

Carbonarius Ltd

*Health Impact Assessment for a
Proposed Wood Gasification Facility,
Pebble Hall, Near Theddingworth*

August 2013

8 Alcotts Green
Sandhurst
Gloucester
GL2 9PE
Tel +44 (0) 1452 730240
Fax +44 (0) 1452 730240
Email gfynes@gf-environmental.co.uk
Web: www.gf-environmental.co.uk

Table of Contents

Table of Contents	ii
Authorisation Sheet	iii
Executive Summary	iv
1. Introduction	1
1.1 Introduction	1
2. Standards and Basis for Assessment	2
2.2 Nitrogen Dioxide (NO ₂)	3
2.3 Sulphur Dioxide (SO ₂)	4
2.4 Particles (PM ₁₀)	5
2.5 Hydrogen Chloride (HCl)	6
2.6 Hydrogen Fluoride (HF)	6
2.7 Volatile Organic Compounds (VOCs)	6
2.8 Heavy Metals	6
2.9 Dioxins and Furans	6
3. Conclusions	8

Authorisation Sheet

Client: Carbonarius Ltd

Project: *Health Impact Assessment for a Proposed
Wood Gasification Facility, Pebble Hall,
Near Theddingworth*

Version: Second Draft

PREPARED BY

Signature:

Name: Geoff Fynes

Position: Director, GF Environmental Ltd

Date: August 2013

AGREED BY

Signature:

Name: Des Mitchell

Position: Research and Development Director, Carbonarius Ltd

Date: August 2013

DISTRIBUTION

Carbonarius Ltd

Statutory Consultees

GP Planning Ltd

Executive Summary

A worst case assessment has been undertaken of the potential impact on the health of local residents resulting from exposure to pollutants release from the proposed wood gasification facility to be built on land at Pebble Hall near Theddingworth, Leicestershire.

The assessment included the pollutants prescribed for co-incineration plants by the EC Industrial Emissions Directive for which the proposed wood gasification facility will be regulated by the Environment Agency when it becomes operational. The assessment compared the maximum Process Contribution (PC) to ground level pollutant concentrations against the Air Quality Standard (AQS) or Environmental Assessment Level (EAL), based upon a factor calculated from the ratio of the PC value to the AQS.

A COMEAP assessment, undertaken for nitrogen dioxide, sulphur dioxide and particles (PM₁₀), also considered the potential increase in hospitalisation as a result of respiratory complaints associated with exposure to these pollutants in the emissions from the proposed wood gasification facility. Increases in hospital admissions due to respiratory complaints of between 0.2% and 0.02% of the population were predicted for the three pollutants at the point of the maximum Process Contribution (~200 metres to the north-east of the chimney of the wood gasification facility); values which are considered to be low and probably not significant. Values at nearby residential properties were likely to be significantly lower in relation to their distance from the wood gasification facility development site, with values for Receptor No.2 (~900m to the east) estimated to be between 0.05% and 0.006% of the population likely to be affected.

An assessment of the potential uptake of dioxins as a result of inhalation and dietary factors showed that the exposure to dioxins released from the chimney of the proposed wood gasification facility was likely to represent <1% of the Tolerable Daily Intake for adults and infants living at the nearest downwind residential receptor location (Receptor No.2), and was considered to be insignificant.

The overall conclusion of the health impact assessment is that the magnitude of potential health effects associated with exposure to pollutants released from the chimney of the proposed wood gasification facility is very low and will not have a significant impact on the health of people living and working nearby.

1. Introduction

1.1 Introduction

1.1.1 This document assesses the potential health impacts associated with pollutant emissions to atmosphere from the proposed wood gasification facility to be built by Carbonarius Ltd on land at Pebble Hall, near Theddingworth, Leicestershire. The assessment focuses on the potential impact of emissions from the chimney of the wood gasification facility.

1.1.2 Reference is made to Air Quality Standards and Environmental Assessment Levels specified for the protection of human health.

2. Standards and Basis for Assessment

2.1.1 Air Quality Standards (AQS) have been established primarily to protect the health of the general population. Detailed atmospheric dispersion modelling predicted that there would be no exceedences of any AQS or Environmental Assessment Level as a result of emissions from the chimney of the proposed wood gasification facility. Accordingly, it is expected that the operation of the Facility will not pose a significant risk to the health of the local population living in the area around the development site. In order to quantify the potential impact of airborne pollutants on the health of the surrounding community, a health impact assessment (HIA) has been carried out.

