

MULTI-OBJECTIVE OPTIMISATION OF OPERATION OF COMPLEX WATER DISTRIBUTION NETWORKS: TRADEOFFS BETWEEN PUMP OPERATION AND WATER QUALITY

Helena Mala Jetmarova

**Principal Supervisor: A/Prof Adil Bagirov
Associate Supervisor: Prof John Yearwood
Co-Supervisor: Dr Andrew Barton**

**School of Science, Information Technology & Engineering
University of Ballarat**

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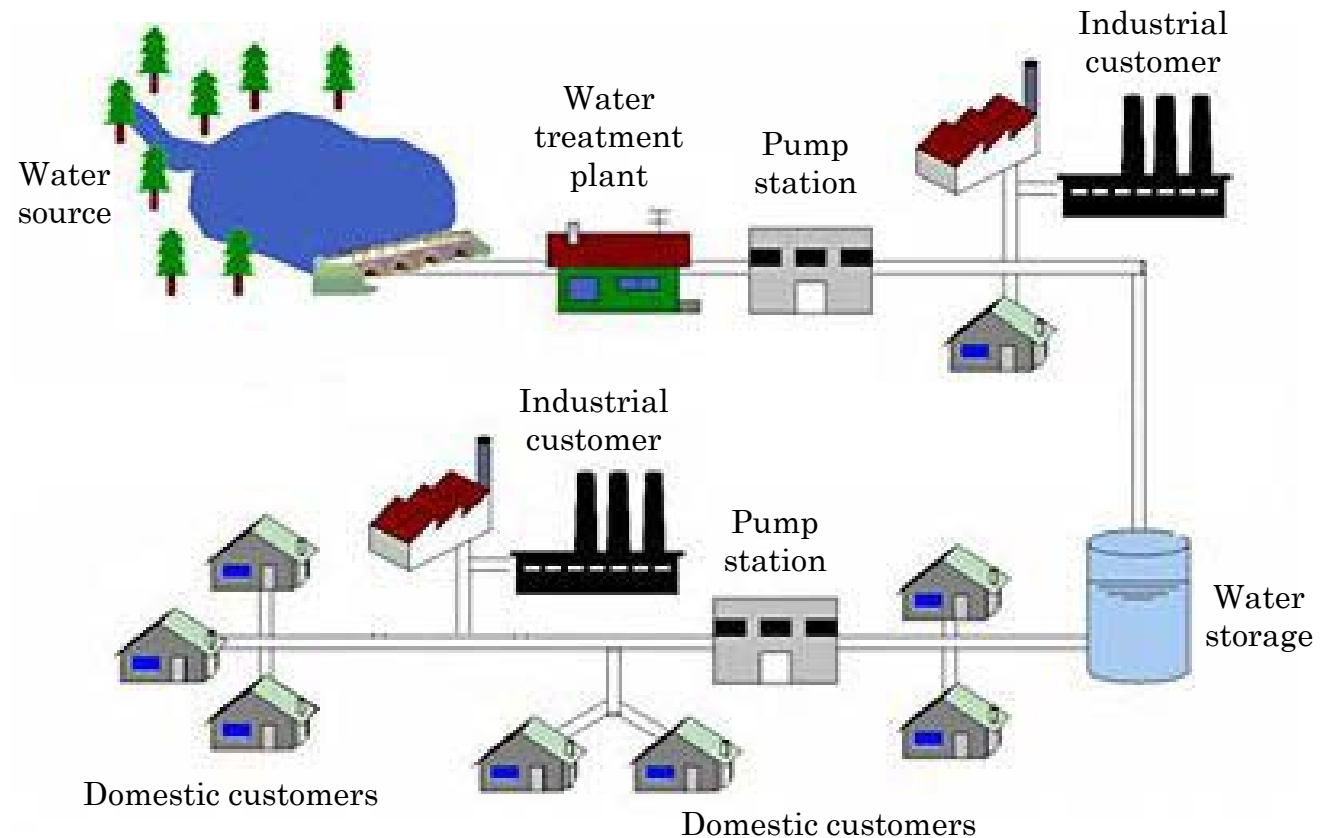
OUTLINE

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1. INTRODUCTION

Water Distribution System (WDS)

Assure that customers receive required flow/
pressure and water quality



1. INTRODUCTION

Operation of WDS represents one of the largest costs for water corporations

Decision making process in operation of WDS is multi-criterial task (multiple objectives):

- ⊙ **Minimum pumping costs**
- ⊙ **Customer requirements**
 - pressure and flow
 - water quality
- ⊙ **Limitations at water sources**
 - quantity
 - water quality
 - mixing ratios

2. RESEARCH OBJECTIVE

Optimise operation of WDS using

MULTI-OBJECTIVE APPROACH

- i.** Optimal pump operation (minimisation of energy cost)
- ii.** Optimal water quality (minimisation of deviations from health and other guidelines)

CASE STUDY

- ⊗ The Wimmera Mallee Pipeline, Western Victoria
- ⊗ Conveys raw water from two reservoirs (Bellfield and Taylors Lake) of different water qualities
- ⊗ Supplies several types of customers /water users (domestic, industrial, recreational, environmental) each with different water quality requirements

