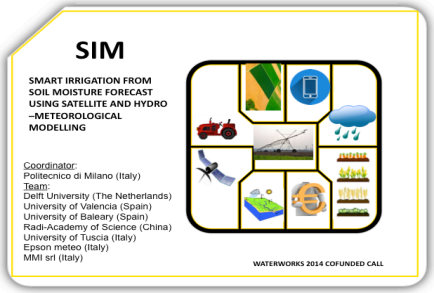
THE IRRIGATION DISTRIBUTION SCHEMES

CASE STUDY : CAPITANATA IRRIGATION CONSORTIUM

RESULTS AND DISCUSSION



Ing. Stefania Meucci – C.E.O. M.M.I. ltd

Ing. Carlo Maiorano – M.M.I. ltd

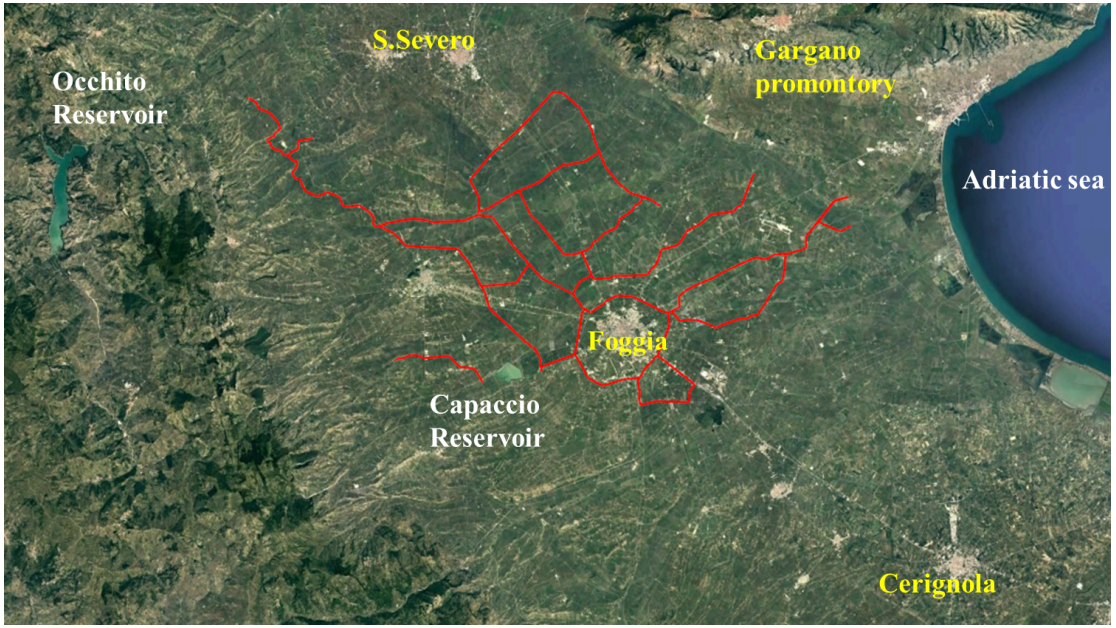
CAPITANATA CASE STUDY

SOUTH FORTORE IRRIGATION DISTRICT

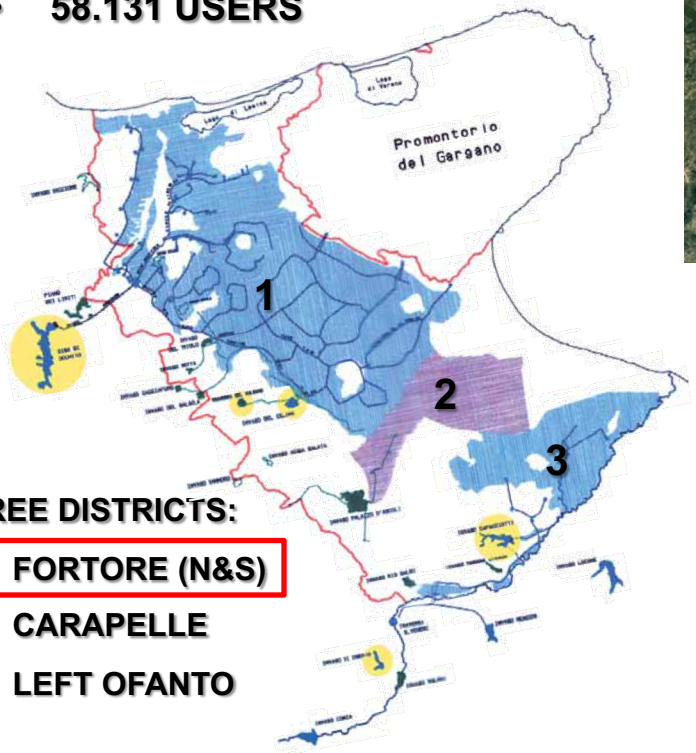
Hydrological Monitoring and Modelling

CONSORZIO PER LA BONIFICA DELLA CAPITANATA

A DISTRICT OF IRRIGATION CONSORTIUM OF CAPITANATA



- 5.907 KM OF PIPELINES (PRIMARY AND SECONDARY NETWORK)
- 144.316 HA OF LANDS
- 37 DISTRICTS
- 58.131 USERS



THREE DISTRICTS:

1. FORTORE (N&S)
2. CARAPELLE
3. LEFT OFANTO

South Fortore District

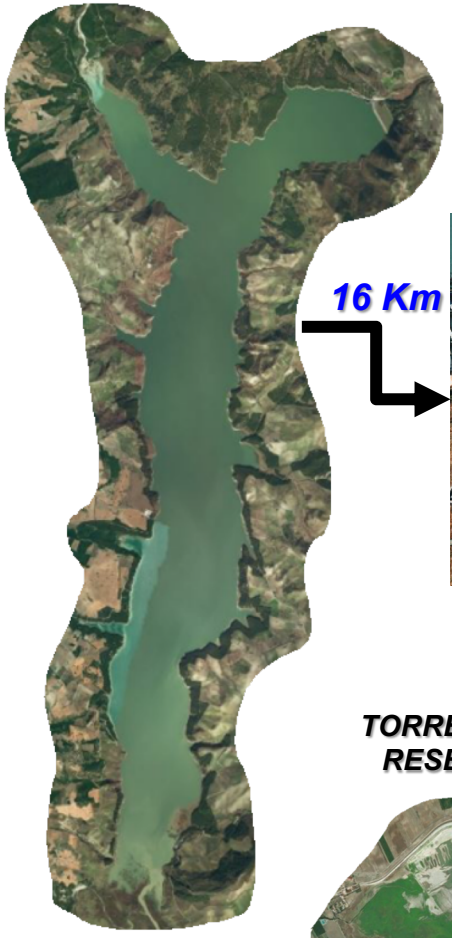
- 54.000 HA OF IRRIGATED LAND
- PRESSURIZED NETWORK
- IRRIGATION ON DEMAND
- 2 RESERVOIRS

