Dŵr Cymru Welsh Water

Five Fords WwTW Combined Heat and Power Plant Project

Environmental Permit Application - Supporting Information Document

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Contents

Glossary

BAT	Best Available Techniques'
CH_4	Methane
CHP	Combined Heat and Power
CHPQA	Combined Heat and Power Quality Assurance Scheme
CO_2	Carbon Dioxide
dB(A)	A-weighted decibel (measurement of noise)
DCWW	Dwr Cymru Welsh Water
EA	Environment Agency
EMS	Environmental Management System
EP	Environmental Permit
EP Regulations	Environmental Permitting Regulations
H1	H1 Environmental Risk Assessment Tool
H_2S	Hydrogen Sulphide
Ha	Hectares
MW	Mega Watts
NOx	Nitrogen Oxides (total)
NGR	National Grid Reference
OPRA	Operational Risk Appraisal
QMS	Quality Management System
SAP	DCWW Corporate Maintenance System
SCADA	Supervisory Control and Data Acquisition
SCR	Site Condition Report
SOx	Sulphur Oxides (total)
tDS	tonnes of Dry Solids
WwTW	Wastewater Treatment Works

1 Permit application and site details

1.1 Introduction

Five Fords Wastewater Treatment Works (WwTW) serves a total population equivalent (PE) of the order of 132,000. Wastewater flows are received and treated from Wrexham and the surrounding district. Final treated effluent is discharged to the River Dee.

The sludge treatment facility at the site treats approximately 9000 tonnes dry solids (tDS) sewage sludge per year, produced from the treatment of sewage both at the Five Fords site (indigenous) and imported from other WwTWs in the area.

The WwTW is owned and operated by Dŵr Cymru cyf. trading as Dwr Cymru Welsh Water (DCWW).

The sewage treatment process at the site is being upgraded, to improve the quality of the final effluent to meet new discharge standards. A new sludge treatment facility is also being constructed to provide the capacity to accommodate the additional sludge produced and improve the asset condition.

As part of the sludge treatment facility it is proposed to include a Combined Heat and Power (CHP) plant, to utilise the biogas produced by the Anaerobic Digestion process and to provide renewable heat and electricity for the operation of the site. An allowance has been made for electricity to be fed back to the local electricity distribution network should the opportunity arise, however this is thought unlikely at this stage.

The CHP will have a total thermal input capacity of greater than 3MW and it therefore identified under Schedule 1 Part 2 Section 1.1 Part A(1)b(iii) of the Environmental Permitting Regulations 2010 (the EP Regulations) and will require an Environmental Permit (permit) to operate.

It is recognised that it is proposed to increase the threshold capacity, identified under the EP Regulations, to 5MW in October 2011. However due to the project programme this application is being submitted, to ensure a permit is in place for the process to be commissioned, in the event of a delay to the change of the regulations.

1.2 Report Format

This report has been prepared as a supporting document to the permit application for the CHP Facility.

The document includes responses to all requested supporting information from Application document A, B and F and provides a description of how the facility will meet all relevant conditions and meet Best Available Techniques' (BAT), as described in the guidance documents How to Comply with your Environmental Permit (EPR 1.00)' and 'Combustion Activities (EPR 1.01).

The headings in this report have been formatted in line with two guidance documents.

Typical conditions identify in the guidance documents are included in condition boxes, where relevant, together with condition numbers and reference to their source guidance document.

Indicative BAT standards as set out in the Sector Guidance Note for Combustion Activities 1.01, issued by the Environment Agency (EA), are included in BAT Boxes.

Further Relevant guidance set out in the guidance note is also included.

Responses to typical conditions, BAT and further guidance is given to demonstrate how Five Fords CHP Facility with achieve all of these.

1.3 Applicant and Site Details

The address of Five Fords WwTW CHP Facility is:

Five Fords Waste Water Treatment Works
Cefn Road
Adenbury
Wrexham
LL13 0PA

DCWW will be the permit holder and licensed operator of the Five Fords Facility; they will operate the site.

The centre of the site is located at National Grid Reference SJ3643247916. A site location plan and a detailed site plan are provided in Appendix B of the Site Condition Report (SCR), which is submitted together with this document.

1.4 Non Technical Summary

Installation: This EPR permit application is submitted for a permit to operate a Combined Heat and Power (CHP) plant at Five Fords Treatment Works, Cefn Road, Adenbury, Wrexham, LL13 0PA. The centre of the site is located at National Grid Reference (NGR) SJ3643247916. The Five Fords CHP plant is defined as a 'combustion activity' under Schedule 1, Section 1.1 of the EPR.

Equipment and processes used on site has been shown to meet 'Best Available Techniques' (BAT) standards as set out in relevant reference documents or the Sector Guidance Note for Combustion Activities (EPR 1.01), issued by the Environment Agency.

The installation consists of two CHP engines with a combined thermal input capacity of 2.822MW thermal input capacity (fuel consumption). Biogas will be combusted within the two gas engines that make up the CHP and drive electrical generators. Heat will be recovered for use in the Five Fords WwTW for sewage sludge treatment. Cooling water from the CHP engines will pass through heat exchangers to produce hot water. The CHP will each have the generating capacity of 1.16 MW thermal output and 1.2MW electrical output.

In addition, one dual fuel (biogas and natural gas) stand-by boiler, with a maximum thermal input capacity of 1.5MW, is available to produce hot water if required, for example during CHP maintenance.

Efficiency: The electrical efficiency of the CHPs will be up to 42.5% of the energy liberated through the combustion of the biogas at full load and together with heat energy the overall efficiency will be up to 85%. This represents a high efficiency rate, typical for new CHP engines, and therefore represents BAT. The CHPs have been sized in relation to the biogas available for combustion and to maximise electrical output and match the thermal requirements of the WwTW, therefore maximising the overall efficiency.

Storage: The biogas to the CHP engines is expected to be composed of 55 to 65% methane (CH4) and 35 to 45% Carbon Dioxide (CO_2). It will be stored in a 1350m³ dual membrane gas storage bag, with continual gas detection linked to the site monitoring system, to identify if any leak occurs. Gas quality (CH4 and H2S concentration) is monitored at the feed to the CHP to ensure optimum CHP operation. Gas flow rate to the CHPs, hot water boiler and waste gas burner is also measured and recorded. In the event of a failure of any systems associated with the gas storage and supply system the gas feed to the CHP will have an auto shutoff valve which is linked to any failure of equipment within the CHP system.

Emissions: NOx emissions from the combustion process will be minimised through the design of the CHP engine, optimisation of the combustion process and through regular maintenance to ensure the engine is tuned correctly.

SOx emissions will be minimised through the use of low sulphur fuel and be controlled by the use of new CHP technology with a robust service plan in place to ensure the optimised operation of the plant. Levels of H2S in the digester gas are expected to be less than 1500ppm. Control of other emissions will be achieved by regular maintenance and monitoring of the combustion process.

The level of H2S passing forward to the CHP engines is expected to be <1500ppm; the engines will be inhibited if the level of H2S exceeds 1500ppm.

Volatile Methyl Siloxanes (siloxane) in the biogas are captured by the siloxane removal plant to prevent damage to the CHP engines. On regeneration of the absorbent media a small portion of the siloxane may be vented to air. The majority is condensed and returned to the WwTW. The level of emission will depend on the quantity of siloxane removed from the biogas, measured at 206mg/m^3 at a similar site. There are no emission limits for siloxane.

There will be no direct discharges of wastewater either to the public sewer or to controlled water. Any liquid stream from the installation will either be reused or discharged to the internal drains of the adjacent WwTW. All WwTW drainage goes to treatment in the WwTW prior to discharge to the River Dee.

The installation will pose negligible risk of odorous releases, and there will be no significant releases of biogas, under normal operating circumstances. The only potential for odour is from the release of biogas. However, adequate containment measures and procedures are in place to prevent any possible releases.

The installation will not cause any noise nuisance. All equipment is designed to achieve at the most 75 dB(A) at 1m distance. Where necessary equipment is enclosed in acoustic chambers and there are no receptors within close proximity of the installation boundary.

Monitoring: Monitoring of emission from all combustion activities will be undertaken on an annual basis to confirm that actual levels in the exhaust gasses are in line with those identified. Continual monitoring of the gas feed to the CHP will be undertaken together with monitoring of electrical output and heat output. Comparison of gas flows and electrical and heat output will be used to confirm the process efficiency.

Management: The Five Fords CHP installation will be run in accordance with the DCWW Quality Management System (QMS). The QMS sets out the policies and procedures in place to cover operation, maintenance and monitoring of the Five Fords CHP Facility.

DCWW have an Environmental Management System (EMS) that is registered to ISO 14001 for waste water operational sites. There is an ongoing programme to develop the EMS further within the business. Five Fords forms part of the scope of the EMS. The management system will apply to all DCWW operations and will be co-ordinated with the DCWW QMS in relation to the management and operation of the Five Fords site.

2 Management of Activities

1.1.1 How to Comply with your Environmental Permit (EPR 1.00). **Part 1 and 2**
Typically, condition 1.1.1 on the permit The operator shall manage and operate the activities: (a) in accordance with a written management system that identifies and minimises risks of pollution, including those arising from operations, maintenance, accidents, incidents, non-conformances, closure and those drawn to the attention of the operator as a result of complaints; and (b) using sufficient competent persons and resources.

2.1 Organisation

DCWW have an EMS Policy, issued in April 2011, see Appendix A2.

In line with the EMS Policy the Five Fords CHP installation will be run in accordance with the DCWW Quality Management System (QMS) and Environmental Management System (EMS).

DCWW have established and maintained documentation that defines and describes how the Quality Management System is established, implemented and maintained in accordance with ISO 9001:2008 and ISO/IEC 17025:2005 and MCERTS Standards. The system is structured on the organisation's strategic business areas, business processes and customer requirements.

DCWW has also established and maintained documentation that defines and describes how the Environmental Management System is established, implemented and maintained in accordance with ISO 14001:2004 for waste water operational sites. The management system applies to all DCWW operations. The EMS is not integrated with the QMS at present. However, certain system procedures and operation procedures are shared by both systems. The QMS sets out the policies and procedures in place to cover operation, maintenance and monitoring applicable to the Five Fords CHP Facility.

Demonstrable procedures are outlined in the DCWW Environmental Policy April 2011 and the Site Operating Manual and Quality Management System.

An overall review of the Quality System takes place every 12 months, and on other occasions as required, by Senior Management. There is a regular programme of audits covering all aspects of the QMS and EMS; they are included on the Internal Audit Programme operated by the Business Assurance (BA) Team and audited by the Environment Agency on a frequent basis. In addition, the EMS and QMS are subject to audit by the inspection and certification company SGS (for accreditation purposes) every 6 months.

DCWW produces an annual report on environmental performance and where required attend local action group meetings.

2.2 Operation and Maintenance

Documented procedures for the operation and maintenance of all plant in the installation are included in WO(3) series procedures of the QMS. Operational managers have overall responsibility for each requirement within these areas.

Documented procedures for maintenance of the CHP units and for the monitoring of emissions or impacts relevant to the site are included in the EMS under SP(2) 06 and EN(3) 01 series procedures. The EQMS Advisor is the procedure owner and is responsible for carrying out and developing environmental management programmes to manage any significant impacts.

A Planned Preventative Maintenance Programme (PPM) is in place and routine maintenance is undertaken in accordance with the QMS and EMS procedures to ensure that the integrity of bunds, pipe work and retaining walls are sufficient to prevent and control pollution. Planned maintenance is prioritised using DCWW Corporate Maintenance System (SAP) based on the risk associated with operating all plant items, including major non productive items, such as storage vessels. The maintenance schedule is based on the suppliers recommendations for maintenance procedures and frequency. Through regular maintenance the operation and performance of all plant items is optimised. The DCWW SAP system ensures that when maintenance is due on a particular item of plant the operation team on site receive an electronic job card detailing the maintenance required. Visual inspections and daily checks are also carried out on a daily basis and captured on site forms. A record of all maintenance and checks are confirmed in SAP.

Biogas, electrical production and useable heat are all measured and collected so that Welsh Water comply with their obligations for ROCs (Renewable Obligation Certificates). It is the intention of the scheme to be fully registered with the Combined Heat and Power Quality Assurance Scheme (CHPQA), and to claim ROCs. To carry this out biogas, electrical production and useable heat (mass balance) will be measured and collated as part of the site Supervisory Control and Data Acquisition (SCADA) system.

The quantity and quality of gas flow to the waste gas burner is monitored. Biogas use and energy production are reported to enable engine optimisation. This represents BAT.

The results of all monitoring undertaken within the installation and within the wider WwTW are reviewed regularly as part of the CHPQA. Maintenance priorities are assessed in light of risk to the environment from failure or substandard performance of equipment.

Final effluent quality discharged from the WwTW has been monitored by DCWW since January 2010 in accordance with the Operator Self Monitoring (OSM) procedures specified by the EA. OSM as detailed in SM (3) 01 procedures will be used to monitor the CHPs when they are brought online. All non-compliances are acted upon and actions reviewed at regular compliance meetings as part of DCWW OPNOT procedures as described in WO(3) 16 series procedures. The site manual and training requirements will be updated to include requirements of the CHP EPR permit.

2.3 Accidents/incidents/non-conformance

An Accident Management Plan forms part of DCWW QMS. An accident risk assessment has been carried out for the installation as part of H1 and all risks identified by this assessment have been incorporated into the QMS.

An accident risk assessment has been undertaken, in line with the H1 annex c methodology. In addition to the risks identified in the risk assessment, Table 1 below identifies risk management techniques included in the QMS and EMS.

Table 1: Specific Procedures/Techniques in place to reduce risks

Typical relevant techniques that should be in place	Method employed at the installation
Up to date inventory of substances, present or likely to be present which could have environmental consequence if they escape.	Refer to Section 7.1 on raw materials. A register of product specifications and COSHH datasheets will be kept on site.
Procedures should be in place for checking and handling raw materials and wastes to ensure compatibility with other substances if they accidentally come into contact.	See Section 7.1 raw materials.
Storage arrangements for raw materials, products and wastes should be designed and operated to minimise environmental risks.	All storage areas are adequately bunded and wastes contained appropriately. Refer to Section 7.1 on raw materials.
Automatic process controls backed up by manual supervision.	The plant will be fully automated but will also be manned as a backup. Any alarms will be picked up by a control centre.
Physical protection should be in place where appropriate (e.g barriers protecting from moving vehicles).	Crash barriers or road side bollards will be used to protect against moving vehicle accidents.
Appropriate secondary containment in place.	All raw materials are within appropriate secondary containment or bunded, see Section 4.2.
Techniques should be in place to prevent from overfilling of tanks.	All tanks on site have level gauges visible from the fill points.
Techniques should be in place to minimise the risk of flooding.	See note below table.
Security systems in place to prevent unauthorised access.	The site is located within the Five Fords WwTW, which is fenced to prevent entrance by intruders.
A formal system in place for logging and recording all incidents, near misses, abnormal events, changes to procedures and significant findings of maintenance inspections	See Section 2.4.
Procedures for responding to and learning from incidents and near misses etc.	

Typical relevant techniques that should be in place	Method employed at the installation
Roles and responsibilities of personnel involved in accident management should be specified.	
Clear guidance should be available on how each accident scenario might best be managed (extinguishing fires etc.)	
Procedures in place to avoid incidents occurring as a result of poor communication between staff at shift change, during maintenance or engineering works.	
Safe shut down procedures should be in place.	
Communication channels with emergency services or relevant authorities should be established, and available for use in the event of an accident.	Emergency services are aware of the site in case of an incident.
Appropriate control techniques should be in place to limit the consequences of an accident (isolation of drains, provision of oil spillage equipment etc)	All site drainage is re-routed to the adjacent WwTW. Spill kits are available and staff are trained to use them under DCWW QM(1) 01.
Personnel training requirements should be identified and training provided.	DCWW Quality Manual QM(1) 01 Section 2.3.
Alarms and backup systems in place to prevent fugitive emissions for drainage systems.	See Section 3.1.
Duplicate or stand-by plant should be provided where necessary.	The standby boiler will be used when necessary to provide the WwTW plant with heat.
Spill contingency procedures in place to minimise accidental releases of raw materials.	DCWW Quality Manual QM(1) 01 and Section 4.2.
Process waters, chemically contaminated waters and spillages etc should be contained and treated before emission to sewer or controlled water.	See Section 4.2.

Procedures for managing accidents or near misses are covered under the Quality Management System QM(1) 01 and EN(1) 01.The EQMS and Operational Managers review likely environmental impacts of operation under normal and abnormal circumstances on a site by site basis and inform staff members on how to reduce negative effects. Incidents are reported to senior management and to the Dŵr Cymru Board via a monthly management report. Near misses are dealt with at the regular performance reviews and outcomes reported to senior managers in Dŵr Cymru.

Staff are adequately trained in aspects that could lead to pollution through environmental awareness training by the EQMS included in the cooperate induction to DCWW. DCWW have a dedicated learner and development department that identifies key competencies required for each area of the business and employees get a personal development plan to identify any gaps in knowledge, for which training is provided.

The existing procedures for investigating and reporting non compliance and near misses are covered in both the Site Operating Manual and the QMS which will be been updated to cover the requirements of the EPR permit. A Compliance Support Group (CSG) has been established in order to proactively improve DCWW asset compliance; any underperforming or non-compliant waste water assets are monitored by a CSG officer and if sample results are in excess of consent levels or warning levels on the Critical Parameter Board the Process Technician is notified. All non-compliances are acted upon and actions reviewed at regular compliance meetings; details of how compliance is achieved and reported are in CS (3) 01 procedures. The Site Operating Manual holds specific emergency procedures relevant to the site; an overview of Emergency procedures is detailed in procedure EN(3) 03. Site emergency procedures are periodically tested where appropriate and records of these tests maintained at local level.

Written procedures for handling, investigating, communicating and reporting actual or potential non-compliance are embedded in the EMS and QMS. DCWW has established a Compliance Support Group (CSG) to help proactively improve compliance and maintain a watching brief over all under-performing assets. This would be implemented in the case of any pollution events or convictions, and the procedure CS (3) 01 would be followed to assist in delivering and maintaining 100% compliance on all waste water assets.

This operation is not subject to the Control of Major Hazard Regulations 1999 (COMAH); the biogas storage tank has a capacity well under the threshold for applicability for COMAH.

No areas of the existing WwTW or proposed site for the anaerobic digestion facility lie within any Flood Zones as defined by the Environment Agency.

2.4 Complaints

All written complaints are covered by the Quality Manual QM(1) 01 and handled according to procedures (DG7 Process Reports). The implementation of the complaints procedure is detailed in CC(3) series procedures. Compliance with these procedures is part of the overall assessment of Dŵr Cymru's performance by OFWAT and there are penalties for poor performance. Telephone complaints are logged onto the DCWW SAP system and actions recorded by the DCWW operation and control centre (Linea). All complaints are analysed for root cause in order to prevent recurrence of the problem and assist with continuous improvement processes.

Complaints about pollution are dealt with the NO(03) 3 series procedures, and there are different procedures according to who reports the pollution. Pollutions may be reported via a number of routes including: general public, local authority, internally, contractor or formally via the Environment Agency. All pollution incident calls or emails are input into DCWWs online control system (SAP) by a Pollution Incident Advisor (PIA). This is then sent to the Waste Water Scheduling Team who allocates a Network Crew or contractor to respond to the incident; they have 4 hours to respond. After attending the incident the operational crew provide feedback via SAP; the pollution incident details along with remedial actions taken or required are also verbally communicated to the Responsible Officer (RO). The SAP incident remains open until all follow-up work has been completed.

Following each incident, the relevant Pollution technician/Environmental Performance Officer reviews the findings and investigates details of the incident. If the root cause of the incident is identified the appropriate remedial action is undertaken and the job is closed on SAP. If the root cause is not obvious, an enhanced investigation is instigated and the findings reviewed for appropriate remedial action. Every category 1 and 2 pollution incident is formally reviewed by the Head of Wastewater (Network).

2.5 Site Security

There are site security measures in place to prevent unauthorised access which will include permanent fencing around the perimeter of the site and separate fencing around the CHP engines. CCTV linked to the DCWW operational control room will also be installed. Gates are closed and locked after normal operating hours and clear warning signs are posted at the entrance to the site.

2.6 Sufficient competent persons and resources

How to Comply with your Environmental Permit (EPR 1.00). **Part 2**
Typically, condition 1.1.4 on the permit The operator shall comply with the requirements of an approved competence scheme.

Competence and training of operations is covered under the QMS WO (3) series procedures. Operational Managers have overall responsibility for each requirement within these procedures. Staff training includes awareness of the environmental consequences arising from both normal and abnormal circumstances.

DCWW also have a dedicated learner and development department, who identify key competencies required for each area of business. This is described in HR(3) 02 series procedures of the DCWW Management system. They hold 6 monthly performance appraisals for every employee, and build a personal development plan to identify any gaps in knowledge, for which training is provided. All employees given environmental awareness training; it is included in the corporate induction and by the EQMS advisor. Training records are kept centrally by the DCWW Training Coordinator and competence assessed by line mangers in individual performance reviews. HR (3) series procedures cover how technical ability is assessed, maintained and developed, with the responsibility for this lying with the L&D department.

Imtech will be providing formal operator training from each of the major equipment & package plant suppliers and subcontractors as well as general training based on operating the entire works. The full training plan for the CHP facility will be developed by Imtech's commissioning team and engineers, with the responsibility lying with the commissioning and handover manager. The operators will be closely involved and encouraged to participate in the commissioning with the Imtech engineers to ensure the training is more than just a classroom exercise and so that they gain hands on experience of running the plant during the commissioning phase.

2.7 Records

1.1.2 How to Comply with your Environmental Permit (EPR 1.00). **Part 1 and 2**
Typically, condition 1.1.2 on the permit Records demonstrating compliance with condition 1.1.1 shall be maintained

Records are maintained for in line with the Quality Manual QM(1) 01 Section 12.

Records are maintained to demonstrate conformance to specified requirements and the effective operation of the Quality System. All records are stored and retained digitally in such a way as to ensure that they are easily retrievable on a central computer system and prevented from loss or damage.

2.8 Access to the Permit

How to Comply with your Environmental Permit (EPR 1.00). **Part 1 and 2**
Typically, condition 1.1.3 on the permit Any person having duties that are or may be affected by the matters set out in this permit shall have convenient access to a copy of it kept at or near the place where those duties are carried out.

A copy of the environmental permit, together with a copy of the application documents will be kept at the site and accessible to all operating staff. Full details of permit conditions are contained in the operating manual held on site and displayed on the site Critical Parameter Board.

3 Operations

3.1 Permitting activities

2.1.0 How to Comply with your Environmental Permit (EPR 1.00)
Typically, condition 2.1 on the permit The operator is only authorised to carry out the activities specified in Schedule 1 table S1.1 (the "activities").

Process Description and In Process Controls

The Five Fords CHP plant is defined as being a 'Combustion Activity' under Schedule 1 of the EPR, specifically in Section 1.1 and is therefore identified as a regulated facility.

The facility consists of:

- 2 Combined Heat and Power (CHP) engines with a combined thermal input capacity of 2.822MW;
- Low Temperature Hot Water (LTHW) circuit taking heat from the CHPs and HWB to the sludge / water heat exchanger;
- Siloxane Removal Plant capable of removing siloxanes from the biogas;
- Biogas storage and supply system;
- Condensate and blow down drainage systems; and
- 1 dual fuel hot water boiler with a thermal input capacity of 1.5MW;
- Low level gas burner for gas system integrity protection.

The location of the main plant items are identified in Appendix A3: Installation Boundary in the SCR and a Process Flow Diagram is provided as Appendix B1 in this Supporting Information document.

CHP Engines

The CHP comprises two units each containing a spark ignition engine supplied by Edina UK Ltd, Model TCG2016. Each gas engine is linked to a LV TPN (Triple Pole Neutral) 400V alternator which converts the mechanical energy of the engines into electricity.

