

A review of wastewater treatment within the UK dairy sector

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leadingedge

The logo for Leading Edge features the text 'leadingedge' in a lowercase, sans-serif font. The text is positioned on a light yellow rectangular background.

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2. Project Objectives

1. Project Objectives

The key project objectives are as follows:

Understand the dynamics of large dairy sites with respect to their production and handling of wastewater

Review what practices are being pursued on those sites

Assess possible opportunities for Irish companies in offering support for this sector

2. Research Methodology and Sample Profile

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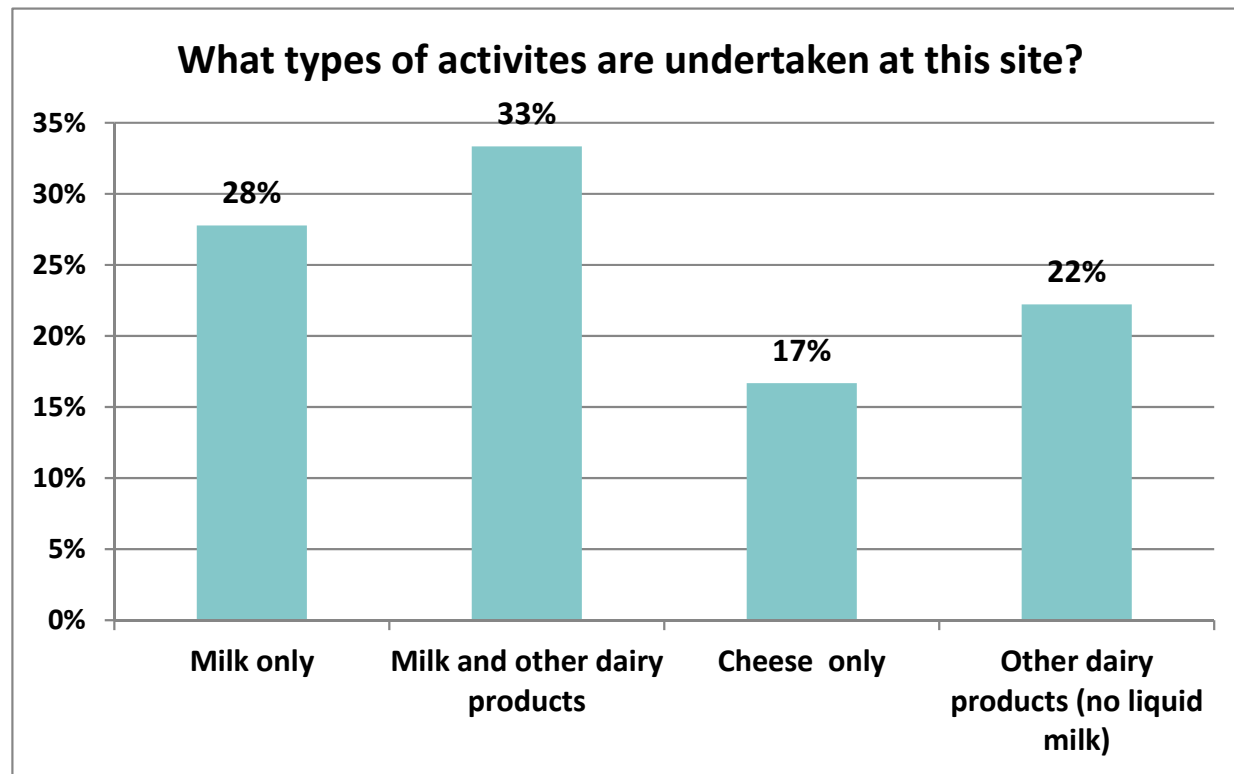
- Contact was made with key players operating in the UK dairy sector that were known to operate large sites. Major companies approached included xxx, xxx, xxx, xxx and xxx.
- Typically EHS (Environmental, Health and Safety) managers and site engineers were the main contacts with responsibility for wastewater matters.
- In total 36 sites were approached. Full interviews were achieved with 16 of these while partial interviews with a further 4 sites.
- No respondents wished to remain anonymous although 4 were not interested in any further contact with Enterprise Ireland regarding the project.
- This presentation provides an overall flavour of the feedback received and an illustration of the approaches towards, and management of, wastewater across the UK's largest dairy sites.
- Individual responses are contained in a separate spreadsheet that has been provided separately to Enterprise Ireland.

2. Research Methodology and Sample Profile (cont.)

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2. Research Methodology and Sample Profile (cont.)

- Sites differ in their focus on particular dairy products.
- Only 28% sites were involved solely in the processing and production of milk.
- A third of sites were producing milk and other dairy products, just under a fifth (17%) cheese and just over a fifth (22%) in dairy products other than milk.