CAPITANATA SOUTH FORTORE DISTRICT

WATER SUPPLY SCHEME

Hydrological Monitoring and Modelling

OCCHITO RESERVOIR

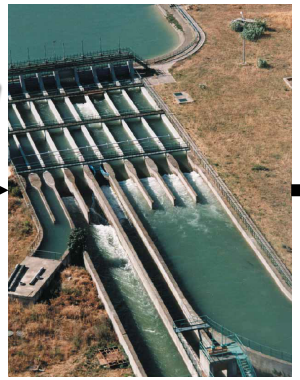


250.000.000 m³

192 m asl

16 Km

FINOCCHITO PARTITOR RESERVOIR



30.000 m³

156 m asl

21 Km

TAVOLIERE RESERVOIR

40.000 m³

143 m asl

TORREBIANCA RESERVOIR

16.800.000 m³

147 m asl

CELONE RESERVOIR

40.000 m³

130 m asl

PRESSURIZED NETWORK

PIEZOMETRIC TOWER P1

74 m asl

PIEZOMETRIC TOWER P2

72 m asl

PIEZOMETRIC TOWER P3

53 m asl

IRRIGATION AQUEDUCT

HYDRAULIC MODEL OF PRESSURIZED NETWORK

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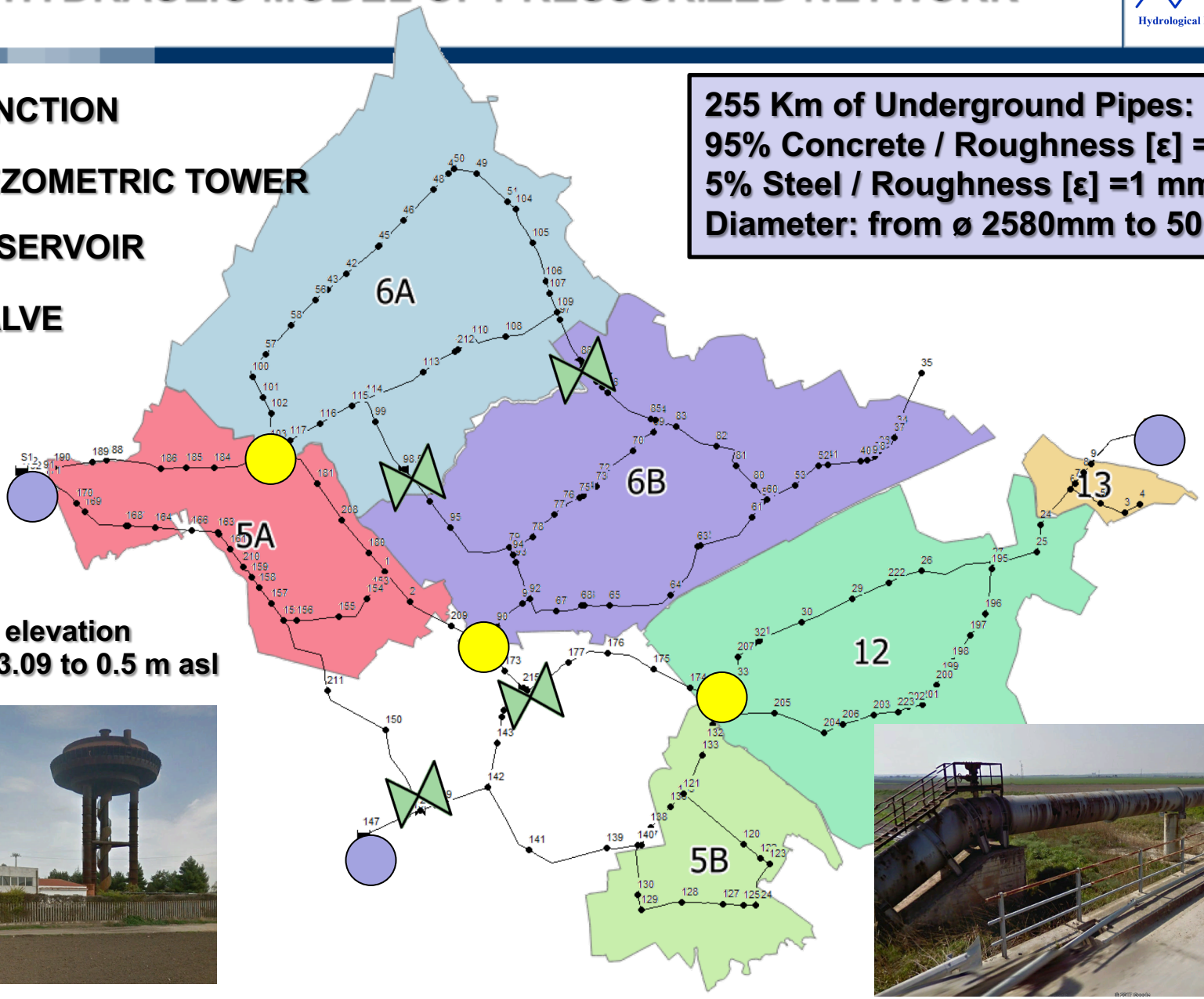
JUNCTION

PIEZOMETRIC TOWER

RESERVOIR

VALVE

255 Km of Underground Pipes:
95% Concrete / Roughness [ε] =10 mm
5% Steel / Roughness [ε] =1 mm
Diameter: from ø 2580mm to 500mm



Network elevation
From 143.09 to 0.5 m asl

SIM PROJECT

Hydrological Monitoring and Modelling

MAIN TARGET:

INPACTS ON PRESSURED IRRIGATION ACQUEDUCT OF SIM IRRIGATION STATEGY → LESS IRRIGATION WATER NEED → REDUCTION OF PEAK DISCAHRGE

Activities

- **STUDY AND ANALYSIS OF ONE OF THE ITALIAN LARGEST PRESSURE IRRIGATION NETWORK** ✓

- **A HYDRAULIC MODEL OF THE NETWORK FOR THE EVALUATION OF BENEFITS FROM WATER SAVING** ✓

- **AN INTERACTION WITH F.E.S.T. – E.W.B. HYDROLOGICAL MODEL OF POLITECNICO DI MILANO FOR THE EVALUATION OF THE CORRECT IRRIGATION DEMAND OF PLANTATIONS** ✓