Each unit has a thermal input capacity of 1.411MW, an electrical generating capacity of 0.6MW each and a thermal generating capacity of 0.58MW.

UK guidance describes spark ignition engines as achieving electrical efficiencies of around 40%; the CHP units proposed are reported to achieve 42.5% efficiency and are therefore considered indicative of BAT.

Each CHP unit is contained within its own acoustic enclosure which also acts as a bund in the event of any spillage of liquids.

Low Temperature Hot Water (LTHW) Circuit

Low grade heat will be recovered from the engine jacket cooling water primary loop (within the CHP containers) of each unit and fed into a secondary loop linked to the LTHW circuit via a plate heat exchanger. The secondary loop will typically operate between 60°C into the heat exchanger and 80°C return to the LTHW circuit. Two pumps, operated on a duty/standby basis, circulate the water in the main LTHW circuit, with additional duty/stand-by pumps used on the secondary loops to the CHP and Standby Hot Water Boiler.

The LTHW circuit is a closed pressurised loop. The CHP primary circuits are filled prior to commissioning with less than 200 litres of glycol, used for anti corrosion. These circuits are contained within the acoustic enclosure of the CHPs. The water in the secondary loop will be dosed with corrosion inhibitors to reduce the corrosion within the LTHW circuit. Corrosion protection will maintain high efficiency of the plant and prolongs life. A pressurisation unit on LTHW circuit will provide the system operating pressure and accommodates the increase in volume of water during system heat up. There are also air release vents fitted at high points and pressure relief valves that drain to a low level. All liquids drained from the LTHW circuit are captured in the site drainage system, and returned via the site drainage to the WwTW inlet for treatment within the onsite treatment process.

The temperature of the return flow will vary according to the heat demand. If no heat load is required, then the return temperature will be equal to the inflow temperature to the CHP. The primary circuit within the CHP units will then transfer flow to the dry air coolers. This allows the CHP engines to run at full load without overheating. The load cannot be reduced as the engines need to burn the biogas and maximise the generation of renewable electricity. As the thermal energy demand rises, the flow to the dry air coolers will stop and all heat will be diverted into the primary circuit heat exchanger linked to the LTHW loop.

If the pressure within the primary circuit drops due to leaks from valves, pump seals, air vents etc. then the pressure is automatically topped up with water through the duty / standby pressurisation unit from the water treatment unit tank. Any leaks from the system will be identified by loss of operating pressure alarmed through the SCADA (Supervisory Control and Data Acquisition) and visual identification during operator checks. Flow monitoring of the makeup water into the circuit will also indicate loss of LTHW from the system and if leaks are significant the SCADA system will also alarm due to loss of heating.

If a CHP unit is not operational (down for maintenance) then the dual fuel HWB will automatically start via the site Programmable Logic Controller (PLC) system to increase the temperature of the water to the heat exchangers to approximately 70°C.

Cooling/Surplus heat

In the event of surplus heat being produced by the CHP engines it is sent to heat dump radiators which use a series of electric fans to cool the water to the required level for the safe operation of the CHP engines.

Efficiency and Availability

CHP technology is a highly efficient means of generating electrical and heat energy compared with other fuel combustion techniques. The CHP units will have high energy efficiencies. The electrical efficiency of the system (engine and alternator) will be up to 42.5% of the energy liberated through the combustion of the biogas at full load and up to 85% overall efficiency. These efficiency levels represent the higher levels achievable by new CHP engines and therefore represent BAT.

The maintenance program for the CHP aims to result in 90% availability.

The CHP is sized to make maximum best use of the electrical and heat output with minimal heat wastage.

Biogas Storage and Supply System

Biogas generated by the digesters associated with the WwTW is stored in a dual membrane gas storage bag with a volume of 1350m³, equivalent to 3 hours of production with the CHPs running at 100% at estimated rates.

There is a common feed pipe from each of the two digesters into the gas holder. There is also a single pipeline to the CHP units and to the standby hot water boiler, via the siloxane removal plant, and a single line out to the waste gas burner. The gas holder can be by-passed to feed directly to the waste gas burner as an abnormal operation.

The storage bag acts as a buffer for variations in gas flow from the digesters. The gas is fed to the CHPs by one gas booster compressor per CHP, operating as duty/standby to ensure constant and optimised combustion.

The pressure in the gas holder is controlled by the inflation pressure of the outer bag, which is inflated with duty/stand-by blowers and back pressured with a regulating system. The level of gas in the gas holder is measured with an ultra-sonic level detector. If the level of the inner membrane increases too high then gas is burned off in the waste gas burner. In the event the waste gas burner is not available there is a single pressure relief valve (simple head of water pressure relief device) on the gas holder. This is an emergency failure valve which should not normally operate as the waste gas burner should operate to reduce the pressure and duty / standby pressure / vacuum relief valves at the digesters will be set to operate before this valve.

The gasholder has an ultrasonic level detector to monitor the level of gas in the inner membrane. This level detector is used to control the start and stop of the CHPs, hot water boiler and waste gas burner. At a low limit, the CHPs and waste gas burner are off, as the gas level builds up the CHPs will be started one at a time. Only once the level has increased to a high limit will the gas burner be operated.

There is a methane gas detector fitted between the two membranes of the gas holder, this will detect any leaks in the system. The leaks will alarm on the site SCADA system.

The biogas to the CHP plant will consist approximately 55 to 65% CH_4 and 35 to 45% CO_2 with less than 1500ppm H_2S per 10kWh produced by the engine. This is based on lab scale trials and analysis.

Gas quality (Methane and H2S concentration) is measured and recorded at the feed to the CHP to ensure optimum CHP operation. Gas flow rate to the CHPs, hot water boiler and waste gas burner is also measured and recorded.

Hydrogen sulphide can cause corrosion of the CHP engines and the hot water boiler. The engines are inhibited if the level of H2S exceeds 1500ppm/10kWh; however this is expected to be less than 1500ppm.

In the event of a failure of any systems associated with the gas storage and supply system the gas feed to the CHP will have an auto slam shutoff valve which is linked to any failure of equipment within the CHP system.

Condensate Handling System

Biogas from the anaerobic digestion process is usually saturated with water vapour and may contain low levels of hydrogen sulphide. The water vapour is removed in the condensate traps on each of the gas lines into and out of the gas storage bag. From here it drains to site liquor return pumping station.

The trap is regularly checked by the site operative and the condensate is drained manually out to the site foul drainage system (see Appendix A3 and A5 of the SCR for locations of the aqueous emission point and drainage layout) where it is returned to the WwTW for treatment. The condensate pots work on a level system with a water level maintained in the pot and overflow as well a manual drain.

Siloxane Removal Plant

Biogas passes through a BioGas Autokleen (BGAK) siloxane removal filter to remove siloxanes prior to combustion in the CHP engines and the boiler.

The system facilitates adsorption onto the filter media of Volatile Methyl Siloxanes compounds (siloxanes) and other VOCs of similar molecular weight.

The filter unit comprises two units operating on a duty standby basis, alternating every 24 hours. During the standby period the filter media is regenerated over 4 hours, by heating using electricity from the CHP. When regeneration takes place the VOCs captured on the filter are passed into the regeneration air stream and are condensed in a prescribed length of cooling pipework. In liquid form they account for around 2 litres a day which is passed into the site drainage system.

The remaining air passes to a Vent Air Stack and subsequently to atmosphere. The compounds generally have a lower vapour pressure than other VOCs and some can remain in vapour form and pass to the atmosphere with the regeneration air.

When combusted in boilers or internal combustion engines siloxanes produce silicon dioxide (silica) particles which are deposited in the combustion chambers. These deposits are abrasive and thus very damaging to the CHP engines. Removal of siloxanes from the biogas helps prolong the life span and reduce the maintenance requirements of both the CHPs and hot water boiler and protects the engine oil from siloxane build up. The media has a design life of 5 years and will be disposed of in accordance with the site waste management plan.

Standby Dual Fuel Hot Water Boiler

A standby dual fuel burner is available to provide supplementary heating to the hot water circuit when required. When both CHP engines are available the hot water boiler would not be required except during particularly cold periods. The boiler has a thermal input capacity of 1.5MW.

If biogas is available then the boiler will use this as the fuel source. If biogas is unavailable then the boiler will use standard rate natural gas as the fuel source.

Waste Gas Burner

There is one low level gas flare unit installed, capable of burning biogas at a rate of 2000Nm3/hr. The low level gas burner unit comprises a nozzles contained within a stainless steel flame tube. The combined burner maximum flow rate capacity is 2000 Nm3/hr. Typically all mild steel surfaces will be zinc sprayed and/or galvanised. All valves will be fitted with nitrile rubber seals. The gas burner location is shown in Appendix A3 of the SCR.

4 Emissions and Monitoring

4.1 Point source emissions to air, water and land

3.1.1 How to Comply with your Environmental Permit (EPR 1.00) **Part 1 and Part 2**
Typically, condition 3.1.1 on the permit There shall be no point source emissions to air, water or land, except from the sources and emission points listed in Schedule x. The limits given in Schedule x, tables y.y, and z.z. shall not be exceeded.

This section identifies all point source emission points. It also outlines the activities and measures undertaken within the installation to control point source emissions to air, water and ground where necessary to the levels indicative of BAT or better. See SCR Appendix A1 Site Location and Appendix A3 Installation Boundary, for the site location and location of all emission points.

4.1.1 Point Source Emission to Air

Emission points

The emissions to air release points are identified in Table 2 below. The inventory of emissions is included in the H1 Assessment. An Air Quality Assessment has been completed and is included in Appendix B3 of this report. The model files have not been included due to their size, but are available on request.

Table 2 Emissions to Air Release Points

Release Point	**Location**	**Source**	**Stack height (m)**	**Efflux velocity (m/s)**	**Grid Reference**
A1	CHP stack (1)	CHP	17	9.97	336404, 347892
A2	CHP stack (2)	CHP	17	9.97	336404, 347892
A3	Boiler stack	Boiler	17	5.91	336404, 347892
A4	Siloxane Removal Unit	Siloxane Removal Unit	5	1.16	336409, 347903
A5	Waste Gas Burner	Flare	7.5	0.32	336404, 347892

Emissions to Air – Combustion of Biogas

Emissions to air will arise from the combustion of biogas in the CHP, the boiler, the waste gas burner and also during media regeneration at the siloxane removal plant.

The worst case emission scenarios is one CHP operating at 100% and the boiler operating on biogas at 100%. This is the scenario modelled in the H1. This scenario is based on the following justification, which has been tested to confirm it resulting in the highest hourly average emission rates.

Biogas will not be combusted in all processes at the same time. The rate of biogas production from the WwTW digesters is approximately 75% of the maximum combined capacity of the CHP engines. However due to the variable energy demand by the WwTW, CHP operation will vary so that 100% capacity is used during periods of maximum energy demand by the WwTW, therefore optimising the energy efficiency of the process.

During CHP maintenance only one engine will be off line at any one time. During these periods the boiler will burn biogas to provide the additional heat demand. Under these conditions boiler will be operated at 100% capacity, as operating on biogas at less than 100% capacity would result in condensation, which would lead to corrosion of the boiler.

Both of the above scenarios require greater than 100% of the gas produced by the digesters, so would occur during periods of high energy demand. During periods of lower energy demand biogas use will be reduced and the gas stored in the gas storage bag for use during the peak hours.

The waste gas burner would only be used for short periods if required, for example if gas production peaks occur that are greater than the volume the storage bag can accommodate. However, its use would not be planned and is therefore considered an unusual operation scenario.

Emissions to Air – Siloxane Removal Plant

Regeneration of the filter media occurs on one of the filter units per day, over a period of four hours. During this period the siloxane and VOC compounds are released from the media and are vented via the stack to atmosphere.

The levels of siloxane and VOC emission will be dependent on the makeup of the volatile components of the raw biogas (siloxanes are a volatile methyl siloxane (VMS), rather than categorised as a VOC). Because there are no digesters currently operating at Five Fords there is no data for siloxane and other VOC levels in the biogas available.

The emission scenarios modelled in the H1 use surrogate emissions data from the the Budds Farm WwTW plant for siloxane, measured as total organo-silicon Compounds as SI, see Appendix B2.

The siloxane removal equipment installed at Budds Farm WwTW and currently being manufactured for Five Fords WwTW are the same model (BGAK 1200). They have similar capacities (a function of gas flow and contamination levels), and the regeneration flow rates will be the same.

At Budds Farm the average biogas flow was 850m3/hr and the siloxane level 75 mg/m3, compared to 540 m3/hr and 96 mg/m3 for the Five Fords plant. The Budds Farm data is therefore been considered to represent a suitable surrogate set of data for to be used for the Five Fords application.

The level of VOCs in the emission cannot be estimated in the same way, as these have not been characterised from Five Fords. However based on the data from Budds Farm these are considered to be negligible, see Appendix B2.

Regarding the effect on the environment from siloxanes the Environment Agency document 'using science to create a better place; Environmental Risk Assessment Report: Decamethylcyclopentasiloxane[1] executive summary states "The overall conclusions of the quantitative risk assessment are: No risks are identified to the air, water, and the terrestrial compartments, nor to humans exposed via the environment from the production and all uses of D5 [Siloxane]".

In addition documents from Dow Corning[2] and from PpTek[3] summarising the effects of siloxanes on the environment indicate that effects are limited, as shown in Appendix B2.

Emission Concentrations

The table below includes the total yearly emission of pollutant parameters from each emission point based on operating times shown. Emission point locations are shown on the Installation Boundary in Appendix A3 of the Site Condition Report.

Table 3 Point-source emissions to air

Emission point reference and location	**Source**	**Parameter**	**Amount**	**Unit**
CHP1 operating at 85%				
CHP stack (A1)	Combustion of biogas in CHP	Methane	0.08	Tonnes/year
CHP stack (A1)	Combustion of biogas in CHP	Carbon dioxide	3,152.14	Tonnes/year
CHP stack (A1)	Combustion of biogas in CHP	Sulphur dioxide	5.99	Tonnes/year
CHP stack (A1)	Combustion of biogas in CHP	Nitrogen	16,872.11	Tonnes/year
CHP stack (A1)	Combustion of biogas in CHP	Carbon monoxide	0.62	Tonnes/year
CHP stack (A1)	Combustion of biogas in CHP	Oxygen	2,155.13	Tonnes/year
CHP stack (A1)	Combustion of biogas in CHP	Moisture (H2O)	1,700.62	Tonnes/year
CHP stack (A1)	Combustion of biogas in CHP	Argon	288.18	Tonnes/year
CHP stack (A1)	Combustion of biogas in CHP	NOx	6.60	Tonnes/year
CHP2 operating at 85%				
CHP stack (A2)	Combustion of biogas in CHP	Methane	0.08	Tonnes/year

[1] Environment Agency. *Using science to create a better place; Environmental Risk Assessment Report: Decamethylcyclopentasiloxane.* Report SCHO0309BPQX-E-P. April 2009
[2] Dow Corning. *An Overview of Volatile Methylsiloxane (VMS)* Fluids in the Environment.* Report 01-1033B-01. 1997
[3] PpTek. *Volatile Methyl Siloxanes (VMS).*

CHP stack (A2)	Combustion of biogas in CHP	Carbon dioxide	3,152.14	Tonnes/year
CHP stack (A2)	Combustion of biogas in CHP	Sulphur dioxide	5.99	Tonnes/year
CHP stack (A2)	Combustion of biogas in CHP	Nitrogen	16,872.11	Tonnes/year
CHP stack (A2)	Combustion of biogas in CHP	Carbon monoxide	0.62	Tonnes/year
CHP stack (A2)	Combustion of biogas in CHP	Oxygen	2,155.13	Tonnes/year
CHP stack (A2)	Combustion of biogas in CHP	Moisture (H2O)	1,700.62	Tonnes/year
CHP stack (A2)	Combustion of biogas in CHP	Argon	288.18	Tonnes/year
CHP stack (A2)	Combustion of biogas in CHP	NOx	6.60	Tonnes/year
Boiler operating at 15%				
Boiler stack (A3)	Combustion of biogas in boiler	Methane	0.01	Tonnes/year
Boiler stack (A3)	Combustion of biogas in boiler	Carbon dioxide	620.77	Tonnes/year
Boiler stack (A3)	Combustion of biogas in boiler	Sulphur dioxide	1.18	Tonnes/year
Boiler stack (A3)	Combustion of biogas in boiler	Nitrogen	3,118.24	Tonnes/year
Boiler stack (A3)	Combustion of biogas in boiler	Carbon monoxide	0.12	Tonnes/year
Boiler stack (A3)	Combustion of biogas in boiler	Oxygen	361.66	Tonnes/year
Boiler stack (A3)	Combustion of biogas in boiler	Moisture (H20)	334.91	Tonnes/year
Boiler stack (A3)	Combustion of biogas in boiler	Argon	53.26	Tonnes/year
Boiler stack (A3)	Combustion of biogas in boiler	NOx	1.33	Tonnes/year
Siloxane Removal plant operating at 17%				
Siloxane Removal Unit (A4)	Regeneration of siloxane removal media	Total organo-silicon compounds as SI	240.37	Kg/year
Siloxane Removal Unit (A4)	Regeneration of siloxane removal media	VOCs	Negligible - Dependant on VOC in biogas.	N/A
Waste Gas Burner operating at 8%				
Waste Gas Burner (A5)	Combustion of biogas in Waste Gas Burner	Methane	0.02	Tonnes/year
Waste Gas Burner	Combustion of biogas	Carbon	681.23	Tonnes/year

(A5)	in Waste Gas Burner	dioxide		
Waste Gas Burner (A5)	Combustion of biogas in Waste Gas Burner	Sulphur dioxide	1.3	Tonnes/year
Waste Gas Burner (A5)	Combustion of biogas in Waste Gas Burner	Nitrogen	2,395.99	Tonnes/year
Waste Gas Burner (A5)	Combustion of biogas in Waste Gas Burner	Carbon monoxide	0.13	Tonnes/year
Waste Gas Burner (A5)	Combustion of biogas in Waste Gas Burner	Oxygen	82.31	Tonnes/year
Waste Gas Burner (A5)	Combustion of biogas in Waste Gas Burner	Moisture (H2O)	367.53	Tonnes/year
Waste Gas Burner (A5)	Combustion of biogas in Waste Gas Burner	Argon	40.91	Tonnes/year
Waste Gas Burner (A5)	Combustion of biogas in Waste Gas Burner	NOx	0.62	Tonnes/year

NOx

Combustion Activities (EPR 1.01)

Point source emissions to air indicative BAT requirements

You should where appropriate:

Indicative BAT

You should where appropriate:

1. Control emissions of NOx by a combination of the following, as applicable:
   - combustion control systems
   - combustion temperature reduction
   - low NOx burners
   - over fire air (OFA)
   - flue/exhaust gas recycling
   - reburn
   - selective catalytic reduction (SCR)
   - selective non catalytic reduction (SNCR).
2. Use low NOx burners for coal- and oil-fired plant.
3. Use OFA or equivalent for existing coal-fired plant above 100 MWth).
4. Use dry low NOx burners in new natural gas-fired gas turbines. For natural gas-fired gas turbines, use water/steam injection, or convert to dry low NOx burning.
5. Where air quality standards or other environmental standards must be met, you must use SCR or SNCR for smaller plant (<100 MW).
6. For new coal and oil-fired plant above 100MW, use SCR or primary measures to achieve equivalent NOx levels.
7. Only combustion optimisation and SCR are feasible on >500MW PF plant firing low volatile coal. In these cases you need SCR for new plant. You need a site specific assessment for existing plant.

Thermal NOx formation is limited by the oxygen availability. The CHP engines and the boiler burners operate at around 450 to 500°C, reducing the level of nitrogen fixing, and therefore the level of NOx. The burner is a forced draught system and installed as a two pass boiler; therefore the boilers are lower NOx burners.

The CHP units will be under an operating and maintenance contract, requiring standard periods of maintenance resulting in specific equipment availability of >90%. A routine maintenance program, see Section 2.2, will ensure the combustion process is optimised to a maximum efficiency while tuning the engines for low NOx production will ensure concentrations of less than 500mg/Nm3.

Primary measures for the control of NOx in the emissions from the installation are therefore considered to represent BAT.

SOx

Combustion Activities (EPR 1.01) Point source emissions to air SOx control indicative BAT requirements
You should where appropriate: 1. Use low sulphur fuels as a primary measure.

Bio gas produced by the digestion of sewage sludge contains H_2S.

These levels are relatively low and constant due to the dosing of ferric sulphide in the WwTW as part of the wastewater treatment process, which limits the level of H_2S produced in the digestion process. Monitoring of the biogas quality to the CHP engines will control levels of H2S below 1500ppm/10kWh, shutting the process off if this level is exceeded.

The primary measures for the control of SOx in the emissions is the use of a low sulphur fuel. This is therefore considered to be BAT.

Particular Matter

Emissions of particulate matter are considered negligible as the fuel used is biogas which generates negligible particulate matter on efficient combustion.

VOCs

Fugitive releases of VOCs may include methane from pressure release valves in the storage and pipeline system and CHP plant. Water seals are provided to prevent continual release.

VOCs captured by the siloxane removal plant on the filter are passed into the regeneration air steam where most are condensed in a prescribed length of cooling pipework. In liquid form they account for 2 litres a day which is passed into the site drainage system and back to the Waste Water Treatment Works. The level of VOC emissions to atmosphere will depend on the makeup of the volatile components of the raw inlet gas to the filter. Because there is not digester currently operating at Five Fords there is no data for VOC levels in the biogas available so the emissions for the site cannot be modelled. Data of the emissions from the Budds Farm siloxane removal plant are provided as substitute data, in Appendix B2.

The combustion of biogas is not expected to give rise to the release of VOCs, as these will be destroyed by the combustion process.

Other releases to air

CO2 and CO is produced during combustion of biogas. The balance between their levels is related to the efficiency of the combustion process and the presence of CO indicates incomplete combustion. However, the overall balance between the levels of CO2, CO and efficiency are also affected by combustion controls for NOx. The balance between the levels of efficiency, CO2, CO and NOx generation will be optimised during the routine maintenance program, see Section 2.2.

The temperature at which the exhaust gases leave the stack is approximately 150 to 180 °C. At this temperature it is not expected that there will be a visible condensate plume, except during very cold periods or when there is no wind.

The raw materials, the process and site activities are unlikely to give rise to any dust. This is not considered any further.

4.1.2 Point Source Emission to Surface Water and Sewer

Combustion Activities (EPR 1.01) 3.1 Point source emissions to water indicative BAT requirements
You should where appropriate: **De-ionisation effluent** 1. Neutralise water de-ionisation plant regeneration effluent before discharge. **Cleaning liquids** 2. Neutralise or treat wash waters and cleaning-out solutions to produce an acceptable waste before discharge or disposal. 3. Boiler cleaning wastes require appropriate disposal. **Site drainage including rainwater** 4. Use an efficient oil/water separation/interceptor system. Further treatment may be required to remove dissolved hydrocarbons. 5. Direct discharge to controlled waters will only be allowed where discharges will meet discharge requirements under all conditions. **Waste water treatment** 6. On-site wastewater treatment plant effluent must meet discharge standards.

There are no point source emissions to either surface water or sewer from the Five Fords CHP installation. The installation does discharge small quantities of aqueous emissions to the WwTW internal drainage system, which is returned to the WwTW for treatment prior to discharge to surface water.

The location of the water emission point to the internal drainage system is shown in the SCR Appendix A3 Installation Boundary, and Appendix A5 Site Drainage and listed in Table 4.

Table 4 Aqueous Emissions Release Points.

Release Point	Location	Source	Grid Reference
W1	Adjacent to biogas storage	Condensate from the gas pipelines and gas storage bag	340900, 347320
W2	Adjacent to the siloxane removal plant	Condensate from the siloxane removal media regeneration process	340900, 347320

Aqueous discharge characteristics are described in Table 5.

The discharge from the gas pipelines and gas storage is condensate with slightly elevated levels of H2S dissolved from the biogas, resulting in a low level of acidity.

