

# Optimised Commissioning with Digital Twins



**M**  
MOTT  
MACDONALD

**M**  
SMART  
INFRASTRUCTURE

# Presentation Content

- Smart Infrastructure Context
- Digital Twins
- Five Fords Case Study
- Lessons Learnt
- Future Applications

**We are facing  
two seismic  
shifts**



The background of the slide features a low-angle shot of several white wind turbines against a clear blue sky. The turbines are partially obscured by a dark blue semi-transparent overlay that covers the top and middle portions of the image. The text and list are positioned on this dark overlay.

# Physical constraints

- Climate change
- Resource limitation
- Population concentration
- Investment constraint



An aerial photograph of a large concrete dam and its reservoir. The dam is a curved wall of light-colored concrete, with a road running along its top edge. A small white car is visible on the road. To the left of the dam, there is a dense forest of green trees. The reservoir is a deep blue-green color, occupying the right side of the image. The overall scene is a mix of natural and man-made elements.

**Never have we  
had to achieve so  
much with so little**



# Digital abundance

"By 2020 there will be 7 times  
more devices than people"

Cisco

Data is  
everywhere,  
insights  
are not



# This requires a new way of thinking

Static reporting



Live analytics

Isolated data



Interconnected data

Outputs



Outcomes



Unlocking  
the potential  
requires **two**  
**core capabilities**

**Domain expertise**

The image features a background of a grid of teal plus signs. A central horizontal bar with a light beige background contains the text "Digital expertise" in a bold, black, sans-serif font. The plus signs are arranged in a regular grid pattern, with the text bar overlapping the middle rows.

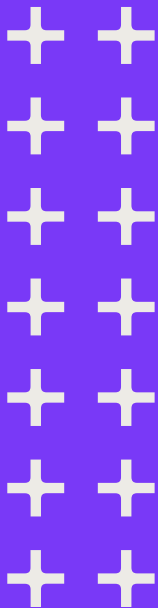
**Digital expertise**





**Smart Infrastructure  
is where these two  
worlds collide**





# Digital Twins

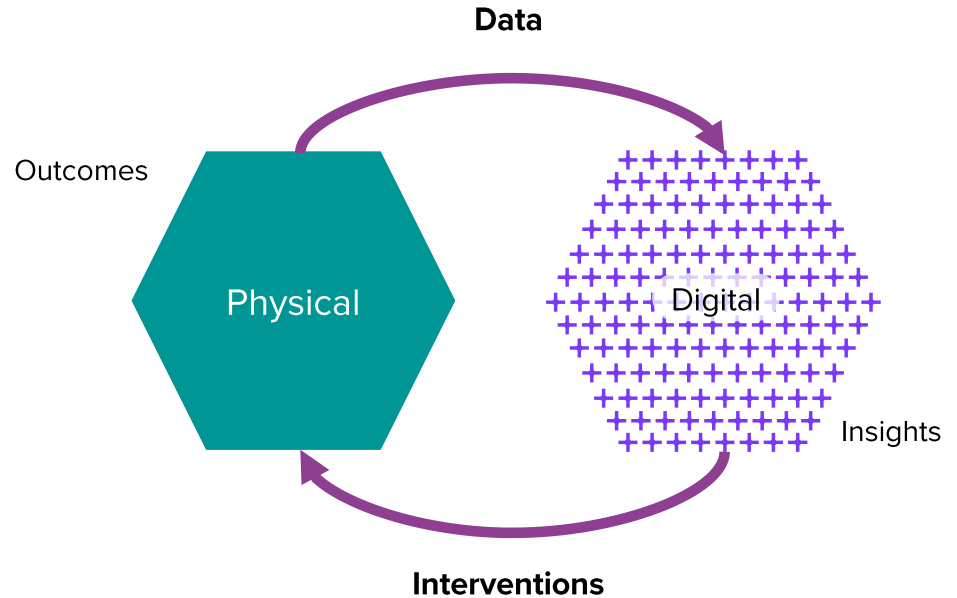
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# Definition

“A realistic digital representation of assets, processes or systems in the built or natural environment”.

