Mathematical Modelling of Wastewater Treatment Plants (WWTP): An Introduction

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Outline

Part I. Why Dynamic Modelling of WWTP?

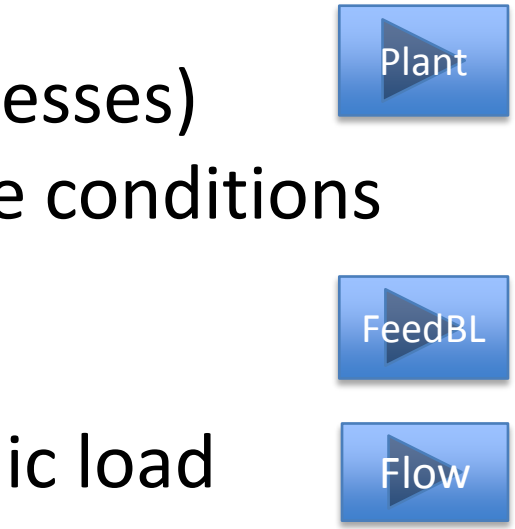
Part II. The Modelling Process

Part III. Mathematics / Dynamics of the Activated Sludge Process

Dynamic Modelling of Wastewater Treatment Plants – Why ?

Wastewater treatment plants are:

- Very complex systems (physical, chemical, biological processes)
- Rarely operated under steady-state conditions
- Many feedback loops
- Subject to diurnal loads (daily and seasonal flow and organic load variations)
- Dynamics/perturbations are also induced through plant operation, e.g., on/off pumps, equipment breakdown, reactors out of service, etc.