HYRAULIC MODEL OF THE NETWORK
CALIBRATION PHASE USING EPANET

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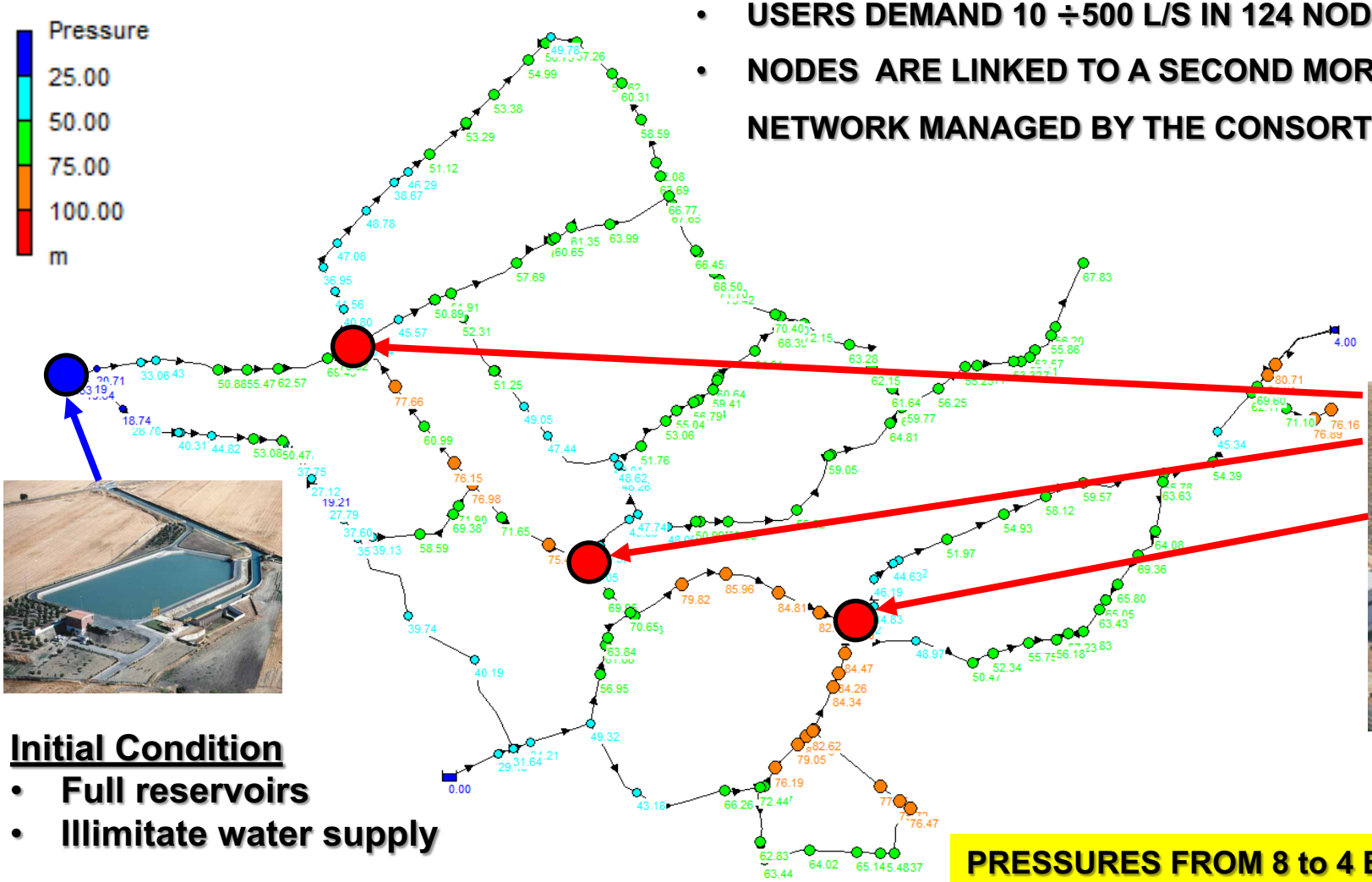
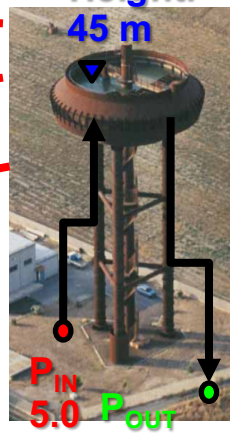
SIMULATION: Design Flow Rate

