CE 3372 WATER SYSTEMS DESIGN

LECTURE 12: STORAGE AND EXTENDED PERIOD SIMULATION

OVERVIEW

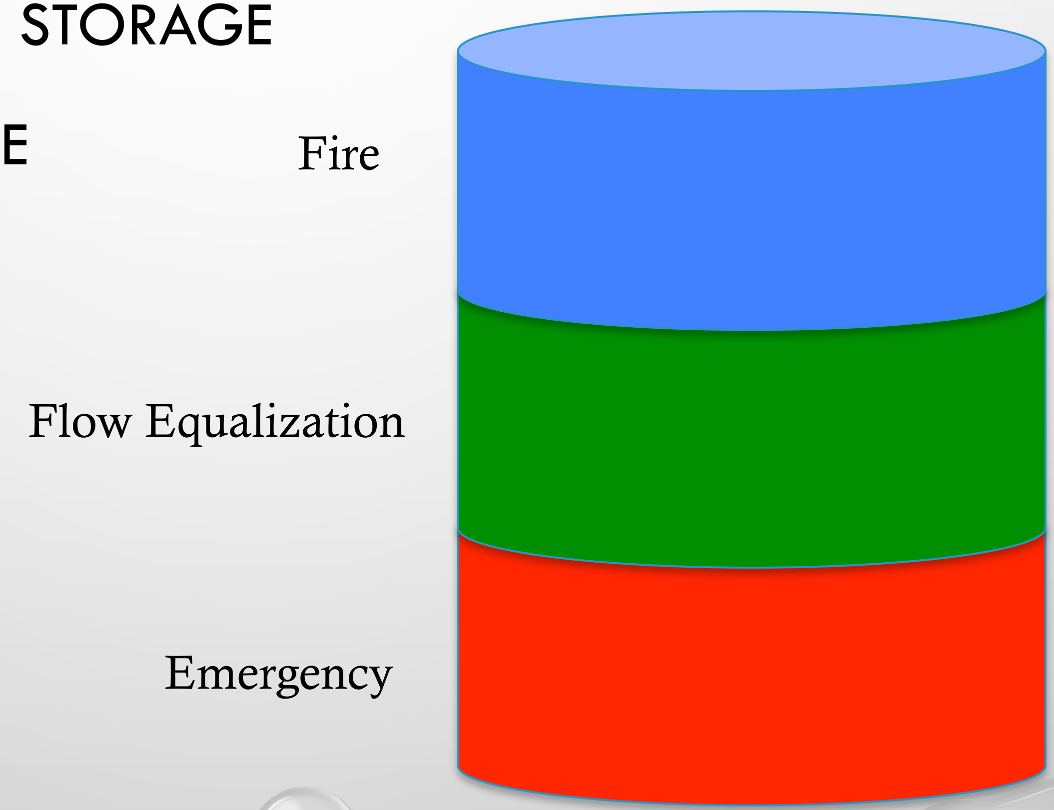
- STORAGE CONCEPTS
  - FLOW EQUALIZATION
- EPANET TANK MODEL(S)
  - SINGLE PERIOD SIMULATION
  - BUT MULTIPLE PERIOD SIMULATION -- INTERESTING
- MULTIPLE PERIOD SIMULATION
  - REASONS
  - MULTIPLIER TABLE

STORAGE

- STORAGE IS USED IN WATER SUPPLY, STORM WATER MANAGEMENT, AND WASTEWATER SYSTEMS FOR A VARIETY OF REASONS.
  - ONE PRIMARY REASON IS FLOW EQUALIZATION — GENERALLY THINGS ARE DESIGNED FOR A PARTICULAR STEADY FLOW RATE AND STORAGE CAN BE USED TO ACCOMMODATE VARIABLE FLOW RATES IN A SYSTEM.
- STORAGE IS EITHER ELEVATED (ABOVE GRADE), AT GRADE (RESERVOIR, TANKS, PONDS, ETC.) OR BELOW GRADE (SUBSURFACE VAULTS — NOT AQUIFERS).

STORAGE COMPARTMENTS

- FIRE STORAGE
- FLOW-EQUALIZATION STORAGE
- EMERGENCY STORAGE



FIRE STORAGE

- FIRE STORAGE IS SUFFICIENT STORAGE TO ALLOW THE SYSTEM TO MEET ROUTINE USES PLUS SUBSTANTIAL FIRE FLOW.
  - THE DESIRABLE VOLUME IS BASED ON EXPECTED FIRE FLOW RATES MULTIPLIED BY THE REQUIRED FIRE FLOW DURATION.

FLOW-EQUALIZATION

- FLOW-EQUALIZATION STORAGE IS SUFFICIENT STORAGE TO ACCOUNT FOR PEAK DEMANDS IN THE SYSTEM WITHOUT HAVING TO EXCEED SUPPLY CAPACITY.
  - A DESIRABLE VOLUME IS 1-2 DAYS OF AVERAGE DAILY DEMAND.

EMERGENCY STORAGE

- EMERGENCY STORAGE TO ALLOW THE SYSTEM TO OPERATE WITHOUT EXTERNAL SUPPLY SOURCES FOR A PERIOD OF TIME TO ALLOW FOR REPAIRS OR OTHER UNUSUAL CIRCUMSTANCES.
  - WITHOUT EMERGENCY STORAGE, EVERY UPSET WILL LEAD TO A "BOIL-WATER" ORDER OR SUBSTANTIAL INTERRUPTION OF SERVICE — THESE KINDS OF INTERRUPTIONS SHOULD BE RARE IF THE SYSTEM IS WELL ENGINEERED.
  - A DESIRABLE VOLUME IS 1-2 DAYS OF AVERAGE DAILY DEMAND.

HOW MUCH?

- ENGINEERING WOULD TEND TO CHOOSE FOR THE LARGER VOLUMES
- ECONOMICS WILL ARGUE FOR THE SMALLER VOLUMES
  - THE ENGINEER WILL HAVE TO BALANCE THESE COMPETING CHOICES IN A DESIGN.

RESIDENCE TIME

- ADDITIONALLY, RESIDENCE TIMES IN ANY STORAGE RESERVOIR FOR TREATED WATER SHOULD NOT EXCEED A REASONABLE AMOUNT DISINFECTION RESIDUAL CONTACT TIME.
  - FOR CHLORINE/CHLORAMINE DISINFECTION TIME IS ON THE ORDER OF 6-10 DAYS
  - AN HYDRAULIC RETENTION TIME OF ANY SUCH RESERVOIR SHOULD BE NO LONGER THAN 8 DAYS (AS A REASONABLE RULE OF THUMB).

HYDRAULIC RETENTION TIME

- HYDRAULIC RETENTION TIME IS THE RATIO OF STORAGE VOLUME TO AVERAGE DISCHARGE THROUGH THE RESERVOIR

$$HRT = \frac{V_{\text{tank}}}{Q_{\text{average-daily}}}$$

HOW MUCH?
FLOW EQUALIZATION

- OPERATING (FLOW-EQUALIZATION) STORAGE IS DETERMINED AS FOLLOWS:
  1. DETERMINE THE HOURLY DEMAND FOR A TYPICAL DESIGN DAY.
  2. COMPUTE THE CUMULATIVE DRAFT (CUMULATIVE VOLUME AS A FUNCTION OF TIME)
  3. COMPUTE THE AVERAGE CONSTANT DRAFT RATE (FLOW RATE THAT IF APPLIED OVER THE DAY END AT THE SAME ACCUMULATED VALUE)
  4. THE EQUALIZATION STORAGE IS THE SUM OF THE TWO LARGEST DEVIATIONS FROM THE AVERAGE FLOW LINE TO THE CUMULATIVE DRAFT LINE.

FLOW EQUALIZATION STORAGE

- DEMAND PATTERN FROM HISTORICAL DATA APPROPRIATE TO THE SERVICE AREA.

