Conclusions on BAT	Applicability Assessment State whether it (describe how the technique is in place or applies or not to your state schedule for installation)	State whether it (describe how the technique is in place or applies or not to your state schedule for installation) implementation
5.1 General BAT for the whole FDM sector		
BAT 1 BAT is to ensure, e.g. by training, that employees are aware of the environmental aspects of the company's operations and their personal responsibilities (see Section 4.1.2).	Site Training	**Yes**
BAT2 BAT is to design/select equipment, which optimises consumption and emission levels and facilitates correct operation and maintenance (see Section 4.1.3.1), optimise the pipework system for the capacity to minimise product losses and install requirements pipes at a gradient to promote self-draining.	Preferred purchasing system to ensure appropriate selection of equipment.	**Yes**
BAT3. BAT is to control noise emissions at source by designing, selecting, operating and maintaining equipment, including vehicles to avoid or reduce exposure (see Sections 4.1.2, 4.1.3.1, 4.1.3.2, 4.1.3.3, 4.1.3.4 and 4.1.5) and, where further reductions in noise levels are required, enclosing noisy equipment (see Section 4.1.3.5).	Applicable – Noise nuisance to be reduced as far as practicable.	**Yes**
BAT4. BAT is to operate regular maintenance programmes (see Section 4.1.5).	Regular maintenance to be completed on equipment as preventative measure.	**Yes**
BAT 5. BAT is to apply and maintain a methodology for preventing and minimising the consumption of water and energy and the production of waste (see Section 4.1.6) incorporating: 5.1 obtaining management commitment, organisation and planning (see Sections 4.1.6.1) 5.2 analysis of production processes, including individual process steps to identify areas of high water and energy consumption and high waste emissions to identify opportunities to minimise these (see Sections 4.1.6.2, 4.1.6.2.1, 4.1.6.2.2 and 4.1.6.2.3), taking into account the water quality requirements for each application, hygiene and food safety 5.3 assessment of objectives, targets and system borders (see Section 4.1.6.3)5.4 identification of options for minimising water and energy consumption, and waste production (see Section 4.1.6.4), using a systematic approach, such as pinch technology (see Section 4.1.6.4.1) 5.5 carrying out an evaluation and doing a feasibility study (see Section 4.1.6.5) 5.6 implementing a programme for minimising the consumption of water and	Applicable -	**Yes**

energy and waste production (see Section 4.1.6.6) and 5.7 ongoing monitoring of water and energy consumption; waste production levels and the effectiveness of control measures (see Section 4.1.6.7). This can involve both measurement and visual inspection		
BAT 6. BAT is to implement a system for monitoring and reviewing consumption and emission levels for both individual production processes and at site level, to enable actual performance levels to be optimised. Examples of parameters to monitor requirements include: energy consumption; water consumption; waste water volumes; emissions to air and water; solid waste generation; product and by-product yield; consumption of harmful substances and frequency and severity of unplanned releases and spillages. A good knowledge of the process inputs and outputs is required to identify priority areas and options for improving environmental performance. A good monitoring system will include records of operating conditions, sampling and analytical methods and will ensure that measuring equipment is calibrated. Further information is available in the "Reference Document on the General Principles of Monitoring" [96, EC, 2003].	Applicable – Already completed during production process. Resource consumption and waste production are monitored to reduce or minimise them to the lowest level practicable.	**Yes**
BAT 7. BAT is to maintain an accurate inventory of inputs and outputs at all stages of the process from reception of raw materials to dispatch of products and end-of-pipe reflect treatments (see Section 4.1.6.2)	Applicable – Already completed as part of the production process to minimise waste and maximise production.	**Yes**
BAT 8. BAT is to apply production planning to minimise associated waste production and cleaning frequencies (see Section 4.1.7.1)	Applicable – The facility has a production plan in place for all products produced on site.	**Yes**
BAT9. BAT is to transport solid FDM raw materials, products, co-products, by-products and waste dry (see Section 4.1.7.4), including avoiding fluming except where washing involving the re-use of water is carried out during fluming and where fluming is necessary to avoid damage to the material being transported	Not Applicable	Not Applicable
BAT 10. BAT is to minimise storage times for perishable materials (see Section 4.1.7.3)	Applicable – Grains and other perishable inputs are stored only for minimal time periods.	**Yes**
BAT 11. BAT is to segregate outputs, to optimise use, re-use, recovery, recycling and disposal (and minimise waste water contamination) (see Sections 4.1.7.6, 4.1.6, 4.1.7.7, reflect 4.7.1.1, 4.7.2.1, 4.7.5.1 and 4.7.9.1)	Applicable – Redmills have waste management system in place referenced to the waste hierarchy and materials are reused or recycled where possible.	**Yes**

BAT 12. BAT is to prevent materials from falling on the floor, e.g. by using accurately positioned splash protectors, screens, flaps, drip trays and troughs (see Section 4.1.7.6).	Applicable – Process materials are contained within closed containers and pipework.	**Yes**
BAT 13. BAT is to optimise the segregation of water streams (see Section 4.1.7.8), to optimise re-use and treatment	Not Applicable – All water used in process is removed as steam -	**No**
BAT 14. BAT is to collect water streams, such as condensate and cooling water separately to optimise reuse (see Section 4.1.7.8)	Applicable – steam could be reused but practicalities and payback on retrofits would need to be assessed.	**Yes**
BAT 15. BAT is to avoid using more energy than needed for heating and cooling processes, without harming the product (see Section 4.1.7.9)	Applicable – Full energy audit completed on site in 2016	**Yes** Energy Audit completed
BAT 16. BAT is to apply good housekeeping (see Section 4.1.7.11)	Applicable – All areas are inspected as part of the quality controls for the site to ensure that housekeeping is maintained.	**Yes**
BAT 17. BAT is to minimise noise nuisance from vehicles (see Section 4.1.7.12)	Applicable – management of vehicles accessing the site at night may be assessed.	**Yes**
BAT 18. BAT is to apply storage and handling methods as concluded in the "Storage BREF" [95, EC, 2005]. Further controls may be required to provide and maintain the required hygiene and food safety standards	Applicable – storage of grain and other process inputs (e.g. soya oil)	**Yes**