The discharge from the siloxane removal plant is condensate with slightly elevated levels of VOCs, dissolved from the biogas.

All discharges are released to the WwTW site drainage system where they flow to the WwTW for treatment.

The aqueous discharge of condensate containing low levels of H2S, siloxane and VOCs to the WwTW is not considered to pose any issues with regards to the effect on the wastewater treatment process or the final effluent discharge consent due to the exceedingly small volume compared to the total sewage flow through the works.

Table 5 Emissions to Water Release Points.

Emission point reference and location	Source	Parameter	Quantity	Unit
W1. Adjacent to the gas storage bag.	Condensate from the gas pipelines and gas storage bag	Condensate with slightly elevated levels of H2S dissolved from the biogas, resulting in a low level of acidity.	Negligible	m^3/day
W2. Adjacent to the siloxane removal plant. All waste waters, process waters and site drainage are re-routed via onsite drains to the Five Fords WwTW for treatment.	Condensate from the gas pipelines and gas storage bag	Condensate with slightly elevated levels of siloxane and VOCs in the biogas, originating from the WwTW sewage sludge.	2	litres/day

Due to the very low levels of contamination of the water and the volumes involved, no monitoring of its composition is proposed prior to the discharge to the WwTW.

Any areas of the installation where there is a risk of contamination of surface water or discharge of process waters are located on impermeable concrete hard standing. All surface water from these areas drain to the WwTW site wide surface drainage system and are returned for treatment prior to discharge to surface water.

4.1.3 Point Source Emissions to Groundwater

There are no point source discharges to groundwater.

Accidental release of materials to the environment are controlled through adequate containment measures and working procedures.

4.2.1 Fugitive Emissions to Air

How to Comply with your Environmental Permit (EPR 1.00) **Part 1 and Part 2**
Typically, condition 3.2.1 on the permit Emissions of substances not controlled by emission limits (excluding odour) shall not cause pollution. The operator shall not be taken to have breached this condition if appropriate measures, including, but not limited to, those specified in table y below and in any approved emissions management plan, have been taken to prevent or, where that is not practicable, to minimise, those emissions. The operator shall: • if notified by the Environment Agency that the activities are giving rise to pollution, submit to the Environment Agency for approval within the period specified, an emissions management plan. • implement the approved emissions management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency.

There are no significant sources of potential releases of dust to air.

Fugitive releases of VOCs may include methane from pressure release valves and condensate traps in the storage and pipe work system and CHP plant.

The quantity of methane released is negligible and only likely to occur as an emergency measure if both the CHP and the gas flares are out of operation. The CHP and gas flare capacity is significantly greater than the maximum quantity of methane produced in the digesters and therefore any release is considered highly unlikely.

4.2.2 Fugitive Emissions to Surface Water, Sewer and Ground Water

How to Comply with your Environmental Permit (EPR 1.00)
Typically, condition 3.2.3 on the permit All liquids in containers, whose emission to water or land could cause pollution, shall be provided with secondary containment, unless the operator has used other

appropriate measures to prevent or, where that is not practicable, to minimise, leakage and spillage from the primary container.

Subsurface structures include potable water pipelines, drains and cabling. These are identified in the SCR, Appendix A5: Site Drainage. Substances within the drains and potable water pipeline pose little risk to the environment and the cabling poses no risk to the environment.

All drain points associated with the LTHW system will be piped to a gulley which will drain to the site liquor pumping station. All potential maintenance points associated with the circuit including pumps and heat exchangers will be located on concrete bases which will contain all spillages and return to the liquor pumping station. Any maintenance liquors will be captured in the site drainage system and any chemical dosing lines will be double contained to prevent release to the environment and for Health and Safety purposes.

Where potable water is used for process make up, the appropriate isolation will be provided to prevent any back contamination by the process.

Operational areas where there are risks of pollution, including in the boiler building and around the CHP are bunded or benched and drain to the site drainage system to ensure any spillages are contained and discharged in a controlled manner. The site drainage system will be impermeable as per standard design and operating requirements. Any oil spillage from plant or equipment during maintenance would generally be noted and cleaned, as set out in the DCWW QMS WO (03) series procedures, before it reached the drainage system. Regular visual inspections take place of all items of plant as detailed in Section 2.2.

Five Fords WwTW is situated in the Dee Water Protection Zone and DCWW holds a consent (DPZ 1010) from the EA to undertake a controlled activity within the zone. This will be reviewed to identify any changes that may be required and as appropriate an application for a variation submitted to the Agency. All water treatment chemicals and other raw materials with the potential to pollute are stored within the site building on impermeable surfacing which falls to the site drainage system, see Table 10.

Surface water from areas where there is risk of pollution is contained on impermeable hardstanding and directed to the WwTW contained drainage system from where it is returned to the WwTW for treatment. However, for the majority of the installation the risk of contamination of surface water is negligible.

4.3 Odour

How to Comply with your Environmental Permit (EPR 1.00) **Part 2**
Typically, condition 3.3.1 on the permit Emissions from the activities shall be free from odour at levels likely to cause pollution outside the site, as perceived by an authorised officer of the Environment Agency, unless the operator has used appropriate measures, including, but not limited to, those specified in any approved odour management plan, to prevent or where that is not practicable, to minimise, the odour.

The operator shall: • if notified by the Environment Agency that the activities are giving rise to pollution outside the site due to odour, submit to the Environment Agency for approval within the period specified, an odour management plan • implement the approved odour management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency.

The installation poses negligible risk of odorous releases. The only substance that could cause odour is the biogas. There will no releases of biogas, except under exceptional circumstances, due to the storage containment and operational measures in place, see H1 Accident Risk Assessment.

4.3.1 Other releases

Combustion Activities (EPR 1.01) Fugitive emissions indicative BAT requirements
1. Intercept rainwater run off from open areas, especially coal and raw materials stocking areas, and remove the suspended solids by settlement or other techniques. Where there are potentially vulnerable receptors, monitor the quality of the water discharged from the storage and blending areas. 2. You should demonstrate that the potential risks of contamination of land by deposition of dust, leachate or run-off are not significant and that you can comply with the requirements of the Groundwater Directive.

Rainwater runoff is returned via the site drainage system to the WWTW to be processed before release.

There are no point source discharges to groundwater. Accidental release of materials to the environment are controlled through adequate containment measures and working procedures.

There are no expected releases of dust from the installation.

4.4 Noise and vibration

3.4.1 How to Comply with your Environmental Permit (EPR 1.00) **Part 2**
Typically, condition 3.4.1 on the permit Emissions from the activities shall be free from noise and vibration at levels likely to cause pollution outside the site, as perceived by an authorised officer of the Environment Agency, unless the operator has used appropriate measures, including, but not limited to, those specified in any approved noise and vibration management plan to prevent or where that is not practicable, to minimise, the noise and vibration; or

> The (rating) level of noise emitted from the site (during normal operations/annual shutdown and maintenance) shall not exceed (X) dB, expressed as an LAeqT, between (hhmm) and (hhmm) Mon to Fri and (Y) dB at any other time, as measured or assessed on the (specified boundary/boundaries/location) of the site at (locations x,y,z) on plan reference Y attached to this permit. The locations shall be chosen and the measurements and assessment made according to BS4142:1997.
>
> **The provision for management plans is the same as for odour.**

Five Fords CHP facility is located immediately to the south of the existing sludge treatment works off Cefn Road, near Marchwiel. The nearest noise sensitive properties are the rear of houses on the eastern end of Marcella Crescent and the eastern end of Ridgeway which are 340m south-west from the centre of the proposed development. Five Fords farm is approximately 400m north of the proposed site. The next nearest property on Cefn Road is approximately 620m from the centre of the site.

The CHP facility is located adjacent to the existing WwTW. The noise from the WwTW is not regarded as being of concern and to date has received no official complaints.

A noise survey has been undertaken to determine the impact on offsite receptors and to determine background noise levels, to support the planning application for the CHP installation and for the new sewage sludge treatment processes. From this a planning limit was established; the main sources of noise and their limits identified from the planning process are identified in Table 6. The installation meets the noise levels as recommended in Table 6.

Table 6 Main Noise Sources and Mitigation Measures

Source	**Noise level**	**Measures to control the noise**
Continuous/frequent		
Digester feed pumps	At 1m 70 dB	N/A
Digester mixers	At 1m 75 dB	N/A
Gas holder inflation	At 1m 75 dB	N/A
CHPs	At 1m 60 dB	Noise attenuation container
Exhaust flue	At 1m 75 dB	N/A
CHP water pumps	At 1m 65 dB	N/A
Heat exchangers	At 1m 75 dB	N/A
Infrequent		
Flare	At 1m 75 dB	N/A
Waste gas burner	At 1m 75 dB	N/A
Hot water boiler	At 1m 75 dB	N/A
Gas tank pressure relief valve	At 1m 75 dB	N/A
Maintenance activities	At 1m 75 dB	N/A
Alarm testing	At 1m 75 dB	N/A

Engines and gas compressors are the main sources of vibration. The engines are located on anti-vibration mounts reducing significant sources of vibration associated with the installation and consequently these are not considered further.

Further to the mitigation measures described in Table 6, the only noise issue would be from possible call outs during the night due to operating alarms and equipment trips of the CHP. These are unlikely and as such the impact from noise would be negligible.

Infrequent sources of noise are further described in Table 7. Infrequent sources of noise may also include alarms on-site for first aid or fire. Road transport deliveries would also contribute to infrequent sources of noise.

Table 7 Infrequent Sources of Noise

Source and location	**Type**	**Hours of operation**
Flare	Infrequent	In case of trip of an engine
Gas tank pressure relief valve	Infrequent	In case of sur-pressure
Maintenance activities	Infrequent	Random
Alarm testing	Periodic	Random

4.5 Monitoring

How to Comply with your Environmental Permit (EPR 1.00)

Part 1

Typically, condition 3.3.1 to 3.3.4 on the permit

The operator shall, unless otherwise agreed in writing by the Environment Agency, undertake monitoring specified in the following tables in Schedule x to this permit:

- point source emissions specified in tables Sxx, Sxx and Sxx
- surface water or groundwater specified in table Sxx
- noise specified in table Sxx
- ambient air monitoring specified in table Sxx
- process monitoring specified in table Sxx
- land specified in table Sxx.

The operator shall maintain records of all monitoring required by this permit including records of the taking and analysis of samples, instrument measurements (periodic and continual), calibrations, examinations, tests and surveys and any assessment or evaluation made on the basis of such data.

How to Comply with your Environmental Permit (EPR 1.00) **Part 2**
Typically, condition 3.5.1 to 3.5.4 on the permit The operator shall, unless otherwise agreed in writing by the Environment Agency, undertake monitoring specified in the following tables in Schedule x to this permit: Point source emissions specified in tables Sxx, Sxx and Sxx; Surface water and groundwater specified in table Sxx; Noise specified in table Sxx; Ambient air monitoring specified in table Sxx; Process monitoring specified in table Sxx; Land specified in table Sxx.

Combustion Activities (EPR 1.01) Monitoring indicative BAT requirements
1. **Emissions to air** Many plants in this sector will be subject to the detailed monitoring requirements of Annex VIII of the Large Combustion Plant Directive (LCPD). For plants co-incinerating waste, the provisions of Articles 10, 11 and Annexes II and III of the Waste Incineration Directive (WID) should also apply. The monitoring requirements of the LCPD and WID are considered to represent appropriate measures for this sector. The LCPD requires that: **For new plants**, emission limit values shall be regarded, for operating hours within a calendar year, as complied with if: (a) no validated daily average value exceeds the relevant figures set out in part B of Annexes III to VII, and (b) 95% of all the validated hourly average values over the year do not exceed 200% of the relevant figures set out in part B of Annexes III to VII. For both existing and new plants, start-up and shut-down periods shall be disregarded. Installations that do not fall within the scope of WID or LCPD should meet the benchmark standards except where you can clearly demonstrate that this is not the appropriate measure. We may require you to monitor and report releases more frequently than required by WID or LCPD where it is considered appropriate to do so. You should process the readouts from continuous emission monitors using software that reports monitoring compliance, to enable direct comparison with the emission limit values specified in relevant European legislation and in this

guidance.

In order to relate emission concentrations to mass releases, you will need to measure or otherwise determine the stack gas flow rate. In order to relate measurements to reference conditions, you will need to determine temperature and pressure. Determination of oxygen or water vapour content may also be required. All such measurements should be recorded.

4.5.1 Monitoring Emissions to Air

Emissions to air point sources (emission points A1 to A5 in Table 3) are monitored at least once a year, as part of the routine maintenance programme. No abatement technology is required and continuous monitoring is not considered necessary. Sample monitoring will be done after each maintenance period on the CHPs and boilers. This will check if the CHP boiler emissions are still within the emissions limit.

A monitoring platform is provided that complies with EA guidance notes M1 and M2. Sampling and analysis is undertaken by specialist air monitoring contractors and analytical companies certified to MCERTS.

In addition process monitoring, is carried out, see Section 4.5.5. This data is used as surrogate data for direct monitoring

Periodic visual and olfactory assessment is carried out as part of the site manager's duty.

4.5.2 Monitoring Emissions to Controlled Water

There are no direct emissions to controlled waters from the Five Fords CHP Facility.

4.5.3 Monitoring Emissions to Sewer

There is no release from the Installation into the public sewer. Any aqueous streams are discharged to the adjacent WwTW drainage system. The WwTW is not part of the facility described in this application and is outside of the scope of the permit applied for.

Liquid discharges returned to the WwTW will consist of surface water and condensate. The aqueous streams are only very slightly contaminated and consist of a low flow volume. They therefore have a negligible impact on the WwTW and it is not considered necessary to monitor them.

4.5.4 Monitoring Waste Emissions

As required by the DCWW EMS various housekeeping and waste management practices are in place. These include segregation of wastes according to their classification and nature, labelling waste and using designated storage containers.

In accordance with the DCWW EMS Policy WO(3) 01 solid waste is disposed of in accordance with 'Duty of Care' Regulations. The composition of the waste, its hazard characteristics and any relevant precautions is clearly stated on the transfer notes provided to licensed waste contractors removing waste from site for recycling and/or disposal. Records are maintained on site and reported to the regulator as required by the EPR permit.

4.5.5 Monitoring of Process Variables

In addition to the emissions monitoring listed above continual process monitoring is done to keep the process operating at optimal condition for biogas production, and to reduce the maintenance and increase equipment life.

Some key parameters to be monitored include:

- Biogas and natural gas flow;
- Biogas methane content;
- Biogas hydrogen sulphide content;
- Potable water consumption
- Gas flow to the waste gas burner;
- Water flow throughout the CHP and LTHW circuit; and
- Gas holder gas level.

Energy specific parameters to be monitored include:

- Total fuel input - annual registered fuel input to the scheme.
- Total power output - annual registered power generation by the scheme.
- Qualifying heat output - annual registered useful heat supplied by the scheme.

5 Records and Notification

5.1 Records

4.1.1 How to Comply with your Environmental Permit (EPR 1.00) Part 1 and Part 2
Typically, condition 4.1.1 on the permit All records required to be made by this permit shall: • be legible • be made as soon as reasonably practicable • if amended, be amended in such a way that the original and any subsequent amendments remain legible, or are capable of retrieval; and • be retained, unless otherwise agreed in writing by the Environment Agency, for at least 6 years from the date when the records were made or in the case of the following records until permit surrender: – off-site environmental effects – matters which affect the condition of land and groundwater.

5.1.1 Reporting emissions to air monitoring

Results of stack monitoring will be reported to the EA.

5.1.2 Reporting of Waste Emissions

Solid waste shall be disposed of in accordance with 'Duty of Care' Regulations and the composition of the waste, its hazard characteristics and any relevant precautions are clearly stated on the transfer notes provided to licensed waste contractors removing waste from site for recycling and/or disposal. Records will be maintained on site and reported to the regulator as required by the EPR permit.

All records will be kept in accordance with the EPR 1.00 and 1.01 permit conditions, and in accordance with DCWW QM (1) 01 procedures, section 12.

Records are maintained to demonstrate conformance to specified requirements, and are stored and retained in such a way as to ensure that they are easily retrievable and are prevented from loss of damage. The implementation of record keeping is detailed in SP (2) 04 series procedures.

5.2 Notification

How to Comply with your Environmental Permit (EPR 1.00)
Typically, condition 4.3.1 on the permit The Environment Agency shall be notified without delay following the detection of: • any malfunction, breakdown or failure of equipment or techniques, accident,

or emission of a substance not controlled by an emission limit which has caused, is causing or may cause significant pollution • the breach of a limit specified in the permit • any significant adverse environmental and health effects. Any information provided under condition 4.3.1 shall be confirmed by sending the information listed in Schedule xx to this permit within the time period specified in that schedule.

When a non-conformance is identified its significance is first evaluated. All non-conformances are analysed to identify the root cause in order to ensure that the effective corrective and preventative action is implemented. All records relating to non-conformances are maintained by the records Programme Co-ordinator. The effectiveness of subsequent action is evaluated during team meetings and internal audits. The procedure for dealing with corrective and preventative actions is detailed in the DCWW QMS policy SP (2) 05.

DCWW QMS policy NO(03) Pollution procedures cover how DCWW receives, records and responds to all pollution incidents originating from waste water treatment works and sewage networks. The procedure is used by customer reported incidents, internally reported incidents and pollution faxes issued by the EA. If a pollution incident is identified by an internal member of staff, the Self-Reporting Procedure NO(3) 04 is followed. These procedures are described in more detail in Section 2.4

5.3 Reporting/Notification

How to Comply with your Environmental Permit (EPR 1.00) **Part 2**
Typically, condition 4.3.5 on the permit Where the operator proposes to make a change in the nature or functioning, or an extension of the activities, which may have consequences for the environment and the change is not otherwise the subject of an application for approval under the Regulations or this permit: • the Environment Agency shall be notified at least 14 days before making the change; and • the notification shall contain a description of the proposed change in operation.

Combustion Activities (EPR 1.01) 2.1 Liquid fuels and 2.2 Gaseous fuels indicative BAT requirements
1. You should inform us, and the local authority, when standby fuel is used, and when you return to gas firing.

Notification of accidental emissions and preventative measures is covered under the Dŵr Cymru Operational Notification procedure (OPNOT) described in WO(3) 16 series, and this will be extended to cover all requirements from the EPR permit. This is used for notification to the EA of an incident or potential incident; it is not a prevention measure.

Any changes in the nature or functioning or extension to the activities planned to be carried out at Five Fords CHP facility will be notified to the EA in accordance to the guidance set out above prior to changes being made.

6 Energy Efficiency

How to Comply with your Environmental Permit (EPR 1.00). **Part 2**
Typically, condition 1.2.1 on the permit The operator shall: • take appropriate measures to ensure that energy is used efficiently in the activities • review and record at least every 4 years whether there are suitable opportunities to improve the energy efficiency of the activities; and • take any further appropriate measures identified by a review.

Combustion Activities (EPR 1.01) Energy efficiency indicative BAT requirements
You should where appropriate: 1. Demonstrate that the proposed or current situation represents BAT where there are other considerations involved, e.g. recovering energy from waste affects the energy efficiency of the process. **Boilers and furnaces** 2. Carry out regular checks to minimize leakage of air into units operating below atmospheric pressure. 3. Ensure good design, operation and maintenance of burners. **Reciprocating engines** 4. Maximise engine efficiency by measures such as turbo charging and air intercooling. However, this should be balanced against increased NOx emissions. 5. Recover exhaust gas heat for process or building heating or absorption chilling. 6. Recover lower-grade heat from engine coolants. 7. Where additional heat is required, supplementary fuel may be fired into the boiler, although this can be complicated by the pulsating exhaust and size limitations.

DCWW is not a participant to the Climate Change Agreement.

A key objective of the DCWW EMS 2011 – 2012 is to reduce energy consumption from the grid. Procedure EMP 003 specifically contains objectives for the Reduction of Energy Consumption Programme; this includes the commitment to produce monthly usage energy reports that are to be sent to Senior and Operational management and obtaining detailed electricity usage information via metering of specific areas of plant.

6.1 Basic energy requirements

A breakdown of energy consumption is provided in Table 8. Table 1

Table 8 Energy consumption – MWh biogas and other fuel/power

Energy source	Energy consumption	
	Primary MWh/yr	MWh% of total
Biogas	17,200	91.5
Natural Gas	1,560	8.5
Exported Energy	-	-

Details on Specific Energy Consumption (SEC) are a benchmark for energy consumption per unit of raw material processed or product output. For a CHP facility, producing steam and electricity, this is interpreted as the overall efficiency of the plant. A summary of the energy use, outputs and efficiency is summarised in Table 9 and presented in the form of a Sankey diagram in Figure 1.

Table 9: Energy efficiency for the CHP units

Parameter	Quantity (at 100% load)	Units
Rated power output	2 x 600	kW
Rated electrical efficiency	42.5	%
Hot water output (max)	2 x 580	kW
Thermal efficiency	41.1	%
Overall efficiency	83.7	%
Fuel consumption	2 x 1411	kW
	2 x 218 (based on 65% methane levels in the gas)	Nm^3/hr

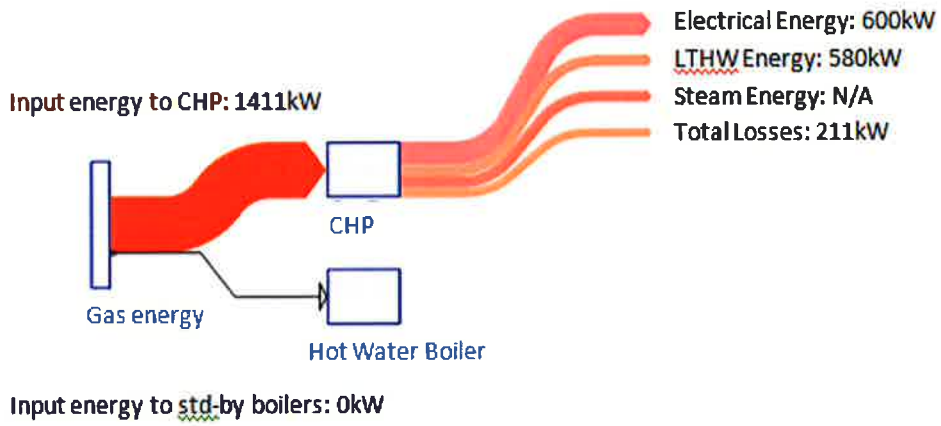


Figure 1 Specific Energy Consumption

6.2 Efficiency Measures

The Installation uses renewable biogas as the fuel for a CHP plant, converting the biogas energy into heat and electricity.

There is a constant gas production from the digesters, via the gas storage, to the two engines.

The combustion temperature is maintained relatively constant for reduced NOx emissions and increased efficiency.

Heat from the CHP cooling is recovered and then used in the process of the WwTW.

The engines are equipped with turbochargers, further increasing energy efficiency.

Ongoing monitoring of plant operating parameters is carried out to ensure process is operating optimally and to enable constant optimisation to increase the plants efficiency.

The maintenance scheme in place ensures fuel is combusted as completely as possible and heat is transferred efficiently.

Good housekeeping measures are employed and regular preventative maintenance will ensure the operations, and therefore energy efficiency, is optimised.

Low cost measures in place to avoid inefficiencies of excessive heating or cooling, include:

- Insulation of main hot water pipes; and
- Insulation of heating equipment such as hot water heat exchanger, boiler feed water tank and boiler feed water pumps and pipework.

The CHP area is not located in a building, but housed in acoustic containers. The only building associated with this application is the heating plant room housing the LTHW circulation pumps and boiler feed water treatment. There are limited opportunities for energy efficiency requirements as the buildings are not heated. Energy efficient lighting will be used throughout the building.

As part of the OFGEM and CHPQA requirements, usable heat will be measured and reported on a monthly basis. The monitoring scheme in place monitors gas use against energy production to determine performance. To achieve government incentives DCWW also monitor heat recovered, electricity production, gas use and overall efficiency of the installation. This information can be used to generate a database for further determination of energy efficiency plans.

