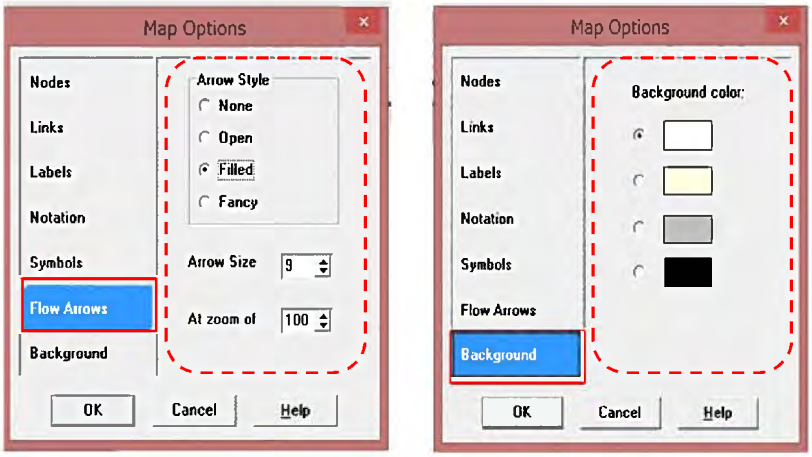


- Symbols Map Options



c. Hatur (Set) Map Options: View>>Options

- Flow Arrows Map Options
- Opsaun ba Antesedente Mapa



3.Kria Skenario ba

a. Dezenu ba Network
- Nodu (inklui Reservoir,tanki)
- Ligasaun Pipa ba Nodu
- Pumps (Bomba)
- Kontrolu valvula

b spesifiku ba Network
- Nodu (Ezezensia, elevasaun)
- Material pipa hanesan (L,D,C)
- Bomba kurva (H vs. Q)
- Kontrolu valvula

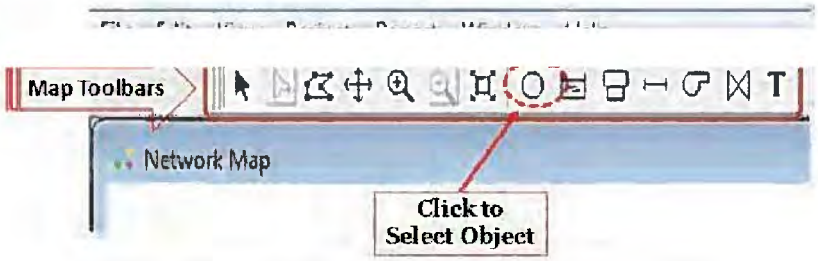
c. Halai ba Simulasan
- Piriodu singular(snapshot) analiza

d.Salva ho loke projetu
- Salva hanesan projetu ida
- Loke ba projetu

a. **Dezenu ba iha Network**

Agora dadaun ita uza network hodi halo dezenu husi butaun (of buttons) nebe iha Map Toobars hare iha kraik

Uza objetivu ba selesaun Button ka (Objeck Select Button)



Karik **Map Toolbars** **la hare hetan** bele mos hanehan (klik) iha select :

a. Dezenya ba network

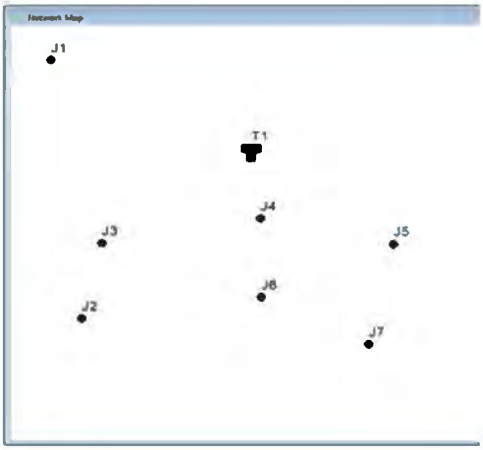
▪ Adding Junctions

- **Dahuluk, ita tenke hatama (add) junction nodu nian. Buti ba simbulu junction O hafoin buti mos iha area mapa nodu 1 nian liu husi 7,**
- **Sempre komesa ho projetu nomos lalaok ne tuir kedas junction rua(2) ih Mapa nia laran, ita mos bele hatama ka (add) junction sira seluk ho oras hanesan ka hafoin adisionalnya ikus.**

a. Dizenya ba network

▪ Adding Tank

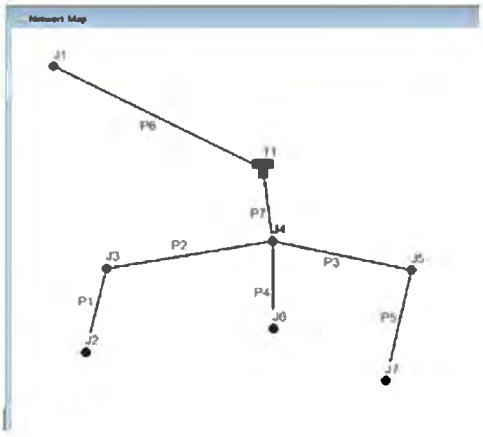
•Ikus liu, hatama(add) Tanki buti maus ho simbulo Tanki nian ka butaun tanki iha area tanki nian.
•Iha dezenyu mapa network ne tenke hare hanesa figura ida iha dezenyu nebe ita halo ne



a. Dezenyu ba network

▪ Adding Links

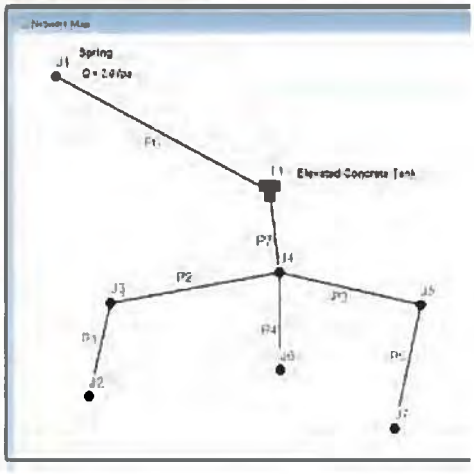
•Tuir mai ita tenke add ba pipa,
hahu husi pipa 1 liga kedas ba J2 to'o ba J3
•Dahuluk buti kedas ba butaun pipa
Iha mapa Toolbar nia laran
•Hafoin buti maus iha mapa J2 ho J3
•Repete ba prosedur ne'e ba pipa p2 liu husi p7



a. Dizenya ba network

▪Adding Labels

- Next we will label the spring and tank
- Select the Text button T on the Map Toolbar and click somewhere close to the spring (Node J1)
- An edit box will appear. Type in the word "Spring" and then hit the Enter key.
- Click next to the Tank and enter its label.



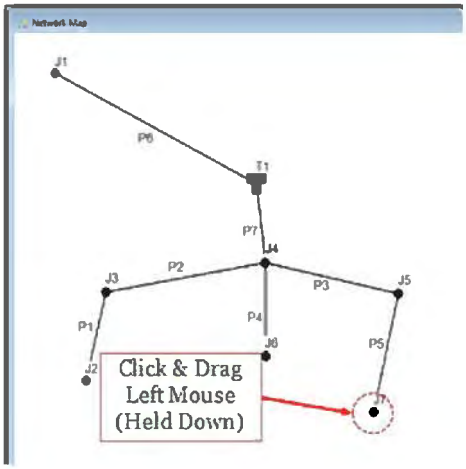
a. Dizenyu ba network

▪Moving an Object

▪Karik Nodu sai husi ninia puzisaun ita bele muda iha nia area I hafoin klik nodu hodi halo selesaun

▪ halo metan tiha pozisaun hafoin Uza maus karuk hodi muda nia butaun mai krai ba iha pozisaun foun

▪Label bele muda nia pozisaun tuir prosedura



b. Spesifiku Network Propiadade

- Halo edit ba iha objetivu hodi hatama(adding) informasaun atu :
  - . Links
  - . Nodu
- Atu hili objetu ida iha Map uza no hili Objetu buttaun nian :
- Buti ba selesaun objetu butaun ka (anak panah) iha Map toolba
- Buti dala rua ba mause liutiha desidi obijetivu iha mapa nia laran
- Atu hili objetu ida tenke uza browser :
- Hili tipu ba objetivu nian husi objetu Listbox kona ba data base browser nian
- Hili no desidi objetu husi Item listbox

b. Spesifiku propidade Network

Halot Propiadade Junction

Pipa nebe iha ita nia esplikasaun asumi hanesan network : mak tuir mai ne.

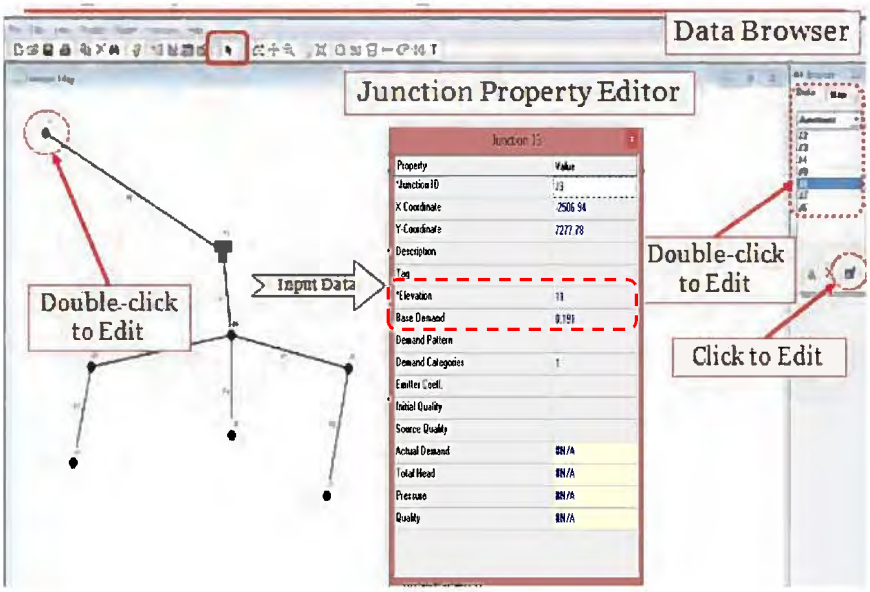
following properties:

Input Data → **Base Demand** → **Elevation**

Network Table - Nodes

Node ID	HHs	Pop1	PF	NRW (%)	Water Demand (lps)		Elevation
					ADD	MDD	m
Junc J1	Spring Source				-2.50		40
Junc J2	14	77	3	30%	0.076	0.099	10
Junc J3	35	193	7	30%	0.191	0.248	11
Junc J4	53	292	11	30%	0.290	0.377	13
Junc J5	67	369	13	30%	0.366	0.476	14
Junc J6	32	176	6	30%	0.175	0.228	12
Junc J7	35	193	7	30%	0.191	0.248	13
Tank1							
Total	236	1300	47		1.289	1.676	

b. Spesifiku propiadade Network



b. Spesifiku propiadade Network

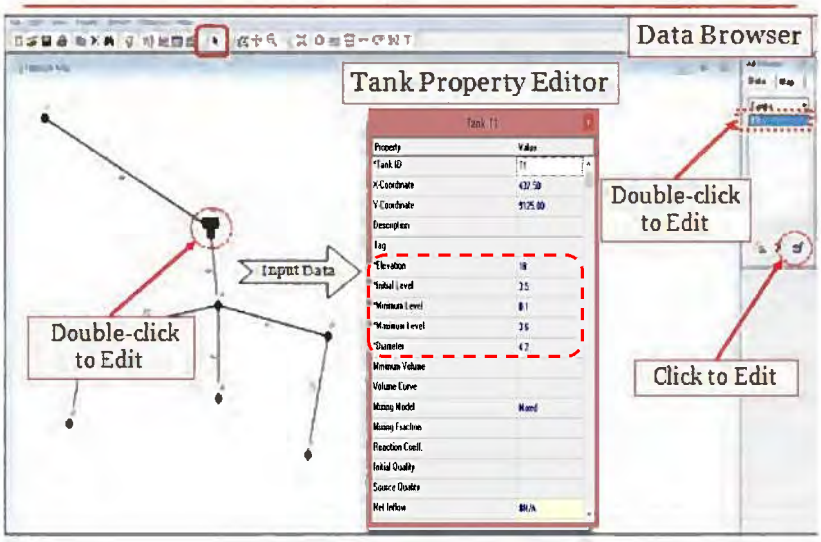
•Halot Propiadae Tanki

Pipa nebe iha ita nia esplikasaun asumi hanesan network : mak tuir mai ne.

Input Data

Tank Node Data :	T1
Tank Bottom Elev. :	18.00
Initial Level :	3.50
Minimum Level :	0.10
Maximum Level :	3.60
Diameter :	4.20

b. Spesifiku propiadade Network



b. Spesifiku propiadade Network

•Halot propiadade pipa

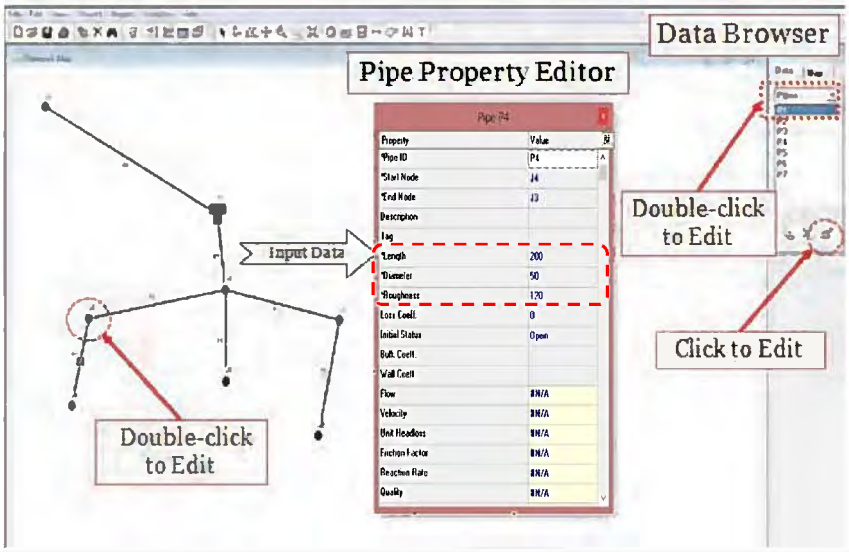
- Pipa nebe iha ita nia esplikasaun asumi hanesan network : mak tuir mai ne.

Input Data **Length** **Diameter** **Roughness**

Network Table - Links

Link ID	Node Number		Length	Diameter	"C"
	From	To	m	mm	
Pipe P1	J2	J3	200	50	120
Pipe P2	J3	J4	300	75	120
Pipe P3	J4	J5	250	75	120
Pipe P4	J4	J6	200	75	120
Pipe P5	J5	J7	250	50	120
Pipe P6	J1	T1	3000	100	120
Pipe P7	T1	J4	30	100	120

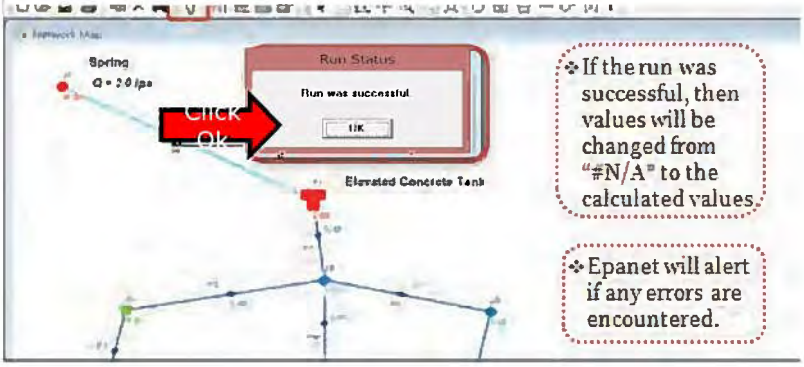
b. Spesifiku propiadade Network



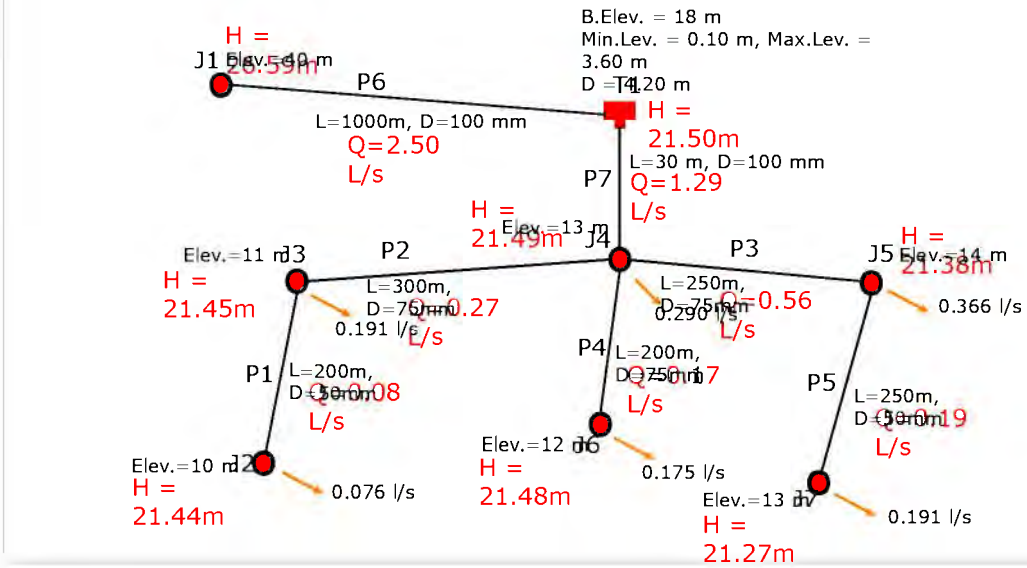
c. Hala'o Simulasaun

Halai ho pontu ida deit ho funsaun diak(steady-state)

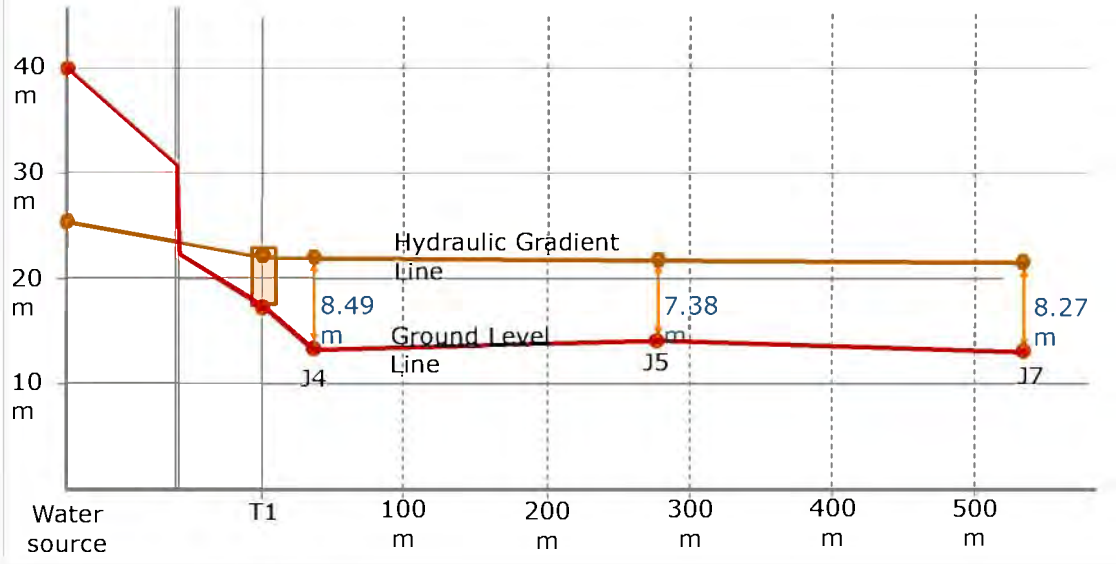
- Ita iha ona informasaun nebe diak atu hala'o single period ka steady-state ba iha analiza hyrdolikua
- Atu hala'o ba analiza nian elect ba Projetu >> hala'o analis ka buti butaun.



Rezultadu ba Kalkulasaun



Profile ba sistema distribuisaun husi bee matan mai pipa /kadorsa



d. Halot & loke (saving &Opening Project)

•Kompleta tiha inisial dezenu nian husi network ida ne ideia diak hodi halot ita nia servisu ba iha arkivu(file)

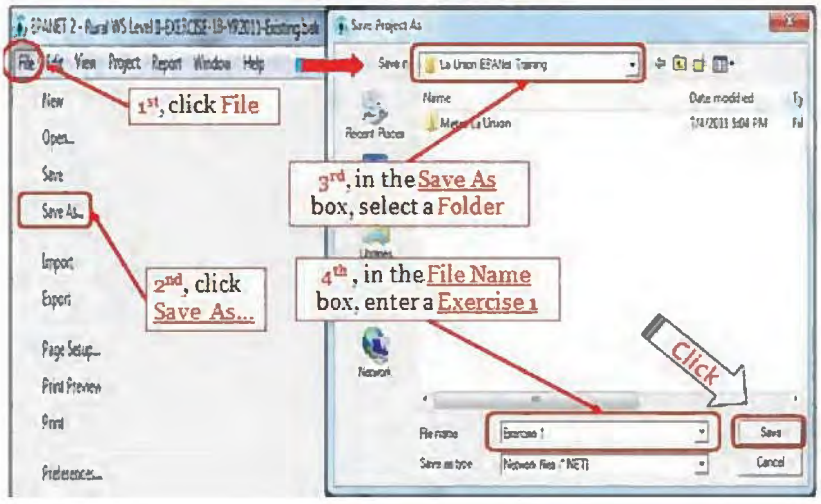
1. Husi menu file nian selesaun atu halot iha opsaun Save As
2. Iha Save As dialogu nian sei mosu, hafoin halo selesaun ida ba Folder ho File name iha nia laran hodi Halot ka Save projetu ne'e, keta haluha mos hanaran file ba ezersiziu 1(lai iha estasaun ida atu of "net") ita halot ba file name hirak ne'e wainhira sira balun la mosu)

1. Buti ba iha save, akumula nia hodi save ba projetu file nian

- Data projetu nian ho kondisaun save iha file ligasaun ho format. Karik ita hakarak save ba iha spesial file tenke akumula ho text, uza file>>Export>> network mak recomenda hodi halo insatala
- Atu loke ita nia projetu iha tempu hanesan ita sempre halo select ba Open husi Menu file ian

d. Saving &Opening Project(Halot no Loke projetu)

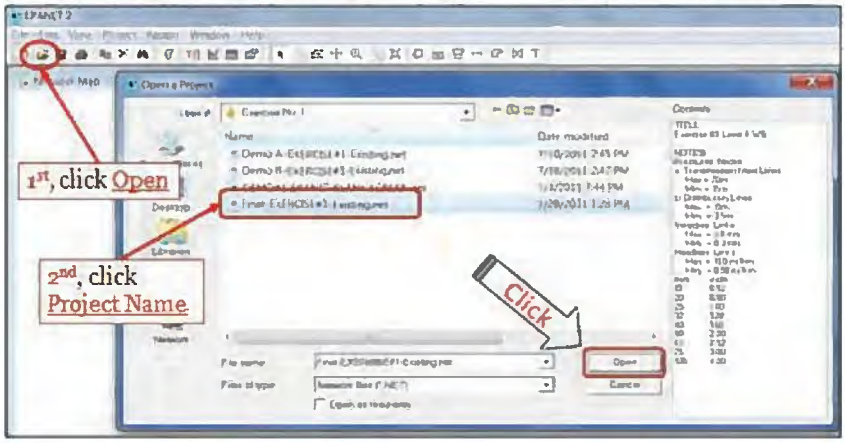
- Saving As a Project



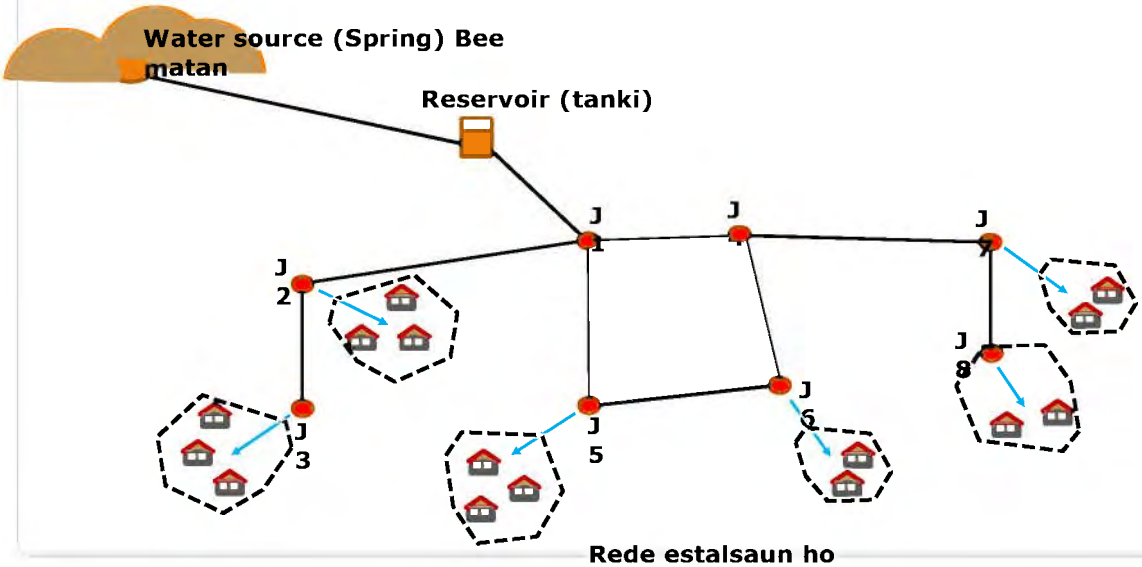
d. Halot (Saving) &Loke Projetu(Opening Project)

- Opening a Project

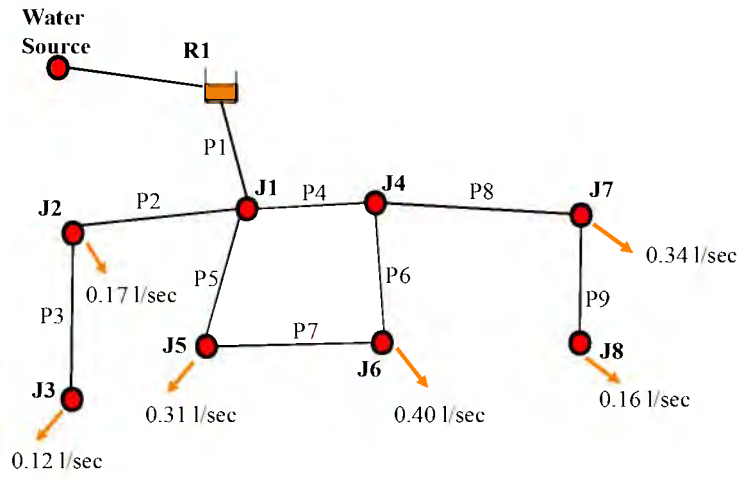
- To open our project at some later time, select the Open command from the File menu (File>>Open), or click the Open button from the map toolbar.