BAT 19. BAT is to optimise the application and use of process controls to, e.g. prevent and minimise the consumption of water and energy and to minimise the generation of waste (see Section 4.1.8) and in particular: 19.1 where heat processes are applied and/or materials are stored or transferred at critical temperatures, or within critical temperature ranges, to control the temperature by dedicated measurement and correction (see Section 4.1.8.1) 19.2 where materials are pumped or flow, to control flow and/or level, by dedicated measurement of pressure (see Sections 4.1.8.2) and/or dedicated measurement of flow (see Section 4.1.8.4) and/or dedicated measurement of level (see Section 4.1.8.3) and using control devices, such as valves (see Section 4.1.8.7) 19.3 where liquids are stored or reacted in tanks or vessels, either during manufacturing or cleaning processes, use level-detecting sensors and level measurement sensors (see Section 4.1.8.3) 19.4 to use analytical measurement and control techniques to reduce waste of material and water and reduce waste water generation in processing and cleaning and in particular to: 19.4.1 measure pH to control additions of acid or alkali and to monitor waste water streams to control mixing and neutralising prior to further treatment or discharge (see Section 4.1.8.5.1) 19.4.2 measure conductivity to monitor levels of dissolved salts prior to water re-use and detect levels of detergent prior to detergent re-use (see Section 4.1.8.5.2) and 19.4.3 where fluids may be cloudy or opaque due to the presence of suspended matter, measure turbidity to monitor process water quality and to optimise both the recovery of material/product from water and the reuse of cleaning water (see Section 4.1.8.5.3)	Applicable	**Yes**
BAT 20. BAT is to use automated water start/stop controls to supply process water only when it is required (see Section 4.1.8.6).	Not Applicable – Low water volumes consumed on site.	Not Applicable
BAT 21. BAT is to select raw materials and auxiliary materials which minimise the generation of solid waste and harmful emissions to air and water (see Sections 4.1.9.1 and 4.1.9.2)	Applicable – All inputs are natural and any controls would be related to emissions of dust etc.	**Yes**
BAT 22. BAT is that landspreading is an option for the outlet of materials from the FDM sector, subject to local legislation, as discussed in Section 4.1.6.	Not Applicable – No landspreading of production waste takes place.	**No**

5.1.1 Environmental Management		
BAT 23. BAT is to implement and adhere to an Environmental Management System (EMS) that incorporates, as appropriate to individual circumstances, the following features : (see Chapter 3) • definition of an environmental policy for the installation by top management (commitment of the top management is regarded as a precondition for a successful application of other features of the EMS) • planning and establishing the necessary procedures • implementation of the procedures, paying particular attention to structure and responsibility training, awareness and competence communication employee involvement documentation efficient process control maintenance programmes emergency preparedness and response safeguarding compliance with environmental legislation. • checking performance and taking corrective action, paying particular attention to monitoring and measurement (see also the "Reference Document on the General Principles of Monitoring") corrective and preventive action maintenance of records independent (where practicable) internal auditing to determine whether or not the environmental management system conforms to planned arrangements and has been properly implemented and maintained. • review by top management.	Applicable – No EMS is in place on site at present	**Yes** Will be updated to reflect IE Licence Requirements for EMS
5.1.2 Collaboration with Upstream and Downstream Activities		
BAT 24. BAT is to seek collaboration with upstream and downstream partners, to create a chain of environmental responsibility, to minimise pollution and to protect the environment as a whole, (see, e.g. Sections 4.1.7.2, 4.1.7.3, 4.1.7.12, 4.1.9.1, 4.2.1.1, requirements 4.2.4.1 and 4.7.2.3).		

5.1.3 Equipment and Installation Cleaning		
BAT 25. BAT is to do the following: 1 - Remove raw material residues as soon as possible after processing and clean 2 - provide and use catch pots over floor drains and ensure they are inspected and cleaned frequently, to prevent entrainment of materials into waste water (see Section 4.3.1.1) 3 - optimise the use of dry cleaning (including vacuum systems) of equipment and installations, including after spillages (see Sections 4.3.1, 4.7.1.2, 4.7.2.2, 4.7.5.2 and 4.7 .9.2) prior to wet cleaning, where wet cleaning is necessary to achieve the required hygiene levels 4 - pre-soak floors and open equipment to loosen hardened or burnt-on dirt before wet cleaning (see Section 4.3.2) 5 - manage and minimise the use of water, energy and detergents used (see Section 4.3.5) 6 - fit cleaning hoses used for manual cleaning with hand operated triggers (see Section 4.3.6) 7 - supply pressure-controlled water and do this via nozzles (see Section 4.3.7.1) 8 - optimise the application of the re-use of warm open-circuit cooling water, e.g. for cleaning (e.g. see Section 4.7.5.17) 9 - select and use cleaning and disinfection agents which cause minimum harm to the environment (see Sections 4.3.8, 4.3.8.1 and 4.3.8.2) and provide effective hygiene control 10 - operate a cleaning-in-place (CIP) of closed equipment (see Section 4.3.9), and ensure that it is used in an optimal way by, e.g. measuring turbidity (see Section 4.1.8.5.3), conductivity (see Section 4.1.8.5.2) or pH (see Section 4.1.8.5.1) and automatically dosing chemicals at the correct concentrations (see Section 4.3.9) 11 - use single-use systems for small or rarely used plants or where the cleaning solution becomes highly polluted, such as UHT plants, membrane separation plants, and the preliminary cleaning of evaporators and spray driers (see Section 4.3.9) 12 - where there are suitable variations in the pHs of the waste water streams from CIP and other sources, apply self-neutralisation of alkaline and acidic waste water streams in a neutralisation tank (see Section 4.5.2.4) 13 - minimise the use of EDTA, by only using it where it is required, with the	Applicable – Cleaning is completed as part of the quality control and general housekeeping at the feed mill site. The level of hygiene, although high, is not at the same required level as other food and drink sectors.	**Yes**