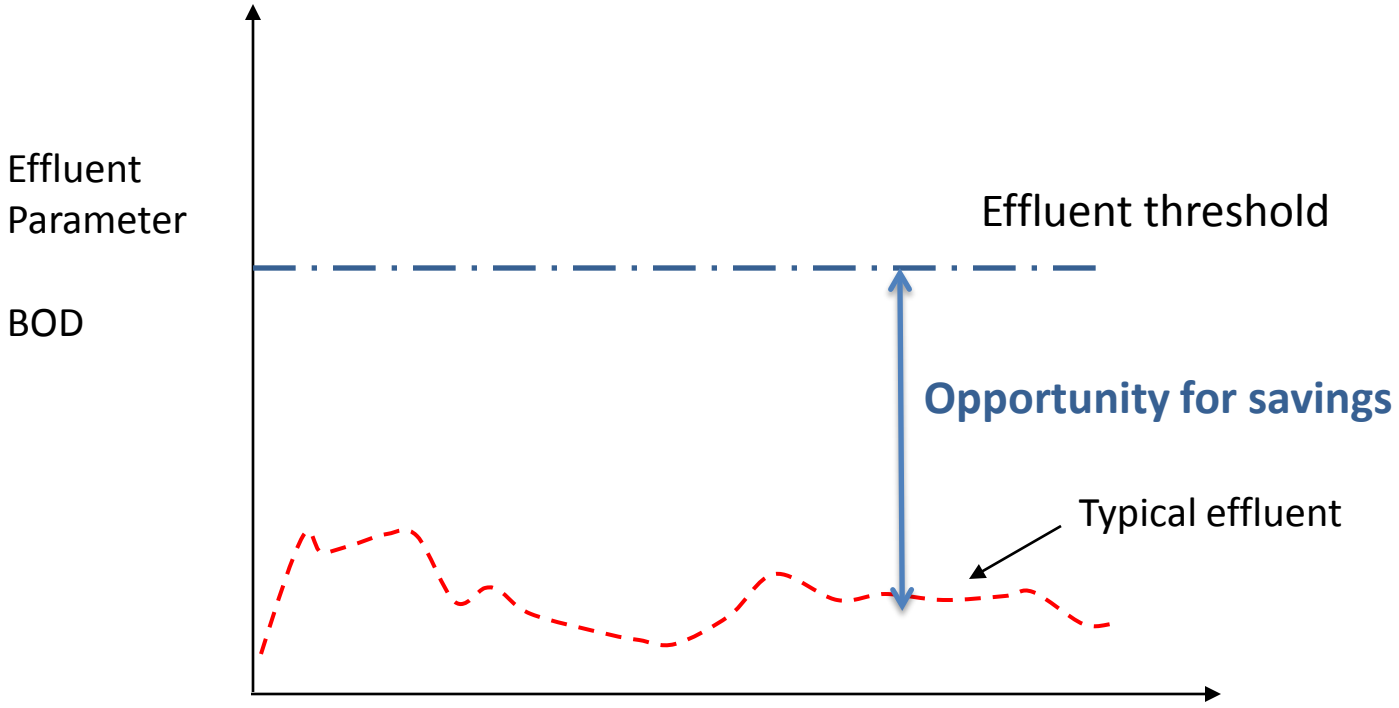


Dynamic Modelling of Wastewater Treatment Plants – Why ?

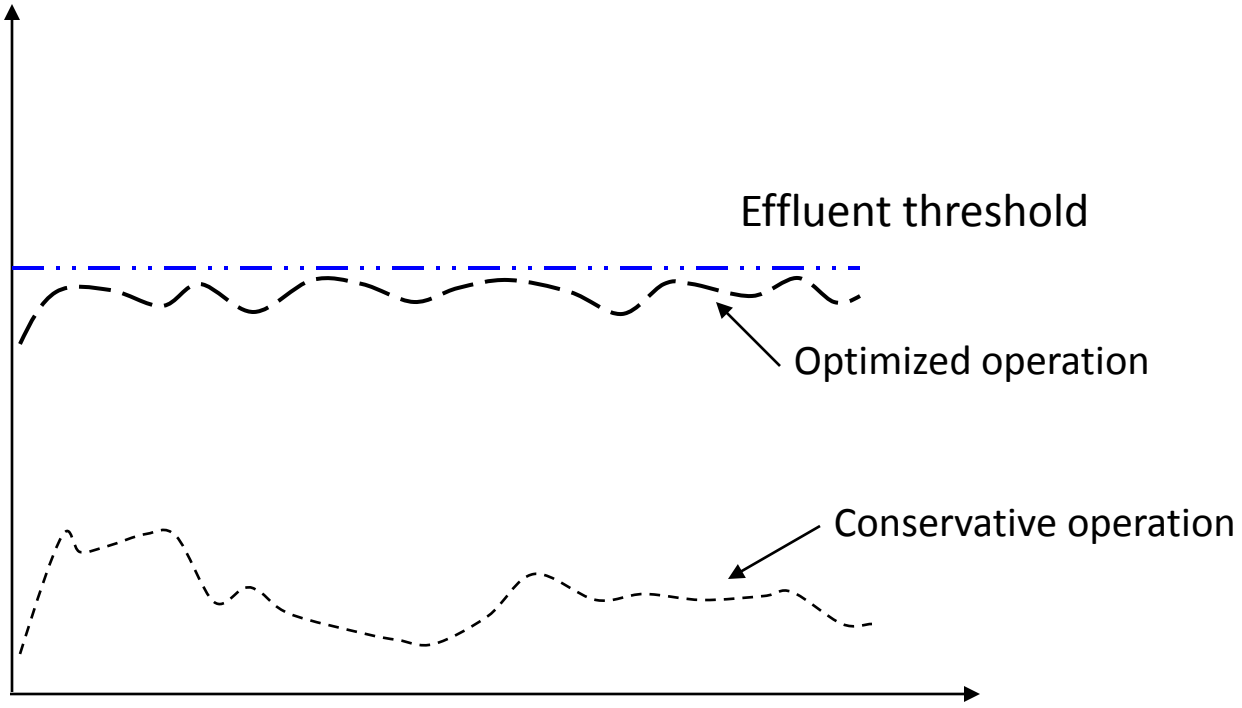
Wastewater treatment plants are:

- Very energy intensive
- Relies on inefficient unit operations, e.g., standard oxygen transfer efficiency 3-10%
- Historically, the operation of WWTP is based on the experience of operators, rules of thumb, heuristics, etc.
- Privatisation of the water industry (e.g., UK in 1988) provided an incentive for WWTP optimisation