3. Executive Summary

3. Executive Summary

- Many dairy sites also specialise in the production of more than one product.
- There is a positive relationship between milk processed and wastewater generated.
- The majority of sites report fairly stable annual wastewater volumes. Where peaks occur these are most likely to be at Spring/Easter and Christmas.
- Treatment and discharge of wastewater is the most common solution adopted.
- Sites generating smaller quantities of wastewater (<400 cubic metres/day) prefer basic, and less costly, approaches. These include pH correction and/or a single treatment solutions such as DAF (Dissolved Air Filtration) and AD (Anaerobic Digestion).
- Sites that generate larger quantities of wastewater (>400 cubic metres/day) typically use additional, and different, treatment solutions. MBR (Membrane Bioreactor) and RO (Reverse Osmosis) are commonly employed in such circumstances.
- Investment in on-site wastewater treatment appears sporadic.

3. Executive Summary (cont.)

- There is little interest in novel finance and operating approaches such as DBO/DBFO (Design Build Operate/Design Build Finance Operate) for on-site wastewater treatment. However, some sites use external contractors to manage their on-site treatment facilities.
- Around three quarters of sites pay an external water company to treat some or all of their wastewater.
- Annual expenditure on wastewater handling and treatment equipment, as well as operating expenditure, varies considerably although samples sizes were small:
 - Over half (55%) of sites spent up to £50,000 on capital expenditure in the last 12 months
 - A similar percentage spent up to £100,000 on operating expenditure.
- The UK dairy sector has a wide range of concerns about the future challenges with respect to the handling of wastewater. Issues include:
 - The ability of existing in-house treatment plant to meet current/future standards.
 - The quality/quantity of effluent being released.
 - A desire to reduce the milk content of wastewater.
 - The issue of COD (Chemical Oxygen Demand) of effluent.