2.1.2 The primary source of pollutant emissions from the proposed wood gasification facility is the 30 metre high chimney associated with the facility. Health effects associated with exposure to pollutants are generally associated with either acute effects (noticeable soon after exposure), or chronic effects (noticeable after prolonged exposure).

2.1.3 The pollutants considered in the air quality assessment fall into the following categories:

Acute Effects

Oxides of Nitrogen (NO_x);

Sulphur Dioxide (SO₂);

Particulates;

Carbon Monoxide (CO);

Hydrogen Chloride (HCl);

Hydrogen Fluoride (HF);

Chronic Effects

Volatile Organic Compounds (VOCs);

Cadmium and Thallium and their compounds (Cd & Tl);

Mercury and its compounds (Hg);

Other Metals; and,

Dioxins and Furans.

2.1.4 The above may have significant health effects in isolation, but may also have synergistic effects in combination with other pollutants. For example, the absorption of acid gases such as SO₂ onto fine particles can result in more severe respiratory effects than exposure to either pollutant in isolation.

2.1.5 The assessment has included the consideration of the direct risks associated with exposure to pollutants released to atmosphere from the chimney of the proposed wood gasification facility .

2.1.6 For most of the pollutants considered, the assessment is based upon the incremental increase in background concentration, the Process Contribution (PC), associated with emissions to atmosphere. Where data are available on background pollutant concentrations then reference is also made to the Predicted Environmental Concentration (PEC), which is the sum of the PC and the estimated background value for 2013.

2.1.7 The Committee on the Medical Effects of Air Pollutants (COMEAP) developed a procedure for assessing the potential health effects associated with exposure to certain

air pollutants¹. The COMEAP procedure involves the calculation of the potential number of members of the population that might be admitted to hospital as a result of exposure to pollutants. The following formula is used in the calculation procedure:

$$\text{Incremental Impact} = C_{\text{avg}} \times \left(\frac{D_{\text{Pollutant}}}{10} \right) \times B_{\text{Health}}$$

Where:

- C_{avg} is the modelled concentration (annual average - µg m⁻³ derived from modelling);
- D_{Pollutant} is the COMEAP dose-response coefficient (% increase per 10 µg m⁻³)
- B_{Health} is the baseline rate for the health effect (per annum)

2.1.8 The dose-risk coefficients specified in the COMEAP study are summarised in the following table:

Pollutant	Health Outcome	Dose-Response Coefficient
Particles (PM ₁₀)	Deaths brought forward (all causes)	+ 0.75% per 10 µg m ⁻³ (24 hour mean)
	Respiratory hospital admissions	+ 0.80% per 10 µg m ⁻³ (24 hour mean)
Sulphur Dioxide (SO ₂)	Deaths brought forward (all causes)	+ 0.6% per 10 µg m ⁻³ (24 hour mean)
	Respiratory hospital admissions	+ 0.5% per 10 µg m ⁻³ (24 hour mean)
Nitrogen Dioxide (NO ₂)	See note below	See note below
Notes:		
For NO ₂ a coefficient of 0.5% per 10 µg m ⁻³ was used to estimate the effect on respiratory hospital admissions in a sensitivity analysis.		
Source: COMEAP (1998)		

2.1.9 The HIA presented in this report considers the potential impact of emissions of all of the above pollutants on the health of local residents living in the vicinity of the proposed wood gasification facility development.

2.1.10 The assessment of the significance of these effects has been determined in relation to the following criteria:

- Comparison with the relevant Air Quality Standard or EAL;
- The ratio between the Process Contribution and the AQS or EAL; and,
- The incremental impact on health (in accordance with COMEAP procedures).

2.1.11 It should be noted that the assessment is based upon the maximum value for the Process Contribution which is predicted to occur within ~200 metres of the chimney of the wood gasification facility. The corresponding values at residential receptors farther afield are significantly lower, as the magnitude of the Process Contribution decreases markedly with distance from the point of release.

2.1.12 In addition, a detailed dioxin health risk assessment has been carried out in line with the Human Health Risk Assessment Protocol (HHRAP) developed by the US EPA², and is reported separately.

2.2 Nitrogen Dioxide (NO₂)

2.2.1 The potential impact on human health of NO₂, arising from emissions of oxides of nitrogen (NO_x) from the proposed wood gasification facility, has been considered in relation to both the maximum hourly average (100% value) and annual average model predictions.

