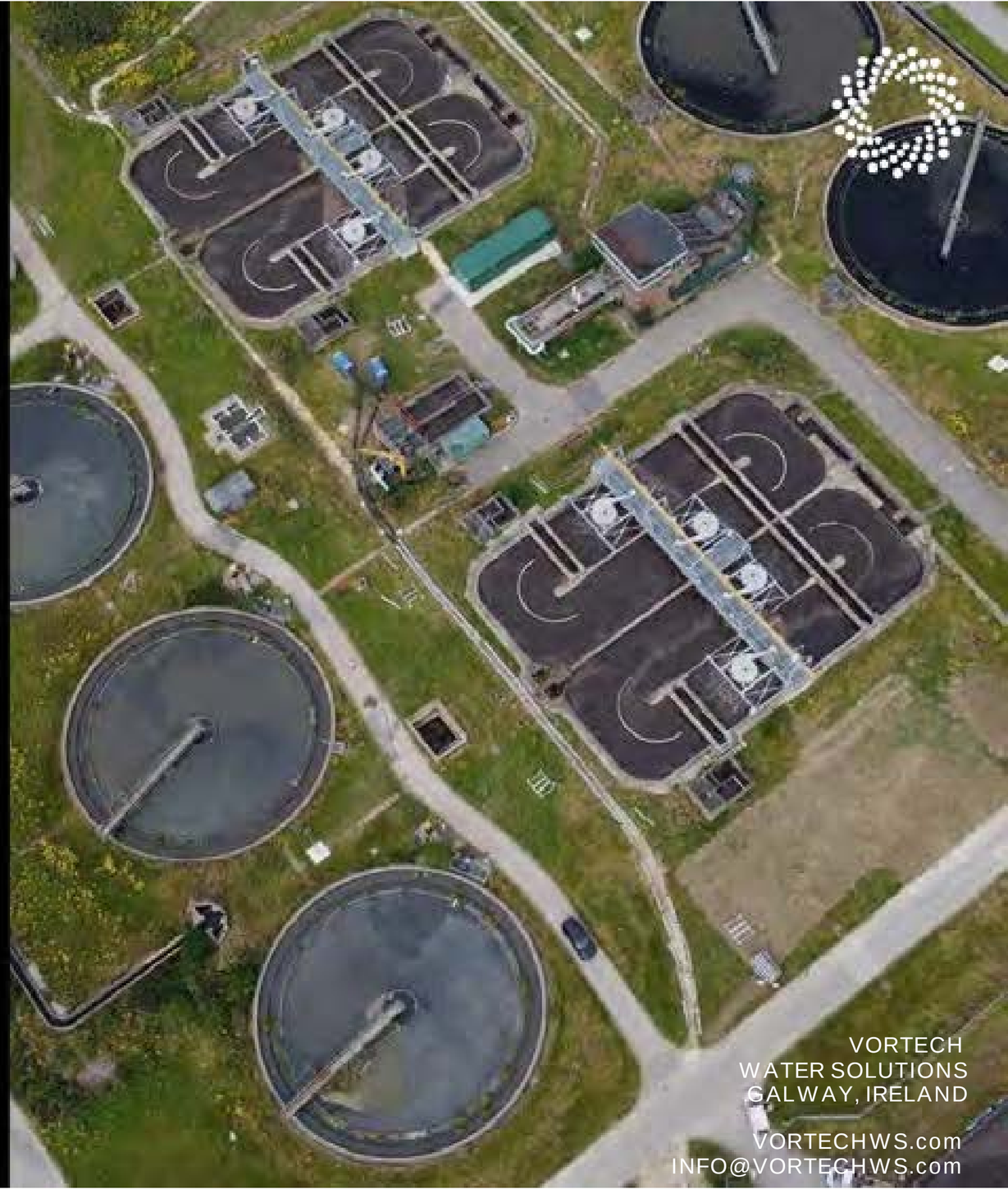
VORTECH

VORTEX POWERED AERATION

A NEW CLASS IN WASTEWATER AERATION TECHNOLOGY



VORTECH
WATER SOLUTIONS
GALWAY, IRELAND

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CHALLENGES IN MUNICIPAL AND INDUSTRIAL WASTEWATER TREATMENT

- Increased wastewater volumes and more stringent regulation continues to drive the need for higher capacity treatment.
- Facility owners are challenged to address needs on multiple fronts.

FASTER CAPACITY UPGRADES

Urgent requirement to increase treatment capacity and replace aged equipment.

ENERGY EFFICIENT TREATMENT

Aeration energy accounts for up to 70% of a plants bill. More energy efficient solutions are required.

LOWER MAINTENANCE COSTS

Traditional aeration technologies are difficult to maintain, risking plant down time and non-compliances.

LONGER LIFE EXPECTANCY

High frequency of overhaul and replacement costs drive up the total cost of ownership.



WHO ARE VORTECH

- **People:** Our team has multidisciplinary expertise in areas of fluid dynamics, process science and digitalization.
- **Product:** Our patented vortex technologies, inspired by fluid dynamics, are designed to accelerate the deployment of wastewater treatment.
- **Purpose:** We are a purpose driven organization, inspiring communities and industries to embrace safer, more robust and energy efficient water management practices.





PROBLEM

AERATION, THE CORE OF THE WASTEWATER TREATMENT PROCESS, SUFFERS FROM A NUMBER OF CHALLENGES

1960's

2020's





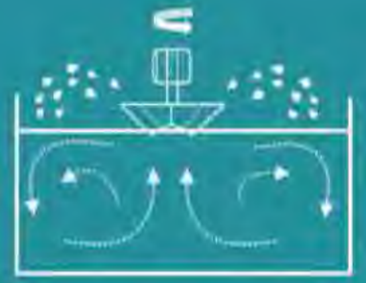
Sector's Unsolved Pain Points

Difficult and costly to install	Energy inefficient	High cost to maintain	Unsafe work environments	Short lifespan

