USE OF PHYSICAL MODELLING AND BUILDING INFORMATION MODELLING FOR MANGERE WASTEWATER PUMP STATION

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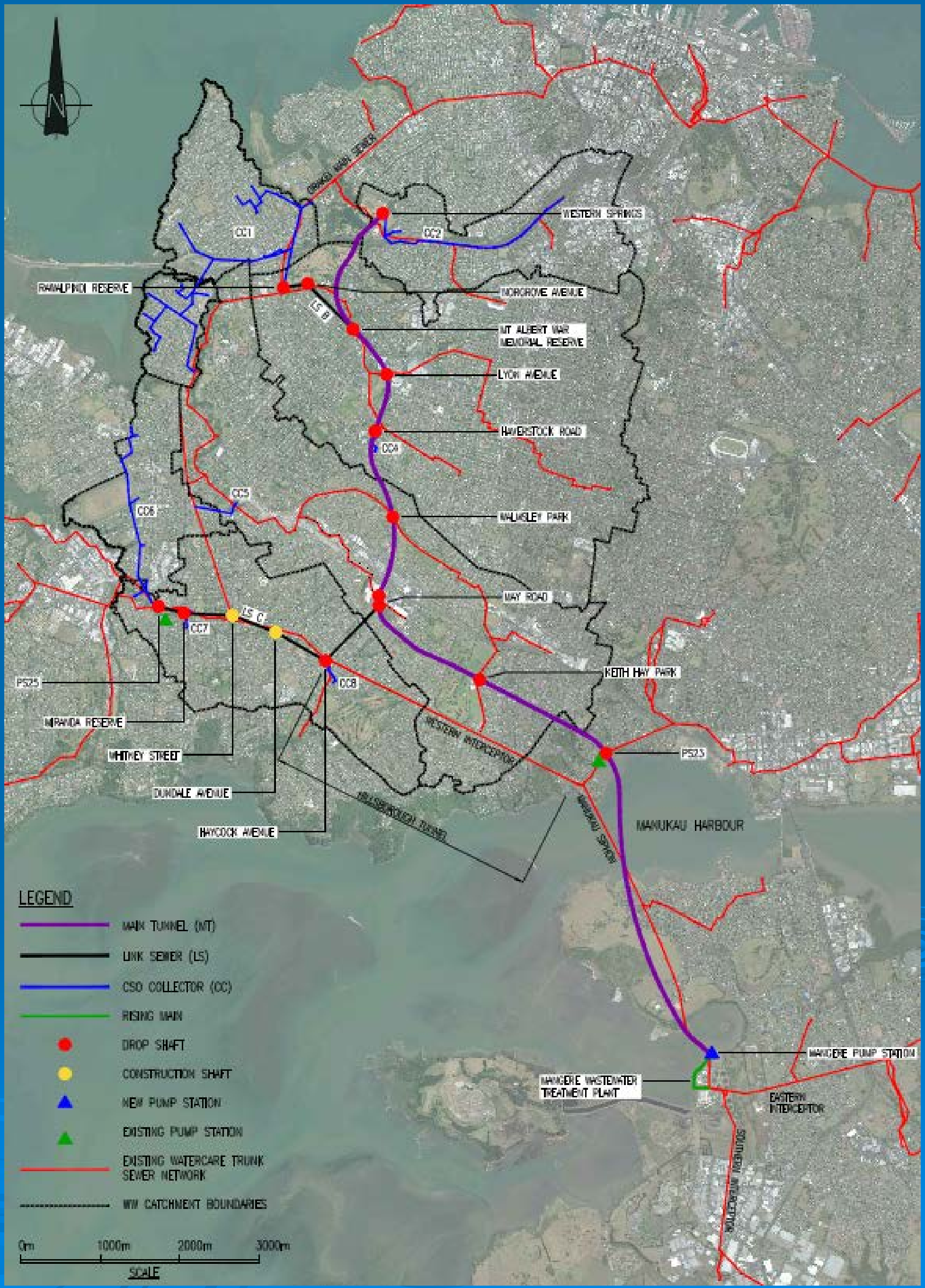
An Auckland Council Organisation

Agenda

- Project overview
- Why model a pump station?
- Physical modelling – scope, objectives and results
- Building Information Modelling – why do it, what are the benefits?

The Central Interceptor - what is it?

- A deep sewer tunnel that conveys and stores wastewater from the combined sewer network
- 13km of Main Tunnel with internal diameter of 4.5m,
- 4.4km of Link Sewers ranging from 2.1m to 2.4m internal diameter
- 16 shafts, up to 70m deep
- A terminal pump station with 6 m3/sec capacity

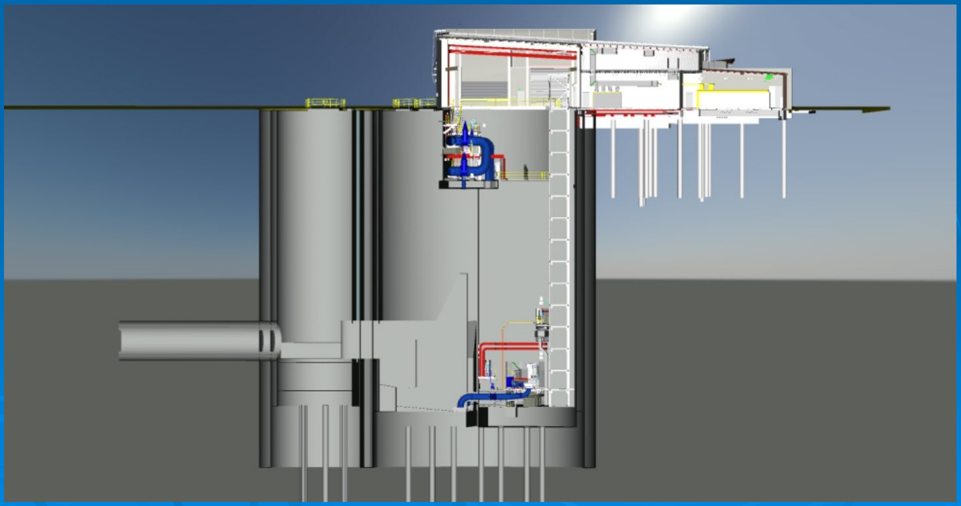


Why model a pump station?

