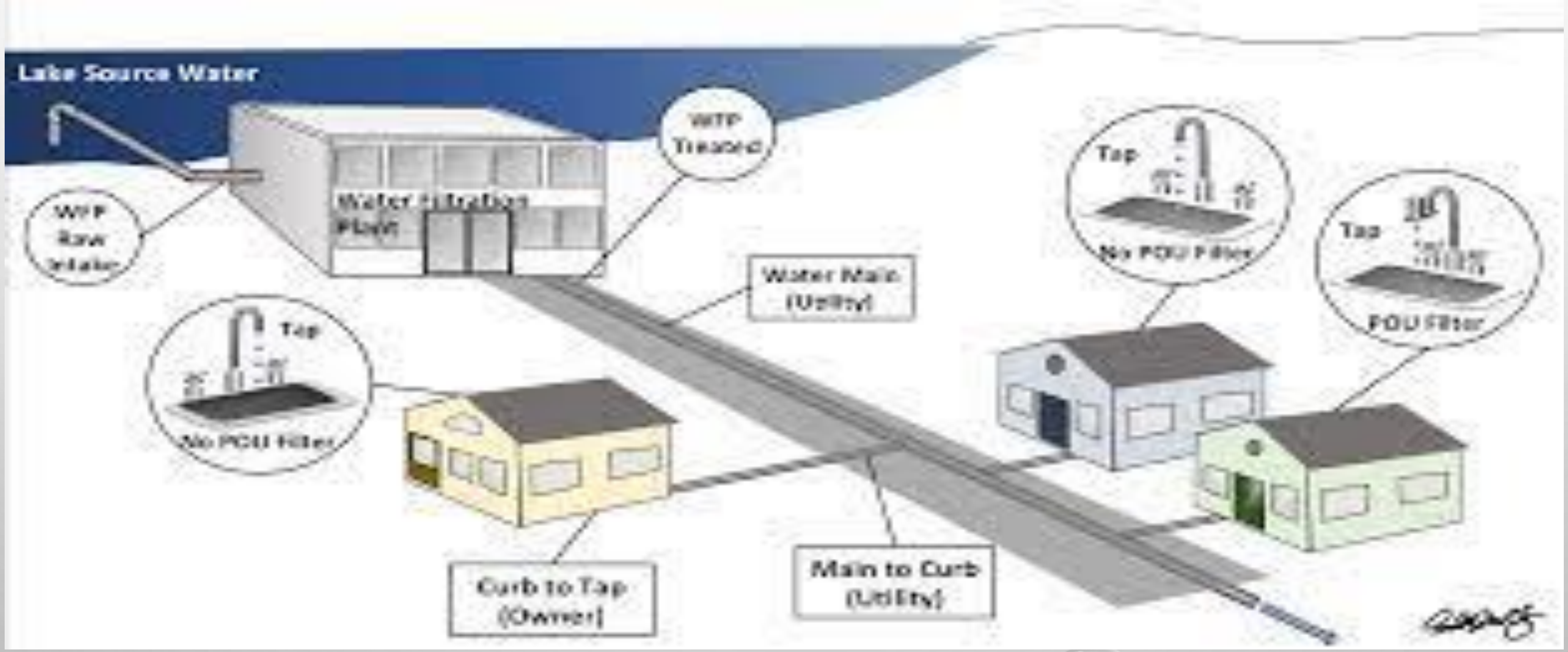
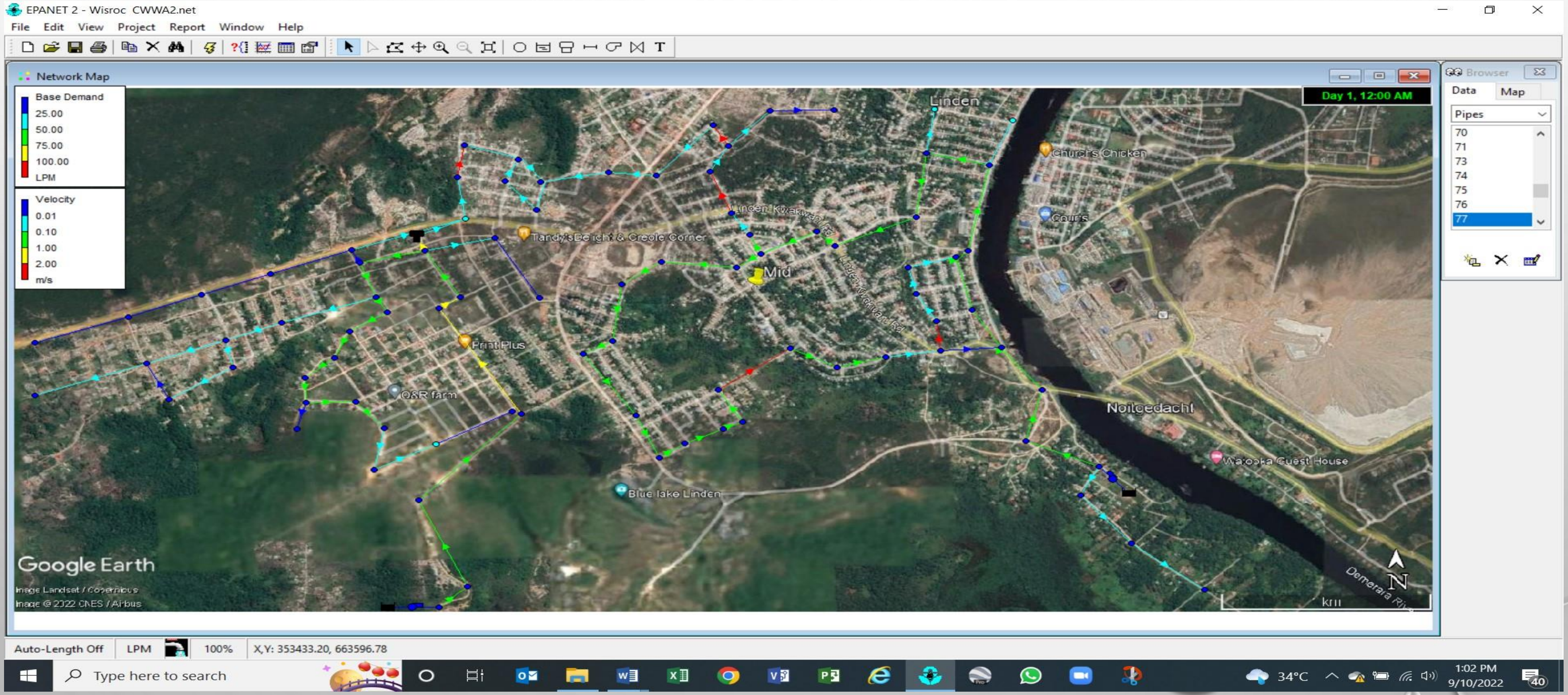
PRINCIPLES REQUIRED FOR THE FORMATION OF A DISTRICT METERED AREA

