

Mid Devon District Council Scrutiny Committee	Working Party Report	Topic: Anaerobic Digestion
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Anaerobic Digestion

Scrutiny Committee Working Party Report

August 2018



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1. Anaerobic Digestion

This report was requested by the Scrutiny Committee, Mid Devon District Council in order to gain a better understanding of the industry and its potential impact upon the environment and human health.

2. Working Party Membership

Cllr Frank Rosemond (Chair), Cllr Margaret Squires, Cllr Rosemary Berry, Cllr Gillian Doe, Cllr Terry Snow, and Kevin Swift (Scrutiny Officer), Julia Stuckey (Secretary).

3. Terms of Reference

To understand the process, science and potential impact of Anaerobic Digestion (AD) on Mid Devon as a source of renewable energy and bio fertiliser.

The remit of the study will include:

- A desktop review of the process.
- A review of the current regulatory framework.
- A review of planning legislation relating to AD; including correlation with waste processes/plants.
- Reference site visits.
- A desktop review of nuisances, environmental concerns/incidents associated with plants and ancillary activities.
- A peer review from health professionals on any potential human health impact associated with AD plants and ancillary activities.

4. Background

In November 2015 a report was prepared for the Scrutiny Committee on Anaerobic Digesters by the Head of Planning and Regeneration and Group Manager, Public Health and Regulatory Services, Mid Devon District Council (MDDC). The report was requested in order to address residents' concerns over the impact upon them of existing operational schemes within parts of the district, how such concerns are investigated, liaison between different organisations with a regulatory role and what lessons can be learnt as a result.

The report outlined the role of the regulatory functions of MDDC such as Planning and Environmental Protection (or Environmental Health) and of external agencies (Environment Agency, Devon County Council Highway Authority/Waste Planning and Public Health England) including multi-agency consultation and liaison.

MDDC's Planning Services assess a range of issues including impact upon residential amenity as a result of noise, odour; nuisance and disturbance; landscape and visual impact, highways and access, drainage, ecology, pollution and contamination, archaeology, appearance and character.

MDDC's Public Health and Regulatory Services provide environmental protection advice on applications and have an enforcing role for Statutory Nuisance legislation. There is an acknowledgment of the legislative complexity surrounding anaerobic digestion and related activities e.g. slurry pits and storage points.

Planning assessment of AD plants has incorporated specific consideration of the scope and extent of planning control. Officers reported to Planning Committee on 6th April and 6th July 2016 in relation to the revised scheme at Red Linhay (Hartnoll Farm, Halberton) considered in some detail the suitability and limits of control of planning conditions. They also took into account the Secretary of State called in planning appeal decision over an AD plant at Fletcher Bank in Lancashire. Within this the Secretary of State included an assessment of what planning conditions were reasonable to apply.

<https://acp.planninginspectorate.gov.uk/ViewCase.aspx?caseid=2224754>)

The consideration of this planning application at the Red Linhay AD plant took account of best practice and Secretary of State guidance together with areas that Planning Committee wished to see controlled. Whilst further revised planning permissions for this particular AD plant have been granted, the decision notice below was taken as a template for the issue of subsequent permissions on this and other sites.

https://planning.middevon.gov.uk/online-applications/files/1B5EB2CF430D77A05EF5A4EE34F34831/pdf/15_01034_MFUL-Decision_Notice-84712.pdf

Key considerations in the Fletcher Bank decision included impact on odour and noise (nearby residents), whilst traffic movements, air quality and pollution from lighting though weighing against the proposal were less of an issue.

Anaerobic Digestion plants are subject to significant scrutiny from planning authorities and the Environmental Agency implements a permit system that seeks to oversee the management and operations of these facilities where waste is a material consideration. The final destination of digestate and its storage, along with other farm related activity and sites used for the management of manure and slurry, in particular slurry pits and lagoons that are not covered by the permitting regime, are addressed in the Position Statement on Anaerobic Digestion of Manure and Slurry released in 2010 by the Environment Agency (Appendix A).

Planning permission is necessary for most anaerobic digestion installations. Small scale digesters using only on-farm waste may be passed as Permitted Development. Any installation accepting third party waste will need full planning permission. Renewable Energy continues to grow in Devon and in the South West generally. In the last RegenSW renewable energy report (2015) it noted that 14% of the South West's energy was derived from renewables. Devon and Somerset lead in producing the most electricity from anaerobic digestion. AD accounts for around 14% of energy derived from renewables.

5. Mid Devon sites

Table 1 illustrates the type of permit and power capacity of the current sites within the Mid Devon District area. There are a number of operators within Mid Devon and they also have sites or business interests at sites in neighbouring districts.

The Willand site currently holds a bespoke permit, though not receiving waste currently, which falls within the remit of the Environment Agency permitting scheme.

Certain types of process (by sector and/or size) can only be issued with a bespoke permit, due to the relative complexity and/or higher level of risk.

The operator reports that only grass silage, maize silage and wheat grain (non-waste) will be used under phase 1 of the project. For phase 2 the facility is proposing to accept wastes to which the EA will apply certain conditions.

Table 1 Mid Devon AD plants

Name	Power generated Mega Watts (MW)	Type of permit/conditions
Broadoak Farm, Cullompton	Less than 5MW	Standard Rules 2012 No10
Menchin Farm, Nomansland	Less than 5 MW	Standard Rules 2012 No10
Edgeworthy Farm, Nomansland	Less than 5 MW	Standard Rules 2012 No10 (not fully operational as yet)
Mountstephen Farm, Uffculme	Less than 0.4 MW	Exempt T24
Hartnoll Farm, Halberton	Less than 5 MW	Bespoke Proximity to residential dwellings required odour/noise management plan
Willand Road, Willand	Less than 5 MW	Bespoke Recently permitted but conditions will apply only once waste is received. Site to operate as a crop fed AD plant in the meantime. Currently under construction. Planning dealt with by Devon County Council as permitted as waste recovery.

The Working Party undertook two site visits, one in Mid Devon at (Red Linhay) Hartnoll Farm, Halberton, and the other at Enfield Farm, Clyst St Mary just east of Exeter in East Devon.