frequency required and by minimising the quantity used, e.g. by recycling cleaning solutions (see Sections 4.3.8, 4.3.8.2, 4.3.8.2.2, 4.3.8.2.3 and 4.3.8.2.5). When selecting chemicals for disinfecting and sterilising equipment and installations, BAT is to: 14 - avoid the use of halogenated oxidising biocides, except where the alternatives are not effective (see Sections 4.3.8.1, 4.5.4.8, 4.5.4.8.1 and 4.5.4.8.2).		
5.1.4 Additional BAT for some processes and unit operations applied in a Number of FDM sectors		
5.1.4.1 Materials reception/despatch		
BAT 26. During the reception and despatch of materials, BAT is to do the following: when vehicles are parked and during loading and unloading, switch off the vehicle engine and the refrigerator unit, if there is one and provide an alternative power supply (see Section 4.2.1.1).	Applicable – The trucks can be turned off when loading. During unloading the grain trucks must run to deposit the grain contents.	**Yes**
5.1.4.2 Centrifugation/Separation		
BAT 27. In all FDM installations carrying out centrifugation, BAT is to do the following: operate centrifuges to minimise the discharge of product in the waste stream (see Section 4.2.3.1).	Applicable – Cyclones used on site are designed to maximise the product and minimise waste.	**Yes**
5.1.4.3 Smoking		
BAT 28. In all FDM installations carrying out smoking, BAT is to do the following: achieve a TOC air emission level of <50 mg/Nm3 (see, e.g. Sections 3.3.1.2.2 and 4.4.3.11.1).	Not Applicable – No smoking on site	No
5.1.4.4 Frying		
BAT 29. In all FDM installations carrying out frying, BAT is to do the following: recirculate and burn exhaust gases (see Section 4.2.7.1)	Not Applicable – No frying on site	No

5.1.4.5 Preservation in Cans, Bottles and Jars		
BAT 30. In all FDM installations carrying out preservation in cans bottles and jars, BAT is to do the following: 1 - apply automated can, bottle and jar seasoning filling systems incorporating closed circuit recycling of spilled liquids (see Section 4.2.8.2) 2 - use can, bottle and jar cleaning tanks with floating oil recovery when preserving oil, foods canned in vegetable oils or oily foods (see Section 4.2.8.3).	Not Applicable – No canning or bottling takes place on site	No
5.1.4.6 Evaporation		
BAT 31. In all FDM installations carrying out evaporation, BAT is to do the following: use multieffect evaporators (see Section 4.2.9.1) optimising vapour recompression (see Section 4.2.9.2) related to heat and power availability in the installation, to concentrate liquids.	Not Applicable	No
5.1.4.7 Freezing and Refrigeration		
BAT 32. In all FDM installations carrying out freezing and refrigeration, BAT is to do the following: 1 prevent emissions of substances that deplete the ozone layer by, e.g. not using halogenated substances as refrigerants (see Section 4.1.9.3) 2 avoid keeping air conditioned and refrigerated areas colder than necessary (see Section 4.2.15.1) 3 optimise the condensation pressure (see Section 4.2.11.2) 4 regularly defrost the entire system (see Section 4.2.15.3) 5 keep the condensers clean (see Section 4.2.11.3) 6 make sure that the air entering the condensers is as cold as possible (see Section 4.2.11.3) 7 optimise the condensation temperature (see Section 4.2.11.3) 8 use automatic defrosting of cooling evaporators (see Section 4.2.15.5) 9 operate without automatic defrosting during short production stops (see Section 4.2.11.7) 10 minimise transmission and ventilation losses from cooled rooms and cold stores (see Section 4.2.15.2)	Not Applicable – No refrigeration or freezing takes place.	No