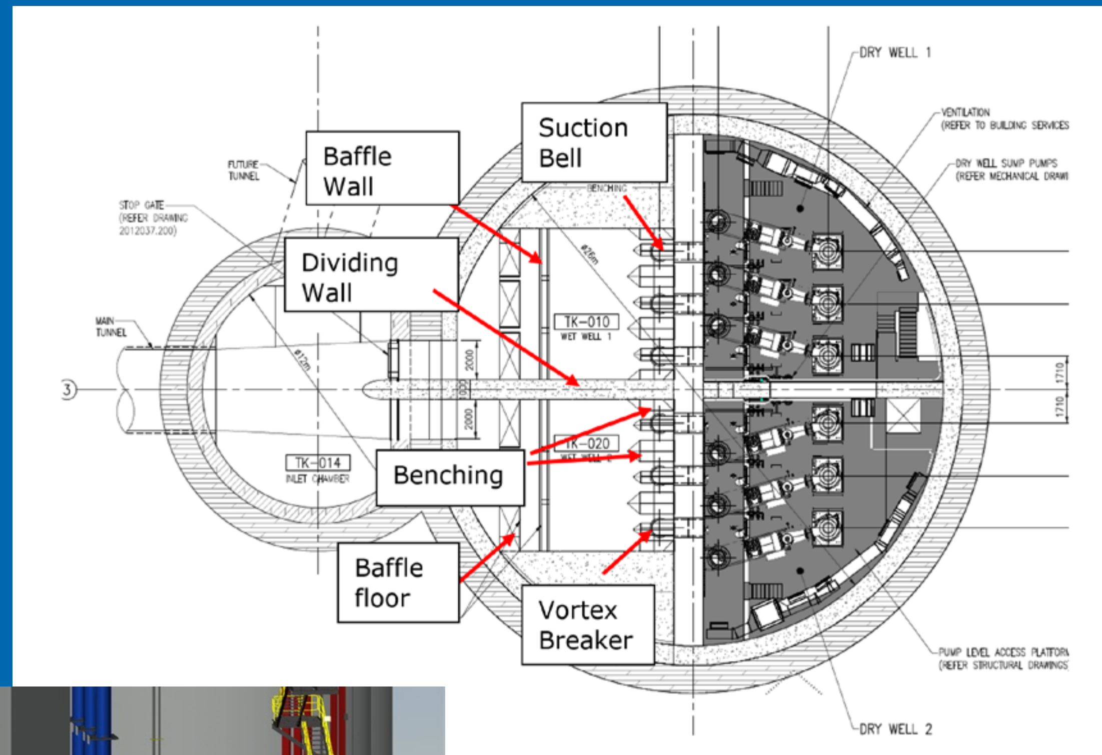
- To confirm the in-service performance of the pump station inlet chamber & wet well over a range of flow scenarios
- To provide a visualisation tool to assist designers, contractors and operators to comprehend the spatial layout of this large and complex asset
- Physical modelling is not commonly used in the New Zealand water industry, but is needed to optimise the design of larger facilities and confirm the ANSI/HI derived design
- Building Information modelling is becoming more common and in the future will become the norm.

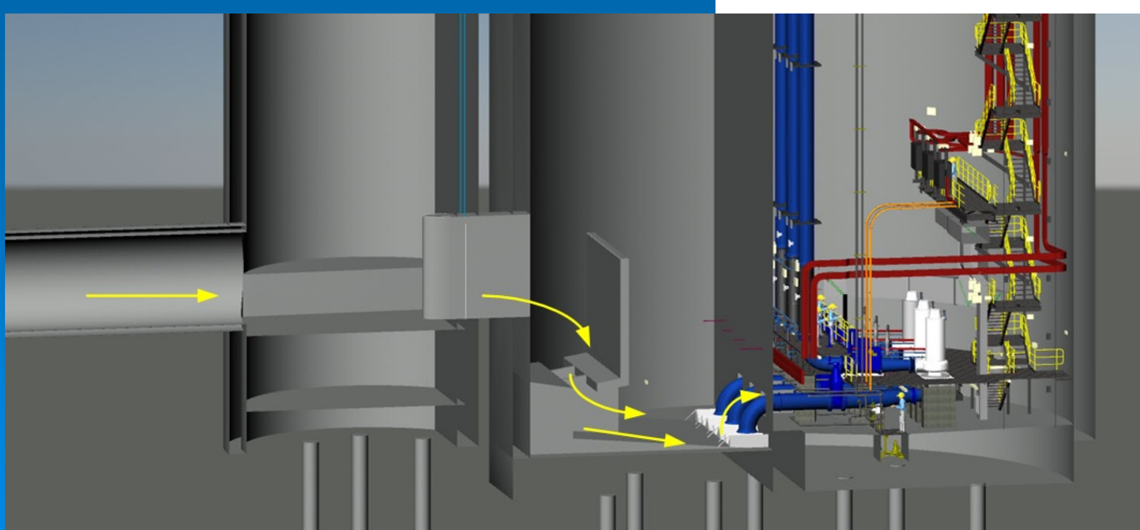
Mangere Pump Station

- Controls flow to Mangere WWTP
- Does not impact the plants peak capacity
- Standby generation provision
- Emergency Pressure Relief (not an overflow facility)