- Digital Built Britain



Make better interventions on physical assets



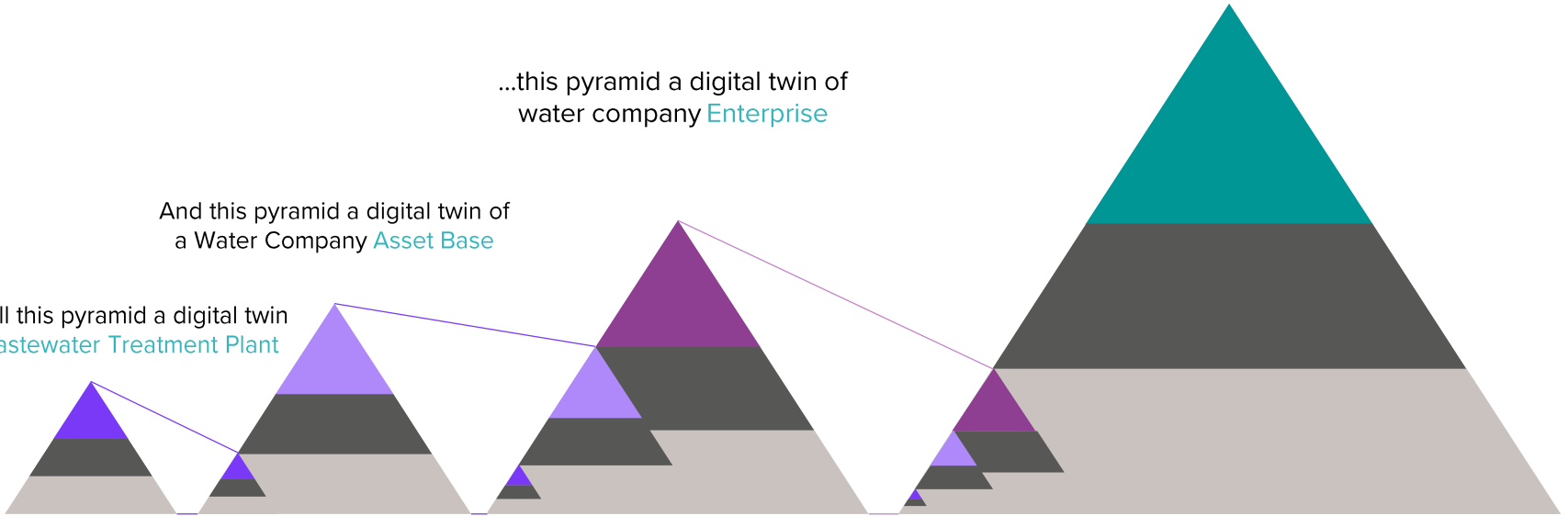
# Understanding scale and complexity

...this pyramid a digital twin of the **UK Water Sector**

...this pyramid a digital twin of water company **Enterprise**

And this pyramid a digital twin of a Water Company **Asset Base**

Let's call this pyramid a digital twin of a **Wastewater Treatment Plant**



# The Gemini Principles

## The Gemini Principles

to guide the national digital twin

**Purpose:**  
Must have clear purpose

Public good

Value creation

Insight

**Trust:**  
Must be trustworthy

Security

Openness

Quality

**Function:**  
Must function effectively

Federation

Curation

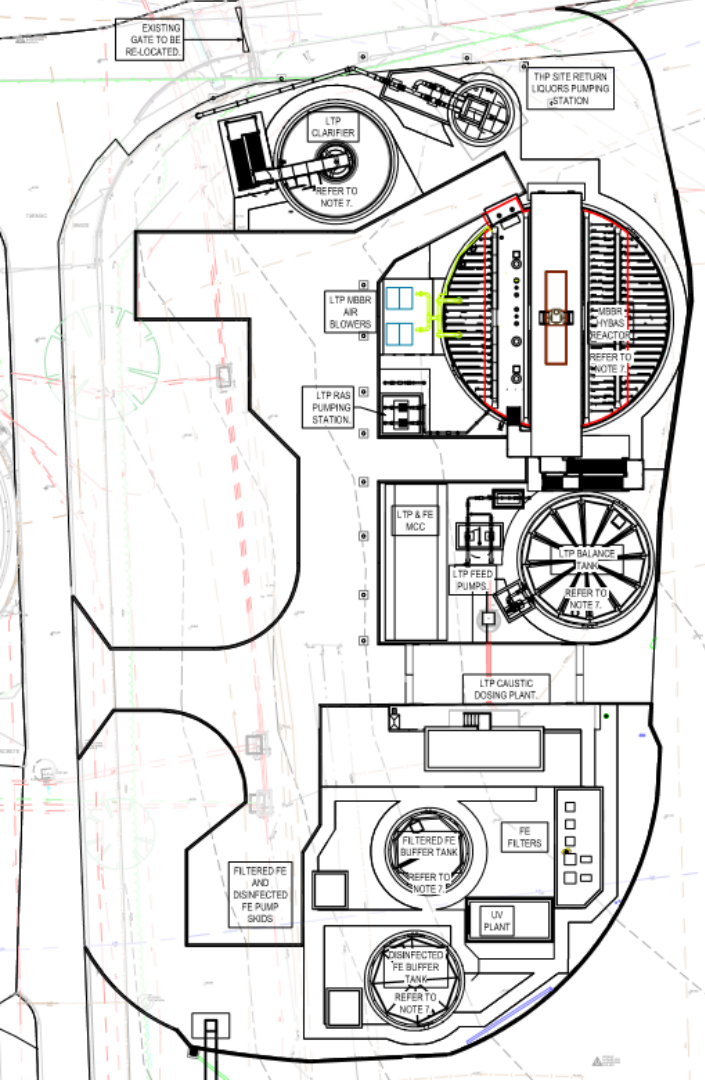
Evolution

National Digital Twin

An aerial photograph of a wastewater treatment plant. The image shows several large circular clarifiers and rectangular aeration basins. A semi-transparent teal rectangle is overlaid on the center of the image, containing the text 'Case Study' in white. The background shows the complex layout of the plant with various channels and structures.