- USERS DEMAND 10 ÷500 L/S IN 124 NODES
- NODES ARE LINKED TO A SECOND MORE COMPLEX NETWORK MANAGED BY THE CONSORTIUM



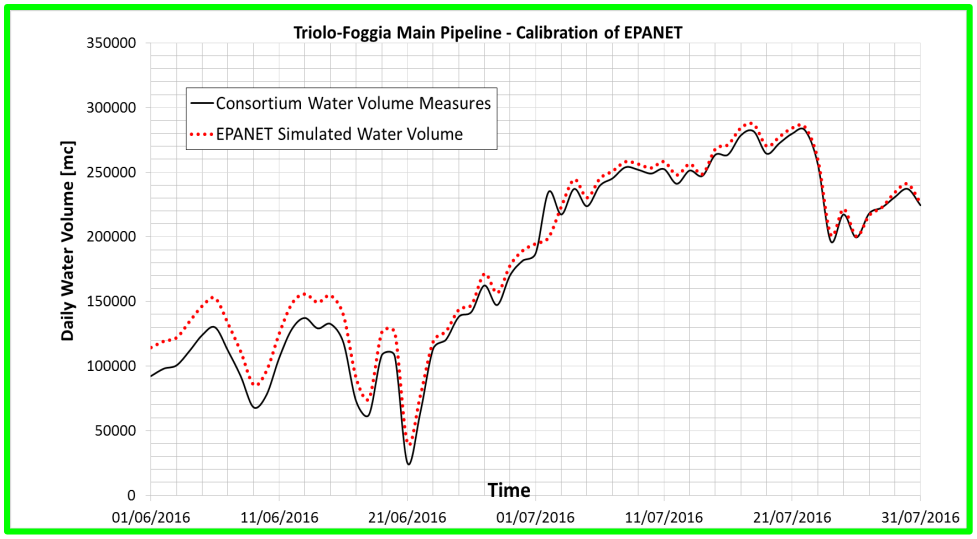


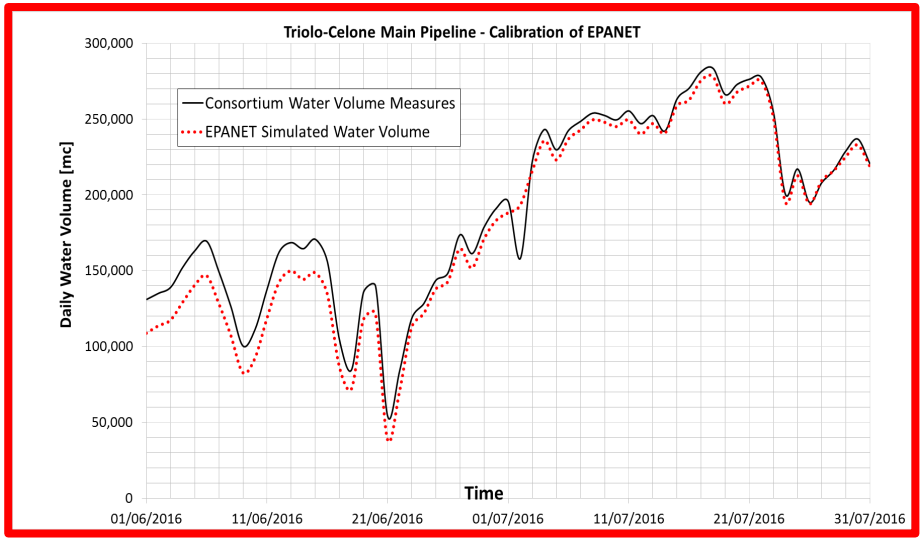
Initial Condition

- Full reservoirs
- Illimitate water supply

PRESSURES FROM 8 to 4 BAR

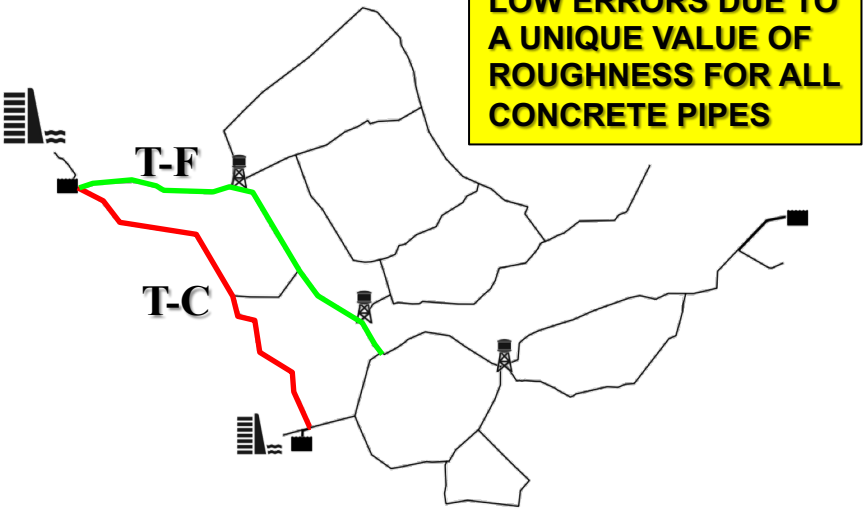
HYDRAULIC MODEL CALIBRATION





CALIBRATION WITH OBSERVED DAILY VOLUME VALUES

LOW ERRORS DUE TO A UNIQUE VALUE OF ROUGHNESS FOR ALL CONCRETE PIPES



EPANET PIPE HEADLOSS FORMULAS

Formula	*Resistance Coefficient (A)*	*Flow Exponent (B)*
Hazen-Williams	$4.727\ C^{-1.852}\ d^{-4.871}\ L$	1.852
Darcy-Weisbach	$0.0252\ f(\varepsilon,d,q)d^{-5}L$	2
Chezy-Manning	$4.66\ n^2\ d^{-5.33}\ L$	2

Notes: C = Hazen-Williams roughness coefficient
ε = Darcy-Weisbach roughness coefficient (ft)
f = friction factor (dependent on ε, d, and q)
n = Manning roughness coefficient
d = pipe diameter (ft)
L = pipe length (ft)
q = flow rate (cfs)

FROM SUB-DISTRICT AGGREATED DAILY VOLUME TO NODES DISCHARGE

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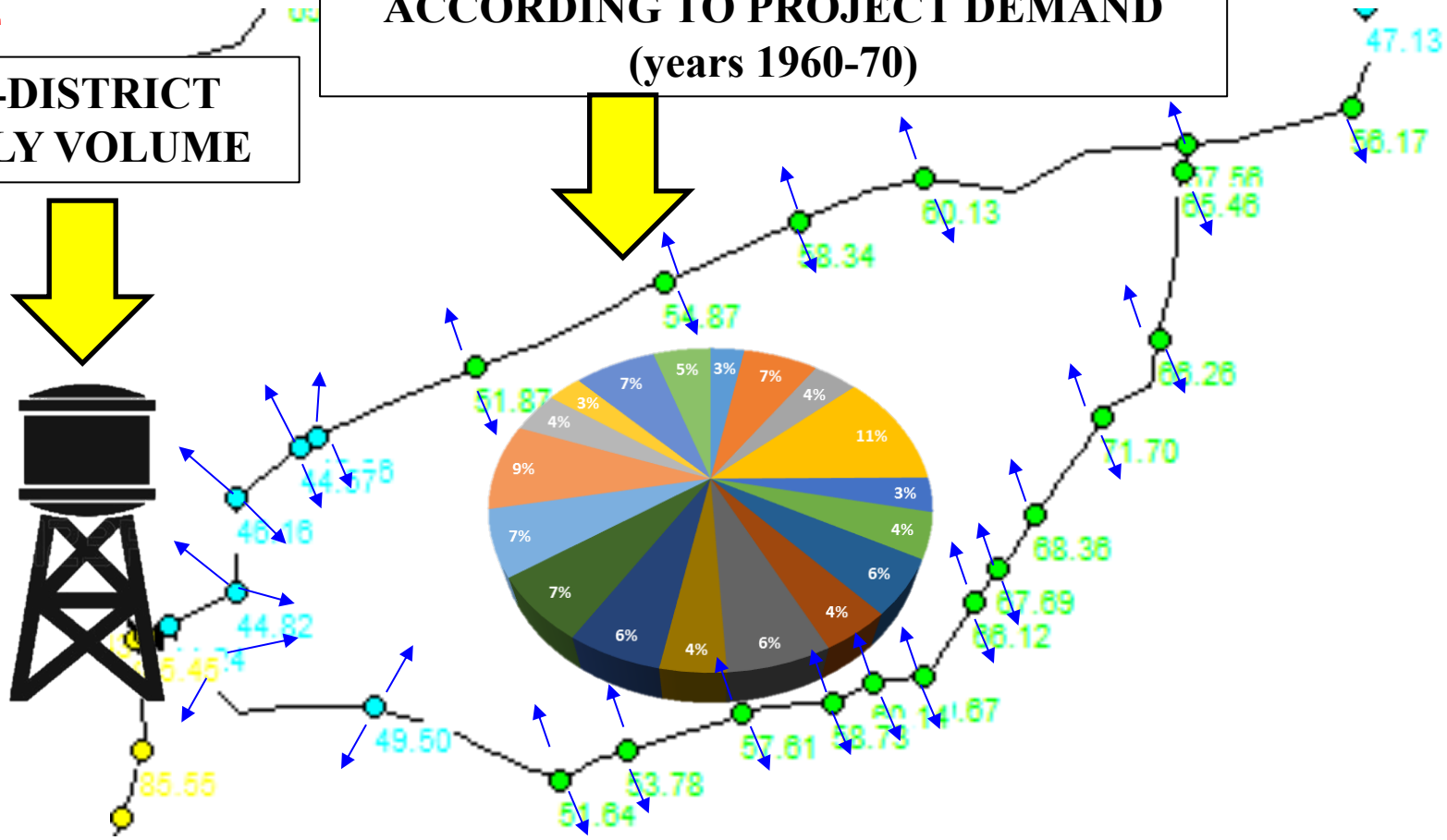
Hydraulic modeling of the irrigation network – Sub District Scale

