HSY Wastewater Pump Optimization — Team Vaporized - Technical Summary

How the Solution Meets the Assignment

- Uses official BLOM geometry for volume ↔ L1 level conversion.
- Ensures L1 level < 8.00m at every timestep
- Daily drain logic empties the inflow tunnel, while avoiding emptying while the inflow is heaviest (2000m3/15min)
- Takes into account energy prices 24h ahead of the inflow event and tries to utilize lowest prices
- Minimizes the number of pumping operations that last less than 2h
- Outputs a similar Excel file with the timesteps, inflow, L1 level, outflow, per pump flows and powers and high/normal energy price columns.

Simplifications:

The model assumes **two pump sizes** with constant flow and power:

- Large pump: **750 m³/15 min**, power **350 kW**
- Small pump: **375 m³/15 min**, power **200 kW**

Pump power values are estimated from the provided benchmark data and treated as constant.

The controller **does not model pumping head or variable pump efficiency**.

Comparison of benchmark data statistics vs our algorithm

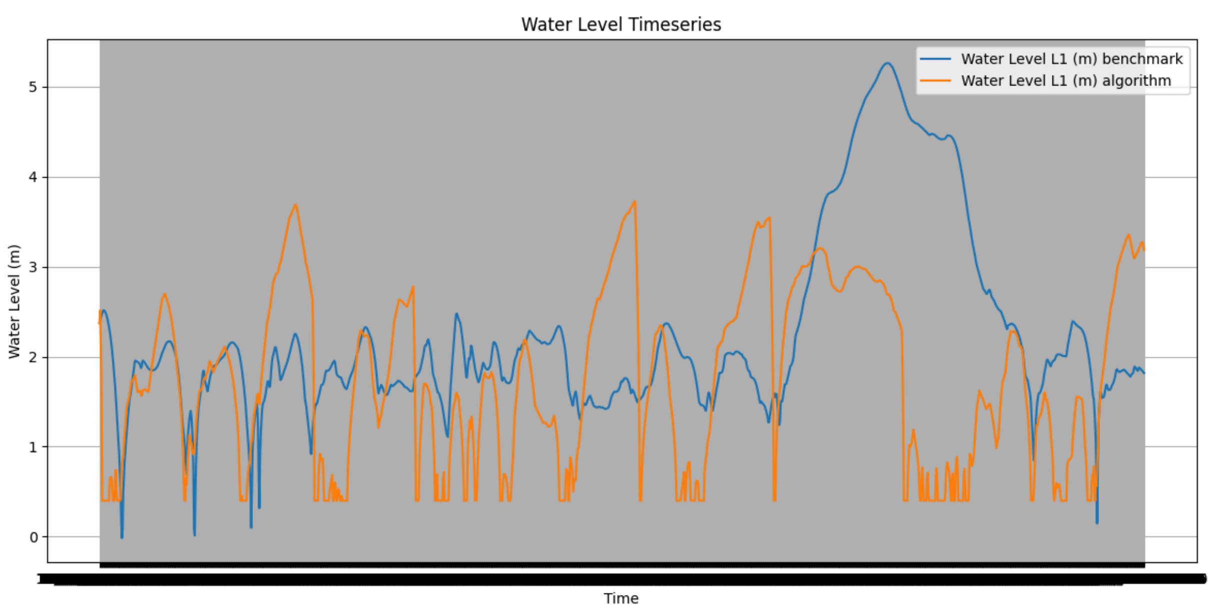
Benchmark is the given dataset

Metric	Benchmark control	Our algorithm	Change (absolute)	Change (%)
Total energy consumption	292,805.55 kWh	300,050.00 kWh	+7,244.45 kWh	**+2.47%**
High energy cost	121,824.63 EUR	116,923.24 EUR	-4,901.39 EUR	**-4.02%**
Normal energy cost	25,690.55 EUR	23,915.99 EUR	-1,774.56 EUR	**-6.91%**
Average price per kWh (normal)	0.00877 EUR/kWh	0.0797 EUR/kWh	-0.00803 EUR/kWh	**-9.15%**
Max total power draw	1,221.76 kW	2,500.00 kW	+1,278.24 kW	**+105%**
Min total power draw	0.00 kW	0.00 kW	–	–

The algorithm is able to reduce the energy costs, even though the total energy consumption is higher than benchmark.