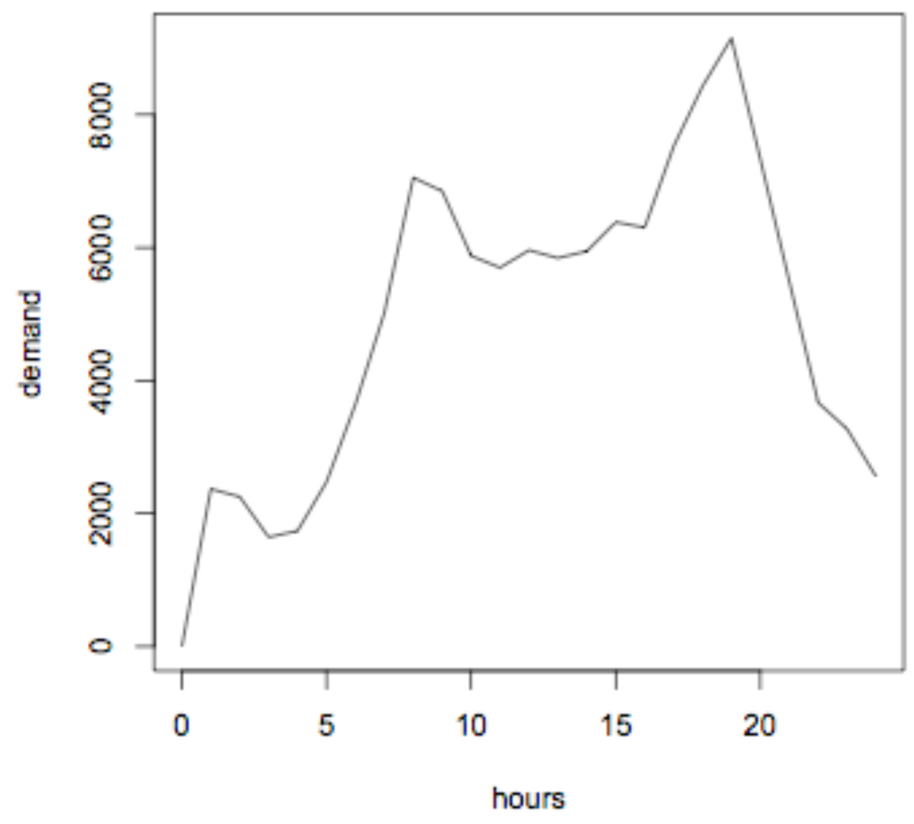


Figure 1: Hourly Demand Pattern for Storage Example

FLOW EQUALIZATION STORAGE

- ACCUMULATE THE DEMAND

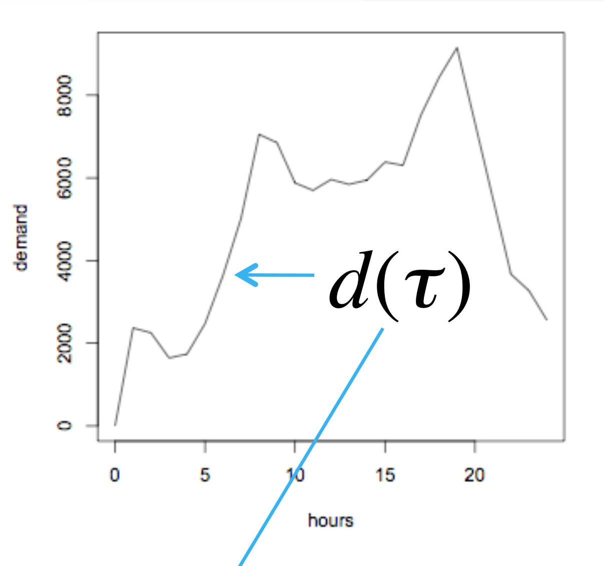


Figure 1: Hourly Demand Pattern for Storage Example

$$D(t) = \int_0^t d(\tau)d\tau$$

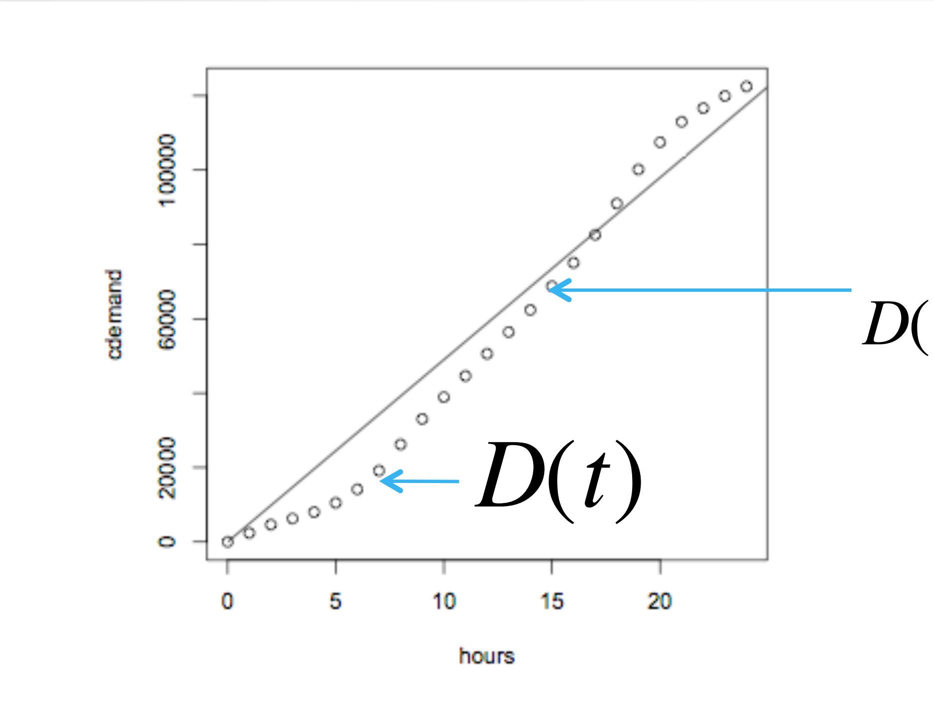


Figure 2: Cumulative Demand Pattern with Constant Supply Rate for Storage Example

FLOW EQUALIZATION STORAGE

- AVERAGE CONSTANT DRAFT

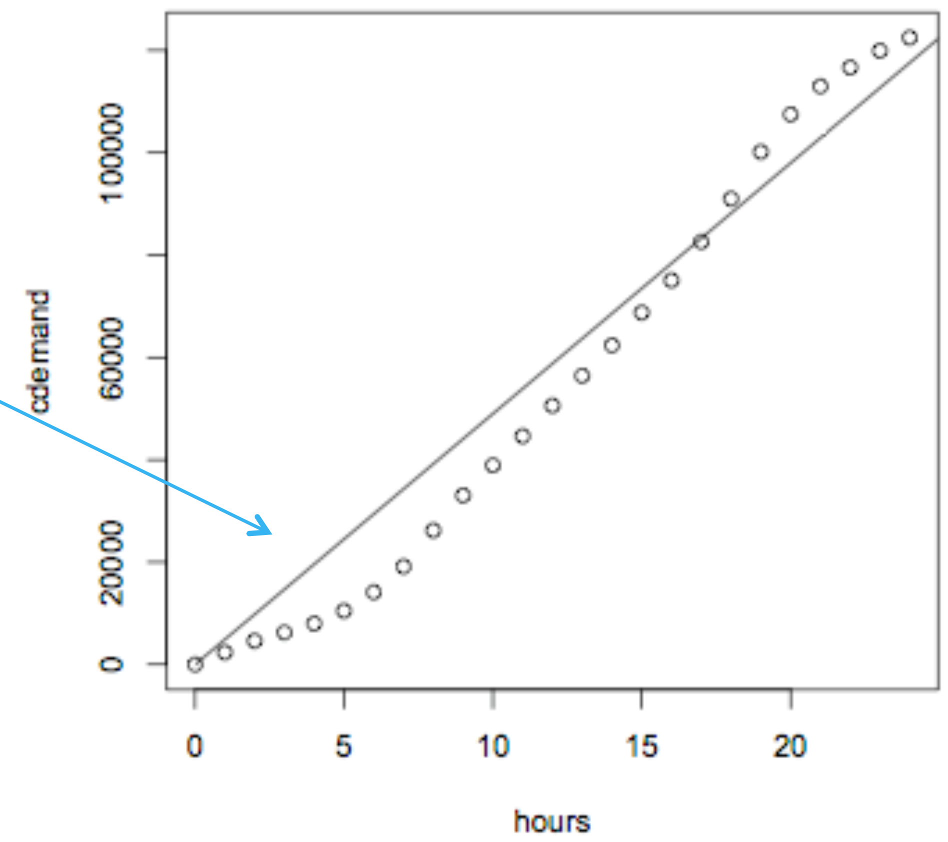


Figure 2: Cumulative Demand Pattern with Constant Supply Rate for Storage Example

FLOW EQUALIZATION STORAGE

- SUM THE 2 LARGEST DEVIATIONS
- STORAGE REQUIRED V1+V2
- IN THIS CHART, ABOUT 25000 VOLUME UNITS.