# Case Study





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# Anammox Process

Complex biological process to treat high ammonia concentrate

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750m<sup>3</sup>/day

Average Flowrate

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14 weeks

Commissioning period quoted by Veolia

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Ammonia

indicates commissioning success

# Proven methodology

What if we knew...?

*How the plant was going to perform in the future?*



Decision making

What data would power this



Sense making

- SCADA
- Lab Data
- Design information
- Commissioning plans

How could we understand this...?



- *Biological wastewater modelling*

Data integration

# Digital Twin Tools

## Moata

(the platform)

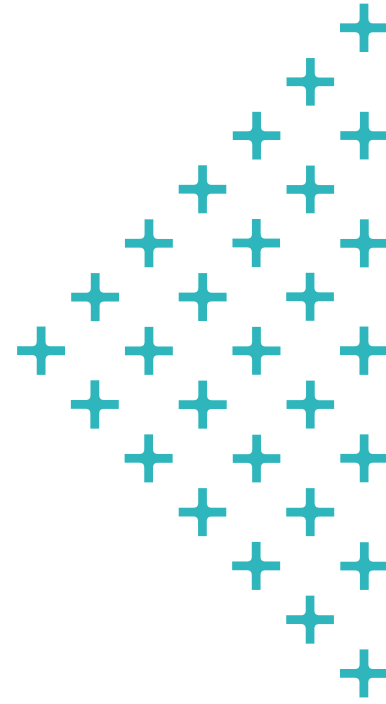
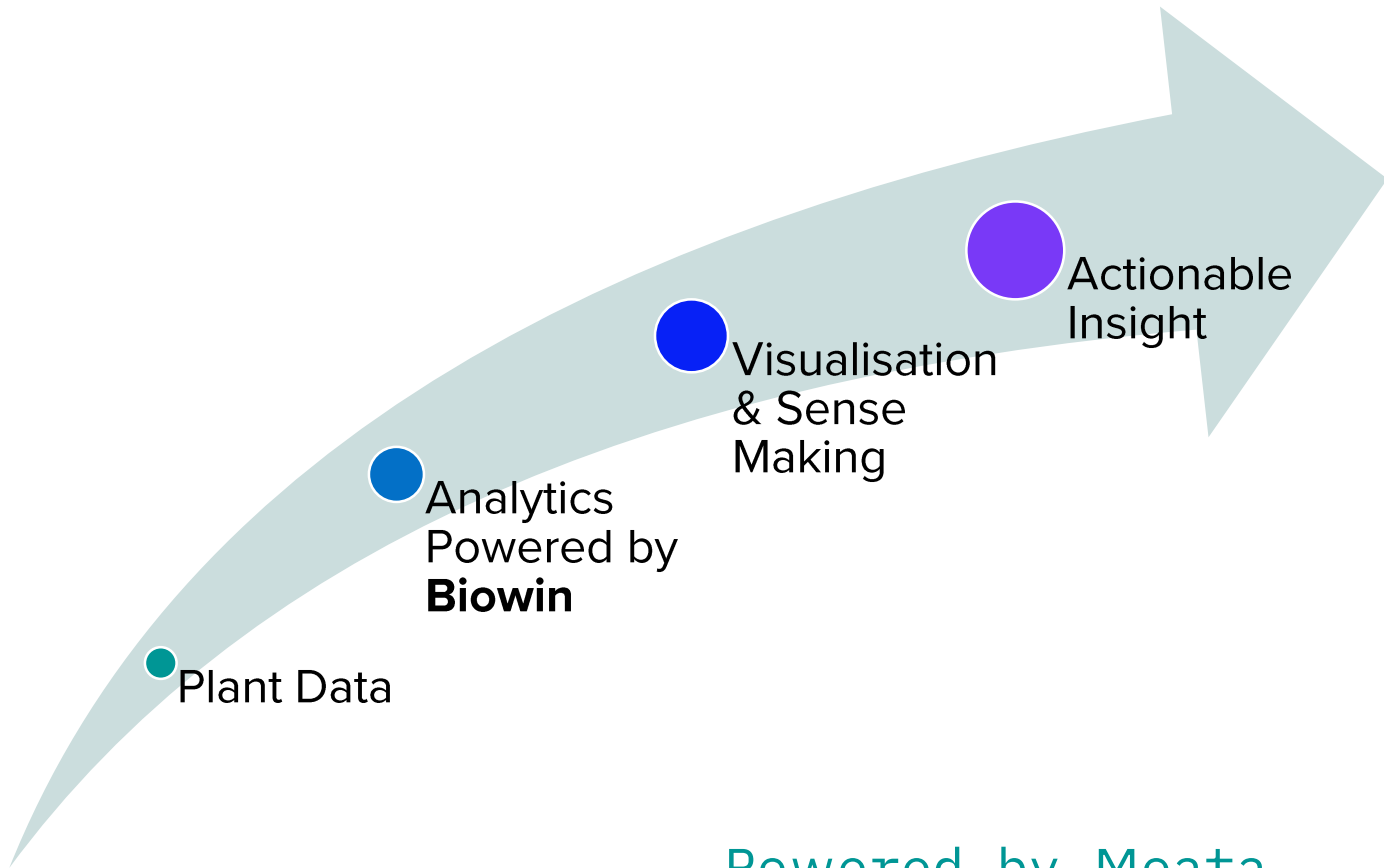
Mott MacDonald's cloud based analytics and visualisation platform