5.1.4.8 Cooling		
BAT 33. In all FDM installations carrying out cooling, BAT is to do the following: 1 optimise the operation of cooling water systems to avoid excessive blowdown of the cooling tower (see Section 4.1.5) 2 install a plate heat-exchanger for precooling ice-water with ammonia, prior to final cooling in an accumulating ice-water tank with a coil evaporator (see Section 4.2.10.1) 3 recover heat from cooling equipment. Water temperatures of 50- 60 oc can be achieved (see Section 4.2.13.5).	Not Applicable	No
5.1.4.9 Packing		
BAT 34. In all FDM installations carrying out packing, BAT is to do the following: 1 optimise the design of packaging, including the weight and volume of material and the recycled content, to reduce the quantity used and to minimise waste (see requirements (Section 4.2.12.2) 2 purchase materials in bulk (see Section 4.1.7.2) 3 collect packaging material separately (see Section 4.2.12.3) 4 minimise overflowing during packing (see Section 4.2.12.6).	Applicable – All packaging used is designed to minimize the volume of material used and potential waste.	**Yes**
5.1.4.10 Energy Generation and Use		
BAT 35. BAT is to do the following: 1 for installations where there is a use for the heat and power produced, e.g. in sugar manufacturing, milk powder production, whey drying, instant coffee production, brewing and distilling, use combined heat and power generation in new or substantially altered installations or those renewing their energy systems (see Section 4.2.13.1) 2 use heat pumps for heat recovery from various sources (see Section 4.2.13.4) 3 switch equipment off when it is not needed (see Section 4.2.13.6) 4 minimise the loads on motors (see Section 4.2.13.7) 5 minimise motor losses (see Section 4.2.13.8) 6 use variable speed drives to reduce the load on fans and pumps (see Section 4.2.13.10) 7 apply thermal insulation, e.g. of pipes, vessels and equipment used to carry, storeor treat substances above or below ambient temperature and to equipment used for processes involving heating and cooling (see Section 4.2.13.3) 8 apply frequency controllers on motors (see Section 4.2.13.9)	Applicable – Energy audit completed in 2016 outlined a number of measures to improve energy efficiency	**Yes**

5.1.4.11 Water Usage		
BAT 36. If groundwater is used, BAT is to do the following: only pump up the quantities of water that are actually required (see Section 4.2.14.1).	Applicable – Relatively low volumes of water are consumed on site and it is normal for only required water to be pumped to the site.	**Yes**
5.1.4.12 Compressed Air Systems		
BAT 37. For compressed air generation, BAT is to do the following: 1 review the pressure level and reduce it if possible (see Section 4.2.16.1) 2 optimise the air inlet temperature (see Section 4.2.16.2) 3 fit silencers at air inlets and exhausts, to reduce noise levels (see Section 4.2.16.3).	Not Applicable	No
5.1.4.13 Steam Systems		
BAT 38. For steam systems, BAT is to do the following: 1 maximise condensate return (see Section 4.2.17.1) 2 avoid losses of flash steam from condensate return (see Section 4.2.17.2) 3 isolate unused pipework (see Section 4.2.17.3) 4 improve steam trapping (see Section 4.1.5) 5 repair steam leaks (see Section 4.1.5) 6 minimise boiler blowdown (see Section 4.2.17.4).	Applicable – condensate is returned where possible and pipework is inspected on an on-going basis and repaired immediately when required.	**Yes**

5.1.5 Minimisation of Air Emissions		
BAT 39. To prevent air emissions from FDM installations, BAT is to do the following: 1 apply and maintain an air emissions control strategy (see Section 4.4.1) incorporating: 1.1 definition of the problem (see Sections 4.4.1.1 and 4.4.1.1.1) 1.2 an inventory of site emissions, including, e.g. abnormal operation (see Sections 4.4.1.2 and 4.4.1.2.1) 1.3 measuring the major emissions (see Sections 4.4.1.3 and 4.4.1.3.1) 1.4 assessing and selecting the air emission control techniques (see Section 4.4.1.4) 2 collect waste gases, odours and dusts at source (see Section 4.4.3.2) and duct them to the treatment or abatement equipment (see Section 4.4.3.3) 3 optimise the start-up and shut-down procedures for the air emission abatement equipment to ensure that it is always operating effectively at all ofthe times when abatement is required (see Sections 4.4.3.1) 4 unless specified otherwise, where process-integrated BAT which minimise air emissions by the selection and use of substances and the application of techniques do not achieve emission levels of 5- 20 mg/Nm3 for dry dust, 35- 60 mg/Nm3 for wet/sticky dust and <50 mg/Nm3 TOC, to achieve these levels by applying abatement techniques. This document does not specifically consider emissions from combustion power plants in FDM installations and these levels are, therefore, not intended to represent BAT associated emission levels from those combustion plants. Some air abatement techniques are described in Sections 4.4 to 4.4.3.12 5 where process-integrated BAT do not eliminate odour nuisance, apply abatement techniques. Many of the techniques described in Section 4.4 are applicable to odour abatement.	Applicable – particulate emissions are considered the main emission from the site. The process has cyclone systems and sock filter units in place to minimise the loss of particulate from the Mill process.	**Yes**