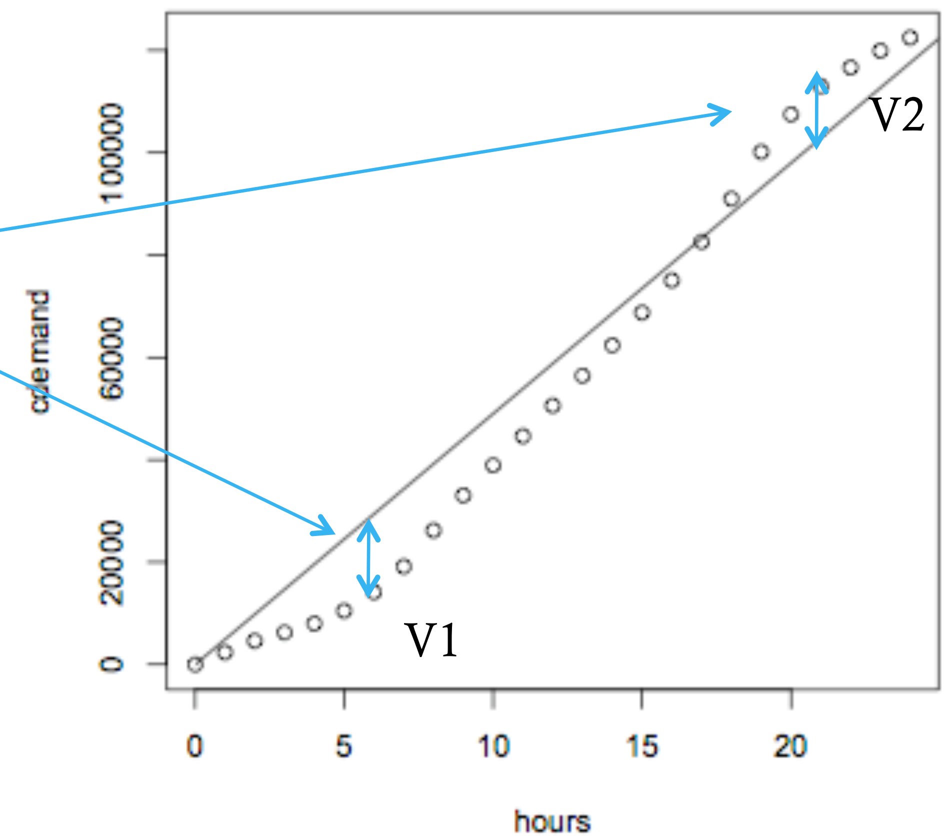


Figure 2: Cumulative Demand Pattern with Constant Supply Rate for Storage Example

FLOW EQUALIZATION

- THE ENGINEER NEEDS TO DECIDE WHICH DEMAND TO USE:
  - DAILY
  - PEAK
- THESE VOLUMES ARE ADDED TO THAT NEEDED FOR EMERGENCY AND FIRE FLOW.
- DETERMINES THE TANK VOLUME REQUIRED
- TANK TYPE (ELEVATED, AT-GRADE, BURIED) DETERMINES SHAPE – ELEVATION, DIAMETER, MIN-LEVEL, MAX-LEVEL.
  - ELEVATED TANKS HAVE SUBSTANTIAL STRUCTURAL CONSIDERATIONS

TYPICAL INSTALLATION

Notice of Public Hearing
City of Pharr
DWSRF Program Clean Water Tier II Program
City of Pharr WTP Expansion Project

Date/Time/Place of Hearing

The City of Pharr will hold a public hearing on **Tuesday, January 21, 2014 at 5:00 PM** in the Council Chambers (118 S. Cage Blvd, Pharr, TX 78577) as part of the regularly scheduled City Council Meeting.

The hearing is to discuss the proposed City of Pharr Water Transmission Main and Elevated Storage Tank Project, alternatives to the proposed project, and their associated costs. One purpose of the hearing is to discuss the potential environmental impacts of the project and the alternatives to it.

Project Description

The City of Pharr (City) is making improvements to the water distribution system to address low pressures in the City's North Region and adding elevated storage to accommodate growth. The improvements include the installation of a water transmission main from the High Service Pump Station (HSPS) to the existing Expressway 83 and LBJ Elevated Storage Tanks. The transmission mains range from 12, 16, to 20-inch and extend approximately 4-miles. A 1-MG elevated storage tank is also being added (Eldora Elevated Storage Tank) at the intersection of Eldora and Dahlia St.

Project Cost and Estimated Monthly Bill to a Typical Residential Customer

The estimated construction cost of the proposed project is approximately $9.1-Million. The City of Pharr has carefully studied the economic impact of not only this project but

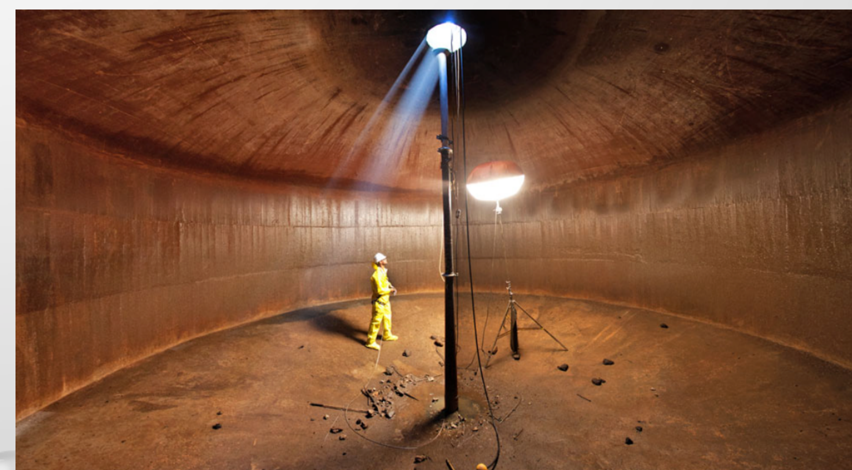
STORM WATER STORAGE

- USED TO MITIGATE PEAK FLOWS FROM DEVELOPMENT.
- PROVIDE WATER QUALITY BENEFIT.
- DEVELOP A WATER RESOURCE (RAINWATER HARVESTING)

UNDERGROUND "TANK"

- MORE THAN A HOLE IN THE GROUND
  - NEEDS STRUCTURE TO SUPPORT SURFACE LOADS
  - NEEDS A WAY TO DRAIN COMPLETELY (USUALLY A PUMP)

Rainstore[3] is perfect for water harvesting. two layers of geotextile fabric encase an impermeable liner. A maintenance/access port is shown.

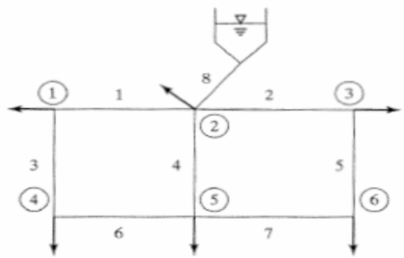


READINGS

- EPA NET USER MANUAL – HOW TO MODEL STORAGE TANKS IN A WATER DISTRIBUTION SYSTEM.
  - INTERESTING WEB-RESOURCES
  - HTTP://WWW.INVISIBLESTRUCTURES.COM/RAINSTORE3.HTML
  - HTTP://WWW.UPOUT.COM/BLOG/SAN-FRANCISCO-3/HERES-WHAT-IT-LOOKS-LIKE-UNDER-THOSE-BRICK-CIRCLES-IN-THE-STREET

RECALL EARLIER EXAMPLE

Compute the discharge in each pipe and the pressure at each junction node for the 8-pipe system shown in Figure 1. The water surface elevation in the storage tank is 315.0 ft. Prepare your solution using EPA-NET. Report your results in U.S. Customary units. Identify the node with the lowest pressure in your solution. Include a transmittal letter with the solution.



Pipe Data

Pipe no.	Length m	Length ft	Diameter mm	Diameter in.	Friction factor
1	1,220	4,000	254	10	0.024
2	1,829	6,000	254	10	0.024
3	1,829	6,000	305	12	0.022
4	1,982	6,500	610	24	0.018
5	2,134	7,000	254	10	0.024
6	915	3,000	457	18	0.020
7	1,524	5,000	254	10	0.024
8	91	300	305	12	0.022

Junction Data

Junction node	Ground elevation m	Ground elevation ft	Demand ℓps	Demand gpm
1	51.8	170	31.5	500
2	54.9	180	31.5	500
3	50.3	165	31.5	500
4	47.3	155	94.6	1,500
5	45.7	150	63.1	1,000
6	44.2	145	94.6	1,500