## Biowin

(the analytics)

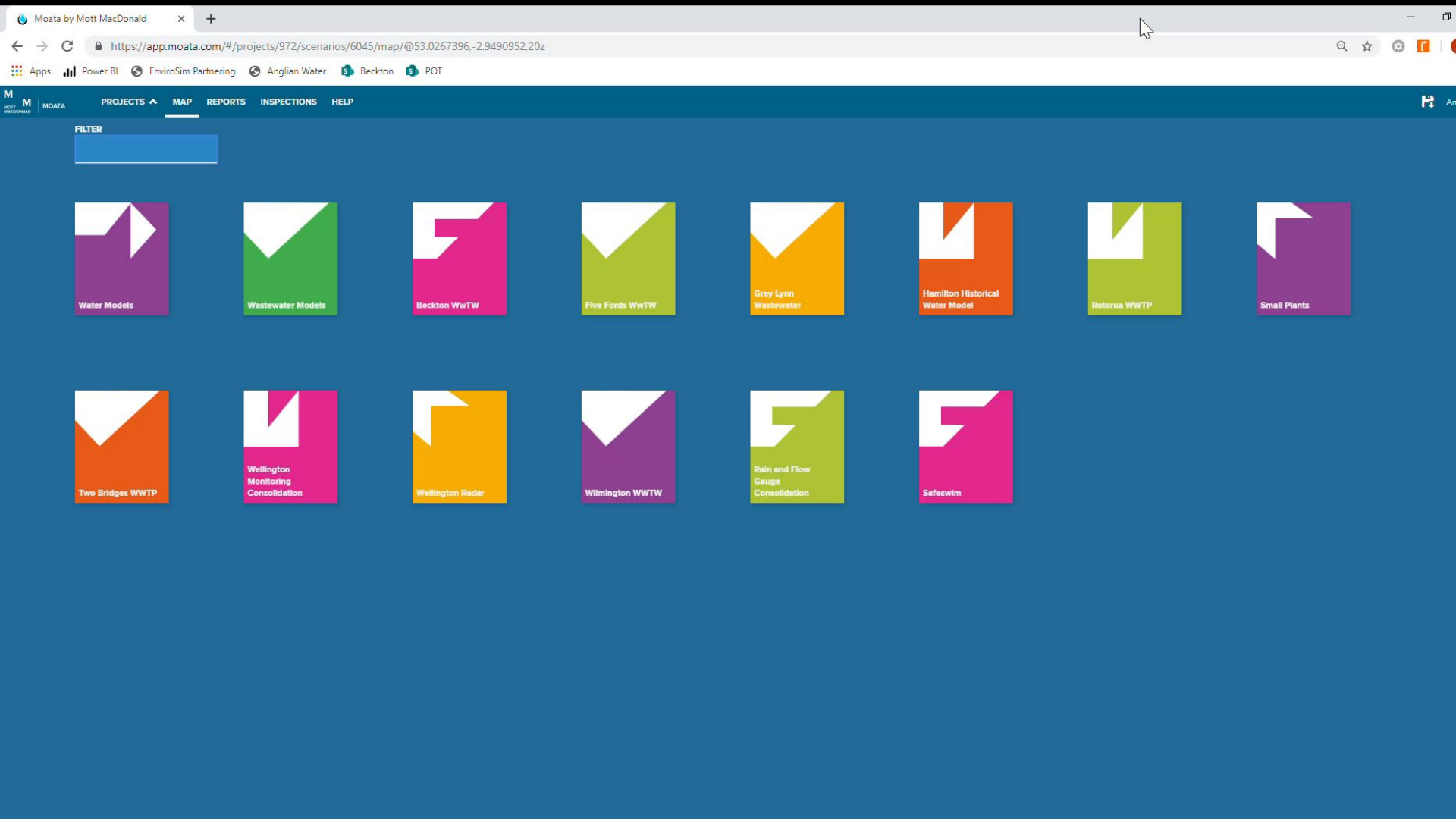
Wastewater modelling simulation software developed by EnviroSim