WATER DISTRIBUTION SYSTEM

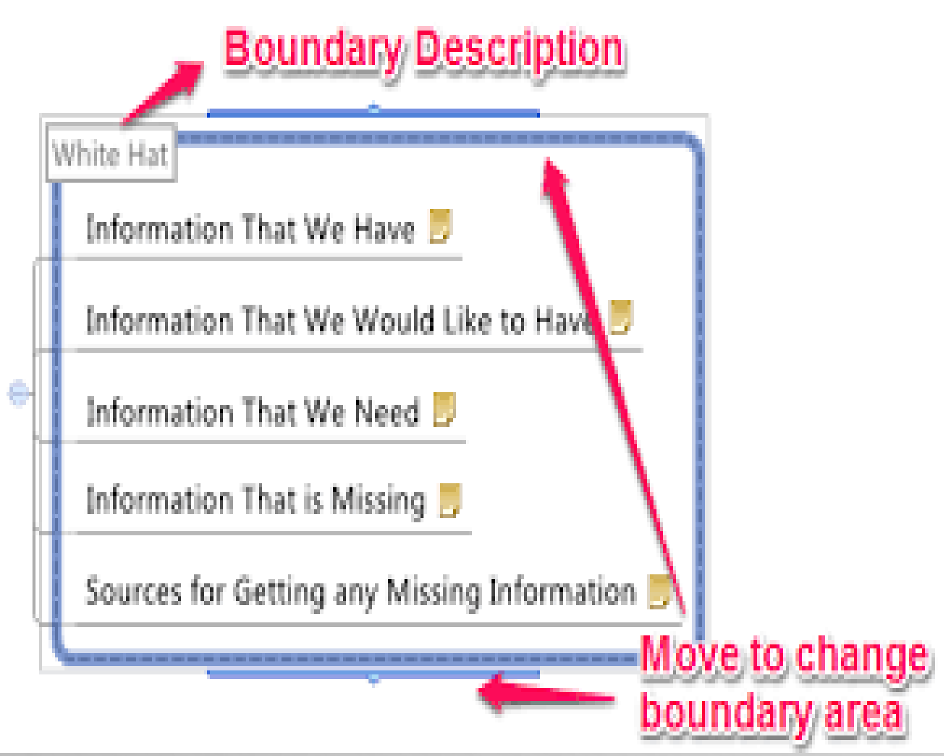


MANAGEMENT OF HIDDEN ASSETS

ADJUSTMENT OF MAZE IN QUESTION

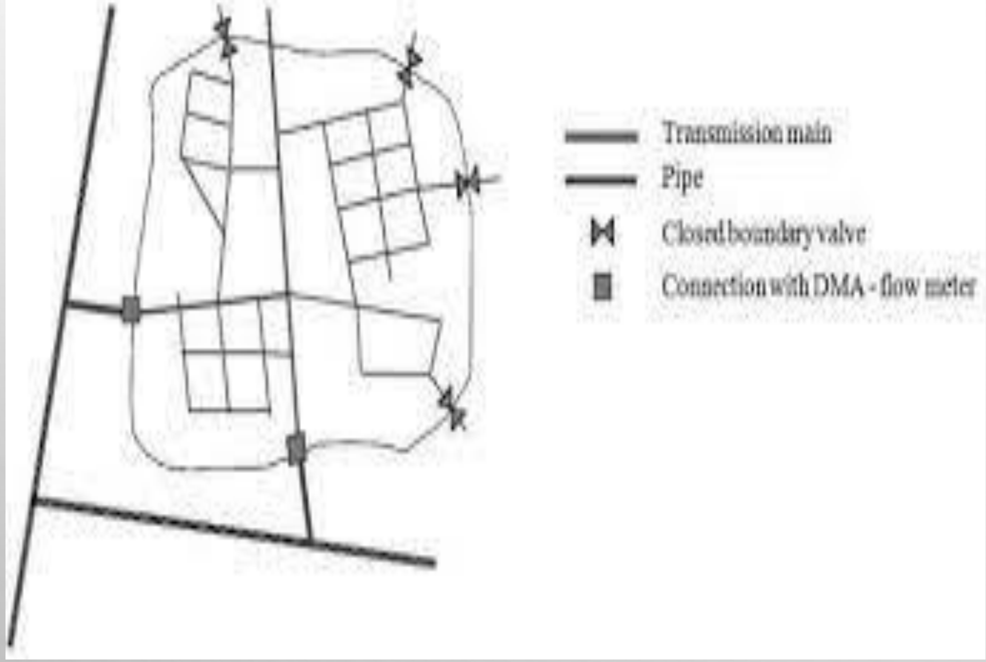


BOUNDARY SCALE NETWORK



