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Institution of Civil Engineers

Membership

ICE Further Learning Exam Case Study:

Withernsea, Wastewater Treatment Works

Withernsea, Wastewater Treatment Works

Constructed in 1991, the existing Withernsea Sewage Treatment Works (STW) lies 2km south of the coastal resort town of Withernsea and was built some 180m from the cliff edge with an expected asset life of over 60 years. Since 1998, coastal erosion rates have accelerated, with a current average loss of 4m per year. In January 2021 the sea was just 44m from the site boundary (Figure 1).

Figure 1 Google image showing the existing STW and cliff erosion

Withernsea STW serves a winter population of 7,100 which increases to 15,000 in the summer. The existing STW comprises a traditional activated sludge plant, with sludge thickening and UV disinfection. Increasing concern about bathing water quality means full treatment of storm flows, not currently treated, must now be considered.
The range of potential solutions include new coastal defences to protect the current works together with STW upgrade; and decommissioning the current STW whilst constructing new wastewater treatment works further inland.

Agriculture, leisure and tourism are the main industries of the district. Local residents and businesses are concerned about the visual and odour impacts any new facilities may have on tourism. Farmers are concerned about the loss of valuable agricultural land required for any new works, and the current accelerating rate of coastal erosion.

Questions:

1. **Question 1**: Describe how, as feasibility stage Project Manager, you and your team will identify and evaluate Withernsea STW options to recommend the most advantageous solution.

   After considering multiple process options, the client agrees to adopt innovative Aero-Fac® technology (nominated supplier Gurney Environmental) to offer the lowest whole life cost and carbon solution. This is in line with the clients commitment to Net Zero and wider UNSDG outcomes. Though there are a growing number of Aero-Fac® systems in operation, it's use will be a first for this client which will be commissioning the largest installation of its kind in the UK. Aero-Fac® is a high-process-rate, modular wastewater treatment system that employs an advanced form of a completely biological aerated facultative treatment (Figure 2) able to handle extreme variations in flows and loadings. Given its modular design, it can be scaled and adapted to suit any flow, load, and population size.

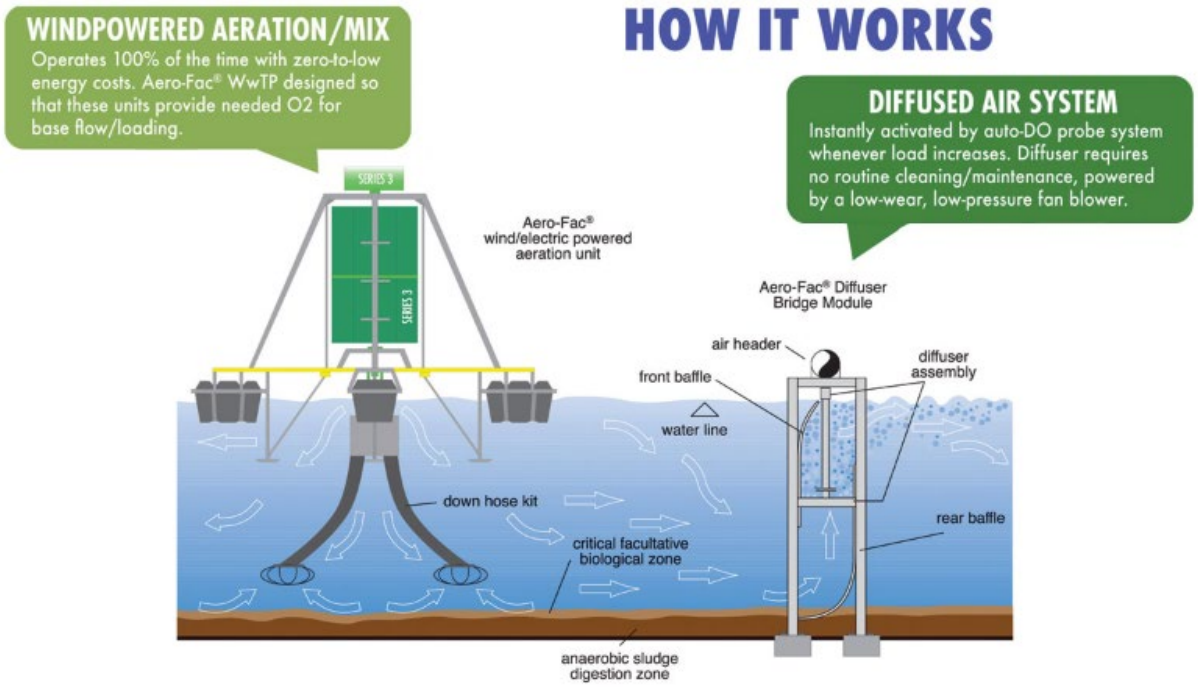

Figure 2: Aero-Fac® process diagram

By employing a facultative biological process, significant costs can be eliminated in both the initial Capital Expenditure (CAPEX) of construction and equipment and the ongoing Operating Expenditure (OPEX). Facultative processing can stabilise wastewater

more thoroughly than standard mechanical treatment at lower cost and complexity.

This form of technology requires a larger area of land than other solutions. In this case approximately 72,000m2 of land. Withernsea is surrounded by flat agricultural land. Extensive ground investigations were undertaken to determine the best location and a suitable site was identified that limits the impact on the local community.

With a combined stored volume of approximately 144,000m3, and an escapable volume of over 25,000m3 per cell, the works falls under the Reservoirs Act 1975. This requires an external Registered Reservoir Engineer to sign off the design, to approve construction work prior to filling, and undertake inspections over the facility lifetime.

The depth of the cells from crest to base is 5.6m, with 1:3 batters internally. A requirement of the design, rather than a reservoir safety requirement, is to have an impermeable geomembrane layer. An initial underlay layer is required, followed by the main impermeable sheeting which is then welded together. Adverse weather will make installation very challenging.

Figure 3: Aerial view of the works nearing completion.

2. **Question 2**: As Project Manager for design, discuss procurement of the works shown in Figure 3, given the clients wish to use a nominated supplier for specialist plant (Aero-Fac). Advise the client accordingly.

3. **Question 3:** As Construction Manager, discuss the main challenges you may face at Withernsea, and the management & leadership interventions you would use to deliver expected outcomes.

4. **Question 4:** How should the design Project Manager, and Construction Manager, address the main health and safety risks in this project to ensure everyone goes home safe and well each day?

5. **Question 5:** As the client Project Director, discuss the governance processes you will adopt to demonstrate value for money for your customers and that your company's sustainability goals are achieved.

Our vision

Civil engineers at the heart of society, delivering sustainable development through knowledge, skills and professional expertise.

Core purpose

- **To develop and qualify professionals engaged in civil engineering**
- **To exchange knowledge and best practice for the creation of a sustainable and built environment**
- **To promote our contribution to society worldwide**

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As a membership organisation and an employer, we value diversity and inclusion - a foundation for great engineering achievement

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