SOLUTION
BRINGING SIMPLICITY TO A COMPLEX PROBLEM

Rotating Mechanical Aeration

Surface Mounted

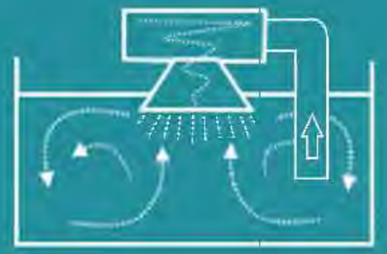


Coarse Bubbles

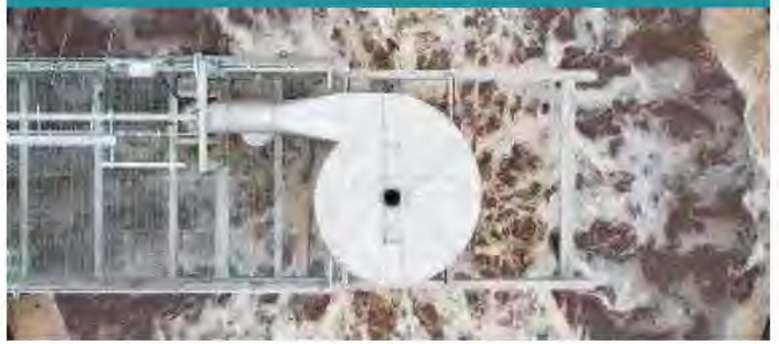


Vortex Powered Aeration VPA™

Surface Mounted

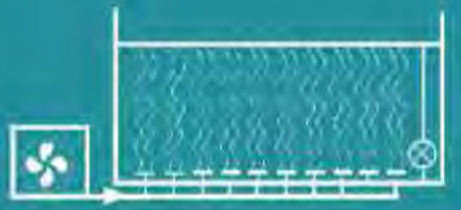


Fine Bubbles



Fine Bubble Diffused Aeration

Floor Mounted



Fine Bubbles



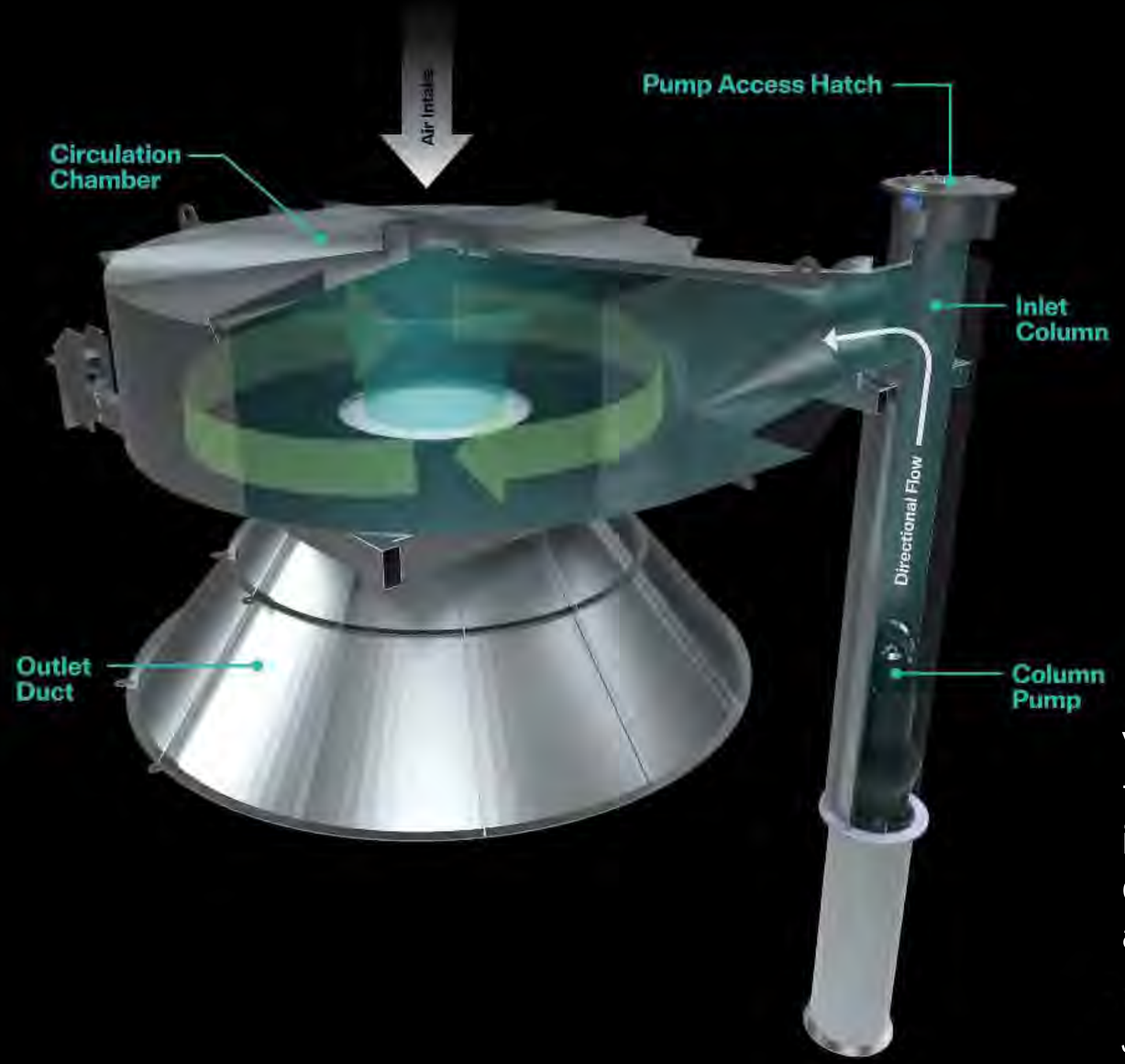
VORTEX POWERED AERATION™ (VPA™)

A NEW CLASS IN WASTEWATER AERATION TECHNOLOGY

“

I still can’t quite believe that we have waited over a hundred years for someone to come-up with this seemingly obvious innovation in aeration technology.....”

Principal Engineer, Large Municipal Utility



“

Vortex Powered Aeration technology is attractive to us as it is a practical, low risk energy efficient alternative not requiring a change in treatment process.....”

John Durkan, ABP Food Group

VORTEX POWERED AERATION™ (VPA™)

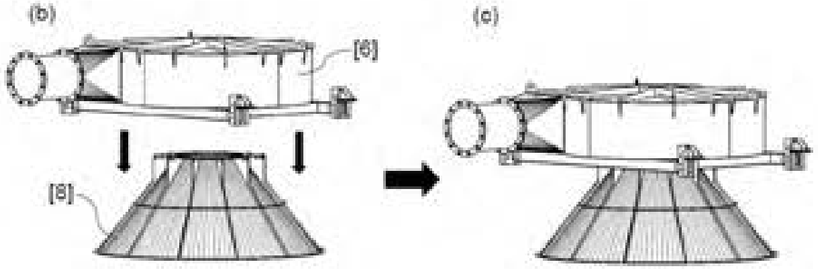
HOW DO WE DESIGN AND INSTALL?

Step 1

Client Specifies Oxygen Demand

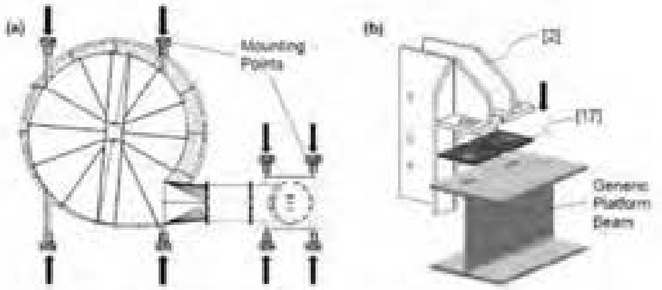
Step 2

Vortech Selects Number of Units and Sizes



Step 3

Client Sources Platform and Panel

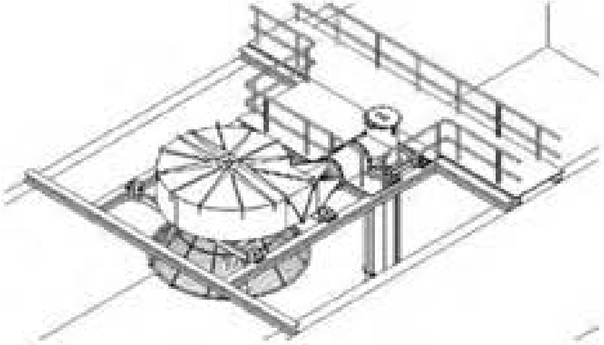


Step 4

Vortech Ships Units Ready for Assembly

Step 5

Client Installs in a Matter of Days





VORTEX POWERED AERATION™

HOW IT WORKS?