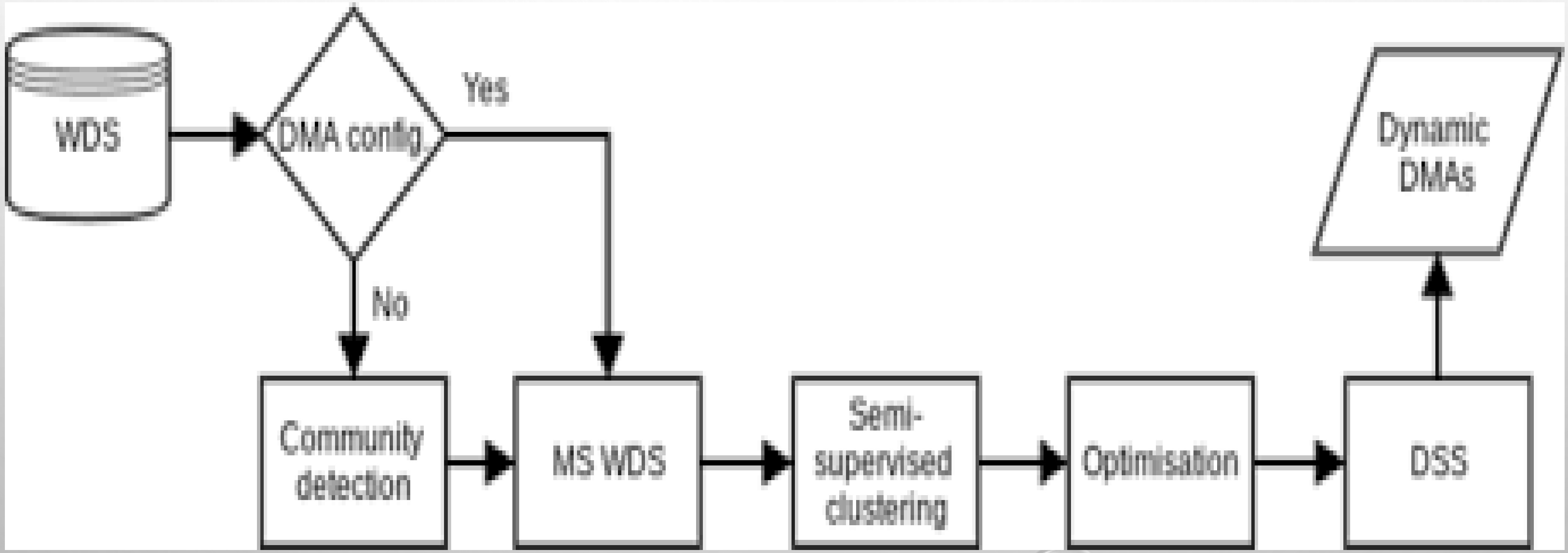
- SINGLE ASSETS : LINKS OR PIPES, NODES OR JUNCTIONS, TANKS RESERVOIRS AND PUMP STATIONS
- BOUNDARY NODES : JUNCTIONS LOCATED ALONG BOUNDARIES CAN BE INLETS FOR FLOW.