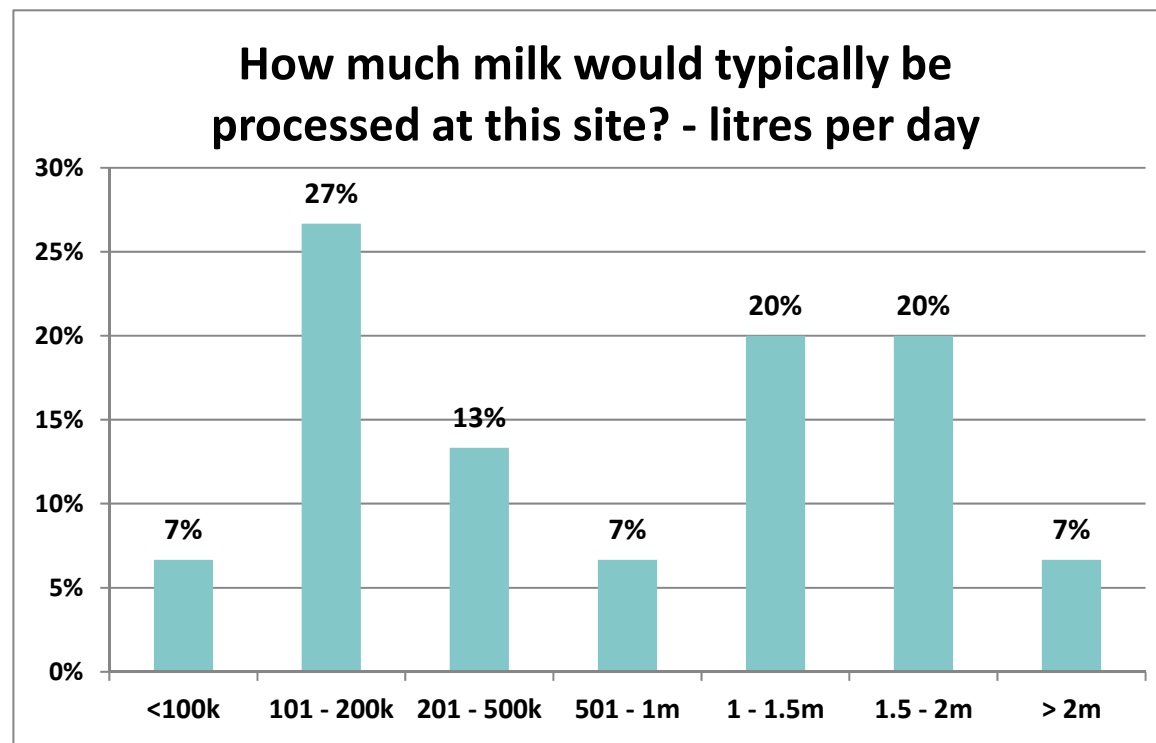
4. Detailed Research Findings



**a. The size of the market –
milk and wastewater volumes**

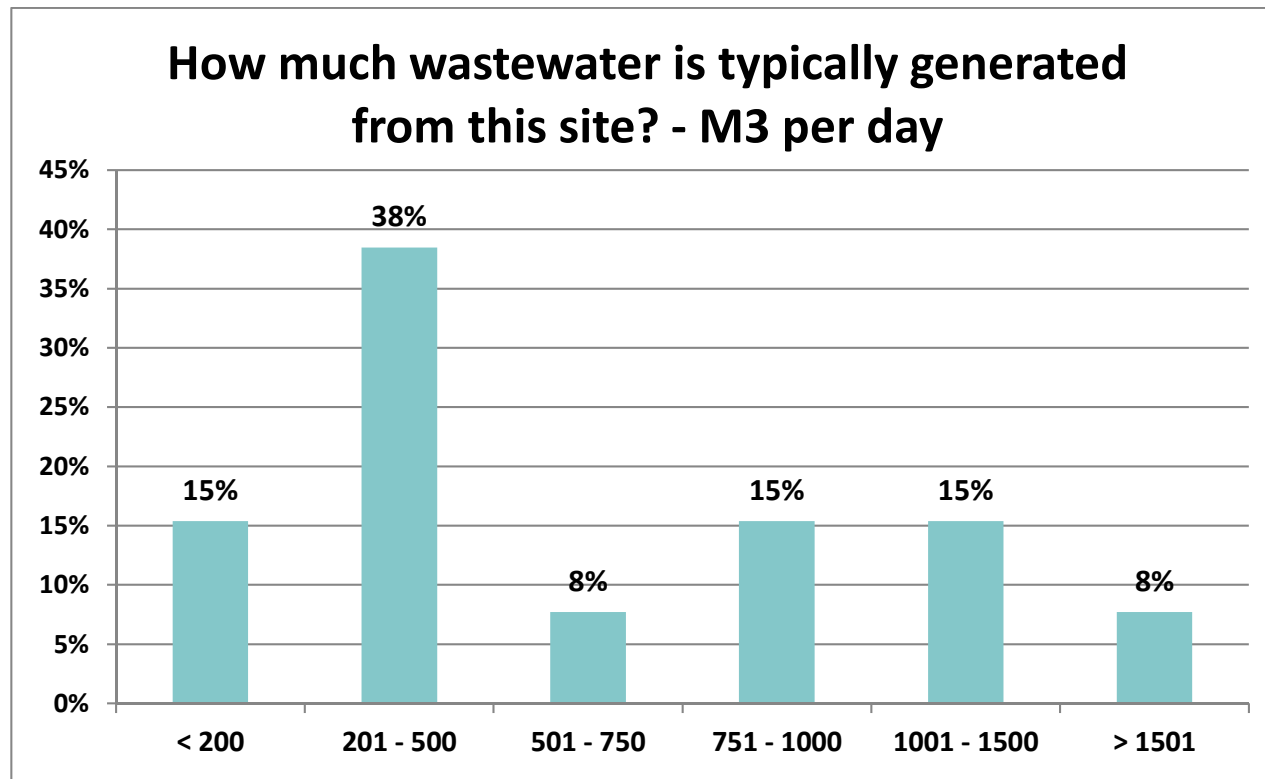
The amount of milk processed and wastewater generated at individual sites varies considerably

- Just under half of the sites reviewed process up to 500,000 litres of milk per day with a third up to 200,000 litres per day.
- Nearly half (47%) can be classed as 'super' sites processing in excess of 1 million litres of milk per day.