Physical Modelling for Hydraulic Testing



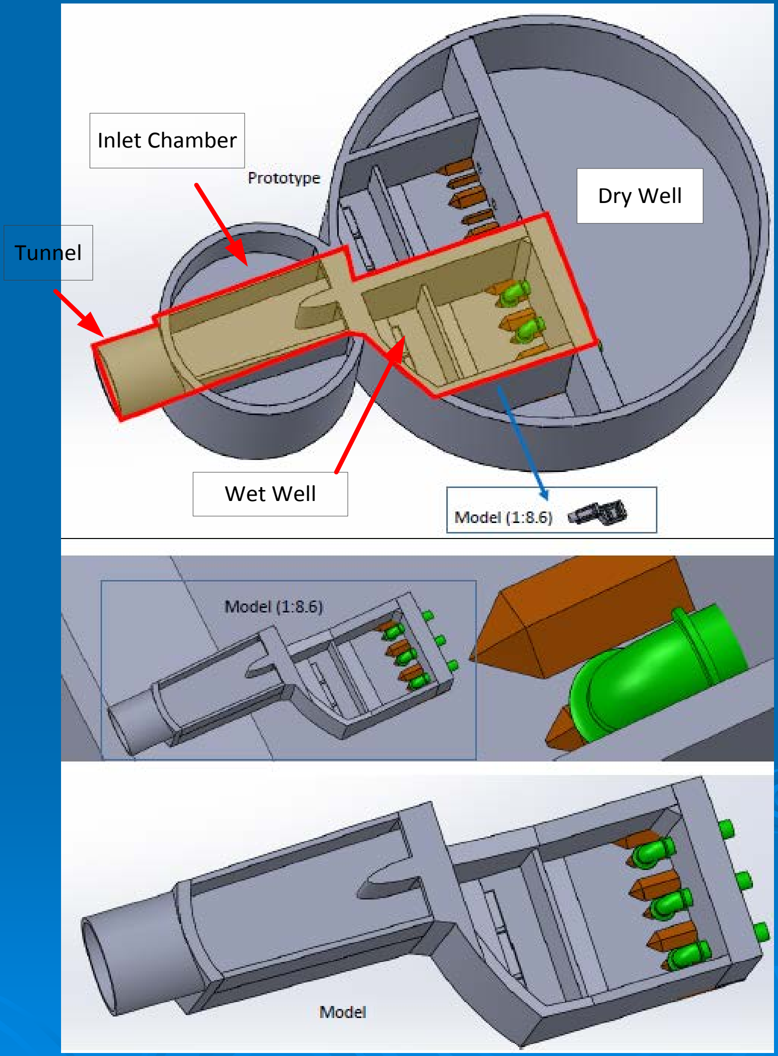


Objective of the Physical Model Study

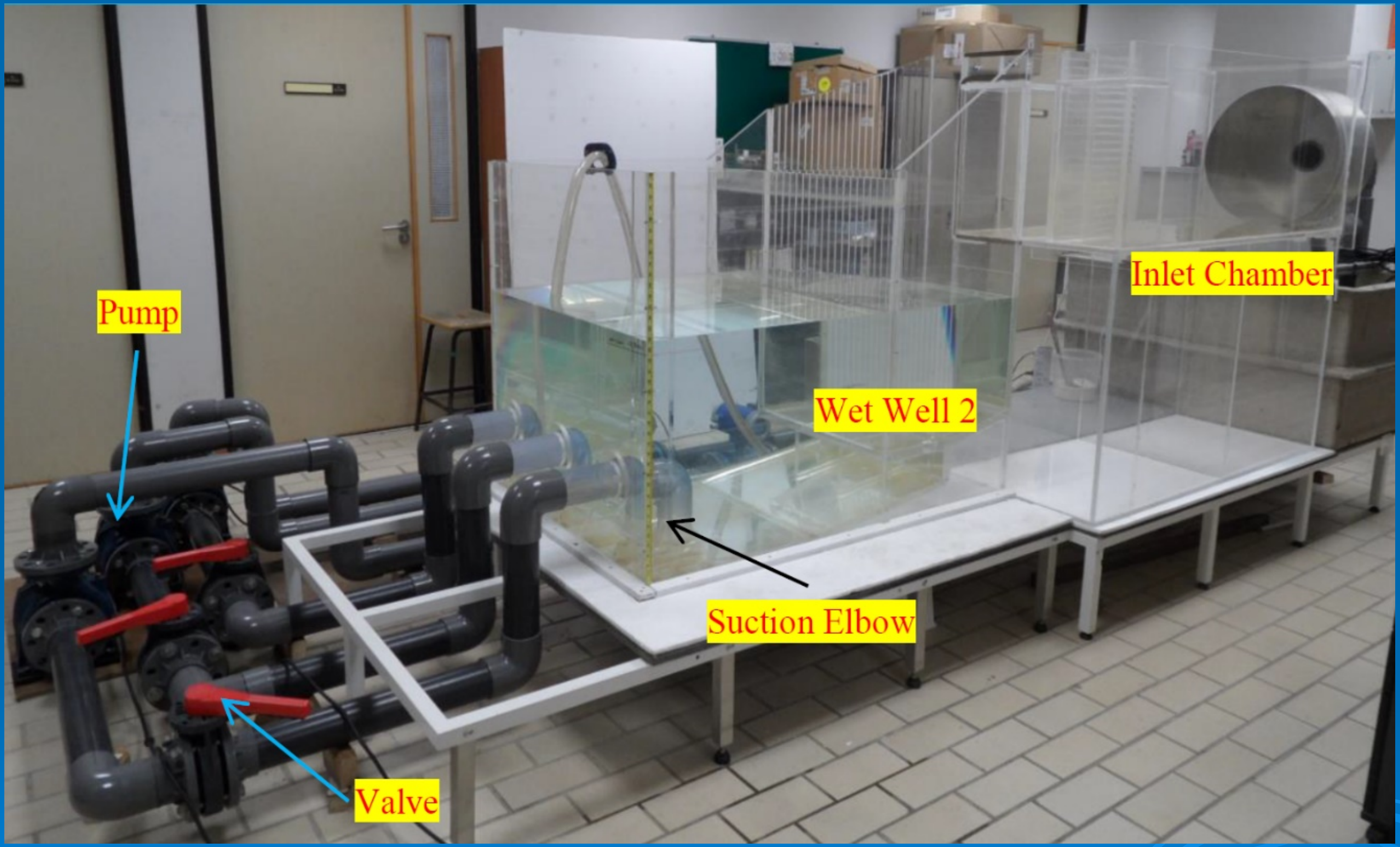
- Observe the general flow characteristics
- Determine the existence and magnitude of adverse flow phenomena
- Document the satisfactory performance in accordance with ANSI/HI