DISTRICT METERED AREAS



- CLOSED TO MEASURE
- LABOR INTENSIVE
- COST
- RECORD KEEPING CHALLENGES

DYNAMIC DMAS



RESILIENCE INDEX (IR)

- THE RESILIENCE INDEX (IR) ALLOWS THE DESIGNERS OR IN THE CASE OF WELL ESTABLISHED NETWORKS NRW PLANNERS TO ASSESS THE VIABILITY OF THE PROPOSED DMA BASED ON SHAPE OR UNITY AND NOT THE NORMAL CONSTRAINTS SUCH AS DEMAND AND PRESSURE ETC. THE MAIN INPUTS ARE A WELL CALIBRATED MODEL (EPANET) AND AN OPTIMUM USE OF VALVES.

DYNAMIC DMA PARAMETERS

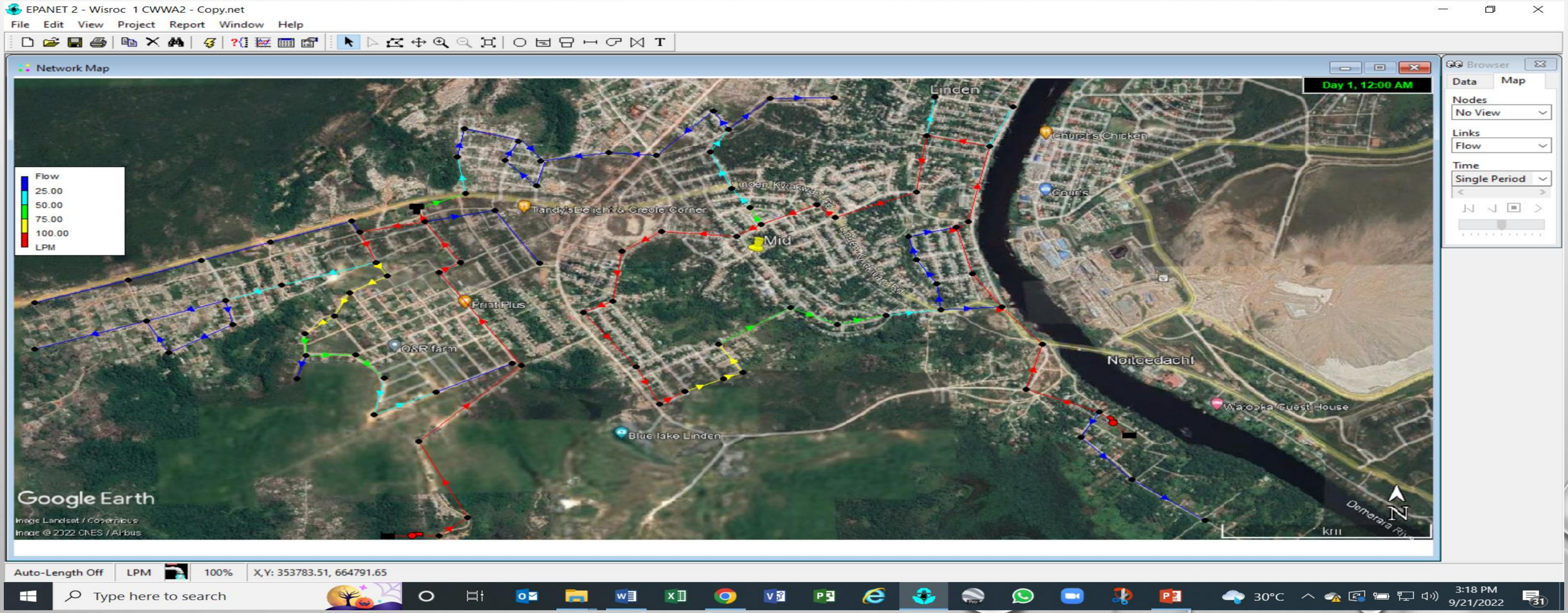
- NEC – NO OF BOUNDARY LINKS BETWEEN CLUSTERS
- NFM – FLOW METERS OR GATE VALVES
- NGV = NEC – NFM – NUMBER OF VALVES OR CLOSED PIPES
- HMIN HMAX HMEAN PRESSURE MAX, MIN, MEAN.