To see video click
Here



WHY WE ARE BETTER?

WE DELIVER IMMEDIATE AND LASTING VALUE

80%

LOWER INSTALLATION TIME

compared to traditional aeration systems

30%

LESS ENERGY

used in the aeration process

75%

LOWER MAINTENANCE COSTS

compared to traditional aeration systems

2x

LIFE EXPECTANCY

compared to traditional aeration systems

*Results from VPA installations over last 4 years, representative of general outcomes



GENERALISABLE TECHNOLOGY

WHERE DOES IT FIT?

- **New Builds:** Not requiring blowers, blower buildings, complex civil works or mechanical assemblies, VPA™ can introduce significant capital savings in new builds.
- **Retrofit to Save Opex:** Retrofit existing infrastructure without down time to save up to 40% in operational costs (energy and maintenance).
- **Upgrade Ageing Infrastructure:** At twice the lifespan of traditional equipment, VPA™ is being deployed to ageing infrastructure to increase capacity and reduce total lifecycle costs by up to 35%.
- **Generalizable for Many Configurations:** VPA™ is suitable for CMAS, Oxidation Ditches, MBR, Plug Flow and many more processes.
- **Scale:** VPA has different size units for all scales. Our largest install to date is a 250,000 Population Equivalent site in Western Australia





GENERALISABLE TECHNOLOGY

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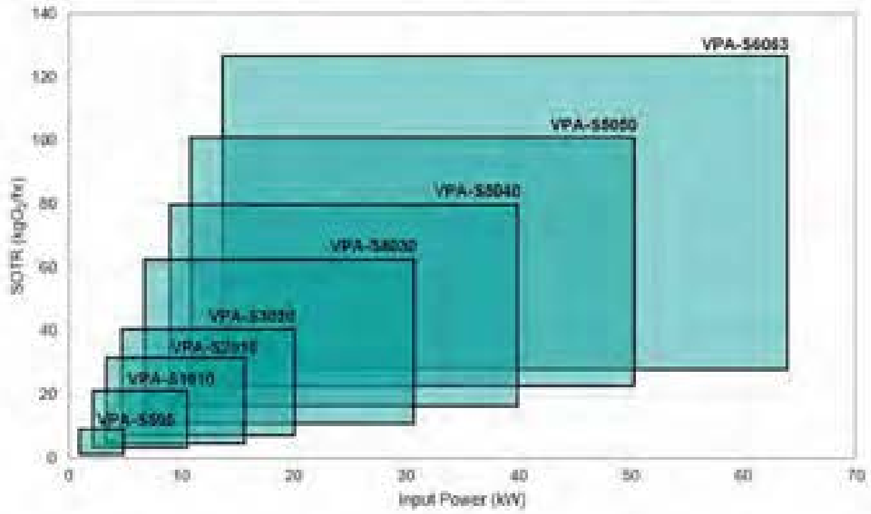
	VPA-S505	VPA-S1010	VPA-S2016	VPA-S3020	VPA-S4030	VPA-S5040	VPA-S5050	VPA-S6063
Max Power Input (kW)	4.4	10.6	15.5	20.0	30.8	40.0	50.1	63.6
Max SOTR (kgO_2/h)	8.8	21.2	31.0	40.0	61.6	80.0	100.2	127.2
Min Power Input (kW)	1.0	2.4	3.6	4.6	7.1	9.2	11.5	14.6
Min SOTR (kgO_2/h)	2.0	4.9	7.1	9.2	14.2	18.4	23.0	29.3
Max Airflow Rate (m^3/hour)	248.7	596.3	872.0	1,125.1	1,732.7	2,250.2	2,818.4	3,577.9



VORTEX POWERED AERATION™

CASE STUDY 1

MUNICIPAL OXIDATION DITCH (PE = 110,000)



MUNICIPAL CASE STUDY

CHALLENGE

- A UK municipal wastewater treatment plant underwent upgrade to comply with enhanced biological phosphorus removal and increased treatment capacity.

- Secondary treatment process consisted of four 60-year-old oxidation ditches.

- Existing oxidation ditches exhibited significant challenges, namely:
  - Equipment at end of life (number of failed assets).
  - No aeration control and high energy intensity.
  - High maintenance requirements.
  - High noise and aerosol generation.

- A sustainable aeration upgrade was required to reduce capex, opex (energy and maintenance), carbon emissions and total lifecycle costs of the facility.



MUNICIPAL CASE STUDY

SOLUTION

- 8 x VPA-S5040 units installed to provide efficient aeration.
- Phased upgrade, first units installed in August 2023 (+1 year in operation).
- 8 x Flygt low speed mixers installed to provide efficient directional flow.
- Installation in two days per tank on pre-installed access platforms.
- Complete oxidation ditches maintainable via the VPA™ solution through a simple monorail system.
- Full aeration control now enabled by VPA™ solution regulated via dissolved oxygen sensor feedback (PID control).