Dizenu ho sistema fornese bee mos



Pratika ho EPANET



No	Diameter (mm)	Length (m)
P1		50
P2		200
P3		250
P4		100
P5		150
P6		130
P7		175
P8		330
P9		150

No	Q (l/sec)	Elevation (m)
R1		30
J1	0.00	22
J2	0.17	20
J3	0.12	16
J4	0.00	20
J5	0.31	18
J6	0.40	15
J7	0.34	18
J8	0.16	14

GOOD LUCK !
BOA SORTE !

Pratika ho EPANET

Sistema analiza ho distribuisaun husi EPANET katak sistema modofikasi ka (diameter pipa no seluk_seluk tan) wainhira hetan difikuldade ka failansu ruma iha rezultadu husi EPANET

Matadalan ba Bee Mos iha area rural Timor Leste (DENSA, MPW/PU): Standarti Disenya GFC

1.Preasaum Max ba statitikas iha rede : <= 100m wainhira hetan kauza husi topografi

2. Preasaun Minimum ba statitika iha rede : 5 - 10m

3. Preasaun max-min statis iha torneira : 5 - 15m

4. Diameter entre intake ho tangki sedimentasaun:> = 50mm

5. Diameter entre tangki: kada kontiudu hidrolik

6. Diameter iha torneire hari /tornera standup : 3/4inch GS

7. Pipa velosidadi ho diameter (min - max)

(1) 20 – 40mm: 0.3 – 2m/sec

(2) 50 – 75mm: 1 – 3m/sec

Pratika-1

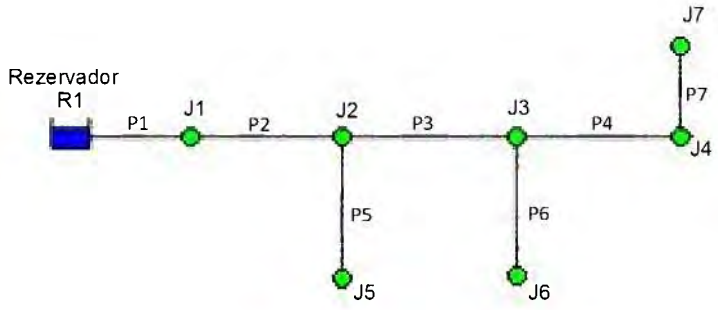


Table 1: Propriodade Rede ho Nodu

Nodu	Elevevasaun (m)	Ezezensia (L/s)
R1	100	0.00
J1	85	0.09
J2	82	0.00
J3	78	0.00
J4	77	0.00
J5	82	0.10
J6	78	0.07
J7	76	0.05

Table 2: Propriodade Rede pipa

Pipe	Length/Naruk (m)	Diametro (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	50	120
P5	40	20	120
P6	25	20	120
P7	50	20	120

Pratika-2

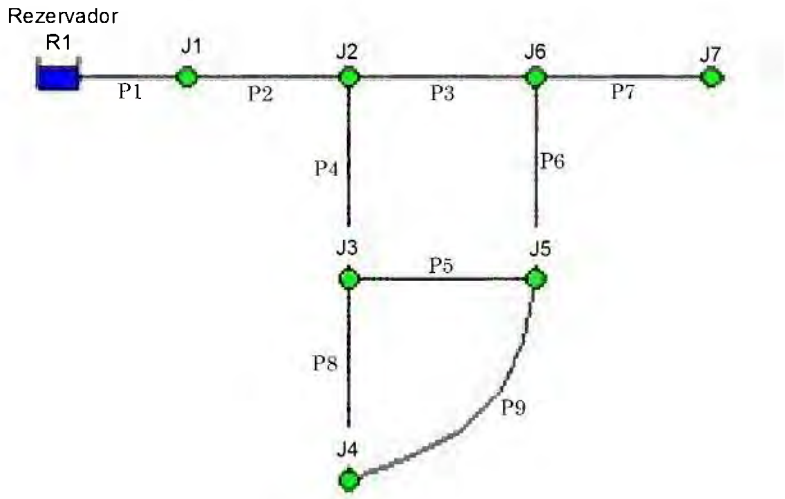


Table 1: Propriodade Rede ho Nodu

Nodu	Elevasaun (m)	Ezezensia(L/s)
R1	100	0.00
J1	86	0.09
J2	77	0.09
J3	68	0.13
J4	58	005
J5	70	0.10
J6	75	0.07
J7	80	0.05

2: Propriodade Rede pipa

Pipa	Length (m)	Diameter (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	40	120
P5	400	40	120
P6	250	40	120
P7	500	40	120
P8	350	40	120
P9	800	40	120

Pratika-3

Pratika ba analiza kazu-2 ho konsedersaun tempu iha kolom kraik.

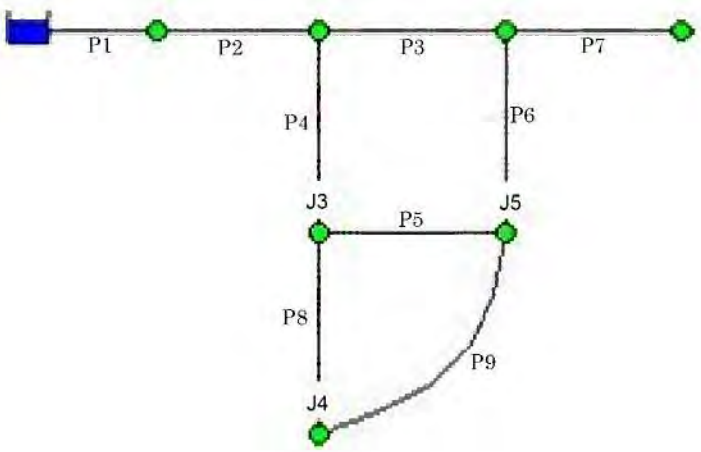


Table 1: Tabela propriodade no rede nodu

Nodu	Elevasaun (m)	Ezezensia (L/s)
R1	100	0.00
J1	86	0.09
J2	77	0.09
J3	68	0.13
J4	58	005
J5	70	0.10
J6	75	0.07
J7	80	0.05

Table 2: Propriodade pipa Nodu

Pipa	Length (m)	Diametru (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	40	120
P5	400	40	120
P6	250	40	120
P7	500	40	120
P8	350	40	120
P9	800	40	120

Tabela 3: Horas Pattern nian/ Pola Waktu

Horas	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Faktori Horas	0.60	0.40	0.30	0.25	0.25	0.30	0.75	1.55	1.80	1.75	1.50	1.20

Horas	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
Factori Horas	1.00	0.90	0.80	0.75	0.80	0.90	1.20	1.50	1.55	1.50	1.35	1.10

2 UZA MANUAL EPANET P. 21- P.23

2.8 Hanaruk periodu hodi Analisis

Atu kriar ita nia rcdi nebe realistis liu no analiza tempu operasaun nian ita tenke kriarhoras hodi hala'o ezezensia ba nodu iha avariasaun nian ho nia periodu duranti loron ida.Iha ezemplu simples nian ne'e ita tenke uza iha horas pattern nian husi oras 6 hodi halo'o ezezensia oras nian nebe troka husi oras 4 nian

duranti nini ezezensia, nomos ba iha loron ida lahanesan. (oras pattern nian ba oras 1 hanesan numeru nebe spesifika liu no hanesan defaul nebe alokasaun ba iha area projetu foun.) Ita atu kria pattern Time husi etapa liu husi selesaun Optins –Time husi Data Browser's ,klik ba iha Browser's, Edit Button hodi halo mosu Property Editor (Karik ne'e sedauk bele mosu ho diak), no hatama valor 6 husi etapa pattern Time nian (hanesan hatudu iha figura 2.8 ninia kraik). Bainhira ita hili Time Option nebe iha ita bele mos kriar ninia durasaun hodi hatutan periodu tempu atu hala'o. Tenke uza loron 3 ba oftime (Kriar sistema 72 horas ba Durasaun propiodade nian).

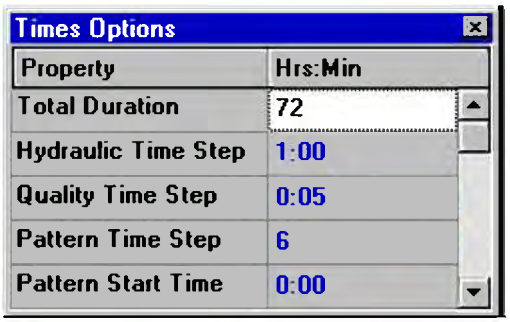


Figura 2.8 Opsaun Tempu/Time Option

Atu kriar pattern halo selesaun ba iha kategori pattern iha Browser's,klik button pattern  n 1 tenke kriar mos pattern dialog hodi mosu(hare figura 2.9). kriar valor multiplier 0.5, 1.3, 1.0, 1.2 ba tempu period 1 to'o 4 nebe bele hetan tempu pattern nian husi oras 24 nia laran. Uza multiplier hodi modifika ezezensia husi baze nivel 1 ba kada tempu period nian.Desde ami hala'o husi horas 72 pattern sei falun hale'u hodi hahu, hafoin kada oras 24 hala'o ninia intervalu.

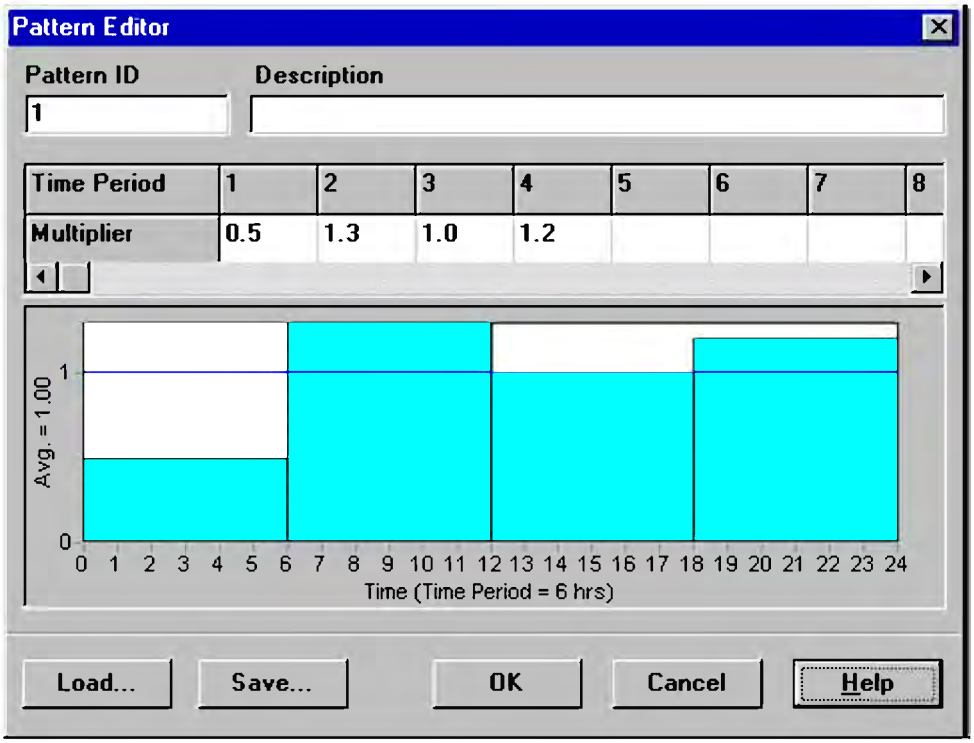


Figura 2.9 Pattern Editor

Ita persiza mos assign pattern 1 ba iha ezezensia propiodade pattern ba iha junction hotu-hotu iha ami nia

rede. Ami bele mos utiliza EPANET Hydrolico ba iha opsaun atu evita hodi hetan junction ida-idak ba individuali nian. Karik ita konvoka Opsaun Hidroliku iha Editor Properti nian, Ita harc katak iha item nebe ita bolu pattern default.kriar valor hanesan pattern 1 hodi hetan ezezensia nian hanesan pattern 1 mos, hancsan ita hatenc labcle iha patern seluk nebc kriar.Ita agora persiza kriar pattern 1 ba iha ezezensia propiadade

Depois ida nc'c hala'o ninia analisis (Hili Project >>Run analysis ka klik bu iha Standar Toolbar). Atu analiza periodu ita iha dalan nebe barak los nebe persiza hodi hare rezultadu:

- Iha scrollbar no Browser's kontrolu horas nian hodi uza atu hatudu redi mapa nian iha pontu no oras nebe lahanesan. Tenta hodi hala'o preasaun ne'e no halo selesaun hanesan parameter nodu no Sasulin hanesan parameter link nian.
- Tombol VCR-modelo hanesan Browser bele hamoris mapa liu husi tempu ka horas. Klik tombol Forward hodi ha' imasi nomos ba tombol Stop hodi hapara.
- Kriar dir n sasulin nian ba iha mapa (Hili View >> Options, hili mos Flows Arrows page husi opsaun mapa dialog, no kontrola mos gaya arrows nian nebe ita persiza). Hafoin hahu ho animasi no observa ba iha mudansa husi dirasaun sasulin nian liu husi ligasaun pipa ba iha tanki hancsan tanki nebe ensc husi tempu ba tempu.
- Kria tempu nebe serio ba iha plot nodu ho link. Ezemplu, atu hare oinsa elevasaun(elevation)bcc iha tanki laran halo mudansa ho tempu:
    1. Klik ba iha tangki.

2. Hili report >>Graph (ou klik tombol Grafiku ba iha Standard Toolbar) hodi bele mosu Ggrafiku ba selesaun kaixa dialog.
3. Hili tombol Time Series ba iha dialog.
4. Hili HeadPilih Kepala sebagai parameter untuk merencanakan.
5. Hili OK atu aceita ita nia grafiku.

Hare didiak hahalok periodi nian iha elevasaun bec ba tangki husi tempu ba tempu (Figura 2.10).

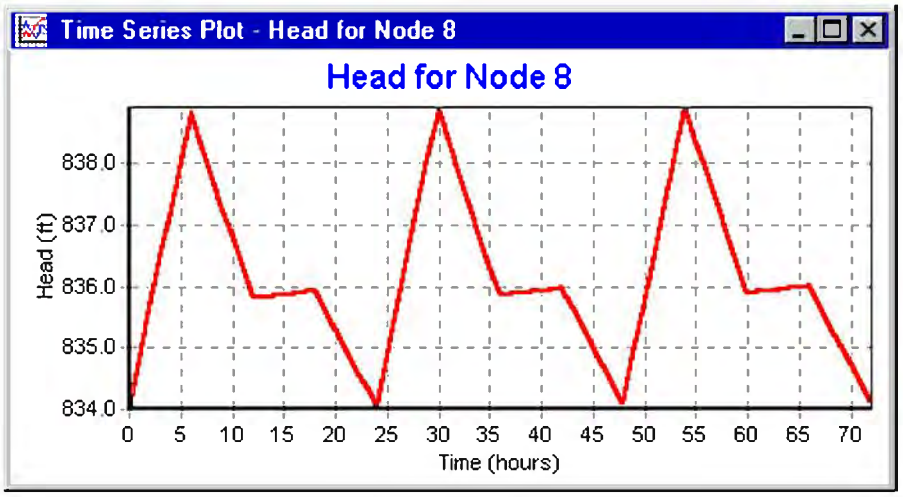


Figura 2.10 Ezemplu Time Series Plot

Pratika-4

Analiza sistema distribuisaun husi Bomba.

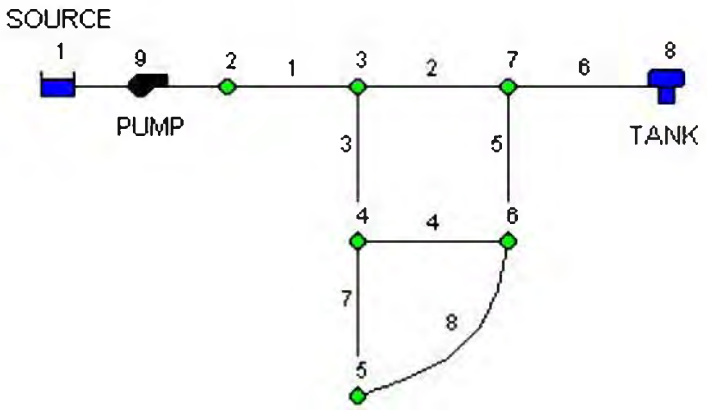


Tabela 1 Propiodade Rede Nodu

Node	Elevation (m)	Demand (L/s)
1	100	0.00
2	100	0.00
3	103	9.46
4	100	9.46
5	85	12.62
6	100	9.46
7	100	0.00
8	140	0.00

Tabela 2: Propiodade Rede Pipa

Pipe	Length (m)	Diameter (mm)	C
1	900	350	100
2	1,500	300	100
3	1,500	200	100
4	1,500	200	100
5	1,500	200	100
6	2,100	250	100
7	1,500	150	100
8	2,200	150	100

Nodu 8: Tengki (Nodu 8) iha 18 m ba diametru, huis nivel nia as 1,5 m, no nivel maksimum 6 m.

Link 9: Bomba (Link 9) bele fornese iha 46 m husi bee ulun iha 38 L/ detik.

Bee ulun = 60.00-0.0097 〔sasulin〕 ^ 2.00

UZA MANUALP EPANET 2.19

2.5 Hatur objetivu propertics

Ba bomba, ita persiza atu tau/monta kurva bomba nian (relasaun ho versu sasulin ulun nian). Hatama ID label 1 iha Kurve Bomba.

Tuir mai ita tenke halo Kurva Bomba 1. Husi data page ba iha Browser window, hili Kurva husi dropdown iha lista box no klik tombol Add . Iha Kurva foun 1 nc'e bele hatama database no Kurva editor dialog nian sei mosu (Hare iha Dizenya 2.6). Hatam dezain sasulin bomba (600) no bee ulun (150) mai iha format ida nee. EPANET otomatikamente kria kompletu mos ba kurva bomba no halo pontu nee sai ida deit. Equasaun (equation) kurva nee mosu hamutuk ho nia modelu. Klik OK atu hodi taka Editor.

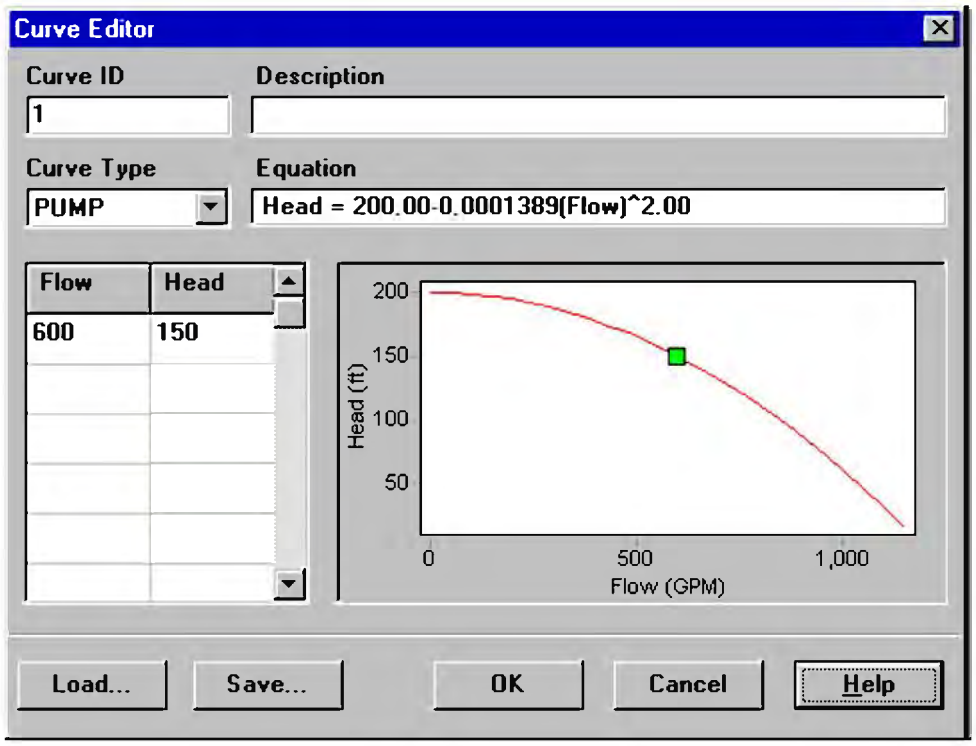


Figura 2.6 Kurva Editor

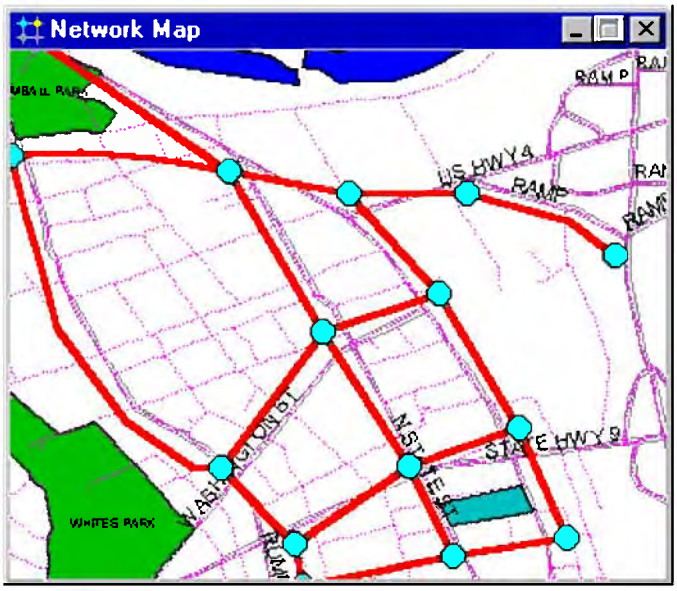
Pratika-5

Dizenya ba redi pipa mapa backdrop.

UZA MANUAL **EPANET 2 P.85 – P.86**

7.3 Utuliza Mapa Backdrop

EPANET bele hamosu mapa backdrop iha redi pipa nia kotuk. Utuliza Mapa Backdrop dalaruma mapa dalan/kompas,mapa utulitas, mapa topografi, dezenvolve planu iha site, ka dizenya seluk ka pinturas katak dalaruma bele vale.Ezemplu,Uza mapa dalan/kompas atu utuliza lori halo



prosesu hodi kriar redi ba iha pipa,hahu husi parti ida mos bele halo dizitasaun ba redi nodu no diretamente husi kedas fatin as.

Utuliza mapa backdrop tenke hasa'e metafile ba windows ka bitmap kria iha EPANET nia lalo'ok . Depois de impor , fiaturas ninian hirak ne'e labele edit, maski, skala nian no extent sei muda hanesan mapa windows nebe leno no nakloke boot. Ba iha razaun ne'e servisu metafile nian diak liu duke bitmap razaun katak sei lalakon resolusaun nwainhira rescaled. Dala barak programa CAD no GIS iha kapasidade atu save dizenya no mapa hanesan metafile.

Selesaun View >> Backdrop husi Menu Bar atu hamosu sub-menu mak tuir mai ne'e :

- Todan (load file ba mapa backdrop ba projetu)
- Unload/hafahe/sobu (hafahe backdrop husi projetu)
- Align/hametin (halo los rede pipa nia backdrop)
- Hamosu /hasubar (mosu toggles backdrop nian no halakon)

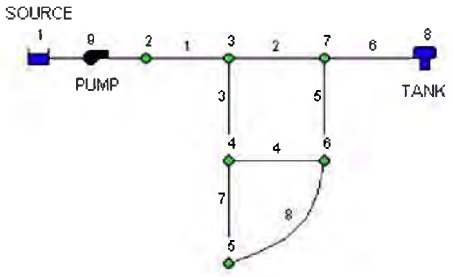
Momentu hahu dala uluk, figura kona ba fatin backdrop atu hatur iha lidun karuk nia leten iha coinciding nia kraik halai hadulas hanesan rede/network husi mapa ree nan. Backdrop bele halo re-pozisaun fila fali husi positioned relasaun ho rede mapa nain no hiliView >> Backdrop >> Align. Linya allowsan nee husi rede pipa nebe muda iha backdrop (Muda kursu mause nian no hanehan tombol karuk) to'o hodi deside ba linya katak linya nee lao tuir backdrop nia fatin. Naran file backdrop no alignment hirak nee sei tau hamutuk ho data projetu nian nebe rai hela/restu iha file projetu nia laran.

Atu hetan rezultadu nebe diak husi backdrop tenke :

- Uza metafile, la'os bitmap.
- Dimensiu ba redi mapa nee haksoi/hakat hanesan kuadradu tuir aspetu rasio nian(rasio nia luan-Ass) hanesan mos backdrop.