FORMULA

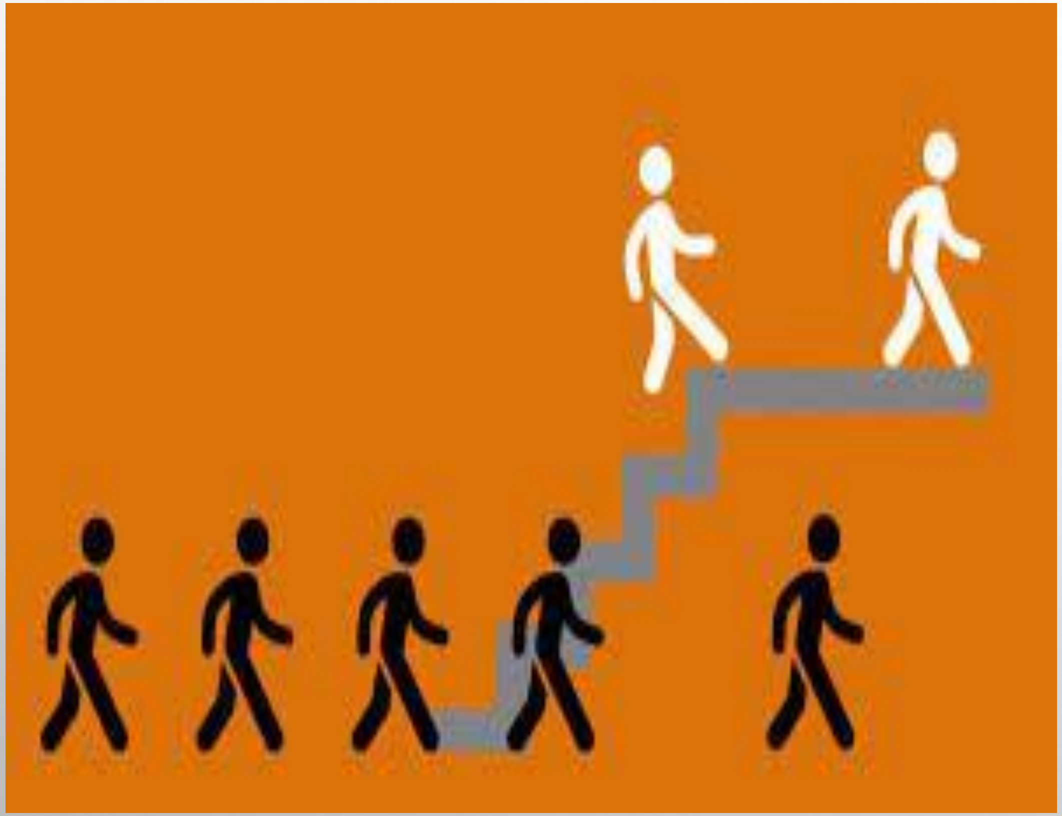
$$I_r = \frac{\sum_{i=1}^{n_n} Q_i (h_i - h^*)}{\sum_{r=1}^{n_r} Q_r H_r - \sum_{i=1}^{n_n} Q_i h^*}$$

- QI- DISCHARGE AT A SPECIFIC POINTS ON THE BOUNDARY OF DMA
- HI – HEAD AT SAME SPECIFIC POINTS ON BOUNDARY
- H* - DESIGN HEAD WITHIN DMA VALUE MUST BE WITHIN RANGE OF HMIN AND HMAX AT SAME SPECIFIC POINTS
- QR – DISCHARGE AT ENTRY POINT OF DMA
- HR HEAD AT ENTRY POINT OF DMA
- IR – THE CLUSTER BALANCED INDEX, HOW WELL THE CLUSTERS ARE BALANCED WITH RESPECT TO THEIR NUMBER OF NODES.