Geometric Scale of Physical Model – 1:8.6

- Scaled determined through Froude similarity criteria
- One half of the sump was modelled – one wet well
- Model was made of transparent acrylic plates



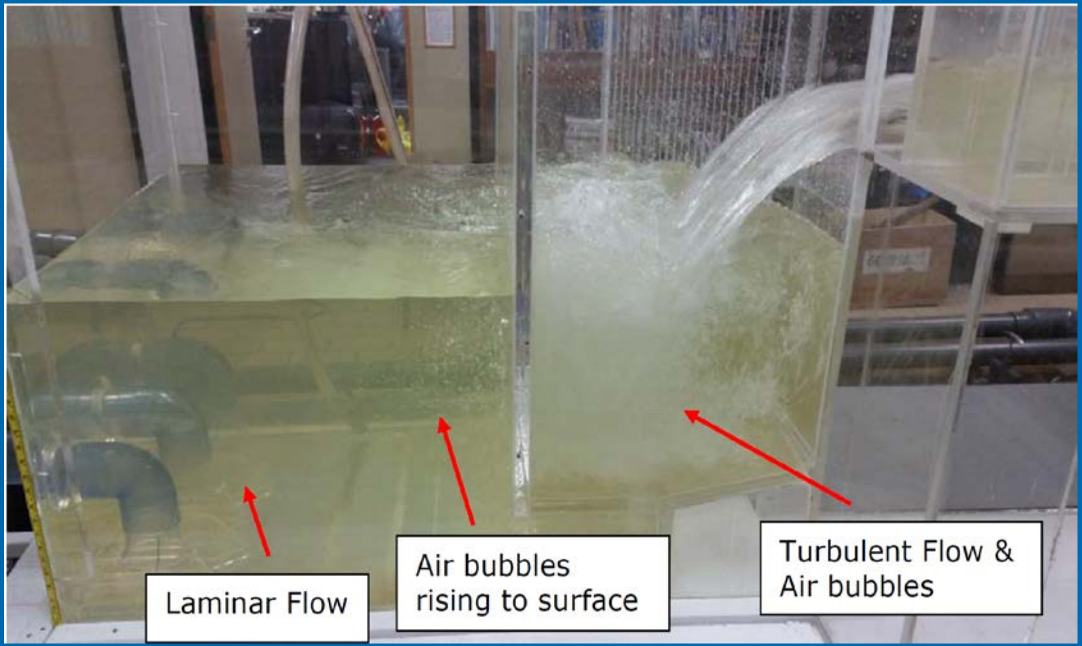
Physical Model



Test Cases

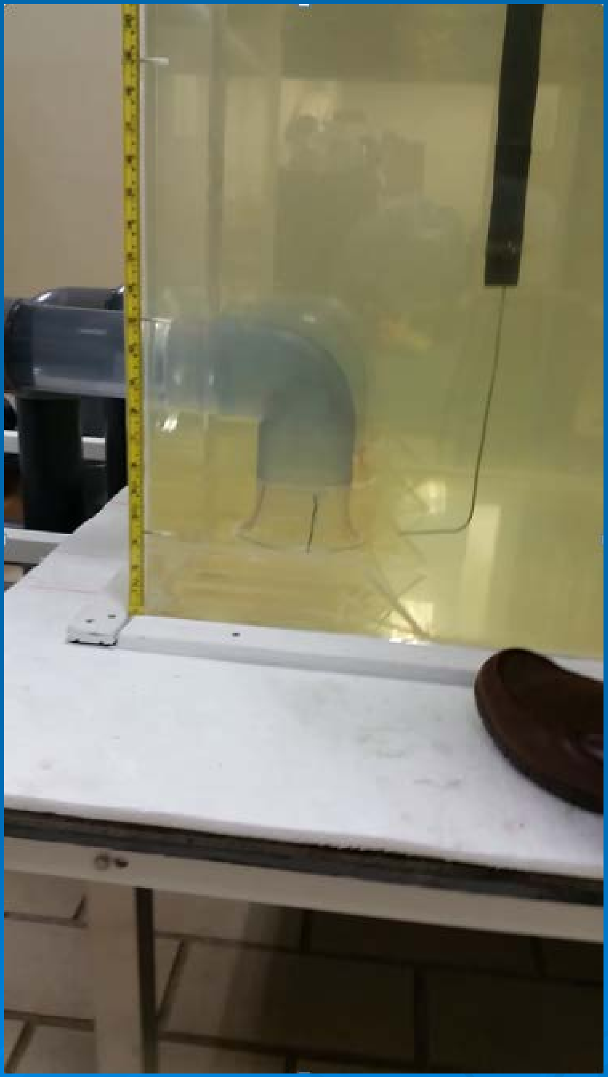
- A total of 15 operating scenarios
- Key scenarios include:
  - 1 pump operating at
    - minimum operating level and
    - maximum speed
  - 1 pump operating at
    - minimum operating level
    - maximum speed
    - 1.5 times the Froude scale flows (to evaluate scale effects)