<table>
<tr><th colspan="3">5.1.6 Waste Water Treatment</th></tr>
<tr>
<td>BAT 40.
For the treatment of waste water from FDM installations, BAT is to use a suitable combination of the following:
1 apply an initial screening of solids (see Section 4.5.2.1) at the FDM installation represent levels currently achieved within the industry but are based on the expert
judgement of the TWG.
2 remove fat using a fat trap (see Section 4.5.2.2) at the FDM installation, if the waste water contains animal or vegetable FOG
3 apply flow and load equalisation (see Section 4.5.2.3)
4 apply neutralisation (see Section 4.5.2.4) to strongly acid or alkaline waste water
5 apply sedimentation (see Section 4.5.2.5) to waste water containing SS
6 apply dissolved air flotation (see Section 4.5.2.6)
7 apply biological treatment. Aerobic and anaerobic techniques applied in the FDM sector are described in Sections 4.5.3.1 to 4.5.3.3.2
8 use CH4 gas produced during anaerobic treatment for the production of heat and/or power (see Section 4.5.3.2).
Unless otherwise stated in this chapter, the emission levels given in Table 5.1 are indicative of the emission levels that would be achieved with those techniques generally considered to represent BAT (see Section 4.5.1.1). They do not necessarily represent levels currently achieved within the industry but are based on the expert judgement of the TWG:
<table>
<tr><td>BOD</td><td><25</td></tr>
<tr><td>COD</td><td><125</td></tr>
<tr><td>Total Suspended Solids</td><td><50</td></tr>
<tr><td>pH</td><td>6-9</td></tr>
<tr><td>Oil & Grease</td><td><10</td></tr>
<tr><td>Total Nitrogen</td><td><10</td></tr>
<tr><td>Total Phosphorus</td><td>0.4 – 5.0</td></tr>
</table>
When further treatment is required to either achieve these levels or to meet special discharge limits, the following techniques are available:
9 remove nitrogen biologically (see Sections 4.5.4.1 and 4.5.4.7)
10 apply precipitation to remove phosphorus (see Section 4.5.2.9), simultaneously with the activated sludge treatment, where applied (see Section 4.5.3 .1.1)
11 use filtration for waste water polishing (see Section 4.5.4.5)
12 remove dangerous and priority hazardous substances (see Section 4.5.4.4)
13 apply membrane filtration (see Section 4.5.4.6).</td>
<td>Applicable – Although the site does not produce waste water from their process they do have a site waste water treatment system for their toilets and sinks (Klargester).</td>
<td>Yes</td>
</tr>
</table>

BAT 41. When the quality of the waste water is suitable for re-use in FDM processing, BAT is to do the following: 14 re-use water after it has been sterilised and disinfected, avoiding the use of active chlorine (see Sections 4.5.4.8, 4.5.4.8.1 and 4.5.4.8.2) and which meets the standard of Council Directive 98/83/EC [66, EC, 1998].	Not Applicable	No
BAT 42. BAT is to treat waste water sludge using one or a combination of the following techniques: 15 stabilisation (see Section 4.5.6.1.2) 16 thickening (see Section 4.5.6.1.3) 17 dewatering (see Section 4.5.6.1.4) 18 drying (see Section 4.5.6.1.5), if natural heat or heat recovered from processes in the installation can be used	Not Applicable – Sludge from Klargester treatment system is removed from site by permitted contractor.	No
	5.1.7 Accidental releases	
BAT 43. In general, to prevent accidents and minimise their harm to the environment as a whole, BAT is to do the following: 1 identify potential sources of incidents/accidental releases that could harm the environment (see Section 4.6.1) 2 assess the probability of the identified potential incidents/accidental releases occurring and their severity if they do occur, i.e. to carry out a risk assessment (see Section 4.6.2) 3 identify those potential incidents/accidental releases for which additional controls are required to prevent them from occurring (see Section 4.6.3) 4 identify and implement the control measures needed to prevent accidents and minimise their harm to the environment (see Section 4.6.4) 5 develop, implement and regularly test an emergency plan (see Section 4.6.5) 6 investigate all accidents and near misses and keep records (see Section 4.6.6)	Applicable – Connolly's Red Mills have a health and safety system in place to identify potential hazards and ensure employee and contractor safety on site.	**Yes**

5.2 Additional BAT for some individual FDM sectors		
5.2.1 Additional BAT for the meat and poultry sector		
BAT 44. In addition to the BAT in Section 5.1- 5.1.7, for meat and poultry processing installations, BAT is to do the following: 1 thaw meat in air (see Section 4.2.2.5) 2 avoid the use of flake ice by using a suitable mixture of chilled and frozen raw materials (see Section 4.7.1.3) 3 dose spices and other solid ingredients from a bulk container rather than from plastic bags (see Section 4.1.7.2) 4 stop the water supply automatically when sausage fillers and similar equipment are not used at breaks or at production stops (see Section 4.1.8.4).	Not Applicable	No

5.2.2 Additional BAT for the fish and shellfish sector		
BAT 45. In addition to the BAT in Section 5.1- 5.1.7, for fish and shellfish processing installations, BAT is to do the following: 1 maintain the quality of fish for optimal use by minimising storage times (see Section 4.1.7.3) 2 use high quality fish by ensuring collaboration with upstream suppliers (see Section 4.7.2.3) 3 operate regular maintenance programmes (see Section 4.1.5) to, e.g. ensure efficient skinning (see Section 4.7.2.3) 4 thaw mackerel, by immersing them in containers filled with water which is mixed by bubbling air through it. The level of the water is maintained by recirculation and using level-actuated switches (see Section 4.2.2.1), achieving a water consumption of <2 m3 /t of raw fish 5 thaw whitefish, by immersing them in containers filled with water which is mixed by bubbling air through it. The level of the water is maintained by using level-actuated switches (see Section 4.2.2.2), achieving a water consumption of 1.8- 2.2 m3 /t of raw fish 6 thaw shrimps and prawns by immersing them in containers filled with filtered peeling water, if available. The water is mixed by bubbling air through it. The level of the water is maintained by recirculation and using level-actuated switches (see Section 4.2.2.1), or by using level-actuated switches (see Section 4.2.2.2) 7 avoid scaling if the fish is subsequently skinned (see Section 4.7.2.7) 8 where scaling is undertaken, i.e. where fish is not subsequently skinned, use filtered recirculated scaling waste water for preliminary fish rinsing and properly adjust the scaler operation by weighing the right amount of scales for a specific water flow (see Section 4.7.2.8) 9 remove and transport skin and fat from the skinning drum using vacuum suction (see Section 4.7.2.4) 10 remove and transport fat and viscera from mackerel by vacuum suction (see Section 4.7.2.5) 11 use fine mesh conveyor belts to transport solid products, by-products and wastes, to enable their separation from water (see Section 4.7.2.6) 12 when filleting: 12.1 remove the frames from fish fillets by two sets of rotating knives (see Section 4.1.8.8)	Not Applicable	No