IMPORTANCE OF FLOW

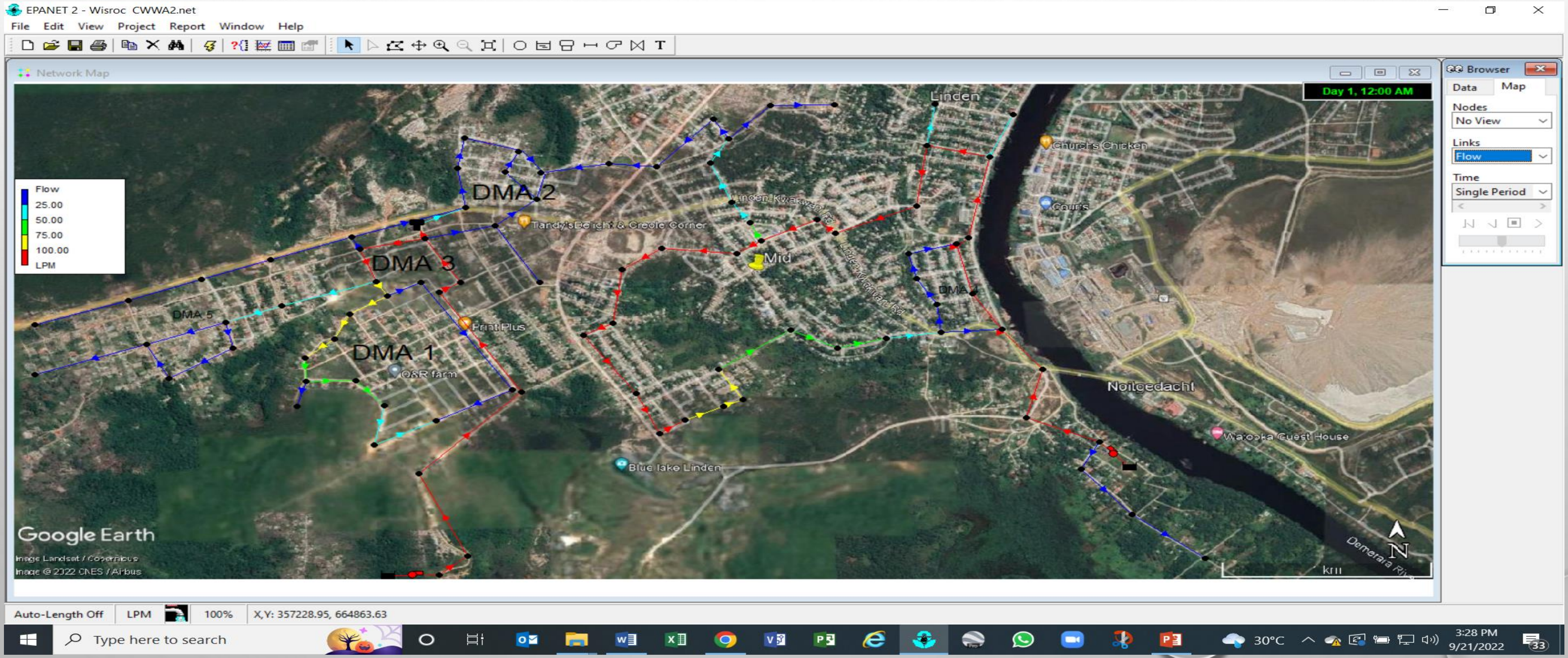


ECONOMIC CRITERION



- AN ECONOMIC CRITERION FOR SELECTING A FINAL OPTIMUM SOLUTION BETWEEN THE SET OF CONFIGURATIONS SATISFYING THE HYDRAULIC CRITERIA.
- AN OPTIMAL RESILIENCE INDEX FOR THE WDS
- AN OPTIMAL HEAD PRESSURE MANAGEMENT TO LEAKAGE CONTROL.