Typical Operation



Optimized Operation



Plant Operation

To operate closer to the effluent limit imposed by the regulator/legislator

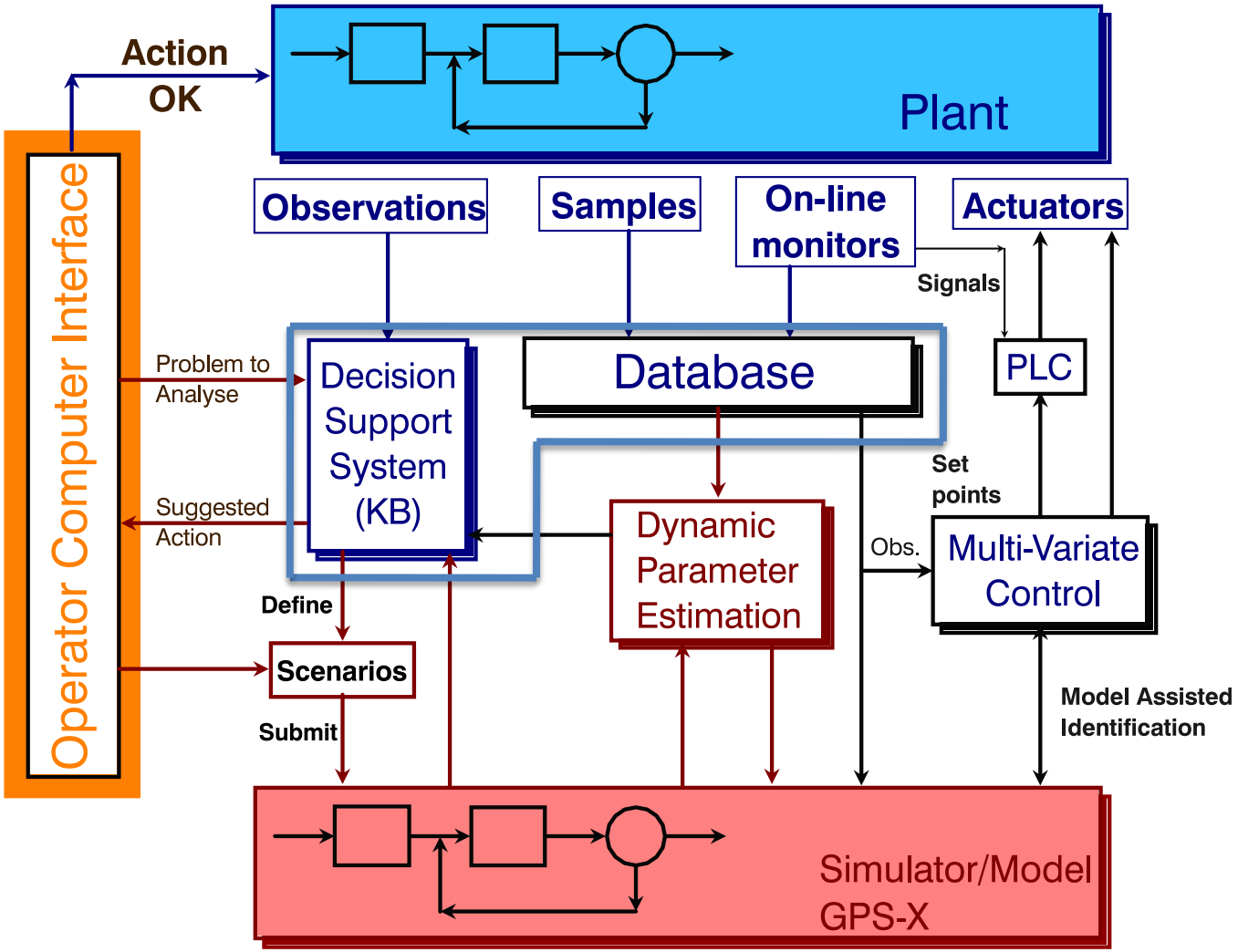
means that we are effectively decreasing the operational safety factor