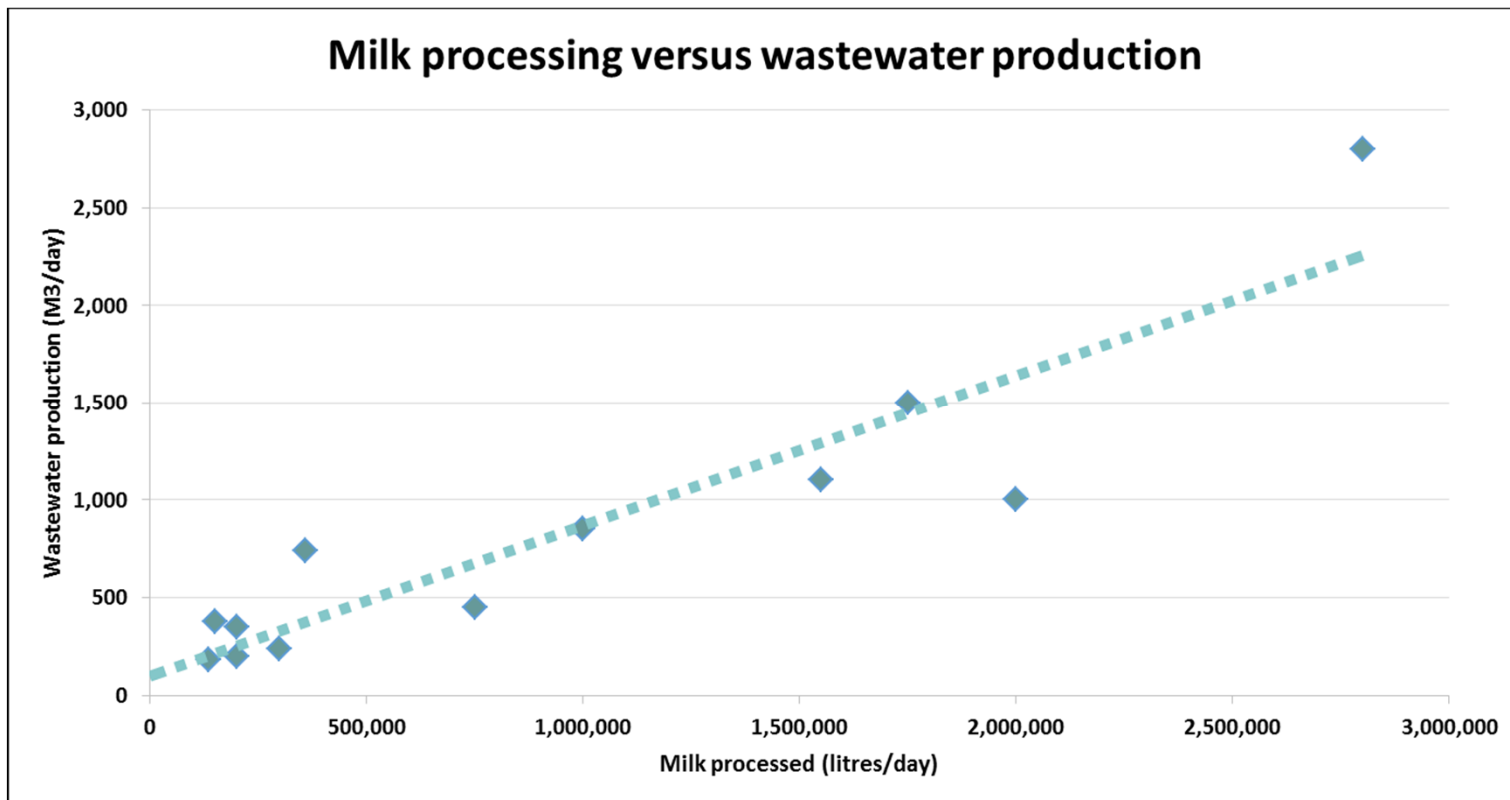
The amount of milk processed and wastewater generated at individual sites varies considerably (cont.)

- Just over half (53%) of sites generate up to 500 cubic metres of wastewater per day.
- Nearly 4 in 10 (38%) of sites generate in excess of 750 cubic metres of wastewater per day.



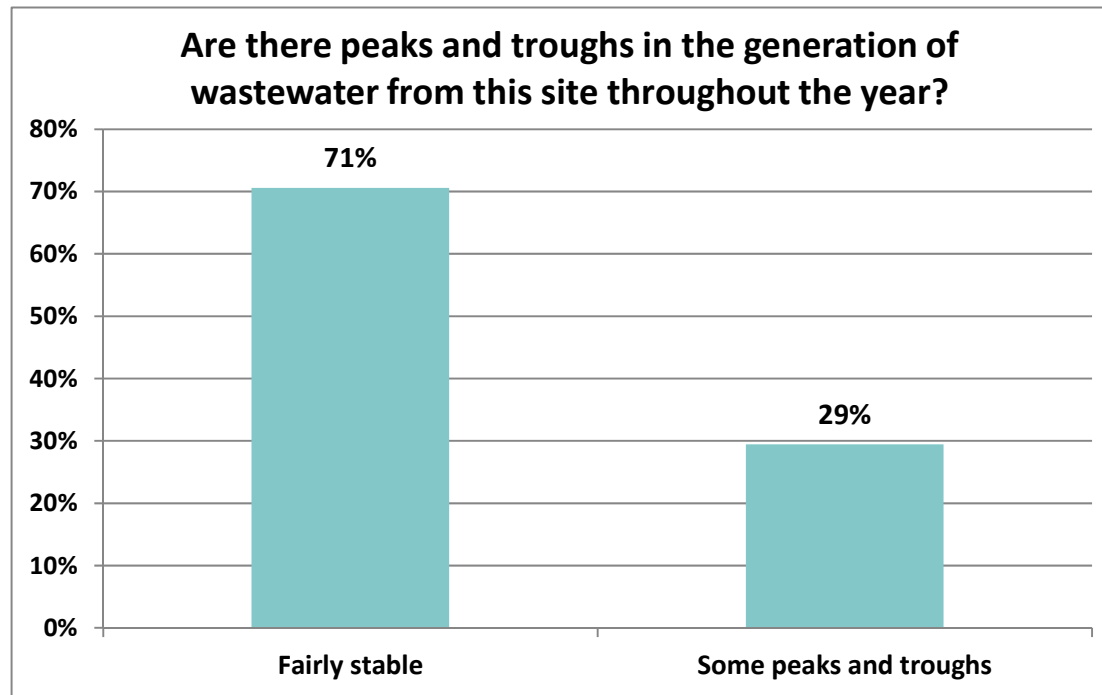
... although there is a positive relationship between both