INPUT

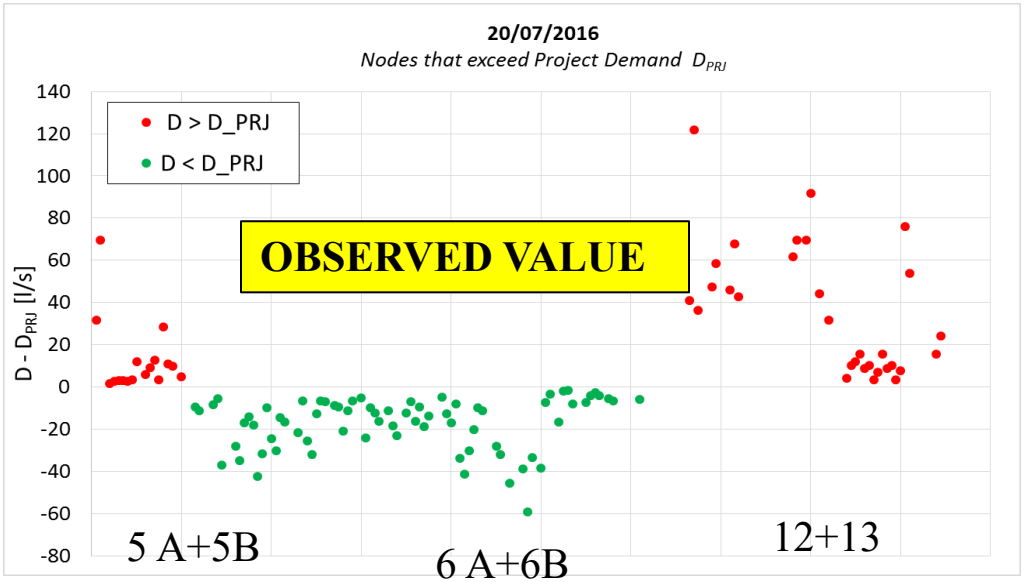
SUB-DISTRICT DAILY VOLUME

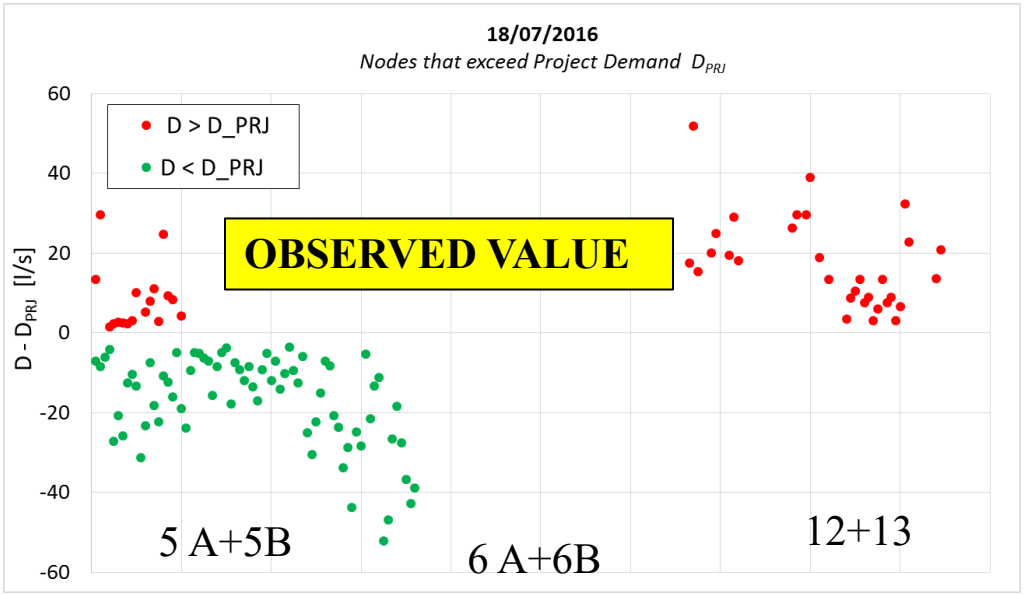
WATER DEMAND [L/S] FOR EACH NODE ACCORDING TO PROJECT DEMAND (years 1960-70)