Oinsa atu uza EPANET

1. Saida mak EPANET
2. Etapa Analiza ba EPANET
3. Pratik a



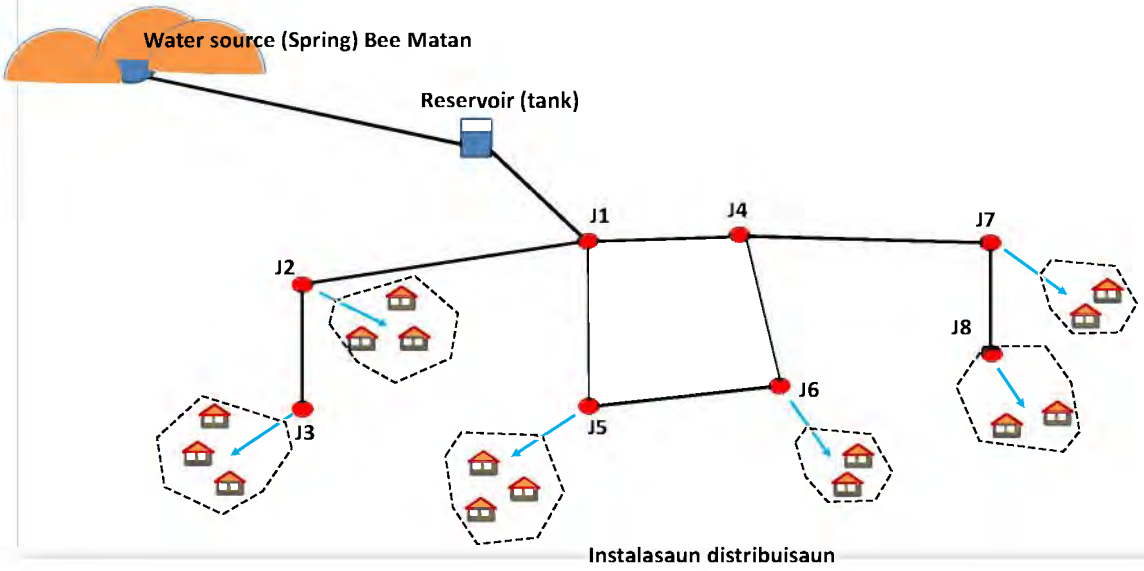
Saida mak EPANET

Prepara husi U.S. Agensia Protesaun Ambiente (EPA)

EPANET: Programa komputer ba simulasaun hosi
(1) Hydroliku
(2) Kualidade Bee ho Preasaun redi pipa nian

Redi Instalasaun: pipa, nodu (pipa sentral), bomba, valvula, tanki rezervador, rezervoirs

Dizenu husi sistema fornese Bee Mos



Etapa analis ba EPANET

Tipu hodi hala'o tuir etapa wainhira :

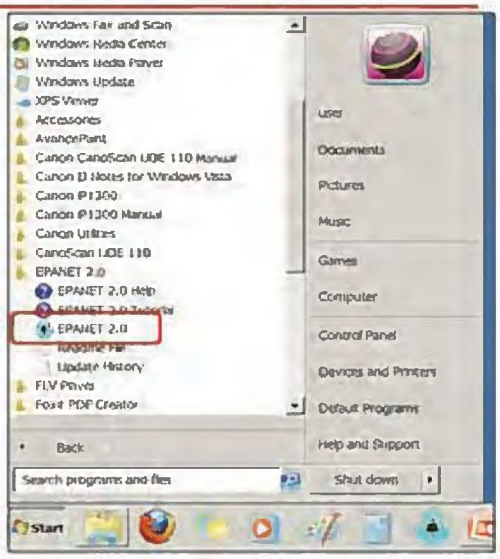
uza EPANET ba iha modelu ho sistema distribuisaun:

1. Loke programa EPANET 2.0
2. Set-up ka hatur ba New project
3. Kria skenario ba projetu
4. Analiza ba Network
5. Hare hikas rezultadu ba Analiza

1. Loke programa EPANET 2.0

- To Run EPANET program, simply select this item off of the Start Menu
- Select EPANET 2.0 from the submenu
- Click to Run:

Epanet2w.exe

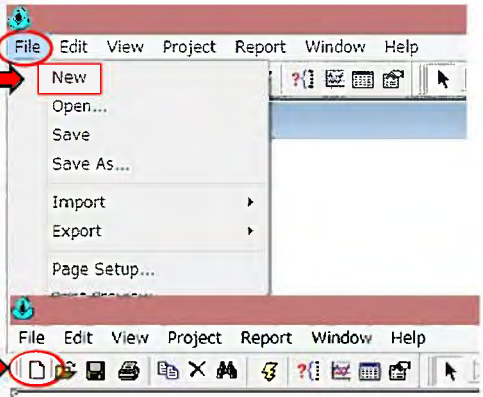


2.Hatur (Set up)Projetu foun

a. Kria projetu foun
b. Hatur (Set) ba iha Projetu Preferences
c. Hatur (Set)ba iha Projetu Difaoults
d. Hatur (Set) ba iha Mapa Opsaun

a. Kria projetu foun

•Husi Main Toolbars
Select :file >> New
•Select New, Laiha naran file, kria ho opsaun hirak ne depois set iha Default values

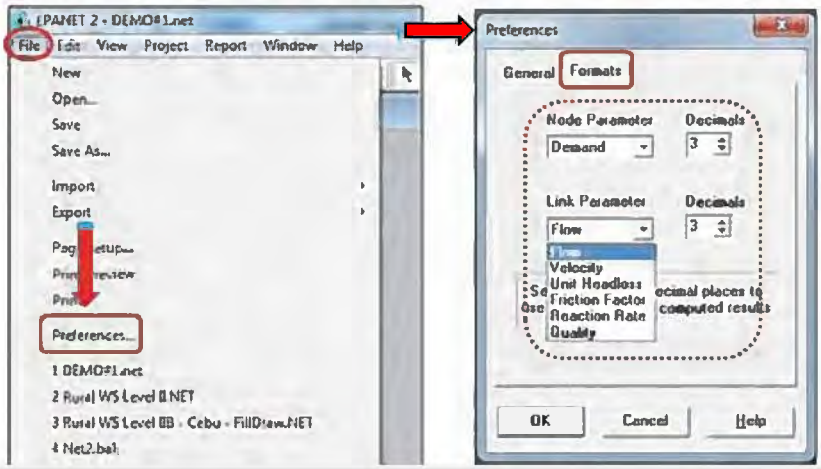


•Ou,klik New Project
Husi Standard Toolbars
▪Propoint mos ba iha Save I exiting project nebe iha , antes atu kria new Project

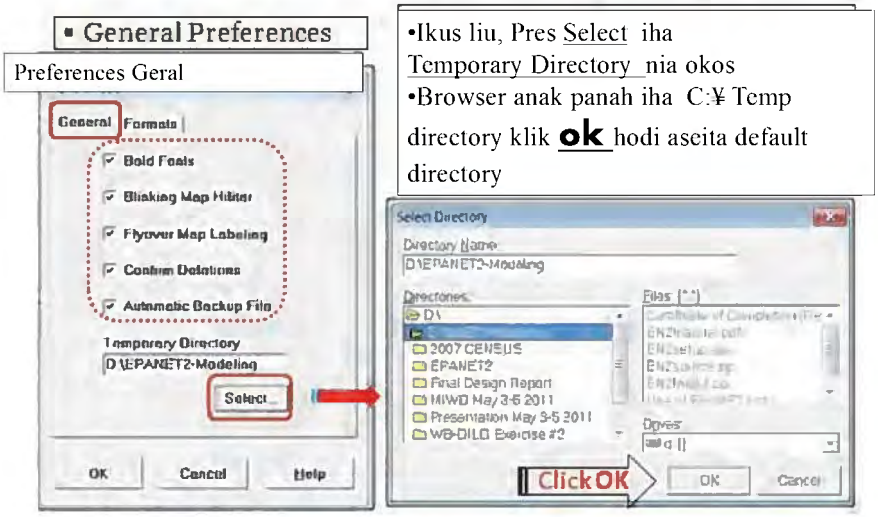
b. Hatur (Set) Project Preferences nian: File>>Preferences

•Husi Main Toolbars
Select :file >> Preferences

• Formats Preferences



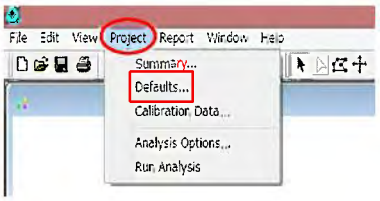
b. Set ba Project Preferences: File>>Preferences



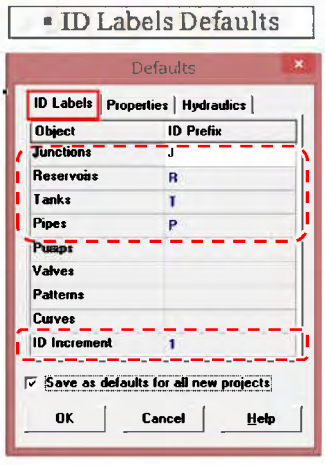
•Ikus liu, Pres Select iha Temporary Directory nia okos
•Browser anak panah iha C:¥ Temp directory klik **ok** hodi aseita default directory

c. Set Project Defaults: Project>>Defaults

•Husi Toolbars Geral
Select :Project>> Defaults



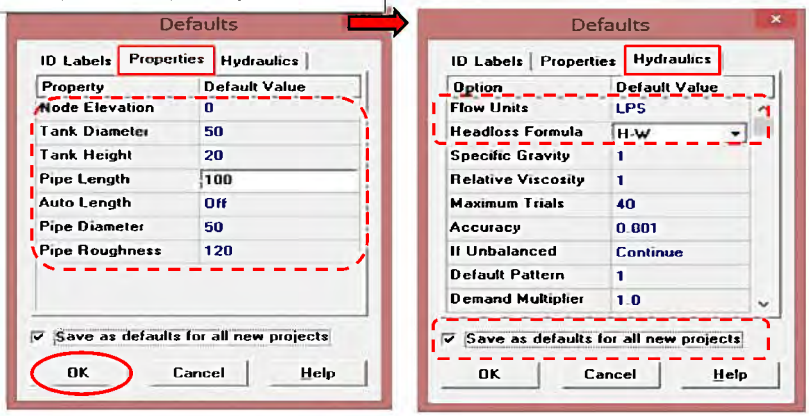
•Husi Main Toolbars
Select :file >> Preferences



c.Hatur (Set) Projetu Defaults: Project>>Defaults

▪Properties Defaults
•Konsedera Auto length ho keadaan Off
•Ba Diameter Pipa =50
•Pipa roughness =120
Select :file >> Preferences

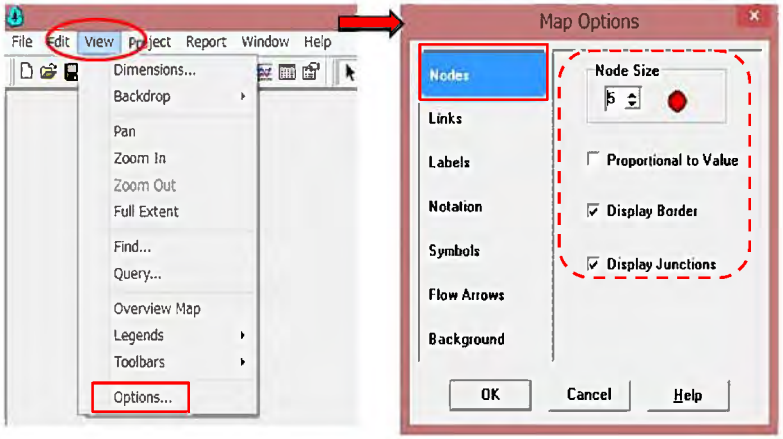
•Hydraulics Defaults
•Select Flow Unit >>LPS
•Select headloss formula >>H-W



c. Hatur (Set) ba Map Options: View>>Options

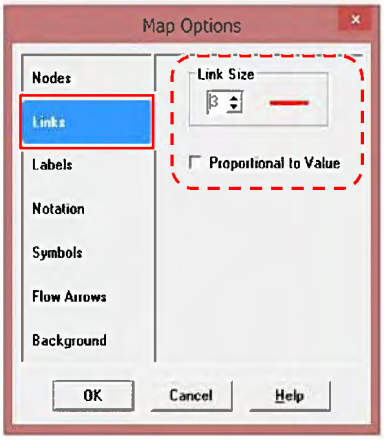
•Husi Main Toolbars
Select :View >> Option

•Opsaun Nodes Map

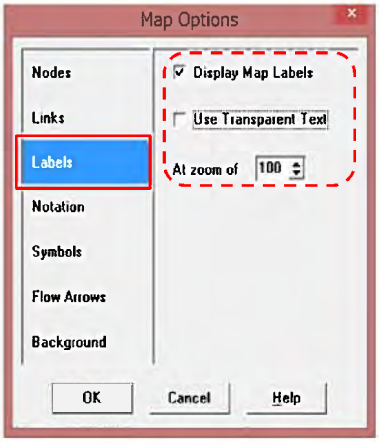


c. Marka ba Map Options: View>>Options

- Links Map Options

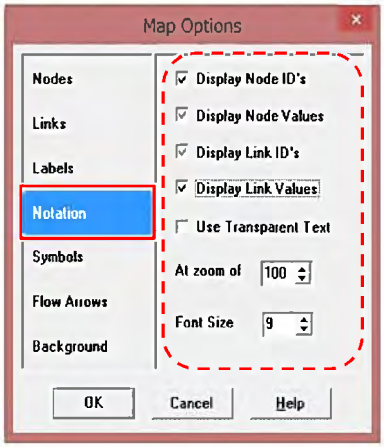


- Labels Map Options

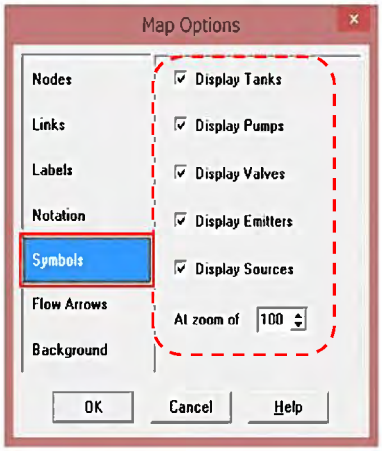


c. Hatur (Set) ba Map Options: View>>Options

- Notation Map Options

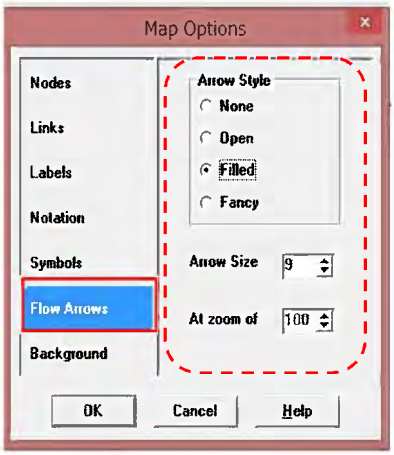


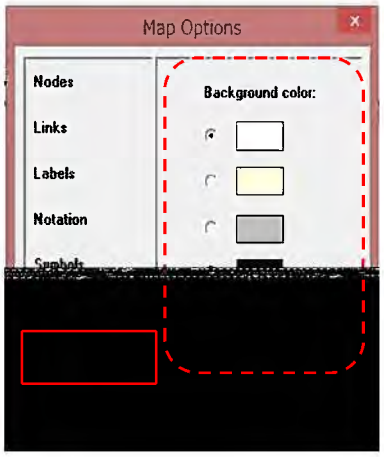
- Symbols Map Options



c. Hatur (Set) Map Options: View>>Options

- Flow Arrows Map Options
- Opsaun ba Antesedente Mapa





3.Kria Skenario ba project

a. Dezenu ba Network
- Nodu (inklui Reservoir,tanki)
- Ligasaun Pipa ba Nodu
- Pumps (Bomba)
- Kontrolu valvula

b spesifiku ba Network
- Nodu (Ezezensia, elevasaun)
- Material pipa hanesan (L,D,C)
- Bomba kurva (H vs. Q)
- Kontrolu valvula

c. Halai ba Simulasan
- Piriodu singular(snapshot) analiza

d.Salva ho loke projetu
- Salva hanesan projetu ida
- Loke ba projetu

a. **Dezenu ba iha Network**

Agora dadaun ita uza network hodi halo dezenu husi butaun (of buttons) nebe iha Map Toobars hare iha kraik

Uza objetivu ba selesaun Button ka (Objeck Select Button)

Karik **Map Toolbars** **la hare hetan** bele mos hanehan (klik) iha select :

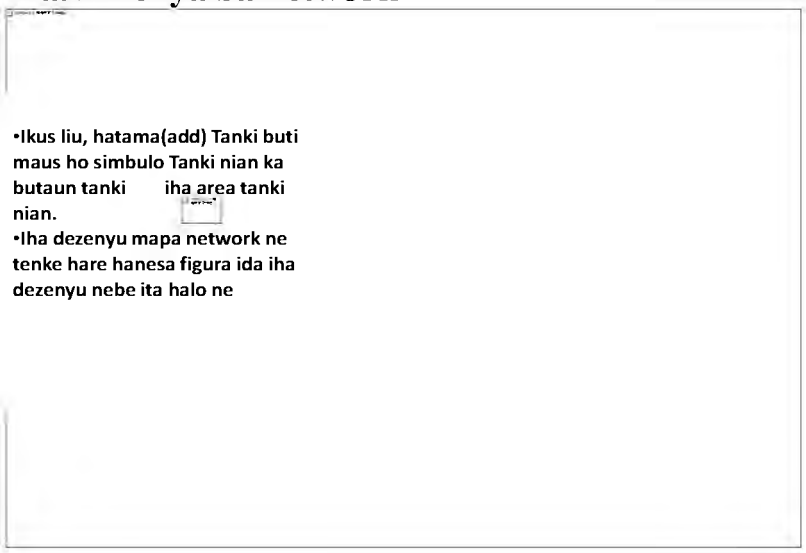
a. Dezenya ba network

- **Dahuluk, ita tenke hatama (add) junction nodu nian.**

Buti ba simbulu junction O hafoin buti mos iha area mapa nodu 1 nian liu husi 7,

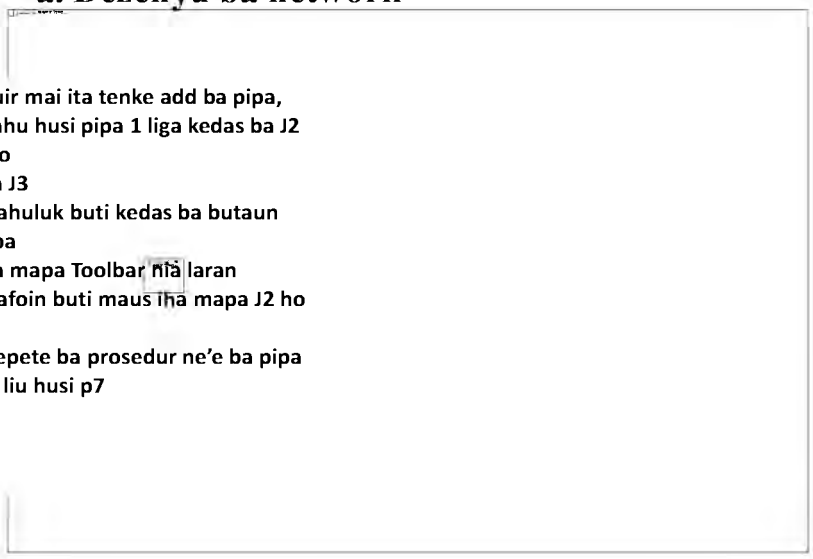
- **Sempre komesa ho projetu nomos lalaok ne tuir kedas junction rua(2) ih Mapa nia laran, ita mos bele hatama ka (add) junction sira seluk ho oras hanesan ka hafoin adisionalnya ikus.**

a. Dizenya ba network



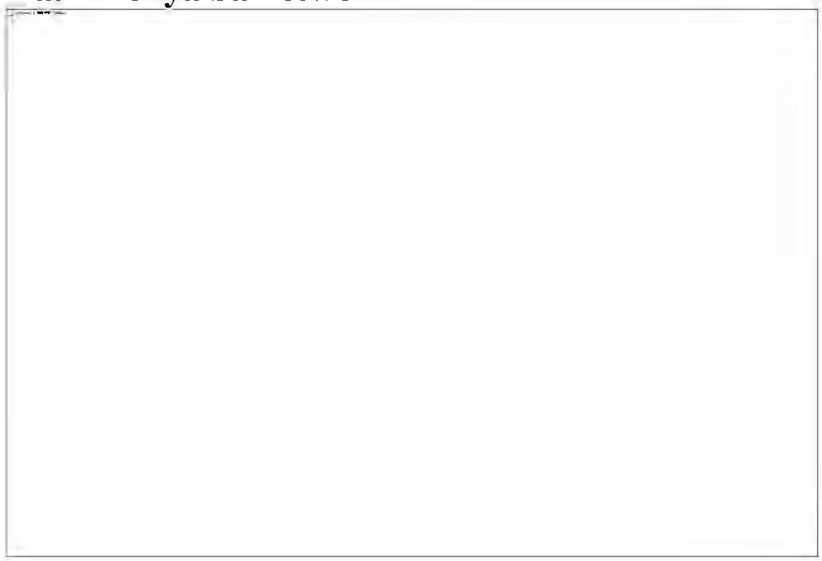
•Ikus liu, hatama(add) Tanki buti maus ho simbulo Tanki nian ka butaun tanki iha area tanki nian.
•Iha dezenyu mapa network ne tenke hare hanesa figura ida iha dezenyu nebe ita halo ne

a. Dezenyu ba network



•Tuir mai ita tenke add ba pipa,
hahu husi pipa 1 liga kedas ba J2
to'o
ba J3
•Dahuluk buti kedas ba butaun pipa
Iha mapa Toolbar nia laran
•Hafoin buti maus iha mapa J2 ho J3
•Repete ba prosedur ne'e ba pipa p2 liu husi p7

a. Dizenya ba network



a. Dizenyu ba network

- Karik Nodu sai husi ninia puzisaun ita bele muda iha nia area I hafoin klik nodu hodi halo selesaun
- halo metan tiha pozisaun hafoin Uza maus karuk hodi muda nia butaun mai krai ba iha pozisaun foun
- Label bele muda nia pozisaun tuir prosedura

b. Spesifiku Network Propiadade

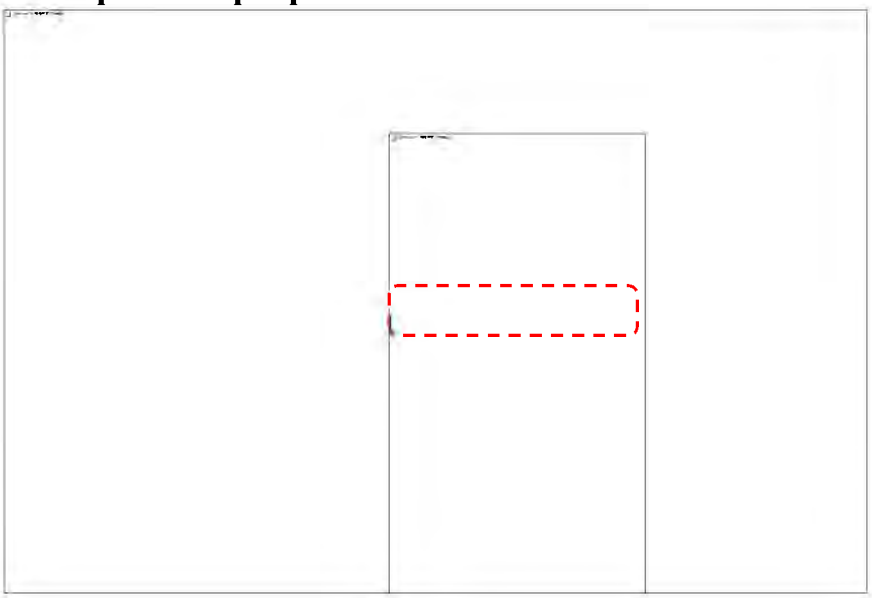
- Halo edit ba iha objetivu hodi hatama(adding) informasaun atu :
  - . Links
  - . Nodu
- Atu hili objetu ida iha Map uza no hili Objetu buttaun nian :
- Buti ba selesaun objetu butaun ka (anak panah) iha Map toolba
- Buti dala rua ba mause liutiha desidi obijetivu iha mapa nia laran
- Atu hili objetu ida tenke uza browser :
- Hili tipu ba objetivu nian husi objetu Listbox kona ba data base browser nian
- Hili no desidi objetu husi Item listbox

b. Spesifiku propidade Network

Halot Propiadade Junction

Pipa ncbe iha ita nia esplikasaun asumi hanesan network : mak tuir mai ne.

b. Spesifiku propiadade Network

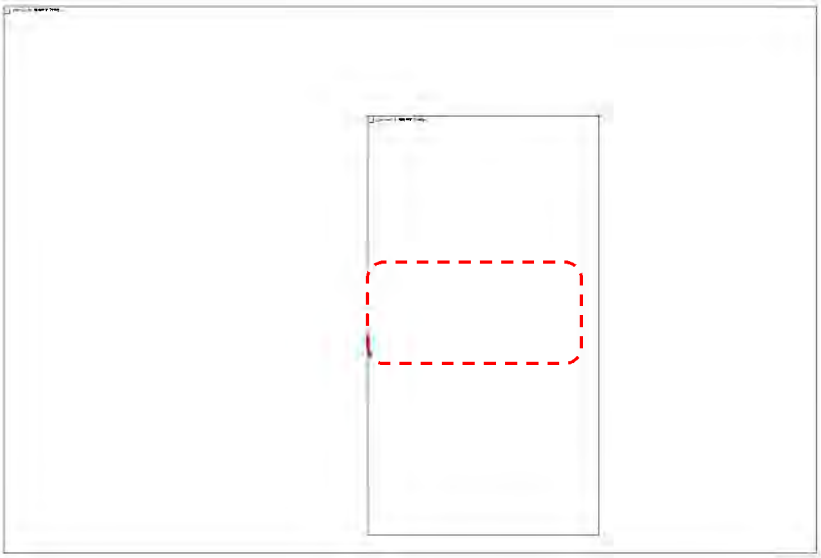


b. Spesifiku propiadade Network

•Halot Propiadae Tanki

Pipa nebe iha ita nia esplikasaun asumi hanesan network : mak tuir mai ne.

b. Spesifiku propiadade Network

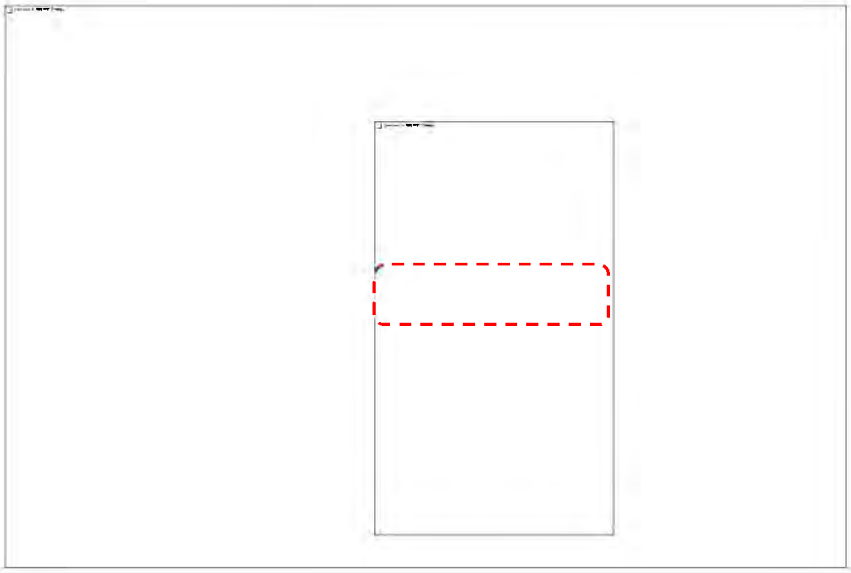


b. Spesifiku propiadade Network

•Halot propiadade pipa

Pipa nebe iha ita nia esplikasaun asumi hanesan network : mak tuir mai ne.

b. Spesifiku propiadade Network



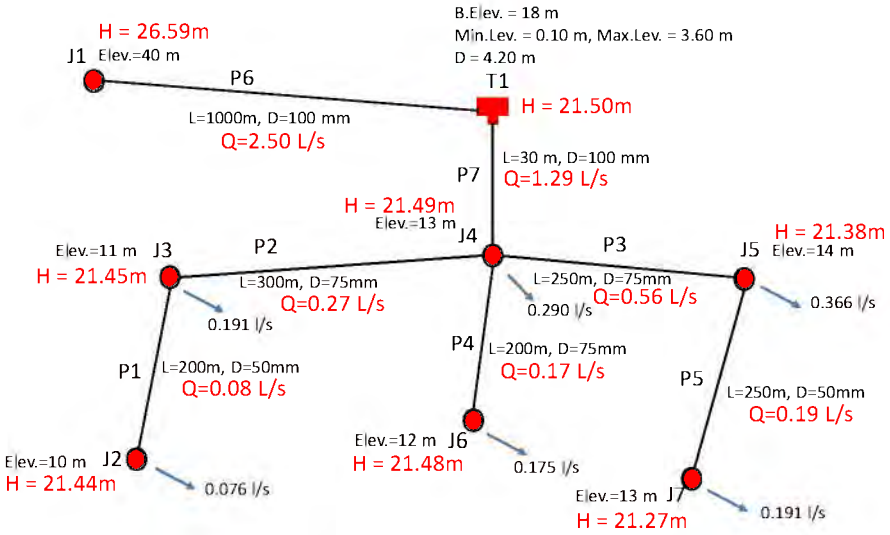
c. Hala'o Simulasaun

Halai ho pontu ida deit ho funsaun diak(steady-state)

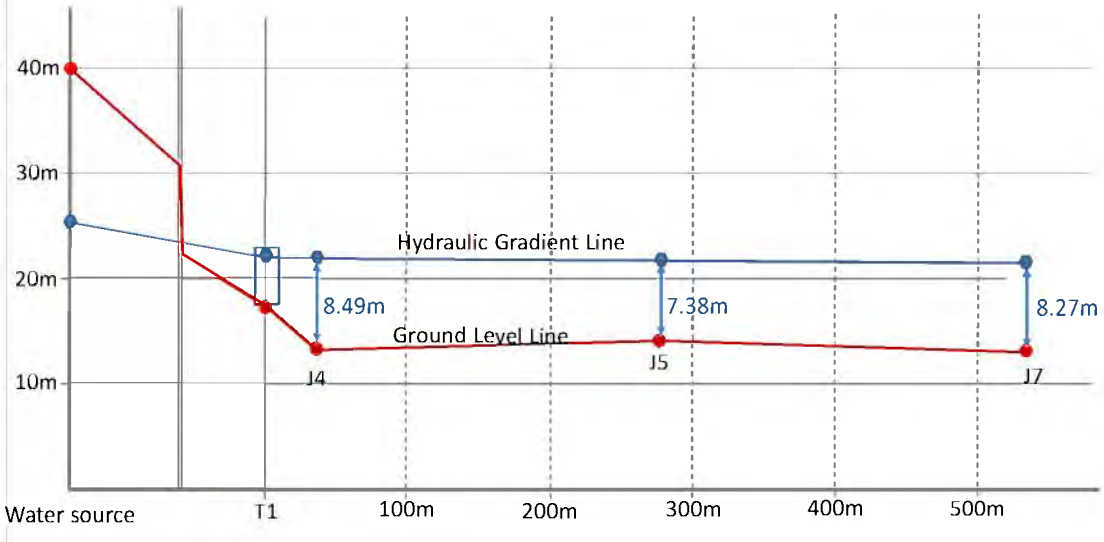
•Ita iha ona informasaun nebe diak atu hala'o single period ka steady-state ba iha analiza hyrdolikua

•Atu hala'o ba analiza nian elect ba Projetu >> hala'o analis ka buti butaun.