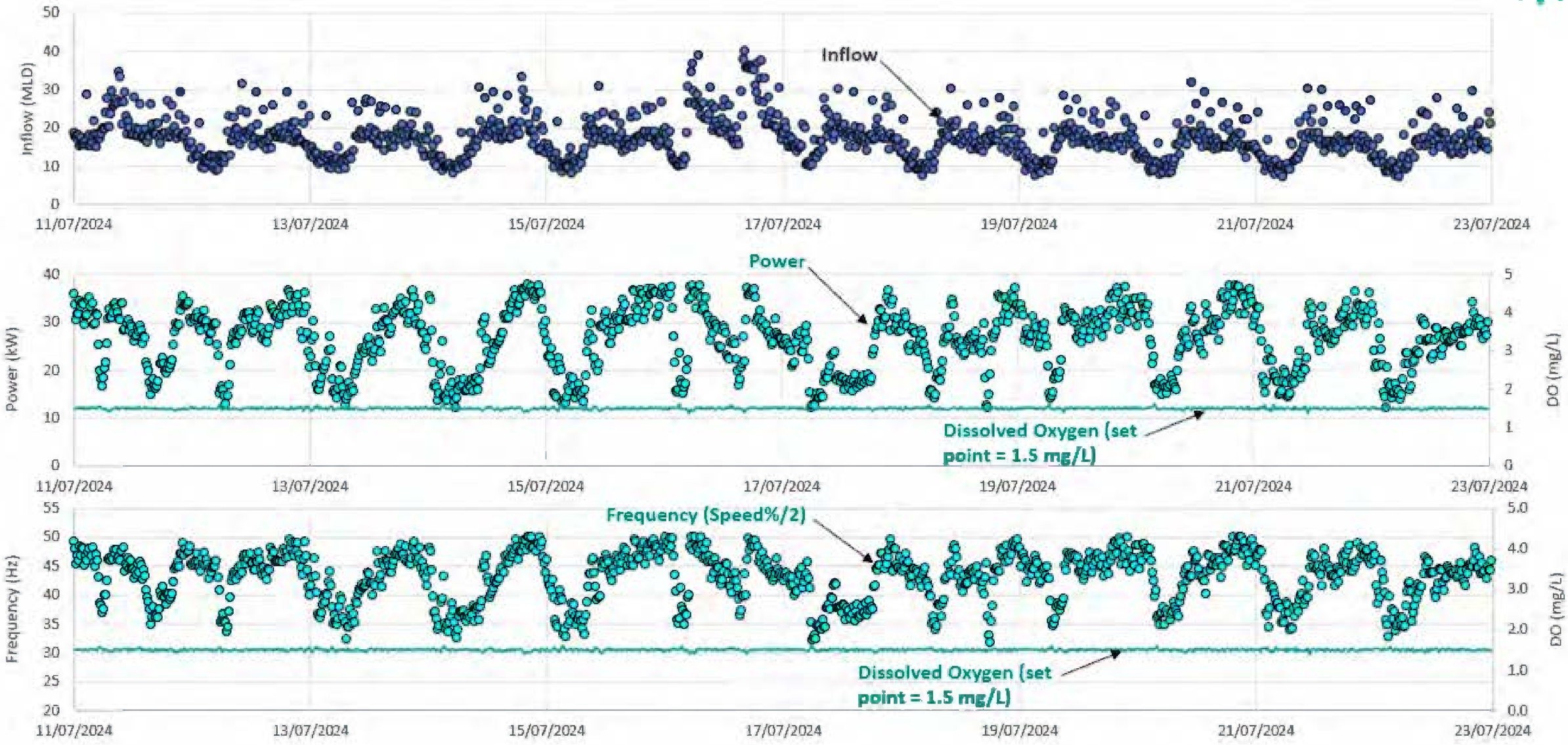
MUNICIPAL CASE STUDY

PROCESS RESULTS

Parameter	Average	Peak (95th Percentile)	Units
Influent Flow	20,404	34,858	m^3/day
BOD_5 Concentration	240	913	mg/L
BOD_5 Load	3,870	6,339	kg/day
COD Concentration	562	2,447	mg/L
COD Load	8,718	16,528	kg/day
NH_4-N Load	980	1,726	kg/day
Inlet NH_4-N Concentration	49	82	mg/L
NH_4-N Removal Efficiency	98.60%	99.79%	%
PE	64,495	105,650	PE
Average power for all ditches	236		kW

MUNICIPAL CASE STUDY

ENERGY CONTROLLABILITY UNDER VARIABLE LOADING



MUNICIPAL CASE STUDY

SUTAINABLE IMPACT

- Easy installation in one day on pre-installed access platforms
- Demonstrated 99% removal efficiencies for BOD_5 and ammonia under highly variable loading conditions.
- Maintenance transformed at the site (pump accessible within minutes) improving safety of operations.
- Significant reduction in noise across the site.
- Anticipated impact of the installation provided below:





VORTEX POWERED
AERATION™

CASE STUDY 2

COMPLETELY MIXED MUNICIPAL (PE = 3,333)



MUNICIPAL CASE STUDY

CHALLENGE

- Population equivalent of 3,333 people
- 14 m long, 6.5 m wide, 4.5 m deep reactors (working volume of 420 m^3)
- Load increase observed at facility in 2021.
- Significant variations in demand seasonally and throughout the day.
- Existing aeration system – 3 x 11 kW blowers and 1 x 5.5 kW compact mixer.
- Baseline energy - 3.15 kWh/kgBOD_5 or 68 kWh/PE/annum.







MUNICIPAL CASE STUDY
SOLUTION

- 1 x VPA-S3022 unit (3.5 years in operation)
- No submersible mixer required (cyclonic pulsed aeration)
- All equipment arrived on site largely assembled for lifting directly onto the tank.
- Mechanical installation took 3 days total.
- A customised Vortech motor control centre (MCC) was provided to enable advanced dynamic control and data monitoring of the reactor.