HYDRAULIC MODELING OF THE IRRIGATION NETWORK
DAYS EXCEEDING PROJECT DEMAND

Hydrological Monitoring and Modelling

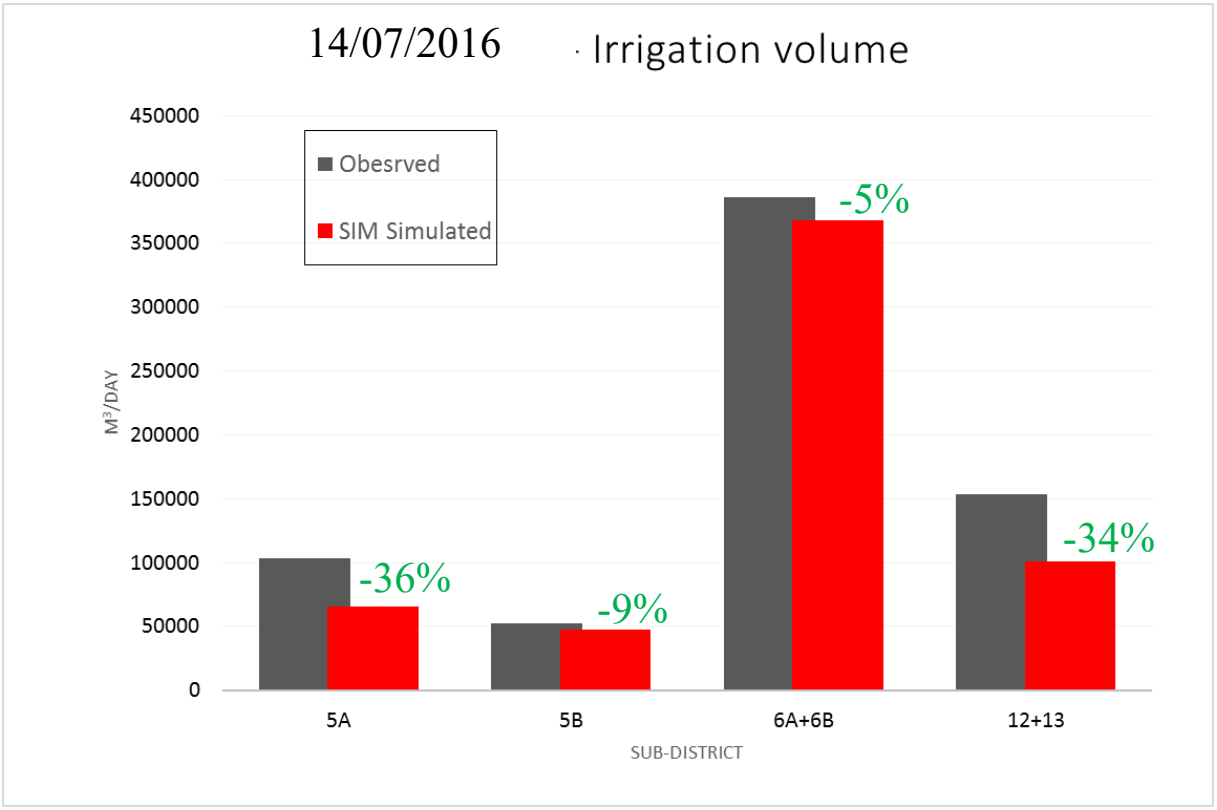


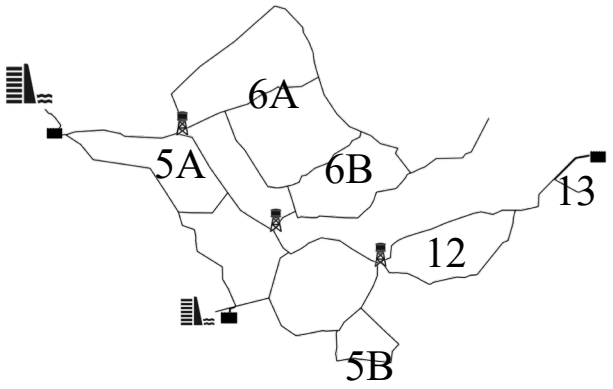


- **+35% OF WATER DEMAND**
- **LOCAL PRESSURE PROBLEMS DURING PEAKS DISCHARGE**

IRRIGATION VOLUME AT SUB-DISTRICT SCALE OBSERVED VS SIM RESULTS FOR 14/07/2016

Hydrological Monitoring and Modelling





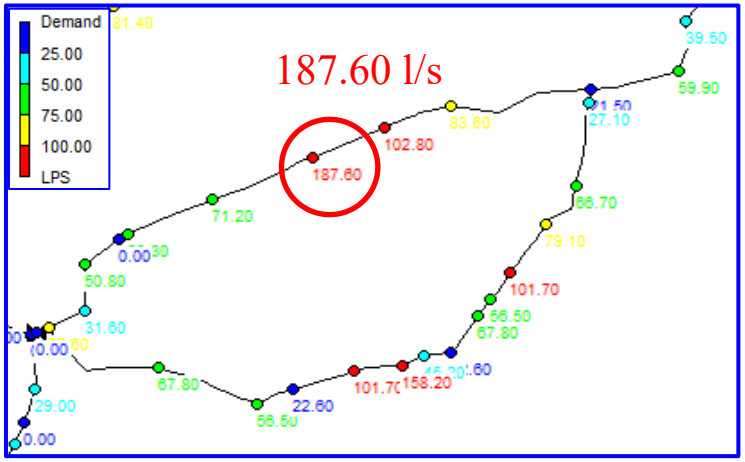
AVERAGE WATER SAVING ON 13/07/2016 USING SIM: 16%