Rezultadu ba Kalkulasaun



Profile ba sistema distribuisaun husi bee matan mai pipa /kadorsa



d. Halot & loke (saving &Opening Project)

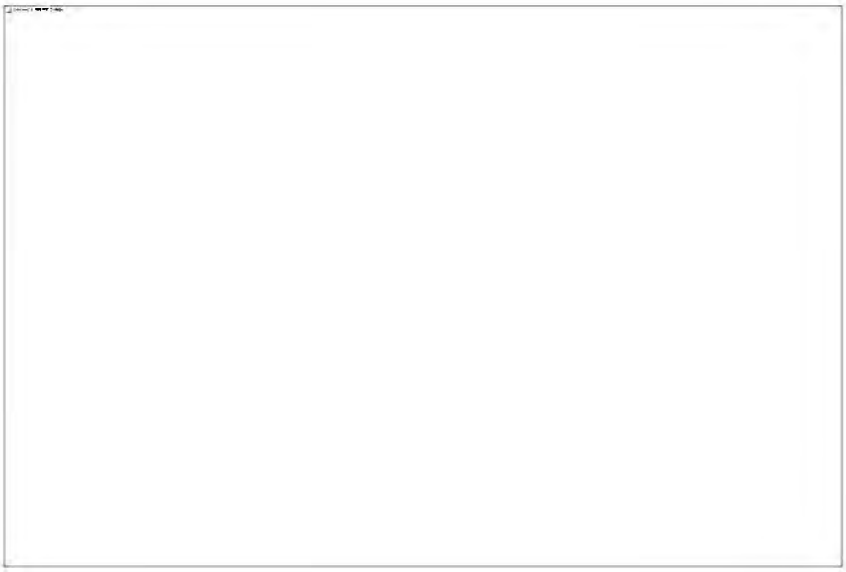
•Kompleta tiha inisial dezenu nian husi network ida ne ideia diak hodi halot ita nia servisu ba iha arkivu(file)

1. Husi menu file nian selesaun atu halot iha opsaun Save As
2. Iha Save As dialogu nian sei mosu, hafoin halo selesaun ida ba Folder ho File name iha nia laran hodi Halot ka Save projetu ne'e, keta haluha mos hanaran file ba ezersiziu 1(lai iha estasaun ida atu of "net") ita halot ba file name hirak ne'e wainhira sira balun la mosu)

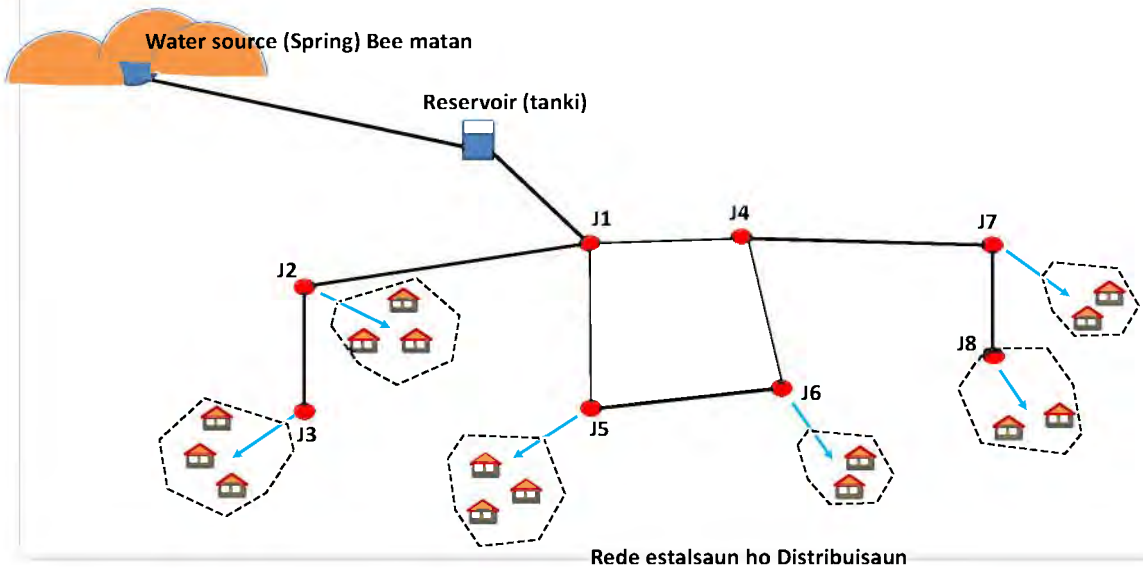
1. Buti ba iha save, akumula nia hodi save ba projetu file nian
- Data projetu nian ho kondisaun save iha file ligasaun ho format. Karik ita hakarak save ba iha spesial file tenke akumula ho text, uza file>>Export>> network mak recomenda hodi halo insatala
- Atu loke ita nia projetu iha tempu hanesan ita sempre halo select ba Open husi Menu file ian

d. Saving &Opening Project(Halot no Loke projetu)

d. Halot (Saving) &Loke Projetu(Opening Project)

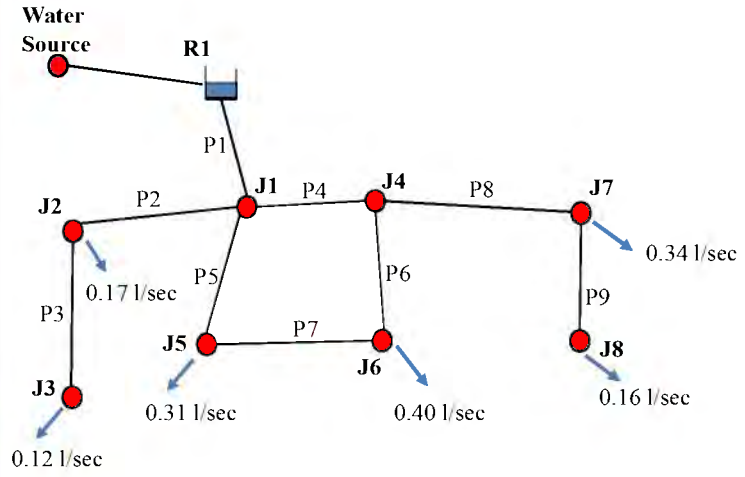


Dizenu ho sistema fornese bee mos



Rede estalsaun ho Distribuisaun

Pratika ho EPANET



No	Diameter (mm)	Length (m)
P1		50
P2		200
P3		250
P4		100
P5		150
P6		130
P7		175
P8		330
P9		150

No	Q (l/sec)	Elevation (m)
R1		30
J1	0.00	22
J2	0.17	20
J3	0.12	16
J4	0.00	20
J5	0.31	18
J6	0.40	15
J7	0.34	18
J8	0.16	14

GOOD LUCK !
BOA SORTE !

Practices of EPANET/ Praktek EPANET

Menganalisis sistem distribusi oleh EPANET bawah memodifikasi sistem (diameter pipa dll) ketika ada sesuatu yang salah dalam hasil EPANET.

Timor Leste Rural Pedoman (Pasokan Air DENSA, MPW/PU): Standar desain GFC

1. Max Tekanan statis dalam jaringan: <= 100m kecuali kendala topografi
2. Tekanan minimum yang statis dalam jaringan: 5 - 10m
3. Tekanan max-min statis di keran: 5 - 15m
4. Diameter antara intake dan tangki sedimentasi:> = 50mm
5. Diameter antara tangki: Per perhitungan hidrolik
6. Diameter di keran berdiri/keran standup : 3/4inch GS
7. Velocity pipa dengan diameter (min - max)
   (1) 20 – 40mm: 0.3 – 2m/sec
   (2) 50 – 75mm: 1 – 3m/sec

Practice-1

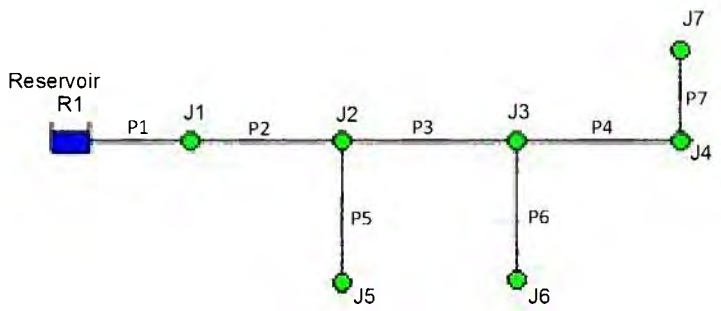


Table 1: Network Node Properties

Node	Elevation (m)	Demand (L/s)
R1	100	0.00
J1	85	0.09
J2	82	0.00
J3	78	0.00
J4	77	0.00
J5	82	0.10
J6	78	0.07
J7	76	0.05

Table 2: Network Pipe Properties

Pipe	Length (m)	Diameter (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	50	120
P5	40	20	120
P6	25	20	120
P7	50	20	120

Practice-2

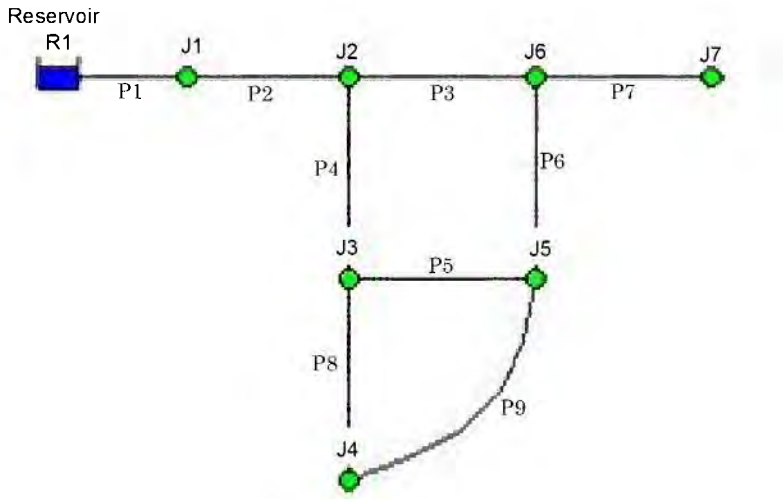


Table 1: Network Node PropertiesTable 2: Network Pipe Properties

Node	Elevation (m)	Demand (L/s)
R1	100	0.00
J1	86	0.09
J2	77	0.09
J3	68	0.13
J4	58	005
J5	70	0.10
J6	75	0.07
J7	80	0.05

Pipe	Length (m)	Diameter (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	40	120
P5	400	40	120
P6	250	40	120
P7	500	40	120
P8	350	40	120
P9	800	40	120

Practice-3

Menganalisis kasus Praktek-2 dengan pola waktu bawah menjadi pertimbangan.

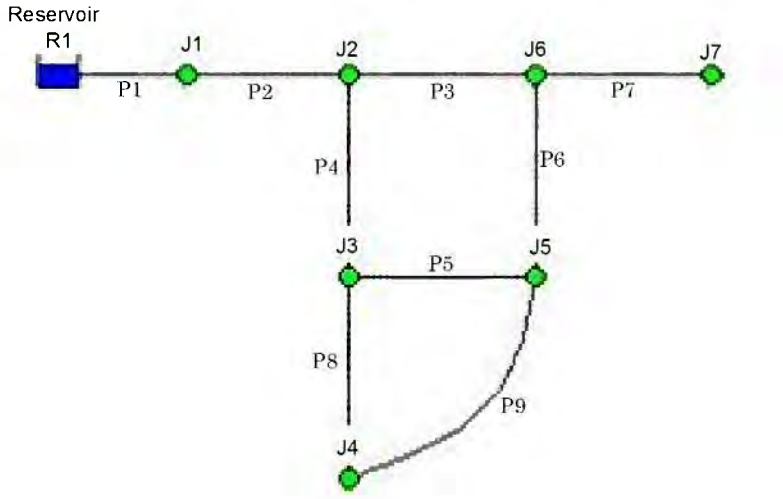


Table 1: Network Node PropertiesTable 2: Network Pipe Properties

Node	Elevation (m)	Demand (L/s)
R1	100	0.00
J1	86	0.09
J2	77	0.09
J3	68	0.13
J4	58	005
J5	70	0.10
J6	75	0.07
J7	80	0.05

Pipe	Length (m)	Diameter (mm)	C
P1	450	50	120
P2	350	50	120
P3	400	50	120
P4	250	40	120
P5	400	40	120
P6	250	40	120
P7	500	40	120
P8	350	40	120
P9	800	40	120

Table 3:Time Pattern/ Pola Waktu

Time	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Time Factor	0.60	0.40	0.30	0.25	0.25	0.30	0.75	1.55	1.80	1.75	1.50	1.20

Time	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
Time Factor	1.00	0.90	0.80	0.75	0.80	0.90	1.20	1.50	1.55	1.50	1.35	1.10

EPANET 2 USERS MANUALP.21-P.23

2.8 Periode Diperpanjang Menjalankan Analisis

Untuk membuat jaringan kita lebih realistis dan menganalisis jangka operasi kita akan menciptakan Pola Waktu yang membuat tuntutan pada node bervariasi dengan cara periodik selama sehari. Sebagai contoh sederhana ini kita akan menggunakan pola langkah waktu dari 6 jam sehingga membuat tuntutan perubahan di empat waktu yang berbeda dalam sehari. (Pola 1 jam langkah waktu adalah nomor yang lebih khas dan merupakan default ditugaskan untuk proyek-proyek baru.) Kami mengatur waktu langkah pola dengan memilih Options-Times dari Browser Data, mengklik Browser tombol Edit untuk membuat Property Editor muncul (jika tidak sudah terlihat), dan memasukkan 6 untuk nilai Pola Waktu Langkah (seperti yang ditunjukkan pada Gambar 2.8 di bawah). Sementara kita memiliki Pilihan Waktu yang tersedia kami juga dapat mengatur durasi yang kami ingin jangka untuk menjalankan. Mari kita gunakan oftime waktu 3 hari (masukkan 72 jam untuk properti Durasi).

Gambar 2.8 Kali Pilihan

Untuk membuat pola, pilih kategori Pola Browser dan kemudian klik tombol Add Pola baru 1 akan dibuat dan Pola Editor dialog akan muncul (lihat Gambar 2.9). Masukkan nilai multiplier 0.5, 1.3, 1.0, 1.2 untuk periode waktu 1 sampai 4 yang akan memberikan pola kita durasi 24 jam. Pengganda digunakan untuk memodifikasi permintaan dari tingkat dasar dalam setiap periode waktu. Karena kita membuat lari dari 72 jam, pola akan membungkus ke awal setelah setiap interval 24 jam waktu.

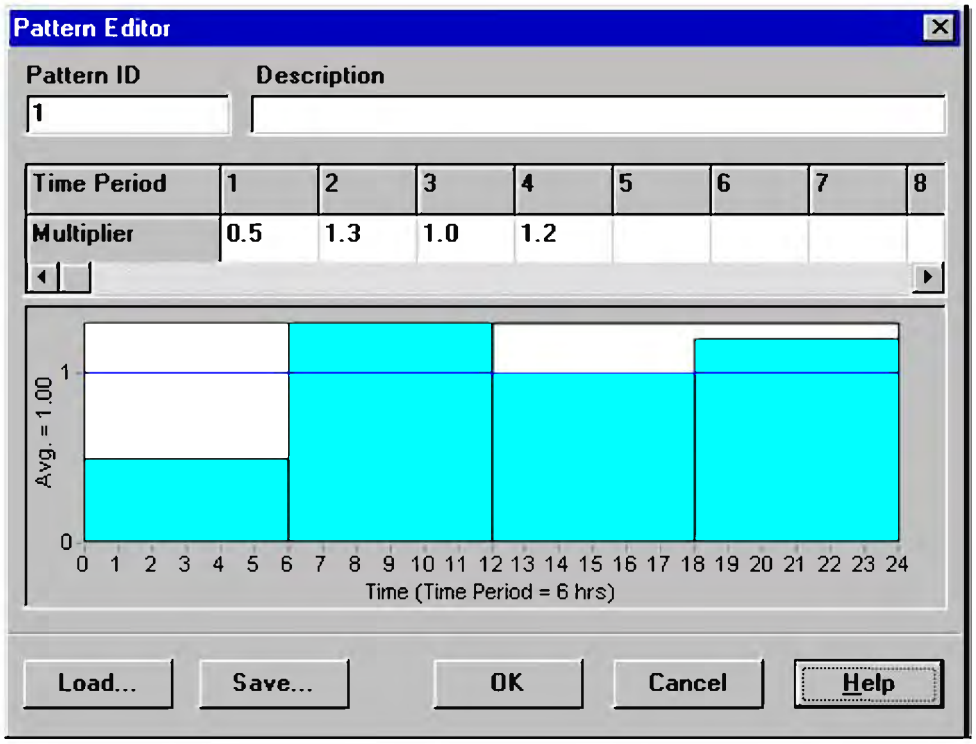


Figure 2.9 Pattern Editor

Kita sekarang perlu untuk menetapkan Pola 1 Pola properti Permintaan semua persimpangan di jaringan kami. Kita bisa memanfaatkan salah satu EPANET yang Hydraulic Pilihan untuk menghindari harus mengedit setiap persimpangan secara individual. Jika Anda membuka Options Hidrolik di Editor Properti Anda akan melihat bahwa ada item yang disebut Pola default. Mengatur nilainya sama dengan 1 akan membuat Pola Permintaan di setiap persimpangan yang sama Pola 1, asalkan tidak ada pola lain ditugaskan untuk persimpangan.

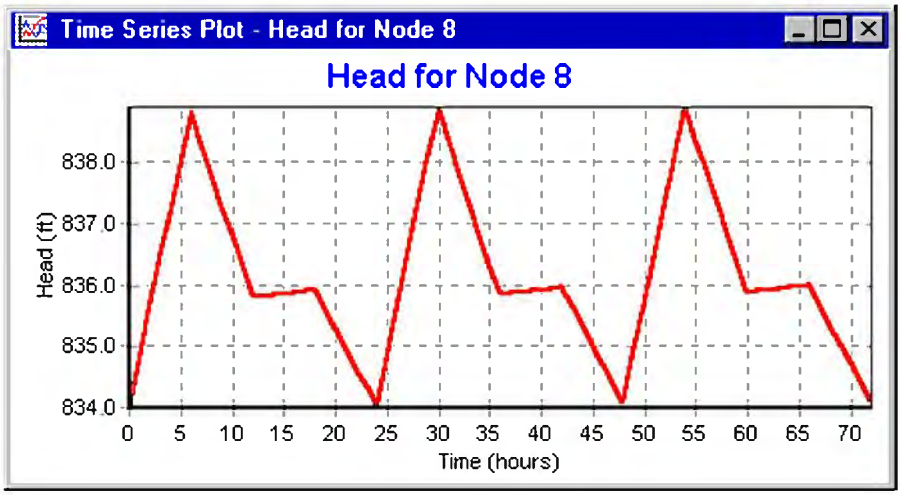
Kita sekarang perlu untuk menetapkan Pola 1 ke properti Pola Permintaan

Selanjutnya jalankan analisis (pilih Project >> Analisis Run atau klik tombol pada Standar Toolbar). Untuk analisis jangka Anda memiliki beberapa cara yang lebih di mana untuk melihat hasil:

- The scrollbar in the Browser's Time controls is used to display the network map at different points in time. Try doing this with Pressure selected as the node parameter and Flow as the link parameter.

- Tombol VCR-gaya dalam Browser dapat menghidupkan peta melalui waktu. Klik Forward button untuk memulai animasi dan tombol Stop untuk menghentikannya
- Tambah arah aliran panah ke peta (pilih View >> Options, pilih halaman Arrows Arus dari Peta dialog Opsi, dan memeriksa gaya panah yang ingin Anda gunakan). Kemudian mulai animasi lagi dan perhatikan perubahan arah aliran melalui pipa terhubung ke tangki sebagai tangki mengisi dan bermuara dari waktu ke waktu.
- Buat serangkaian petak waktu untuk setiap node atau link. Misalnya, untuk melihat bagaimana elevasi air dalam perubahan tangki dengan waktu:
  1. Klik pada tangki.

2. Pilih Laporan >> Graph (atau klik tombol Grafik pada Standard Toolbar) yang akan menampilkan kotak dialog Seleksi Grafik.
3. Pilih tombol Time Series pada dialog.
4. Pilih Kepala sebagai parameter untuk merencanakan.
5. Klik OK untuk menerima pilihan Anda grafik.



Perhatikan perilaku periodik dari elevasi air dalam tangki dari waktu ke waktu (Gambar 2.10).

Gambar 2.10 Contoh Time Series Plot

Practice-4

Analyze the system distributed by a pump.

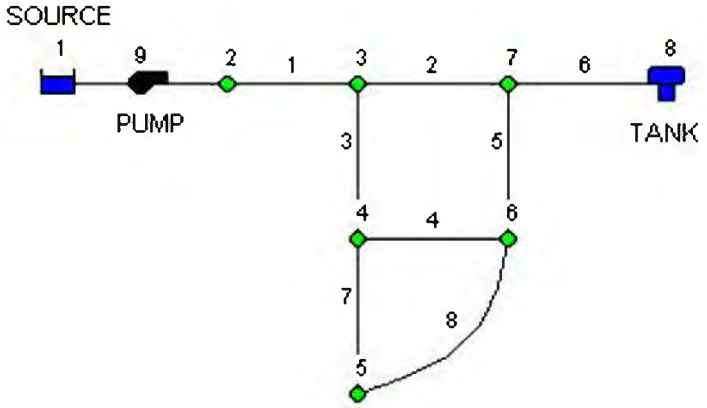


Table 1: Network Node PropertiesTable 2: Network Pipe Properties

Node	Elevation (m)	Demand (L/s)
1	100	0.00
2	100	0.00
3	103	9.46
4	100	9.46
5	85	12.62
6	100	9.46
7	100	0.00
8	140	0.00

Pipe	Length (m)	Diameter (mm)	C
1	900	350	100
2	1,500	300	100
3	1,500	200	100
4	1,500	200	100
5	1,500	200	100
6	2,100	250	100
7	1,500	150	100
8	2,200	150	100

Node 8: Tangki (Node 8) memiliki diameter 18 m, tingkat air 1,5 m, dan tingkat maksimum 6 m.

Link 9: Pompa (Link 9) dapat memberikan 46 m kepala di aliran 38 L / detik.

Kepala = 60,00-0,0097 [] Arus ^ 2.00

EPANET 2 USERS MANUALP.19

2.5 Kedudukan object properti

Untuk pompa, kita perlu menetapkan kurva pompa (kepala vs hubungan arus). Masukkan label ID 1 di bidang Curve Pompa.

Selanjutnya kita akan membuat Curve Pompa 1. Dari halaman data dari jendela Browser, pilih Curves dari kotak daftar dropdown dan kemudian klik tombol Add. Sebuah Curve baru 1 akan ditambahkan ke database dan bentuk dialog Editor Curve akan muncul (lihat Gambar 2.6). Masukkan desain aliran pompa (600) dan kepala (150) ke dalam bentuk ini. EPANET secara otomatis membuat kurva pompa lengkap dari titik tunggal ini. Persamaan kurva ini yang ditampilkan bersama dengan bentuknya. Klik OK untuk menutup Editor.