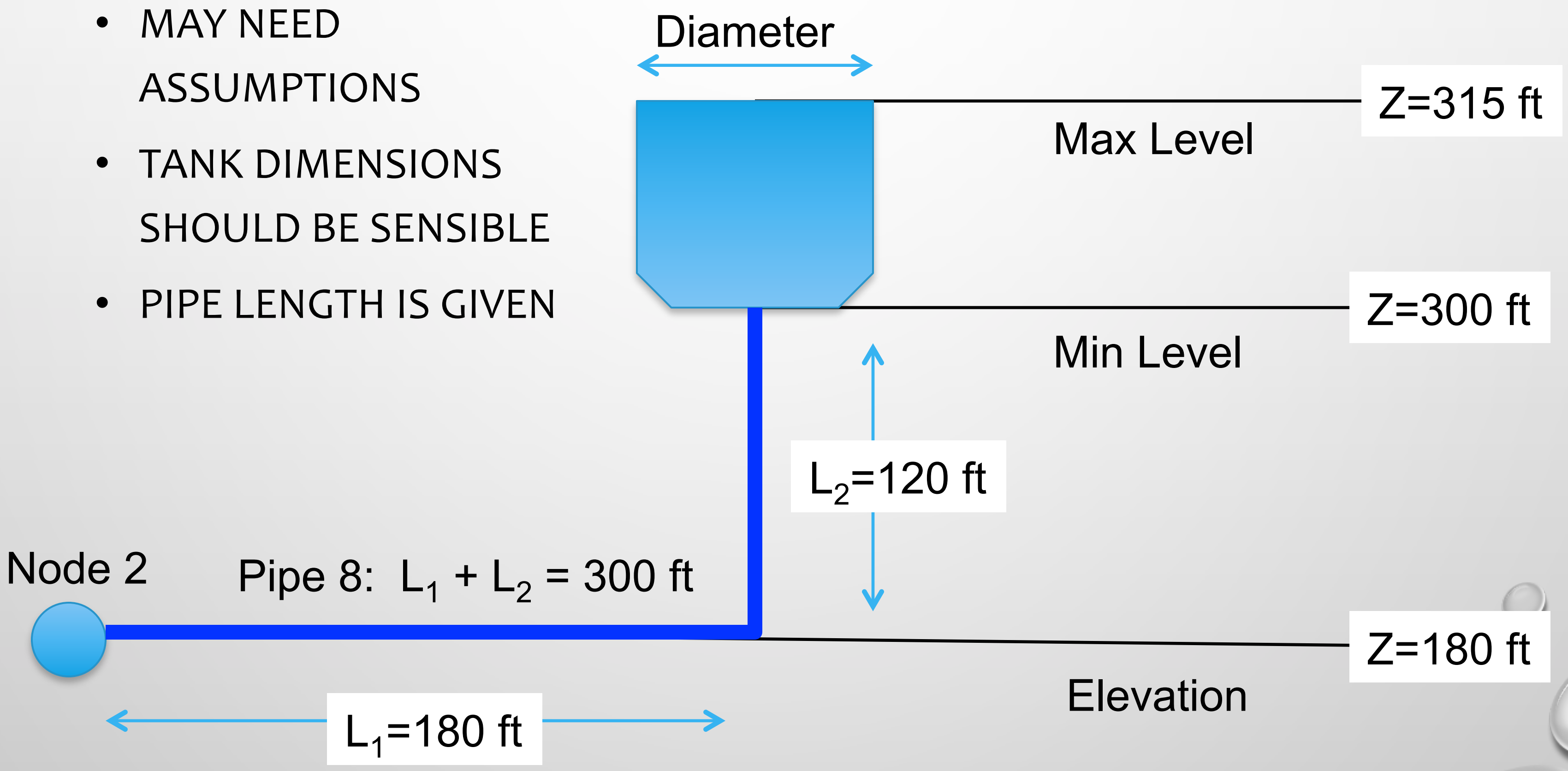
Figure 1: Network and Data for Problem 1

MODELING PROTOCOL

- SKETCH A LAYOUT ON PAPER
- IDENTIFY PIPE DIAMETERS; LENGTH; ROUGHNESS VALUES
- IDENTIFY NODE ELEVATIONS; DEMANDS
- SUPPLY RESERVOIR (OR TANK); IDENTIFY RESERVOIR POOL ELEVATION
- IDENTIFY PUMPS; PUMP CURVE IN PROBLEM UNITS

TANK

- SUPPLY RESERVOIR (OR TANK); IDENTIFY RESERVOIR POOL ELEVATION
  - MAY NEED ASSUMPTIONS
  - TANK DIMENSIONS SHOULD BE SENSIBLE
  - PIPE LENGTH IS GIVEN



EXTENDED PERIOD SIMULATION

- EPANET AND SIMILAR PROGRAMS FIND STEADY-FLOW SOLUTIONS
- EXTENDED PERIOD SIMULATION PRODUCES A SEQUENCE OF STEADY STATES WITH APPROXIMATIONS FOR:
  - TANKS DRAIN AND FILL
  - PRESSURES CAN CHANGE AT BEGINNING AND END OF A TIME INTERVAL
  - PUMP OPERATING POINTS MOVING ALONG A PUMP CURVE

USES

- EXTENDED PERIOD SIMULATION USED FOR:
  - MODELING PRESSURE IN SYSTEMS DURING CHANGING DEMAND –USUALLY AT HOURLY TIME SCALE
  - STORAGE TANK OPERATION AND SIZING
  - WATER QUALITY SIMULATION
    - EPANET CAN APPROXIMATE WATER QUALITY FROM MULTIPLE SOURCES – HAS USES IN
      - WATER AGE IN SYSTEM
      - DETECTION OF INTRUSIONS INTO A SYSTEM
      - SEVERITY OF CONTAMINATION (IMPACT ASSESSMENT)

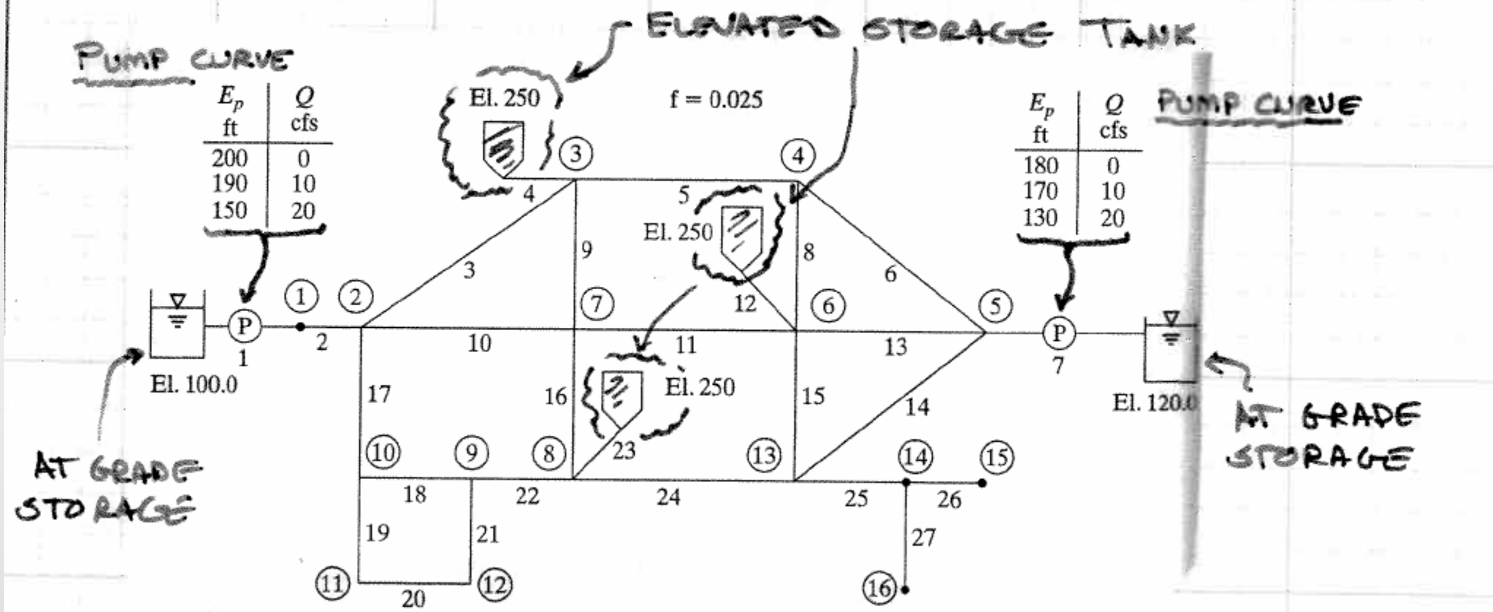
HOW IMPLEMENTED?