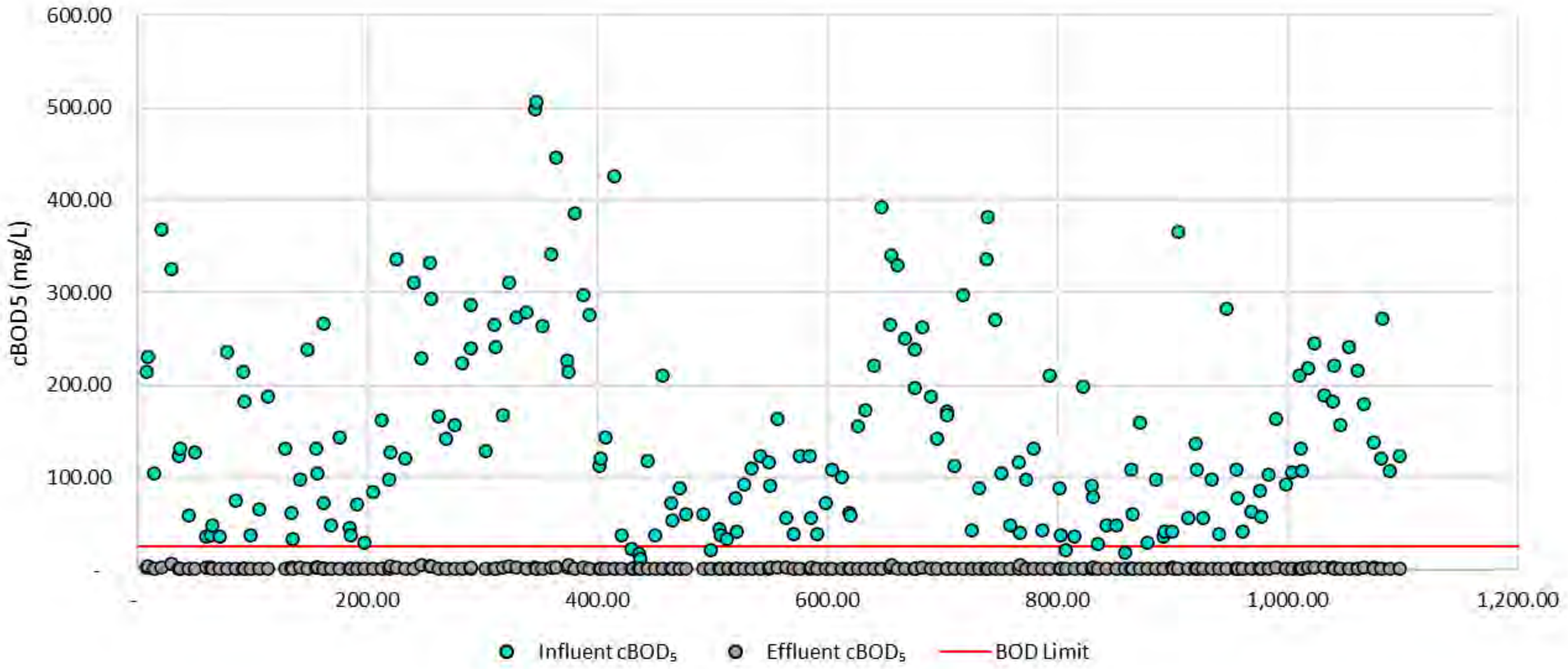






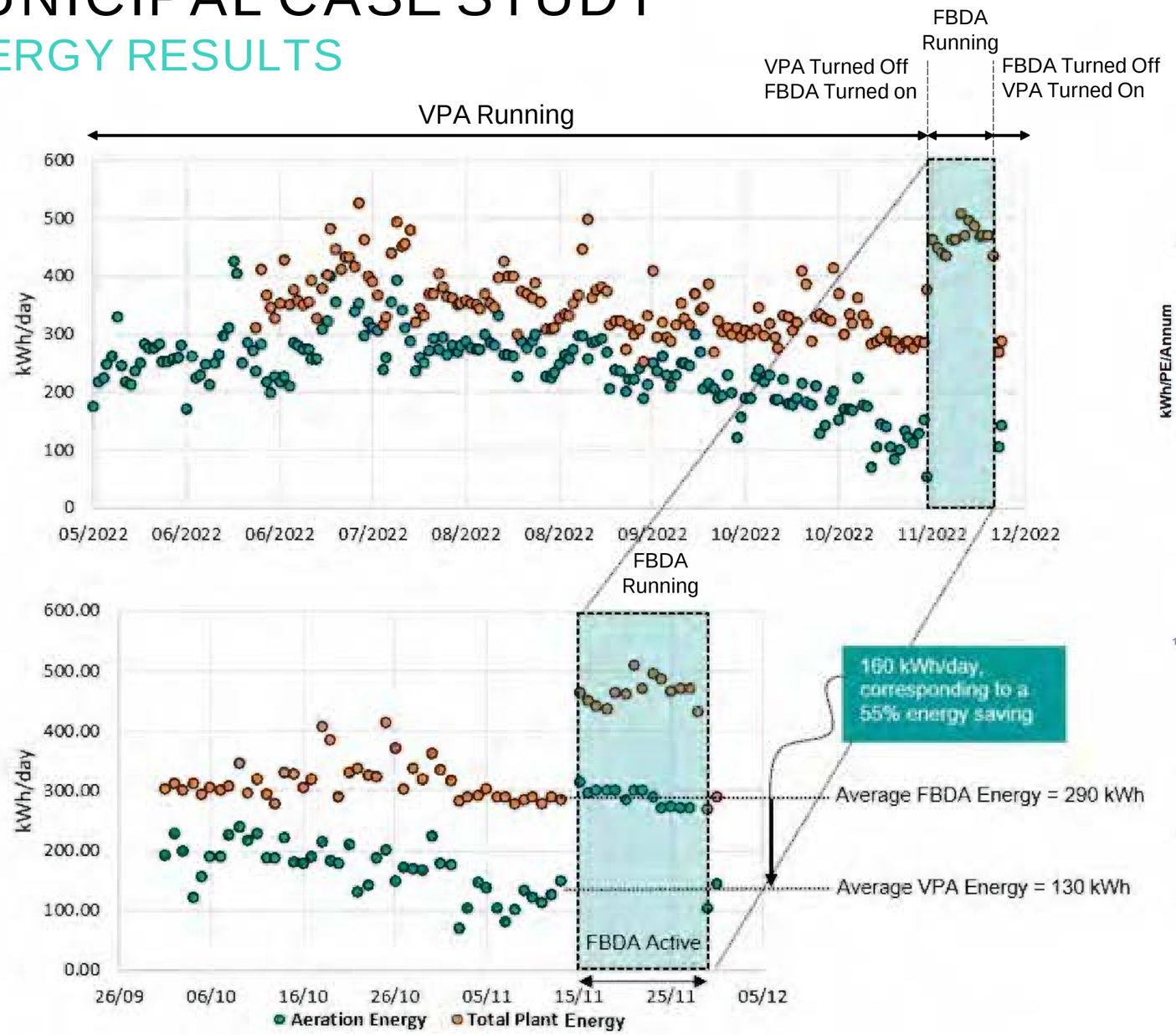
MUNICIPAL CASE STUDY

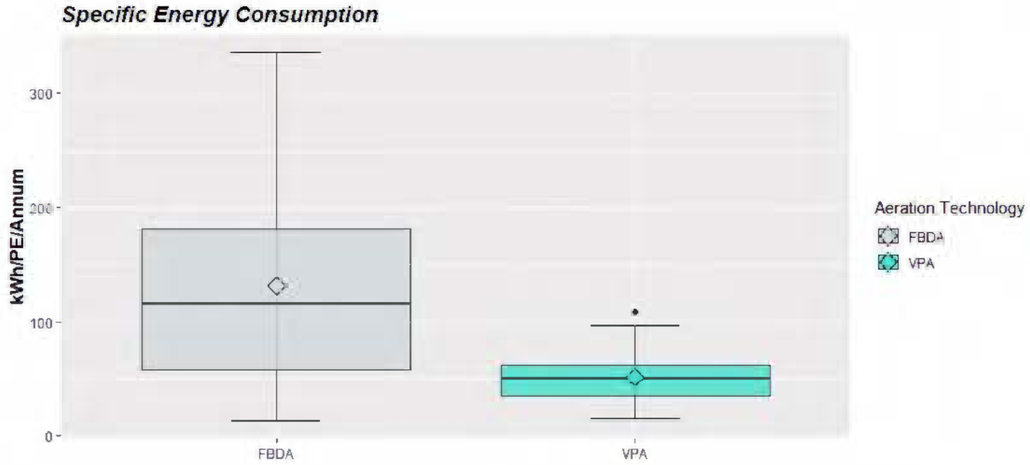
PROCESS RESULTS

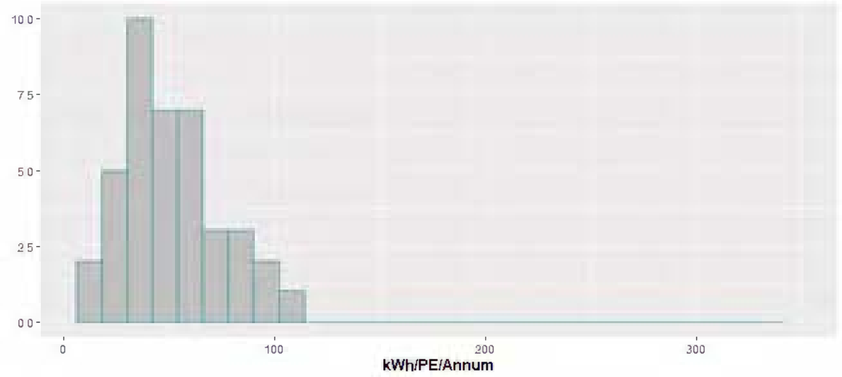


MUNICIPAL CASE STUDY

ENERGY RESULTS







MUNICIPAL CASE STUDY

SUSTAINABLE IMPACT

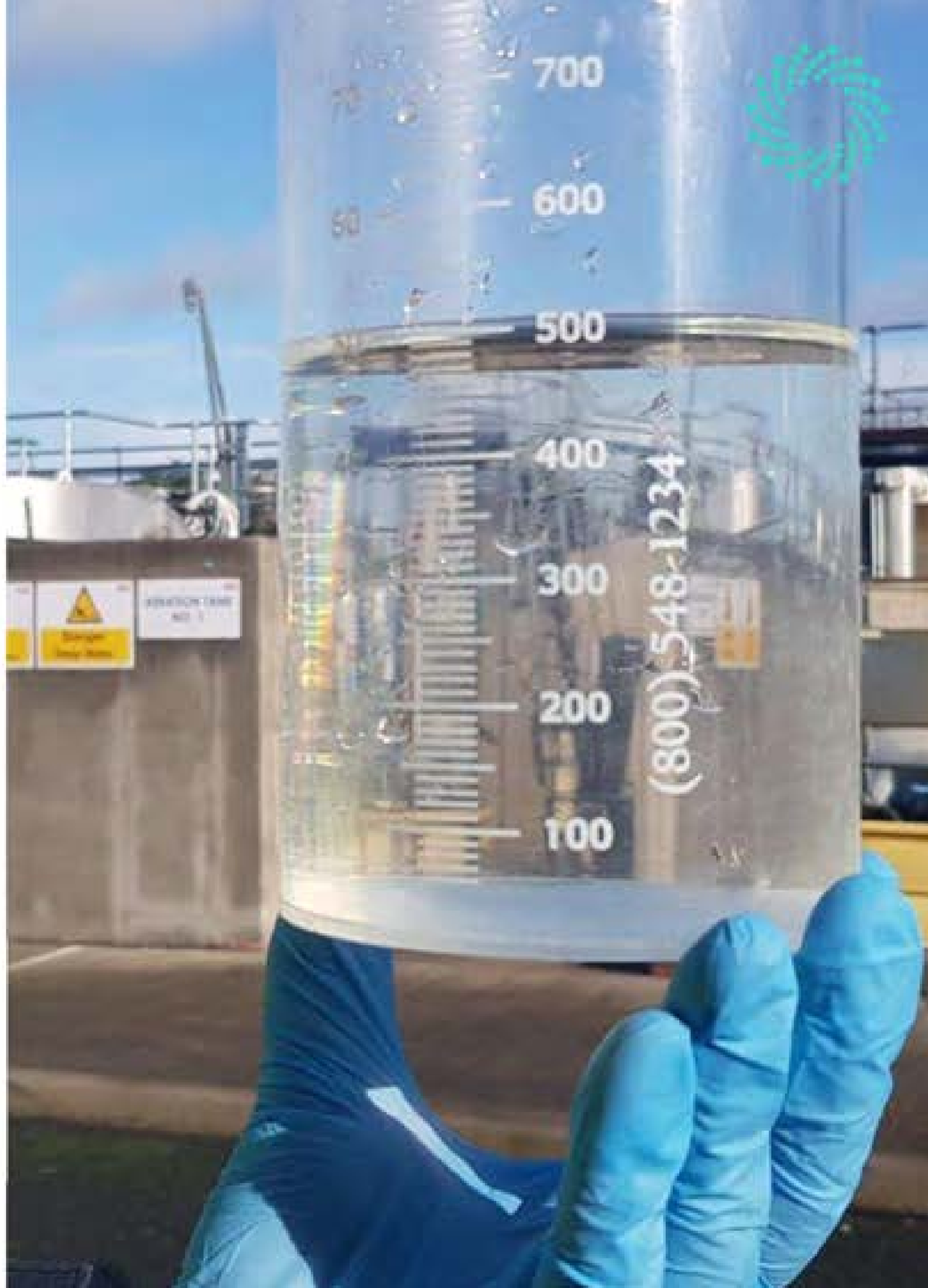
- Easy install in only 3 days.
- 99% removal efficiencies for BOD_5 and ammonia have been consistently achieved since commissioning.
- Maintenance transformed at the site (pump accessible within minutes) improving safety of operations.