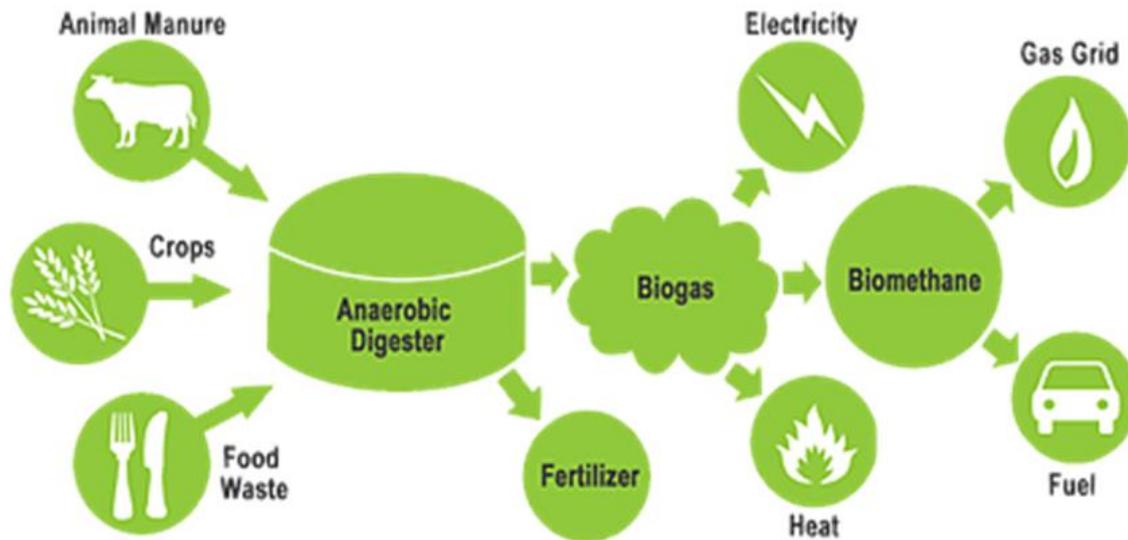
Environment Agency officers were also in attendance to answer any queries relating to their area of expertise. The sites provided the Working Party with a good understanding of large scale AD operations. Members of the Working Party commented that the facilities appeared to be well managed and maintained and were subject to a high level of scrutiny and regulation from the Environment Agency.

At the Enfield farm site visit a presentation was given by a farmer in Somerset that received the digestate from the plant which illustrated the benefits for his particular circumstances (chalky soil). Mid Devon soils are characterised as slightly acid loams and clays and therefore the benefits of the use of digestate as a soil improver and fertiliser will be different.

There are further controls and guidelines that the Environment Agency imposes to protect land and water from contamination and over nitrification seen in many areas in Mid Devon (Nitrate Vulnerable Zones). The spreading of digestate needs to be carefully monitored to avoid adding to the problem of nitrate pollution in ground water.

6. The Anaerobic Process

The process of Anaerobic Digestion (AD) occurs in several steps and requires a community of micro-organisms.



Hydrolysis - large, complex polymers like carbohydrates, cellulose, proteins and fats are broken down by hydrolytic enzymes into simple sugars, amino acids and fatty acids.

Acidogenesis - simple monomers are broken down into volatile fatty acids.

Acetogenesis - the products of acidogenesis are broken down into acetic acid, releasing hydrogen and carbon dioxide.

Methanogenesis - bacteria called methane formers produce methane either by cleaving two acetic acid molecules to form carbon dioxide and methane, or by reduction of carbon hydroxide with hydrogen.

7. Anaerobic Digestion systems

AD is a very flexible process that can be configured in multiple ways, according to the inputs, outputs, site access, space and layout.

The options are described below. AD systems can be classified according to whether they are:

- Mesophilic or thermophilic
- Wet or dry
- Continuous or batch flow
- Single, double or multiple digesters
- Vertical tank or horizontal plug flow

7.1 Mesophilic or Thermophilic

Mesophilic systems operate at 25-45°C and thermophilic systems operate at 50-60°C or above. Thermophilic systems have a faster throughput with faster biogas production per unit of feedstock and m³ digester and there is greater pathogen

kill. However, the capital costs of thermophilic systems are higher, more energy is needed to heat them and they generally require more management.

7.2 Wet or Dry

The difference between what is considered a wet process and a dry process is quite small. Effectively, in wet AD the feedstock is pumped and stirred (5-15% DM) and in dry AD it can be stacked (over 15% DM). Dry AD tends to be cheaper to run as there is less water to heat and there is more gas production per unit feedstock. However, wet AD has a lower set-up capital cost.

7.3 Continuous or Batch Flow

Most digesters are continuous flow as opening the digester and restarting the system from cold every few weeks is a management challenge. They also generally give more biogas per unit feedstock and their operating costs are lower. Some dry systems are batch flow, however. To overcome peaks and troughs in gas production there is usually multiple batch digesters with staggered changeover times.

7.4 Single, Double or Multiple Digesters

As explained above, AD occurs in several stages. Some systems have multiple digesters to ensure each stage occurs sequentially and is as efficient as possible. Multiple digesters can give you more biogas per unit feedstock but at a higher capital cost, higher operating cost and greater management requirement. Most digesters in the UK are single or double digesters.

7.5 Vertical Tank or Horizontal Plug Flow

Vertical tanks simply take feedstock in a pipe on one side whilst digestate overflows through a pipe on the other. In horizontal plug-flow systems a more solid feedstock is used as a 'plug' that flows through a horizontal digester at the rate it is fed in.

Vertical tanks are simple and cheaper to operate, but the feedstock may not reside in the digester for the optimum period of time. Horizontal tanks are more expensive to build and operate, but the feedstock will neither leave the digester too early nor stay in it for an uneconomically long period.

All anaerobic digester operators in the UK must comply with regulations concerning environmental protection, animal by-products, duty of care, health and safety and waste handling.

8. Agency Roles

8.1 Planning (Mid Devon District Council and Devon County Council)

The planning permission for AD processes which involve non-waste and waste materials is undertaken by both Mid Devon District Council (MDDC) and Devon County Council (DCC). In the context of AD processes the consenting planning authority will deal with any enforcement issues. In most cases DCC are the relevant planning authority if the material is classified as waste and MDDC if it involves non-waste. Nevertheless, MDDC Planning is a statutory consultee on DCC applications and vice versa.

MDDC Environmental Health is a statutory consultee with regard to a range of material planning considerations including as relevant; statutory nuisances, private water supplies, air quality and contaminated land. Further regulatory controls can be applied by Animal Health and Plant Agency (APHA) should the AD process involve any wastes containing Animal Bi-Products (ABPs) and covered by the Animal By-Products Regulations.

The Planning Service at MDDC is responsible for assessing and determining planning applications for AD plants and associated development where feedstock for such schemes is not predominantly waste disposal, but instead from sources such as crops. The planning application will involve assessment of a range of issues including impact upon residential amenity as a result of noise, odour; nuisance and disturbance; landscape and visual impact, highways and access, drainage, ecology, pollution and contamination, archaeology, appearance and character.