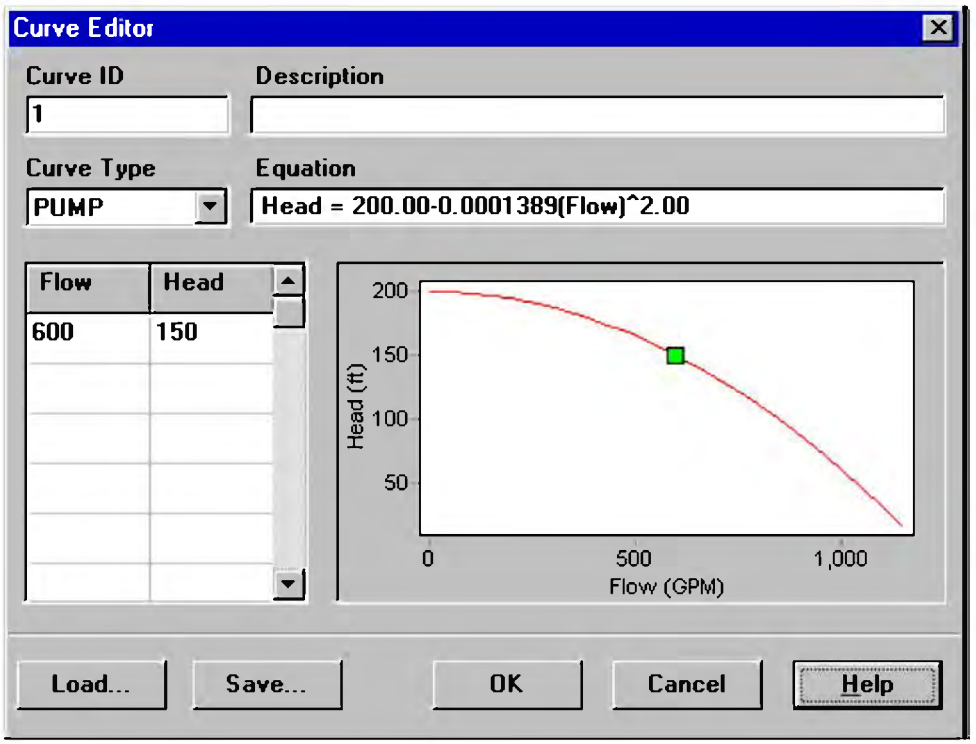


Figure 2.6 Curve Editor

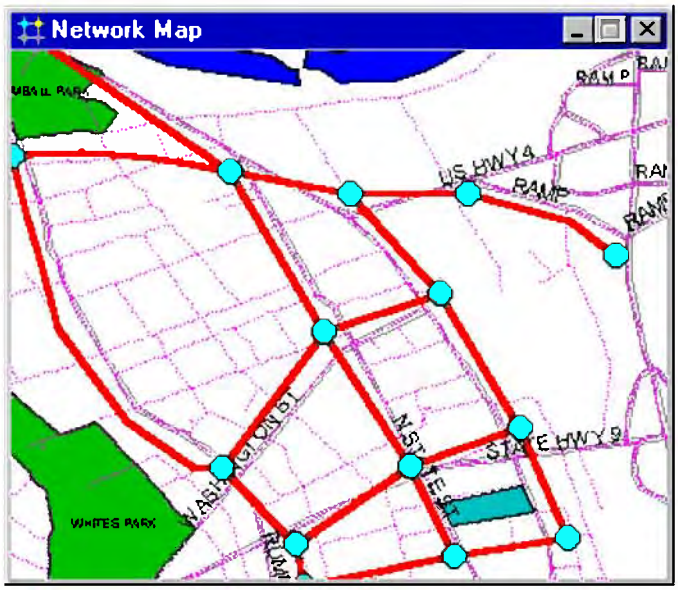
Practice-5

Menggambar jaringan pipa pada peta latar belakang.

EPANET 2 USERS MANUALP.85 – P.86

7.3 Memanfaatkan Backdrop Peta

PANET dapat menampilkan latar belakang peta di belakang peta jaringan pipa. Latar belakang peta mungkin peta jalan, utilitas peta, peta topografi, rencana pengembangan situs, atau gambar lain atau gambar yang mungkin bisa bermanfaat. Misalnya, menggunakan peta jalan akan



menyederhanakan proses penambahan pipa ke jaringan karena salah satu dasarnya bisa mendigitalkan node jaringan dan link langsung di atasnya.

Latar belakang peta harus ditingkatkan metafile Windows atau bitmap dibuat di luar EPANET. Setelah diimpor, fitur-fiturnya tidak dapat diedit, meskipun skala dan luasnya akan berubah sebagai jendela peta diperbesar dan menyorot. Untuk alasan ini metafile bekerja lebih baik daripada bitmap karena mereka tidak akan kehilangan resolusi saat rescaled. Kebanyakan program CAD dan GIS memiliki kemampuan untuk menyimpan gambar dan peta mereka sebagai metafile.

Memilih View >> Backdrop dari Menu Bar akan menampilkan sub-menu dengan perintah berikut:

- Beban (load file peta latar belakang ke dalam proyek)
- Membongkar (membongkar peta latar belakang dari proyek)
- Sejajarkan (meluruskan jaringan pipa dengan latar belakang)
- Tampilkan / Sembunyikan (toggles tampilan latar belakang dan mematikan)

Ketika pertama kali dimuat, gambar latar belakang ditempatkan dengan yang pojok kiri atas coincidingwith bahwa berlari persegi panjang jaringan. Latar belakang dapat kembali positionedrelative ke peta jaringan dengan memilih View >> Backdrop >> Align. Ini

garis allowsan dari jaringan pipa yang akan dipindahkan di latar belakang (dengan menggerakkan themouse dengan tombol kiri ditekan) sampai salah satu memutuskan bahwa itu berbaris latar belakang benar withthe. Nama file latar belakang dan keselarasan saat ini yang menyimpan bersama dengan sisa data proyek setiap kali proyek disimpan ke file.
Untuk hasil terbaik dalam menggunakan peta latar belakang:

- Gunakan metafile, bukan bitmap.
- Dimensi peta jaringan sehingga persegi panjang yang berlari memiliki rasio aspek thesame (rasio lebar-tinggi) sebagai latar belakang.

添付資料 26 現地調査報告書(給水)(英語版)

Inspection Summary of MDG Suco Projects

Prepared by JICA Engineer

May 2013

1. Site Visit Schedule

JICA Water Supply Engineer accompanied by ADN Engineer has visited MDG Suco poject sites in the period from 7 May to 10 May 2013. Table below outlines schedules of the site visit by the engineers.

Table - Site Visit Schedule

Date	Move		Activities
	From	To	
7 May (Tue)	Dili	Lospalos	Visit Mehara project site
	Lospalos	Baucau	Stay at Baucau ADN office
8 May (Wed)	Baucau	Viqueque	Visit Wesoru project site
			Stay at Viqueque ADN office
9 May (Thu)	Viqueque	Manatuto	Visit Natarbora project sites
	Manatuto	Viqueque	Visit SP4 project site
	Viqueque	Baucau	Stay at Baucau ADN office
10 May (Fri)	ADN office	F-FDTL	Visit F-FDTL office, meeting with Commando,
			visiting project site and Aubaka spring.
	Baucau	Dili	Return to Dili

2. Project Location

MDG Suco projects, in general, are located in rural area of each district, far from its district center. The majority of residents to be settled in the planned houses are mainly farmers. They currently live in traditional sago-leaves roofed huts. Number of houses to be constructed ranges from 50 units to 300 units in one Suco Project, depending on needs of the people.

Fig – Project Site in Districts; Baucau, Lautem, Viqueque and Manatuto

3. Progress and Findings

Project progress as of May 2013 and major findings by ADN & JICA Engineers are summarized in a table below.

Table – Project Progress and Engineer Observation

District	Sub-district	Suco/Aldeia	Number of Houses	Progress				Probelms Observed	Action/Suggestion Made
				Houses	Drainage	Road	Sanitation		
Baucau	Baucau	F-FDTL	200	Completed	Not yet	Not yet	Not yet	1. There exists **leakage** on the existing raw water main, causing water shortage at FDTL. 2. Suco leader rejects additional supply to MDG Suco area through a branch from the main.	1. Leak repair is required. 2. Dialogue with the society is necessary to solve water right issue.
Lautem	Tutuala	Mehara	150	Completed	Under construction	Under construction	Not yet	1. Sands utilized for concrete contain a lot of silts and clays, evaluated not appropriate. 2. It requires borehole construction to supply water to the area.	1. Immediate replacement ordered by Engineer. 2. Engineer ordered Contractor to propose borehole sites, design and schedule.
Manatuto	Natarbora	Uma Boco-Fehuk Krin	126	Completed	Completed	Completed	Not yet	1. Boreholes are not in operation because of a lack of fund. 2. Water supply to the project site is not determined.	1&2. DNSA shall provide budget to operate the borehole to supply water to the public, including MDG Suco area. Coordination between DNSA and the Society is required.
		Aubeon-Buburlaran	87	Completed	Completed (Repair)	Completed (Repair)	Not yet	1. Stagnant water are observed in drainage channels. 2. Existing borehole is not functioning because of lack of pump and its accessories.	1. Immediate amendment of base concrete ordered by Engineer. 2. As the existing borehole is a possible water source to the project site, Engineer ordered the Contractor to propose newly installation of pumps and tanks with necessary pipeworks and public taps.
Viqueque	Luca	SP4	52	Completed	Completed	Completed	Not yet	1. Well construction is under way.	1. Works shall be continued.
	Watulari	Wesoru	364	Under construction	Under preparation	Under preparation	Not yet	1. Project site suffers from frequent flood. 2. Subsurface of the area consists of mostly soft clay. 3. It requires borehole construction to supply water to the area.	1. Drainage channel provision shall be started first before initiation of house construction to improve work performance. 2. Carefull attention shall be paid to site clearance and refill. 3. Engineer ordered Contractor to propose newly construction of boreholes.
Total			979						

Note: Engineer means ADN engineer responsible for MDG Suco projects in Baucau, Lautem, Viqueque and Manatuto.

4. Photographs (7 May – 10 May, 2013)

[Mehara] -1. Roads & Channels under Construction

[Mehara] – 2. Drainage Channels under Construction

[Mehara] – 3. Sands Sampled by Engineer (Replacement directed by Engineer)

[Mehara] – 4. Proposed Site for Boring

[Wesoru] – 1. Construction newly Started in April

[Wesoru] – 2. Foundation with Reinforcement

[Wesoru] – 3. Backhoe for Earthwork

[Wesoru] – 4. Existing Well near the Project Site
(9m depth in operation)

[Aubeon-Buburlaran] – 1. Stagnant Rain Water in Drainage Channel
(Immediate repair ordered by ADN Engineer)

[Aubeon-Buburlaran] – 2. Existing Handpump Well (Made in Japan)

[Aubeon-Buburlaran] – 3. Exiting Borehole without Pump set
(Considered as possible source)

[Aubeon-Buburlaran] – 4. Earthworks not completed
(Backfill observed insufficient)

[Uma Boco-Fehuk Krin] – 1. Completed 126 House Units (while water has not been provided yet)

[Uma Boco-Fehuk Krin] – 2. Borehole Constructed by USAID in 2010 (62m in depth, not in operation because of a lack of gov. budget for operation)

[Uma Boco-Fehuk Krin] – 3. Ground Storage Reservoir No.1 to the Town(20m3 x 2 basins)

[Uma Boco-Fehuk Krin] – 4. Storage Reservoir No.2 located on a hill (50m3 x 2 basins), high enough to supply water to the project site by gravity

[SP4] – 1. Overview of Project Site

[SP4] – 2. Dug Well under Construction

[SP4] – 3. Excavated Silt and Sand of the Dug Well Bottom Layer

[Natarbora] - Meeting with Suco Leader on Possible MDG Suco Project

[F-FDTL] – 1. Leaks from the Bottom of the Reservoir newly Constructed

[F-FDTL] – 2. 200 Houses Completed

[F-FDTL] – 3. Aubaka Spring Located inside Forest, (Suco leader reluctant to visit the spring)

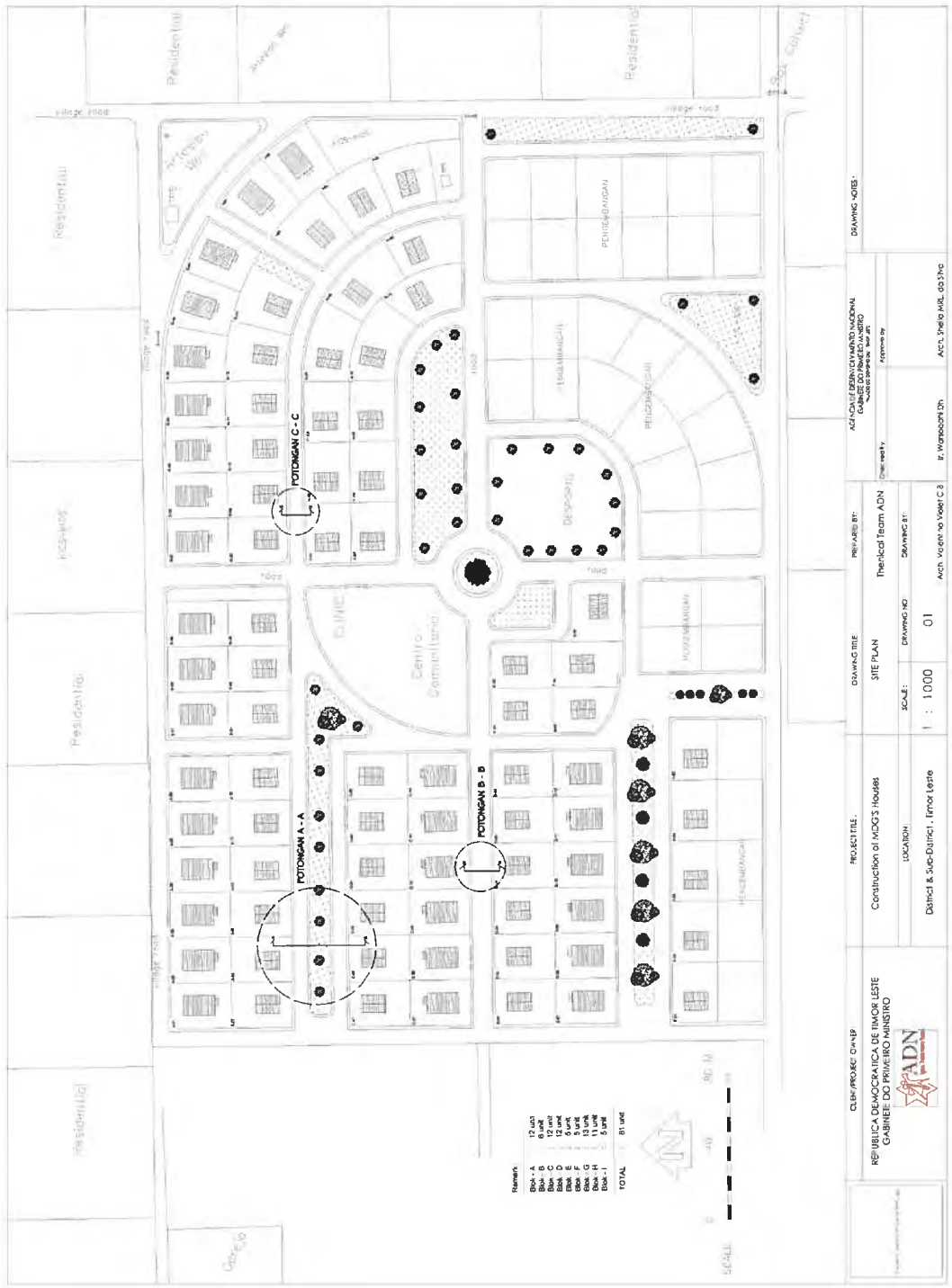
[F-FDTL] – 4. Existing Raw Water Transmission to F-FDTL (4km x 3" in diameter, GSP)

Attachment
(Drawings)