An energy efficiency plan will be developed once the site is operational; this will determine areas of improvement and will be developed under DCWW's Environmental Policy and EMS.

6.3 Energy Supply Techniques

All electricity and heat required by the plant is provided via the CHP engine. Heat and electricity produced by the CHP is also used by the adjacent WwTW. This is the most efficient method of electricity supply available for the facility.

7 Efficient use of raw materials and water

How to Comply with your Environmental Permit (EPR 1.00) **Part 2**
Typically, condition 1.3.1 on the permit The operator shall: • take appropriate measures to ensure that raw materials and water are used efficiently in the activities • maintain records of raw materials and water used in the activities • review and record at least every 4 years whether there are suitable alternative materials that could reduce environmental impact or opportunities to improve the efficiency of raw material and water use; and • take any further appropriate measures identified by a review.

7.1 Raw Materials

All raw materials used at the Five Fords CHP Facility are identified in Table 10 below. This list will be maintained and updated throughout the lifetime of the permit and updated within the Site Operating Manual.

All materials are handled and stored in such a way are to ensure containment. Fugitive emissions to the environment are therefore negligible.

Biogas is the primary raw material. Its consumption will be continuously monitored. The use of biogas as the fuel source offers the best environmental option and there is therefore no environmental incentive to reduce biogas consumption and consider an alternative source of fuel. Further opportunities to provide a more efficient combustion of biogas are considered in Section 6.

Biogas is stored within a double membrane inflatable bag type holder, constructed of PVC coated polyester fabric which is resistant to UV and microbial degradation. The base of the holder is constructed from reinforced concrete treated to withstand the potentially acidic conditions within the holder. The gas bag is completely enclosed so the gas is not in contact with the concrete.

Secondary raw materials include chemicals used in processes such as water treatment and natural gas for the backup hot water boiler. Their consumption will be monitored, based on purchase records.

Natural gas is required in the event that there is no biogas available for example during maintenance. Natural gas may also be required during particularly cold periods or where additional gas is required to supplement the biogas to provide additional heat. Natural gas is not stored on site, but taken direct from the mains supply.

Water treatment chemical are stored within the site building on hard standing and within a contained drainage area.

The DCWW purchasing procedures are included in DCWW QMS PP(3) series. The procedures ensure purchased items conform to specified requirements, including quality parameters, and review suitability for use, including efficiency and minimisation of use of raw materials.

All substances are assessed for COSHH (Control of Substances Hazardous to Health) compliance, where relevant. Material safety data sheets for all materials used and kept on site will be maintained on the site.

All raw materials are handled and stored within the confines of the building following the unloading from vehicles, with the exception of biogas which is contained within the gas handling system.

Releases of raw materials to land are considered to be negligible due to adequate containment of the materials within suitable storage vessels.

Table 10 The types and amounts of raw materials

Activity	Use	Raw material and chemical composition	Storage location and capacity	Quantities used	Fate of the material in the installation (i.e. approximate percentages to each environmental medium and to the products	Environmental impact (e.g. degradability, bioaccumulation potential, toxicity to relevant species);	Reasonably practicable alternative raw materials	Justification for the continued use of any substance for which there is a less hazardous alternative
Combustion	Combustion fuel	Bio gas $CH_4/CO_2/N_2$/trace substances	Gas holders 1350m^3 at standard operating pressure	2.65 x10^6 m^3/ annum	100% combustion products to air	Combustion product CO_2 is a greenhouse gas	None. The biogas is from a waste	Renewable energy under the OFGEM ROCs system.
		Natural Gas	National Grid	1.4x$10^5$$m^3$/ annum	100% combustion products to air	Combustion product CO_2 is a greenhouse gas	Fuel Oil	There is no less hazardous alternative. Fuel Oil was rejected due to the H&S issues associated with storage and discharge particulates. NG is only to be used as a back up to the Biogas
	Low Temperature Hot Water System	Potable Water	Various pipework and locations around the site	Variable but once system is full it is a closed system and should only be topped up if there is loss of pressure due to leakage	100% contained within the system.	Negligible	N/A	N/A

Activity	Use	Raw material and chemical composition	Storage location and capacity	Quantities used	Fate of the material in the installation (i.e. approximate percentages to each environmental medium and to the products	Environmental impact (e.g. degradability, bioaccumulation potential, toxicity to relevant species);	Reasonably practicable alternative raw materials	Justification for the continued use of any substance for which there is a less hazardous alternative
	Hot water pipework	Corrosion inhibitor	N/A due to small quantities only added periodically. If used the corrosion inhibitor will be brought to site as and when required and will therefore not required storage.	50 litres / first fill of hot water pipework with 5 litres/m^3 of water.	100% to boiler feed water	Negligible, no residual expected. If the pipework is drained down it will be routed through the treatment works.	N/A	The initial design is that oxygen scavenger will not be required in the boiler water. If it is required it will likely be sodium bisulphate and will be in the quantities shown in this row.
	Engine lubrication	Lubricating Oil	Not stored on site. Brought on site when necessary by maintenance team. Engine filled with100l of oil total. Engine pipework containing oil is inside the CHP container which acts as a bund.	$1.5m^3$/annum	Recovered, re-used or disposed	Negligible	N/A	N/A

Table 11 The Type of Fuel Burned in the Combustion Units

Installation Reference: Five Fords			
Type of Fuel	When run as normal	When started up	When shut down
Biogas	100%	100%	100%
Natural gas	N/A	N/A	N/A

The CHP will always run on biogas and cannot be operated on Natural Gas. When the boiler is operating on biogas it will start, operate and shut down on biogas, and when operating on natural gas it will also start up operate and shut down on natural gas only.

Table 12 The Composition Range Of Any Fuels Currently Permitted To Burn

Fuel Use and analysis			
Installation reference	Five Fords		
Parameter	unit	Biogas	Natural gas
Moisture	%	0.3 to 0.5	0
Methane	%	50 to 65	70 to 90
Carbon dioxide	%	35 to 50	0 to 8
Nitrogen	%	trace	0 to 5
Propane	%	0	0 to 20
Oxygen	%	0	0 – 0.2%
Hydrogen sulphide	Ppm / %	<1500ppm	0 to 5%

7.2 Waste Minimisation Audit

The CHP facility at Five Fords will manage its waste streams in accordance with ISO 14001, legal requirements and DCWW Environmental Management Programmes. Opportunities to further recover waste will be investigated during the waste minimisation audit which will be carried out, in line with DCWW EMS 2011.

The provision of an action plan to highlight improvements and areas of waste reduction will develop once the site is operational.

The audit will be reported to DCWW Senior Managers and to the EA. Waste is discussed in further detail in Section 8.1

7.3 Minimising Water Use

Water use at Five Fords CHP Facility includes:

- Top-up water for the hot water boiler;
- Top-up water for closed loop cooling system for the engines and LTHW circuit; and
- Site services and potable water.

All water used at the installation is either from the potable water mains supply or final effluent from the neighbouring WwTW. Appendix 5 of the SCR identifies the site water supply infrastructure.

A water efficiency audit is covered under the DCWW Environmental Policy, 2011, and the DCWW Capital Investment Procedures Manual. This is also be covered by the EMS under ISO 14001, April 2011. The use of water is limited therefore the audit scope is expected to be limited but will include:

- Reviews of the flow diagrams and water mass balances for the installation;
- Reducing water used for cleaning;
- Potential for additional monitoring; and
- Opportunities for water reuse.

The installation is new and it is designed to minimise raw material use. It is not expected that any further opportunities for reducing water use will be identified but where they are they will be put into place.

8 Waste

8.1 Avoidance, recovery and disposal of wastes

1.4.1 How to Comply with your Environmental Permit (EPR 1.00). **Part 2**
Typically, condition 1.4.1 on the permit The operator shall: • take appropriate measures to ensure that waste produced by the activities is avoided or reduced, or where waste is produced it is recovered wherever practicable or otherwise disposed of in a manner which minimises its impact on the environment • review and record at least every 4 years whether changes to those measures should be made; and • take any further appropriate measures identified by a review.

The CHP facility at Five Fords will manage its waste streams in accordance with ISO 14001, legal requirements and DCWW Environmental Management Programmes. There will be a Waste Management Plan that includes details of the types of waste produced at site, how wastes are segregated, stored and removed from site. Minimal quantities of waste will be produced at the CHP facility and will be recovered where possible. Waste will be segregated and where possible waste will be recycled. EN (3) 02 procedure in the EMS details the waste management principles that will be used at the site.

Further consultation with waste contractors will ensure that all waste streams have been considered. The sampling and characterisation of wastes will be covered under the requirements of Duty of Care.

Release of particulate matter from the site, either as dust or in surface water is considered to be negligible due to the fact that limited quantities of dry solid materials are used or held on site. All dry raw materials that are used within the installation are stored appropriately; see Table 1 and Table 10.

All condensate arising within the gas holder runs to the condensate traps located on the gas pipework external to the gas holder. The condensate trap takes water out of the gas by reducing the velocity of the gas and allowing the liquid to separate from the gas. There is a level of condensate at the base of the trap with the manual valve and overflow. This is regularly checked by the site operator in line with Dŵr Cymru QMS WO(3) series procedures. Operational Managers have overall responsibility for each requirement within these procedures. The valve is periodically manually opened to allow condensate to drain out to the site liquor drainage system where it is returned to the WwTW for treatment. There is also an over flow which runs directly into the same drainage system.

Surface water is generally isolated from any potential pollution source, with the exception of that falling into the gas holder pipework; therefore, surface water is uncontaminated. Surface water falling to the on site drains is returned to the WwTW for treatment along with condensate from the pipework and gas holder.

Waste Handling

To be compliant with the Hazardous Waste Regulations (2005) a system is in place to determine waste handling procedures and records under EN (3) 02 procedures of the EMS. Waste is segregated and records of disposal are kept on site in line with Duty of Care requirements. The site is registered with the EA under the Hazardous Waste Regulations (Reg No. ACQ687). Solid wastes will be held in skips before appropriate removal or disposal.

Expected waste streams are summarised in Table 5 below.

Table 5: Waste Streams, Storage and Fate

Waste Stream	Storage	Fate
Siloxane Removal Plant	Media will be contained in the siloxane removal plant at all times	Each stream (duty / standby) on the siloxane removal plant will contain approximately 180kg of media. The media comprises of a coated granular polymer manufactured specifically for the supplier to remove siloxanes. It has an engineered pore size suited to the various siloxanes found in biogas. When the media reaches the end of its life cycle it is removed by the media supplier who is able to recycle it.

Duty of Care Transfer Notes will be covered under ISO 9001 and recorded and maintained on site for at least 3 years.

8.2 Waste Recovery or Disposal

Combustion Activities (EPR 1.01)

1.2 Avoidance, recovery and disposal of waste indicative BAT requirements

You should where appropriate:

1. Store, handle and transport all waste streams to prevent the release of waste, dust, VOC, leachate or odour.
2. Store bottom ash and fly ash separately. This provides flexibility to re-use the different ash fractions.
3. Where scale allows, store ash fractions and other dusty residues in closed silos fitted with high level alarms and dust abatement plant.
4. Explore markets for waste streams, for example:
   - bottom ash for aggregate
   - PFA for cement manufacture and construction products
   - FGD gypsum and fused slags for construction products
5. Recycle materials back into the process whenever possible, e.g. re-using partially reacted lime.
6. Where recycling or re-use is not possible, then consider regeneration of other materials or return to the manufacturer e.g.:
   - ion exchange resins
   - reverse osmosis membranes
   - molecular sieves
   - catalysts

Minimal quantities of waste will be produced at Five Fords CHP facility. Waste will be recovered where possible. Opportunities for further recovery will be investigated during the waste minimisation audit.

Implementation of EMS procedures and the current Environmental Policy ensures optimum disposal of the wastes produced. Submission of a detailed assessment is not considered necessary due to the minimal quantity of waste produced.

The audit of waste recovery and disposal routes will be covered under the EMS.

Waste will be segregated and where possible waste will be recycled. This will be covered under ISO 9001. Further consultation with waste contractors will ensure that all waste streams have been considered and covered under the EMS.

The transfer of solid waste will be covered under ISO 14001.

The sampling and characterisation of wastes will be covered under the requirements of Duty of Care.

9 Further Information

9.1 Closure

Indicative BAT requirements for closure
Operations during the life of the permit should not lead to any deterioration of the site. Potential problems relating to the design and build which may cause a rise during decommissioning should be identified. A site closure plan should be maintained to demonstrate that, in its current state the installation can be decommissioned to avoid any pollution risk and return the site of operation to a satisfactory state. For existing activities the operator should complete any detailed studies, and submit the site closure plan as an improvement condition.

The Site Condition Report describes the present condition at the time of this application. Containment measures to ensure operations do not lead to any further deterioration are discussed in this report; see Section4.

No potential problems have been identified relating to the design and build.

A specific site closure plan will be developed. Under the Construction (Design and Management) Regulations 2007, a live document will be maintained (health and Safety file), including as built drawings, dismantling methods etc. This will be integrated into the EMS and be submitted to the EA upon request.

Appendix A

Permit Application Forms Supporting Information

A1 Relevant Offenses and Post Conviction Plan

Date of Conviction – 21st April 2011
Cardiff Crown Court
Gowerton WwTW
Between 23rd April 2007 and 20th January 2009 at Gowerton Waste Water Treatment Works, Victoria Road, Gowerton Swansea in the area of the Environment Agency did cause polluting matter to enter controlled waters namely the River Loughor Estuary, contrary to section 85(1) of the Water Resources Act 1991
Fined £20,000
Costs £25,000

Date of Conviction – 11th April 2011
Bridgend Magistrates Court
Nant Cefn Glas, Bridgend

i) On or before the 13th day of February 2010, at Cefn Glas, Bridgend in the area of the Environment Agency did cause polluting matter namely crude sewage to enter controlled waters, namely the Nant Cefn Glas contrary to Section 85(1) of the Water Resources Act 1991
Fined £3000.00
ii) On or before the13th day of February 2010, at Cefn Glas, Bridgend in the area of the Environment Agency did cause to flow into waters containing fish, namely the Nant Cefn Glas, certain liquid or solid mater, namely crude sewage, to such an extent as to cause the said waters to be poisonous or injurious to fish and the food of fish contrary to Section 4(1) of the Salmon and Freshwater Fisheries Act 1975

No Separate Penalty Imposed
Costs - £4450.61

Date of Conviction – 24th June 2010
Wrexham Magistrates Court
On or before 17th August did cause polluting matter, namely untreated sewage to enter controlled waters namely the Afon Goch at Rhosllanerchrugog, Wrexham, contrary to section 85(1) & (6) of the Water Resources Act 1991

Fined £1,400
Costs £1,900

Date of Conviction – 19th June 2009
Llwynypia Magistrates' Court
1. On or Before 19th May 2008, did cause poisonous, noxious, polluting matter, namely untreated sewage from the Coed Ely Combined Sewer Overflow, to enter controlled waters, namely the River Ely, contrary to Section 85(1) & (6) of the Water Resources Act 1991.
Fined - £1,000
1. On or Before 19th May 2008, did knowingly put into waters containing fish, namely the River Ely, any liquid or solid matter, namely untreated sewage

from the Coed Ely Combined Sewer Overflow, to such an extent as to cause the waters to be poisonous or injurious to fish or the spawning grounds, spawn or fish food, contrary to Section 4(1) of the Salmon and Freshwater Fisheries Act 1975.

Fined – £500
Costs – £2,552.49

Date of Conviction – 29 January 2009
Wrexham Magistrates' Court

1. Between 29th February and 7th April 2008, at Five Fords STW, Cefn Road, Abenbury, Wrexham LL13 0PA, DID breach Condition No. 14 of a Discharge Consent No. CM0077801 in that the levels for suspended solids were exceeded, contrary to Section 85(6) of the Water Resources Act 1991.

Fined - £1,000
Costs - £1,214.88

Date of Conviction – 21 October 2008
Abertillery Magistrates Court
1. On the 9th September 2006, did cause polluting matter, namely sewage effluent, to enter controlled waters namely an unnamed tributary of Malpas Brook, Newport, contrary to section 85(1) and (6) of the Water Resources Act 1991
Fined - £800
2. On or before 9th September 2006, did cause to flow into a tributary of waters containing fish, namely an unnamed tributary of Malpas Brook, Newport, certain liquid or solid mater, namely sewage effluent, to such an extent as to cause the said waters to be poisonous or injurious to fish, contrary to Section 4(1) of the Salmon and Freshwater Fisheries Act 1975.
Fined - £200
Costs - £2, 310.63

Date of Conviction – 18 September 2008
Llwynypia Magistrates Court

1. On the 9th April 2007, did cause polluting matter, namely sewage effluent, to enter controlled waters namely the River Clun, contrary to Section 85(1) and (6) of the Water Resources Act 1991

Fine - £1,000
Costs - £3,500
2. On the 9th April 2007, did cause to flow into waters containing fish, namely the River Clun, certain liquid or solid mater, namely sewage effluent, to such an extent as to cause the said waters to be poisonous or injurious to fish, contrary to section 4(1) of the Salmon and Freshwater Fisheries Act 1975
No separate penalty

Date of Conviction – 24 July 2008
Holyhead Magistrates' Court

On 15th August 2007, did cause polluting matter, namely sewage, to enter controlled waters namely Benllech Sands, Benllech, Anglesey, contrary to Section 85(1) and (6) of the Water Resources Act 1991

Fine - £1,000.00
Costs - £1,178.76
. On 21st September 2007, did cause polluting matter, namely sewage, to enter controlled waters namely Benllech Sands, Benllech, Anglesey, contrary to Section 85(1) and (6) of the Water Resources Act 1991

Taken into Consideration
Summary of Facts
During heavy rainfall the pumping station at Benllech did not activate and resulted in a discharge entering the sea at Benllech which is an EC Bathing Water Beach.

Date of Conviction – 21 July 2008
Mold Magistrates' Court
On 18th June 2007, at Mold Sewage Works (Aeration Outfall) did breach Condition No. 13 of a Discharge Consent No. CM0031001 in that the levels for suspended solids were exceeded, contrary to Section 85(6) of the Water Resources Act 1991.

Fine - £2,500.00
Costs - £1,257.50
Summary of Facts
On the 18th June 2007, a routine sample taken from Mold STW final effluent was found to contain high levels of suspended solids. The sample showed the suspended solids level was more than twice the discharge consent limit.

Date of Conviction – 25 June 2008
Stroud Magistrates' Court
1. That on 14th July 2007, did cause sewage effluent to be discharged into controlled waters, namely the Valley Brook from Newland Sewage Treatment Works contrary to Section 85(3) of the Water Resources Act 1991
Fine £1,000.00
Costs - £2866.21
Summary of facts
On the 14th July 2007, sewage effluent was discharged to the Valley Brook from Newland Sewage Treatment Works. The actual impact from the incident was limited due to the fact that there was a high level of rainfall, resulting in significant dilution. The watercourse was discoloured for 200m downstream.

Date of Conviction – 11 January 2008
Llwynypia Magistrates' Court
1 On or about 30th April 2007, at the Nant Myddlyn from a combined sewage overflow at Tynant, Beddau did breach a condition of Discharge Consent No. AN0229801, contrary to Section 85(6) of the Water Resources Act 1991
Fine £5,000
2 On or about 30th April 2007 did cause to flow into controlled waters / a tributary of waters containing fish, namely the Nany Myddlyn, certain liquid or solid mater, namely sewage effluent, to such an extent as to cause the said waters to be injurious to fish / food of fish, contrary to Section 4(1) of the Salmon and Freshwater Fisheries Act 1975
Fine £1,700
Costs £2,249.20

Date of Conviction – 17 September 2007
Aberdare Magistrates' Court
1 On the 13th August 2006 did cause polluting matter, namely aluminium sulphate, to enter controlled waters, namely Taf Fechan River at Ponsticill, Merthyr Tydfil, contrary to Section 85(1) and (6) of the Water Resources Act 1991
Fine £13,000

On the 13th August 2006 did cause to flow into controlled waters / a tributary of waters containing fish, namely the Taf Fechan River at Pontsticill, Merthyr Tydfil, certain liquid or solid mater, namely aluminium sulphate, to such an extent as to cause the said waters to be injurious to fish / spawning grounds of fish / spawn of fish / food of fish, contrary to Section 4(1) of the Salmon and Freshwater Fisheries Act 1975

Fine £3,500
Costs £4,184.80
Appeal lodged against sentence and subsequently abandoned - further £1,765 costs ordered to the Environment Agency
Summary of Facts
On 13th August 2006 the Agency were informed that there had been a potential pollution of the Taf Fechan at Pontsticill WTW. Investigations identified that

approximately 3 tonnes of aluminium sulphate had leaked from a waste storage tank into its bund and subsequently discharged the liquid to the Taf Fechan. The pollution impacted on approximately 5 km of the Taf Fechan downstream of Pontsticill WTW and caused a fish mortality of approximately 23,000 fish.

Date of Conviction – 17 September 2007
Bridgend Magistrates' Court
1 On or before 27 September 2006 did cause polluting matter, namely untreated sewage effluent to enter controlled waters namely, Nant Crymlyn, contrary to section 85(1) and (6) of the Water Resources Act 1991.
Fine £6,000.00
Costs £1,260.00
Summary of Facts
A sewer had become blocked and raw sewage was discharged from two manholes. Sewage and sewage debris were found on farmland and covered the bed of the Nant Crymlyn over a stretch of 600 meters.

Date of Conviction – 10 September 2007
Aberdare Magistrates' Court
On 17 July 2006 did cause polluting matter, namely raw untreated sewage to enter controlled waters namely the Nant y Wenallt, Abernant, Aberdare, contrary to section 85(1) and (6) Water Resources Act 1991

Fine £5,000.00*
. On 17 July 2006 did cause to flow into waters containing fish, namely Nant y Wenallt, Abernant, Aberdare, certain liquid or solid matter, namely raw untreated sewage, to such an extent as to cause the said waters to be poisonous or injurious to fish and food of fish, contrary to section 4(1) of the Salmon and Freshwater Fisheries Act 1975.

Fine *£1,250.00
Costs £4,420.81
* Reduced from £5,000.00 on Appeal
Summary of Facts
An abnormal operation of a weir type combined sewer overflow caused by a down-flow blockage resulted in pollution, namely untreated raw sewage entering controlled waters and causing a large fish fill of approximately 1739 fish over a 0.6 km length of the water course.

Date of Conviction – 26th July 2007
Wrexham Magistrates' Court
1. On 2nd July 2006 did cause polluting matter, namely sewage, to enter controlled waters, namely the River Gwenfro at Park Avenue CSO, Wrexham, contrary to Section 85(1) & (6) of the Water Resources Act 1991.

Fined - £2,500.00
2. On 2nd July 2006 did cause to flow into waters / a tributary of waters containing fish, namely the River Gwenfro at Park Avenue CSO, Wrexham,

certain liquid or solid mater, namely sewage, to such an extent as to cause the said waters to be poisonous or injurious to fish / food of fish, contrary to Section 4 of the Salmon & Freshwater Fisheries Act 1975.
Fine - £2,500.00
Costs - £1,076.56
Summary of Facts
On Sunday 2nd July 2006 Agency officers were called out to the River Gwenfro at Caia Park, Wrexham where they had been notified that there were dead fish in the river. Upon arrival it was evident that cloudy water smelling of sewage was being discharged into the Gwenfro from a surface water culvert on the riverbank. An immediate impact on the River Gwenfro was evident as sewage debris was evident on the river bed. The SSO was discharging under dry weather conditions and samples were taken upstream of the discharge and downstream at various points. Officers discovered around 300 dead fish, mainly trout along a 2 mile section of the Gwenfro downstream of the discharge to its confluence with the River Clywedog.