Powered by Moata





FILTER

Water Models

Wastewater Models

Beckton WwTW

Five Fords WwTW

Grey Lynn Wastewater

Hamilton Historical Water Model

Rotorua WWTP

Small Plants

Two Bridges WWTP

Wellington Monitoring Consolidation

Wellington Radar

Wilmington WWTW

Rain and Flow Gauge Consolidation

Safeswim

Select date range

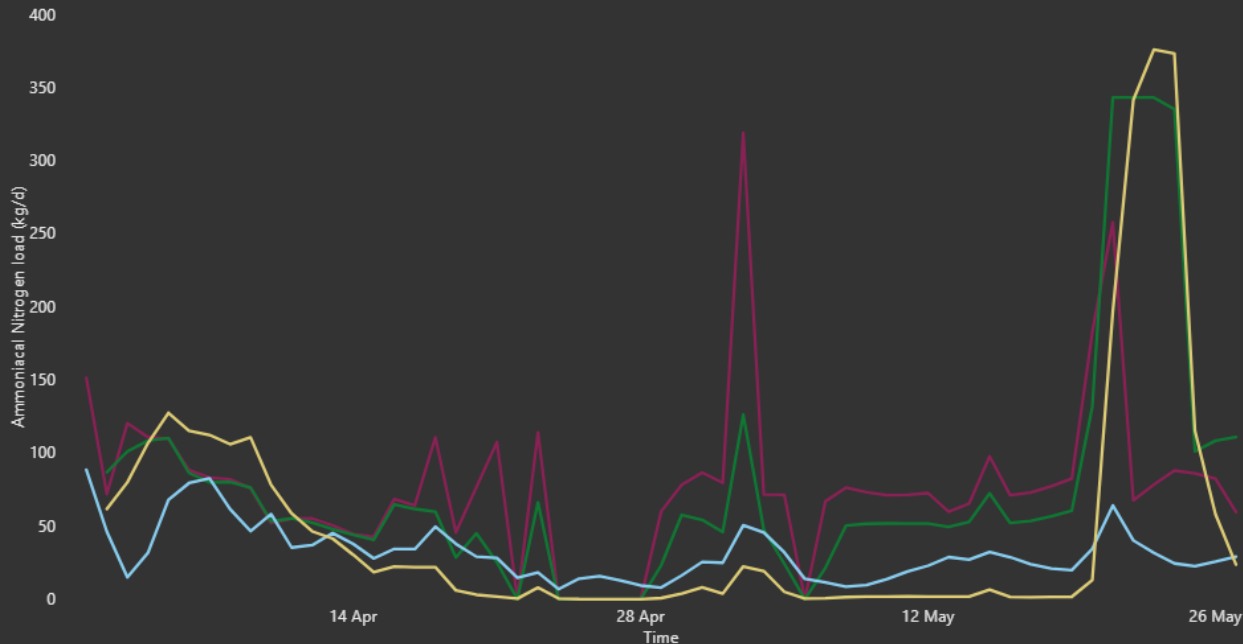
01/04/2019

27/05/2019

Select Series

- Select all
- Inlet NH4-N Load - Actual
- Inlet NH4-N Load - Biowin
- Inlet NH4-N Load - MMB
- Inlet NH4-N Load - Theoretical Veolia
- No Detriment Line
- Reactor NH4-N Load - Actual
- Reactor NH4-N Load - Biowin
- Reactor NH4-N Load - MMB
- Theoretical NH4-N Load Removed - Veolia
- Theoretical NH4-N Outlet Load - Veolia

Dashboard



Description

- Inlet NH4-N Load - Actual
- Inlet NH4-N Load - Biowin
- Reactor NH4-N Load - Actual
- Reactor NH4-N Load - Biowin

Ammonia Rmv. Rate - Actual

28.3 %

Inlet NH4-N Load - Actual

59.7 kg/m<sup>3</sup>Outlet NO<sub>2</sub> Concentration...

5.3 mg/l

DO Concentration - Actual

0.5 mg/l

Reactor NO<sub>3</sub> Concentratio...

9.7 mg/l

Tank Level Value

0.0 m

Reactor pH - Ac...

7.4

LTH Temperature...

degC

HTH Temperatur...

85.4 d...

LTH Temperat...

degC

HTH Temperat...