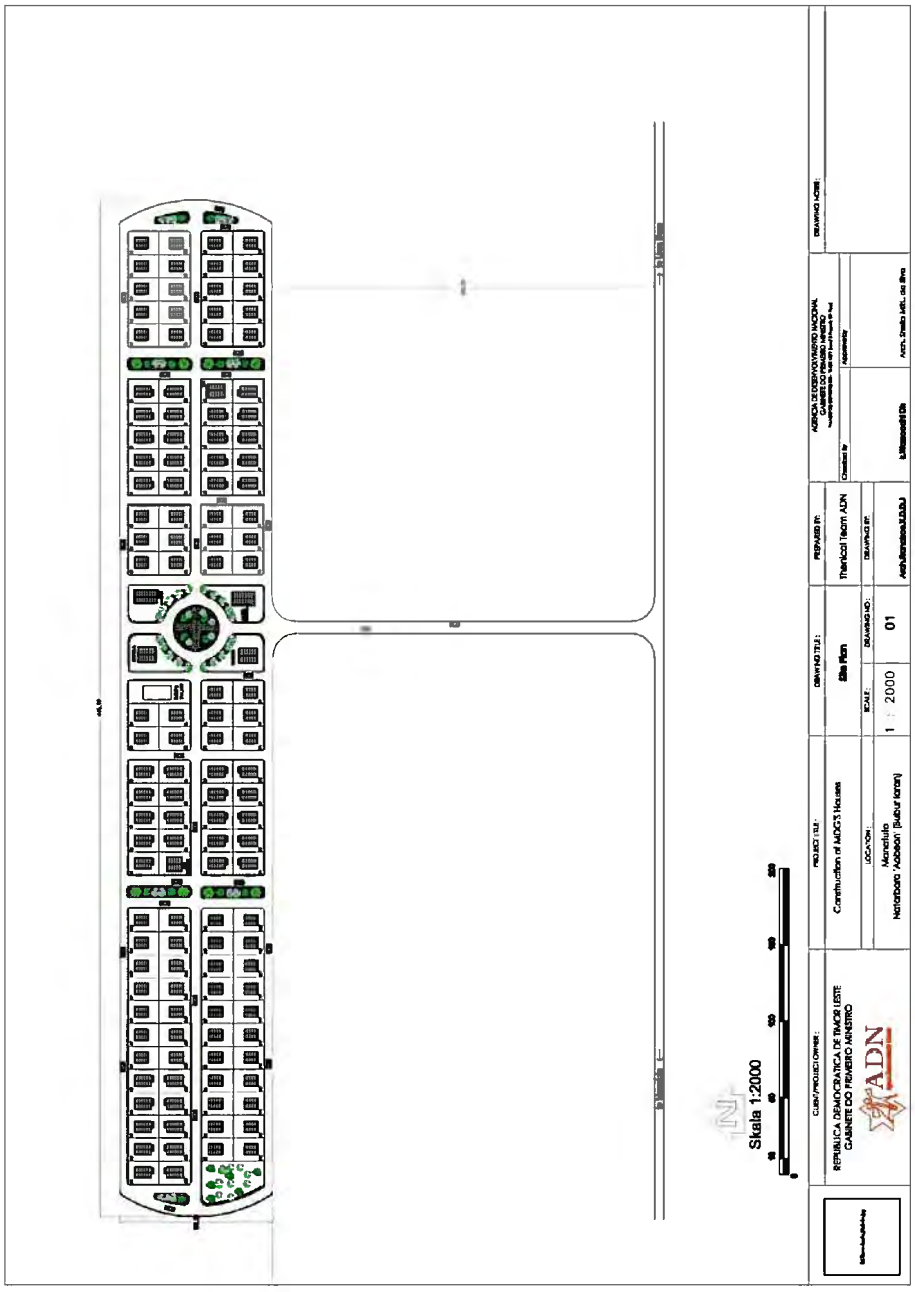
1. Mehara, Lautem district

2. Wesoru, Viqueque district

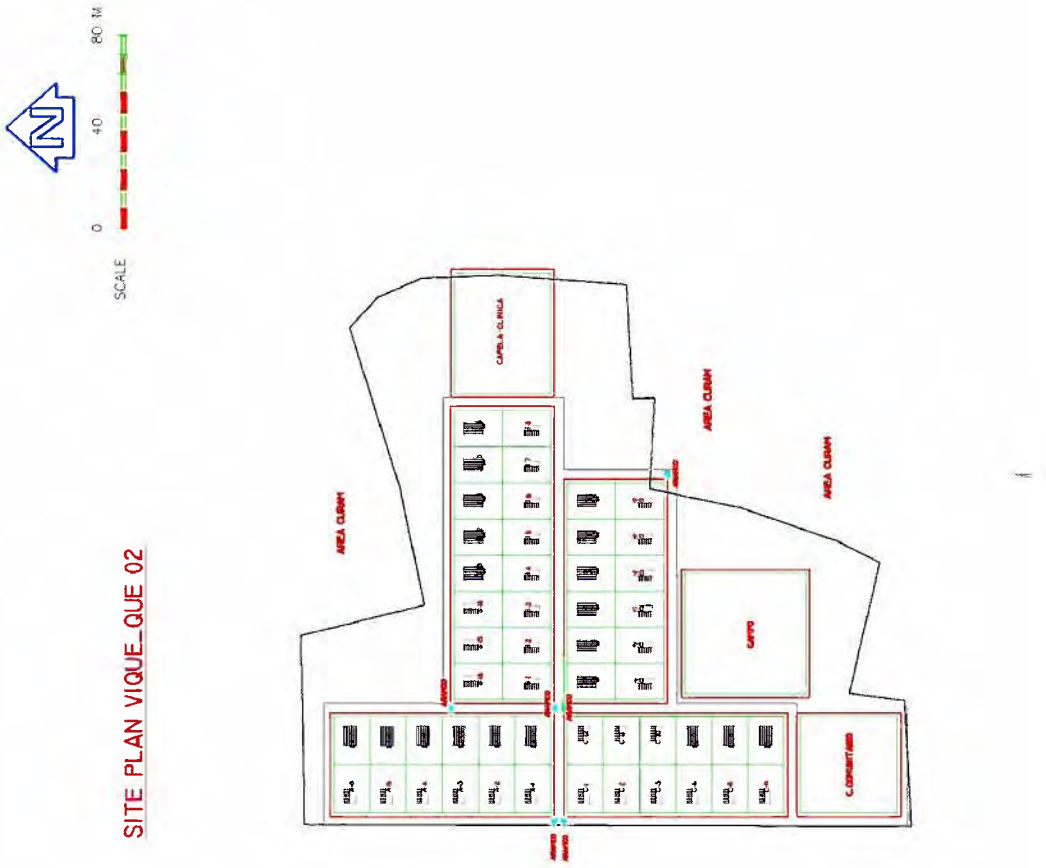
3. Aubeon-Buburlaran, Manatuto district



4. Uma Boco-Fehuk Krin, Manatuto district

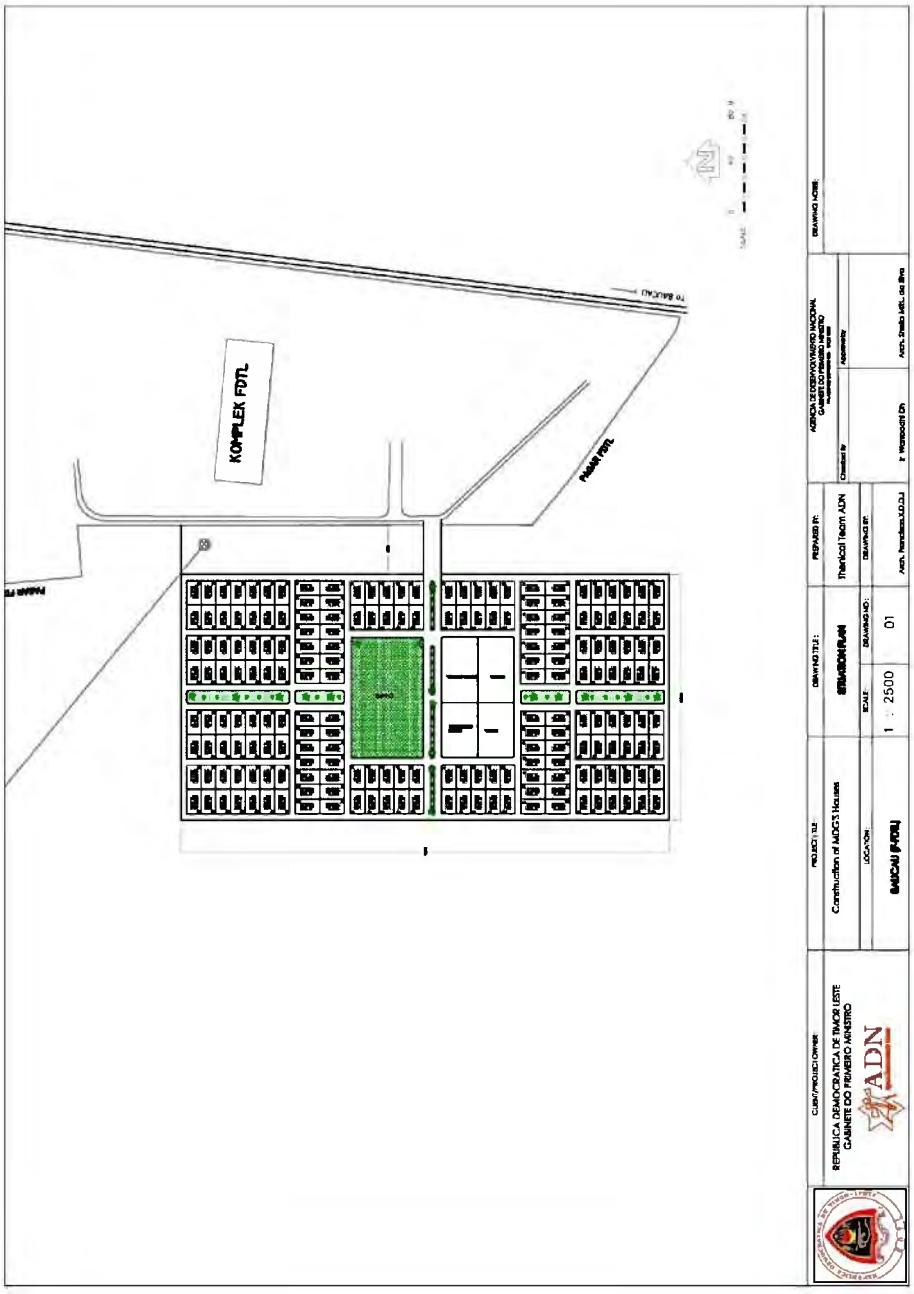


5. SP4, Viqueque district

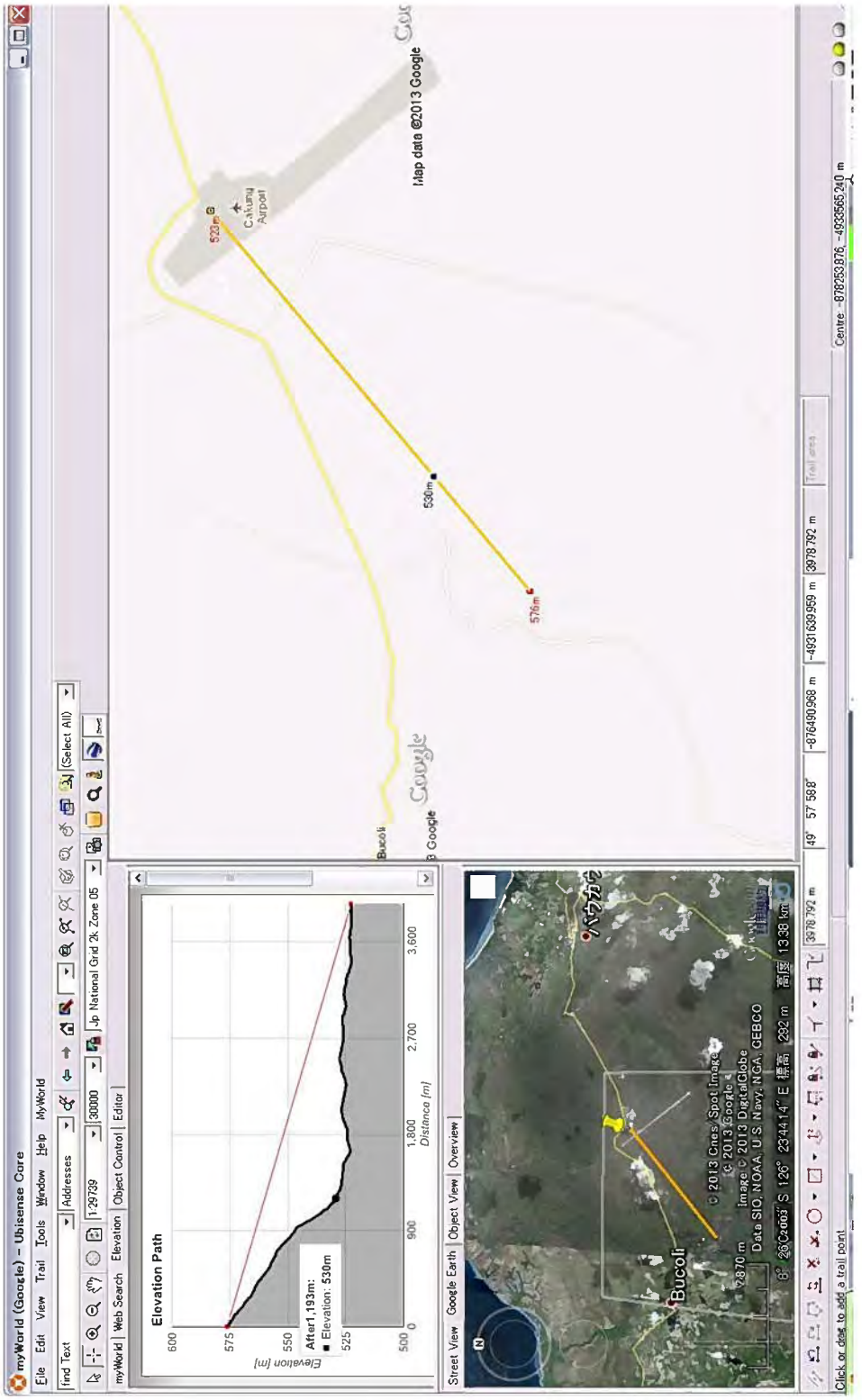


6. F-FDTL, Baucau district

1) Plan



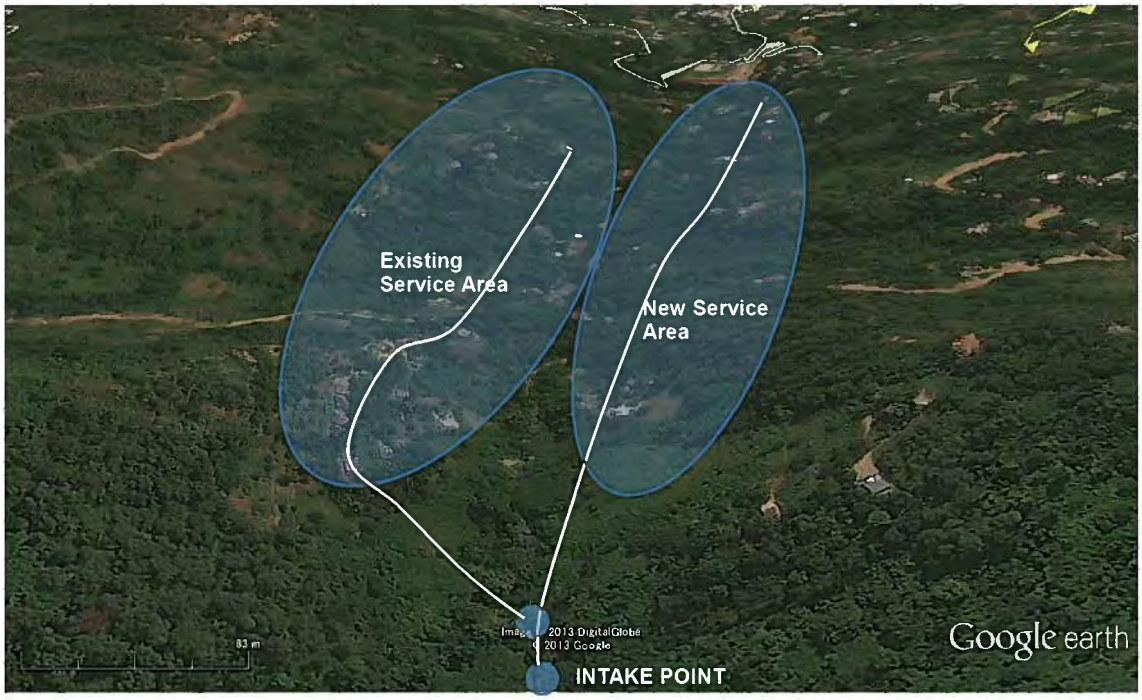
2) Profile of Raw Water Main



Site Inspection Report on Lahane, Dili District

By Higuchi Hideo, JICA-ADN

Inspection Date: 31 July, 2013, 9:00 – 14:00
Location: Suco Lahane Oriental, Dili District
Project name: Rehabilitation of Water Supply System in Suco Lahane Oriental
Inspector: Paul Abrantes, Lisandro Manuel
JICA-ADN: Higuchi Hideo



1. Inspection Root

The inspection was done from a distribution tank at downstream to the intake along the transmission pipeline.

2. List of facilities

- Intake facilities
- Distribution tanks (3 tanks)
- Transmission pipelines (4 lines)
- Distribution pipe
- Public taps (4 taps)

3. Results of inspection

a. General issues

The Inspector is responsible for determining that the work being done and the materials being used meet the requirements of the Drawings and Specifications. The authority of the Inspector is explained as followings:

- The Inspector has the authority to reject defective material or work that is being done improperly.
- The Inspector also has the authority and obligation to notify the Contractor when unusual conditions have been created or encountered during construction.
- The Inspector should realize that he/she is not authorized to revoke, alter, or relax any requirements of the Contract; or to issue a Stop Work Order to the Contractor.

In the Inspection of this time, the general issues of critical importance are as followings.

- Inspection is to ensure that the contractor's work is carried out in accordance with contract documents and specifications of the project. But the drawings are too poor, so it is unreasonable not only to construct in accordance with the design drawings, but also to inspect it based on the contract documents.
- The external appearances such as tank's dimension can be checked, but invisible parts such as reinforced bars in concrete and concrete strength cannot be inspected by site inspection.
- The contract document must be changed according to the actual situation and conditions before the inspection. But, there is no person in charge of supervising and the work variation.
- It is very difficult to ensure good quality of infrastructure without daily supervising because contractors often select cheaper materials and easier ways.

b. Intake facilities

photo-1

photo-2

photo-3

photo-1 to 3: unsatisfactory infiltration basin

- The raw water is surface water of a stream, it looks like clean.
- An infiltration basin is made next to the stream. The idea is very good.
- The structure is not optimal. The bed depth is 40 cm, it is too shallow.
- The bed is designed as three layers of gravel and sand, but the constructed bed structure is different from the design.
- The bottom of basin is not necessary to get better quality water.

c. Distribution tanks

- The dimension of tanks are almost correct.
- Concrete thickness of a tank roof is not sufficient.
- Manhole structure of a tank roof is not correct.
- Inlet amount of a tank is not sufficient.
- There are some additional outlet pipes from tanks (not on design drawings).
- There are no valves on inlet and outlet pipes.
- There are no air ventilation on design drawings. Ones are there at some tank, but there is no ventilation at one tank.
- The tanks are painted, so the workmanship of concrete cannot be confirmed.
- Reinforcing bar and concrete thickness of wall cannot be confirmed.

photo-4: painted tank

photo-5: bad manhole structure

photo-6: low water level

photo-7: small Q of inlet

photo-8: another inlet

photo-9: with air ventilator

photo-10: additional outlet pipe

d. Transmission pipeline

- The pipeline lengths and diameters are inspected correctly.
- The pipeline lengths are far different from the design. Lack of survey at designing.
- GI pipe are bended by force without using bend-joints.
- Pipes are laying on ground. In design they are laid underground.
- There are no drawing of profile of pipe laying.
- Pipes are laid up-and-down without air valves.

photo-11: complex jointing

photo-12: bending without bend-joint

e. Public tap

- Pipe connected to a faucet is not installed in the concrete stand.

photo-13: pipe passed through concrete stand

4. Summary

a. It is the biggest problem that water cannot be served to residents after the completion of water supply system in spite that there is sufficient amount of water source. It is not the hydraulics of the pipeline or the diameter of pipes. The main causes are (1) up-down profile of the pipeline, (2) no air release valve at summit of pipeline, and (3) insufficient air release from the pipeline when water was filled into the pipeline first.

b. There are many differences between the design drawings and the actual site conditions. In these cases the contract including the drawings must be changed to meet the actual site conditions during the construction works. The different works from the contract are equal to no-contract works. Finally it may become a trouble at the payment.

c. Construction inspection consists of the site inspection and the document inspection generally. At the document inspection the records of used materials and photos under constructing are necessary as the evidences to prove that the works were done correctly.

d. The construction works were proceeded without any supervising. Therefore many incorrect points were found at the inspection, but it was too late. In the worst case some constructed facilities must be destroyed or replaced. Daily supervising is very important to prevent incorrect construction. Supervising system in small projects such as PDD should be established.

CHECKSHEET: Design of Water Supply System of Gleno Residence (MDGsuco)

1. Project concept

Is the project proposed in accordance with Government Strategy (rural and urban water supply development strategy)?

MDGsuco: New Residence Development

2. Coordination

Was all coordination made between the relevant agencies?

3. Project area

a. Are data/information available, including;

a-1. number of present population and households,

a-2. major income sources,

a-3. development history of the villages/towns,

a-4. rainfalls?

b. Are the area frequently affected by natural disaster like

□ floods or □ landslides?

c. Present population = 0 HHs x _____ Persons/HH

HH: Household

4. Project target

a. Target year: _____

b. Number of households to be served: 170

c. Number of population to be served: 170 x 5 = 850

5. Existing condition

a. Are data are available on:

a-1. What are the present water sources for people's daily lives?

a-2. What are their major problems

(□quantity, □quality, □distance)?

a-3. What are health condition of the people? (morbidity rate of water borne diseases)

6. Planned water source

a. Is water source sufficient in quantity and quality?

a-1. Quantity: 2.0 L/sec

a-2. Quality : ☑turbid, □ not turbid

The category of water source is stream, not spring. Turbidity may be under 5 ntu (WHO Guideline), but pollution by microbial contaminants is worried. Slow sand filtration or intake of infiltrated water/ground water as raw water is recommended.

b. Is its yield stable throughout the year? ☑ yes, □ no

c. Is gravity flow system applied for water transmission?

☑ yes, ☐ no

d. Catchment area of the source: _____ m length x _____ m width

7. Future water demand

a. How to supply water to the people

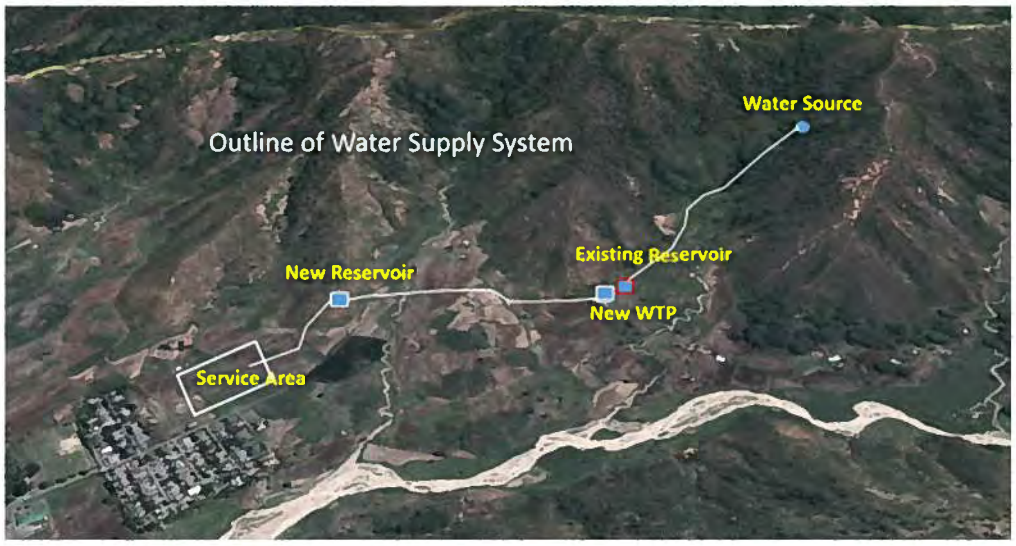
☑house connection □ public taps

b. Design value of unit water consumption per capita per day: 100 L/c/d

c. Is calculation for future water demand by the service population made or not?

□ yes, □ no

8. Pipeline design



a. Is pipe diameter estimated using pipe-flow formula with variables of distance, height and flow rate?

☐ yes, ☐ no

b. Are drawings of hydraulic profile based on field survey attached?

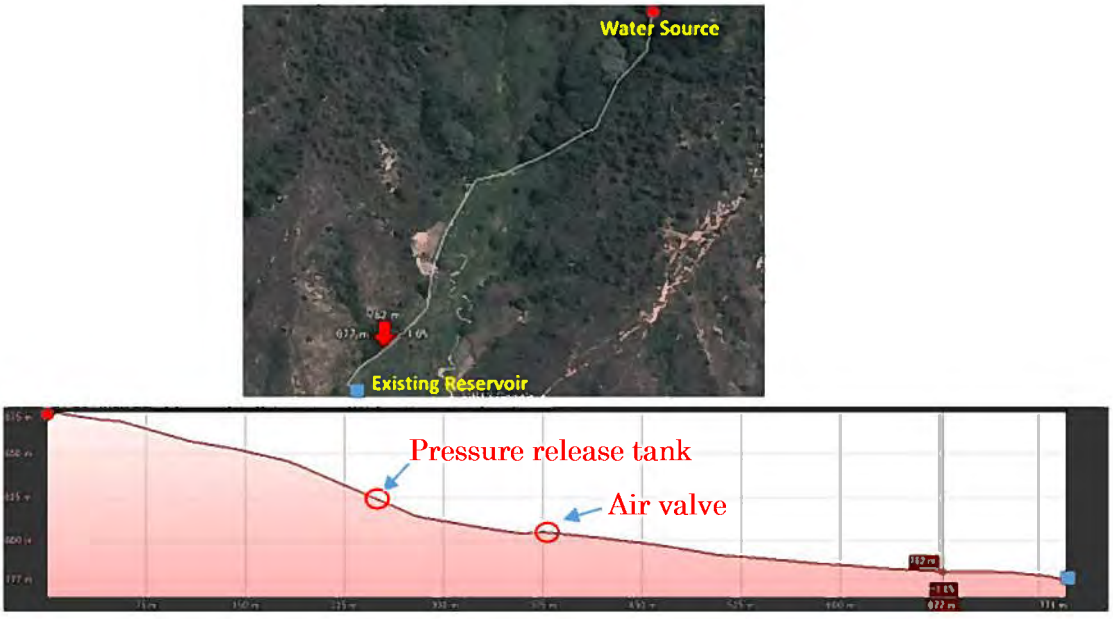
☐ yes, ☐ no

c. Are pipe accessories such as gate valves, air valves, wash-outs properly designed?

□ yes, □ no

Point 1: Raw water transmission main (from the water source to the existing water reservoir)

- ✧ Pipe diameter (by PIPECAL)
- ✧ Air valve
- ✧ Wash-out valve
- ✧ Pressure release
- ✧ New pipe laying or existing pipe repair
- ✧ Water quantity control valve (Inlet valve of reservoir)



GL of Water Source: 875 m (uncertain)

GL of Existing Reservoir: 777 m

It is better to set a pressure release tank at place of GL 825 m, and water quantity control valves are necessary at inlet pipes of both new tank and existing reservoir.

Point 2: Transmission main (from the WTP to the new reservoir)

- ✧ Pipe diameter (by PIPECAL)
- ✧ Air valve
- ✧ Wash-out valve
- ✧ Water quantity control valve (Inlet valve of reservoir)

Point 3: Distribution main (from the new reservoir to houses)

- ✧ Pipe diameter (by EPANET) and Peak Factor (=2.0)
- ✧ District valve

- ✧ Air valve
- ✧ Wash-out valve
- ✧ Fire hydrant

9. Service reservoir design

a. Is the capacity of reservoir sufficient? _____ m^3

Cr = (1/4) (ADD)

where:

Cr = Reservoir capacity in liters

ADD = Average day demand in liters per day

Cr = 1/4 x 850 x 100 = 22000 L (L 4m x W 3m x H 2m)

b. Is the reservoir equipped with

□ inlet valves, □ outlet valves, □ drain pipes, □ overflow pipes,

□ air ventilator.

c. Is concrete structure with reinforcement bars normally designed:

□ yes, □ no

10. Public taps

a. Number of faucets equipped at a public stand: ____ faucets

b. Number of households to be served by a public stand: _____ households

c. Are concrete apron properly designed:

□ yes, □ no

d. Are drain pipes equipped at the concrete apron:

□ yes, □ no

11. Operation & maintenance after construction

a. Is water user committee planned to organize in the village/town:

□ yes, □ no

b. Is an operation plan (cleaning, valve control, etc.) prepared:

□ yes, □ no

c. Will fixed amount of fees for O&M be collected from the households:

US$_____ /month/household

12. People's awareness

a. Do people have an awareness to pay for O&M fees:

□ yes, □ no

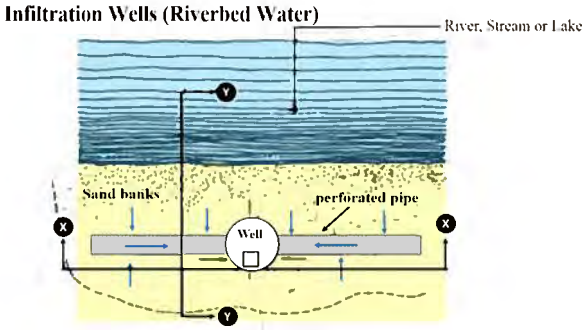
b. Do people have a willingness to be serviced:

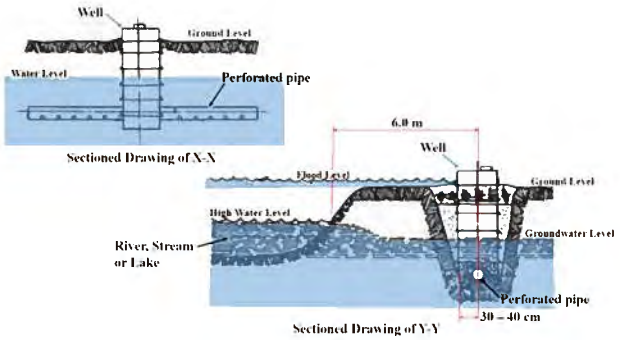
_____ households out of _____ households

Alternative Plan

It is better to find another water source when WTP would not be constructed.

Infiltration intake is an alternative.





Site Inspection Report on Water Supply Facilities in Viqueque District

By Higuchi Hideo, JICA-ADN

Inspection Date: 12 - 13 Augast
Location: Viqueque District
Project name: (a DNSA's project)
Inspector: Demistocles G. X. F. Cabral (PDID Section Chief),
two ADN engineers
JICA-ADN: Higuchi Hideo

This is an inspection report on only water supply facilities.

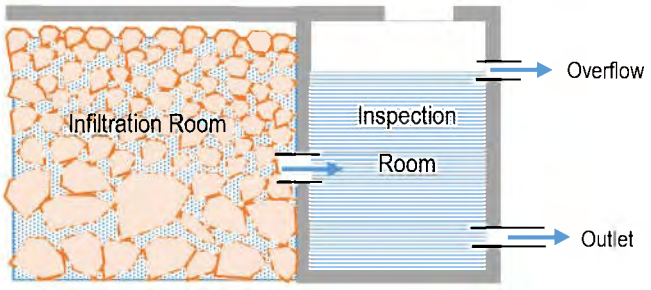
1. Inspection facilities

- Intake facilities

2. Results of inspection

Intake facilities of water supply system

- The water source is spring water, it looks like clean and sufficient judging from the overflow water.
- The structure of intake facilities in the design consists of two rooms which are an infiltration room and an inspection room.



- The partition wall between the infiltration room and the inspection room was not constructed. Therefore, the whole space was filled with sand and gravel. As a result, it is impossible to monitor the quantity and the quality of the raw water.
- The transmission pipe from the water source is crossing a fast-flowing stream and the protection on the pipe from rolling stones is not sufficient. The pipe is easy to be damaged.

photo-1: Overall view of the Intake facilities and Transmission pipe

photo-2: the Intake facilities

photo-3: the Intake facilities filled with sand and gravel

photo-3: the Transmission pipe crossing a fast-flowing stream

3. General Issue

The construction works might be proceeded without any supervising. Therefore several critical points were found at the inspection, and the repairs or the recovery of faults after construction completion are usually very difficult. In the worst case some constructed facilities must be destroyed or replaced. This is waste of time, energy and money.

To prevent these incorrect constructions or to control the quality of constructions, supervising during construction is very important.

The fig.-1 shows the general structural chart of project implementation. In governmental projects, the parts of outline letters on a colored background are the actual governmental works in general.

In a case of PDID, the parts of Verification and Inspection are the roles of ADN. The ADN's inspection is the last gate to ensure good quality of infrastructures, but it does

not have the function to control the quality of infrastructures. Supervising system (the place of duty and job description) in small projects such as PDID should be made clear.

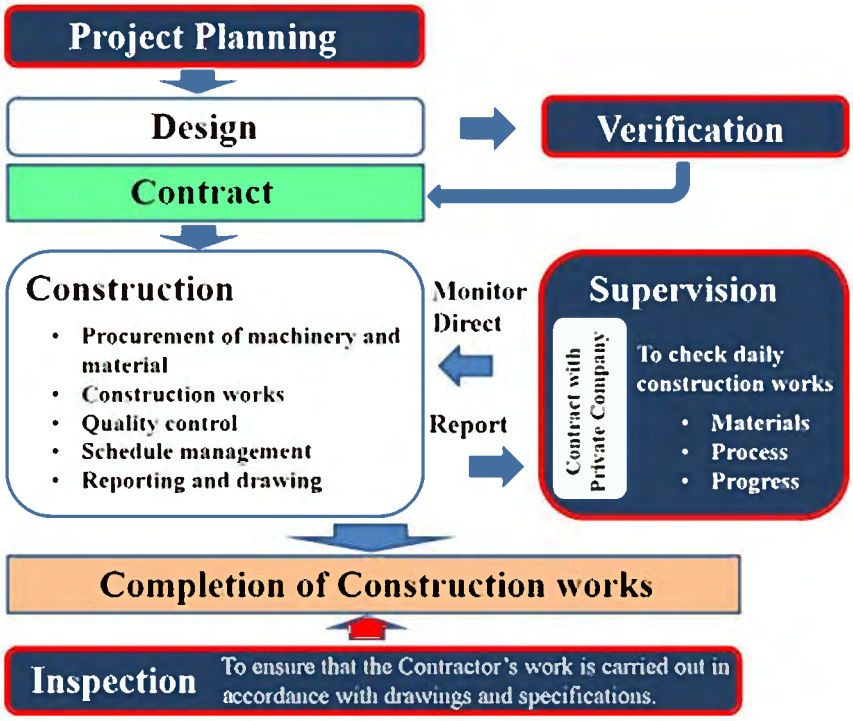


fig.-1: General structural chart of project implementation

添付資料 27 現地調査報告書(給水)(テトン語版)

Resumo ba Inspeksaun MDG ba Projektu Iha Suku

Prepara husi Engineiro JICA

Maiu 2013

1. Orario kona-ba fatin vizita nian

Engineiro JICA fornese wee nian akompana husi Engineiro AND nebe vizita tiha ona fatin Projektu MDG Suku husi periodo 7 de Maiu to'o 10 de Maiu 2013. Tabela tuir mai kona-ba orariu lina koodenasaun husi Engineiro sira nebe vizita iha fatin neba.

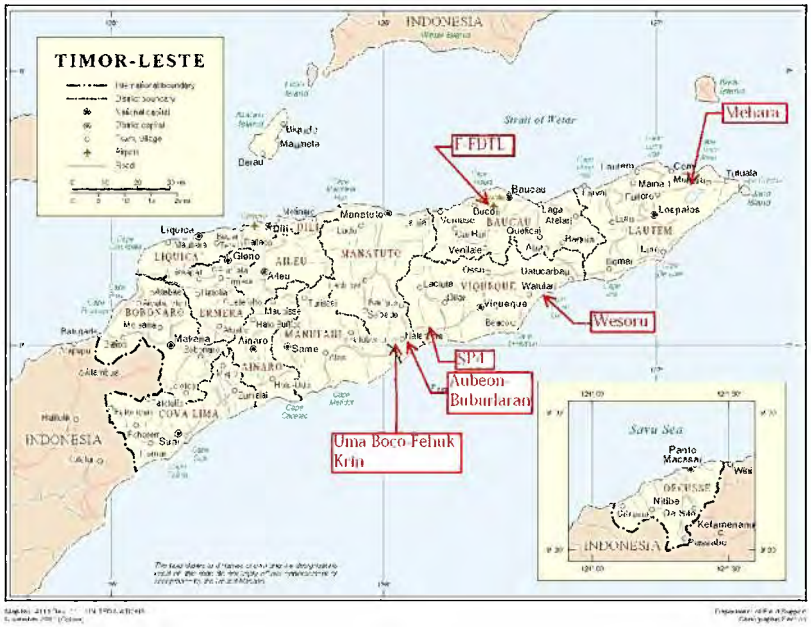
Tabela - Orariu kona-ba fatin vizita

Date	Move		Activities
	From	To	
7 May (Tue)	Dili	Lospalos	Visit Mehara project site
	Lospalos	Baucau	Stay at Baucau ADN office
8 May (Wed)	Baucau	Viqueque	Visit Wesoru project site
			Stay at Viqueque ADN office
9 May (Thu)	Viqueque	Manatuto	Visit Natarbora project sites
	Manatuto	Viqueque	Visit SP4 project site
	Viqueque	Baucau	Stay at Baucau ADN office
10 May (Fri)	ADN office	F-FDTL	Visit F-FDTL office, meeting with Commando,
			visiting project site and Aubaka spring.
	Baucau	Dili	Return to Dili

2. Fatin Projektu

Projektu MDG Suku, jeralmente fatin sira nee iha area rurais iha Distritu id-idak,,nebe dook husi sentru Distritu Residentes(residents) barak liu nebe hatu'ur (settled)nebe liu-liu planu tiha ona ba agrikultores dadaun nee sira uza tradisional hanesan tali tahan no aitalin(roofed huts).Iha Projektu Suku ida ba numeru konstrusaun uma entre husi unidade 50 to'o unidade 300,depende husi ema ninia presiza..