The Planning Service works closely with other MDDC services such as Environmental Health over potential public health and amenity / nuisance issues; together with other organisations such as the DCC Highway Authority over access and transport considerations and the Environment Agency over environmental protection and waste management.

Planning applications must be determined in accordance with the development plans unless material considerations indicate otherwise. Assessment is made against planning policies also taking into account national planning guidance. For such schemes it is often the case that a 'planning balance' exercise is undertaken whereby the benefits of the scheme are weighted against the dis-benefits on coming to a conclusion whether to grant permission.

Larger schemes may be required to be accompanied by an Environmental Impact Assessment (EIA) which seeks to understand comprehensively the likely impact of the development upon the environment. This is formal process where significant environmental effects are anticipated. Whether the development is subject to EIA is established through a scoping exercise for which Government advice deals with scale and nature of the development, sensitivity of the area and the scale / nature of likely impacts.

Planning permission may be granted subject to conditions. Conditions are required to meet a series of tests. They may only be imposed where they are necessary, relevant to planning and the development to be permitted; enforceable; precise and reasonable in all other respects. Planning conditions requiring compliance with other regulatory requirements such as the Environmental Protection Act, waste regulations or terms of an environmental permit (all regulated by other bodies) do not meet the test of necessity and should not be imposed.

Devon County Council has several roles of relevance. The first of these is as waste planning authority where it has responsibility for the determination of planning applications relating to waste development. Where the feedstock for AD plant schemes is predominantly waste, such as the scheme at Lloyd Maunder Road, Willand planning applications are dealt with by the County Council and MDDC is a consultee in the process.

The County Council also has a function as Highway Authority. The Highway Authority is a consultee for planning purposes when the development is likely to result in a material increase in the volume or a material change in the character of traffic entering or leaving a classified road or involves the formation of or change to an access. The impact of the proposal upon highway safety is major consideration. The Highway Authority is also responsible for roads maintainable at public expense. Issues in relation to highway safety, condition and damage are dealt with by DCC as part of this role.

8.2 Environmental Protection (MDDC Public Health and Regulatory Services)

The Specialist Environmental Protection officers have a key consultation role regarding the determination of planning applications for AD plants, poultry installations and farm storage facilities. They provide advice on the environmental protection matters, private water supplies and nuisance issues that could arise at sensitive locations in the vicinity of the proposed development. The focus is on potential impacts to public health (prejudicial to health) in addition to other statutory nuisance, amenity issues and wider land or air quality considerations. In particular this helps to support decisions on the general principle and suitability of land-use proposals at specific locations. Where information is available, potential cumulative impacts from existing or approved facilities in the surrounding area are taken into account in the advice provided.

Public Health also have a role in providing input into the formal determination (pre-approval) of the scope of any Environment Assessment or Environmental Impact Assessment (EA/EIA) that may be required for larger proposals and the technical evaluation of the subsequent assessments when submitted. In accordance with this role there is a well-established consultation mechanism in place and an effective working relationship with colleagues in Planning.

MDDC are also the enforcing authority for Statutory Nuisance legislation. This is essentially a reactive duty exercised by Public Health to investigate complaints of odour, noise, dust, grit, fumes and other nuisances. The test for issuing a notice is that the Council must be satisfied that the nuisance exists or is likely to occur or recur. The test for prosecuting a breach of an abatement notice is whether there is sufficient evidence to provide a realistic prospect of conviction and then whether it is in the public interest to do so.

These powers do not apply where the source of the complaints is a site or facility which holds an integrated environmental permit issued by the Environment Agency (more below), in which case the Agency is the sole regulator under the Environmental Permitting legislation. Where Public Health receives complaints that are ultimately the responsibility of the Agency or vice versa then there is a duty to share information.

In respect of AD and related activities then certain on-farm storage facilities for slurry or AD digestate and other activities can give rise to nuisance (typically noise and odour) but may not require an Environment Agency permit. If this is the case the Environmental Health statutory nuisance provisions apply and any complaints would be investigated in the same manner as any other agricultural premises or activity.

Non-permitted sites include those where the storage point is considered to be on-farm i.e. the final point of storage on that farm to be spread directly onto the land. Slurry is also often used alongside chicken waste as biodegradable feedstock for the AD process and as indicated above, digestate is the non-biogas material remaining after digestion has taken place. If the storage involved digestate which came from an AD plant where animal by-products were used a permit would still be required. Any complaints in relation to noise or odour from farming activities arising from the preparation of any feedstocks for an AD unit will be dealt with by Environmental Health, again under statutory nuisance legislation.

8.3 European legislation

The majority of environmental regulation in the UK is currently driven by the requirements of European legislation. The key European Directives are:

The Revised Waste Framework Directive (2008/98/EC): Established the waste hierarchy and set targets that prioritised recycling over recovery.

The EU Landfill Directive (1999/31/EC): The Landfill Directive defines technical standards for the disposal of waste and sets targets for the reduction of biodegradable municipal waste disposal to land.

The Industrial Emissions Directive (2010/75/EU): Combined seven existing directives (including the Integrated Pollution Prevention and Control Directive) into one Directive.

The EU Animal By-Product Regulation (EC) No. 1069/2009: The regulations include sanitary requirements for the handling and treatment in an AD plant of waste containing animal by-products. This includes food waste from commercial and household sources.

8.4 Environmental Permitting (Environment Agency)

Environmental Permitting (EP) is a scheme in England and Wales for regulating business activities that could have an impact on the environment and human health. All AD plants are required to obtain a permit or exemption to operate and to spread digestate – completing an application with relevant technical information and demonstrating competency to operate the plant. As a sector, all AD plants requiring an environmental permit come under the Environment Agency responsibilities within the Environmental Permitting legislation.

The Environment Agency has a general responsibility for the protection of the countryside and the natural environment. In the context of AD, there are a number of areas of interest ranging from the AD plants themselves and associated or related activities such as intensive poultry installations in addition to manure, slurry/digestate storage, use and land spreading or disposal as waste.

For the industrial or intensive agricultural activities then the Agency has specific proactive environmental permitting responsibilities. They issue and regulate integrated permits setting out management and operational controls on emissions from these sites to air, land and water. This therefore includes emissions from

chimneys and stacks, releases into rivers and onto land, dust, noise, odour and vibration. The permits are 'living documents' whereby there are provisions to vary or otherwise amend the permit controls in response to changes in best practice, operations and scale etc. Where problems and non-compliance are identified then permits can be used to specify improvement plans. The permits are designed to prevent problems and damage being caused to the environment and local community in the first place. All AD plants whose feedstock contains waste and directly technically linked activities are covered by this regulation in addition to all intensive poultry sites with a combined capacity of 40,000 or more birds.