3 # DMAS



EPANET 2 - Wisroc CWWA2.net
File Edit View Project Report Window Help
Network Map
Day 1, 12:00 AM
Flow
25.00
50.00
75.00
100.00
LPM
DMA 2
DMA 3
DMA 5
DMA 1
Linden
Mid
Noitgedacht
Blue lake Linden
Print Plus
Q&R farm
Google Earth
Browser
Data Map
Nodes
No View
Links
Flow
Time
Single Period
Auto-Length Off
LPM
100%
X,Y: 357228.95, 664863.63
Type here to search
30°C
3:28 PM
9/21/2022

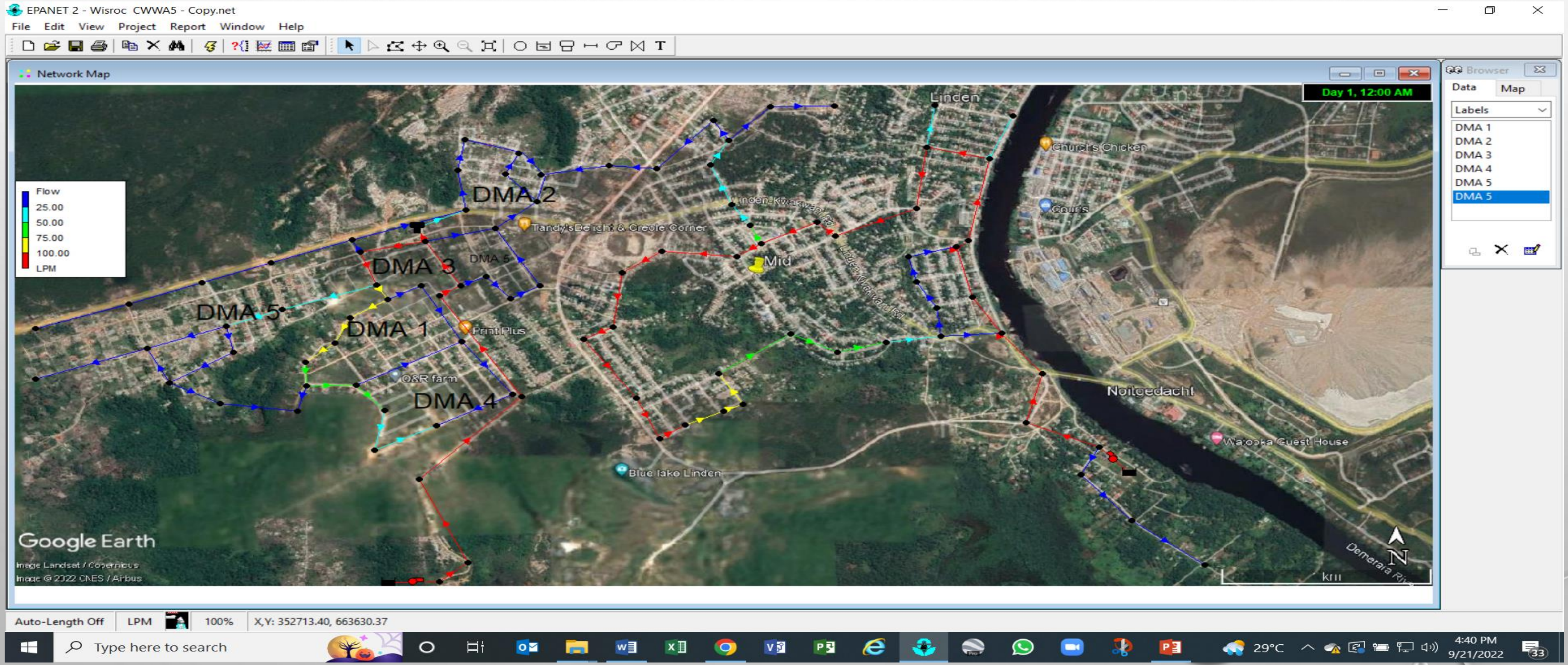
FIELD DATA

						h*	10			
	Hmin	Hmean	Hmax	Q i	Pipe	Qi	Hi	QiHi	QiH*	
	6.00	5.68	11.00	Pipe	Qr 29	12.00	9.10	109.2	120	
					21	8.00	11.00	88	80	
					20	2.00	8.00	16	20	
					43			0		
		Hr			35	4.00	6.00	24	40	
Qr	12.00	9.10	436.80	Sum		26.00		237.2	260	FALSE
Qi h*			260.00		Mean	4.33				
Amt Pipes	4									
								-22.8		
								176.80	Ir=	-0.129