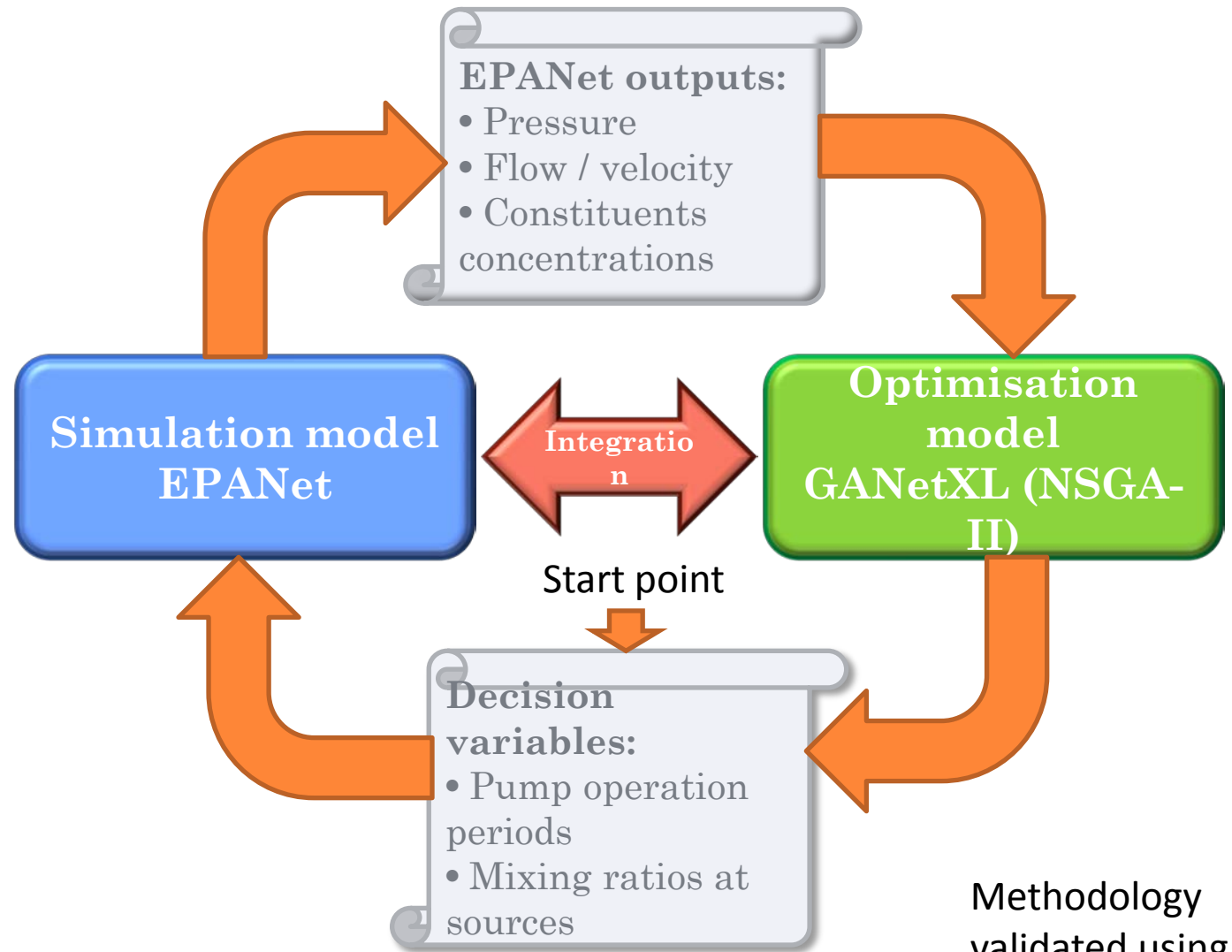
3. RESEARCH QUESTIONS

- ③ What are the tradeoffs between optimal pump operation and optimal water quality objectives?
- ③ What is the range of optimal ratios to blend water from multiple sources to deliver required water quality for each customer group?

4. RESEARCH APPROACH AND METHODS

- i.** Development of hydraulic and water quality model
- ii.** Development of optimisation model
- iii.** Integration between simulation and optimisation model
- iv.** Analysis and presentation of results

4. RESEARCH APPROACH AND METHODS



Methodology validated using test problem

5. RESEARCH IMPORTANCE

© Multi-objective approach: tradeoff between optimal pump operation and water quality which is not currently fully understood:

- i. Improved understanding of the complexity of WDS operation
- ii. Improved decision making

© Pump run times = continuous variable, whereas previous research considers integer variables

© Methodology applied to the Wimmera Mallee Pipeline which was not a subject of any previous research in regards to system optimisation

6. COLLABORATION

- ④ Supported and funded by both University of Ballarat and industry partner GWMWater

- ④ University of Ballarat:
 - ARC Linkage Project LP0990908 Pipeline Operations Optimisation
 - Scholarship stipend

- ④ GWMWater:
 - Data for simulation model
 - One day per week
 - Travel and conference expenses
 - Industry supervisor

Thank You for Your Attention

Questions?