HYDRAULIC MODELING OF THE IRRIGATION NETWORK RESULTS FOR SUB DISTRICT N.12 – 14/07/2016

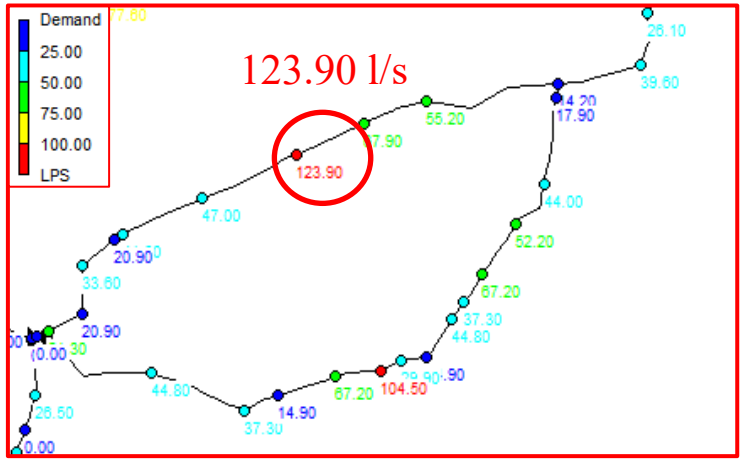
Hydrological Monitoring and Modelling

Observed VS SIM results

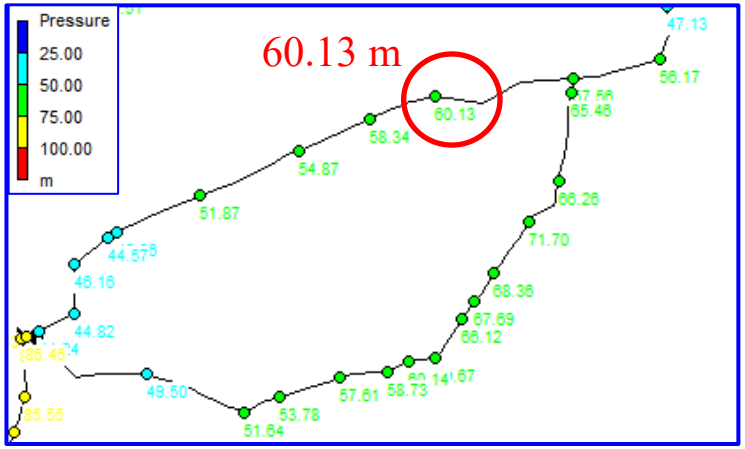
Observed Demand at nodes



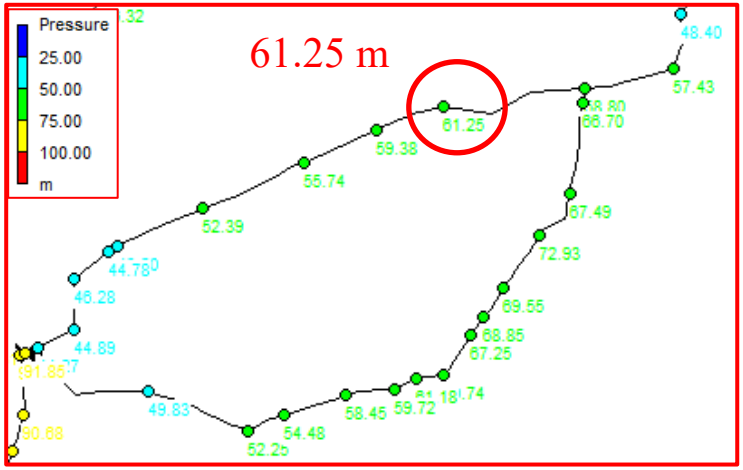
SIM Demand at nodes



Observed Pressure at nodes



SIM Pressure at nodes

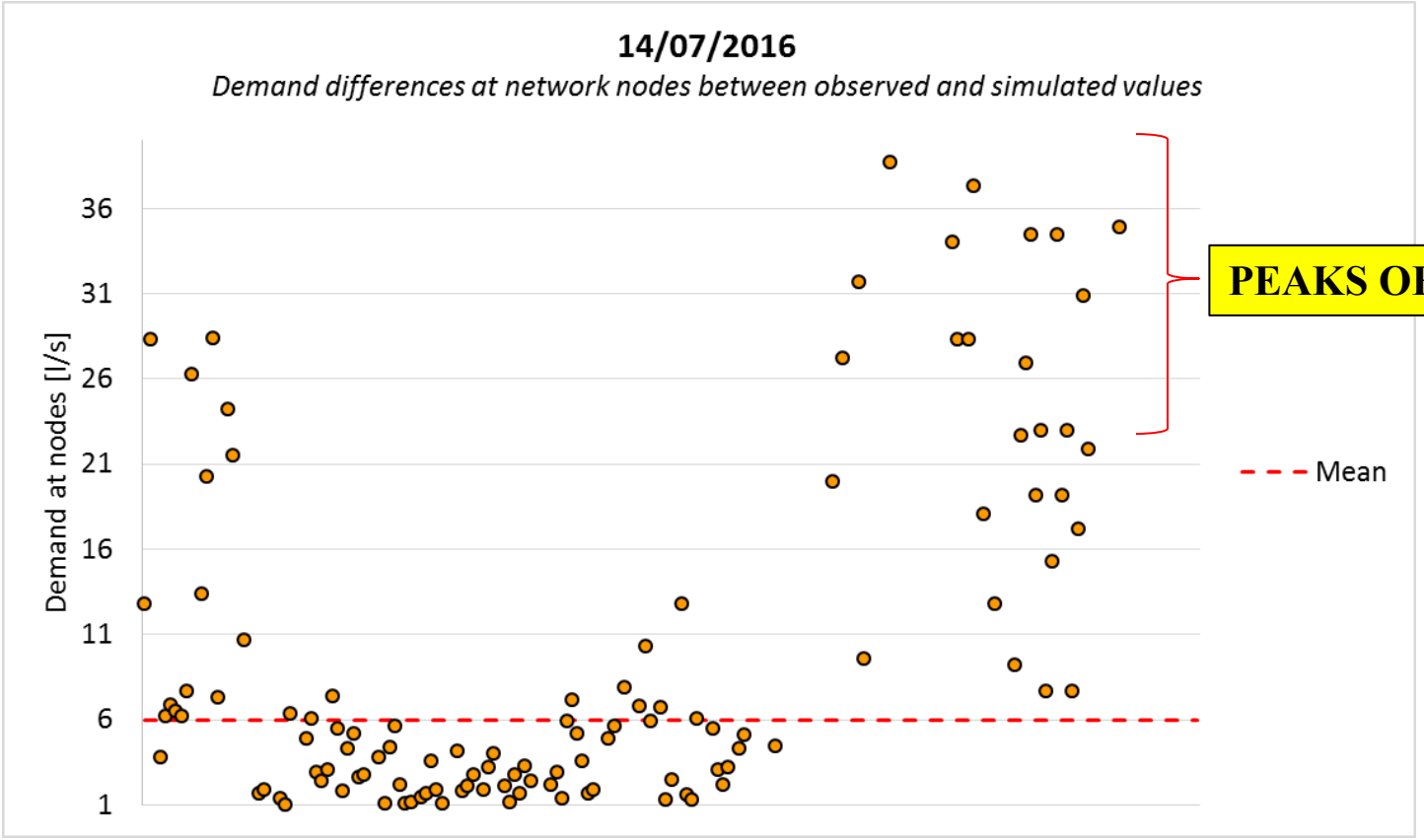


HYDRAULIC MODELING OF THE IRRIGATION NETWORK
RESULTS FOR THE NETWORK – 14/07/2016

Hydrological Monitoring and Modelling

Observed VS SIM results

OBSERVED DEMAND – SIM DEMAND



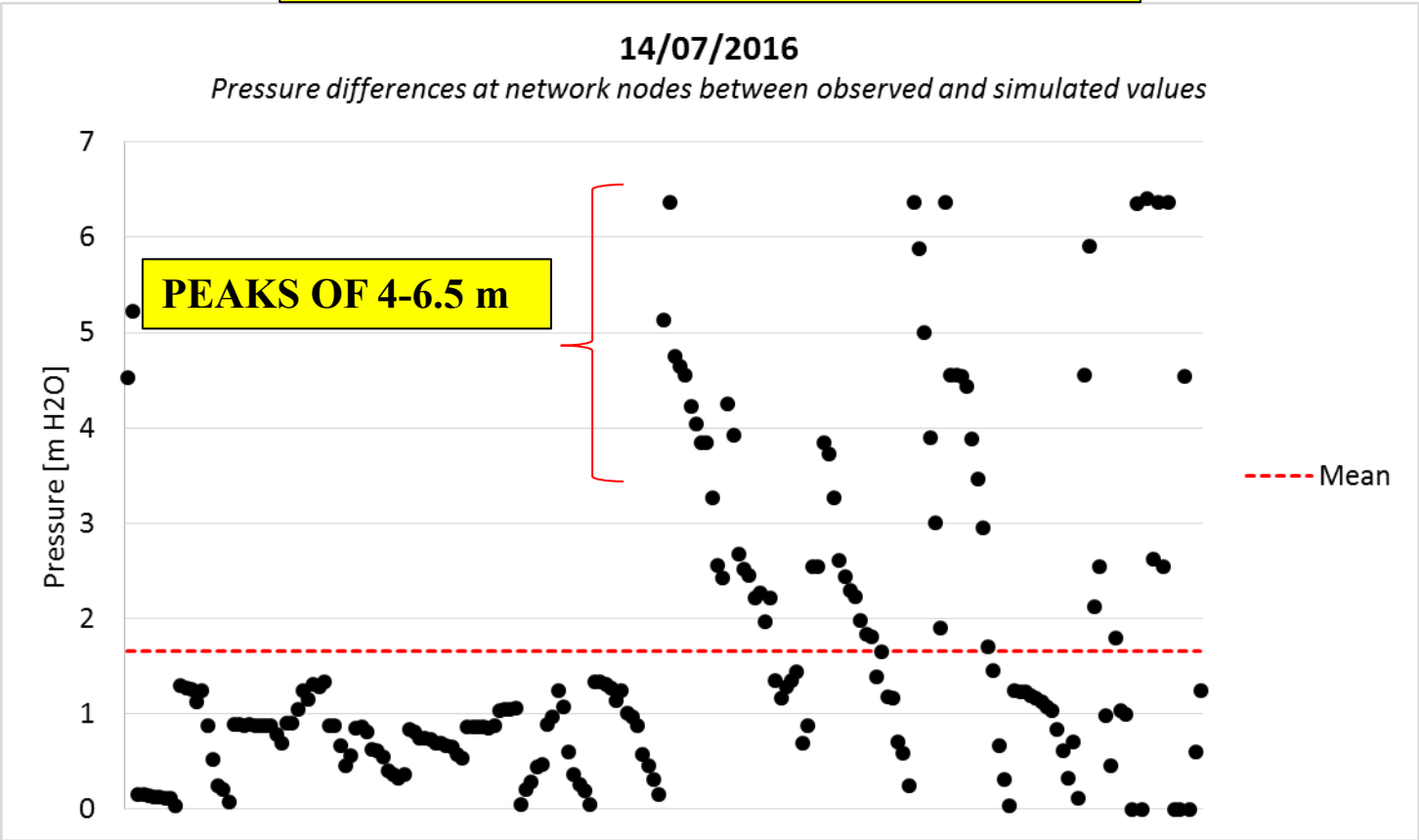
- 6 L/S OF DEMAND IN EACH NODE OF THE NETWORK (MEAN VALUE)

HYDRAULIC MODELING OF THE IRRIGATION NETWORK