requires some assistance

has resulted in the concept of an

Integrated Computer Control Systems for Wastewater Treatment Plant Operation

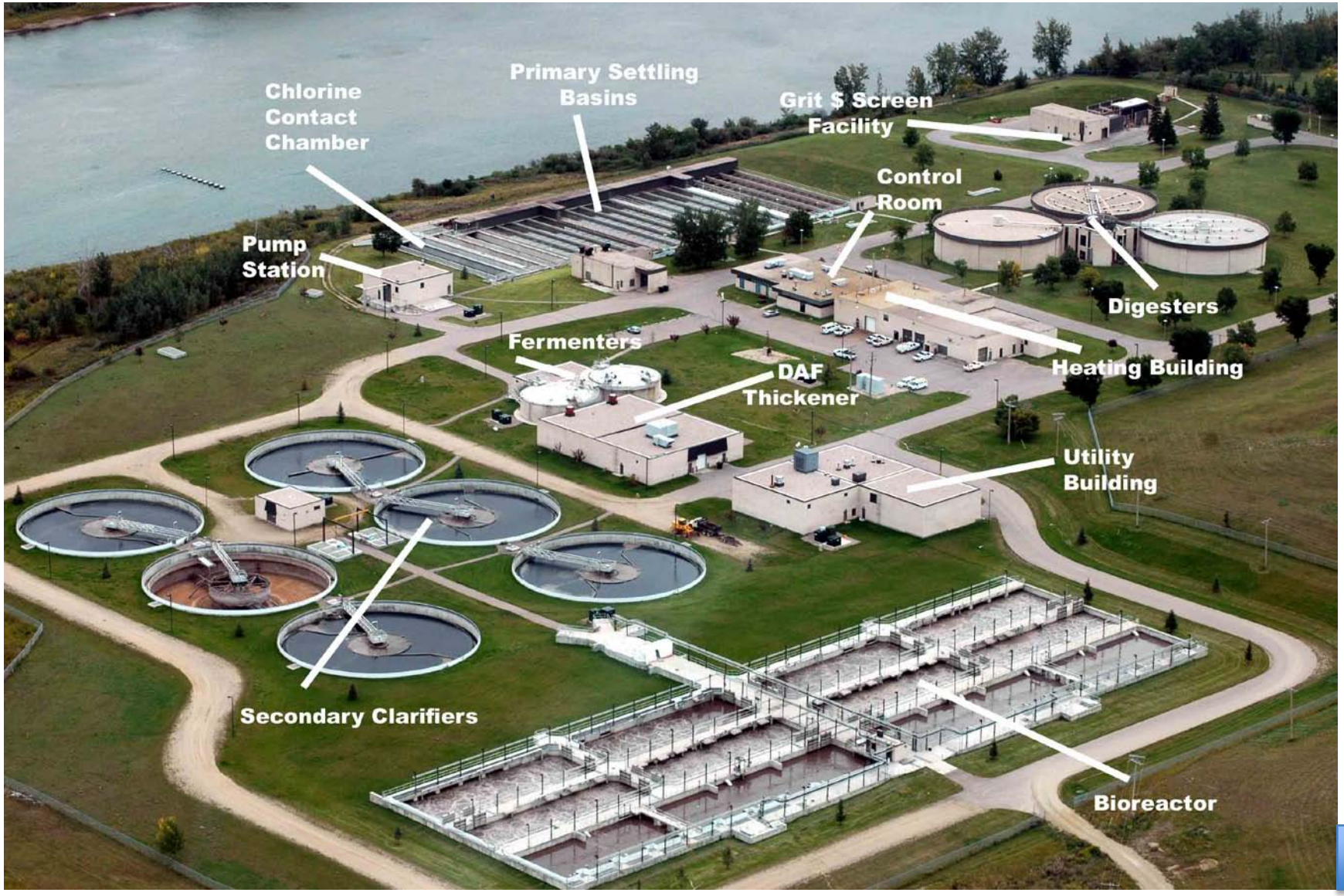
Elements of an Integrated Computer Control Strategy