Date of Conviction – 11th May 2007
Ammanford Magistrates' Court
1. On or before 20th August 2006 did cause polluting matter, namely sewage, to enter controlled waters, namely Pendine Pill, Pendine contrary to section 85(1) and (6) of the Water Resources Act 1991.
Fine - £2,500.00
Costs - £1,020.78
Summary of Facts
On 20th August 2006 officers witnessed a manhole surcharging on Marsh Road, Pendine. Sewage was pooling on the road and draining into a surface water drain. The sewage was seen to discharge into the Pill. Enquiries suggest that a blockage had formed over the inlet of the pumping station but without entering the pump, causing it to trip. It was accepted there had been a breakdown in communication between an operative who had attended the station on 19th August 2006 and the relevant control centre; a telemetry alarm had been reset at the station but not at the control centre.

Date of Conviction – 14th March 2007
Neath Magistrates' Court
1. On or before 27th July 2006 did cause polluting matter, namely untreated sewage effluent, to enter controlled waters namely the River Clydach at Bryncoch, contrary to Section 85(1) and (6) of the Water Resources Act 1991.
Fine - £3,500.00
Costs - £400.00
Summary of Facts
On 27th July 2006 a complaint was received from a member of public in respect of the river. Agency officers who attended witnessed untreated sewage emanating from the ground and flowing down a steep bank into the river. The following day excavation works were undertaken and the source of the discharge was isolated to a fracture of the sewer line.

Date of Conviction – 12th February 2007

Bridgend Magistrates' Court

1. That on 24th January 2006 did cause polluting matter, namely milk and milk washings to enter controlled waters, namely the Nant Pontsannau, a tributary of the River Ewenny contrary to Section 85(1) of the Water Resources Act 1991

Fined - £750.00

1. That on 6th July 2006 did cause polluting matter, namely milk and milk washings to enter controlled waters, namely the Nant Pontsannau, a tributary of the River Ewenny contrary to Section 85(1) of the Water Resources Act 1991

Fined - £750.00
Costs - £ 919.85
Summary of Facts
The Agency responded to two separate pollution incidents on the Nant Pontsannau, a tributary to the River Ewenny in Bridgend in January and July of 2006. Agency Officers attended the site on both occasions and found that milk washing originating from the foul sewer in the vicinity of the Golden Vale Creamery on Bridgend Industrial Estate, Bridgend was entering the culverted Nant Pontsannau. It is believed that the discharge occurred due to blockages in the foul sewer causing the effluent to back up into a private connection and out into the Nant Pontsannau.
Contractors engaged by Dwr Cymru Welsh Water attended the site on the two occasions and put measures in place to stop the pollution and made efforts to source the route of the problem. Since the incident DCWW have deployed specialist equipment to monitor levels with the problem inspection chamber and the sewer line within the vicinity are being routinely jetted.

Relevant Offences Post Conviction Plan

Dwr Cymru cyf. is a statutory water and sewerage undertaker operating in Wales and adjacent parts of England. It is responsible for the provision of water supplies and the collection and treatment of sewage effluent for some 3 million people. To provide these services we currently operate some 67 water treatment works and over 800 wastewater treatment works. The latter are served by a 19,000km sewer network with over 1900 pumping stations and 3,200 combined sewer overflows. With a system of this size breakdowns, sewer collapses and blockages are inevitable and regrettably some of these lead to pollution incidents.
The Company has been convicted of 18 relevant offences under Section 85 of the Water Resources Act 1991 and details of these offences have been provided as part of the application. The remedial measures taken were as follows:

> i) For the discharge at Pontsticill Water Treatment Works the arrangements for emptying the storage tank bund were changed so an accidental discharge can no longer occur.
> ii) The incidents at Newlands and Mold Wastewater Treatment Works were caused by mechanical breakdowns which were repaired. The incident at Five Fords Wastewater Treatment Works was resolved by changes to operational practice. For Gowerton Wastewater Treatment Works there is a staged programme of capital investment planned during the AMP5 period which will improve overall performance at Gowerton WwTW and also meet the new Environmental Quality Obligation. The expenditure will include modifications to the sludge treatment facility, modifications to the works to increase the capability to treat more flow and modifications to meet the new phosphorus consent under the Habitats Directive. In addition repairs will be made to the works outfall.
> iii) The 14 relevant offences related to pollution incidents on the sewerage network were due to either equipment failure, pipe bursts or blockages on the network. As part of our pollution reduction strategy we invested some £5 million during the AMP4 period (2005-10) to reduce the number of these events. For example, over 600 HawkEye GSM/GPRS enabled telemetry units have been installed on the sewerage network to provide advance warning of potential spills from CSOs. For the AMP5 period (2010-2015) we are in discussion with the Agency to identify additional sites where the provision of spill monitoring and telemetry will be beneficial.
> On a day to day basis all incidents are now reported to and managed by a dedicated 24hr pollution control desk at our Operational Control Centre and we have 5 dedicated Pollution Information Advisors working exclusively in this area.

Dwr Cymru cyf. takes all pollution incidents, including those not leading to prosecution, very seriously and all incidents are included in reports to our Board. Over the years we have significantly reduced the number of incidents and will continue to do so through improved management procedures and capital investment projects.

A2 DCWW Environmental and Quality Statement

Environmental and Quality Policy Statements

Environmental Policy Statement

Dŵr Cymru Welsh Water recognises that the protection of our environment is an integral and fundamental part of our business operations. Our principal aims are to operate in a sustainable manner, to evaluate and manage our environmental impacts and to promote greater environmental awareness amongst our employees, contractors and suppliers. Welsh Water will continually improve environmental performance and incorporate, where practical, identified best practice in sustainable development.

We will achieve this by:

- Continuing to prevent, reduce and minimise the impact of any polluting emissions to the environment by utilising 'best practice' implemented through effective environmental management control systems with the objective of ensuring continual improvement.
- Complying with all relevant legal and other standards and requirements relating to our Environmental Management System.
- Seeking to use environmentally responsible suppliers and working with existing and potential new suppliers to encourage environmental improvements. Encouraging the effective use of materials and supplies, promoting the application of the waste hierarchy.
- Developing Welsh Water Environmental Management System Objectives based on our significant environmental aspects and compliance with legal requirements, these objectives will be regularly reviewed with the aim of ensuring continual improvement.
- Optimising energy efficiency and encourage and facilitate the use of appropriate environmental technology throughout the business.
- Ensuring that all employees are aware of this Policy and the Welsh Water Environmental Management System. This will be achieved through environmental awareness training enabling employees to implement and develop practices appropriate to the objectives contained in the Welsh Water Environmental Management System.
- Developing an Environmental Management System that conforms to the requirements of BS EN ISO 14001 which is documented, implemented and maintained.

In line with other company management system policies, Welsh Water will incorporate the above commitments into our business practices and ensure that we translate them into appropriate environmental objectives and targets.

This policy will be communicated to all Welsh Water employees and anyone working on behalf of Welsh Water and will be available to the public via the Internet. This policy will be reviewed annually or when business needs or relevant legislation changes.

Nigel Annett

Nigel Annett
Managing Director
Dŵr Cymru-Welsh Water
April 2011

EN(1)02

Datganiad Polisi Amgylcheddol y Ansawdd

Datganiad Polisi Amgylcheddol

Mae diogelu'r amgylchedd yn rhan integrol a sylfaenol o waith Dŵr Cymru Welsh Water. Ein prif amcanion yw gweithredu mewn modd cynaladwy, gwerthuso a rheoli effeithiau amgylcheddol a hyrwyddo ymwybyddiaeth o'r amgylchedd gan ein gweithwyr, contractwyr a chyflenwyr. Bydd Dŵr Cymru yn parhau i geisio gwella'i berfformiad amgylcheddol ac ymgorffori, ble'n ymarferol, yr arferion gorau ym maes datblygu cynaladwy.

Byddwn yn gwneud hynny wrth wneud yr isod:

- Parhau i atal, gostwng ac isafu effaith unrhyw allyriadau llygredig wrth ddilyn yr 'arferion gorau' a'u gweithredu drwy gyfrwng systemau rheoli amgylcheddol effeithiol gyda'r nod o barhau i wella perfformiad.
- Cydymffurfio â'r holl safonau cyfreithiol a gofynion eraill yn gysylltiedig â'n system rheoli amgylcheddol.
- Defnyddio cyflenwyr sy'n trin yr amgylcheddol yn gyfrifol a chydweithio â chyflenwyr hen a newydd i symbylu gwelliannau amgylcheddol a defnydd o ddeunyddiau a chyflenwadau addas i'r hierarchaeth wastraff.
- Datblygu amcanion system rheoli amgylcheddol Dŵr Cymru ar sail agweddau amgylcheddol arwyddocaol y cwmni a chydymffurfiad â gofynion cyfreithiol, gan eu hadolygu'n rheolaidd gyda'r nod o gynnal gwelliant parhaus.
- Uchafu effeithiolrwydd ynni a chymell defnydd o dechnolegau amgylcheddol addas ar draws y busnes.
- Sicrhau bod pob gweithiwr yn ymwybodol o'r polisi hwn a system rheoli amgylcheddol Dŵr Cymru. Gwneir hynny wrth drefnu hyfforddiant ymwybyddiaeth o'r amgylchedd er mwyn galluogi gweithwyr i weithredu a datblygu arferion cymwys i amcanion system rheoli amgylcheddol Dŵr Cymru.
- Datblygu system rheoli amgylcheddol fydd yn cydymffurfio â gofynion BS EN ISO 14001 gan ei gofnodi, gweithredu a chynnal yn barhaus.

Yn unol â pholisïau systemau rheoli eraill y cwmni, bydd Dŵr Cymru yn ymgorffori'r uchod o fewn arferion y busnes ac yn eu trosi'n amcanion a thargedau amgylcheddol addas.

Hysbysir pob gweithiwr Dŵr Cymru o'r polisi hwn ynghyd ag unrhyw un yn gweithio ar ran Dŵr Cymru, a bydd yn agored i'r cyhoedd. Adolygir y polisi bob blwyddyn neu pan fydd y busnes neu ddeddfwriaeth yn newid yn sylweddol.

Nigel Annett

Nigel Annett
Rheolwr Gyfarwyddwr
Dŵr Cymru Welsh Water
Ebrill 2011

Quality Policy Statement

Dŵr Cymru Welsh Water is committed to providing clean, safe drinking water and sanitation to our customers – both today and for future generations. Our goal is to be recognised by our customers as being the best at providing this essential service. Welsh Water strives to exceed customer and other stakeholder expectations in an environment of continual improvement.

We will achieve this by:

- Implementing high standards of service to all customers in all business activities.
- Complying with all relevant legal and other standards and requirements relating to our Quality Management System.
- Continually improving the effectiveness of our quality management system by fully utilising the skills, knowledge and experience of our employees and through planned programmes of training and development.
- Identifying, and where practicable, adopting 'best practice' in all our business activities, including management and operational practices and technologies.
- Providing a framework for establishing and reviewing quality objectives and targeting maintenance schemes to improve operational performance whilst remaining within approved budgets.
- Communicating the content of the Quality Policy and this Statement throughout Welsh Water and implementing a 'Plan, Do, Check, Act' framework for continuous business improvement.
- Reviewing the Quality Policy and this Statement to ensure continuing suitability.
- Developing a Quality Management System that conforms to the requirements of BS EN ISO 9001 which is documented, implemented and maintained.

Welsh Water are committed to delivering professional practice to activities associated with Operator Self-Monitoring, including testing and calibration activities.

To ensure the effective implementation of this Quality Policy, Welsh Water has established and maintains a Quality Management System. The Welsh Water Quality Management System incorporates the general requirements for the competence of testing and calibration in relation to Operator Self-Monitoring and Welsh Water is committed to compliance with ISO/IEC 17025 and MCERTS Standards for Self Monitoring of Effluent Flow.

Welsh Water monitors performance and establishes and maintains quality objectives and targets which are documented and reviewed. This Policy will be communicated to all Welsh Water staff and those working on behalf of Welsh Water including suppliers and contractors.

This Policy will be reviewed annually and when significant or material changes are identified.

Nigel Annett

Nigel Annett
Managing Director
Dŵr Cymru-Welsh Water
April 2011

QM(1)02

Datganiad Polisi Ansawdd

Mae Dŵr Cymru Welsh Water wedi ymrwymo i ddarparu gwasanaeth iechydaeth a dŵr yfed glân a diogel ar gyfer ein cwsmeriaid - heddiw ac yn y dyfodol. Ein nod yw cael ein cwsmeriaid i'n cydnabod fel y cwmni gorau'n darparu'r gwasanaethau hanfodol hyn. Bydd Dŵr Cymru yn ymdrechu i wneud mwy na bodloni disgwyliadau cwsmeriaid a rhanddeiliaid o fewn amgylchedd o barhau i wella perfformiad.

Byddwn yn gwneud hynny drwy'r isod:

- Cynnal safonau gwasanaeth uchel ym mhob rhan o'r busnes.
- Cydymffurfio â'r holl safonau cyfreithiol a gofynion eraill yn gysylltiedig â'n system rheoli ansawdd.
- Parhau i wella effeithiolrwydd ein system rheoli ansawdd wrth ddefnyddio sgiliau, gwybodaeth a phrofiad ein gweithwyr a threfnu rhaglenni hyfforddi a datblygu.
- Nodi a ble'n addas mabwysiadu'r 'arferion gorau' ym mhob maes gweithgaredd, yn cynnwys rheoli ac arferion a thechnolegau gweithredol.
- Darparu fframwaith i sefydlu ac adolygu amcanion ansawdd, a thargedu cynlluniau cynnal a chadw i wella perfformiad gweithredol tra'n cadw o fewn cyllidebau cymeradwyedig.
- Hysbysu pawb o fewn Dŵr Cymru o gynnwys y polisi ansawdd a'r datganiad hwn, a gweithredu fframwaith 'cynllunio, gweithredu, gwirio, profi' er gwella'r busnes yn barhaus.
- Adolygu'r polisi ansawdd a'r datganiad hwn er sicrhau byddant yn para'n gymwys.
- Datblygu system rheoli ansawdd fydd yn cydymffurfio â gofynion BS EN ISO 9001, gan ei gofnodi, gweithredu a chynnal yn barhaus.

Mae Dŵr Cymru wedi ymrwymo i ddilyn arferion proffesiynol wth gynnal gweithgareddau cysylltiedig â hunan fonitro gweithwyr, yn cynnwys profi a chalibro.

Er mwyn gweithredu'r polisi ansawdd hwn yn effeithiol, mae Dŵr Cymru wedi sefydlu ac yn cynnal system rheoli ansawdd. Mae system rheoli ansawdd Dŵr Cymru yn ymgorffori gofynion cymhwysedd profi a chalibro cyffredinol mewn cysylltiad â hunan fonitro gweithwyr ac mae Dŵr Cymru wedi ymrwymo i gydymffurfio â safonau ISO/IEC 17025 a MCERTS ar gyfer hunan fonitro llif elifiant.

Mae Dŵr Cymru yn monitro perfformiad ac wedi sefydlu ac yn cynnal amcanion ansawdd a thargedau, gan eu cofnodi ac adolygu'n rheolaidd. Hysbysir pob aelod staff Dŵr Cymru o'r polisi, ynghyd â phawb yn gweithio ar ran y cwmni, yn cynnwys cyflenwyr a chontractwyr.

Adolygir y polisi bob blwyddyn a phan nodir newidiadau sylweddol.

Nigel Annett

Nigel Annett
Rheolwr Gyfarwyddwr
Dŵr Cymru-Welsh Water
Ebrill 2011

A3 Planning Permission and Environmental Statement

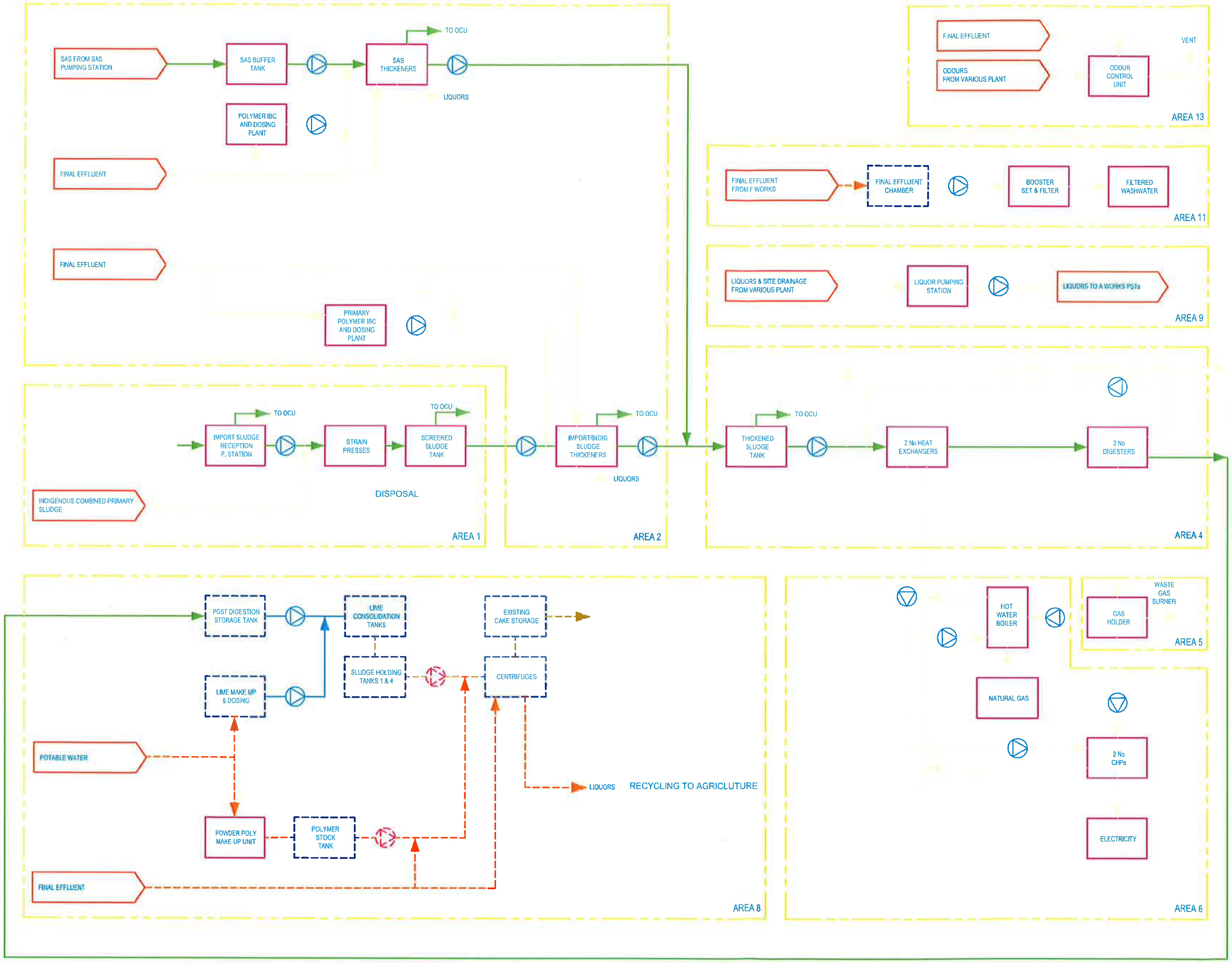
The Planning Permission and Environmental Statement are included on a disk due to their size.

The application was determined 'granted' on 8 March 2010 by the Chief Planning Officer, who has delegated powers and therefore the application did not go to Planning Committee.

Appendix B

Techniques for pollution control

B1 Process Diagram



NOTES:

LINE IDENTIFICATION

- MAIN PROCESS (NEW)
- MAIN PROCESS (EXISTING)
- ODOUR
- SECONDARY PROCESS (NEW)
- SECONDARY PROCESS (EXISTING)

Rev.	Nature of Revision	Drawn	Chkd.	Appd.	Date
C0	RAISED TO CONSTRUCTION	MH	AJS	SAC	07/04/11

CONSTRUCTION

Dŵr Cymru Welsh Water

DC-WW Unique Ref.	Costain Ref.	Imtech Ref.
DC-WW SAP Ref. A991.S.040.021	2480265	P1607

NORTH WALES AMP5 PROGRAMME
FIVE FORDS Sludge Treatment & Sustainable Energy

PROCESS BLOCK DIAGRAM

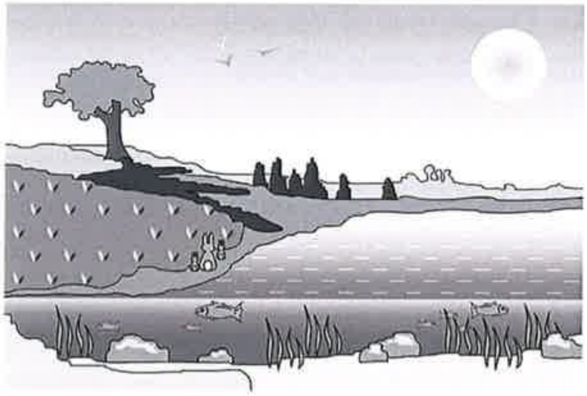
Dŵr Cymru - Welsh Water
Vista,
St Davids Park,
Ewloe,
FLINTSHIRE.
CH5 3DT
Tel: 01244 529700
Fax: 01244 529888

Drawn	Checked	Approved	Date	Scale
B Allen	C Ingram	A Smyth	22.07.09	NTS

Designer's Ref.	Drawing no.	Rev
	P1607/1101	C0

B2 Budds Farm Siloxane removal plant emission data

DOW CORNING



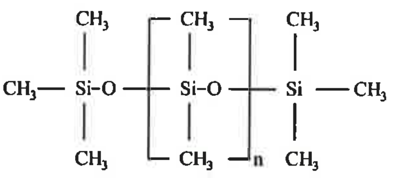
An Overview of Volatile Methylsiloxane (VMS)* Fluids in the Environment

Environmental Information - Update

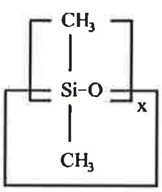
Health, Environment & Regulatory Affairs (HERA)

Summary of Use:

Volatile methylsiloxane (VMS) fluids are low molecular weight organosilicon materials with significant vapor pressure under ambient environmental conditions. They are volatile, low-viscosity silicone fluids consisting of-$(CH_3)_2SiO$- units in either linear or cyclic structures.



typically, n=0-4



typically, x=4-6

Although they are primarily used as intermediates in manufacturing high molecular weight silicone polymers, some VMS fluids are also found in cosmetics and other personal care formulations, often as carriers and emollients in antiperspirant, hair care, and skin care applications. The majority of the VMS materials in these personal care applications have a cyclic structure, and are designated as 'cyclomethicones' by the Cosmetic Toiletry and Fragrance Association (CTFA). Some linear VMS materials are finding applications in the USA as VOC-exempt solvents and CFC replacements in precision cleaning applications under the name *Dow Corning© OS* Fluids.

Environmental Entry:

VMS emissions from industrial sources are limited, because the compounds are manufactured and used as intermediates in enclosed systems. Although most of the VMS fluid volatilizes into the atmosphere from consumer applications, the amount released per use is extremely small, and environmental emissions are therefore very diffuse. Small amounts of VMS can also end up in wastewater. If these essentially insoluable compounds should end up in surface waters with treated effluent, they have been shown to partition to the atmosphere. VMS degrades readily in the air via ongoing natural processes, such as oxidation by OH radicals. [1, 2] With its short lifespan, the atmospheric content of VMS is expected to remain far below the No Observable Effect Level (NOEL).

Environmental Fate and Effects:

Atmospheric: The lifetime of volatile methylsiloxanes in the atmosphere is between 10 and 30 days. [1,2] The ultimate oxidative degradation products are naturally-occuring substances: carbon dioxide, silica and water. Because they contain no chlorine or bromine atoms and degrade quickly in the troposphere, [1,2] VMS materials have no potential to deplete (or even reach) stratospheric ozone. They do not contribute significantly to global warming in comparison to organic compounds, which have much higher carbon levels that are converted to CO_2.

* Refers to materials with a molecular weight under 600

Since all VMS compounds have the same building blocks (i.e., chains of silicon and oxygen atoms, and methyl groups attached to silicon), they degrade according to the same mechanisms to yield increasingly less volatile, silanol-rich structures with increased water solubility and decrease lipophilicity.