Baffle Wall


Laminar Flow
Air bubbles
rising to surface
Turbulent Flow &
Air bubbles

Vortices and Swirls

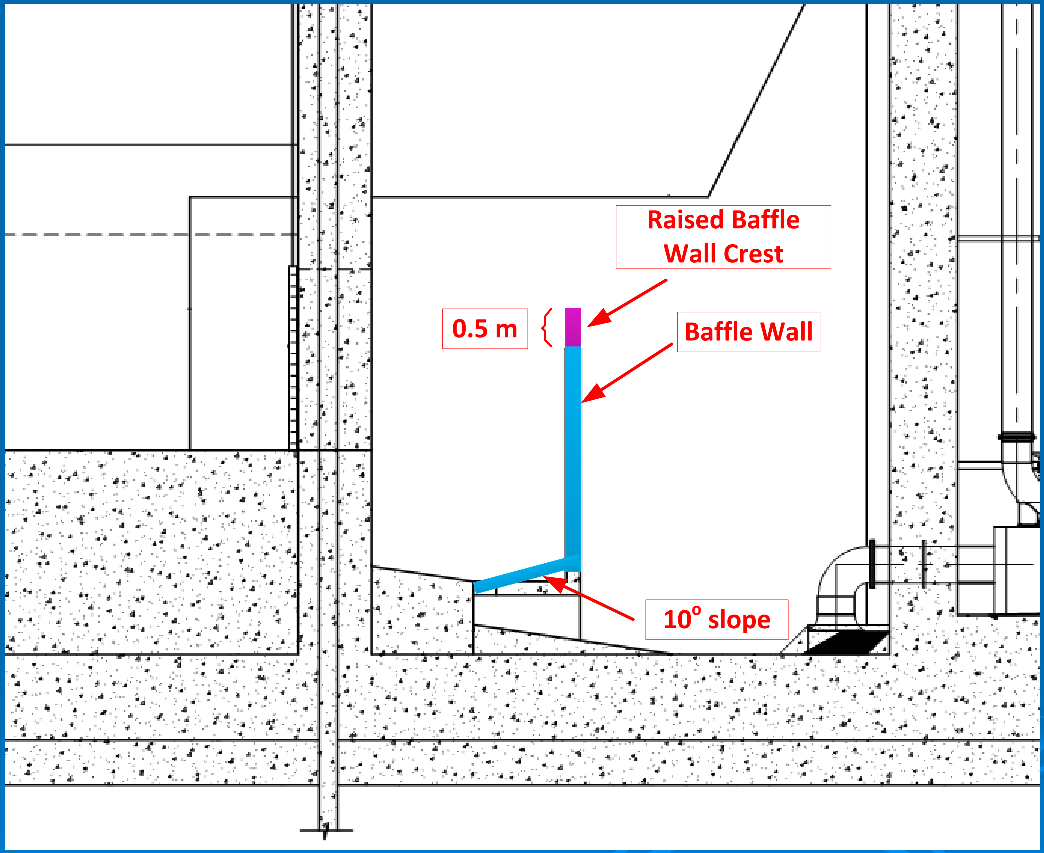
Vortices and Swirls



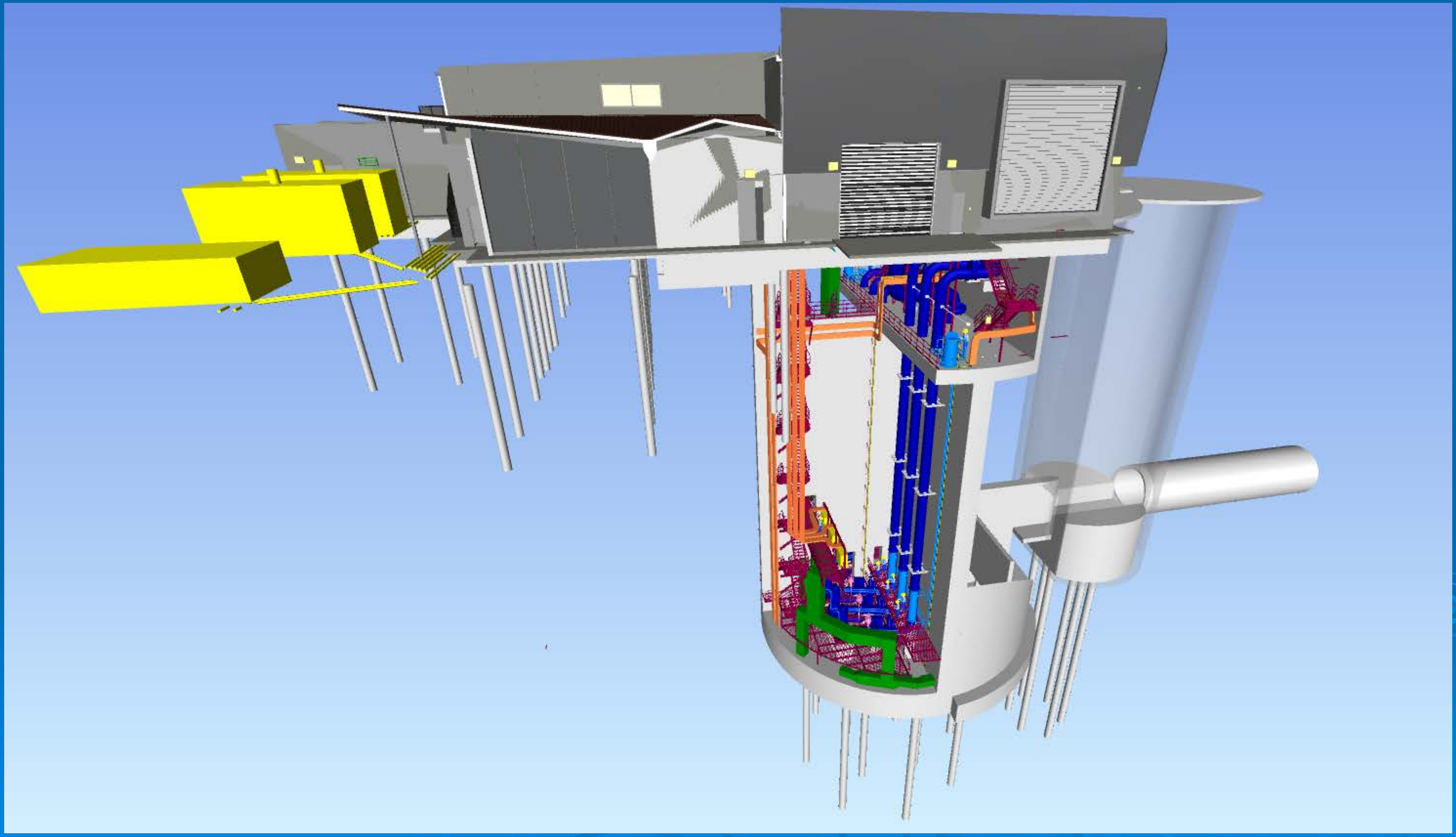
Snore Cycle

Recommendations

- Increase in baffle wall height
- Slope in baffle floor