12.2 where water nozzles or spray cleaning systems are required, install them with presence-activated sensors (i.e. intermittent operation) (see Section 4.1.8.8). 12.3 a 60- 75% reduction in water consumption can be obtained by: 12.3.1 removing unnecessary nozzles so that water is only added where required (see Section 4.1.8.8) 12.3.2 replacing those nozzles that take the fish from the tail cut with a mechanical device (see Section 4.1.8.8) 12.3.3 replacing the nozzles for cleaning the driving wheels on the filleting part with mechanical devices (see Section 4.1.8.8) 12.3.4 replacing existing nozzles by nozzles with a lower water consumption (see Section 4.1.8.8) 12.3.5 using pulsating water nozzles, i.e. alternating the opening and closing of the water supply using an automatic valve (see Section 4.1.8.8) 12.3.6 replacing the waste drain by drain-belts and closing the nozzles in the waste drain. The waste will be separated from the process water directly near the filleting machine, resulting in shorter contact time (see Section 4.7 .2.6) 12.4 reduce both the number and size of spray nozzles (water saving of about 75 %) (see Section 4.1.8.8).		

5.2.3 Additional BAT for the fruit and vegetables sector		
BAT46. In addition to the BAT in Section 5.1- 5.1.7, for fruit and vegetable processing installations, BAT is to do the following: 1 where storage cannot be avoided, minimise storage times (see Section 4.1.7.3), and where weather conditions do not increase the speed of degradation and/or harm the quality, avoid refrigeration by storing fruit and vegetables and their by-products which are intended for use as animal feed, outdoors in a clean covered area or in containers (see Section 4.7.3.3) 2 apply dry separation of rejected raw material from the sorting step and solid residues (e.g. in sorting, trimming, extraction, filtration steps) (see Section 4.1.7.6) 3 collect soil in sedimentation and/or filtration steps instead of washing into the WWTP (see Sections 4.1.7.6, 4.5.2.5 and 4.5.4.5) 4 peel fruit and vegetables using a batch steam process (see Section 4.7.3.4.2) or a continuous steam process (see Section 4.7.3.4.1) not using cold water to condense the steam and, if for technological reasons steam peeling cannot be applied, use dry caustic peeling (see Section 4.7.3.4.6), unless the recipe requirements cannot be met if either ofthese techniques is used 5 after blanching, cool fruit and vegetables before freezing them by passing them through cold water (see Section 4.7.3.6) 6 optimise the re-use of water with or without treatment, depending on the unit operations which require water and the quality of water these require, ensuring that adequate hygiene and food quality standards are maintained (see Section 4.7.3.7).	Not Applicable	No

5.2.4 Additional BAT for the vegetable oils and fats sector		
BAT 47. In addition to the BAT in Section 5.1- 5.1.7, for vegetable oil processing installations, BAT is to do the following: 1 use a countercurrent flow desolventiser-toaster in vegetable oil extraction (see Section 4.7.4.2) 2 in vegetable oil processing, use the vapour generated in the desolventiser-toaster in the first step of the miscella distillation pre-evaporator (see Section 4.7.4.3) 3 use the exothermic reaction heat from the hydrogenation of vegetable oil to heat the product to the desired reaction temperature and to generate steam later in the reaction (see Section 4.7.4.4). The achievable energy (steam) generation is 25-125 kWh/t (90 - 450 MJ/t) (40- 200 kg/t) unrefined oil 4 use water ring pumps to generate an auxiliary vacuum for oil drying, oil degassing or minimising oxidation of oil (see Section 4.7.4.11) 5 recover hexane from condensable vapours from meal desolventising-toasting, miscella distillation and from the stripping column of the mineral oil system, using a hexanewater gravity separator and a reboiler (see Section 4.7.4.6) 6 use a mineral oil scrubber to recover hexane from uncondensable vapours from meal desolventising-toasting, miscella distillation, the reboiler and from the stripping column of the mineral oil system (see Section 4.7.4.5) 7 use cyclones, to reduce wet dust emissions arising from vegetable oil extraction, to achieve a wet dust emission level of <50 mg/Nm3 (see Section 4.7.4.10) 8 refine crude oils by physical refining (see Section 4.7.4.7.2), or if they have an ffa content <2 %, by chemical refining (see Section 4.7.4.7.1) 9 deodorise vegetable oils using a double scrubber in combination with a once through cooling system (see Section 4.7.4.12.1)	Not Applicable	No