degC

Recycle Flow - Actual

0.1 m<sup>3</sup>

RF daily volume

2.5 l/s

RF daily average

Inlet Flow - Actual

0.2 m<sup>3</sup>

IF daily volume

2.9 l/s

IF daily average

SAS Flow - Actual

0.1 m<sup>3</sup>

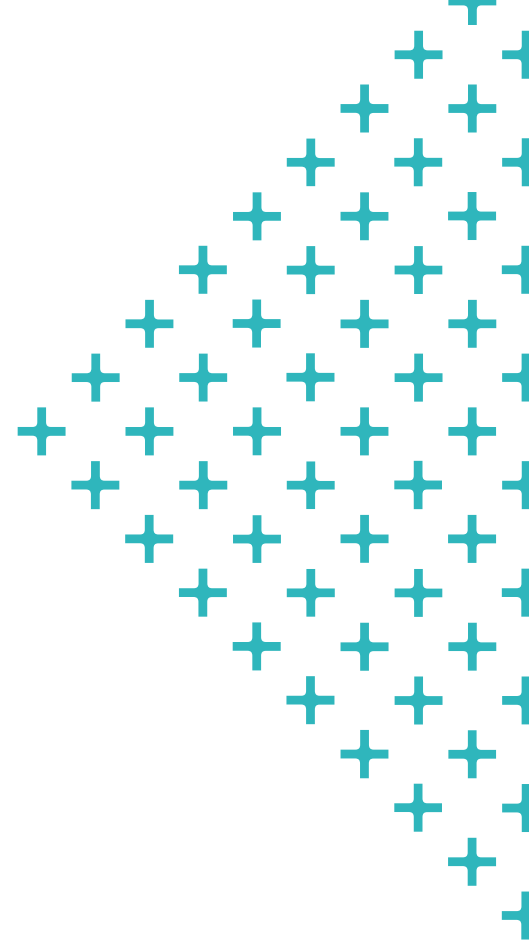
SAS daily volume

0.6 l/s

SAS daily average

# What did we achieve?

- An operational predictive digital twin
- The ability to simulate operating scenarios in near real time
- A plant operating below the Ammonia limit



# Lessons Learnt

**1.**

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**Challenging complex  
dynamic modelling**

**2.**

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**New ways of working**

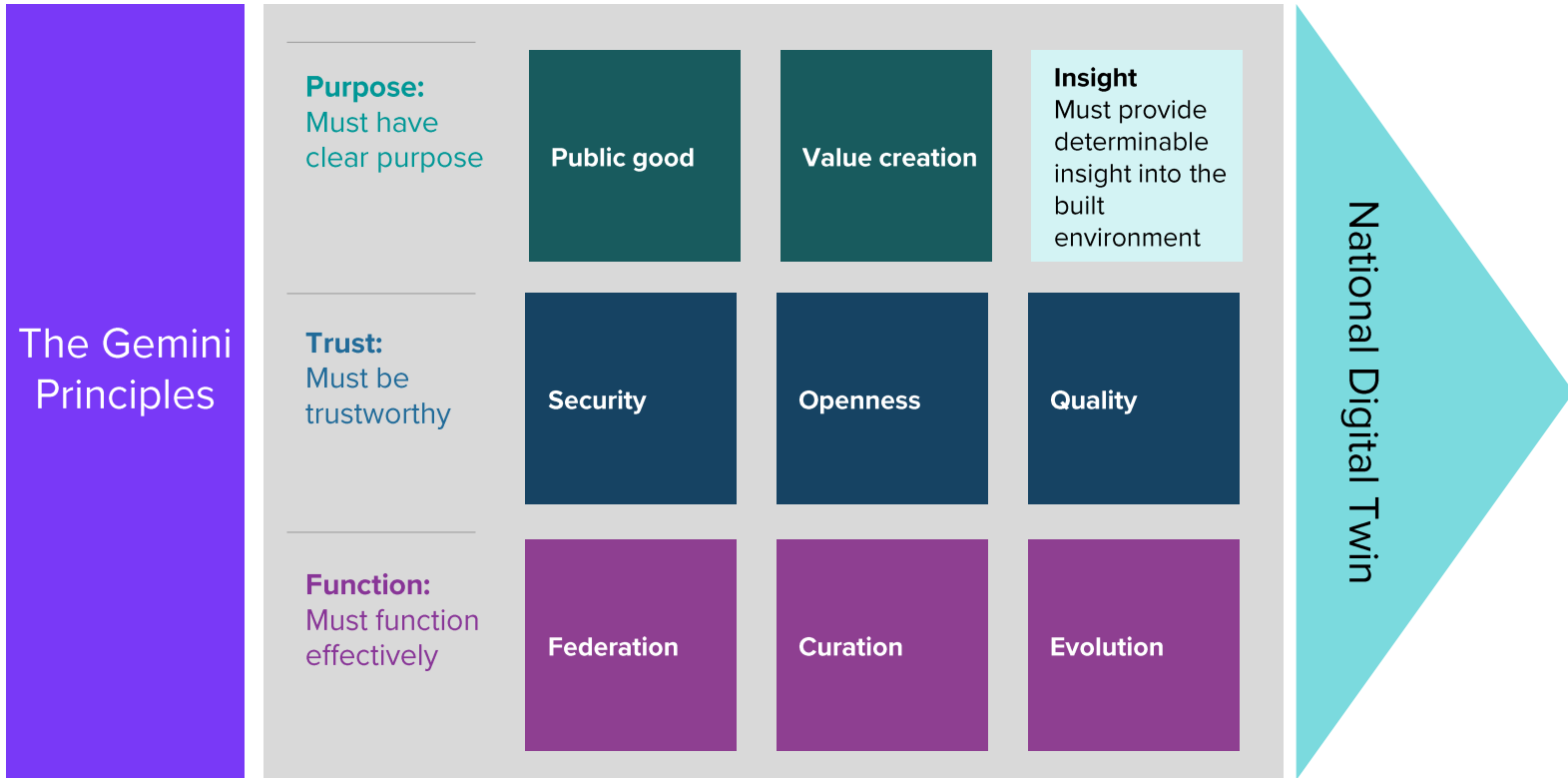
**3.**

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**Ensuring quality and  
security of data**