Mathematical Modeling of Wastewater Treatment Plants

Part II: The Modelling Process

A Typical Activated Sludge Plant



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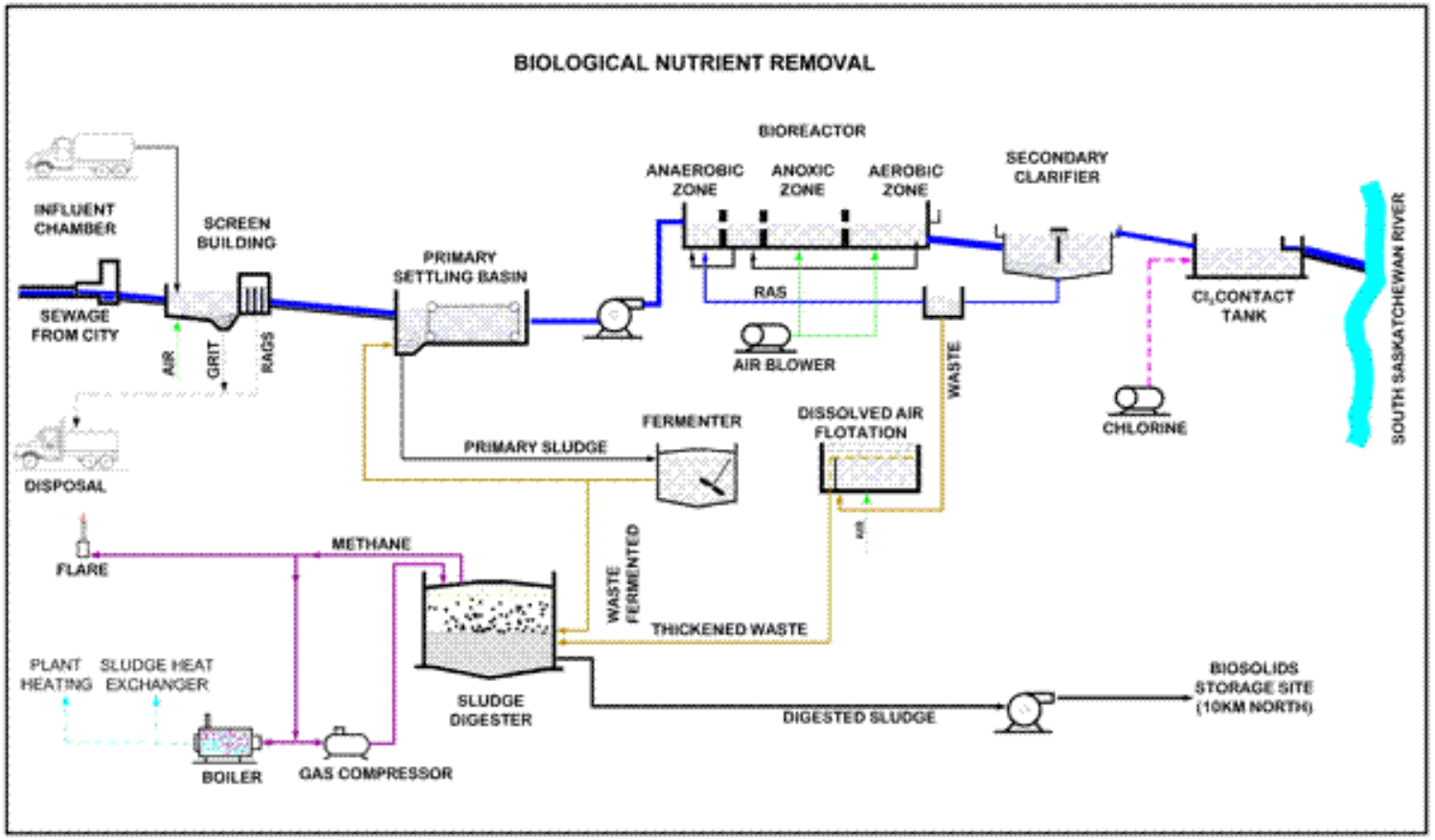
Saskatoon Flow Diagram