- IN EPANET ASSIGN A DEMAND PATTERN TO A NODE
- SET SIMULATION TIMES
- PROGRAM THEN FOLLOWS THE PATTERN

MODELING PROTOCOL

- SKETCH A LAYOUT ON PAPER
- IDENTIFY PIPE DIAMETERS; LENGTH; ROUGHNESS VALUES
- IDENTIFY NODE ELEVATIONS; DEMANDS
- SUPPLY RESERVOIR (OR TANK); IDENTIFY RESERVOIR POOL ELEVATION
- IDENTIFY PUMPS; PUMP CURVE IN PROBLEM UNITS
- IDENTIFY DEMAND PATTERN(S) AND TANK OPERATING CONSIDERATIONS

EXAMPLE



Elevation ft	Storage ft^3
220.0	0
230.0	40,000
240.0	120,000
250.0	200,000
260.0	250,000

ELEVATION/STORAGE RELATION FOR ELEVATED STORAGE TANKS

ILLUSTRATE BY EXAMPLE

Pipe no.	Node US	Node DS	Length (ft)	Diameter (in)	Minor loss coefficient	Fixed grade (ft)
1	0	1	2,000.0	24.0	0.5	100.0
2	1	2	800.0	24.0	0.0	
3	2	3	5,000.0	18.0	0.0	
4	3	0	700.0	18.0	0.5	250.0
5	3	4	3,700.0	12.0	0.0	
6	5	4	3,900.0	15.0	0.0	
7	0	5	2,100.0	24.0	0.5	120.0
8	6	4	2,500.0	10.0	0.0	
9	3	7	3,100.0	12.0	0.0	
10	2	7	5,500.0	18.0	0.0	
11	6	7	3,700.0	15.0	0.0	
12	0	6	900.0	18.0	0.5	250.0
13	5	6	2,900.0	15.0	0.0	
14	5	13	4,500.0	15.0	0.0	
15	6	13	2,500.0	15.0	0.0	
16	7	8	2,700.0	15.0	0.0	
17	2	10	3,100.0	18.0	0.0	
18	10	9	1,900.0	15.0	0.0	
19	10	11	1,600.0	8.0	0.0	
20	11	12	1,500.0	6.0	0.0	
21	9	12	1,650.0	8.0	0.0	
22	8	9	2,900.0	15.0	0.0	
23	0	8	1,900.0	18.0	7.5	250.0
24	13	8	3,100.0	15.0	0.0	
25	13	14	1,600.0	8.0	0.0	
26	14	15	1,750.0	6.0	0.0	
27	14	16	1,500.0	6.0	0.0	

PIPE CHARACTERISTICS

(ADJUST LOSS COEF. TO GET $f = 0.025$ (given))

IN PRACTICAL CASE USE PIPE MATERIAL INFO.

ILLUSTRATE BY EXAMPLE

Junction no.	Elevation (ft)	Demand (gpm)	
1	90.00	0	
2	110.00	694	1.54
3	95.00	694	1.54
4	105.00	2,083	4.64
5	100.00	694	1.54
6	103.00	2,428	5.40
7	97.00	2,083	4.64
8	103.00	1,044	2.32
9	107.00	0	
10	112.00	0	
11	115.00	350	0.77
12	112.00	350	0.77
13	110.00	0	
14	120.00	0	
15	135.00	175	0.39
16	130.00	175	0.39

BASE DEMAND & NODE TOPOGRAPHY

DEMAND (CFS)

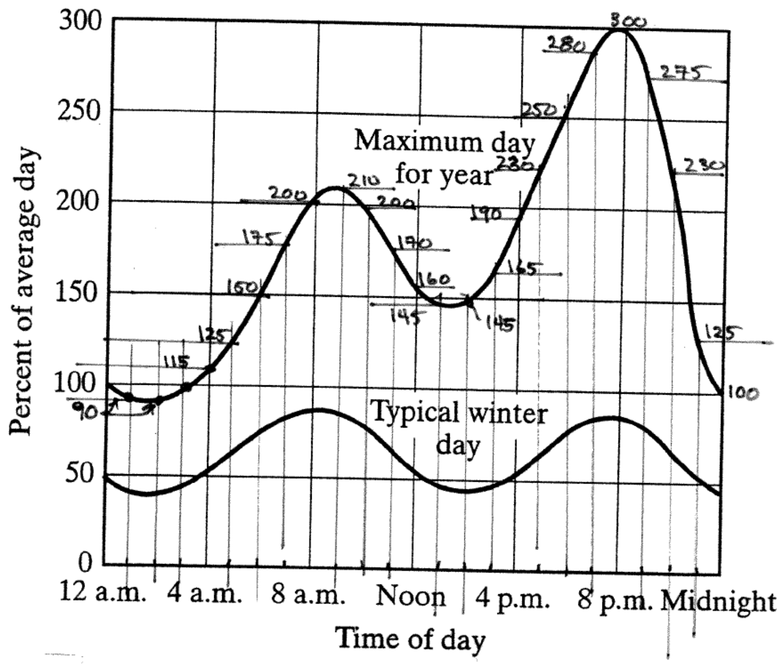
0

1.54

1.54

$\frac{1\,gal}{min} * \frac{ft^3}{7.48\,gal} * \frac{1\,min}{60\,sec}$

ILLUSTRATE BY EXAMPLE



DEMAND MULTIPLIERS – READ FROM CHART FOR HOUR OF DAY,
BUILD MULTIPIER TABLE

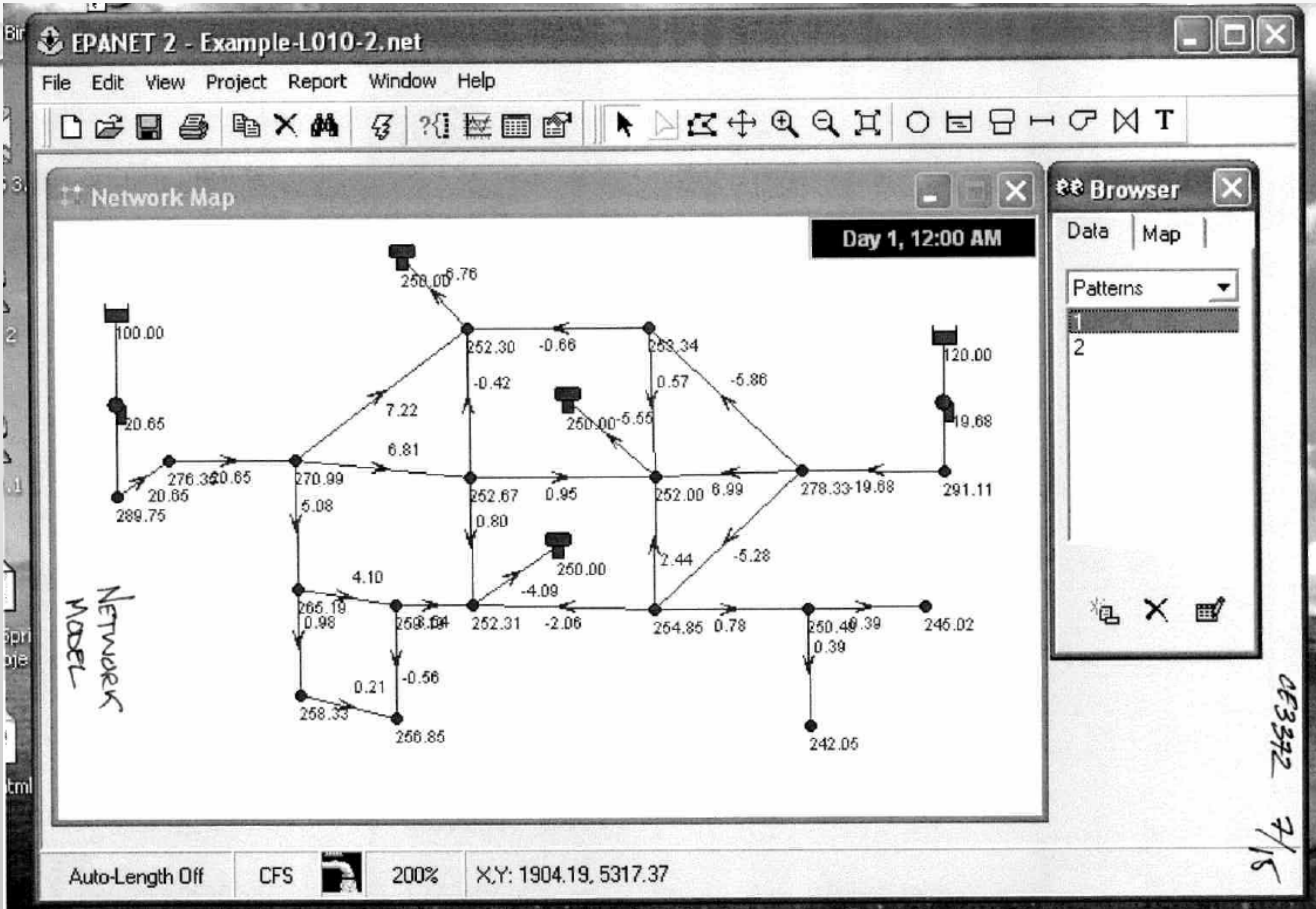
HOUR	FACTOR (MULTIPLIER)	CLOCK TIME
1	1.0	0:00
2	0.9	1:00
3	0.9	2:00
4	1.0	3:00
5	1.15	4:00
6	1.25	5:00
7	1.5	6:00
8	1.75	7:00
9	2.0	8:00
10	2.10	9:00
11	2.0	10:00
12	1.7	11:00
13	1.6	12:00
14	1.45	13:00
15	1.45	14:00
16	1.65	15:00
17	1.90	16:00
18	2.30	17:00
19	2.50	18:00
20	2.80	19:00
21	3.00	20:00
22	2.75	21:00
23	2.30	22:00
24	1.25	23:00