In respect of chicken litter, slurry and AD digestate then the Agency has broad responsibilities under waste management legislation and protecting controlled waters (rivers and groundwater) from pollution. There are relatively complex regulations governing how the Agency determine if a material is classified as waste (therefore has to be transported by a licenced carrier and treated/reused or disposed of at a permitted waste facility) or is exempt and can be used for other purposes such as fertiliser. If material is to be spread on land for agricultural benefit then there are further controls and guidelines that the Agency imposes to protect land and water from contamination and over nitrification including many areas in Mid Devon controlled as Nitrate Vulnerable Zones.

Certain industry sectors (A1 installations) fall under the remit of the Environment Agency and include industrial processes like refineries, food and drink factories and intensive farming activities (e.g. large-scale chicken farms). They also include certain waste activities like disposing of waste to landfill, hazardous waste treatment and waste incineration. Smaller facilities (A2 or B installations) are normally dealt with by the local authority.

Where the only waste feedstock to an AD plant is agricultural manure and slurry or where non - waste feedstocks such as crops grown specifically for AD are used with the manure or slurry, the digestate output is not waste if it is used in the same way that undigested manure and slurry would normally be used, i.e. spread as a fertiliser on agricultural land, and would not need to be authorised by the Environment Agency (EA).

If other wastes such as food wastes are digested on their own or with manure, slurry or crops grown for AD, then the storage and spreading of the digestate on land will require authorisation (i.e. permit or exemption).

A quality protocol identifies the point at which waste, having been fully recovered, may be regarded as a non-waste product that can be used in specified markets, without the need for waste management controls. Quality protocols have been produced for a range of materials.

In order for an environmental permit to be granted, the EA must be satisfied that the activity will be operated in a manner so as to prevent pollution of the environment and harm to human health. The permit conditions indicate what needs to be done to prevent different types of pollution.

Standard rules environmental permits (SRPs) are available where the size/scale, location and types of operation are such that the Environment Agency has determined that the level of environmental risk from the operation is suitable for control by such an environmental permit. Where an AD facility does not meet the criteria for an exemption or an SRP, then a bespoke environmental permit (also known as a Tier 3 permit) will be required.

There is no formal consultation mechanism put in place locally by the Agency for Public Health and Regulatory Services or the Planning Authority to comment on the proposed integrated permits and conditions set out therein for relevant sites. To apply for environmental permit operators must demonstrate their technical competence. There are currently two approved schemes for England and Wales; the **CIWM/WAMITAB** scheme and the **ES/EAU Sector Skills** scheme.

Standard Rules govern the type of facility and category of waste. They enable anaerobic digester operators to carry out anaerobic digestion of wastes and also combustion of the resultant biogas in gas engines. They also cover the storage of waste.

The Quality Protocol and PAS110 sets out criteria for the production of quality outputs from anaerobic digestion of material that is biodegradable waste (bio-waste). Quality outputs from anaerobic digestion include the whole digestate, the separated fibre fraction and the separated liquor. If the criteria in the Quality Protocol are met (including certification to PAS110), quality outputs from anaerobic digestion will normally be regarded as having been fully recovered. This means that in those circumstances the use of the fully recovered material may not require an authorisation. Useful links are provided below:

<http://www.wrap.org.uk/content/bsi-pas-110-specification-digestate>

<https://www.gov.uk/government/publications/quality-protocol-anaerobic-digestate>

There are three levels of permitting (Exemption, Standard and Bespoke) that the Environment Agency can apply:

8.4.1 Exemption – for small scale, non-waste facilities

You are still required to register with the EA and provide some technical information. There are a number of activities that entitle you to an exemption:

T24 - anaerobic digestion at premises used for agriculture and burning of resultant biogas

There are specific waste types that can be used under this exemption (including manures, slurries and plant tissue) and a total quantity of waste treated or stored at any one time must not exceed 1,250 cubic meters. The appliance used must have a net rated thermal input of less than 0.4 megawatts.

T25 - anaerobic digestion at premises not used for agriculture and burning of resultant biogas

This exemption allows the treatment of food and other biodegradable wastes by anaerobic digestion to produce a digestate which can be used for providing benefit to land. The gas produced must be used for generating energy. You can store or treat up to 50 cubic meters of waste at any one time. Any biogas produced must be burned in an appliance with a net rated thermal input of less than 0.4 megawatts. With this exemption you cannot treat wastes that are animal by-products without an appropriate authorisation from the Animal Health and Plant Agency (APHA)

8.4.2 Standard – for plants which fit within a number of pre-defined standard rules, including throughput, output and nature of material being digested.

8.4.3 Bespoke – for all plants which do not comply with one or more of the standard rules. The permitting mechanism is more complex but such a permit is tailored to individual plant operations and may have wider coverage and controls in comparison to a different process where standard rules apply.

8.5 Permits for Spreading Digestate (Environment Agency)

Material that has reached **PAS 110** and **Quality Protocol standards** is no longer regarded as a waste. However, to spread waste material (prior to achieving PAS110 accreditation) to agricultural and non-agricultural land to confer benefit or ecological improvement you will have to apply for a permit or register for an exemption.

Spreading exemptions relate only to digestate produced under **T24** or **T25** with a quantity limit of 50 tonnes per hectare and a storage limit of 200 tonnes, at any one time.

U10 - spreading of digestate from pre-defined feedstock on agricultural land to confer benefit.

U11 - spreading of digestate from pre-defined feedstock on non-agricultural land to confer benefit.

There is a standard rule permit for spreading waste material to land (if you do not fit the criteria for an exemption). Standard permit SR2010 No.4 allows the spreading of no more than 250 tonnes per hectare and that no more than 3,000 tonnes of waste material is stored at any one time and for no longer than 12 months.

The Environment Agency has also issued guidance for **Seeding AD Plants** – to explain when a permit or exemption may apply during plant start-up.

8.6 Animal By-Products Regulations (APHA/AHVLA)

The Animal and Plant Health Agency (APHA) was formed in 2014 and consists of the Inspectorates from the Food and Environment Research Agency (FERA) including the Bee Inspectorate, Plant Health and Seeds Inspectorate, Plant Variety and Seeds Group and the GM Inspectorate as well as the Animal Health and Veterinary Laboratories Agency (AHVLA).

Animal by-products (ABPs) are animal carcasses, parts of carcasses or products of animal origin that are not intended for human consumption. The **Animal By-Products Regulations (ABPR)** permit the treatment in approved composting and

biogas premises of low-risk (category 3) ABPs and catering waste which contains meat or which comes from a premises handling meat.

High risk (Category 2) ABPs cannot be used as feedstock in biogas plants, except where they have first been rendered to the 133°C/3 bar/20 minute EU pressure-rendering standards.