- There is a positive relationship both milk processing and wastewater production.
- Smaller sites, <500,000 litres per day, typically generate <500 cubic m per day of wastewater.
- Larger sites generate more wastewater and have greater variability in wastewater volumes.



Annual wastewater volumes are largely stable

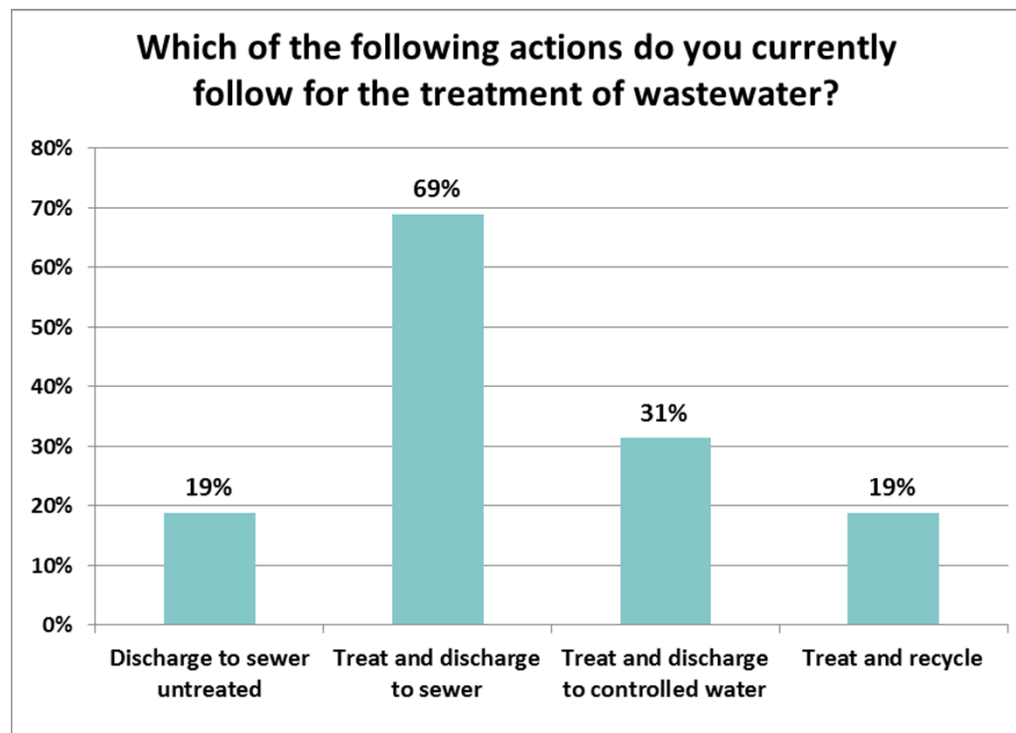
- The majority of sites have fairly stable wastewater volumes.
- Spring/Easter, and the run up to Christmas, are the times when peaks are typically seen.



b. Approaches towards the handling of wastewater

Treat and discharge to sewer is the most popular approach

- Around 7 out of 10 (69%) sites treat and discharge some or all of their wastewater to sewer.
- A further 31% treat and discharge some or all of their wastewater to controlled water.
- Discharge untreated (19%) and treat and recycle (19%) are much less popular practices.



Example of quotes



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Discharge and treatment solutions vary by site

- Reliance solely on treat and discharge to sewer is popular with smaller sites.
- Larger sites typically look at multiple solutions. Treat and discharge to controlled water and treat and recycle are both popular.