3 DMAS; DESIGN HEIGHT MODIFIED

		3DMAs	Modified h* adjusted, Qih* > Qihi							
						h*	9			
	Hmin	Hmean	Hmax	Q i	Pipe	Qi	Hi	QiHi	QiH*	
	6.00	5.68	11.00	Pipe	Qr 29	12.0 0	9.10	109.2	108	
					21	8.00	11.00	88	72	
					20	2.00	8.00	16	18	
					43			0		
		Hr			35	4.00	6.00	24	36	
Qr	12.00	9.10	436.80	Sum		26.0 0		237.2	234	True
Qi h*			234.00		Mean	4.33				
Amt Pipes	4									
								3.2		
								202.80	Ir=	0.0158

5 DMAS


EPANET 2 - Wisroc CWWA5 - Copy.net
File Edit View Project Report Window Help
Network Map
Day 1, 12:00 AM
Flow
25.00
50.00
75.00
100.00
LPM
DMA 2
DMA 3
DMA 5
DMA 1
DMA 4
Linden
Church's Chicken
Courts
Tandy'sDelight & Creole Corner
Mid
Print Plus
Noitgedacht
Blue lake Linden
Google Earth
Browser
Data
Map
Labels
DMA 1
DMA 2
DMA 3
DMA 4
DMA 5
DMA 5
Auto-Length Off
LPM
100%
X,Y: 352713.40, 663630.37
Type here to search
29°C
4:40 PM
9/21/2022

5 DMAS 3 PIPES ADDED, IR IMPROVES

						h*	10			
	Hmin	Hmean	Hmax	Q i	Pipe	Qi	Hi	QiHi	QiH*	
	6.00	5.68	11.00	Pipe	Qr 29	12.00	9.10	109.2	120	
					21	8.00	11.00	88	80	
					20	2.00	8.00	16	20	
					43			0		
					35	4.00	6.00	24	40	
					98	4.00	5.00	20		
					6	7.00	4.00	28		
		Hr			7	9.00	6.00	54		
Qr	12.00	9.10	436.80	Sum		46.00		339.2	260	True
Qi h*			260.00		Mean	7.67				
Amt Pipes	7									
								79.2		
								176.80	Ir=	0.448

FLOW INCREASED IR DECREASED

	Hmin	Hmean	Hmax	Q i	Pipe	Qi	Hi	QiHi	QiH*	
	6.00	5.68	11.00	Pipe	Qr 29	20.00	9.10	182	180	
					21	8.00	11.00	88	72	
					20	2.00	8.00	16	18	
					43			0		
					35	4.00	6.00	24	36	
					98	4.00	5.00	20		
					6	7.00	4.00	28		
		Hr			7	9.00	6.00	54		
Qr	20.00	9.10	728.00	Sum		54.00		412	306	True
Qi h*			306.00		Mean	9.00				
Amt Pipes	7									
								106		
								422.00	Ir=	0.2512

PRESSURE REGULATED IR INCREASED

						h*	9			
	Hmin	Hmean	Hmax	Q i	Pipe	Qi	Hi	QiHi	QiH*	
	6.00	5.68	11.00	Pipe	Qr 29	10.00	9.10	91	90	
					21	8.00	11.00	88	72	
					20	2.00	8.00	16	18	
					43			0		
					35	4.00	6.00	24	36	
					98	4.00	5.00	20		
					6	7.00	4.00	28		
		Hr			7	9.00	6.00	54		
Qr	10.00	9.10	364.00	Sum		44.00		321	216	True
Qi h*			216.00		Mean	7.33				
Amt Pipes	7									
								105		
								148.00	Ir=	0.7095

CONCLUSION

- BASED ON THE RESULTS FROM THE FIVE TABLES THE SIZE OF THE DMAS CAN BE ADJUSTED TO SUIT THE PARTICULAR REQUIREMENTS. THE SMALLER THE AREA THE MORE ACCURATE THE INFORMATION HOWEVER LARGE AREAS ARE POSSIBLE SINCE THERE ARE MUCH EASIER TO MANAGE AND STILL GIVE RELIABLE RESULTS. 3 AS OPPOSED TO 5 DMAS.
- ALSO BY THE USE OF DYNAMIC DMAS EXPANSION OF THE NETWORK CAN BE DONE WITH A DMA FOCUS.

ANY QUESTIONS ?

REFERENCES

- AUTOMATIC MULTI SCALED APPROACH FOR WATER NETWORK PARTITIONING INTI DISTRICT METERED AREAS BY *CARLO GIUDICIANI, MANUEL HERRERA, ARMANDO DI NARDO, KENRI A DEYEYE*
- MULTILEVEL OPTIMIZATION: ALGORITHMS AND APPLICATIONS, BY *A. MIGDALAS, P. VARBRAND*