¹ COMEAP (Committee on the Medical Effects of Air Pollutants) (1998) The quantification of the effects of air pollution on health in the United Kingdom. Department of Health, London: The Stationery Office

² http://www.epa.gov/Region6/6pd/rcra_c/protocol/protocol.htm

Maximum PC	Estimated Background Concentration	AQS	Ratio of AQS/EAL to PC (PEC)
74 $\mu\text{g m}^{-3}$	-	200 $\mu\text{g m}^{-3}$	~2.7 (2.1)
4.1 $\mu\text{g m}^{-3}$	10.4 $\mu\text{g m}^{-3}$	40 $\mu\text{g m}^{-3}$	~10 (~2.8)

- 2.2.2 The background NO_2 concentration used to calculate the PEC value is the average for the area in the vicinity of the wood gasification facility development site, taken from the DEFRA 2010 update background maps website³.
- 2.2.3 As can be seen, there is a factor of ~2.7 for the ratio between the maximum hourly PC of ~74 $\mu\text{g m}^{-3}$ and the hourly average AQS of 200 $\mu\text{g m}^{-3}$. The corresponding factor for the annual average is ~10, which falls to ~2.8 when the PEC value is taken into account. The results apply to the location of the maximum Process Contribution which is ~200 metres from the chimney of the wood gasification facility, within the confines of the site, and therefore unlikely to affect third parties. Results at nearby residential receptors are significantly lower in relation to their distance from the site.
- 2.2.4 It should be noted that the above assessment is based upon the short term NO_x ELV of 400 $\mu\text{g m}^{-3}$ for the prediction of the maximum hourly Process Contribution, and the corresponding long term NO_x ELV was used to calculate the maximum annual average Process Contribution. The hourly average PC value is the maximum value for the 8,784 hours considered in the assessment, and so represents an absolute worst case scenario. Accordingly the above assessment represents an overly pessimistic representation of what is likely to occur when the proposed wood gasification facility becomes operational.
- 2.2.5 When the COMEAP methodology is applied to the data for NO_2 , and based upon the worst case maximum annual average Process Contribution value, the estimated increase in respiratory admissions to hospital per year could increase by 0.2% which can probably be screened out as insignificant.
- 2.2.6 It should be borne in mind that this relates to the location of the maximum Process Contribution, which is within ~200 metres of the chimney of the proposed wood gasification facility stack. At Receptor No.2, the location of the nearest downwind residential property ~900 metres to the north-east of the chimney of the wood gasification facility, the annual average NO_2 Process Contribution was predicted to be ~1 $\mu\text{g m}^{-3}$, with an associated 0.05% increase in hospital admissions due to respiratory complaints.
- 2.2.7 Maximum hourly average NO_2 PEC values at this location, are likely to be ~100 $\mu\text{g m}^{-3}$ (based upon an estimated annual average background concentration of 10.4 $\mu\text{g m}^{-3}$ and a Process Contribution of ~74 $\mu\text{g m}^{-3}$), or about 50% of the hourly average AQS. This corresponds to an air quality description in the "Low Band", with an Air Quality Index of 2, with the following recommended health advice for at-risk individuals; "Enjoy your usual outdoor activities"⁴.

2.3 Sulphur Dioxide (SO_2)

- 2.3.1 The potential impact on human health of SO_2 , arising from emissions from the proposed wood gasification facility, has been considered in relation to both the hourly peak and annual predictions.

Maximum PC	Existing Background Concentration	AQS	Ratio of AQS/EAL to PC
110 $\mu\text{g m}^{-3}$	-	350 $\mu\text{g m}^{-3}$	~3.3
1.5 $\mu\text{g m}^{-3}$	-	20 $\mu\text{g m}^{-3}$	~11