| Milk Processed (litres/day) | Wastewater (M3/day) | Discharge to sewer untreated (%) | Treat and discharge to sewer (%) | Treat and discharge to controlled water (%) | Treat and recycle (%) | Main method/s for on-site treatment |
|-----------------------------|---------------------|----------------------------------|----------------------------------|---|-----------------------|--|
| 10,000 | 25* | 100.0 | | | | No on-site treatment |
| 135,000 | 180 | 30.0 | 70.0 | | | AD plant |
| 200,000 | 200 | | 100.0 | | | pH correction |
| 300,000 | 239 | | 100.0 | | | DAF plant |
| 200,000 | 350 | | 100.0 | | | DAF plant |
| 150,000 | 380 | | 100.0 | | | DAF plant |
| 750,000 | 450 | | 1.0 | 99.0 | | MBR plant |
| 700,000* | 500 | | | | | no data |
| 750,000 | 550* | | 40.0 | | 60.0 | Reverse Osmosis plant |
| 360,000 | 740 | 100.0 | | | | No on-site treatment |
| 1,000,000 | 850 | | | 100.0 | | DAF plant |
| 2,000,000 | 1,000 | | 60.0 | | 40.00 | DAF and MBR plants with recycling (RO) |
| 1,550,000 | 1,100 | | | 32.5 | 37.5 | DAF and MBR plants with recycling (RO) |
| 1,500,000 | 1,300* | 100.0 | | | | No on-site treatment |
| 1,750,000 | 1,500 | | 100.0 | | | Reverse Osmosis plant |
| 2,800,000 | 2,800 | | 50.0 | 50.0 | | DAF plant, MBR plant under construction |
| no data | no data | | 100.0 | | | pH correction |
| no data | no data | | | 100.0 | | pH correction. AD plant under construction |

Small sites focus on treat and discharge to sewer

Large sites are more complex

c. On site treatment, technology and financing

DAF plants are the mainstay of on-site wastewater treatment

- DAF (Dissolved Air Filtration) plants are popular with all sites. Larger sites, 1,000 cubic metres per day and above, also use MBR (Membrane Bioreactors) and RO (Reverse Osmosis) technologies.
- AD (Anaerobic Digestion) is another technology in use albeit on a limited basis.

| Milk Processed (litres/day) | Wastewater (M3/day) | Main method/s for on-site treatment |
|-----------------------------|---------------------|--|
| 135,000 | 180 | AD plant |
| 200,000 | 200 | pH correction |
| 300,000 | 239 | DAF plant |
| 200,000 | 350 | DAF plant |
| 150,000 | 380 | DAF plant |
| 750,000 | 450 | MBR plant |
| 700,000 * | 500 | no data |
| 750,000 | 550 * | Reverse Osmosis plant |
| 1,000,000 | 850 | DAF plant |
| 2,000,000 | 1,000 | DAF and MBR plants with recycling (RO) |
| 1,550,000 | 1,100 | DAF and MBR plants with recycling (RO) |
| 1,750,000 | 1,500 | Reverse Osmosis plant |
| 2,800,000 | 2,800 | DAF plant, MBR plant under construction |
| no data | no data | pH correction |
| no data | no data | pH correction. AD plant under construction |

* - estimated

Example of quotes

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Investment is taking place in both large and small dairies

- Investment in wastewater treatment is taking place across different sites using different technologies.

| Milk Processed (litres/day) | Wastewater (M3/day) | Investment in last 5 years? | Technology Implemented |
|-----------------------------|---------------------|-----------------------------|------------------------|
| 135,000 | 180 | yes | AD plant (£ unknown) |
| 200,000 | 200 | no | |
| 300,000 | 239 | no | |
| 200,000 | 350 | yes | DAF plant (£ unknown) |
| 150,000 | 380 | no | |
| 750,000 | 450 | yes | MBR plant (£ unknown) |
| 700,000 * | 500 | no | |
| 750,000 | 550 * | yes | RO plant (£6 mn) |
| 1,000,000 | 850 | no | |
| 2,000,000 | 1,000 | no | |
| 1,550,000 | 1,100 | no | |
| 1,750,000 | 1,500 | no | |
| 2,800,000 | 2,800 | yes | MBR plant (£3.5 mn) |
| | | | |
| no data | no data | no | |
| no data | no data | no | |