These oxidative degradation products are not expected to have any significant adverse environmental effects. As long as they remain in the atmosphere, such degradation products (i.e., partially oxidized VMS derivatives) are subject to the same oxidative conditions as their precursors, and will continue to degrade. Recent results have also shown the possibility of these partial degradation products being dry-deposited by attaching to dust particles.[3]

When the partial oxidates are deposited or scrubbed out of the atmosphere, they are not expected to present any threat to aquatic or terrestrial biota due to their decreased lipophilicity. These partial oxidates are expected to ultimately oxidize to natural silica, water and carbon dioxides.[4]

Recent studies demonstrate that VMS compounds have negligible potential to adversely impact urban air quality. Specifically, these studies show that VMS materials do not contribute to the formation of ozone in the urban atmosphere.[5] Similar conclusions were drawn when atmospheric reactivity data[1] were used to calculate the Photochemical Ozone Creation Potential (POCP) of VMS materials using the Harwell Photochemical Trajectory Model.[6]

VMS compounds are not persistent in the atmosphere. No significant contribution has been observed from VMS materials to ground level ozone generation[5] or aerosol formation.[7] Based on these findings, the U.S. EPA and almost all individual states in the U.S. have issued formal VOC exemptions for VMS fluids, acknowledging that they are not VOC ozone precursors.[8] These materials have also been approved as CFC replacements in precision-, metal-, and electronic cleaning applications.[9]

Aquatic: The cyclic tetramer $[(CH_3)_2SiO]_4$ (octamethylcyclotetrasiloxane, or OMCTS) has been extensively tested for ecotoxicological properties as part of an industry testing program carried out under the U.S. EPA Toxic Substances Control Act.[10] This regulatory-driven effort evaluated the possible transport of OMCTS from consumer products to aquatic ecosystems and the potential effects on aquatic organisms. The testing has served to define No Observable Effect Levels (NOEL) for this material, and the program (under a consent order negotiated with the EPA) included physico-chemical and environmental fate studies, as well as extensive aquatic toxicity testing.

Additional voluntary work sponsored by the industry through the Silicones Environmental, Health, and Safety Council (SEHSC) included broad-scale environmental fate modeling, wastewater treatment plant (WWTP) monitoring, and the development of a comprehensive aquatic risk assessment.

Although the studies indicated that toxic aquatic effects can be observed in laboratory tests,[11] a subsequent Exposure Assessment[12] and exposure monitoring at wastewater treatment plants[12] concluded that levels in the aquatic environment can be conservatively estimated at 64 to 444 times below the NOEL.[13] For benthic organisms, 157- to 1080-fold margins of safety have been estimated.[14] Rapid volatilization and additional dilution in most aquatic environments will increase this ratio even further.

Because of their physical properties (low water solubility, low density, rapid volatilization) and short lifetimes, OMCTS and other VMS compounds are not expected to reach ecologically significant levels in the aquatic environment. Concentrations are expected to be low and transient in water and sediments. No adverse effects are expected in the aquatic environment from the use of VMS in various applications.

The U.S. EPA has issued its "Final RM1 Aquatic Risk Characterization"(March 15, 1995), concluding that OMCTS represents a low risk to aquatic organisms.[15] The SEHSC risk assessment (including the supplemental studies) was the basis for the EPA conclusion that the agency's concerns had been addressed, and no additional ecotoxicity data was required. This RM1 decision brings to closure the TSCA Section 4 Consent Order ecotoxicity testing program which was initiated in 1984 by the Interagency Testing Committee (ITC).

Dow Corning's commitment to environmental responsibility includes continuous research to determine the fate and effects of our products. This summary is based on the most current information available on VMS materials. We will continue to share the results of our ongoing studies in a program of open communication with regulatory agencies, customers, employees, industry associations and the public. The company maintains an extensive facility in the U.S. dedicated to health and environmental sciences, and was a significant contributor to a handbook on the environmental aspects of organosilicon materials which is now in publication.[16]

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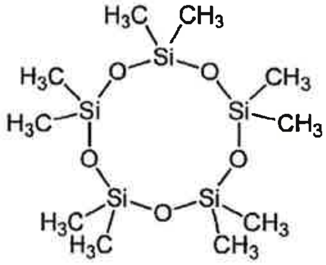
Volatile Methyl Siloxanes (VMS)

Methyl Siloxanes are widely used in a variety of industrial processes and are frequently added to consumer products, such as detergents, shampoos, cosmetics, paper coatings and textiles.



They are a subgroup of silicones containing Si–O bonds with organic radicals bound to Si and including methyl, ethyl and other functional organic groups. Siloxanes are widely used because of their useful properties, including high compressibility, low flammability, low surface tension and water repelling properties, high thermal stability and the limited effect of temperature on the useful properties. They present, moreover, a low toxicity and a very low allergy; they are biodegradable in the atmosphere (not environmental persistent); and they are compliant with any volatile organic compounds (VOC) restrictions.

The atmospheric chemistries of several volatile methyl siloxanes have been studied extensively, and demonstrate that methyl siloxanes are degraded efficiently by atmospheric photochemical reactions but do not contribute significantly to the formation of ground level (urban) ozone.

Based upon these experimental results, the Environment Agency classified several volatile methyl siloxanes as *non-reactive* volatile organic compounds (VOCs) and exempted them from VOC control regulations.

The water solubility of Siloxanes is very low. These a-polar compounds enhance the octanol–water partition coefficient. Siloxanes do not accumulate in the water phase but are selectively adsorbed on the sludge.

When emitted into the atmosphere, several reactions occur, which ultimately achieve total destruction of the siloxanes.

Volatile Methyl Siloxane (VMS) compounds are low molecular weight, linear or cyclic species with significant vapour pressure under ambient environmental conditions, some of which can arise as intermediates in the siloxane degradation processes.

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E-mail enq@pptek.co.uk Company Number 4047710 VAT Number 760 2735 39

CERAM TEST RESULTS

CERAM Reference: (106063)

Determination of Siloxanes

GC-MS (Method C51)

Date of Test: 29-Nov-2010 to 01-Dec-2010

CERAM Sample Reference		(106063)-27909
Material Type		Tedlar Bag
Your Reference		Budds Air 11-11-10 18:40
Result(s)	**Units**	
Hexamethylcyclotrisiloxane	mg/m³	273.6
Octamethylcyclotetrasiloxane	mg/m³	142.6
Decamethylcyclopentasiloxane	mg/m³	111.5
Hexamethyldisiloxane	mg/m³	13.2
Octamethyltrisiloxane	mg/m³	1.2
Decamethyltetrasiloxane	mg/m³	<1.0
Total Organo-Silicon Compounds as Si	mg/m³	205.8
UKAS Accredited		Yes

Mr S W Watson
Authorised Signatory

CERAM TEST RESULTS

CERAM Reference: (106063)

LFG Trace Suite
GCMS (Method C51)

Date of Test: 18-Nov-2010 to 22-Nov-2010

CERAM Sample Reference		(106063)-27909
Material Type		Tedlar Bag
Your Reference		Budds Air 11-11-10 18:40
Result(s)	**Units**	
Dichloromethane	mg/m³	<1.0
1,1,1-Trichloroethane	mg/m³	<1.0
Trichloroethylene	mg/m³	<1.0
Tetrachloroethylene	mg/m³	<1.0
1,1-Dichloroethane	mg/m³	<1.0
cis-1,2-Dichloroethylene	mg/m³	<1.0
Vinyl Chloride	mg/m³	<1.0
1,1-Dichloroethylene	mg/m³	<1.0
trans-1,2-Dichloroethylene	mg/m³	<1.0
Chloroform	mg/m³	<1.0
1,2-Dichloroethane	mg/m³	<1.0
1,1,2-Trichloroethane	mg/m³	<1.0
Chlorobenzene	mg/m³	<1.0
Dichlorobenzene	mg/m³	<1.0
Chloroethane	mg/m³	<1.0
Carbon Tetrachloride	mg/m³	<1.0
Freon 113	mg/m³	<1.0
Freon 11	mg/m³	<1.0
Freon 12	mg/m³	<1.0
Freon 21	mg/m³	<1.0
Freon 22	mg/m³	<1.0
Freon 114	mg/m³	<1.0
Freon 142b (semi-quantitative)	mg/m³	<1.0
Dimethylsulphide	mg/m³	<1.0
Dimethyldisulphide	mg/m³	<1.0
Ethane Thiol	mg/m³	<1.0
Carbon Disulphide	mg/m³	<1.0
Diethyl Sulphide	mg/m³	<1.0
Methane Thiol	mg/m³	<1.0
Ethylmethylsulphide	mg/m³	<1.0
Diethyldisulphide	mg/m³	<1.0
1,2-Dichloropropane	mg/m³	<1.0
Bromochloromethane	mg/m³	<1.0
cis-1,3-Dichloropropene	mg/m³	<1.0
trans-1,3-dichloropropene	mg/m³	<1.0
Dibromochloromethane	mg/m³	<1.0
Dibromomethane	mg/m³	<1.0
Bromoform	mg/m³	<1.0
UKAS Accredited		Yes

The following compounds are not covered by the CERAM UKAS 17025 scope of accreditation. Methanethiol, ethanethiol, Dibromomethane, 1,1,2,2-tetrachloroethane, 1,2,4-trimethylbenzene, 1,2,3-trimethylbenzene, 1,3,5-trimethylbenzene,

Mr S W Watson
Authorised Signatory

CERAM TEST RESULTS

CERAM Reference: (106063)

LFG Trace Suite
GCMS (Method C51)

Date of Test: 18-Nov-2010 to 22-Nov-2010

CERAM Sample Reference		(106063)-27909
Material Type		Tedlar Bag
Your Reference		Budds Air 11-11-10 18:40
Result(s)	**Units**	
Total Chlorinated Compounds	mg/m^3	<1.0
Total Fluorinated Compounds	mg/m^3	<1.0
Total Organo-Sulphur Compounds	mg/m^3	<1.0
Total Chlorinated Compounds as Cl	mg/m^3	None Detected
Total Fluorinated Compounds as F	mg/m^3	None Detected
Total Organo-Sulphur Compounds as S	mg/m^3	None Detected
neo-Pentane	ppm	<1
Pentane	ppm	<1
Hexane	ppm	<1
Heptane	ppm	<1
Octane	ppm	<1
Nonane	ppm	<1
Decane	ppm	2
Dodecane	ppm	<1
Butyl Acetate	mg/m^3	<1.0
Ethyl Acetate	mg/m^3	<1.0
iso-Propyl Acetate	mg/m^3	<1.0
Propyl Acetate	mg/m^3	<1.0
Amyl Acetate	mg/m^3	<1.0
sec-Butyl Acetate	mg/m^3	<1.0
tert-Butyl Acetate	mg/m^3	<1.0
Benzyl Acetate	mg/m^3	<1.0
Cumene	mg/m^3	<1.0
d-Limonene	mg/m^3	1.3
alpha-Pinene	mg/m^3	<1.0
beta-Pinene	mg/m^3	<1.0
3-Carene	mg/m^3	1.3
Methyl Butyrate	mg/m^3	<1.0
UKAS Accredited		Yes

Mr S W Watson
Authorised Signatory

CERAM TEST RESULTS

CERAM Reference: (106063)

LFG Trace Suite
GCMS (Method C51)

Date of Test: 18-Nov-2010 to 22-Nov-2010

CERAM Sample Reference		(106063)-27909
Material Type		Tedlar Bag
Your Reference		Budds Air 11-11-10 18:40
Result(s)	**Units**	
2-Butoxyethanol	mg/m³	1.5
Ethyl Butyrate	mg/m³	<1.0
1-Pentene	mg/m³	<1.0
1,3-Butadiene	mg/m³	<1.0
Furan	mg/m³	<1.0
1-Butanethiol	mg/m³	<1.0
1-Propanethiol	mg/m³	1.5
Benzene	mg/m³	<1.0
Toluene	mg/m³	53.1
Ethyl Benzene	mg/m³	<1.0
m,p-Xylene	mg/m³	<1.0
o-Xylene	mg/m³	<1.0
1-Butene	mg/m³	<1.0
2-Butene	mg/m³	<1.0
o-ethyltoluene	mg/m³	<1.0
m-ethyltoluene	mg/m³	<1.0
p-ethyltoluene	mg/m³	<1.0
Phenol	mg/m³	1.7
1,1,2,2-Tetrachloroethane	mg/m³	<1.0
1,2,3-Trimethylbenzene	mg/m³	<1.0
1,2,4-Trimethylbenzene	mg/m³	1.9
1,3,5-Trimethylbenzene	mg/m³	<1.0
1,2,3-Trichlorobenzene	mg/m³	<1.0
1,2,4-Trichlorobenzene	mg/m³	<1.0
1,3,5-Trichlorobenzene	mg/m³	<1.0
2-Pentene	mg/m³	<1.0
Thiopene	mg/m³	<1.0
1,4-dichlororbenzene	mg/m³	<1.0
1-Pentanethiol	mg/m³	<1.0
UKAS Accredited		Yes

End of Test Report

Mr S W Watson
Authorised Signatory

B3 Emissions data and Air Quality Assessment

Appendix B4 Emissions to Air calculations sheet

Substances	CHP 1										Stack internal daimeter	Internal area	
	mg/m3	m3/hr	mg/hr	kg/hr	kg/yr (pro rata)	g/sec	tonnes/yr (pro rata)	Operating time %	tonnes/yr		mm	m2	m/s
Methane	3.98	2537.69	10,100.01	0.01	88.48	0.00	0.09	85%	0.08		300	0.07	9.97
Carbon dioxide	166818.52	2537.69	423,333,690.02	423.33	3,708,403.12	117.59	3,708.40	85%	3,152.14		300	0.07	9.97
Hydrogen sulphide	0.00	2537.69	0.00	0.00	0.00	0.00	0.00	85%	0.00		300	0.07	9.97
Sulphur dioxide	317.24	2537.69	805,066.78	0.81	7,062.30	0.22	7.05	85%	5.99		300	0.07	9.97
Nitrogen	892910.26	2537.69	2,265,929,437.70	2,265.93	19,849,541.87	629.425	19,849.54	85%	16,872.11		300	0.07	9.97
Carbon monoxide	32.86	2537.69	83,388.49	0.08	730.48	0.02	0.73	85%	0.62		300	0.07	9.97
Oxygen	114054.20	2537.69	289,434,202.80	289.43	2,535,443.62	80.40	2,535.44	85%	2,155.13		300	0.07	9.97
Moisture	90000.57	2537.69	228,393,546.48	228.39	2,000,727.47	63.44	2,000.73	85%	1,700.62		300	0.07	9.97
Argon	15251.18	2537.69	38,702,766.97	38.70	339,036.24	10.75	339.04	85%	288.18		300	0.07	9.97
Total NOx	349.14	2537.69	886,009.09	0.89	7,761.44	0.2461	7.76	85%	6.60		300	0.07	9.97

Substances	CHP 2										Stack internal daimeter	Internal area	
	mg/m3	m3/hr	mg/hr	kg/hr	kg/yr (pro rata)	g/sec	tonnes/yr (pro rata)	Operating time %	tonnes/yr		mm	m2	m/s
Methane	3.98	2537.69	10,100.01	0.01	88.48	0.00	0.09	85%	0.08		300	0.07	9.97
Carbon dioxide	166818.52	2537.69	423,333,690.02	423.33	3,708,403.12	117.59	3,708.40	85%	3,152.14		300	0.07	9.97
Hydrogen sulphide	0.00	2537.69	0.00	0.00	0.00	0.00	0.00	85%	0.00		300	0.07	
Sulphur dioxide	317.24	2537.69	805,066.78	0.81	7,062.30	0.22	7.05	85%	5.99		300	0.07	9.97
Nitrogen	892910.26	2537.69	2,265,929,437.70	2,265.93	19,849,541.87	629.425	19,849.54	85%	16,872.11		300	0.07	9.97
Carbon monoxide	32.86	2537.69	83,388.49	0.08	730.48	0.02	0.73	85%	0.62		300	0.07	9.97
Oxygen	114054.20	2537.69	289,434,202.80	289.43	2,535,443.62	80.40	2,535.44	85%	2,155.13		300	0.07	9.97
Moisture	90000.57	2537.69	228,393,546.48	228.39	2,000,727.47	63.44	2,000.73	85%	1,700.62		300	0.07	9.97
Argon	15251.18	2537.69	38,702,766.97	38.70	339,036.24	10.75	339.04	85%	288.18		300	0.07	9.97
Total NOx	349.14	2537.69	886,009.09	0.89	7,761.44	0.2461	7.76	85%	6.60		300	0.07	9.97

Substances	Boiler exhaust stack using biogas										Stack internal daimeter	Internal area	
	mg/m3	m3/hr	mg/hr	kg/hr	kg/yr (pro rata)	g/sec	tonnes/yr (pro rata)	Operating time %	tonnes/yr		mm	m2	m/s
Methane	4.22	2672.29	11,281.26	0.01	98.82	0.0031	0.10	15%	0.01		400	0.13	5.91
Carbon dioxide	176788.94	2672.29	472,430,745.02	472.43	4,138,493.33	131.23	4,138.49	15%	620.77		400	0.13	5.91
Hydrogen sulphide	0.00	2672.29	0.00	0.00	0.00	0.00	0.00	15%	0.00		400	0.13	5.91
Sulphur dioxide	336.20	2672.29	898,416.74	0.90	7,870.13	0.25	7.87	15%	1.18		400	0.13	5.91
Nitrogen	888036.95	2672.29	2,373,089,363.91	2,373.09	20,788,262.83	659.191	20,788.26	15%	3,118.24		400	0.13	5.91
Carbon monoxide	34.83	2672.29	93,070.36	0.09	815.30	0.03	0.82	15%	0.12		400	0.13	5.91
Oxygen	102995.19	2672.29	275,232,673.74	275.23	2,411,038.22	76.45	2,411.04	15%	361.66		400	0.13	5.91
Moisture	95379.73	2672.29	254,881,985.29	254.88	2,232,766.19	70.80	2,232.77	15%	334.91		400	0.13	5.91
Argon	15166.38	2672.29	40,528,928.57	40.53	355,033.41	11.26	355.03	15%	53.26		400	0.13	5.91
Total NOx	379.41	2672.29	1,013,903.02	1.01	8,881.79	0.2816	8.88	15%	1.33		400	0.13	5.91

Substances	Siloxane removal plant										Stack internal daimeter	Internal area	
	mg/m3	m3/hr	mg/hr (only 4hr/d)	kg/hr (only 4hr/d)	kg/yr (accounts for 4	g/sec (only 4hr/d)	tonnes/yr (pro rata)	Operating time %	tonnes/yr	kg/yr	mm	m2	m/s
Total organo-silicon Compounds as Si	205.80	800.00	164,640.00	0.16	1,442.25	0.05	1.44	17%	0.24	240.37	494	0.19	1.16

Substances	Waste gas burner								
	mg/m3	m3/hr	mg/hr	kg/hr	kg/yr	g/sec	tonnes/yr (pro rata)	Operating time %	tonnes/yr
Methane	5.80	3998.97	23,212.46	0.02	203.34	0.01	0.20	8%	0.02
Carbon dioxide	243082.76	3998.97	972,079,722.26	972.08	8,515,418.37	270.02	8,515.42	8%	681.23
Hydrogen sulphide	0.00	3998.97	0.00	0.00	0.00	0.00	0.00	8%	0.00
Sulphur dioxide	462.27	3998.97	1,848,594.11	1.85	16,193.68	0.51	16.19	8%	1.30
Nitrogen	854955.75	3998.97	3,418,939,043.44	3,418.94	29,949,906.02	949.705	29,949.91	8%	2,395.99
Carbon monoxide	47.89	3998.97	191,502.80	0.19	1,677.56	0.05	1.68	8%	0.13
Oxygen	29372.11	3998.97	117,458,088.24	117.46	1,028,932.85	32.63	1,028.93	8%	82.31
Moisture	131146.03	3998.97	524,448,529.41	524.45	4,594,169.12	145.68	4,594.17	8%	367.53
Argon	14597.52	3998.97	58,375,000.00	58.38	511,365.00	16.22	511.37	8%	40.91
Total NOx	220.23	3998.97	880,696.58	0.88	7,714.90	0.2446	7.71	8%	0.62

Totals

Substances	mg/l	Total t/yr
Methane	17.99	0.18
Carbon dioxide	753,508.75	7,606.29
Hydrogen sulphide	0.00	0.00
Sulphur dioxide	1,432.95	14.46
Nitrogen	3,528,813.22	39,258.45
Carbon monoxide	148.44	1.50
Oxygen	360,475.70	4,754.22
Moisture	408,526.90	4,103.69
Argon	60,266.27	670.53
NOx	1,297.93	15.14

Dŵr Cymru Welsh Water

Five Fords WwTW Advanced Digestion Project

Air Quality Assessment

216723

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Document Verification

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Contents

1 Introduction

Five Fords Wastewater Treatment Works (WwTW) serves a total population equivalent (PE) of the order of 132,000. Wastewater flows are received and treated from Wrexham and the surrounding district. Final treated effluent is discharged to the River Dee.

The sewage treatment process at the site is being upgraded, to improve the quality of the final effluent to meet new discharge standards. A new sludge treatment facility is also being constructed to provide the capacity to accommodate the additional sludge produced and improve the asset condition.

As part of the sludge treatment facility it is proposed to include a Combined Heat and Power (CHP) plant, to utilise the biogas produced by the Anaerobic Digestion (AD) process and to provide renewable heat and electricity both for the operation of the site and to be fed into the local electricity distribution network.

This study assesses the potential air quality impact from the combustion of the gas produced by the enhanced digestion process. This Report includes:

- A review of relevant air quality standards;
- A brief review of the current air quality situation in Wrexham County Borough Council (WCBC);
- Modelling of concentrations of carbon monoxide, sulphur dioxide and nitrogen dioxide within the study area and at discrete sensitive receptor locations; and
- A comparison of modelling results against relevant Air Quality Standards.

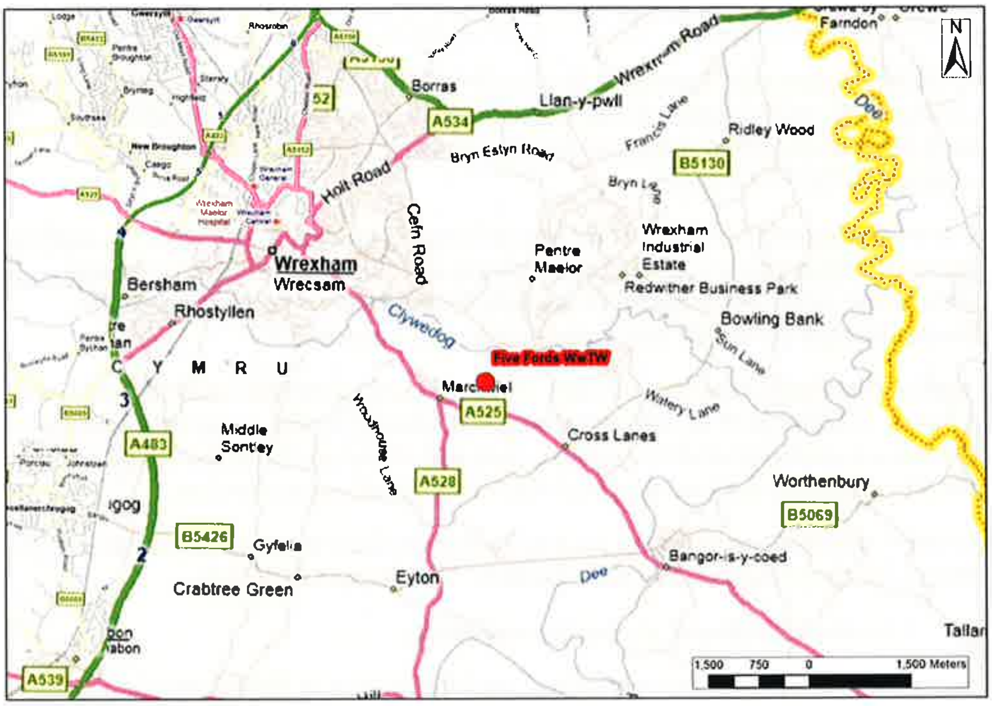
2 Five Fords WwTW Site Details

Five Fords WwTW is located at Grid Reference SJ363 481, approximately 3.5km to the south east of Wrexham Town Centre. The outskirts of the village of Marchwiel are located between 200 to 250m to the south west of the WwTW boundary and the village of Cross Lanes 1170m to the east, south east.