5.2.5 Additional BAT for dairies		
BAT48. In addition to the BAT in Sections 5.1- 5.1.7, for dairies, BAT is to do the following: 1 partially homogenise milk (see Section 4.7.5.3) 2 replace batch pasteurisers with continuous ones (see Section 4.7.5.5) 3 use regenerative heat exchange in pasteurisation (see Section 4.7.5.6) 4 reduce the required frequency of cleaning of centrifugal separators by improving the preliminary milk filtration and clarification (see Section 4.7.5.7) 5 use just-in-time "component filling" to avoid losses and minimise water pollution (see Section 4.7.5.12) 6 maximise the recovery of diluted, but otherwise uncontaminated, product from CIP initial rinses, HTST start-up, shut-down and change-over and from the rinsing of other equipment and pipework by online detection of transition points between the product and the water phase (see Section 4.7.5.10). This can be done by, e.g. measuring the volume using flow (see Section 4.1.8.4) or density transmitters; measuring the density using conductivity transmitters (see Section 4.1.8.5.2) and using scattered light turbidity sensors (see Section 4.1.8.5.3) to differentiate water from the product 7 for large dairies with highly branched tubing, use several small CIP systems instead of a centralised CIP system (see Section 4.3.9) 8 re-use cooling water, used cleaning water, condensates from drying and evaporation, permeates generated in membrane separation processes and final rinse water after the treatment, if any required, to ensure the level of hygiene necessary for the re-use application (see Section 4.7 .5.16) 9 achieve the levels given in Table 5.2 (see Section 5.2.5.1), Table 5.3 (see Section 5.2.5.2) and Table 5.4 (see Section 5.2.5.5). These are indicative of the levels that can be achieved by applying in-process BAT. They are based on achieved levels reported by the TWG. The ranges reported reflect a variety of conditions under which installations operate. Energy consumption levels may vary due to, e.g. production volumes. Warm climates may use more energy for cooling and vice versa. Water consumption and waste water emission levels may vary due to, e.g. different product portfolios, batch sizes and cleaning. The waste water emission level may be lower compared to the water consumption level because many dairies measure the intake of cooling water, often from their own wells, but then discharge it unmeasured. In warm climates water may be lost due to evaporation.	Not Applicable	No

<table>
<tr><th colspan="3">5.2.5.1 Additional BAT for the production of market milk</th></tr>
<tr><td>BAT 50.
In addition to the BAT in Sections 5.1- 5.1.7 and 5.2.5, for the production of market milk, BAT is to do the following:
1 achieve the consumption and emission levels shown in Table 5.2 (see Sections 3.3.5.1.1, 3.3.5.1.2, 3.3.5.4 and 5.2.5 paragraph 9)
<table><tr><th>Energy Consumption (kWh/kg)</th><th>Water Consumption (l/kg)</th><th>Waste Water (l/kg)</th></tr><tr><td>0.6 – 2.8</td><td>4.0 – 5.0</td><td>2.7 – 4.0</td></tr></table>Table 5.2 - Consumption and emissions levels associated with the production of market milk from 1 litre of received milk</td><td>Not Applicable</td><td>No</td></tr>
<tr><th colspan="3">5.2.5.2 Additional BAT for milk powder production</th></tr>
<tr><td>BAT 51.
In addition to the BAT in Sections 5.1- 5.1.7 and 5.2.5, for milk powder production, BAT is to do the following:
1 to produce powdered milk use multi-effect evaporators (see Section 4.2.9.1), optimising vapour recompression (see Section 4.2.9.2) related to heat and power availability in the installation, to concentrate liquid milk before spray drying, followed by FBD, e.g. integrated FDB (see Section 4.7.5.8)
2 apply an early warning fire alarm, e.g. CO detector, to reduce the risks of explosion in spray driers (see Section 4.7.5.8).
3 achieve the consumption and emission levels shown in Table 5.3 (see Sections 3.3.5.1.1, 3.3.5.1.2, 3.3.5.4 and 5.2.5 paragraph 9)
<table><tr><th>Energy Consumption (kWh/kg)</th><th>Water Consumption (l/kg)</th><th>Waste Water (l/kg)</th></tr><tr><td>0.6 – 2.8</td><td>4.0 – 5.0</td><td>2.7 – 4.0</td></tr></table>Table 5.3 - Consumption and emissions levels associated with the production of milk powder from 1 litre of received milk</td><td>Not Applicable</td><td>No</td></tr>
<tr><th colspan="3">5.2.5.3 Additional BAT for Butter Making</th></tr>
<tr><td>BAT 52.
In addition to the BAT in Sections 5.1- 5.1.7 and 5.2.5, for butter making, BAT is to do the following:
1 remove residual butter from pipework using a cooled butter block pushed by compressed air (see Section 4.3.4)
2 rinse the cream heater with skimmed milk before cleaning it (see Section 4.7.5.13.1).</td><td>Not Applicable</td><td>No</td></tr>
</table>

<table>
<tr><th colspan="3">5.2.5.4 Additional BAT for cheesemaking</th></tr>
<tr><td>BAT 53.
In addition to the BAT in Sections 5.1- 5.1.7 and 5.2.5, for cheesemaking, BAT is to do the following:
1 use the heat from warm whey for preheating cheese milk (see Section 4.7 .5.14.7)
2 maximise whey recovery and use (see Section 4.7.5.14.4)
3 segregate salt whey (not to be mixed with sweet or acid whey) (see Section 4.7.5.14.4)
4 reduce fat and cheese fines in whey and screen liquid streams to collect fines (see Section 4.7.5.14.2)
5 minimise the occurrence of acid whey and drain the top or platform of the salting vats to avoid brine spillage to the WWTP (see Section 4.7.5.14.3)
6 to produce whey powder use multi-effect evaporators (see Section 4.2.9.1), optimising vapour recompression (see Section 4.2.9.2) related to heat and power availability in the installation, to concentrate whey before spray drying, followed by FBD, e.g. integrated FDB (see Section 4.7.5.8)</td><td>Not Applicable</td><td>No</td></tr>
<tr><th colspan="3">5.2.5.5 Additional BAT for ice-cream manufacturing</th></tr>
<tr><td>BAT 54.
In addition to the BAT in Sections 5.1- 5.1.7 and 5.2.5, for ice-cream manufacturing, BAT is to do the following:
1 achieve the consumption and emission levels shown in Table 5.4 (see Sections 3.3.5.1.1, 3.3.5.1.2, 3.3.5.4 and 5.2.5 paragraph 9)
<table>
<tr><th>Energy Consumption (kWh/kg)</th><th>Water Consumption (l/kg)</th><th>Waste Water (l/kg)</th></tr>
<tr><td>0.6 – 2.8</td><td>4.0 – 5.0</td><td>2.7 – 4.0</td></tr>
</table></td><td>Not Applicable</td><td>No</td></tr>
<tr><th colspan="3">5.2.6 Additional BAT for starch manufacturing</th></tr>
<tr><td>BAT 55.
In addition to the BAT in Sections 5.1- 5.1.7, for the starch sector, BAT is to do the following:
1 optimise the re-use of process water and/or potato fruit juice in the potato starch making process (see Sections 3.3.7.1, 4.1.6, 4.1.7.6 and 4.7.6.1)
2 use gluten process water (in the protein separation step) for germ and fibre washing and steeping processes in maize starch processing (see Section 4.1.7.8)
3 wash starch slurry, using a counter current flow, before it is dewatered and dried (see Section 4.7.6.1)</td><td>Not Applicable</td><td>No</td></tr>
</table>