* - estimated

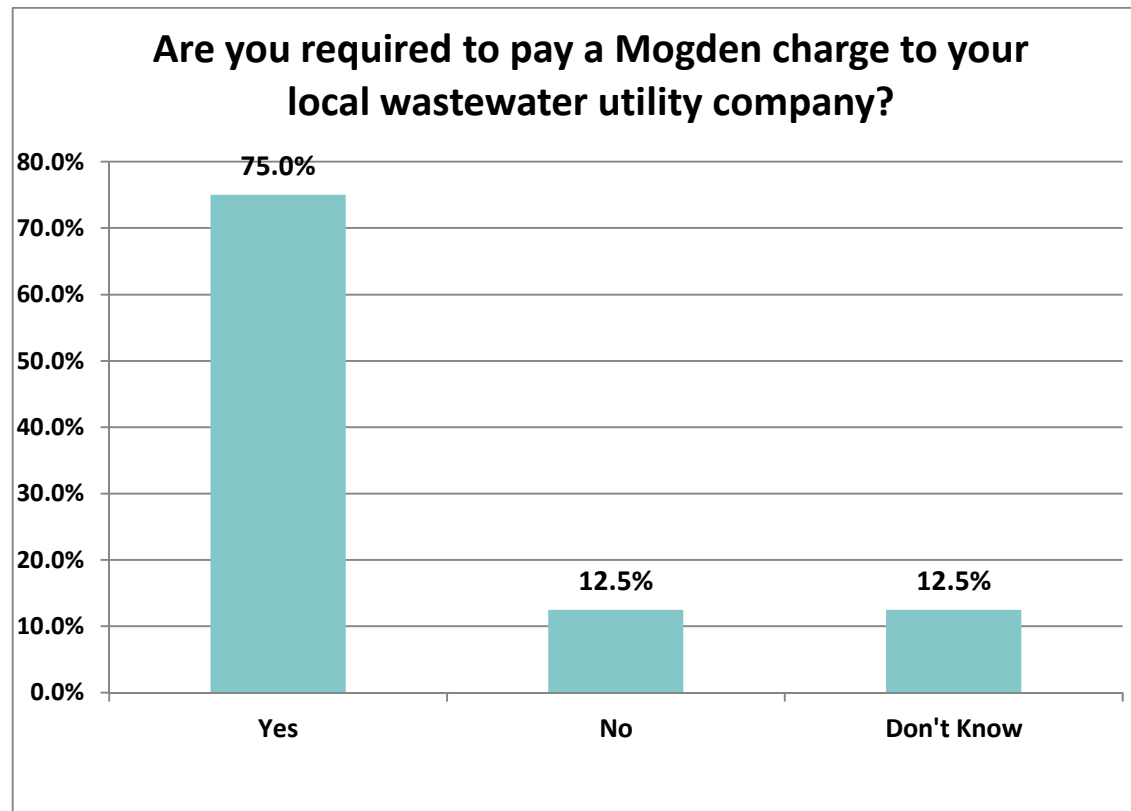
There is no interest in DBO or DBFO arrangements for on-site wastewater treatment facilities

- None of the sites with on-site wastewater treatment have a DBO (Design, Build, Operate) or DBFO (Design, Build, Finance, Operate) agreement with a third party.
- A number of companies do however use external companies to operate their facilities.
- Cost is an important explanation by those who have rejected the DBO/DBFO route.

d. Off site treatment and associated costs

Most sites sending wastewater off-site pay for its treatment although the amount paid varies considerably

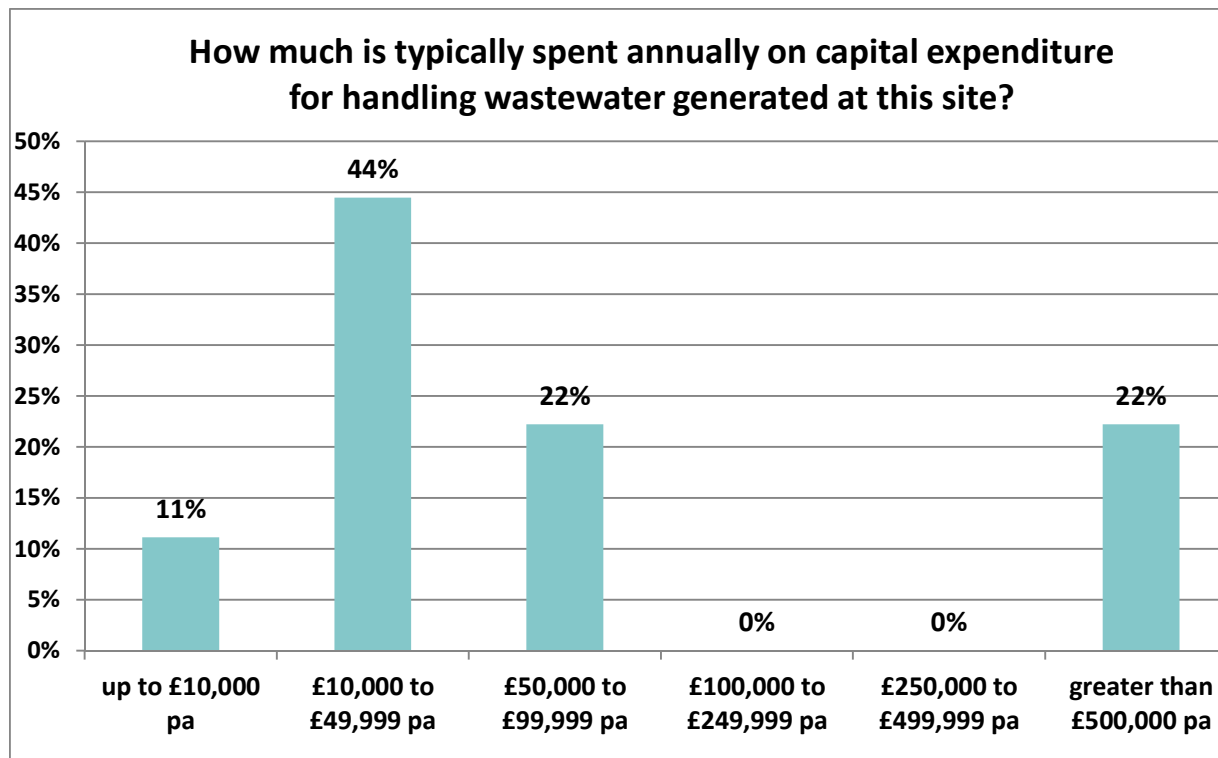
- Three quarters of sites that discharge wastewater off-site are required to pay for treatment under the Mogden charge pricing structure.