REPEATS CYCLE

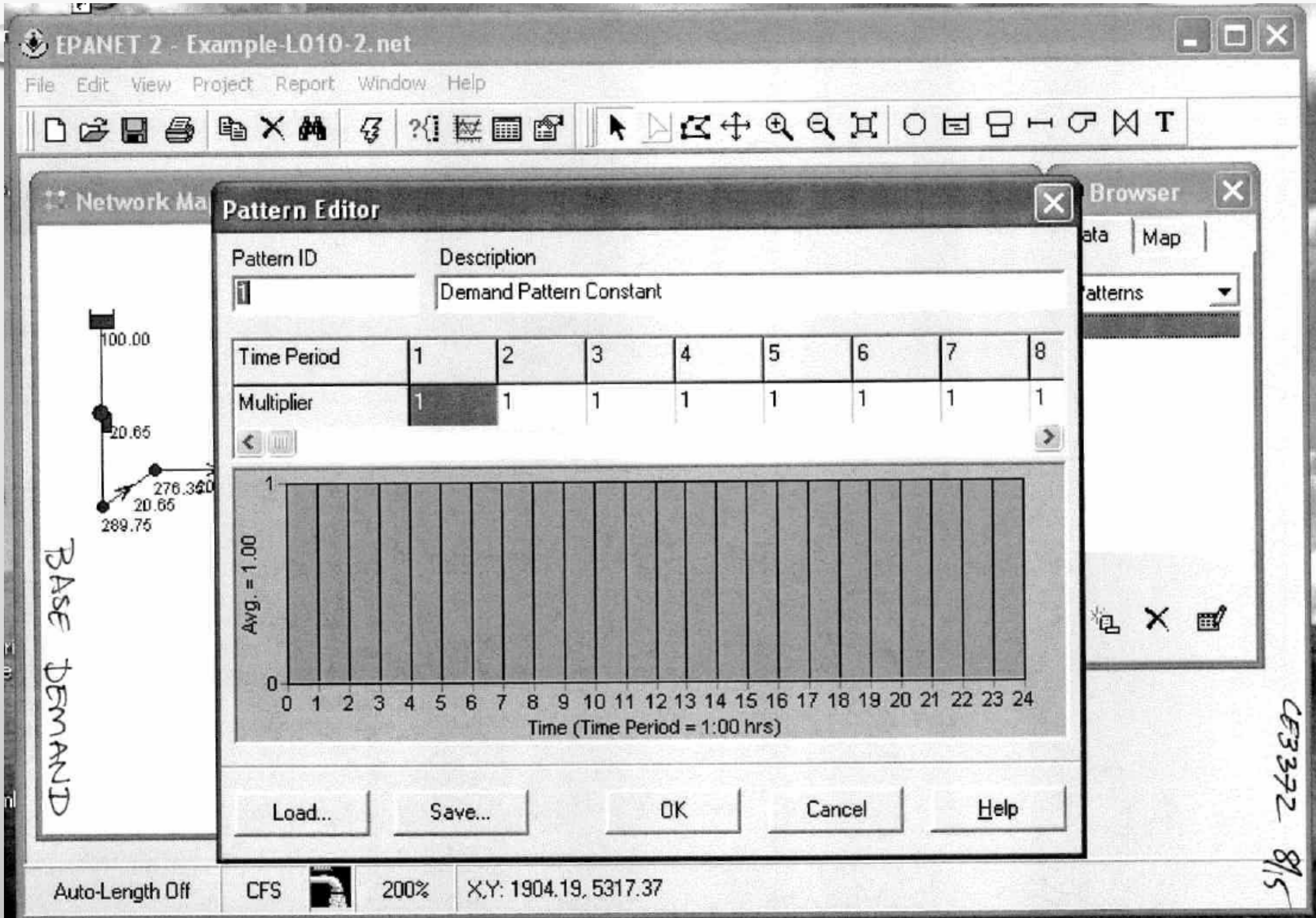
ILLUSTRATE BY EXAMPLE

- BUILD NETWORK LAYOUT
  - NODES (JUNCTIONS, TANKS, RESERVOIRS)
  - LINKS (PIPES, PUMPS, VALVES)
- ADD PUMP CURVES
  - BROWSER/DATA/CURVES/ADD (TYPE=PUMP)
- ADD STORAGE CURVES
  - BROWSER/DATA/CURVES/ADD (TYPE=STORAGE)
- ADD DEMAND PATTERN(S)
  - BROWSER/PATTERNS/ADD