- Energy efficiency – no fouling over time.
- Specific energy reduced to 1.86 kWh/kgBOD_5 and 40 kWh/PE/annum.
- Measured sustainable impact at the site:

ONLY
4
DAYS
to install versus a month for traditional aeration systems

SAVED
41%
ELECTRICITY
in aeration energy for every kgBOD_5 removed in the process

ELIMINATED
15K
kgCO_2EQUIV
per year equal to a reduction of 9 kgCO_2 per person

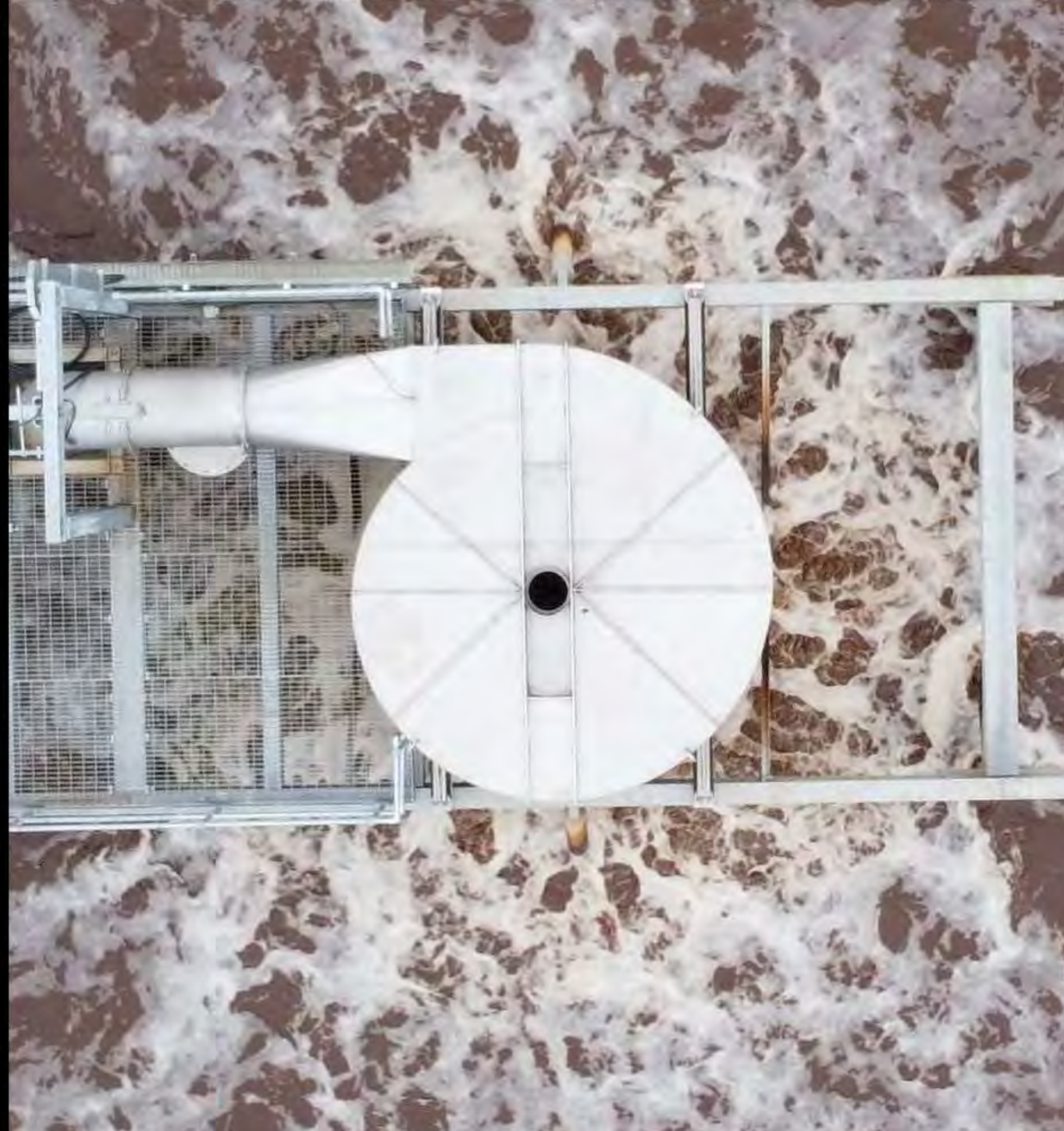
PROJECTED
80%
REDUCTION
in replacement costs compared to traditional aeration systems