The new sludge treatment process will be built within the existing sludge treatment centre at the south east corner of the site.

Figure 1 shows the location of the Five Fords WwTW within WCBC.

Figure 1: Site Location



3 Air Quality Objectives and Limit Values

The following pollutants are considered in this assessment:

- nitrogen oxides (NOx) for the protection of vegetation;
- nitrogen dioxide (NO_2);
- carbon monoxide (CO); and
- sulphur dioxide (SO_2).

The modelled results for these pollutants have been compared against European Union limit values set out in the air quality 'framework' Directive on Ambient Air Quality Assessment and Management[1] and consequent daughter directives, and Air Quality Standards published in the Air Quality Strategy for England, Scotland, Wales and Northern Ireland published in July 2007. These objectives were set into regulation in the Air Quality Regulations 2000 and 2002. The EU limit values and national air quality objectives are presented below in Table 1.

[1] Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management

Table 1: Air Quality Objective and Limit Values

Pollutant	Averaging Period	Limit Value/Objective	Date for Compliance	Basis
Nitrogen dioxide (NO_2)	1 hour mean	200 $\mu g/m^3$, not to be exceeded more than 18 times a year (99.8th percentile)	31stDec 2005	UK
			1st Jan 2010	EU
	Annual mean	40 $\mu g/m^3$	31stDec 2005	UK
			1st Jan 2010	EU
Carbon monoxide (CO)	Running 8 hour mean	10 mg/m^3	31st Dec 2003	UK
	Daily 8 hour mean	10 mg/m^3	1st Jan 2005	EU
Sulphur dioxide (SO_2)	1 hour mean	350 $\mu g/m^3$, not to be exceeded more that 24 times a year (99.7th percentile)	31st Dec 2004	EU
	24 hour mean	125 $\mu g/m^3$, not to be exceeded more than 3 times a year (99.2nd percentile)	31st Dec 2004	EU
Nitrogen oxides (NO_x)*	Annual mean	30$\mu g/m^3$	19th Jul 2001	EU

*For the protection of vegetation

In accordance with Directive 1999/30/EC[2], the annual mean standard for NO_x applies to vegetation and ecosystems in areas:

- More than 20km from an agglomeration (area with a population of more than 250,000);
- More than 5km away from motorways;
- More than 5km away from industrial sources regulated under Part A of the Environment Act;
- More than 5km away from built up areas of more than 5,000 people.

It should be noted that fine particulate matter (PM_{10}) was not considered in this assessment as available emission data indicated that there were no emissions of PM_{10} arising from the operation of the CHP units or boiler.

[2] Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air

4 Baseline Conditions

4.1 Wrexham County Borough Council Review and Assessment of Air Quality

As required under the Environment Act 1995, local authorities have to review and assess air quality with respect to the objectives for seven pollutants specified in the Government's National Air Quality Strategy (NAQS). Local authorities are required to carry out an Updating and Screening Assessment (USA) of their area every three years. If the USA identifies potential hotspot areas likely to exceed air quality objectives, then a Detailed Assessment of those areas is required. Where objectives are not predicted to be met, local authorities must declare the area as an Air Quality Management Area (AQMA). In addition, local authorities are required to produce an Air Quality Action Plan (AQAP) which includes measures to improve air quality within the AQMA.

There are no AQMAs within the jurisdiction of Wrexham County Borough Council.

4.2 Nature Conservation Sites

An assessment of air quality impacts at designated sites is required as part of an environmental permit application. The Environment Agency's H1 guidance[3] states that conservation sites need to be considered where they fall within the following distances from the assessed activity:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 10km of the installation; and
- Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), Local Nature Reserves (LNRs), local wildlife sites and ancient woodland within 2km of the location of the installation.

There are no SSSI or other conservation sites within 2km of the proposed scheme. There is one Ramsar site within 10km of the application flue, namely the Midland Meres & Mosses Phase 2 site, located approximately 5.8km to the north of the site. The Midland Meres & Mosses Phase 2 site is designated for its rare and endangered species associated with wetlands. In addition, the River Dee and Bala Lake SAC is located approximately 2.6km to the southeast of the application flue. The primary reasons for the designation of this site are the Annex I Habitat *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation,* the distribution of which is unknown for this habitat, and the Annex II species Atlantic salmon *Salmo salar* and floating water-plantain *Luronium natans.*

The critical load for raised and blanket bogs is 5-10 kg N/Ha/year[4].

[3] Environment Agency (2010): H1 Environmental Risk assessment – annex f, v2.1 April 2010
[4] See: www.apis.ac.uk

4.3 Background Pollutant Concentrations

In the UK Air (Air Information Resource) website operated by AEA, Defra has produced background air pollution data for 2008 and projections for other years for nitrogen oxides (NO_x) and NO_2 for each 1km by 1km OS grid square (available from the UK Air website: http://uk-air.defra.gov.uk). **Table 2** shows background pollutant concentrations for the grid square within which the Five Fords WwTW is located.

Table 2: Pollutant Background Concentrations at NGR 336500, 348500

Pollutant	unit	2011
NO_x	$\mu g/m^3$	11.7
NO_2	$\mu g/m^3$	8.8

The UK Air website does not hold data for background CO and SO_2 concentrations after 2001. The SO_2 annual mean background concentration in 2001 was 3.85$\mu g/m^3$ and the annual mean CO background concentration was 0.255mg/m^3. It is likely that current background concentrations of these pollutants are even lower as pollution sources continued to be more tightly regulated.

When comparing the background pollutant concentrations with the relevant air quality objectives and limit values presented in **Table 1** it becomes apparent that background pollutant concentrations are well below the relevant objectives and limit values for all assessed pollutants.

5 Methodology

5.1 Assessment Scenarios

Gas will be combusted within two CHP (combined heat and power) units. The site will also have a dual fuel (biogas and natural gas) boiler that will operate when the CHP units are not in operation. During normal operation the CHPs will run continuously for long periods of time. However the CHP will be periodically shut down for planned maintenance: in this scenario the boiler will come into operation to maintain temperature within the heated anaerobic digestion process. The modelling has thus considered two scenarios:

- Scenario 1. Both CHP units (combusting biogas generated within the new sludge digestion process) operating at 100% output.
- Scenario 2. One CHP unit is operational at 100% output and the boiler is operating at 100%.

5.2 Model Description

Modelling of air quality has been undertaken using the BREEZE AERMOD 7.1.18 atmospheric dispersion model. This model is widely used in the United States and is the US EPA's principal model for air dispersion. This model is also widely employed in the UK and accepted by the UK Environment Agency. Five years (2006-2010) of meteorological data from the Hawarden meteorological station have been used in the assessment.

Dispersion of emissions from a source is affected by the following factors:

- physical emissions characteristics, i.e. how much pollutant is being emitted and at what velocity and temperature;
- local meteorology;
- topography; and
- building downwash.

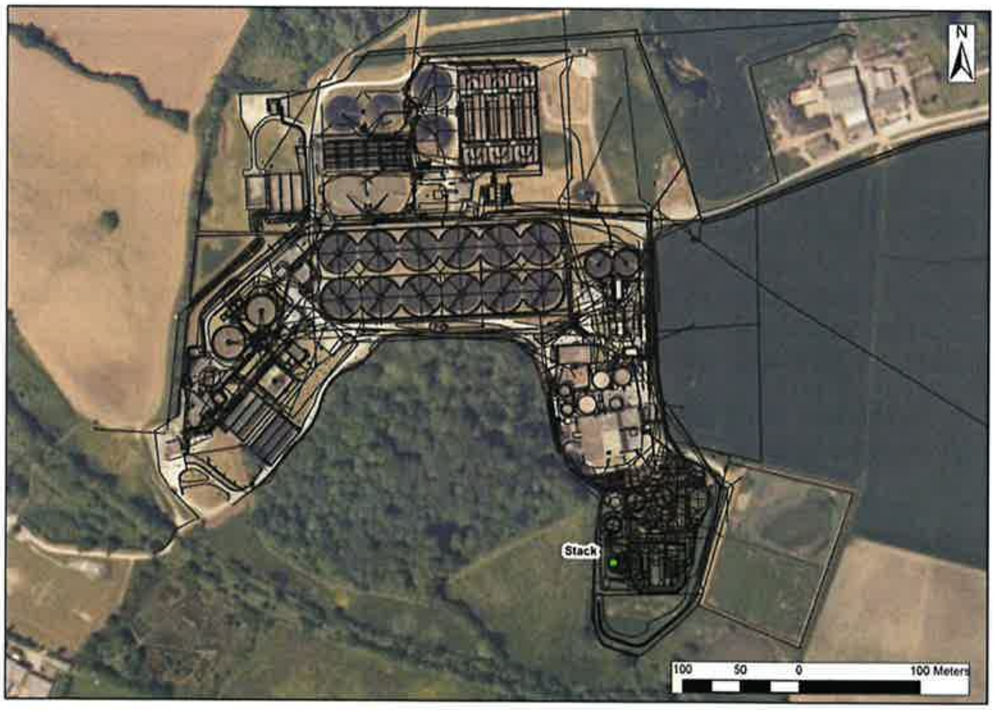
The model, therefore, requires information on the sources of emissions, the nature of local buildings, topography and meteorological conditions. These are described in the following sections.

5.3 Emissions

Emissions of concern from the CHP and boiler stack include NOx, CO and SO_2.

The stack will comprise three flues within a single windshield. The combined stack will have a height of 17m. Within the windshield the CHP flues will each be of 400mm diameter and the boiler flue of 300mm diameter. The location of the stack is shown in Figure 2.

Figure 2: Location of Modelled Stack



The modelling assessment has taken into account the emissions stack as the only point source on the site. Since emissions from each CHP and boiler are emitted from a separate vent in close proximity to each other (all atop one emission stack), for the purpose of realistic dispersion physics, the CHP emissions were treated as one release and the boiler emissions treated as one release. The model source stack diameter and hence mass flux was adapted to account for the different number of CHP and boiler units operating. The characteristics of the emission sources are shown in Table 3 below.

Table 3: Characteristics of Modelled Stack Emissions

Emission Point	Grid Reference	Stack Diameter (m)	Release Temp (K)	Stack Height (m)	Efflux Velocity (m/s)
Scenario 1: 2 CHP units					
CHP x2	336404, 347892	0.424	453	17	16.55
Scenario 2: 1 CHP unit and 1 boiler					
CHP	336404, 347892	0.3	453	17	16.55
Boiler	336404, 347892	0.4	473	17	10.23

Emissions data were provided by Imtech N.V. process engineers as shown in Table 4 below. Emissions rates were modelled as constant maximum production for the entire year (24 hours a day, 365 days a year) for the two different scenarios.

Table 4: Emission Rates of Modelled Stack

Pollutant	Scenario 1: 2 CHP units (g/s)	Scenario 2: 1 CHP and 1 boiler (g/s)	
	CHP flue	CHP flue	Boiler flue
NO_x	0.492	0.246	0.282
CO	0.04	0.02	0.03
SO_2	0.44	0.22	0.25

5.4 Buildings

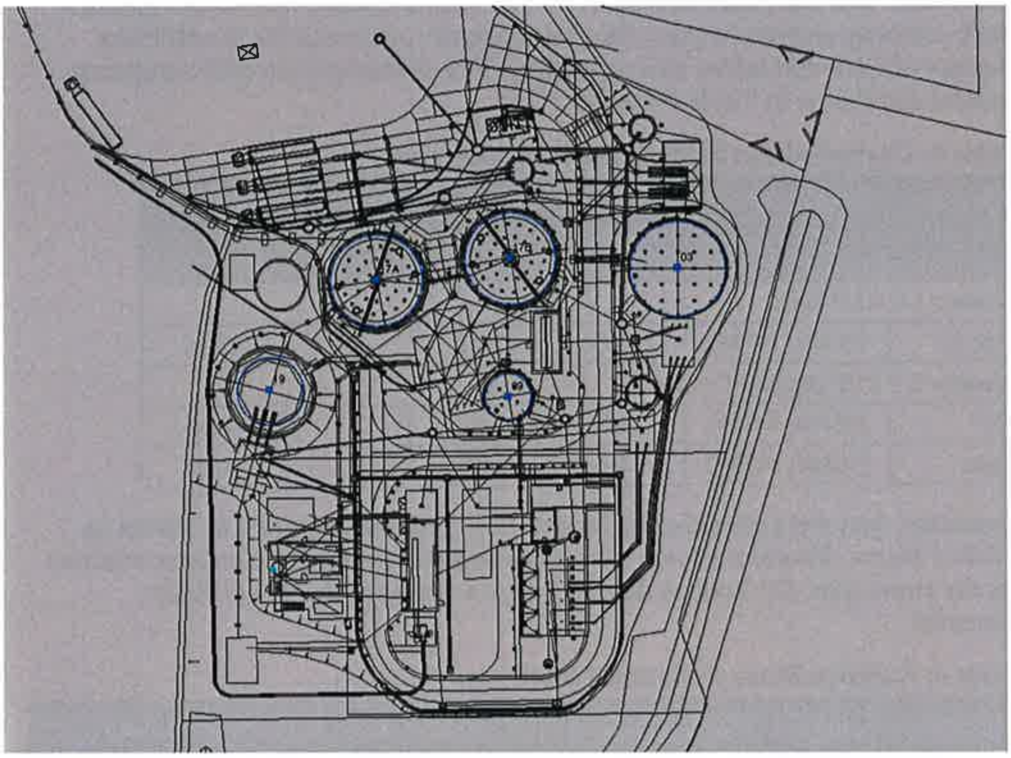
Building downwash can result in a significant increase in pollutant concentrations close to the point of emission. The AERMOD model can account for the effects of building downwash. The main effect is to entrain pollutants into the cavity region in the immediate leeward side of the building, bringing them rapidly down to ground level. Consequently, concentrations near buildings are increased but decreased further away.

The structures included in the modelling are shown in Figure 3 and details are provided in Table 5.

Table 5: Characteristics of Modelled Buildings

Building No.	Building Description	Shape	Height (m)
03	Screened Sludge Storage Tank	Circular	12.8
09	Thickened Sludge Buffer Tank	Circular	11.7
17a	Digester	Circular	21.0
17b	Digester	Circular	21.0
19	Gas Holder	Circular	11.0

Figure 3: Modelled Structures



5.5 Receptors

A polar grid of radius 4500m, radial spacing of 15m and angular spacing of 7.2° was used to predict pollutant concentrations. The grid was centred on the point source being modelled at 336404, 347892.

In addition, discrete receptors in the vicinity of the proposed site were chosen. **Table 6** and **Figure 4** provide details of the discrete receptor locations.

Table 6: Details of Discrete Receptors

Receptor	Location	Description
R1	336078,348678	Farm approximately 850m north of the stack
R2	335873,347936	Residential approximately 540m west of the stack
R3	336020,347752	Residential approximately 410m southwest of the stack
R4	336592,348480	Farm approximately 615m northeast of the stack
R5	336573,348262	Farm approximately 410m northeast of the stack

Figure 4: Discrete Receptor Locations

5.6 Background Pollutant Concentrations

Background pollutant concentrations need to be added to the predicted model results to determine if air quality standards and objectives are likely to be met or exceeded.

Long-term (annual) average background pollutant concentrations were taken from maps provided on the UK Air website (see section 4.3). The projected annual average background concentrations for the year 2011 were added to the process contribution to provide a total concentration for comparison with the annual mean objectives for NOx and NO_2. To model the short term objectives for NO_2, CO and SO_2, double the annual average background concentration was added to the process contribution to give total short term concentrations in accordance with Defra's Local Air Quality Management: Technical Guidance (09)[5].

5.7 NO_x to NO_2 Conversion

The model predicts NO_x concentrations which comprise principally nitric oxide (NO) and a small percentage of NO_2. The emitted NO reacts with oxidants in the air (mainly ozone) to form more NO_2. Since only NO_2 is associated with effects on human health, the air quality standards for the protection of human health are based on NO_2 and not total NO_x or NO. A suitable NO_x: NO_2 conversion needs to be applied to the modelled NO_x concentrations.

[5] DEFRA (2009) Part IV of the Environmental Act 1995: Local Air Quality Management: Technical Guidance, LAQM.TG(09), Department for Environment, Food and Rural Affairs, February 2009

A NO_x to NO_2 conversion ratio of 100% for annual means and 50% for 99.79th percentile of hourly means was used as advised by the Environment Agency Air Quality and Assessment Unit[6].

5.8 Terrain

The site is located on a relatively flat coastal flood plain therefore terrain did not need to be taken into account within the model.

5.9 Meteorology

The air quality impact of air pollutant releases can vary widely according to the prevailing weather conditions. Wind speed is an important factor in diluting pollutant releases and wind direction is crucial for determining where a point source pollutant release may impact.

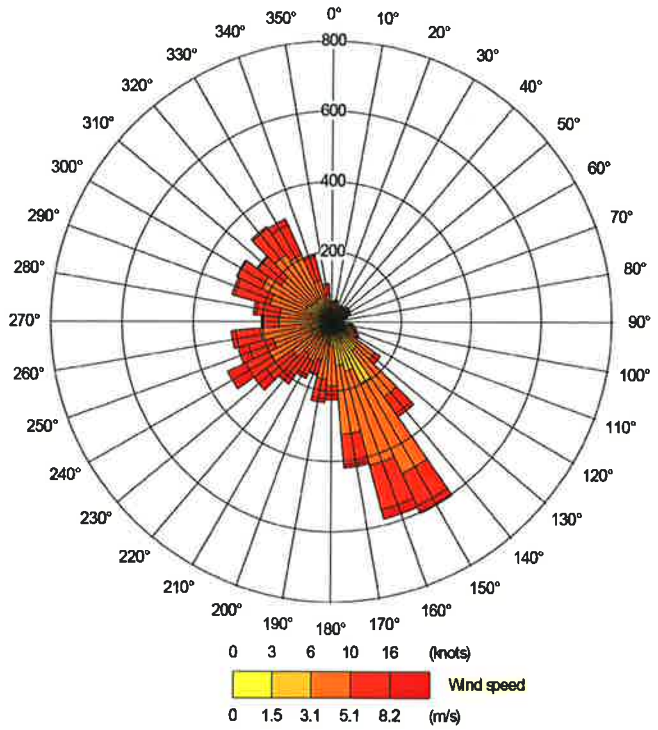
In order for the modelling exercise to be representative of local conditions and to predict long-term averages, the dispersion model requires site-specific representative meteorological data. Hourly observation data for the Hawarden meteorological station were obtained for five years (2006 – 2010). Hawarden meteorological station is located approximately 20km to the north of the site.

Hawarden is an airfield and as such an open, flat space generally similar to the study site. The nearest alternative met station is at Shawbury, over 40km to the south. Whilst Shawbury is again an open, flat airfield, it is significantly further away from the site and further inland. Both Hawarden and Five Fords are closer to the coast and less sheltered by the Welsh Hills (to the west) than Shawbury.

The wind rose for 2006 is illustrated in Figure 5. Wind roses for the years 2007 to 2010 are presented in Appendix A.

[6] http://www.environment-agency.gov.uk/business/regulation/38791.aspx

Figure 5: Wind Rose for Hawarden Meteorological Station 2006



5.10 Conservation Sites

Nitrogen deposition and annual mean NO_x concentrations at conservation site locations have been assessed using outputs from the Breeze Aermod dispersion model. The annual mean NO_x contribution at the closest point to the stack within the conservation site has been calculated for the worst case meteorological year and the worst case operational scenario. **Table 7** shows the NGR of the modelled locations within the two assessed conservation sites. It should be noted that only NO_x and nitrogen deposition have been considered as the APIS (Air Pollution Information System) website[7] does not list SO_2 as a pollutant which wetland habitats are sensitive to and thus acidification has not been assessed in this study.

Table 7: Model locations within Conservation Sites

Site	Location nearest to the stack
Midland Meres & Mosses Phase 2 Ramsar site	336021; 353647
River Dee and Bala Lake SAC	338758; 346519

[7] www.apis.ac.uk

6 Results

6.1 Model Output

AERMOD models each year of meteorological data individually in order to determine the effects of each year's particular atmospheric conditions on pollutant concentrations. The maximum hourly and daily averages were modelled over a five-year period (2006 – 2010) in AERMOD. Maximum values and their locations for the five meteorological years in the period 2006-2010 for selected receptor locations are given in this section.

Additionally, contour plots are given for the worst case year to show the geographical distribution of pollutants.

6.2 Nitrogen Oxides

Tables 8 to 11 show the process contribution to annual mean NO_x concentrations and the 99.79th percentile of hourly NO_x concentrations at sensitive receptor locations. The worst case year (i.e. meteorological conditions) for every receptor is shown in bold.

Table 8: Results for annual mean NO_x process contribution in µg/m^3; Scenario 1

Receptor	2006	2007	2008	2009	2010
R1	**0.47**	0.39	0.37	0.45	0.32
R2	0.07	0.07	**0.09**	**0.09**	0.07
R3	0.14	0.09	**0.14**	0.13	0.13
R4	**0.24**	0.18	0.23	0.20	0.15
R5	0.34	0.29	**0.36**	0.31	0.20

Table 9: Results for 99.79 percentile NO_x process contribution in µg/m^3; Scenario 1

Receptor	2006	2007	2008	2009	2010
R1	**7.67**	7.25	7.21	7.66	7.43
R2	4.63	**6.04**	4.64	4.67	4.29
R3	6.65	5.95	**7.61**	6.92	7.24
R4	7.91	8.06	**8.16**	7.81	7.41
R5	9.51	**10.41**	10.03	9.01	8.55

Table 10: Results for annual mean NO_x process contribution in µg/m^3; Scenario 2

Receptor	2006	2007	2008	2009	2010
R1	**0.62**	0.53	0.49	0.60	0.43
R2	0.10	0.10	**0.13**	0.12	0.09
R3	0.18	0.12	**0.18**	0.17	0.17
R4	**0.32**	0.25	0.31	0.28	0.20
R5	0.47	0.39	**0.49**	0.43	0.28

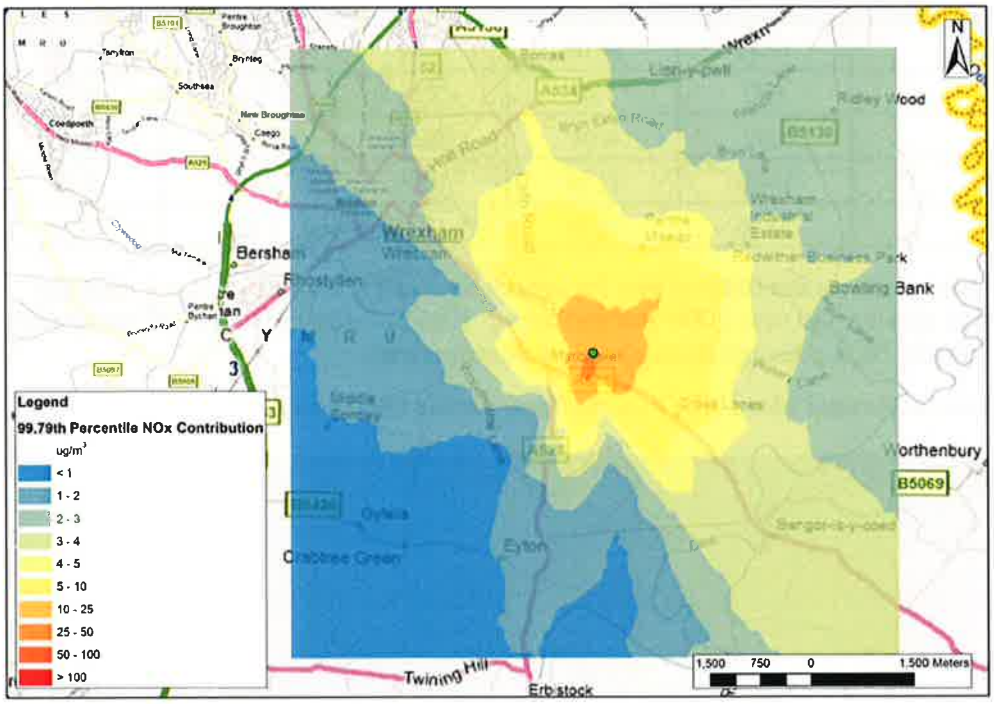
Table 11: Results for 99.79 percentile NO_x process contribution in µg/m³; Scenario 2

Receptor	2006	2007	2008	2009	2010
R1	10.47	10.08	9.89	**10.71**	10.56
R2	5.63	**7.67**	7.26	7.24	5.21
R3	8.92	8.01	**10.36**	9.53	8.77
R4	**10.90**	11.20	10.79	10.63	9.77
R5	12.80	12.99	**13.26**	12.50	10.62

Figure 6 shows the contour plot for annual mean NO_x concentrations within the study area for the year 2008 and scenario 2. **Figure 7** shows the 99.79th percentile of hourly NOx concentrations (process contribution).