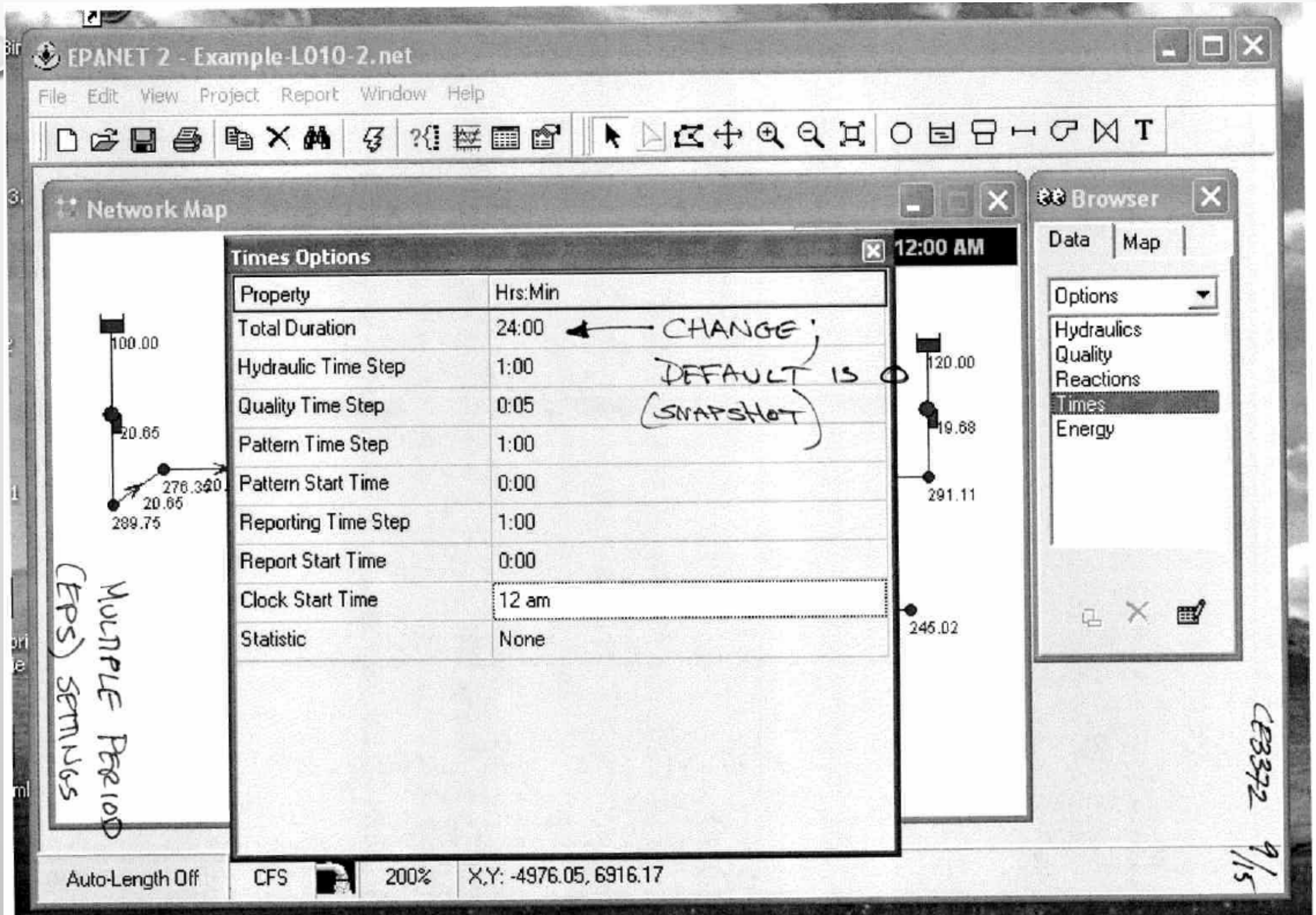
ILLUSTRATE BY EXAMPLE



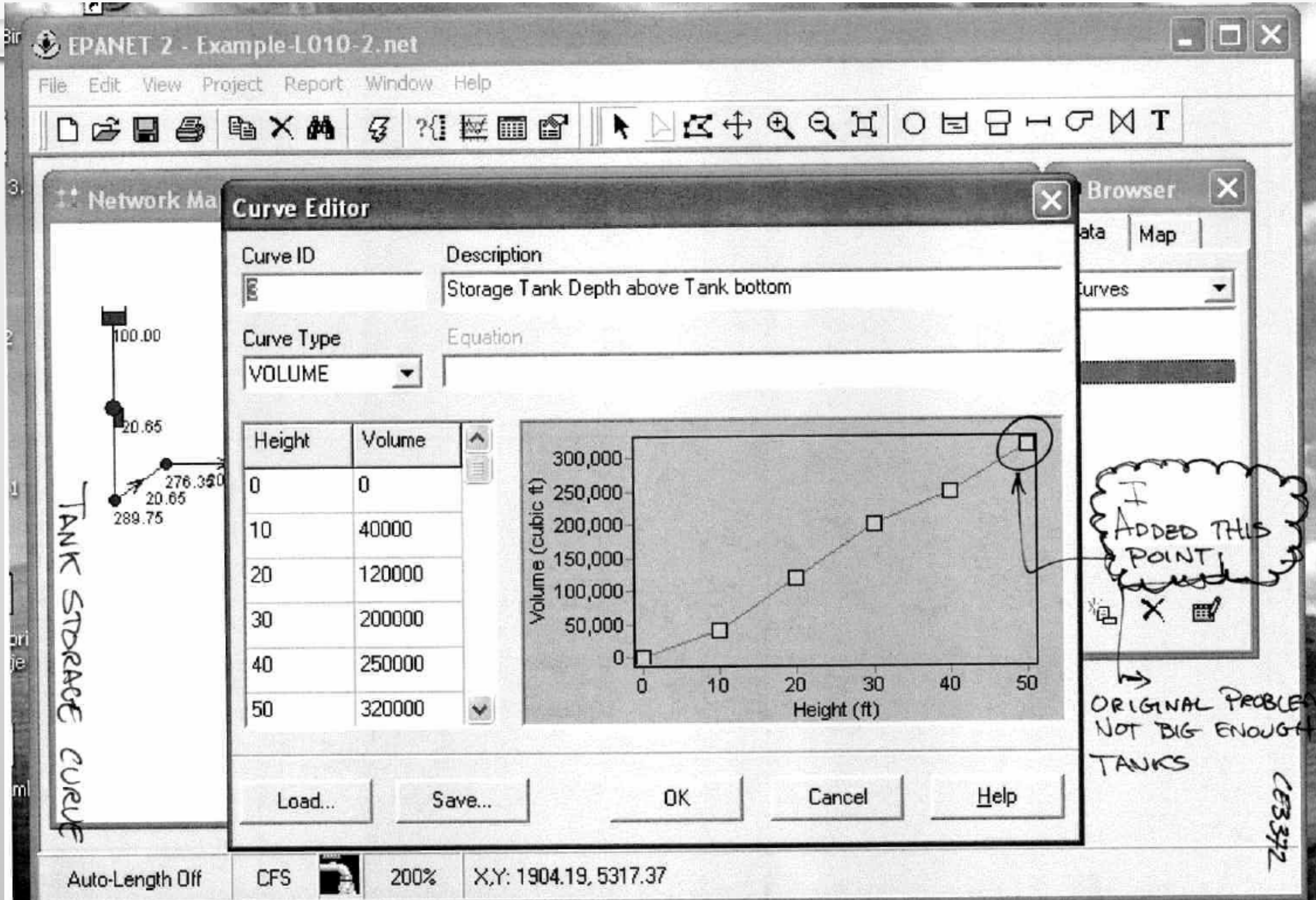
ILLUSTRATE BY EXAMPLE



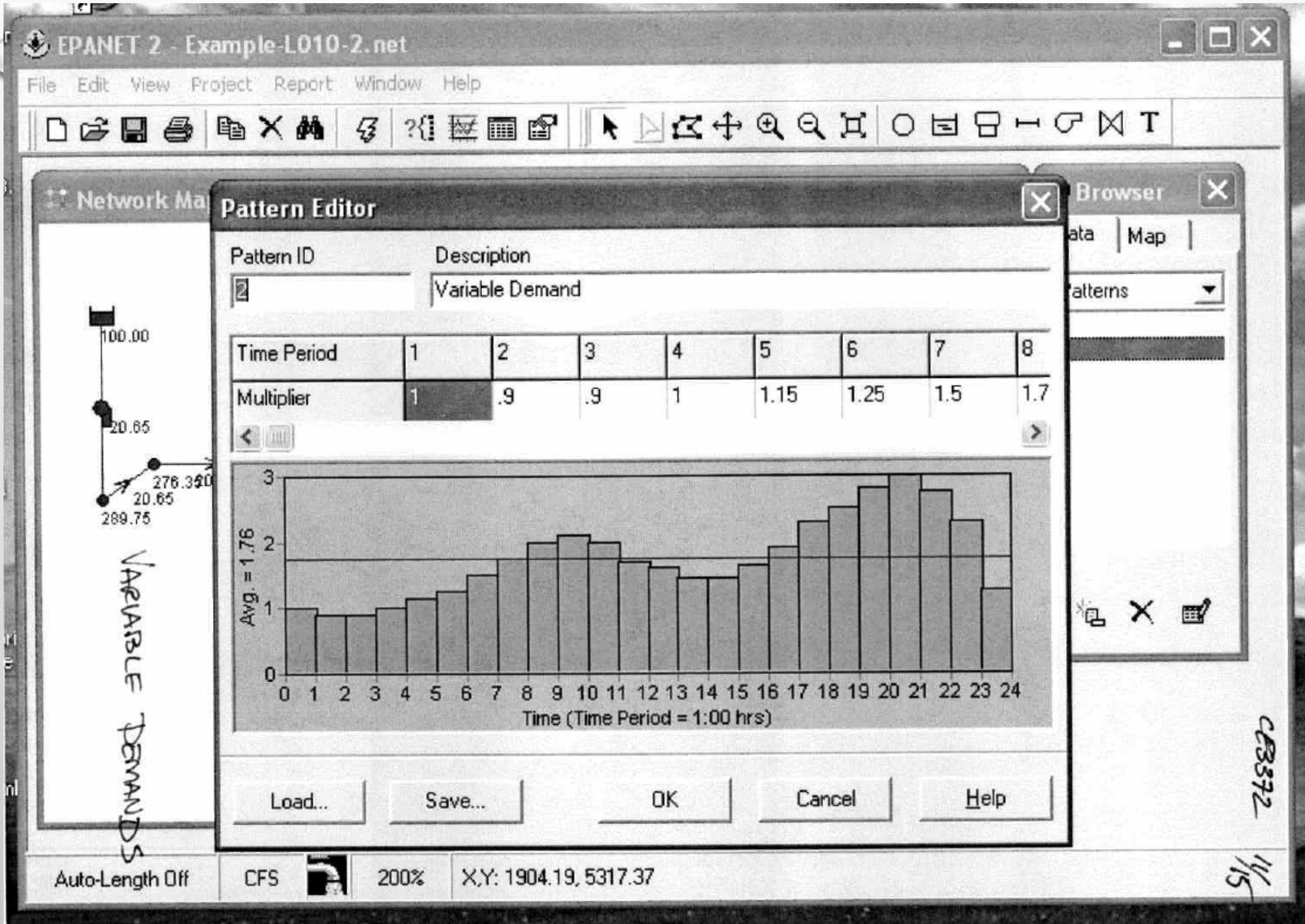
ILLUSTRATE BY EXAMPLE



ILLUSTRATE BY EXAMPLE



ILLUSTRATE BY EXAMPLE



REPORT OUTPUT

12/15

FIRST FEW PAGES OF ~~STATUS~~ FULL REPORT

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Page 1                                               9/27/2010 7:02:32 PM
**********************************************************************
*                             E P A N E T                            *
*                    Hydraulic and Water Quality                     *
*                    Analysis for Pipe Networks                      *
*                           Version 2.0                              *
**********************************************************************