VORTEX POWERED AERATION™

CUSTOMER CASE STUDY 3

ABATTOIR



ABATTOIR NEW BUILD CASE STUDY

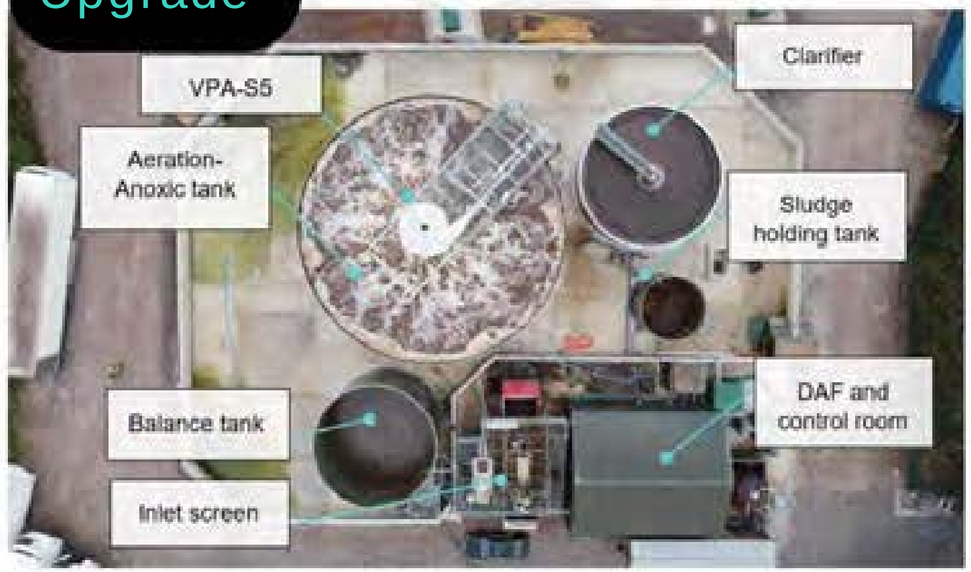
CHALLENGE

- Facility production load increase of 30% expected in 2023.
- Population equivalent of up to 19,000 people to be treated, (400 livestock per day).
- Crude treatment via DAF and discharge to sewer where effluent was subject to trade effluent discharge fees.
- Operational costs were ~£246,000 per annum prior to upgrade. High costs for chemicals and trade effluent discharge fees.
- Key Challenges: Requirement for a quick and efficient capacity increase, low maintenance, low energy consumption and minimal noise generation.

Pre 2020



Upgrade



ABATTOIR NEW BUILD CASE STUDY

SOLUTION

- 1 x VPA-S6063 (63 kW) installed in a 17 m diameter, 5.2 m deep reactor. (+4 years in operation)
- All equipment arrived on site largely assembled on modular skids for lifting directly onto the tank.
- Full turnkey solution provided with installation partners.
- Mechanical and electrical installation took 10 days total.
- A customised Vortech motor control centre (MCC) was provided to enable advanced dynamic control of the reactors along with monitoring of energy and carbon emissions savings.
- Watch video here





MUNICIPAL CASE STUDY

ENERGY RESULTS

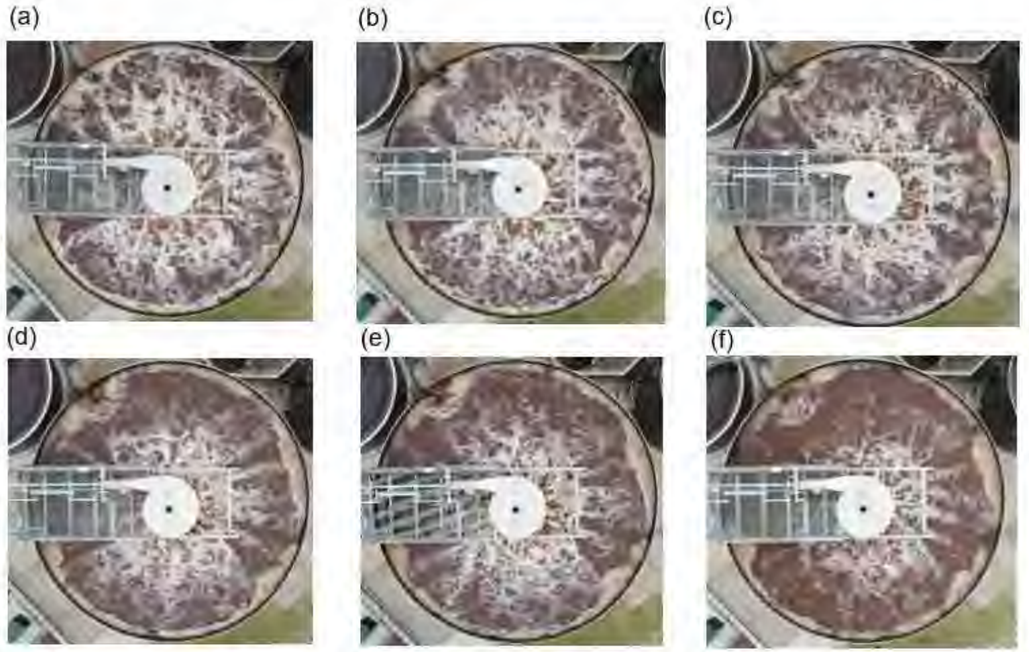
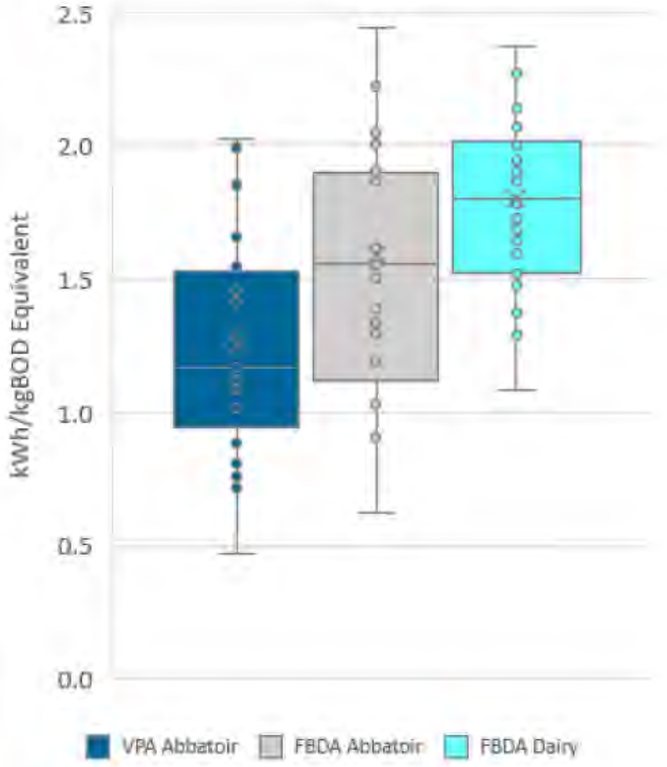


Figure 7: Aerial images of the VPA and reactor outlining mixing conditions at (a) 63 kW, $Q_w \approx$ 950 l/s $Q_a \approx$ 1106 l/s, (b) 54 kW, $Q_w \approx$ 872 l/s $Q_a \approx$ 1058 l/s, (c) 39 kW, $Q_w \approx$ 813 l/s $Q_a \approx$ 875 l/s, (d) 31 kW, $Q_w \approx$ 774 l/s $Q_a \approx$ 673 l/s, (e) 20 kW, $Q_w \approx$ 625 l/s $Q_a \approx$ 337 l/s, (f) 14.8 kW, $Q_w \approx$ 562 l/s $Q_a \approx$ 255 l/s.