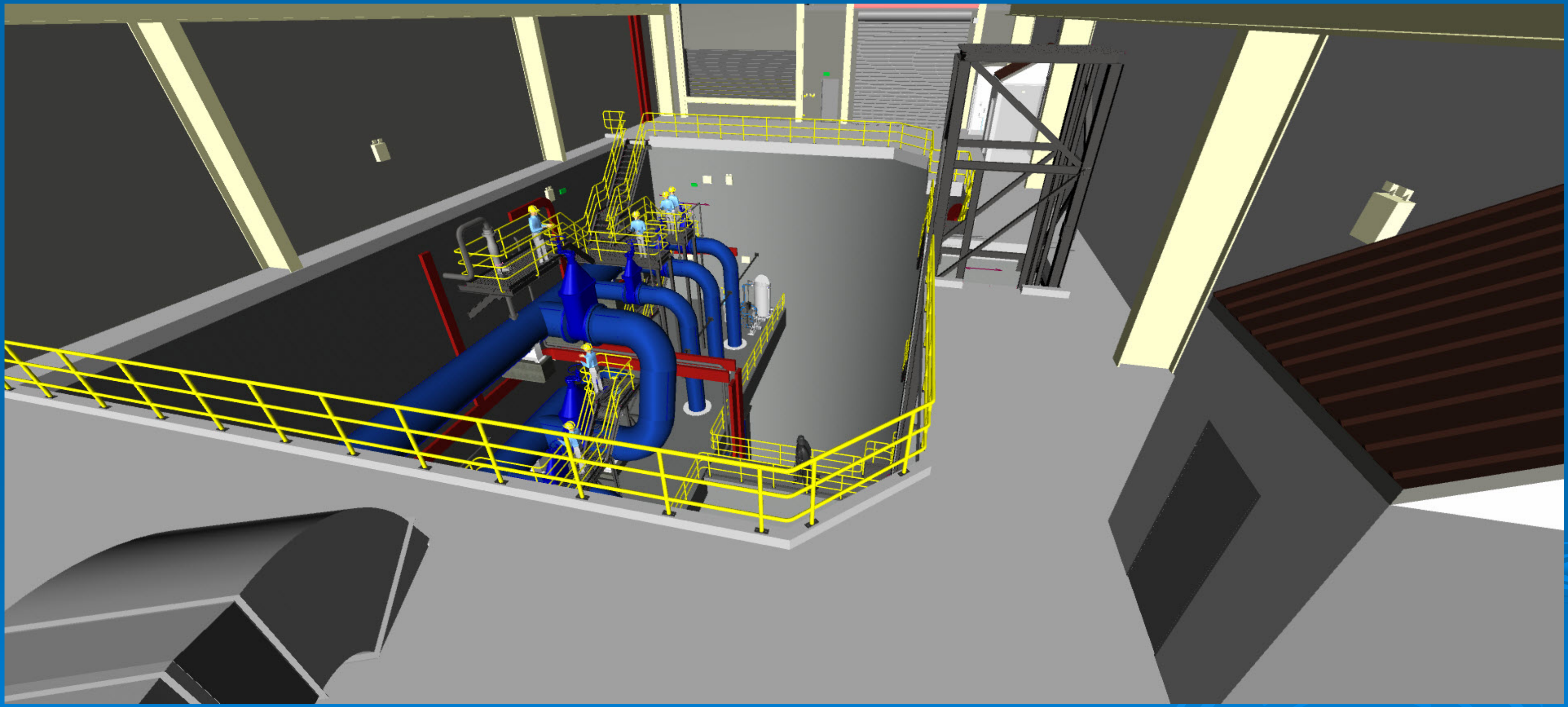
BIM Model for Mangere Pump Station



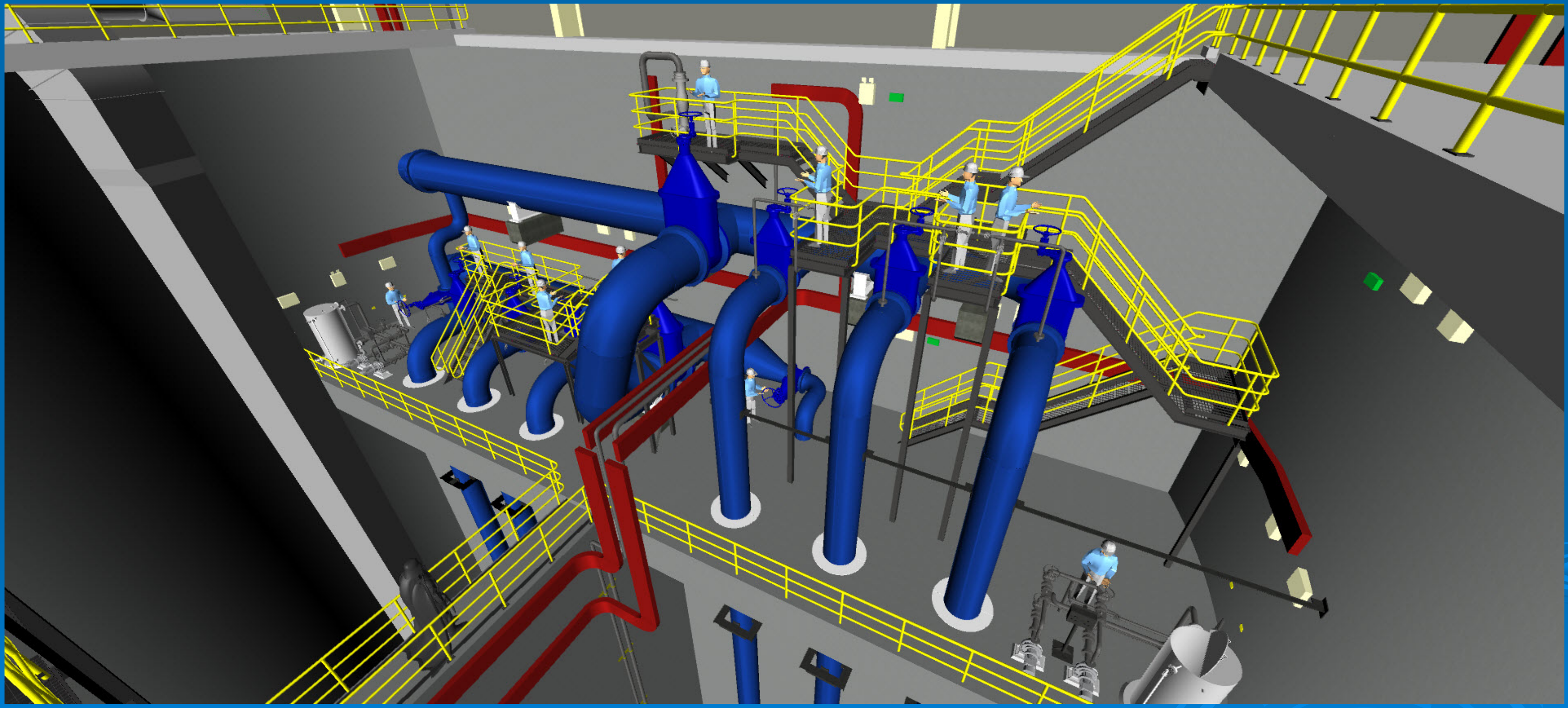
Benefits of BIM

- 3D visualisation to improve understanding of the design drawings
- Improved design processes and coordination between different design disciplines, including collaborative sharing and clash detection
- Useful for SiD workshops & discussions with O & M staff
- Potential to assist the construction planning processes, including activity scheduling, space proofing and commissioning
- Assistance with maintenance of the pump station including operator training and work order management