Input File: Example-L010-2.net
```

SKILLED USER CAN INFER NETWORK FROM START & END NODES

Link - Node Table:

Link ID	Start Node	End Node	Length ft	Diameter in
3	17	1	2000	24
4	1	2	800	24
5	2	3	5000	18
6	3	4	3700	12
7	4	5	3900	15
8	5	18	2100	24
9	5	6	2900	15
10	4	6	2500	10
11	3	7	3100	12
12	2	7	5500	18
13	7	6	3700	15
14	2	10	3100	18
15	10	9	1900	15
16	9	8	2900	15
17	8	13	3100	15
18	13	14	1600	8
19	14	15	1750	6
20	14	16	2700	6
21	13	6	2500	15
22	13	5	4500	15
23	10	11	1600	8
24	11	12	1500	6
25	12	9	1650	8
26	7	8	2700	15
29	StorageTank1	3	700	18
30	StorageTank2	6	900	18
31	StorageTank3	8	1900	18
1	Left_Reservoir	17	#N/A	#N/A Pump
2	Right_Reservoir	18	#N/A	#N/A Pump

IPE#

TOPOLOGY

REPORT OUTPUT

Page 2
Energy Usage:

Pump	Usage Factor	Avg. Effic.	Kw-hr /Mgal	Avg. Kw	Peak Kw	Cost /day
1	100.00	75.00	802.66	438.17	452.22	0.00
2	100.00	75.00	714.04	378.48	391.05	0.00
					Demand Charge:	0.00
					Total Cost:	0.00

Node Results at 0:00 Hrs: ← 1st STRESS PERIOD

Node ID	Demand CFS	Head ft	Pressure psi	Quality	
1	0.00	276.35	80.75	0.00	
2	1.54	270.99	69.76	0.00	
3	1.54	252.30	68.16	0.00	
4	4.64	253.34	64.27	0.00	
5	1.54	278.33	77.27	0.00	
6	5.40	252.00	64.56	0.00	
7	4.64	252.67	67.45	0.00	
8	2.32	252.31	64.70	0.00	
9	0.00	259.19	65.94	0.00	
10	0.00	265.19	66.38	0.00	
11	0.77	258.33	62.11	0.00	
12	0.77	256.85	62.76	0.00	
13	0.00	254.85	62.76	0.00	
14	0.00	250.49	56.54	0.00	
15	0.39	245.02	47.67	0.00	
16	0.39	242.05	48.55	0.00	
17	0.00	289.75	82.22	0.00	
18	0.00	291.11	74.14	0.00	
Left_Reservoir	-20.65	100.00	0.00	0.00	Reservoir
Right_Reservoir	-19.68	120.00	0.00	0.00	Reservoir
StorageTank1	6.76	250.00	13.00	0.00	Tank

PRESSURES IN PSI

HEADS

REPORT OUTPUT

StorageTank2	5.55	250.00	13.00	0.00 Tank
StorageTank3	4.09	250.00	13.00	0.00 Tank

TANK BEHAVIOR

TANKS FILLING

Link Results at 0:00 Hrs:

Link ID	Flow CFS	VelocityUnit fps	Headloss ft/Kft	Status
3	20.65	6.57	6.70	Open
4	20.65	6.57	6.70	Open
5	7.22	4.09	3.74	Open
6	-0.66	0.84	0.28	Open
7	-5.86	4.78	6.41	Open
8	-19.68	6.26	6.09	Open
9	6.99	5.70	9.08	Open

Page 3

Link Results at 0:00 Hrs: (continued)

Link ID	Flow CFS	VelocityUnit fps	Headloss ft/Kft	Status
10	0.57	1.04	0.54	Open
11	-0.42	0.54	0.12	Open
12	6.81	3.85	3.33	Open
13	0.95	0.77	0.18	Open
14	5.08	2.88	1.87	Open
15	4.10	3.34	3.16	Open
16	3.54	2.89	2.37	Open
17	-2.06	1.68	0.82	Open
18	0.78	2.23	2.73	Open
19	0.39	1.99	3.12	Open
20	0.39	1.99	3.12	Open
21	2.44	1.99	1.14	Open
22	-5.28	4.31	5.22	Open
23	0.98	2.82	4.29	Open
24	0.21	1.09	0.99	Open
25	-0.56	1.59	1.42	Open
26	0.80	0.65	0.13	Open
29	-6.76	3.82	3.28	Open
30	-5.55	3.14	2.22	Open
31	-4.09	2.31	1.22	Open
1	20.65	0.00	-189.75	Open Pump
2	19.68	0.00	-171.11	Open Pump

PUMP BEHAVIOR

Node Results at 1:00 Hrs:

NEXT STRESS PERIOD

Node ID	Demand CFS	Head ft	Pressure psi	Quality
1	0.00	280.04	82.34	0.00
2	1.39	274.94	71.47	0.00
3	1.39	257.10	70.24	0.00
4	4.18	258.53	66.52	0.00

REPORT OUTPUT

30	-5.55	3.14	2.22	Open
31	-4.09	2.31	1.22	Open
1	20.65	0.00	-189.75	Open Pump
2	19.68	0.00	-171.11	Open Pump

PUMP BEHAVIOR

Node Results at 1:00 Hrs:

Node ID	Demand CFS	Head ft	Pressure psi	Quality	
1	0.00	280.04	82.34	0.00	
2	1.39	274.94	71.47	0.00	
3	1.39	257.10	70.24	0.00	
4	4.18	258.53	66.52	0.00	
5	1.39	281.90	78.82	0.00	
6	4.86	256.42	66.48	0.00	
7	4.18	257.20	69.41	0.00	
8	2.09	256.32	66.43	0.00	
9	0.00	263.43	67.78	0.00	
10	0.00	269.35	68.18	0.00	
11	0.69	263.37	64.29	0.00	
12	0.69	261.74	64.88	0.00	
13	0.00	259.08	64.59	0.00	
14	0.00	255.52	58.72	0.00	
15	0.35	251.06	50.29	0.00	
16	0.35	248.63	51.40	0.00	
17	0.00	292.78	83.53	0.00	
18	0.00	294.01	75.40	0.00	
Left_Reservoir	-20.13	100.00	0.00	0.00	Reservoir

NEXT STRESS PERIOD

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Node Results at 1:00 Hrs: (continued)

Node ID	Demand CFS	Head ft	Pressure psi	Quality	
Right_Reservoir	-19.14	120.00	0.00	0.00	Reservoir
StorageTank1	6.66	254.87	15.11	0.00	Tank
StorageTank2	6.12	253.99	14.73	0.00	Tank
StorageTank3	4.95	252.94	14.27	0.00	Tank

Link Results at 1:00 Hrs:

Link ID	Flow CFS	Velocity fps	Unit Headloss ft/Kft	Status

REPORT OUTPUT

1	19.25	0.00	-197.62	Open Pump
2	18.32	0.00	-178.24	Open Pump

Node Results at 6:00 Hrs:

Node ID	Demand CFS	Head ft	Pressure psi	Quality	
1	0.00	285.74	84.82	0.00	
2	2.31	281.07	74.12	0.00	
3	2.31	268.66	75.25	0.00	
4	6.96	265.69	69.63	0.00	
5	2.31	286.57	80.84	0.00	
6	8.10	266.66	70.91	0.00	
7	6.96	266.48	73.43	0.00	
8	3.48	266.24	70.73	0.00	
9	0.00	270.36	70.78	0.00	
10	0.00	275.37	70.79	0.00	
11	1.15	263.58	64.38	0.00	
12	1.15	262.89	65.38	0.00	
13	0.00	268.12	68.52	0.00	
14	0.00	258.51	60.02	0.00	
15	0.58	246.50	48.31	0.00	
16	0.58	239.97	47.65	0.00	
17	0.00	297.44	85.55	0.00	
18	0.00	297.78	77.03	0.00	
Left_Reservoir	-19.28	100.00	0.00	0.00	Reservoir
Right_Reservoir	-18.41	120.00	0.00	0.00	Reservoir
StorageTank1	1.37	268.55	21.04	0.00	Tank
StorageTank2	-1.24	266.76	20.26	0.00	Tank
StorageTank3	1.66	265.85	19.86	0.00	Tank

← TANK DRAINING

REPORT OUTPUT

23	1.30	3.72	7.30	Open
24	0.14	0.73	0.46	Open
25	-1.01	2.90	4.52	Open
26	0.64	0.52	0.09	Open
29	-1.37	0.78	0.15	Open
30	1.24	0.70	0.12	Open
31	-1.66	0.94	0.21	Open
1	19.28	0.00	-197.44	Open Pump
2	18.41	0.00	-177.78	Open Pump

) PUMPS PRODUCING LESS Q

Node Results at 7:00 Hrs:

Node ID	Demand CFS	Head ft	Pressure psi	Quality
1	0.00	285.05	84.51	0.00
2	2.69	280.32	73.80	0.00
3	2.69	269.26	75.51	0.00
4	8.12	262.59	68.28	0.00
5	2.69	284.82	80.08	0.00
6	9.45	265.78	70.53	0.00
7	8.12	265.85	73.16	0.00
8	4.06	266.43	70.81	0.00
9	0.00	269.68	70.49	0.00
10	0.00	274.44	70.39	0.00
11	1.35	259.39	62.56	0.00
12	1.35	258.86	63.63	0.00

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Node Results at 7:00 Hrs: (continued)

Node ID	Demand CFS	Head ft	Pressure psi	Quality
13	0.00	267.47	68.23	0.00
14	0.00	254.47	58.27	0.00
15	0.68	238.23	44.73	0.00
16	0.68	229.42	43.08	0.00
17	0.00	296.87	85.31	0.00
18	0.00	296.36	76.42	0.00
Left_Reservoir	-19.39	100.00	0.00	0.00 Reservoir
Right_Reservoir	-18.69	120.00	0.00	0.00 Reservoir
StorageTank1	-0.20	269.26	21.34	0.00 Tank
StorageTank2	-2.25	266.13	19.99	0.00 Tank
StorageTank3	-1.36	266.70	20.23	0.00 Tank

] TANKS DRAINING

Link Results at 7:00 Hrs:

Link ID	Flow CFS	VelocityUnit fps	Headloss ft/Kft	Status

NEXT TIME

- WATER QUALITY IN EPANET