5.2.7 Additional BAT for the sugar sector		
BAT 56. In addition to the BAT in Sections 5.1- 5.1.7, for the sugar beet sector, BAT is to do the following: 1 recycle transport water (see Section 4.7.7.3) 2 use evaporator condensate for sugar extraction from sugar beets (see Section 4.1.7.8) 3 avoid drying sugar beet pulp if an outlet is available for pressed sugar beet pulp, e.g. animal feed; otherwise dry sugar beet pulp using steam driers (see Section 4.7.7.1.4) or using high temperature driers (see Section 4.7.7.1.2), combined with measures to reduce emissions to air. In HTD possible measures to reduce emissions to air include, e.g. minimising the quantity of small beet particles dried, drying to a maximum dry matter content of 91 %, mechanical pressing of pulp prior to drying, minimising the quantity of added mollases before drying and optimising the operation of cyclones (see Section 4.4.3.5.2) and spray scrubbers (see Section 4.4.3.5.3).	Not Applicable	No
5.2.8 Additional BAT for the coffee sector		
BAT 57. In addition to the BAT in Sections 5.1- 5.1.7, for the coffee sector, BAT is to do the following: 1 when roasting coffee, recirculate air from the roaster back into the roaster (see Section 4.7.8.4.1) 2 when roasting coffee, where process-integrated BAT which minimise air emissions by the selection and use of substances and the application of techniques do not achieve emission levels of 5-20 mg/Nm3 for dry dust; <50 mg/Nm3 TOC for light roasted coffee (this level is more difficult to achieve as the darkness of roasting is increased, see Section 3.2.39.2); to achieve these levels by applying abatement techniques. Some air abatement techniques are described in Sections 4.4 to 4.4.3.12. Emission levels for NOx were provided too late for full verification by the lWG, these are reported in section 7.5 of the Concluding remarks chapter 3 in instant coffee manufacturing, use the waste heat from the hot liquid coffee extract to heat the process water prior to extraction and use countercurrent heatexchange to use the heat from spray drying within the roasting sector (see Section 4.7.8.1) 4 during instant coffee manufacturing, after drying, agglomerate the dust to make granules then recycle the remaining dust and apply air abatement (see Section 4.7.8.2).	Not Applicable	No

5.2.9 Additional BAT for drinks manufacturing		
BAT 58. In addition to the BAT in Sections 5.1- 5.1.7, for drinks processing installations, BAT is to do the following: 1 if C02 is used in the installation, use C02 which is either recovered from the fermentation process or as a by-product of another process, to avoid the production of C02 directly derived from fossil fuels especially for use in the installation (see Section 4.2.4.1) 2 recover yeast after fermentation (see Section 4.7.9.3) 3 where diatomaceous earth is used as a filter, collect the spent filter material to optimise re-use and/or disposal (see Section 4.7.9.4.3) 4 use multistage bottle cleaning systems (see Section 4.7.9.5.2) 5 optimise water consumption of the rinsing zone in the bottle cleaning machine, by controlling the rinsing water flow, installing an automatic valve to interrupt the water supply in case the line stops and using fresh water for the two last rows of rinsing nozzles (see Section 4.7.9.5.4) 6 re-use bottle cleaning overflows after sedimentation and filtration (see Section 4.7.9.5.3).	Not Applicable	No
5.2.9.1 Additional BAT for brewing		
BAT 59. In addition to the BAT in Sections 5.1- 5.1.7 and 5.2.9, for breweries, BAT is to do the following: 1 optimise the re-use of hot water from wort cooling (see Section 4.7.9.6.4) and recover heat from wort boiling (see Section 4.7.9.6.5) 2 re-use bottle pasteurising overflow water (see Section 4.7.9.5.5) 3 achieve a water consumption level of 0.35- 1 m3 /hi of beer produced (see Section 3.3.11.1).	Not Applicable	No
5.2.9.2 Additional BAT for winemaking		
BAT 60. In addition to the BAT in Sections 5.1- 5.1.7 and 5.2.9, for winemaking, BAT is to do the following: 1 after the cold stabilisation of wine, re-use the alkaline cleaning solution (see Section 4.7.9.8.1) and when the spent alkaline solution can no longer be re-used and the pH is still high enough to disrupt the operation of theWWTP, apply selfneutralisation (see Section 4.5.2.4) or if the pH levels and the flowrate will not disrupt the operation of the WWTP, gradually release the cleaning solution to the WWTP (see Section 4. 7 .9.8.2)	Not Applicable	No