³ <http://laqm.defra.gov.uk/maps/maps2010.html>

⁴ <http://uk-air.defra.gov.uk/air-pollution/daqj>

- 2.3.2 As can be seen, there is a significant factor of ~3 for the ratio between the maximum hourly PC of ~110 $\mu\text{g m}^{-3}$ (based upon the maximum Process Contribution and the short term IED ELV of 200 mg Nm^{-3}) and the hourly average AQS of 350 $\mu\text{g m}^{-3}$, and the corresponding factor for the annual average is ~11, which indicates that there is little risk of exceeding the health-based AQS for SO_2 .
- 2.3.3 When the COMEAP methodology is applied to the data for SO_2 , and based upon the worst case maximum Process Contribution value, the estimated increase in respiratory admissions to hospital per year could increase by 0.08%, and can probably be screened out as insignificant. As noted above, this relates to the location of maximum Process Contribution, which is within ~200 metres of the chimney of the proposed wood gasification facility.
- 2.3.4 At Receptor No.2, the location of the nearest downwind residential property, the annual average SO_2 Process Contribution was predicted to be ~0.3 $\mu\text{g m}^{-3}$, with an associated 0.02% increase in hospital admissions due to respiratory complaints, and unlikely to have a significant impact on the health of local residents.
- 2.3.5 Maximum hourly average SO_2 PC values at this location, are likely to be about 6 $\mu\text{g m}^{-3}$, or about 1.5% of the hourly average AQS. This corresponds to an air quality description in the “Low Band”, with an Air Quality Index of 1, with the following recommended health advice for at-risk individuals; “*Enjoy your usual outdoor activities*”.
- 2.3.6 The magnitude of the number of predicted increase in additional admissions to hospital per year due to respiratory complains associated with increased background concentrations of SO_2 from the proposed wood gasification facility is very small, and can be screened out as not significant.

2.4 Particles (PM_{10})

- 2.4.1 The potential impact on human health of particles (PM_{10}), arising from emissions from the proposed wood gasification facility development has been considered in relation to both the hourly peak and annual predictions.

Maximum PC	Existing Background Concentration *	AQS	Ratio of AQS/EAL to PC
17.1 $\mu\text{g m}^{-3}$	-	50 $\mu\text{g m}^{-3}$	~2.9
0.3 $\mu\text{g m}^{-3}$	15.2 $\mu\text{g m}^{-3}$	40 $\mu\text{g m}^{-3}$	~133 (2.6)

- 2.4.2 The background PM_{10} concentration used to calculate the PEC value is the average for the area in the vicinity of the wood gasification facility development site, taken from the DEFRA background maps website.
- 2.4.3 As can be seen, there is a significant factor for the ratio of ~3 between the maximum daily PC of ~17 $\mu\text{g m}^{-3}$ (based upon the short term IED ELV of 30 mg Nm^{-3}) and the daily average AQS of 50 $\mu\text{g m}^{-3}$, and the corresponding factor for the annual average is ~133, falling to about 3 when the background is taken into account, indicating that there is little risk of exceeding the health-based AQS for PM_{10} . It should be noted that the AQS applies to PM_{10} whereas the emissions from the wood gasification facility are based upon total particulate emission. Therefore, the assessment may overestimate the significance of particulate emissions.
- 2.4.4 When the COMEAP methodology is applied to the data for particulates as PM_{10} , and based upon the worst case maximum Process Contribution value, the estimated increase in respiratory admissions to hospital due to respiratory complaints could increase by 0.02%, and can be screened out as insignificant.
- 2.4.5 At Receptor No.2, the location of the nearest downwind residential property, the annual Process Contribution was predicted to be ~0.08 $\mu\text{g m}^{-3}$, with an associated 0.006% increase in hospital admissions due to respiratory complaints.

2.4.6 Maximum rolling daily average PM₁₀ PEC values at this location, are likely to be about 26 µg m⁻³, or about half of the daily average AQS. This corresponds to an air quality description in the “Low Band”, with an Air Quality Index of 1, with the following recommended health advice for at-risk individuals; “*Enjoy your usual outdoor activities*”.

2.4.7 The magnitude of the number of predicted additional admissions to hospital per year due to respiratory complaints associated with increased background concentrations of PM₁₀ is very small, and can be screened out as insignificant.

2.5 Hydrogen Chloride (HCl)

2.5.1 The health effects associated with exposure to hydrogen chloride are primarily acute impacts on the respiratory system, accordingly, the assessment is based upon the short term modelling predictions. The maximum hourly PC for hydrogen chloride is ~30 µg m⁻³, based upon the short term IED ELV of 60 mg Nm⁻³, which gives a factor of ~24, for the ratio of the PC to the short term EAL of 750 µg m⁻³. Consequently no significant effects on the health of the community are expected as a result of the emission of HCl from the proposed wood gasification facility development.

2.6 Hydrogen Fluoride (HF)

2.6.1 The health effects associated with exposure to hydrogen fluoride are primarily acute impacts on the respiratory system, accordingly, the assessment is based upon the short term modelling predictions. The maximum hourly PC for hydrogen fluoride is ~2 µg m⁻³, based upon the short term IED ELV of 4 mg Nm⁻³, which gives a factor of ~75 for the ratio of the PC to the short term EAL of 160 µg m⁻³. Consequently no significant effects on the health of the community are expected as a result of the emission of HF from the proposed wood gasification facility development.