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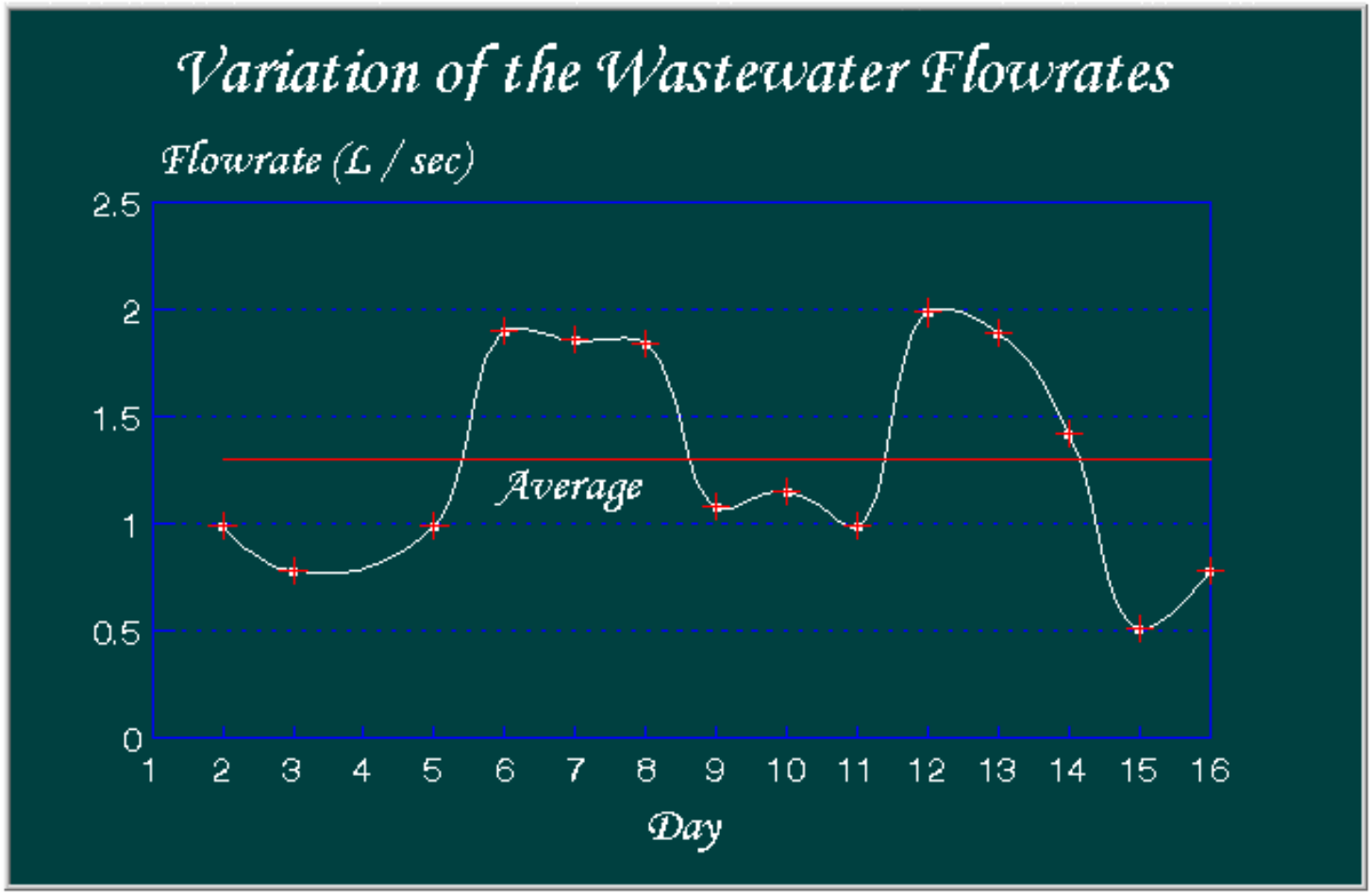
Diurnal Flow Variations