RESULTS FOR THE NETWORK– 14/07/2016

Hydrological Monitoring and Modelling

Observed VS SIM results

SIM PRESSURE – OBSERVED PRESSURE

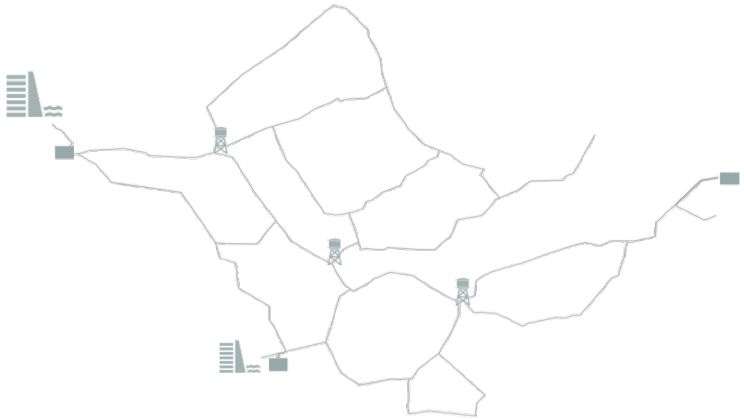


+ 1.65 m PRESSURE IN THE NETWORK (MEAN VALUE)

CONCLUSIONS

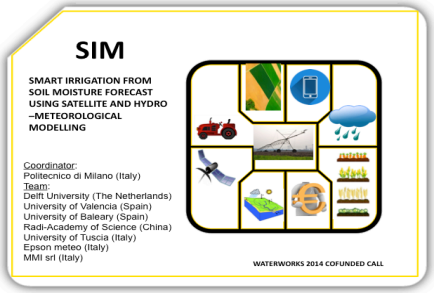
Hydrological Monitoring and Modelling

- GOOD REPRODUCTION OF THE PRESSURED NETWORK THROUGH EPANET
- SIM IRRIGATION STRATEGY IMPLIES REDUCTION IN PEAK DISCHARGE AND INCREASE NETWORK PRESSURE
- A DEEP ANALYSIS BASED ON VALUES OBSERVED ON EACH NODE MAY GENERATE EVEN BETTER RESULTS IN TERMS OF PRESSURES CONSIDERING THE PEAKS



Hydrological Monitoring and Modelling

Thank you for your attention!



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SIM
FINAL MEETING
12 JUNE 2019, ROME