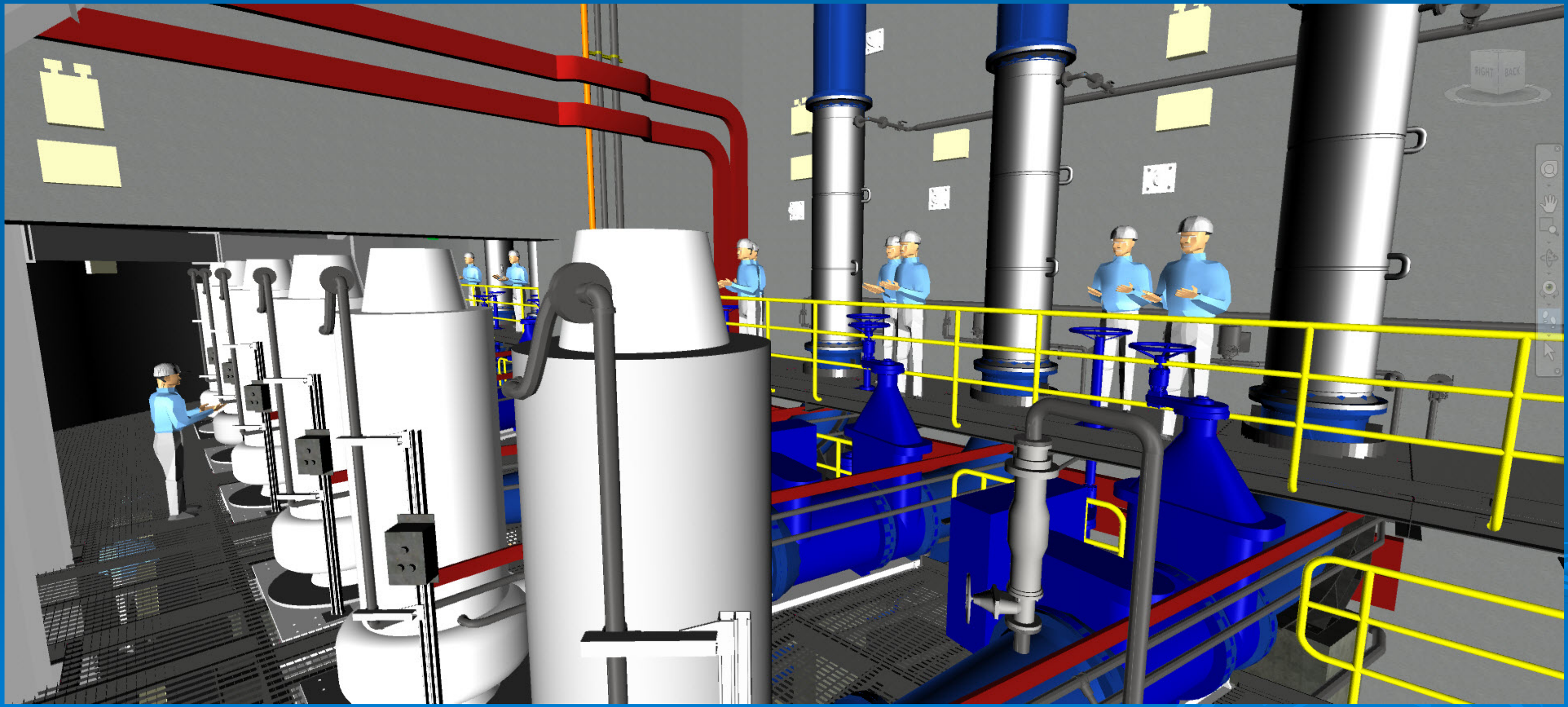
View at ground level



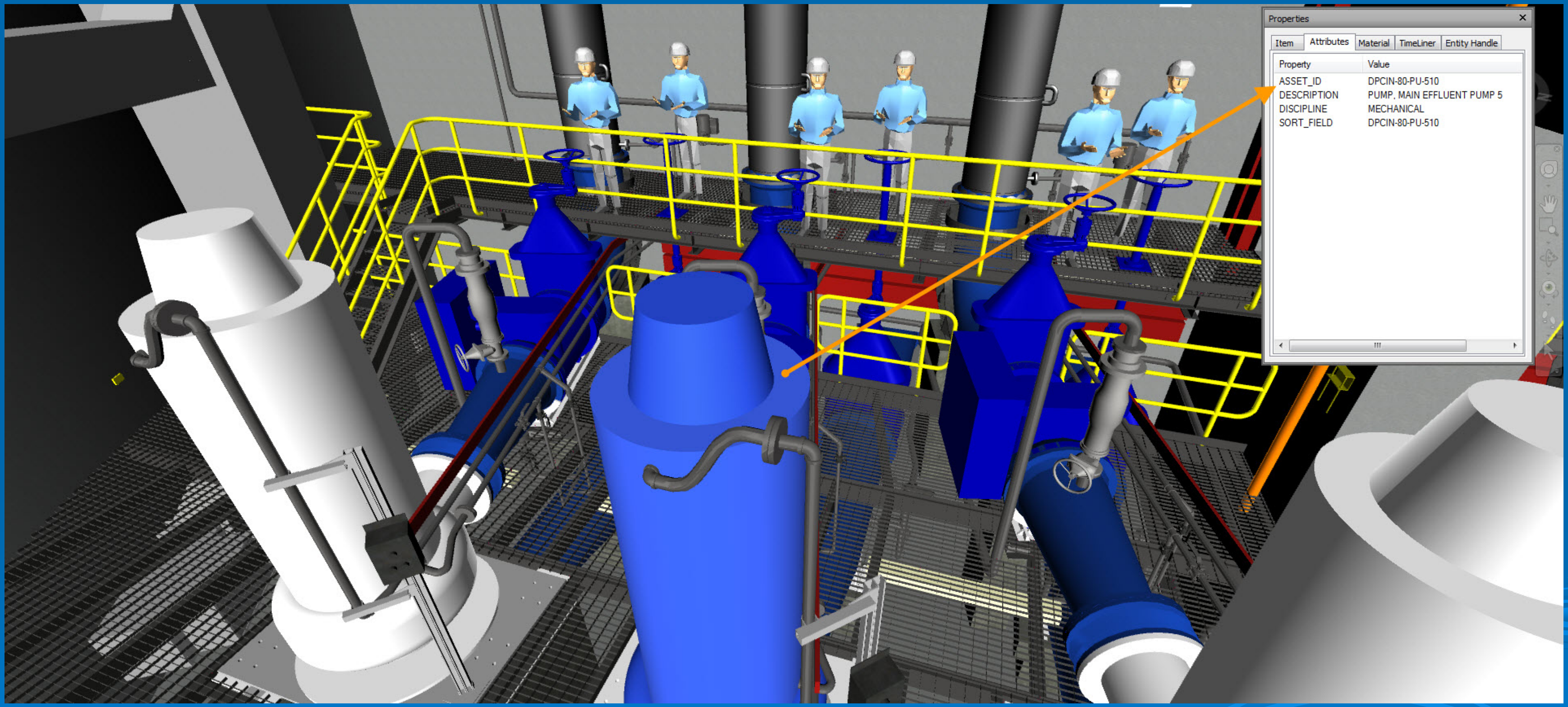
View at upper gallery level



View at pump level



Asset Attribution



Summary

- The use of physical modelling confirms that the design meets the project requirements and will deliver the specified performance
- The BIM model helps in visualising the pump station and will assist contractors and operators through the construction and commissioning phases, through to operation and maintenance. It will be developed further and integrated with Watercare’s asset management systems.