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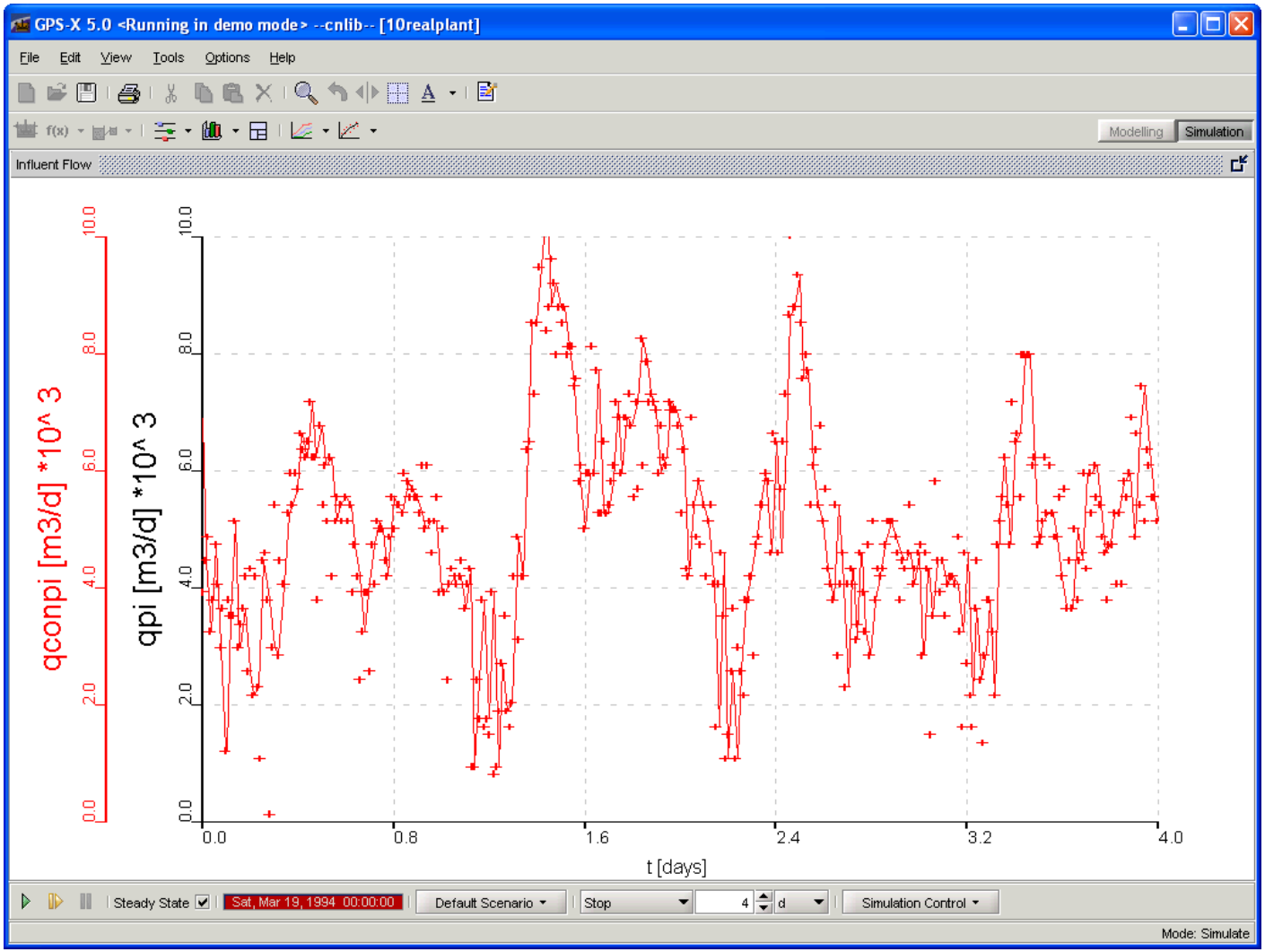

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