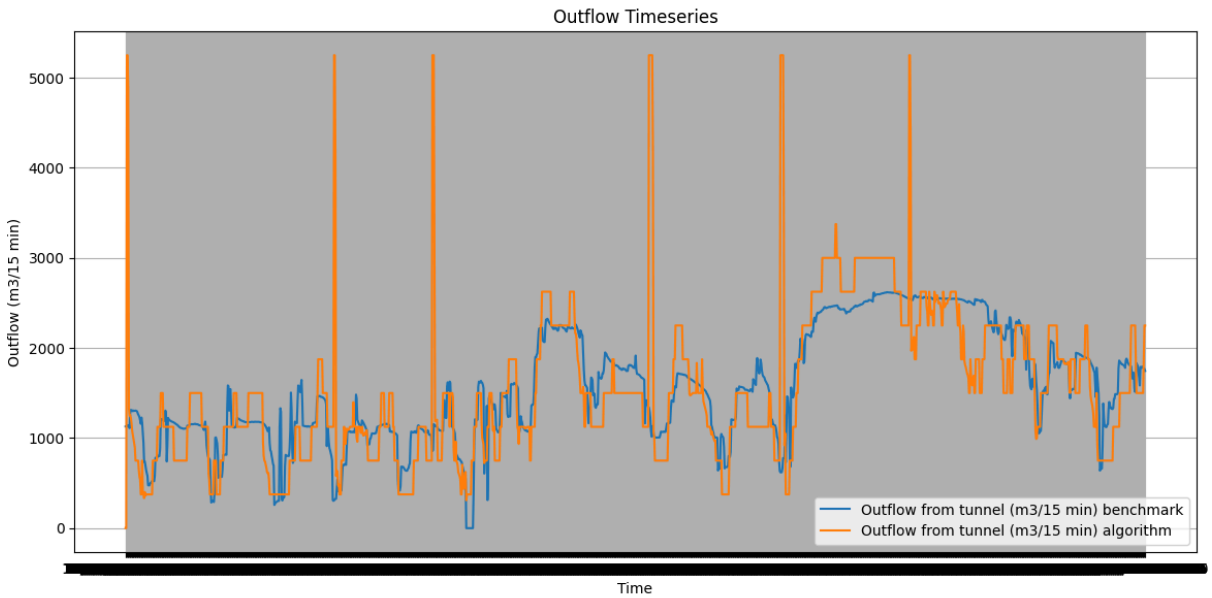
Pump	Runtime h (Benchmark)	Short runs <2h (Benchmark)	Runtime h (Our algorithm)	Short runs <2h (Our algorithm)
1.1	119.75	8	171.75	0
1.2	53.75	5	110.00	1
1.3	0.00	0	179.50	1
1.4	154.50	9	282.00	0
2.1	79.00	11	219.00	0
2.2	199.25	2	12.00	0
2.3	191.25	17	19.00	0
2.4	149.50	7	31.50	0
Total / stats	**947.0 h**	**59 short runs**	**1,024.75 h**	**2 short runs**

The algorithm is able to minimize the number of short runs down to 2 compared to 59 in the benchmark.

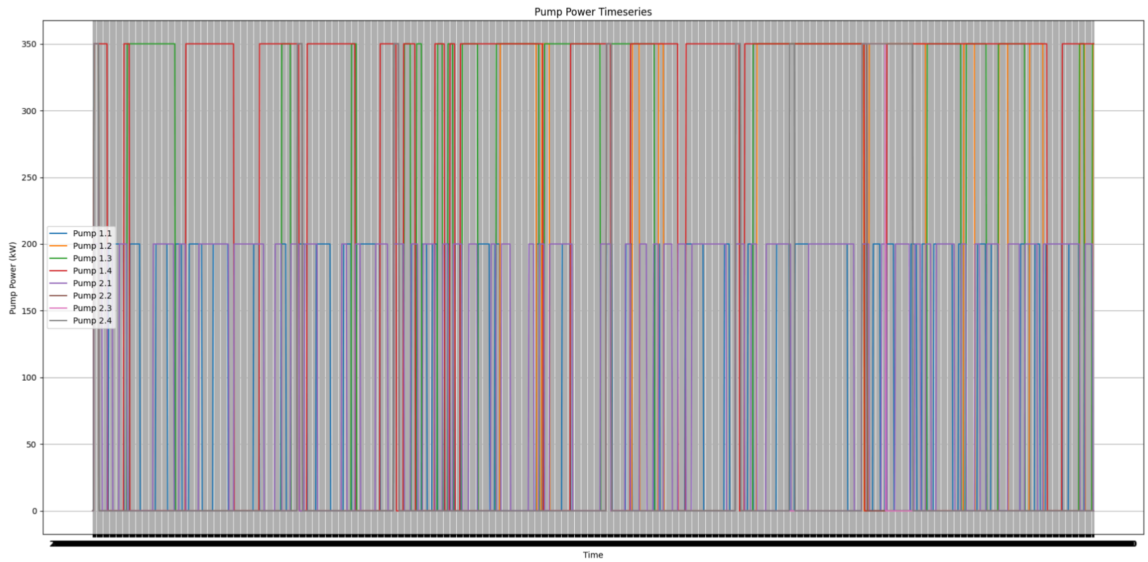


L1 water level, benchmark vs algorithm

In the graph above, the algorithm does daily emptyings, but avoids emptying during the heaviest inflow



Outflow, benchmark vs algorithm



Pump power usage chart from algorithm (keeps at least one pump on at all times, except for the start where no pump is running)

Future Enhancements

- Replace fixed pump data with real pump curves (flow & efficiency).
- Model head-dependent flowrate.
- Add weather forecast to predict inflow peaks