Manure and digestive tract content are classified as a category 2 ABP, but they can be used without processing as raw material in a biogas plant. However, where manure or digestive tract content is sent to a biogas plant for treatment with other ABPs (including catering waste) the plant **must** be approved and the mixture treated to approved standards.

Generally speaking, where AD plants are treating animal by-products, including waste food, they will need an approval from the Animal Health Veterinary Lab Agency (AHVLA) under Animal By-Products legislation. Regulation (EC) 1069/2009 on the handling and use of animal by-products permits the use in AD of low-risk animal by-products which are essentially material passed fit for purpose, but no longer intended for human consumption.

High-risk material such as dead/fallen stock cannot be used in AD. Permissible AD plant treatment and hygiene standards are set out in the Implementing Regulation (EC)142/2011. The EU rules are administered and enforced in England by the Animal By-Products (Enforcement England) Regulations 2011 (SI 2011/881). There are certain limited exceptions where AD plants treating animal by-products, including food waste, will not need to have an approval from AHVLA. These include AD plants treating food waste on the premises of origin, and there is a small list of animal by-products that can be used in AD without needing an AHVLA approval, including manure, milk and milk products and colostrum.

Digestate derived from AD plants treating animal by-products and approved by AHVLA is subject to a grazing ban once the digestate is used on land. Livestock must not be allowed access to the land during this time period.

8.7 Health and Safety (HSE)

Under the Control of Major Hazards Regulations 2015 (COMAH) the HSE regulate major hazards by working jointly, as a competent authority, with the Environment Agency, Local Authorities and other regulatory bodies.

Anaerobic digestion can be regarded as a chemical process with all the associated risks: flammable atmospheres, fire and explosion, toxic gases, confined spaces, asphyxiation, pressure systems, COSHH, etc. In addition, it also incorporates gas handling and gas storage. Therefore, it is essential that thorough hazard and risk assessments are carried out at each stage of a project from design to installation to commissioning to implementation and operation.

8.8 The Renewable Energy Association (REA)

The Renewable Energy Association (REA) operates a Safety Alert service to incidents affecting safety and the environment that have occurred in the Anaerobic Digestion and bio-waste industries. Serious incidents related to slurries and manures on farms outside the industry will also be included. The service is intended to raise

standards and reduce incidents by building trust across the industry to report, share and learn. The REA Safety Alert demonstrates that the industry is aware of the importance of safety and environmental standards and is prepared to take continuous measures to improve performance.

8.9 Health and Well-being (Public Health England)

Public Health England (PHE) is an executive agency of the Department of Health and Social Care. It has relatively few direct enforcement powers and is largely an advisory and policy body. Its overall function is to protect and improve the national health and wellbeing, and reduce health inequalities. The organisation employs scientists, specialists and researchers to provide expert public health advice. As such, local authorities and NHS bodies with direct health responsibilities such as Directors of Public Health, Public Health consultants, Environmental Health Officers and Medical Clinicians can use PHE to provide authoritative opinion of local public health concerns and specific case issues. In the context of AD and related activities, the Mid Devon Environmental Health team has sought advice from PHE in respect of potential health impacts arising from the storage and spreading of AD digestate.

9. Feed in Tariffs (FIT)

The FIT started in April 2010. It supports anaerobic digestion, onshore wind, hydro and solar PV projects up to 5MW in capacity, as well as small scale fossil-fuel CHP (capped at a certain number of installations).

The scheme requires certain licensed electricity suppliers to pay eligible installations for the generation and export of renewable and low carbon electricity.

The FIT scheme, introduced by the Department of Energy and Climate Change (DECC) (now known as the Department for Business, Energy and Industrial Strategy [BEIS]), is administered by the Gas and Electricity Markets Authority (the Authority), which is assisted in its day-to-day functions by the Office of Gas and Electricity Markets (Ofgem).

Ofgem has since produced **Guidance on sustainability criteria and feedstock restrictions** for anaerobic digestion (AD) generators in England, Scotland and Wales accredited on the Feed-in Tariffs scheme. It explains how to demonstrate compliance with the sustainability criteria and feedstock restrictions which came into force on 1 May 2017¹.

From 1 May 2017 generators of all new anaerobic digestion (AD) eligible installations will have to comply with sustainability requirements and will have their FIT generation payments limited according to feedstock type. Tariff payments are scheduled to fall as per the table below which may impact upon the further expansion of AD plants.

Table 2 New FIT payments from April 2017 (quarterly)

Generation Tariffs p/kWh (2017 prices)	Apr-2017	Jul-2017	Oct-2017	Jan-2018	Apr-2018	Jul-2018	Oct-2018	Jan-2019
0 – 250 kW	6.93	6.88	6.83	6.78	6.73	6.68	6.63	6.58
250 – 500 kW	6.56	6.51	6.47	6.43	6.38	6.34	6.30	6.25
500 - 5000 kW	2.49	2.45	2.42	2.38	2.35	2.31	2.27	2.24

10. Regional and local monitoring

The Environment Agency (EA) responded to a Freedom of Information request for AD plant complaints and incidents in Devon and Cornwall (Appendix A) for installations under its regulation. These only relate to incidents directly associated with installation (plant) activities. In respect of the Mid Devon area the EA provided the following information.

Menchine Farm, Nomansland, Tiverton, Devon, EX16 8NP

Between 5/12/2014 and 9/4/2017 17 incidents were reported:

2 x exceeding daily limit / working at night / brought >5 miles from site.

1 x stockpiles of chicken litter

3 x pollution in River Dalch

6 x noise

3 x spreading of digestate over hedges from the highway and pooling in the field

1 x fly infestation

1 x leeching

Broadoak Farm, Clyst Hydon, Cullompton, EX15 2NH

No reported incidents

Hartnoll Farm, Crown Hill, Halberton, Tiverton, EX16 7AY

July 17 – report that someone was spreading digestive from a bio plant using a splash plate rather than a dribble bar.

11. Health and Environmental Impact

The main risk to health from the slurry and digestate is from the release of Hydrogen Sulphide, Ammonia and Methane. In mitigating these risks the Environment Agency imposes control measures through its permitting system.

11.1 Ammonia

The toxic effects of ammonia gas can result in the damage and death of plants. Some species are very sensitive to high ammonia levels.

Lichens and mosses (lower plants) are the most sensitive, but there is also evidence of a damaging effect on some trees and shrubs (higher plants). The nitrogen component of ammonia settles out (known as 'nitrogen deposition') on land causing

a fertilising effect. This leads to an increase in nitrogen-loving plant species. These species out-compete species more characteristic of the natural environment, especially those which are sensitive to increased nitrogen.