Figure 6: Annual Mean NO_x Process Contribution (Scenario 2; 2008)

Figure 7: 99.79th Percentile NO_x Process Contribution (Scenario 2, 2008)



6.3 Nitrogen Dioxide

The modelling results for NO_2 are presented in Tables 11 to 14. It should be noted that these results have been derived from the modelled NOx results by assuming 100% of NOx is converted to NO_2 for the annual mean concentrations (long term) and 50% of NO_x is converted to NO_2 for the hourly mean (short term) concentrations. This is a conservative approach and would result in worst case concentrations. Background pollutant concentrations have been added to the modelled results as discussed in section 5.6.

Table 12: Results for annual mean NO_2 concentrations in µg/m³; Scenario 1

Receptor	2006	2007	2008	2009	2010
R1	9.37	9.29	9.27	9.35	9.22
R2	8.97	8.97	8.99	8.99	8.97
R3	9.04	8.99	9.04	9.03	9.03
R4	9.14	9.08	9.13	9.10	9.05
R5	9.24	9.19	9.26	9.21	9.10
Limit/ Objective	40	40	40	40	40

Table 13: Results for 99.79 percentile NO_2 concentrations in µg/m^3; Scenario 1

Receptor	2006	2007	2008	2009	2010
R1	21.64	21.42	21.40	21.63	21.52
R2	20.11	20.82	20.12	20.14	19.95
R3	21.12	20.78	21.60	21.26	21.42
R4	21.76	21.83	21.88	21.71	21.51
R5	22.56	23.01	22.81	22.31	22.07
Limit/ Objective	200	200	200	200	200

Table 14: Results for annual mean NO_2 concentrations in µg/m^3; Scenario 2

Receptor	2006	2007	2008	2009	2010
R1	9.52	9.43	9.39	9.50	9.33
R2	9.00	9.00	9.03	9.02	8.99
R3	9.08	9.02	9.08	9.07	9.07
R4	9.22	9.15	9.21	9.18	9.10
R5	9.37	9.29	9.39	9.33	9.18
Limit/ Objective	40	40	40	40	40

Table 15: Results for 99.79 percentile NO_2 concentrations in µg/m^3; Scenario 2

Receptor	2006	2007	2008	2009	2010
R1	23.03	22.84	22.75	23.16	23.08
R2	20.62	21.63	21.43	21.42	20.40
R3	22.26	21.80	22.98	22.56	22.19
R4	23.25	23.40	23.20	23.12	22.68
R5	24.20	24.30	24.43	24.05	23.11
Limit/ Objective	200	200	200	200	200

The results in **Table 12** to **Table 15** show that both annual and hourly NO_2 concentrations are well below the relevant air quality objective and limit value.

6.4 Sulphur Dioxide

The results for the 1 hour mean (99.73rd percentile) and the 24 hour mean (99.18th percentile) are presented in the tables below. Contour plots are presented in **Figure 8** and **Figure 9**.

Table 16: Results for 99.73 percentile SO_2 process contribution in µg/m^3; Scenario 1

Receptor	2006	2007	2008	2009	2010
R1	**6.69**	6.34	6.28	6.67	6.46
R2	3.60	**4.27**	3.97	3.90	3.47
R3	5.72	5.09	**6.47**	5.95	6.07
R4	6.90	6.88	**7.08**	6.83	5.93
R5	7.93	**9.18**	8.73	7.67	6.89
Limit/ Objective	350	350	350	350	350

Table 17: Results for 99.18 percentile SO_2 process contribution in µg/m^3; Scenario 1

Receptor	2006	2007	2008	2009	2010
R1	**2.45**	2.00	2.06	2.04	2.06
R2	1.10	1.11	**1.31**	1.27	0.83
R3	**2.61**	1.64	2.40	2.33	1.71
R4	1.34	1.22	**1.51**	1.30	1.36
R5	2.17	1.84	**2.22**	1.76	1.93
Limit/ Objective	125	125	125	125	125

Table 18: Results for 99.73 percentile SO_2 process contribution in µg/m^3; Scenario 2

Receptor	2006	2007	2008	2009	2010
R1	9.12	8.88	8.66	**9.24**	9.19
R2	4.76	**5.75**	5.06	5.42	4.38
R3	7.36	6.46	**8.33**	8.03	7.49
R4	9.33	**9.43**	8.86	9.15	7.99
R5	10.98	11.34	**11.55**	10.99	9.05
Limit/ Objective	350	350	350	350	350

Table 19: Results for 99.18 percentile SO_2 process contribution in µg/m³; Scenario 2

Receptor	2006	2007	2008	2009	2010
R1	**3.52**	2.56	2.69	2.92	2.55
R2	1.42	1.69	1.50	**1.70**	1.08
R3	3.20	2.11	2.98	**3.78**	2.02
R4	**1.87**	1.61	**1.87**	1.59	1.62
R5	2.73	2.23	**2.98**	2.31	2.27
Limit/ Objective	125	125	125	125	125

The background concentration for annual mean SO_2 concentrations at the receptor locations is 3.85µg/m³. Adding twice that concentration to any of the modelled process contribution results would still result in total concentrations well below the relevant objective and limit value.

Figure 8: 1hr SO_2 Process Contribution (Scenario 2, 2008)

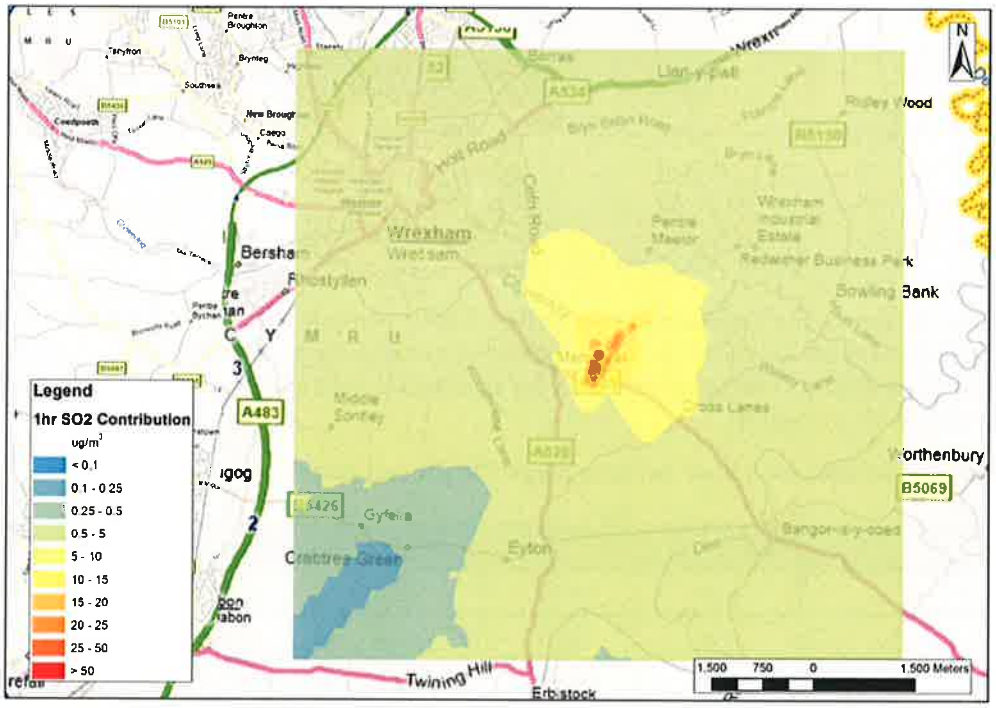
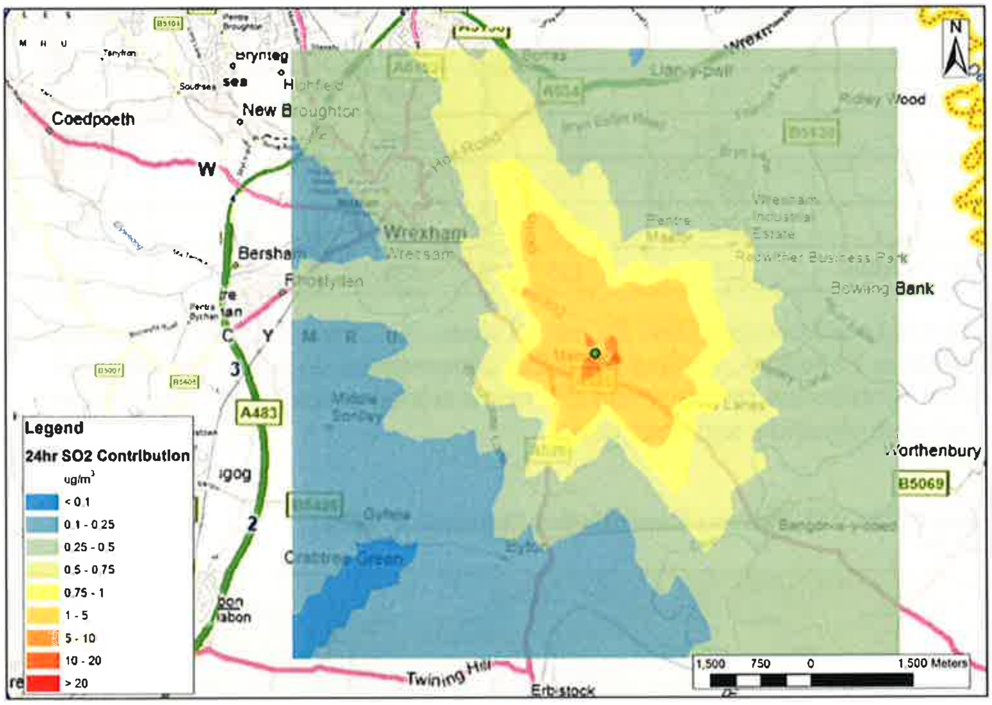


Figure 9: 24hr SO_2 Process Contribution (Scenario 2, 2008)



6.5 Carbon Monoxide

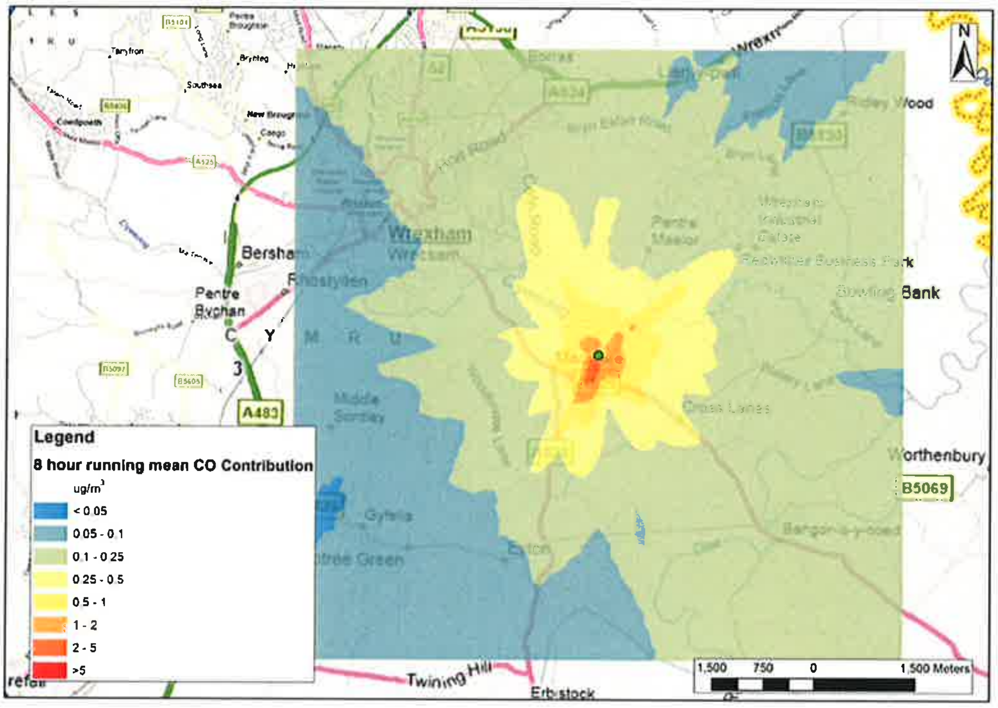
Table 20 shows the results of the modelled 8 hour running mean for CO at all assessed receptor locations for the 5 meteorological years considered. It is considered appropriate to present data for scenario 2 only as this gives worst case results for all pollutants.

Table 20: Results for 8 hour running mean CO process contribution in µg/m³; Scenario 2

Receptor	2006	2007	2008	2009	2010
R1	**0.69**	0.51	0.56	0.65	0.65
R2	0.49	0.53	**0.60**	0.56	0.38
R3	**0.78**	0.53	0.77	0.63	0.42
R4	0.54	0.41	**0.59**	0.41	0.39
R5	0.65	0.64	**0.87**	0.58	0.60
Limit/ Objective	10000	10000	10000	10000	10000

Figure 10 shows a contour plot for the 8 hour running mean CO concentrations within the study area.

Figure 10: Process Contribution to 8hour running mean CO concentrations (Scenario 2; 2008)



The background CO concentrations obtained from the UK Air website for 2001 (latest year available) is 0.255mg/m^3. Adding twice that concentration to any of the modelled CO process contribution concentrations would still result in total concentrations well below any air quality objective and limit value.

6.6 Conservation Sites

The process contribution of annual mean NOx concentrations has been calculated for the nearest location within the Midland Meres & Mosses Phase 2 Ramsar site and the River Dee and Bala Lake SAC. The process contribution to annual mean NOx concentrations at both sites has been modelled as less than 0.1µg/m^3. It is considered that this contribution is insignificant and would not have any impact on the conservation sites.

7 Conclusions

The model results show that the process contribution from the CHP units and boiler at 100% operation will not give rise to a significant increase in pollutant concentrations. The assessment showed that air quality objectives and limit values for all assessed pollutants and scenarios are comfortably met.

Appendix A

Wind Roses

A1 Wind Roses

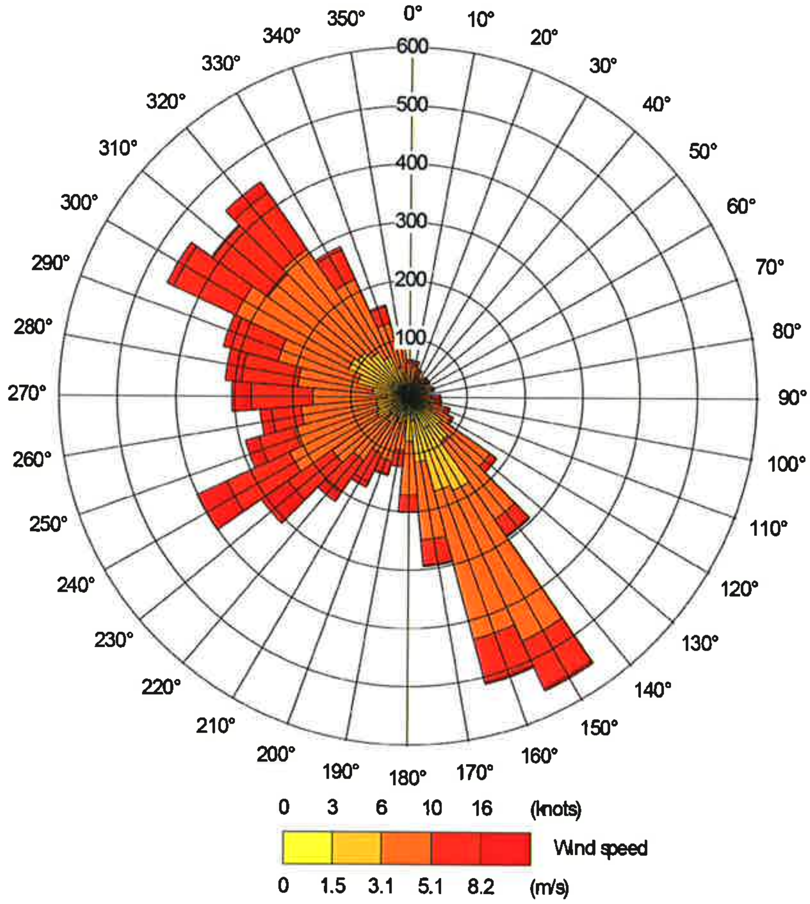


Figure A1: Wind Rose for Hawarden Meteorological Station 2007

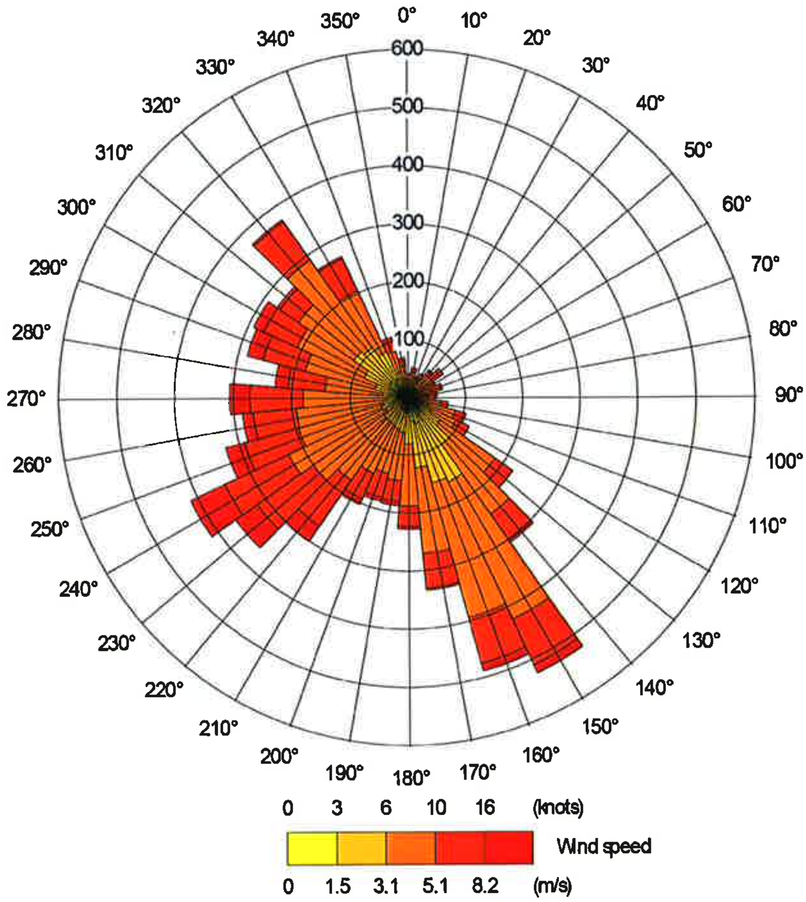


Figure A2: Wind Rose for Hawarden Meteorological Station 2008

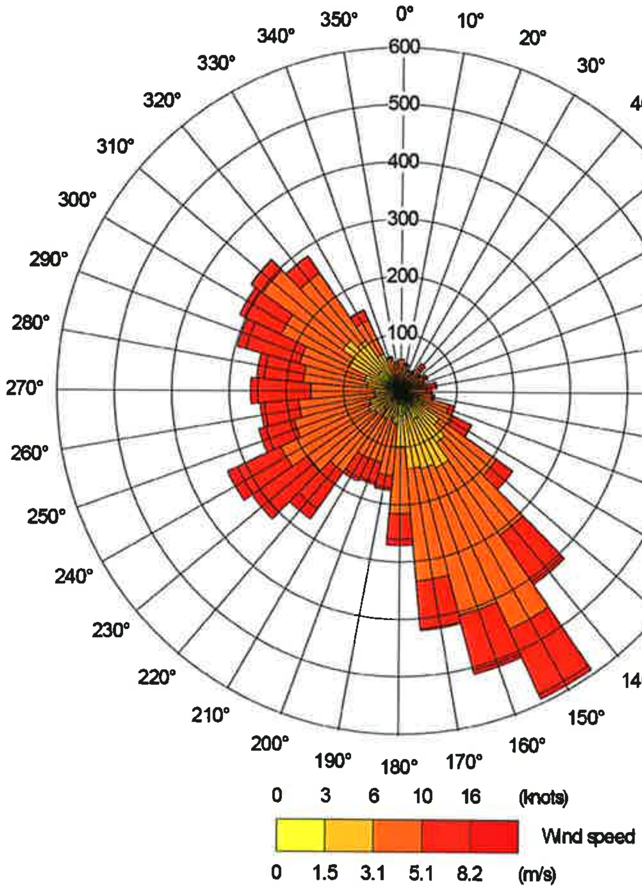


Figure A3: Wind Rose for Hawarden Meteorological Station 2009

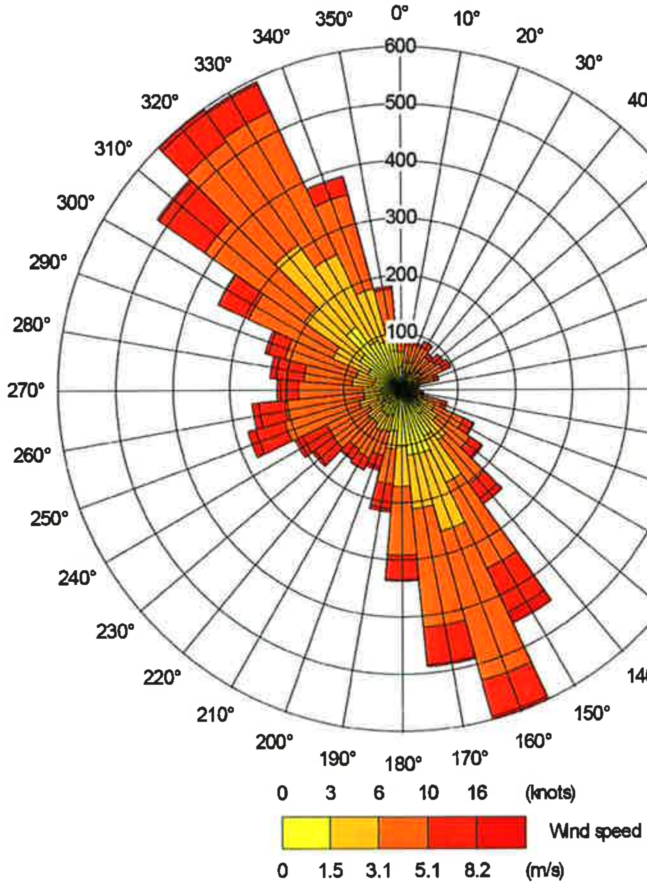


Figure A4: Wind Rose for Hawarden Meteorological Station 2010