Fig – Project Site in Districts; Baucau, Lautem, Viqueque and Manatuto



3. Progreso no Atinji

Progreso Projektu ba Maiu 2013 ho maioridade husi Engineiro AND & JICA tabela resumo mak

Tabela – Progreso projektu no observasaun Engineiro

Distrito	Sub-distrito	Suco/Aldeia	total uma kain	Progreso				Problema observasaun	Aksaun/ Halo sugestaun
				uma	baleta	Estrada	Sanitasaun		
Baucau	Baucau	F-FDTL	200	ompleto	Sei dauk	Sei dauk	Sei dauk	1. Iha neba nebe bee prinsipal suli sai. tan nee menus we ba F- FDTL. 2.Lider Suku rejekta additional supply ba MDG area Suku nia liu husi we sanak bee prinsipal ninian.	1.Bee kuak suli sai nee presiza hadian. 2.Presiza dialogo(Dialogue) ho sosiedade hudi resolve kestaun(issue) diak kona-ba bee..
Lautem	Tutuala	Mehara	150	Kompleto	nee.	Konstrusaun halao hela	Sei dauk	1. Utiliza raihenek ba konkretu (concrete) iha tauk ten barak (silts) no sura (days). laiha evaluasaun atu apar. (appropriate). 2. Presiza konstrusaun fura bee ba supply bee area nee.	1. Rekomenda husi Engineiro imidiatamente troka. 2. Engineiro rekomenda kontraktor kona-ba proposta fura be. dezenho(design) no orario.
Manatuto	Natarbora	Uma Boco-Fehuk Krin	126	Kompleto	Kompleto	Kompleto	Sei dauk	1. Laiha operasaun fura we tamba falta fundu(fund). 2. Fatin projektu ba supply bee sedauk determina.	1&2. DNSA sei foo orsamentu ba operasaun fornese (supply/fura bee iha publiku. inklui MDG area Suku . Koordenasaun entre DNSA ho sosiedade ninia nesesidade.
	Aubeon-Buburlaran		87	Kompleto	Kompleto (Reparasaun/repair)	Kompleto (Reparasaun/Repair)	Sei dauk	Observa bee nalihun iha baleta. 2. Bee fura la funsiona tamba fakta asesores (accessories) bomba.	1. Imediatamente amendment ba baze konkretu(concrete)rekomenda husi Engineiro. 2. Ba Projektu fatin nebee iha bele fura we matan. Engineer rekomenda kontraktor the hafoun hikas proposta asesores bomba instelasaun no tanki nesesidade kanu no torneira Publika.
Viqueque	Luca	SP4	52	Kompleto	Kompleto	Kompleto	Sei dauk	1. Konstrusaun posu halao hela.	1. Servisu sei kontinua.
	Watulari	Wesoru	364	Konstrusaun halao hela	Halao preparasaun	halao preparasaun	Sei dauk	1. Fatin projektu sofre liu bee sae beibeik. 2. Konsidera parte substansia nebee sura barak mamar. 3. Presiza konstrusaun fura bee fornese ba area.	1. Baleta provizoriu inisiativa antes primeiro sei komesa konstrusaun ba uma hadian diak liu. 2. Atensaun kuidadu sei fatin nebee mos lolos no refere. 3. Engineiro rekomenda kontraktor kona-ba hafoun proposta konstrisaun fura bee.
Total			979						

Note: Engineiro hanesan dalan(means) Engineiro ADN responsabiliza projektu Suku MDG iha in Baucau, Lautem, Viqueque and Manatuto.

4. Photographs (7 May – 10 May, 2013)

[Mehara] -1.
Konstrusaun Estrada & Kanals halo'o hela

[Mehara]-2 Konstrusaun baleta halo hela

[Mehara] – 3. Fo exemplo raihenek husi Engineiro
(Diretamente troka husi Engineiro)

[Mehara] – 4.Fatin proposto fura be(proposed)

[Wesoru] – 1. Konstrusaun foun hahu iha April

[Wesoru] – 2. Fundasaun nebe forte

[Wesoru] – 3. Backhoe for Earthwork

[Wesoru] – 4.Bee posu nebe iha besik fatin projektu (Iha opersaun klean 9m)

[Aubeon-Buburlaran] – 1. Udan bee nalihun iha baleta laran. (Imidatamente hadian tuir rekomenda husi Engineiro ADN)

[Aubeon-Buburlaran] – 2.Be posu bomba manual (Japones mak halo)**buatan Jepang**

[Aubeon-Buburlaran] – 3.Fura rai kuak(Borehole) laiha bomba
(Konsidera posibilidade la hetan bee)

[Aubeon-Buburlaran] – 4.Ateru rai ladauk kompletu Earthworks not completed
(Observa katak ateru latoo)Backfill observed insufficient)

[Uma Boco-Fehuk Krin] – 2. Konstrusaun fura bee husi USAID tinan 2010 (klean 62m , la funsiona

Uma Boco-Fehuk Krin] – 1. Uma kain126 kompletu ona(enkuantu sei dauk fornese bee

tamba orsamento gov. la too atu halao operasaun)

[Uma Boco-Fehuk Krin] – 3. Reservador lubu ida (**Ground Storage)** No.1 ba sidade(basia20m3 x 2)

[Uma Boco-Fehuk Krin] – 4. Storage Reservador No.2 aloka iha foho leten(basia 50m3 x 2) projektu husi graviti (gravity)sufisiente fornese bee .

[SP4] – 1. Hare hikas fali ba fatin projektu

[SP4] – 2.Konstrusaun kee bee posu halao hela(Dug Well under Construction)

[SP4] – 3. Kee tauk ten(Silt) no kee raihenek iha posu dalas kraik.

[Natarbora] - Enkontru ho xefe Suku kona-ba projektu MDG bele iha Suku.

[F-FDTL] – 1.Hafoun hikas konstrusaun reservador bee suli liu ba kraik (Leaks from the Bottom of the Reservoir newly Constructed)

[F-FDTL] –Uma kain 2. 200 kompletu ona

[F-FDTL] – 3. Aubaka Bee matan nebe aloka iha ailaran.
(Lideransa Suku halo ligasaun ba vizita bee matan.)

[F-FDTL] - 4. Nebee iha we matak(raw water) transmisaun too F-FDTL F-FDTL (iha diameter, GSP 4km x 3")

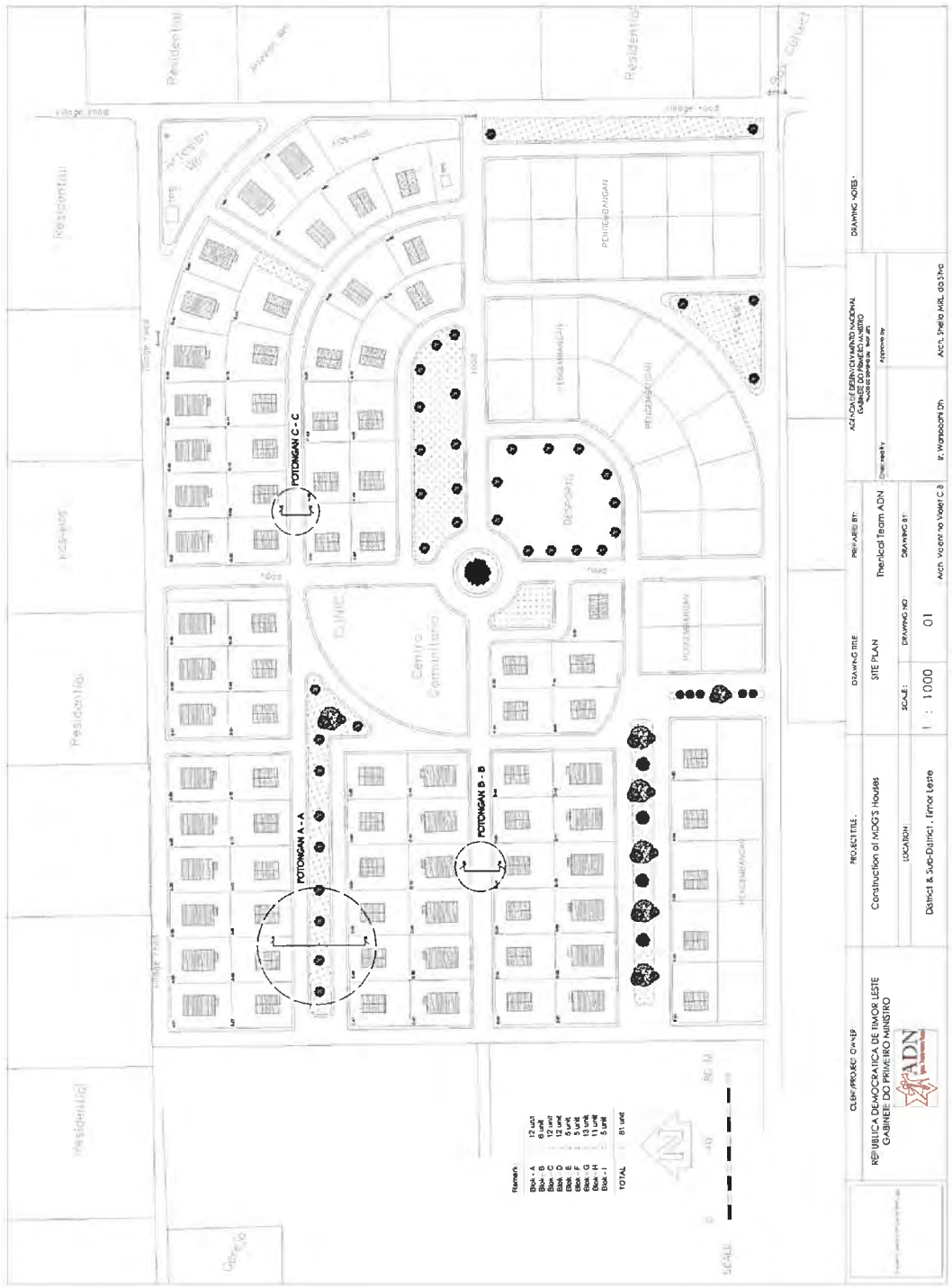
Dezenho

Anexa

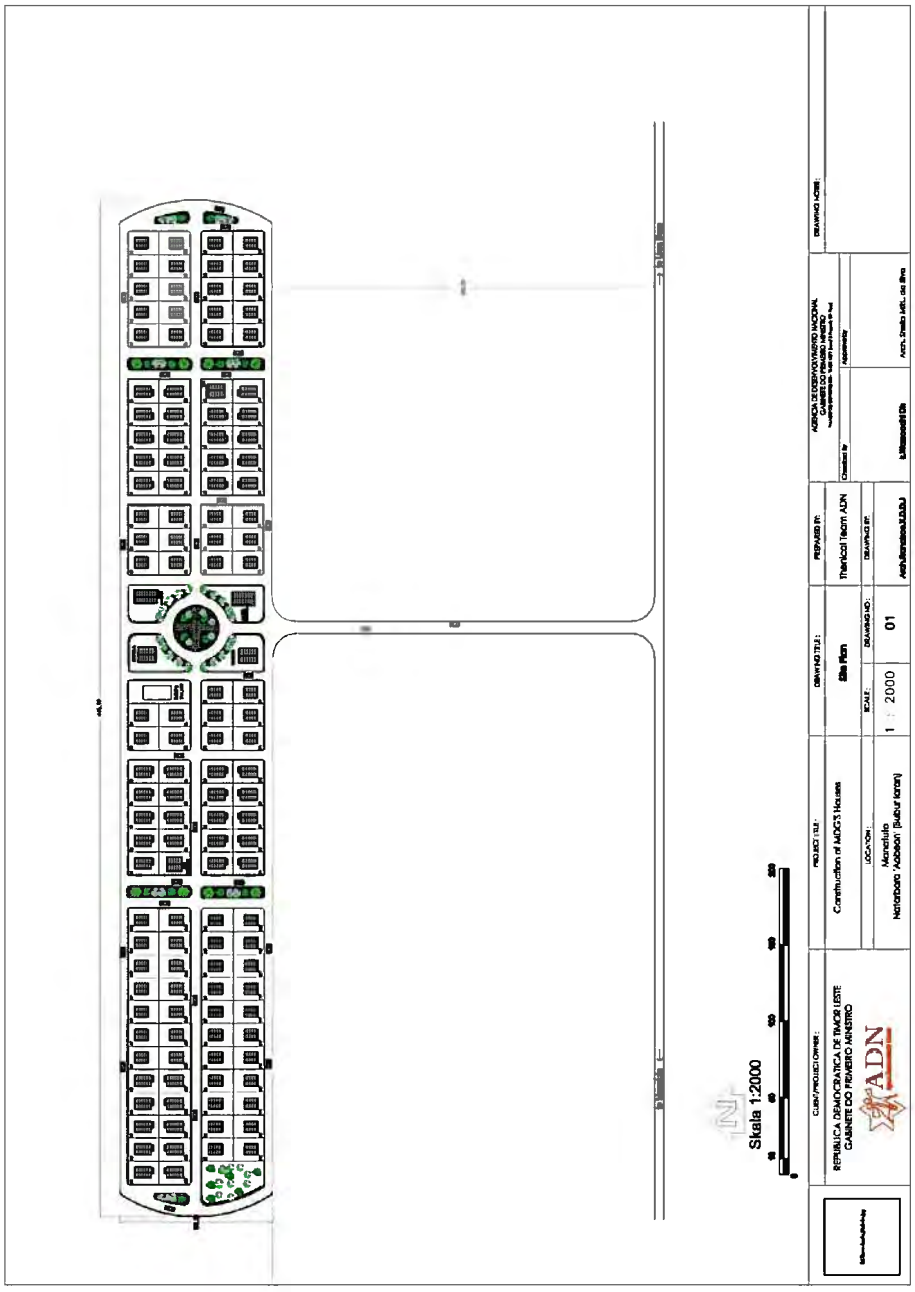
1. Mehara, Lautem district

2. Wesoru, Viqueque district

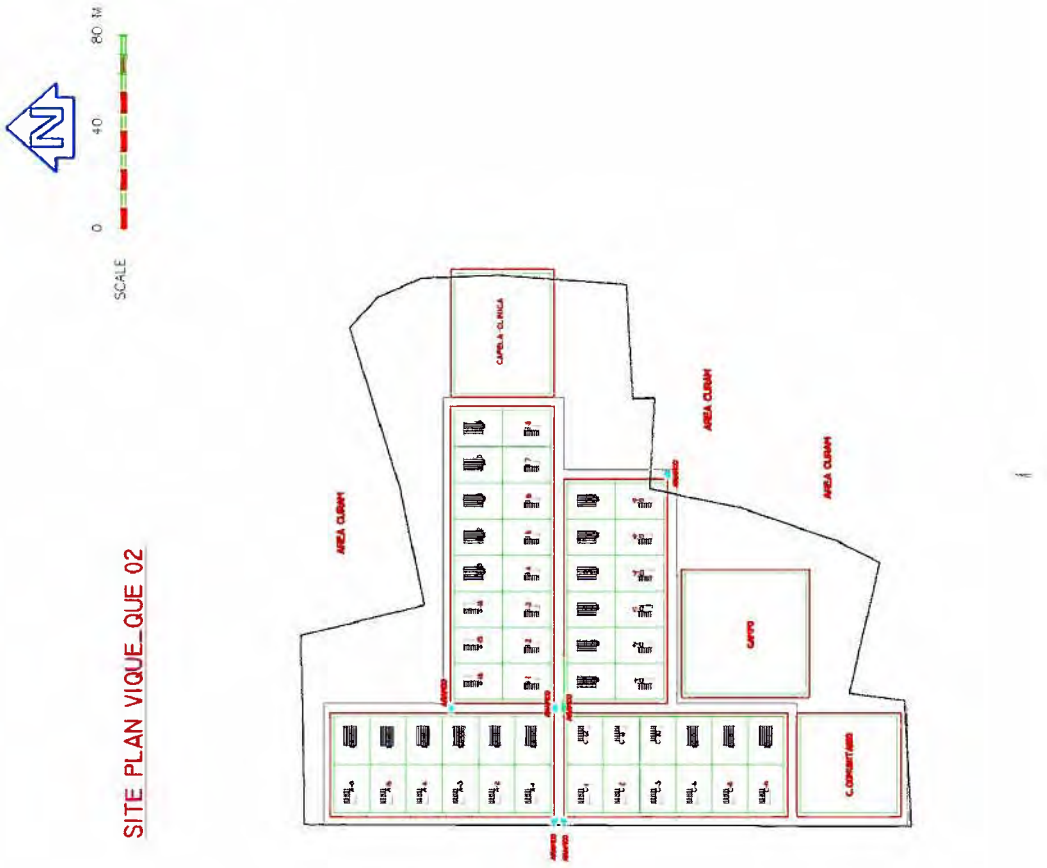
3. Aubeon-Buburlaran, Manatuto district



4. Uma Boco-Fehuk Krin, Manatuto district

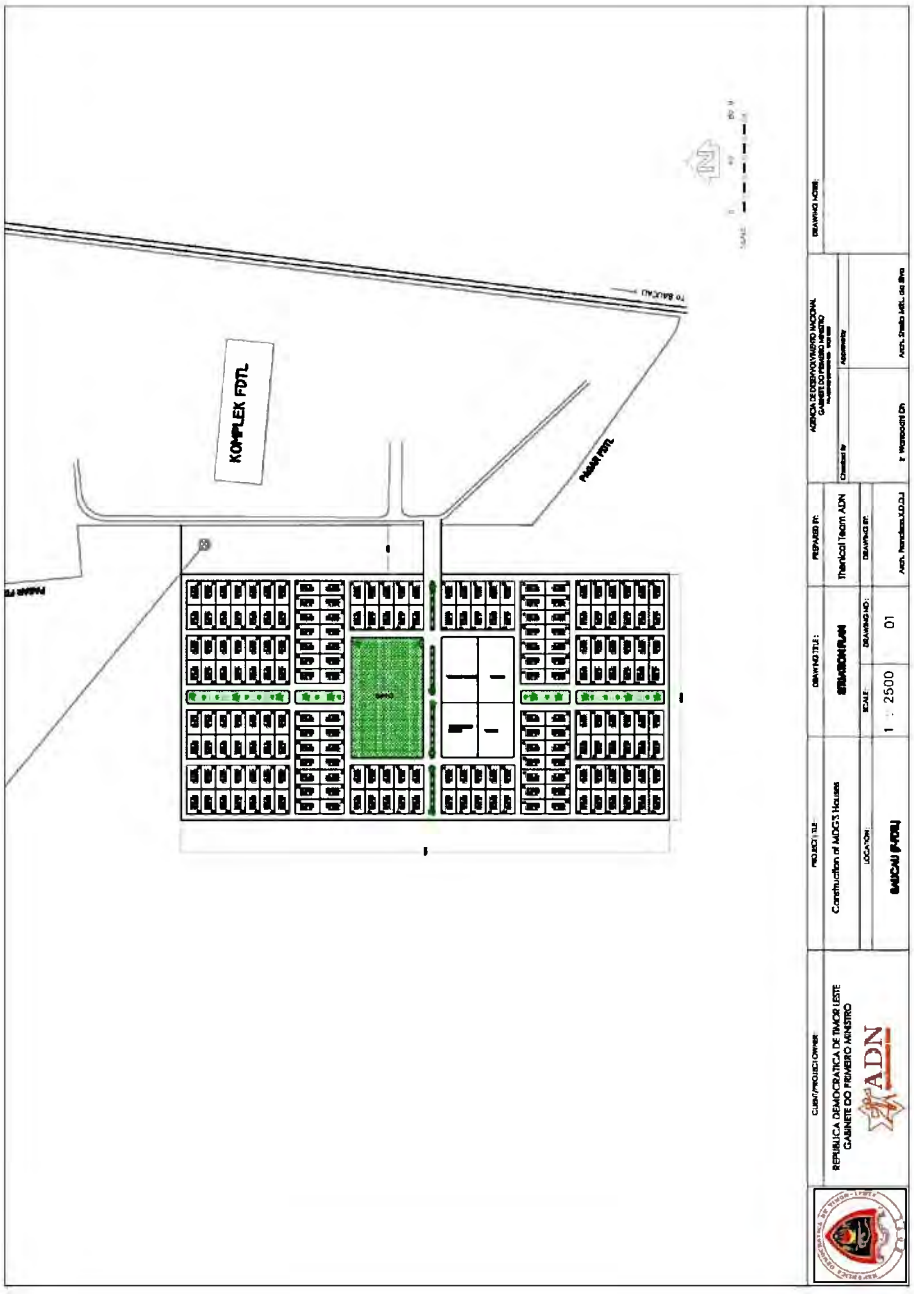


5. SP4, Viqueque district

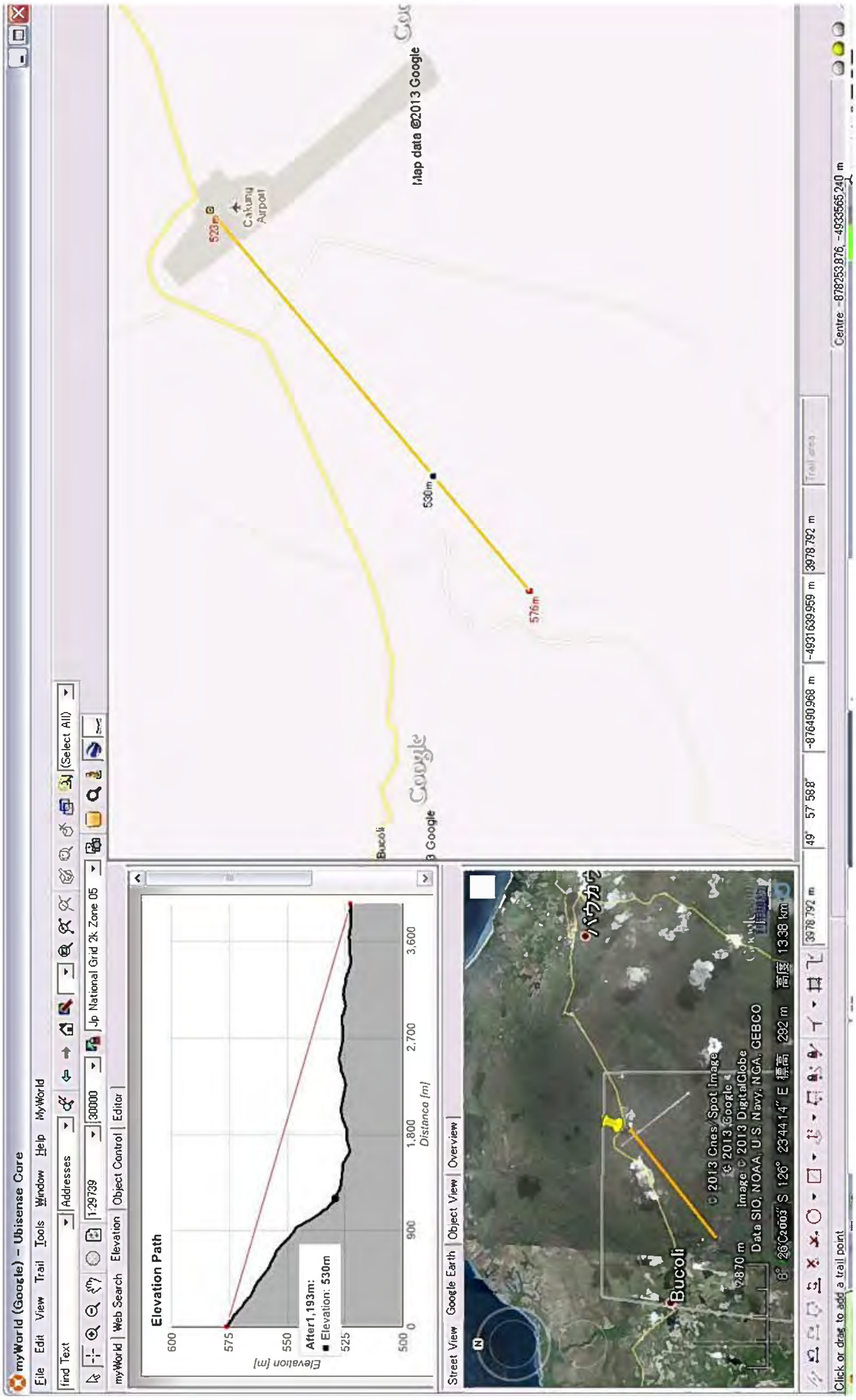


6. F-FDTL, Baucau district

1) Plan



2) Profile of Raw Water Main



Relatóriu konaba Fatin Inspeksaun iha Lahane, Distritu Dili

Husi Higuchi Hideo, JICA-ADN

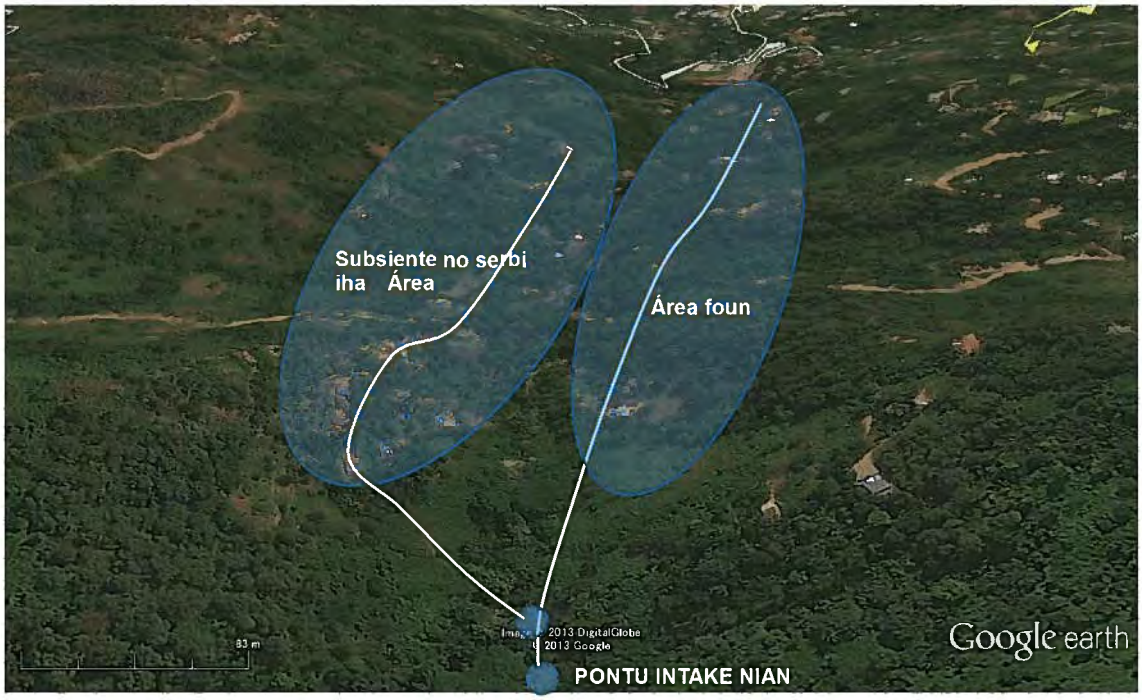
Data Inspeksaun: 31 Julhu, 2013, 9:00 – 14:00

Lokal: Suco Lahane Oriental, Distritu Dili

Naran Projetu: Rehabilitasaun konaba sistema fornese bee Mos iha Suco Lahane Oriental

Inspektor: Paul Abrantes, Lisandro Manuel

JICA-ADN: Higuchi Hideo



1. Hu'un ba Inspesaun / Inspection Root

Inspesaun nebee hala'o husi distribusaun Tanki bee ulun tama tuir transmisaun kadoras nian.