Technology	VPA Abattoir*	FBDA Abattoir	FBDA Dairy
Data Points	28.000	32.000	25.000
Mean	**1.257**	**1.801**	**1.907**
Median	1.170	1.803	1.865
STD Dev	0.408	0.360	0.711
5th Percentile	0.731	1.333	1.089
95th Percentile	1.950	2.317	2.878
Min	0.469	1.084	0.751
Max	2.025	2.846	4.077

* Note: 22 BOD_5 samples were not tested immediately upon collection due to a transit time for testing of circa one week. Therefore, actual BOD_5 concentrations and thus removals may be larger (specific energy consumption may be lower)



ABATTOIR NEW BUILD CASE STUDY

SUSTAINABLE IMPACT

- Treatment performance significantly enhanced (99% BOD_5 and ammonium removal efficiencies).
- +30% increase in site's production capacity.
- 30% lower specific energy consumption compared to a similar abattoir using fine bubble diffused aeration (FBDA).
- ~€2M total lifecycle savings over 20 years projected.
- Measured sustainable impact at the site:





VORTEX POWERED AERATION™

CUSTOMER CASE STUDY 4

BEVERAGE MBR



BEVERAGE MBR UPGRADE CASE STUDY

CHALLENGE

- Membrane bioreactor treatment utilizing diffused aeration.
- Five 18.5 kW blowers on site requiring ongoing maintenance (two for coarse bubble, two for fine bubble diffusers, one standby).
- MBR operated with mixed liquor suspended solids (MLSS) of 12-14g/L.
- High viscosity MLSS significantly increased bubble coalescence and bubble sizes, leading to reduced oxygen transfer.
- Waste streams and high MLSS causing rapid fouling of diffusers
- Net result:
    1. High energy intensity – Average = 1.04 kWh/kgCOD removed and Max = 2.22 kWh/kgCOD removed
    2. High maintenance - To maintain performance, diffusers had to be replaced/cleaned every 18 months. Work required operators to work within hazardous confined spaces.





BEVERAGE MBR UPGRADE CASE STUDY

SOLUTION

- 2 x VPA-S1010 (10 kW) units installed to provide fine bubble aeration.
- All equipment arrived on site largely assembled on modular skids for lifting directly onto tank.
- Vortech system maintained high alpha factors for optimum performance, even at high MLSS.
- There was no requirement for tank draining during installation (no disruption of current treatment processes).
- Mechanical installation took 1.5 days per unit (4 days total with final fixings).
- A customised Vortech motor control centre (MCC) was provided to enable advanced dynamic control of the reactors along with monitoring of energy and carbon emissions savings.
- Watch video here

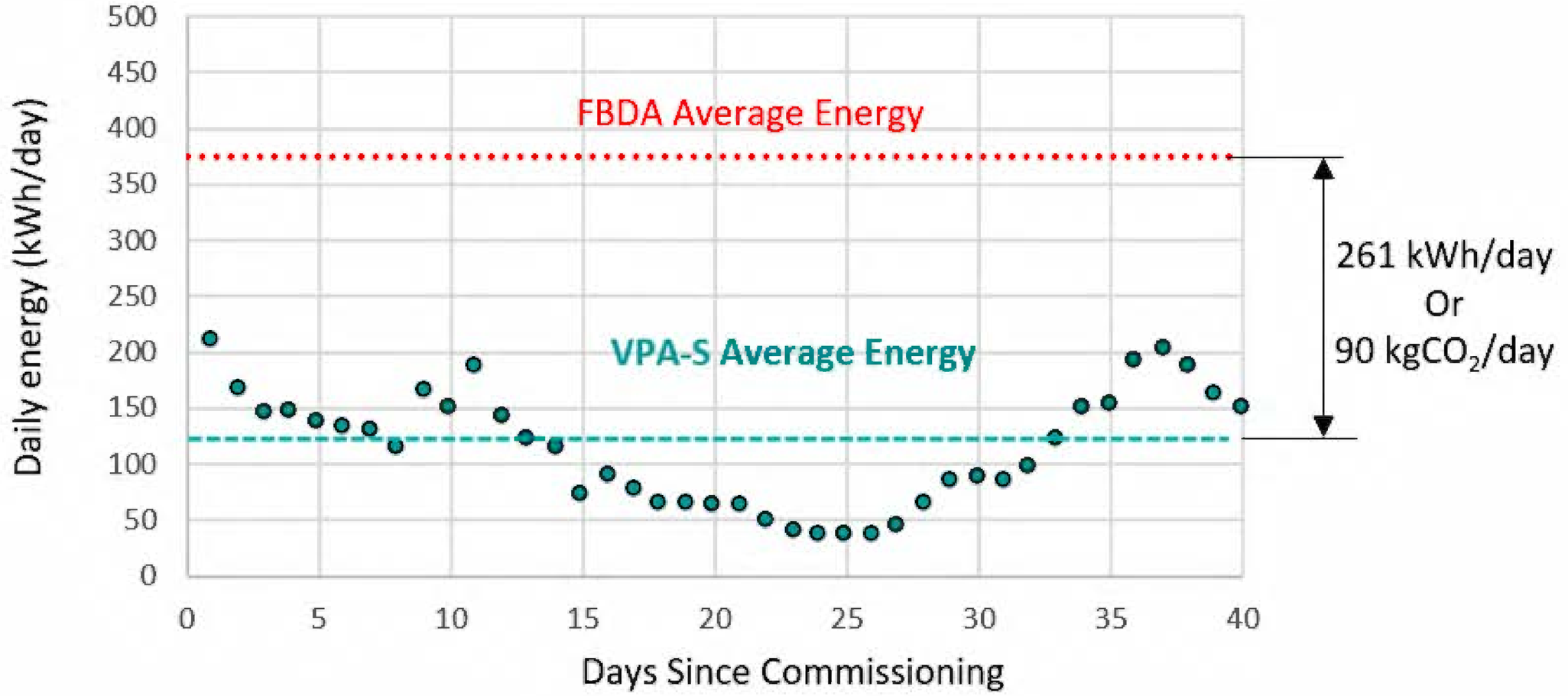






MUNICIPAL CASE STUDY

ENERGY RESULTS



BEVERAGE MBR UPGRADE CASE STUDY

SUSTAINABLE IMPACT

- Oxygen levels now elevated and are better controlled.
- Treatment performance maintained (99% BOD_5 removal efficiencies).
- Reduction in specific energy consumption to Average = 0.7 kWh/kgCOD removed (~30%)
- Annual 2023 energy saving = 38,766 kWh.
- Annual 2023 carbon saving = 13,777 $kgCO_{2Equiv.}$





CONTACT VORTECH

- An international, award winning water technology company underpinned by years of fluid dynamics and process science research and expertise.
- Proven VPA™ solution being embraced globally for solving industrial treatment challenges.
- Partnering with organisations to provide full turnkey solutions to clients.
- Learn more about the people and products behind the company on the following videos:
  - This is VorTech Water Solutions (youtube.com)
  - VORTECH® Brand Film
  - Women in Engineering - Masooma Ijaz (youtube.com)
  - One team, working together (youtube.com)
- Should you feel that VorTech can assist you with your wastewater treatment challenges, contact us at info@vortechws.com.