There is a growing body of evidence available to show that ammonia leads to changes in the natural environment, both locally on nature conservation sites and on a large scale across England and Wales. Damage and loss of the most sensitive species is often the first ecological change identified when ammonia levels increase. At higher levels of nitrogen deposition, species diversity generally reduces, particularly in the most sensitive habitats. This is seen as a shift towards more nitrogen-loving species, and a reduction in sensitive species characteristic of semi-natural habitats in England and Wales.

High ammonia levels in the countryside can have an impact on human health and some people have more sensitivity to it. However, it is worth clarifying how ubiquitous ammonia and its sources are in rural, agricultural areas due to ammonia based fertilizers, nitrate rich slurries and other agricultural by-products and emissions from animals etc. Further to this domestic pets can contribute to localised levels of ammonia within the home.

Agriculture is the main source of ammonia emissions to the atmosphere. In 2008, agriculture contributed about 90% of the 281 kilo-tonnes released in the UK. Of this, cattle are the major contributor, releasing approximately 47% of the UK total. Pigs and poultry contribute about 18% of the UK total. The ammonia arises mainly from the decomposition of animal wastes².

11.2 Hydrogen Sulphide

Hydrogen sulphide is one of the key compounds in the natural cycle of sulphur in the environment. It is produced during the decay of plant and animal protein and it occurs in volcanic gases.

Hydrogen sulphide is a gas therefore it is most likely to be breathed in. Skin and eye contact may also occur. The nervous system and cardiovascular system are most affected by hydrogen sulphide, leading to a range of symptoms. Single exposures to high concentrations may rapidly cause breathing difficulties and death.

Skin exposure may also occur, which may cause discolouration, pain, itching, redness of skin and local frostbite. Eye exposure may cause irritation, inflammation, tearing, sensitivity to light and conjunctivitis.

11.3 Methane

Methane is produced naturally by volcanoes, ruminant animals such as cattle and sheep, decaying plants, extraction of natural gas, coal mining and waste disposal such as landfills. It is a major 'greenhouse gas' that results from such human activities.

High levels of methane can displace oxygen in the air and cause oxygen deprivation, which can lead to suffocation. Breathing high levels of the gas can also lead to agitation, slurred speech, nausea, vomiting, facial flushing and headache. In severe cases, breathing and heart complications, coma and death may occur.

11.4 Pathogens

Research about the level of pathogens in digestate, slurry and soil that could potentially be harmful to humans and the environment is well documented and is an ongoing field of research.

A Literature review on levels of pathogens and their abatement in sludges, soil and treated Biowaste (A.S. Lepeuple, G. Gaval, M. Jovic and M.R. de Roubin)³ deals with the occurrence of pathogens and their abatement. This work has been carried out with financial support from the following EU Member States: UK, Germany, France, Italy, Spain, Nordic countries, Netherlands, Denmark, Austria, EU DG XI and JRC, Ispra (The European Commission's Science and Knowledge Service).

In this literature review they have determined the main pathogens found in Sludge, Biowaste and soil. The different strategies for checking the quality of the final product before land spreading or demonstrating the pathogen removal efficiency of a process are presented and then the literature on the influences of different treatment processes on the abatement of micro-organisms is summarised.

Pathogens studied were those that present a risk for human, animal or plant health, of which there are five classes; bacteria, viruses, yeast, fungi and parasites (protozoa and helminths). Livestock faecal wastes may contain pathogenic microorganisms such as *Listeria*, *Campylobacter*, *Salmonella*, *Escherichia coli* 0157, *Cryptosporidium* and *Giardia*.

Several factors such as heat, moisture, and pH can influence pathogen reduction. Heat treatment inactivates pathogens such as enteric viruses, *Salmonella*, *Cryptosporidium* oocysts and viable helminth eggs when heat is coupled with drying.

Thermophilic anaerobic digestion of at least 55°C has a good impact on pathogens while mesophilic anaerobic digestion does not inactivate all pathogens. *Aerobic* digestion seems to be quite more efficient on total and faecal coliforms than anaerobic digestion. The review states that mesophilic anaerobic digestion induces a pathogen reduction of 99% whereas thermophilic anaerobic digestion ensures a reduction of pathogen of 99.99%.

Another consideration is that microbiological diversity is linked to climates, regions, and types of bio-wastes, type and origin of soils, fertilisers and growing media.

11.5 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. They include about 58% of land in England. The Department for Environment, Food and Rural Affairs (Defra) reviews NVZs every 4 years to account for changes in water pollution.

Large areas of Mid Devon (to the north and east) are designated Eutrophic NVZs and there are large areas to the west that are designated Surface Water NVZ areas⁴.

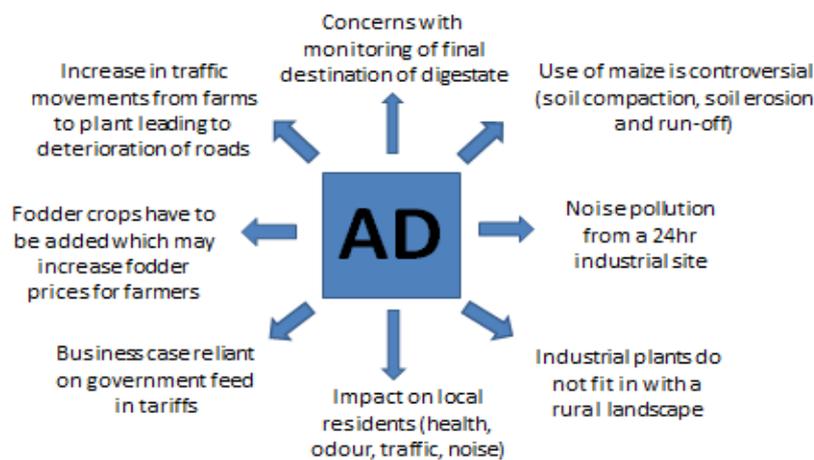
11.6 Land use

The use of good agricultural land for the purpose of providing crops for the production of energy has been questioned. There are compelling arguments for and against. Maize has a high yield in terms of energy output via the anaerobic digestion