2. Lista konaba fasilidade

- Fasilidade Intake
- Tanki Distribusaun (tanki 3)
- Kadoras transmisaun(lyna 4)
- Distribusaun Pipa
- Torneira Publiku (torneira 4)

3. Resultadu husi Inspesaun

a. Kestaun jeral

Inspektor nudar responsabilidade desidi konaba servisu nebee halo'o ho materias nebee uza haktuir dezeñu no espesifikasaun. Kbi'it Inspektor ninia explikasaun mak tuir mai nee:

- Inspektor iha kbi'it/wewenag rejeita konaba material nebe ladiak ka servisu nebee hala'o impropriedade/lalos.
- Inspektor mos iha kbi'it ho kana'ar atu fo hatene ka notifika ba kontraktor sira wainhira hetan kondisaun nebe ladiak duranti konstrusaun hala'o.
- Inspektor mos tenki menyadari katak nia/sira laiha autorizaun atu hapar, ka hasai no halo karta rekerementu hodi hapara servisu kontraktor nian.

Iha Inspeksaun nia laran nee, kestau ida importanti mak tuir mai nee:

- Inspeksaun nee garanti ba servisu nebee kontraktor hala'o haktuir akordu ho dokumentu kontratu nian no espesifikasaun konaba projetu. Maibe dezeñu nee la satisfeitu, tan ne'e favorable los, no la'os deit konstrusaun tuir akordu nian ho dezeñu, maibe bazeia mos ba inspesaun iha dokumentu kontratu.
- Nunee external nebee mosu hanesan tanki dimensiu bele revista, maibe ba parte invisilibildade (invisible)haforsa ba fatin konkretu no konkretu forsa tebes imposibel atu hala'o inspeksaun husi projetu inspeksaun fatin.
- Dokumentu kontratu tenki sér troka ba situasaun aktual no kondisaun molok ba inspesaun.Maibe,iha neba laiha ema atu toma konta konaba supervisaun no servisu oi-oin.
- Nunee difikuldade barak liu hodi garantia kualidade konaba infrastrutura sein diáriu supervisaun tamba dala barak kontraktor sira hala'o selesaun ba folin material baratu liu no dalan nebe meius fasil.

b. Fasilidades Intake

photo-2

photo-3

o-1 ba 3: Infiltrasaun basia nian ladun satisfeitu.

- Ba bee nia sasulin tun mai nee husi bee matan,hare hanesan moos los.

- Hala'o bazia infiltrasaun ruma ba iha bee ulun.Nee ideia diak teb-tebes.
- Ba nia estrutura la optima. fatin kle'an nian iha deit40 cm,fatin kondisaun badak.
- Dezeñu bee hatu'ur fatin iha dalas tolu ho fatuk musan nomos raihenek, maibe konstrusaun estrutura ladiak, diferenti husi dezeñu.
- Iha basia nia leten la presiza hodi hetan bee kualidade diak.

c. Tanki distribusaun

- Dimensaun konaba tanki hira nee los duni.
- Konkretu mahar duni, ba tanki leten la du'un sufisienti.
- Estrutura tampaun nian konaba tanki leten nee la du'un los.
- Montante bee tama ba Inlet ba tanki la du'un sufisienti.
- Iha neba dala ruma aumentu pipa outlet/bee sai nian husi tanki (la iha dezeñu laran).
- Iha neba la'iha valvu inlet laran no pipa inlet.
- Iha dezeñu neba la'iha ventelasi anin nian. Iha neba mos tanki hirak nee ida mos la'iha ventelasi ka anin kuak.
- Tanki pinta hotu,nunee mos ba servisu nain sira konaba konkretu la konfirma.
- Reforsa/hametin tranka no mahar konkretu konaba moru mos la'konfirma.

photo-4: Tank pinta

photo-5:Estrutura tampaun matan la'diak.

photo-6: Level bee nia badak

photo-7: parti Q nian ba inlet ki'ik los

photo-8: Inlet seluk

photo-9: Ho Anin kuak/ventilasi

photo-10: Aumenta pipa outlet/bee sai

d. Kanu Transmisaun

- Besi kanu naruk liu ho diametru hanesan fiskaliza lolos..
- Besi kanu naruk liu hanesan dook liu diferenti husi dezeñu. La iha survey konaba dezeñu.
- Pipa GI junta kurva nian lori deit forsa la uza bend joint.
- Besi kanu latan deit iha rai leten. Maibe tuir dezeñu tenke hakoi iha rai okoos..
- Iha neba la'iha dezenu konaba profile pipa latan iha rai leten.
- Kurva pipa nia leten-no-okoos la'iha valvu anin nian.

photo-11: komplexu/susar ba junta junta-kurva

photo-12: Kurva la'iha

e. Torneira publiku

- Keneksaun pipa ba torneira la'instala tuir konkretu hari.

photo-13: Liu husi pipa konkretu harii

4. Resumu

a. Kestaun boot liu mak bee labele oferese ba iha rezidensi, hdepois hala'o ka

kompletu ba sistema ba bee mos nian katak bee matan montante husi bee nian sufsiente los. Nee la'os hydraulics husi linya pipa nian ka diametru husi pipa. Kazu prinsipal mak (1) profile konaba pipa nia leten no kra'ik, (2) la'iha valvu anin iha linya pipa nia tutun, no (3) Insufisienti iha release anin nian wainhira bee tama ba iha kanu laran.

b. Iha neba diferensi barak tebes entre dezeñu no kondisaun aktual ba fatin projetu durante konstrusaun. Inklui kazu kontratu no dezeñu tenki troka to hetan kondisaun projetu aktual duranti hala'o servisu konstrusaun nee.Diferenti servisu husi kontratu la'hanesan. Finaldade hetan susar teb-tebes halo pagamentu.

c.Konsidera inspesaun ba konstrusaun iha fatin inspesaun ho jeralidade dokumentus inspesaun nian. Ba dokumentu inspesaun rekorda konaba material nebe uza no photos iha konstrusaun presiza teb-tebes ba evidesia katak prova tebes nebee servisu nee hala'o lolos duni.

d. Prosesu konstrusaun servisu nebee la'iha supervisaun ruma.Iha neba hetan iha inspesaun nian pontus balu la'dun los,maibe mos tarde teb-tebes. Dala ruma iha kazu fasilidades mak aat liu ba konstrusaun tenki harahu'un ka troka. Diáriu supervisaun nian importante tebes,hodi prevene ba konstrusaun balu la'dun los. Sistema supervisaun ba projetu ki'ik nia laran hanesan PDD tenki estabelese duni.

CHECKSHEET: Dezeñu konaba sistema fornese Bee Mos ba iha Residensia Gleno (suco MDG nian)

1. Konseptu ba projetu

Iha akordu proposta ba projetu ho estrategia (rural no estrategia dezenvolvimentu fornese bee urban)?

MDGsuco: Dezenvolvimentu Residensia foun

e2. Koordenasaun

Halo koordenasaun ba hot-hotu entre agênsias relevantes.

. Album Projetu

a. Data/informasaun nebee bele, inklui;

a-1. Konaba presenti número populasaun no uma kain,

a-2. Maioridade hu'un nebe mak hetan,

a-3. História dezenvolvimentu konaba Suco/sidade,

a-4.Udan been ?

b. Area nebe afeita husi desastre hanesan

□bee sae/ floods ka □Rai monu/landslides?

c. Presenti husi populasaun = 0HHs x Pesoal/ema/HH

HH: Uma kain

4. Tarjetu ba projetu

a. Targetu ba tinan: _____

b. Número konaba serví ba uma kain : 170

c. Número konaba serví ba populasaun: 170 x 5 = 850

5.Kondisaun nebee iha

a. Data nebee iha:

a-1. Saida maka present bee matan agora, ema sira nebee moris lor-loron nian?

Kestaun boot saida mak ba sira ?

(□kuantidade, □kualidade, □distânsia)?

a-3. Kondisaun saúde saida mak ba ema sira nee?(morbidity rate of water borne diseases)

6. Planu bee matan

a. Bee matan sufusienti iha kuantidade no kualidade?

a-1. Kuantidade: ___2.0 L/sec

a-2. Qualidade : ☑ □ Diak, □ Ladiak

b. Is its yield stable throughout

Kategoria husi bee matan iha leten mak sasulin , la'os bee moris. Kekeruhan ba 5 ntu/krai'ik. (husi WHO nia orientasaun), maibe perkupa mos polusi husi kontaminasaun microbial nian. Infiltrasaun nian akonpanya ho raihenek nebe la'o neneik ka rekomenda liu mak intake nian konaba infiltrasaun bee/rai okoos nakonu ho fo'er

b. Resultadu estavel nebee liu husi tinan nee? ☑ los, □ lae

c. Nee aplika systema bee sasuli graviti konaba transmisaun bee?

□ los, ☑ lae

d. Hetan iha bee matan: naruk metru x luan metru

7. Futuru bee moos

a. Oinsa atu fornese bee ba ema.

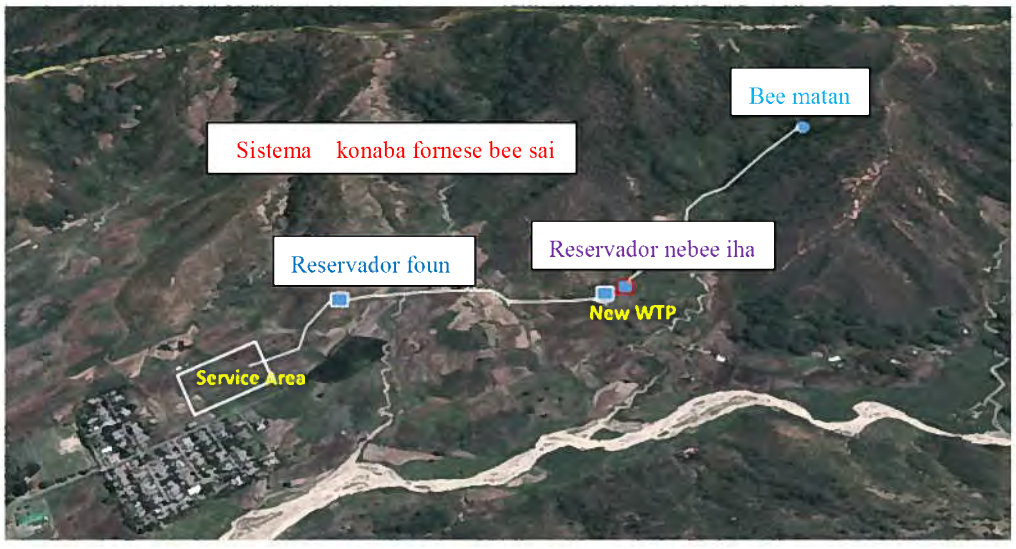
☑Instalasaun ba uma □ Torneira publiku

b. Dezeñu nee konsidera ba unidade ba konsume kada Kapita kada loron: __100___L/c/d

c. Nee kalkulasaun bee moos ba futuru husi serví ba populasaun halo ka lae?

□ Los, □ lae

8. Dezeñu pipa besi



Servi area

a.Estimasaun uza formula pipa diametru pipa-sasuli no oi-oinkona ba distânsia, aas no média sasuli?

☐ Los, ☐ lae

b. Dezeñu baseia profile konaba hydraulic survei kampu anexu?

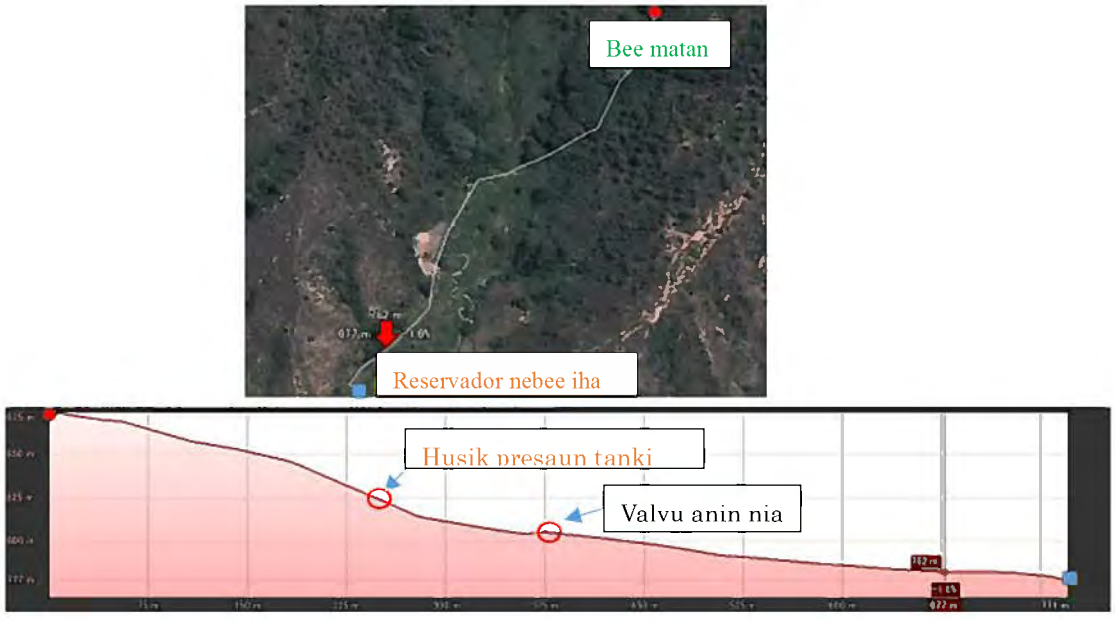
☐ Los, ☐ lae

c. Pipa hanesan asesoris valvu odamatan,valvu anin nian, dezeñu própria bee suli sai?

☐ Los, ☐ Lae

Pontu 1: Bee matak transmisaun prinsipal (husi bee matan ba reservador nebee iha)

- ✧ Diametru pipa nian (husi PECAL)
- ✧ Valvu anin nian
- ✧ Valvu bee suli sai ba liur
- ✧ Husik presaun
- ✧ Hatur'ur/hada pipa foun ka hadia pipa nebee iha.
- ✧ Kuantidade bee kontrola valvu (Valvu Inletba reservador)



GL ba bee matan: 875 m (dúvida)

GL ba reservador nebee iha: 777 m

Diak liu hatu'ur tanki husik presauniha fatin ba GL 825 m, ho kuantidade beekontrola valvu nesesáriu iha inlet konaba nain rua hanesan pipa tanki no reservador nebee iha.

Pontu 2: Transmisaun prinsipal (husi BTP ba resrvador foun)

- ✧ Diametru pipa (husi PIPECAL)

- ✧ Valvu anin nian
- ✧ Valvu bee suli sa ba liur
- ✧ Kuantidade bee valvu kontrola (Valvu Inlet ba resrvador)

Pontu 3: Distribuasaun prinsipal (husi resrvaor foun ba uma)

- ✧ Diametru pipa (husi EPANET) Faktor tutun (=2.0)
- ✧ Valvu distritu
- ✧ Valvu anin nian
- ✧ Valvu bee suli sai ba liur
- ✧ Fire hydrant

9. Dezenu serví ba reservador

a. Nee kapasidadekona konaba reservador sufisienti? m^3

Cr = (1/4) (ADD)

Iha nebee:

Cr = Kapasidade reservador iha litru

ADD = Médiu bee mos ba loron iha litru kada loron

Cr = 1/4 x 850 x 100 = 22000 L (L 4m x W 3m x H 2m)

b. Ekipamentu reservador ho:

□ Valvu inlet, □ Valvu outlet, □ Pipa dreinajen, □ Pipa bee suli sai,

□ Anin kuak.

c. Dezeñu bainbain konaba konkretu ba estruktura ho hametin ba tranka:

□ Los, □Lae

10. Torneira publiku

a. Númeru konaba ekipamentu ba torneira publiku hambri'ik/hari'i: ____torneira

b. Númeru konaba uma kain nebee servi husi torneira publiku hamabri'ik/hari:

_____ Uma kain

c. Dezeñu própria ba konkretu apron:

□ los, □ Lae

d. Ekipamentu pipa dreinajen ba konkretu apron:

□ Los, □ Lae

11. Operasaun & manuntensaun depois konstrusaun

a. Planu komunidade uza bee ba organiza iha suku/sidade:

□ Los, □ Lae

b. Planu operasau seluk (Hamos, kontrola valvu, etc.) prepara:

□ Los, □ Lae

c. Total sei fikxu ba orsamentu O&M nebee kolekta husi uma kain:

US$_____ /fulan/Uma kain

12. Konsiênsia ema nian

a. Ema iha mos konsiênsia ba an atu selu taxa ba O&M :

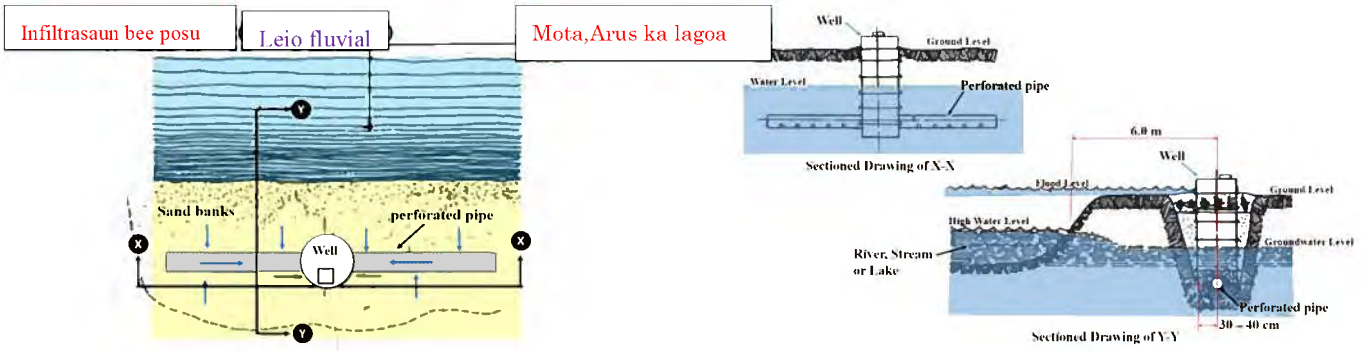
□ Los, □ Lae

b. Ema tenki iha oferese an konaba atu serví:

_____ Uma kain iha liur ba_____ Uma kain

Planu Alternativu

Se diak liu buka bee matan seluk wainhira BTP(bee torneir Publiku) se la'iha konstrusaun Infiltrasaun intake nee alternativu ida.



Relatóriu Inspesaun ba Projetu konaba fasilidades Fornese bee iha Distritu Viqueque.

Husi Higuchi Hideo, JICA-ADN

Data Inspesaun: Agostu,12 – 13
Lokal: Distritu Viqueque
Naran Projetu: (Projetu DNSA)
Inspektor: Demistocles G. X. F. Cabral (Xefe Seksaun PDID),
Engineiru ADN nain 2
JICA-ADN: Higuchi Hideo

Nee relatoriu inspesaun ida konaba fasilidades fornese bee.

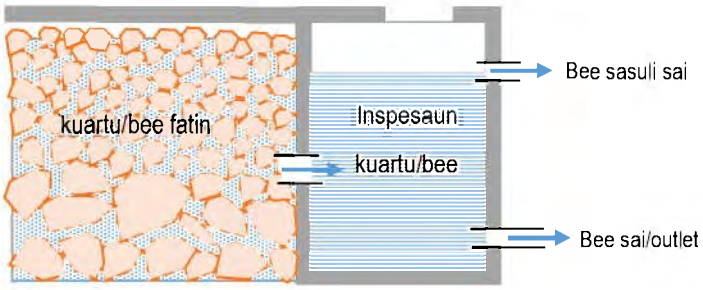
1. Inspesaun ba fasilidades

- Fasilidades Intake

2. Resultadu konaba inspesaun

Inspesaun Intake konaba sistema fornese bee

- Bee matan Hu'un, hare hanesan bee mos no sufisienti tetu husi bee sasuli.
- Estrutura konaba fasilidades intake iha dezeñu konsidera kuartu/bee fatin rua nebee infiltrasaun no inspesaun ba kuartu/bee fatin.



- Ba divisaun moru nian entre infiltrasaun kuartu/bee fatin no kuartu/bee fatin inspesaun nian la'kompletu. Nunee mak espasu hirak nee hotu enxe ho raihenek no fatuk musan. Ho nia resultadu katak imposibel teb-tebes atu monitor nia kualidade konaba bee matak.
- Transmisaun pipa husi pontu krúz bee hu'n nian bee suli – mak'as no protesaun fatuk nakduir kona pipa la'sufisienti. Nebee pipa hirak nee fasil liu atu estraga.

photo-1: Visaun hotu konaba fasilidades Intake ho pipa transmisaun nian.

photo-2: Fasilidades Intake

photo-3: Fasilidades Intake enxe ho raihenek no fatuk musan.

photo-3: the Pipa transmisaun pontu krúz Bee ulun suli-maka'as.

3. Kestaun Jeral

Bele mos prosesu ba konstrusaun servisu nian la'iha supervisaun ruma.Nunee mak pontus kritikal hirak nee nebee hetan husi inspesaun , no hadia ka diak fali konaba falyansu depois ba konstrusaun kompletu hanesan bai-bain difikuldade barak liu. Iha kazu fasilidades construsaun balu mak aat liu nebee tenki harahu'un ka troka. Nee hanesan katak soe tempu, energia no osan.

Hodi prevene ba konstrusaun nebee la'los ka hodi kontrola kualidade konaba konstrusaun , duranti supervisaun ba konstrusaun nee importante teb-tebes.

The fig.-1 Diagrama estruktura jeral hatudu konaba implementasaun ba Projetu. Iha projetu govermental nian, partes balu konaba surat outline iha kôr oin-oin latar belakang govermental aktual bas servisu jeralmente.

Iha kazu konaba PDID, parti ba Verifikasaun no Inspesaun nudar berperanan ba ADN. ADN Inspesaun nee katak odamatan ikus ona hodi garanti kualidade diak ba

infrastrukturas, maibe hala'o la'iha funsiona hodi kontrola kualidade konaba infrastrukturas.Sistema supervisaun (iha servisu fatin konaba job deskripsaun)Nunee katak projetu ki'ik hanesan PDID tenki halo klaru.

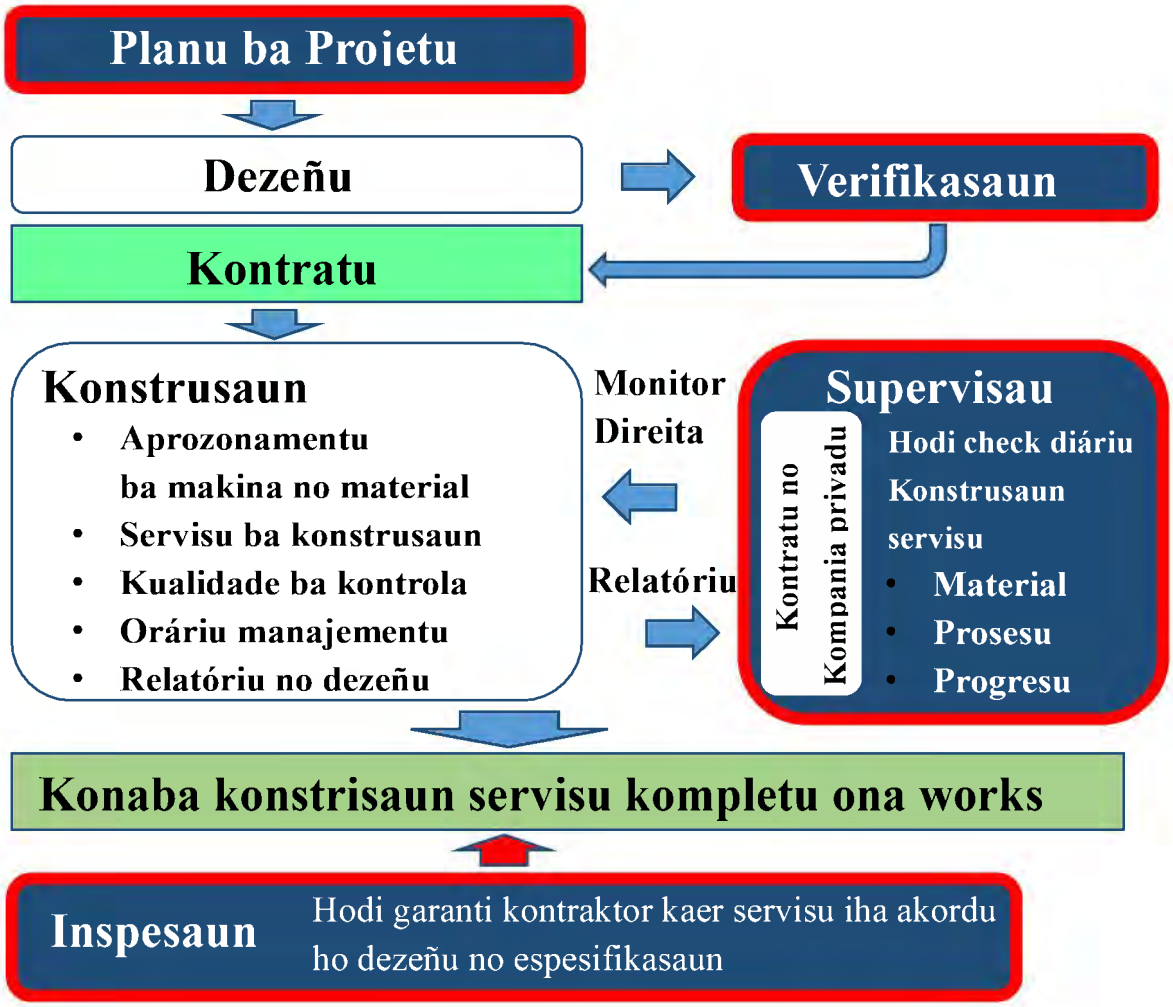


fig.-1: Estructural diagrama jeral diagrama konaba projetu Implementasaun.