e. Expenditure on wastewater management

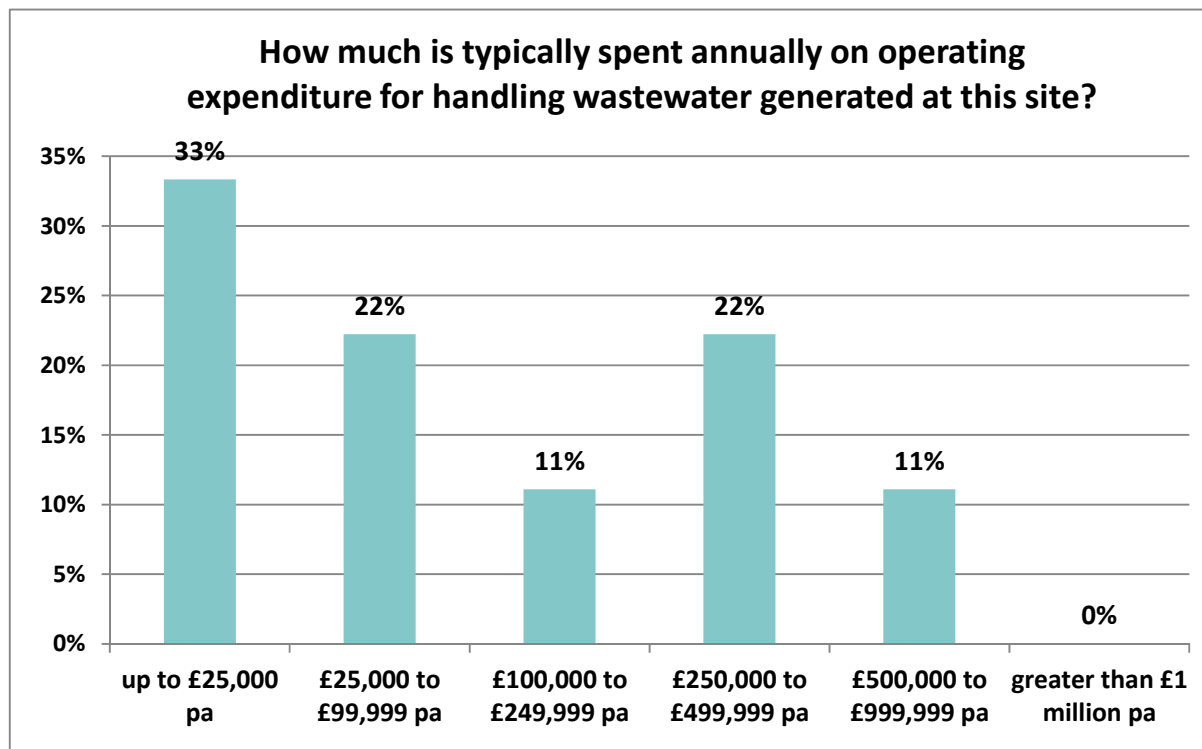
Capital expenditure shows greater variability than operating expenditure

- Annual capital expenditure by dairy sites shows some degree of variability although for many sites annual investment is relatively low.
- Data from 9 sites shows that over half (55%) spent up to £50,000 on wastewater treatment in the last 12 months with over three-quarters spending up to £100,000.



Capital expenditure shows greater variability than operating expenditure (cont'd)

- Operating expenditure shows more variability amongst the 9 sites reviewed although again with a focus on smaller levels of expenditure.
- A third of sites spent up to £25,000 in the last 12 months with 55% up to £100,000. However, a third of sites spent between £250,000 and £1 million on operating expenditure during this period.



f. Key challenges from an industry perspective

Dairies face a number of water and wastewater challenges

- Interviewees were asked about the key water and wastewater challenges they currently face.

- A varied set of responses were given. Key concerns were noted with
 - the performance of in-house treatment facilities
 - the quality/quantity of effluent
 - reducing milk content
 - the COD (Chemical Oxygen Demand) of effluent.

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