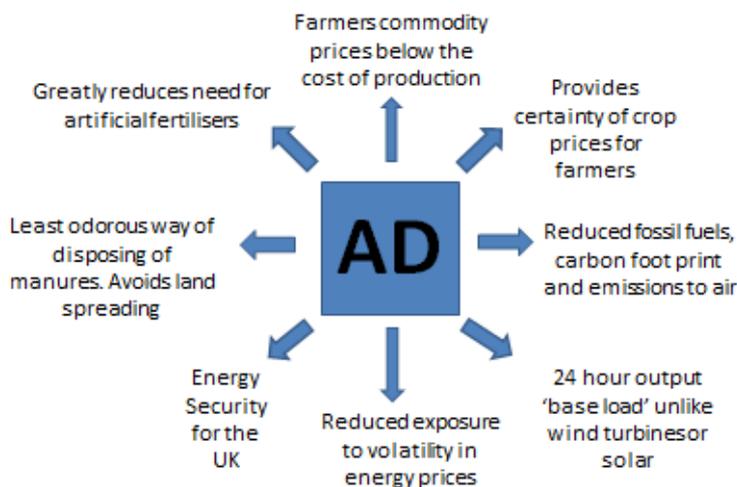
process however there are concerns that for soils in the Devon area this is not a desirable crop to grow. The growing of crops for anaerobic digestion may result in higher feedstock prices for farmers as they compete with the AD industry for land to grow crops for feeding livestock. Granting permission for AD plants should take into account the local need for agricultural land. In planning terms a feedstock crop for use in an anaerobic digester is still an agricultural use of land.

12. Pros and Cons of AD

The disadvantages of AD



The advantages of AD



13. Government position on Anaerobic Digestion 2015

In 2015 Department of Environment Food and Rural Affairs (DEFRA) and the Department of Energy and Climate Change (DECC) released their Anaerobic Digestion Strategy and Action Plan⁵ which confirms the Government's commitment to work towards a 'zero waste' economy and to introduce measures to increase energy from waste through anaerobic digestion (AD).

The Government's Structural Reform Plans of 16 July 2010 included an action to 'set out steps to promote increased energy from waste through anaerobic digestion'. DEFRA incorporated this into its Business Plan and published on 30 November 2010 a Framework Document which aimed to set out the steps necessary to increase energy from waste through anaerobic digestion. A total of £10m over 4 years was initially made available to provide debt finance to stimulate investment in additional Anaerobic Digestion (AD) capacity.

To facilitate the growth of AD the Environment Agency developed revised standard rule permits. This made the granting of a permit easier and quicker for those applicants who could meet the standard rules. A key issue noted in the strategy concerned the existing regulatory framework for AD and that it needed to ensure that the balance between encouraging growth of the industry and the requirement to protect human health and the environment (including animal health) is well understood. Also noted was the need to fully comprehend the competing priorities of land use, environment and biodiversity and the interconnection with feedstocks for on-farm AD plants.

14. Resident concerns

At the time of writing this report concerns have been communicated to Mid Devon District Council, directly to officers and through the scrutiny committee process, in relation to activities *associated* with AD plants, specifically the spreading and storage of digestate. It is not the aim of this report to provide comment on these activities or validate the concerns; nevertheless, it is worth acknowledging these concerns and take account of what investigations have revealed.

The issue has been borne out of a longstanding dispute involving the storage and spreading of digestate. An open slurry pit is used as a final storage point for subsequent on-farm land spreading of slurry and/or digestate for agricultural benefit. The facility does not require a permit from the Environment Agency. The slurry pit has historic planning permission.

During 2016, concerns were raised by residents of the potential health impact of mixed materials being stored at and spread locally. That work is a matter of record for the Scrutiny Committee

15. Recommendations

The following recommendations were made:

1. That a formal request is made to the Environment Agency that Mid Devon District Council (Planning and Public Health) are consultees on Environmental Permitting. This includes input in on-site and off-site odour or other nuisance management plans and digestate spreading protocols relevant to AD permit applications.
2. That where enforcement issues are raised with an AD plant or associated activities (for example through complaints and service requests or routine inspections), coordination takes place between relevant agencies and Mid Devon District Council.
3. That Mid Devon District Council pro-actively liaises with all stakeholders (residents, operators, and agencies) to ensure local issues are dealt with as fairly and openly as legally permissible.

16. Appendix A - Environment Agency Position Statement

Anaerobic digestion of agricultural manure and slurry

Anaerobic Digestion (AD) is a process which harnesses natural bacteria to treat biodegradable materials such as agricultural manure and slurry, food waste and sewage sludge. The AD process produces a methane rich biogas which can be captured and used to generate electricity and heat and the digestate residue can be beneficially applied to farmland as fertiliser or as a soil conditioner. We support the use of AD as a means of diverting biodegradable wastes from landfill, recovering value from them and reducing greenhouse gas emissions.

This note updates and replaces our briefing note issued in December 2008, following changes introduced by the Environmental Permitting (England & Wales) Regulations 2010. It sets out how we will apply waste regulatory controls to the AD of agricultural manure and slurry and the use of the resulting digestate as a fertiliser on agricultural land in England and Wales.

Our position

Agricultural manure and slurry is not considered waste when it is used directly as a fertiliser on land. When agricultural manure or slurry is destined for a treatment process for example composting or AD, it is waste and will be subject to regulatory control.

Digestate

When the feedstock to an AD plant is waste the resulting digestate and biogas are waste until put to their final use. We have taken a different approach for agricultural manure and slurry because we recognise that the digestate produced from manure and slurry has improved fertilising properties and will have less of an environmental impact than undigested manure and slurry.

We do not consider the AD digestate output to be waste if:

- the only waste feedstock to an AD plant is agricultural manure and slurry and it is spread as a fertiliser on agricultural land
- agricultural manure and slurry is mixed with a non-waste feedstock e.g. crops grown specifically for AD and it is spread as a fertiliser on agricultural land.

If the manure and slurry feedstock is mixed with other waste feedstocks, then the resultant digestate will be waste and subject to environmental permitting controls.