2.7 Volatile Organic Compounds (VOCs)

2.7.1 There are no environmental assessment levels for VOCs, therefore to provide a worst case assessment, the PC values for VOCs were compared against the AQS for benzene, which is 5 µg m⁻³ expressed as an annual average. The health effects associated with exposure to benzene in the ambient air are primarily chronic impacts, accordingly, the assessment is based upon the long term modelling predictions. It should also be noted that benzene is likely to comprise a small proportion (probably <5%) of the total VOC emission, and therefore this assessment represents a gross overestimation of the true impact of VOC emissions.

2.7.2 The maximum annual average PC for VOCs was 0.3 µg m⁻³, which gives a factor of ~17 for the ratio of the annual PC to the annual AQS of 5 µg m⁻³, which indicates that there are unlikely to be any significant effects on the health of the community as a result of exposure to emissions of VOCs from the proposed wood gasification facility.

2.8 Heavy Metals

2.8.1 A detailed assessment for Group 3 metals was undertaken as part of the air quality assessment and reported in Section 4.13 of the atmospheric dispersion modelling report that accompanies this application.

2.9 Dioxins and Furans

2.9.1 The UK Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment recommended⁵ a Tolerable Daily Intake (TDI) for dioxins is 2 pg kg⁻¹ day⁻¹. A detailed dioxin health risk assessment has been undertaken that considered dioxin intake via the dietary and inhalation routes, and is reported separately. The conclusions

⁵ Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment, Statement on the Tolerable Daily Intake for Dioxins and Dioxin-like Polychlorinated Biphenyls

were that dioxin intake at nearby residential receptors based upon a series of worst case assumptions would be <1% of the TDI. The assessment indicates that the risk to health of the local population due to exposure to dioxins in emissions from the proposed wood gasification facility is likely to be very low. Furthermore, it should be noted also that the assessment was based upon emissions at the IED ELV of 0.066 ng Nm⁻³ (11% O₂, dry & STP) and that when operational, emissions of dioxins are likely to be significantly lower, with proportionate benefits for lower exposure levels for individuals living in the vicinity of the site.

- 2.9.2 In conclusion, there is no significant health risk associated with emissions of dioxins from the proposed wood gasification facility to be built by Carbonarius on the Pebble Hall site, near Theddingworth.

3. Conclusions

- 3.1.1 A worst case assessment has been undertaken of the potential impact on the health of local residents resulting from exposure to pollutants release from the proposed wood gasification facility to be built on land at Pebble Hall near Theddingworth, Leicestershire.
- 3.1.2 The assessment included the pollutants prescribed for co-incineration plants by the EC Industrial Emissions Directive for which the proposed wood gasification facility will be regulated by the Environment Agency when it becomes operational. The assessment compared the maximum Process Contribution (PC) to ground level pollutant concentrations against the Air Quality Standard (AQS) or Environmental Assessment Level (EAL), based upon a factor calculated from the ratio of the PC value to the AQS.
- 3.1.3 A COMEAP assessment, undertaken for nitrogen dioxide, sulphur dioxide and particles (PM₁₀), also considered the potential increase in hospitalisation as a result of respiratory complaints associated with exposure to these pollutants in the emissions from the proposed wood gasification facility. Increases in hospital admissions due to respiratory complaints of between 0.2% and 0.02% of the population were predicted for the three pollutants at the point of the maximum Process Contribution (~200 metres to the north-east of the chimney of the wood gasification facility); values which are considered to be low and probably not significant. Values at nearby residential properties were likely to be significantly lower in relation to their distance from the wood gasification facility development site, with values for Receptor No.2 (~900m to the east) estimated to be between 0.05% and 0.006% of the population likely to be affected.
- 3.1.4 An assessment of the potential uptake of dioxins as a result of inhalation and dietary factors showed that the exposure to dioxins released from the chimney of the proposed wood gasification facility was likely to represent <1% of the Tolerable Daily Intake for adults and infants living at the nearest downwind residential receptor location (Receptor No.2), and was considered to be insignificant.
- 3.1.5 The overall conclusion of the health impact assessment is that the magnitude of potential health effects associated with exposure to pollutants released from the chimney of the proposed wood gasification facility is very low and will not have a significant impact on the health of people living and working nearby.