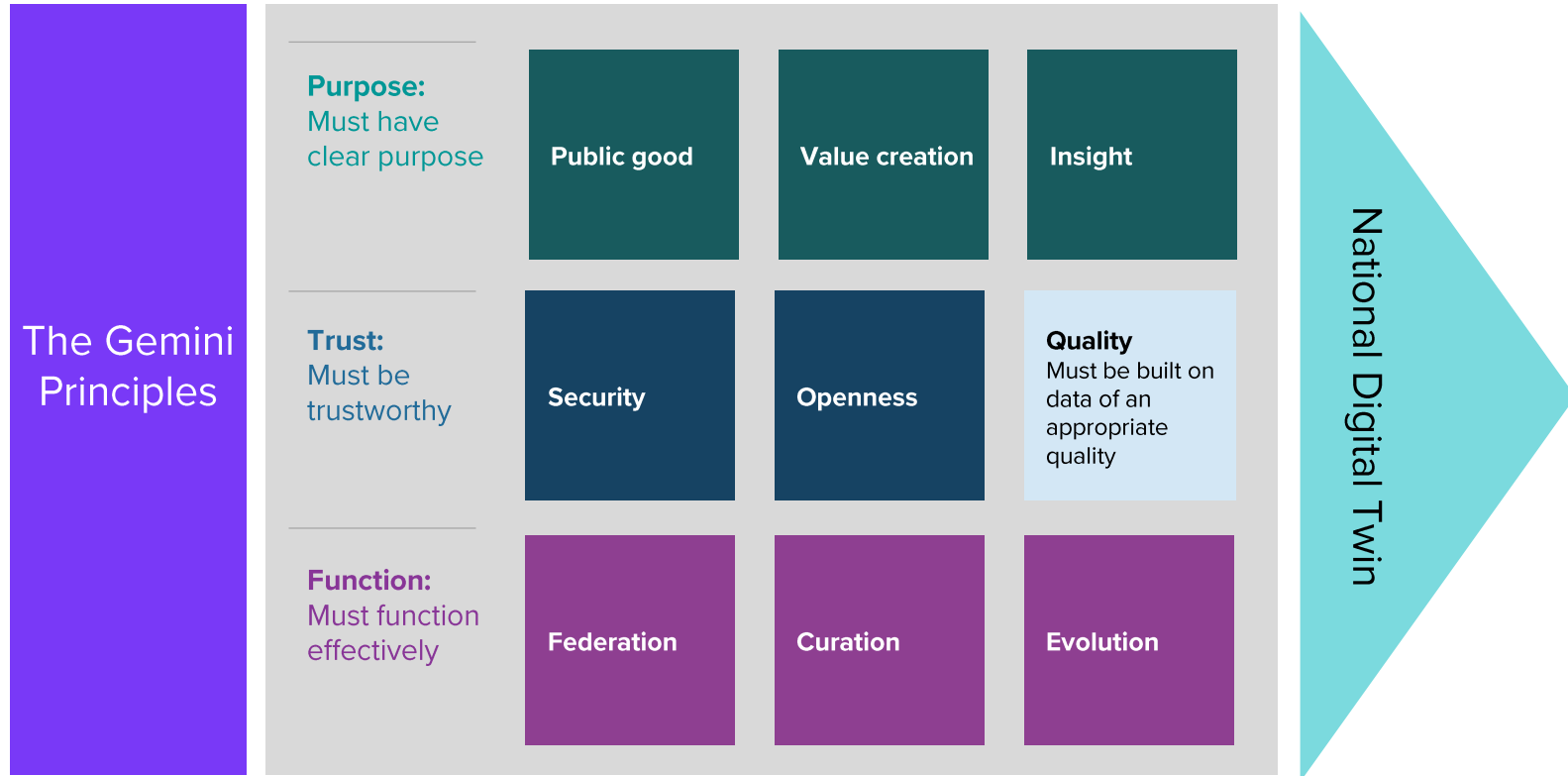
# The Gemini Principles



# Lessons Learnt



# Lessons Learnt



### TRENDS AND INSIGHTS

TIMESERIES

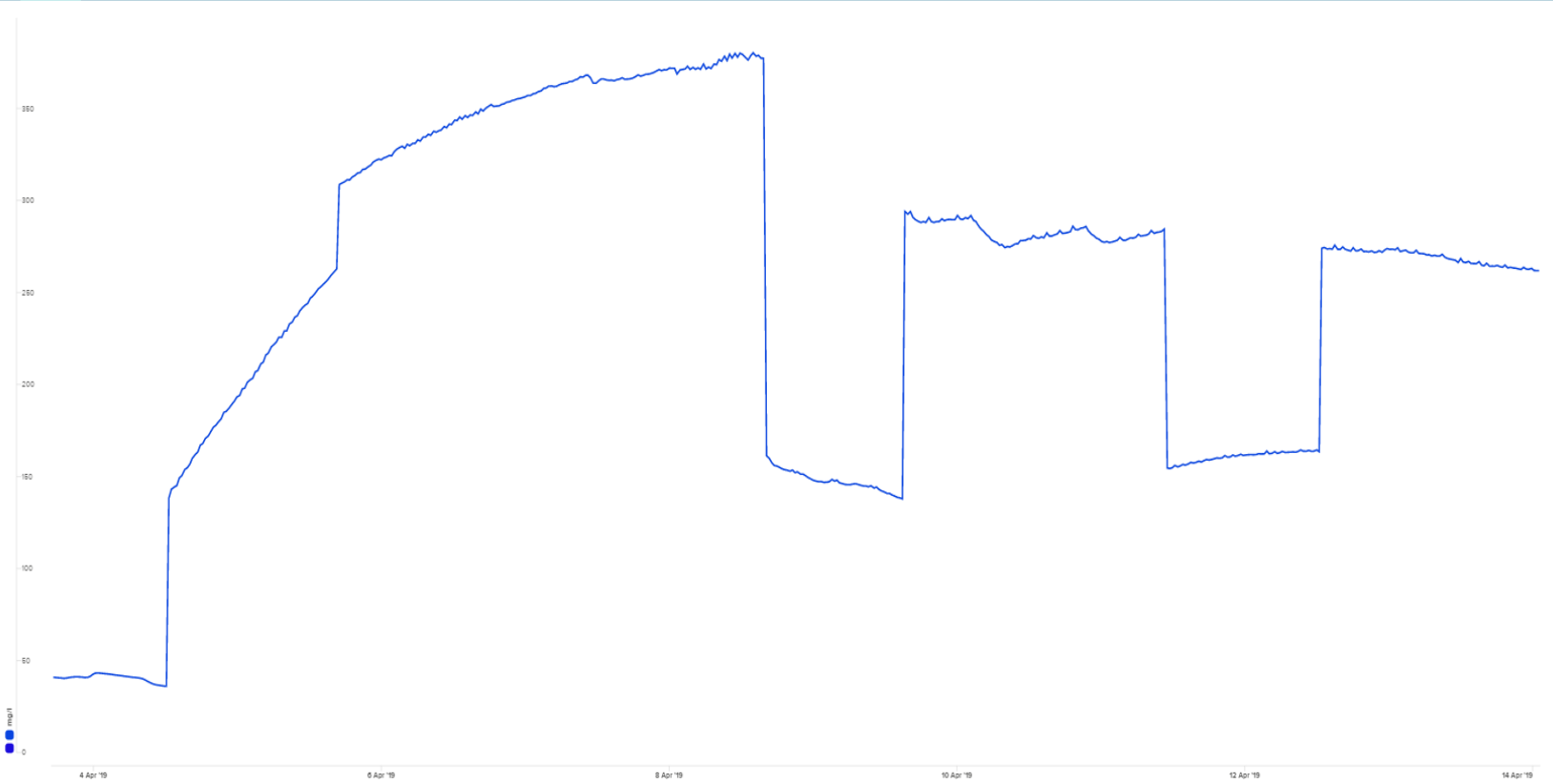
SCATTER PLOT

ASSETS

#### Reactor Monitors

- DO Concentration - Actual
- DO Concentration - Biowin
- DO Concentration - MMB
- No Detriment Line
- Reactor Level - Actual
- Reactor Level - Biowin
- Reactor NH-N4 Concentration - Actual
- Reactor NH-N4 Concentration - Biowin
- Reactor NH-N4 Concentration - MMB
- Reactor NH-N4 Load - Actual
- Reactor NH-N4 Load - Biowin
- Reactor NH-N4 Load - MMB
- Reactor NO-N3 Concentration - Biowin
- Reactor NO-N3 Concentration - MMB
- Reactor NO3 Concentration - Actual
- Reactor NO3 Load - Actual
- Reactor NO3 Load - Biowin

MIN	MAX	MEAN
36.04	380.17	258.43



3 April 2019, 16:57 to 14 April 2019, 01:16



SHOW ALL CHECKED ONLY

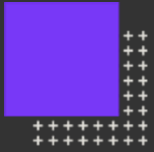
Reactor NO-N3 Concentration - Biowin

1/2/2019 0:00 to 18/5/2019 0:00

Reactor NO-N3 Concentration - MMB



# Future Applications



## Operational Asset Models

A live model of an asset or site providing real-time information for BAU operation



## Integrated Asset Systems

Complete digital twin of all water or wastewater assets



## Strategic Planning Model

Connecting long-term condition data via corporate systems; informing the capital investment process.

# Questions?

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