17. Appendix B - Incidents related to Anaerobic Digestion Plants Devon and Cornwall 2000 to date.

Ref No	Date/Time First Reported	Site	Cause
00166136	16/06/2003 10:38	Holsworthy	Control Measure Failure
00179283	05/08/2003 12:25	Holsworthy	Not Identified
00185205	26/08/2003 17:04	Holsworthy	Normal Operation
00185475	27/08/2003 18:13	Holsworthy	Control Measure Failure
00186071	29/08/2003 16:05	Holsworthy	Unauthorised Discharge or Disposal
00186527	01/09/2003 12:45	Holsworthy	Other Unauthorised Activity
00186541	01/09/2003 14:07	Holsworthy	Unauthorised Discharge or Disposal
00189445	12/09/2003 14:50	Holsworthy	Control Measure Failure
00196935	18/10/2003 12:46	Holsworthy	Control Measure Failure
00236339	13/05/2004 10:02	Holsworthy	Other Unauthorised Activity
00238596 (M)	21/05/2004 09:00	Holsworthy	Other
00257168 (M)	07/08/2004 10:48	Holsworthy	Overfilling of Tank or Container (Bunded)
00268276 (M)	07/09/2004 09:51	Holsworthy	Other Unauthorised Activity
00313439	18/05/2005 09:45	Holsworthy	Other Unauthorised Activity
00325072 (M)	28/06/2005 09:31	Holsworthy	Other Authorised Activity
00338338	15/08/2005 15:03	Holsworthy	Other Unauthorised Activity
00347929	21/09/2005 10:03	Holsworthy	Other Authorised Activity
00353202	13/10/2005 12:15	Holsworthy	Control Measure Failure
00405498 (M)	08/06/2006 14:45	Holsworthy	Abnormal Process Operation
00443967	17/10/2006 13:33	Holsworthy	Abnormal Process Operation
00445314	23/10/2006 12:30	Holsworthy	Abnormal Process Operation
00447320 (M)	31/10/2006 20:31	Holsworthy	Unauthorised Discharge or Disposal
00559770 (M)	26/01/2008 12:35	Holsworthy	Storage Tank or Container Failure (Unbunded)
00671703	20/04/2009 09:16	Holsworthy	Accidental Spillage
00674090	27/04/2009 10:06	Holsworthy	Not Identified
00697503	13/07/2009 11:16	Holsworthy	Control System

00903899	18/07/2011 09:12	Langage	Failure
00949702	22/12/2011 16:30	Langage	Not Identified
00957428 (M)	26/01/2012 14:28	Langage	Not Identified
00964689	23/02/2012 11:30	Langage	Other Inadequate Control or Containment
00965112	27/02/2012 10:11	Langage	Other Inadequate Control or Containment
00994524	25/05/2012 13:46	Langage	Other
01005676	25/06/2012 21:16	Langage	Other Authorised Activity
01008863	04/07/2012 17:00	Langage	Not Identified
01017276	24/07/2012 08:27	Langage	Not Identified
01026127	14/08/2012 14:11	Langage	Not Identified
01029186 (M)	21/08/2012 11:57	Langage	Control System Failure
01031222	27/08/2012 23:57	Langage	Abnormal Process Operation
01034635 (M)	06/09/2012 12:03	Langage	Other Authorised Activity
01118764 (M)	04/06/2013 14:37	Langage	Other Authorised Activity
01263192 (M)	30/07/2014 15:34	Langage	Other
01305838	12/01/2015 08:57	Menchine	Other Inadequate Control or Containment
01312952	11/02/2015 08:34	Fraddon	Control System Failure
01312953	11/02/2015 08:41	Fraddon	Other Authorised Activity
01313009 (M)	10/02/2015 14:47	Menchine	Control Measure Failure
01325449	02/04/2015 11:36	Fraddon	Other
01330260 (M)	20/04/2015 09:00	Fraddon	Abnormal Process Operation
01331925	24/04/2015 12:40	Fraddon	Abnormal Process Operation
01343166	08/06/2015 08:47	Menchine	Other
01348462	25/06/2015 14:13	Holsworthy	Control System Failure
01349432 (M)	29/06/2015 11:04	Fraddon	Other Authorised Activity
01357268	21/07/2015 17:42	Menchine	Control Measure Failure
01365888	19/08/2015 09:09	Fraddon	Abnormal Process Operation
01372872	11/09/2015 10:38	Enfield	Pipe Failure above ground
01373623	16/09/2015 16:15	Holsworthy	Storage Tank or Container Failure (Bunded)
01386872 (M)	10/11/2015 10:20	Fraddon	Other Authorised Activity

01392515 (M)	05/12/2015 15:02	Fraddon	Abnormal Process Operation
01393999 (M)	11/12/2015 17:54	Fraddon	Other Authorised
01403918	18/01/2016 16:31	Holsworthy	Storage Tank or Container Failure (Bunded)
01409571	08/02/2016 15:55	Enfield	Pipe Failure above ground
01411036	13/02/2016 20:30	Fraddon	Control System Failure
01438673 (M)	27/05/2016 10:24	Fraddon	Abnormal Process Operation
01454225 (M)	19/07/2016 18:38	Fraddon	Other Inadequate Control or Containment
01461334	12/08/2016 07:35	Enfield	Other Fire
01469040	07/09/2016 12:13	Fraddon	Abnormal Process Operation
01478084	12/10/2016 11:26	Fraddon	Other Authorised Activity
01481656	30/10/2016 09:04	Fraddon	Control Measure Failure
01484200	11/11/2016 09:50	Enfield	Storage Tank or Container Failure (Bunded)
01485068	16/11/2016 10:00	Enfield	Other
01488113	30/11/2016 14:34	Fraddon	Not Identified
01488136	30/11/2016 15:27	Enfield	Abnormal Process Operation
01490583 (M)	12/12/2016 23:39	Fraddon	Other Authorised Activity
01491379 (M)	16/12/2016 16:32	Fraddon	Other Authorised Activity
01494109	04/01/2017 09:02	Great Hele Barton	Overfilling of Tank or Container (Bunded)
01495698 (M)	15/01/2017 00:16	Enfield	Other
01497016 (M)	22/01/2017 15:28	Fraddon	Normal Operation
01510801 (M)	27/03/2017 10:30	Fraddon	Other Authorised Activity
01516373 (M)	18/04/2017 09:38	Fraddon	Other Inadequate Control or Containment
01517879	22/04/2017 22:20	Enfield	Other
01524216	19/05/2017 11:04	Enfield	Control System Failure
01530492	13/06/2017 00:18	Enfield	Other Authorised Activity
01557517 (M)	26/09/2017 09:02	Fraddon	Abnormal Process Operation

18. References

¹ https://www.ofgem.gov.uk/system/files/docs/2017/05/feed-in_tariffs_guidance_on_sustainability_criteria_and_feedstock_restrictions.pdf

² http://webarchive.nationalarchives.gov.uk/20140328145728/http://www.environment-agency.gov.uk/static/documents/Business/Ammonia_fact_sheet.pdf

³ Lepeuple, Anne-Sophie & Gaval, G & Jovic, M & de Roubin, Marie-Renée. (2018). Literature review on levels of pathogens and their abatement in sludges, soil and treated bio-waste.

⁴ <http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683&y=355134&scale=1&layerGroups=default&ep=map&textonly=off&lang=en&topic=nvz#x=308736&y=101995&lg=1,10&scale=4>

⁵ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69400/anaerobic-digestion-strat-action-plan.pdf

Other reference sources

<https://www.gov.uk/government/policies/waste-and-recycling>

<https://www.gov.uk/government/publications/ammonia-properties-incident-management-and-toxicology>

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/337717/Hydrogen_Sulphide_General_Information_phe_v1.pdf