ATTACHMENT 5

AIR DISPERSION MODELLING REPORT

Document Lead Sheet

PM Project No: 002666

Document No: 002666-22-RP-002

INDAVER IRELAND

WASTE MANAGEMENT FACILITY, CARRANSTOWN

AIR DISPERSION MODELLING REPORT

ISSUE	DATE	ORIG	AUTH CHK	REVIEW	APPRVD PM	APPRVD CLIENT	DESCRIPTION
A	8/1/2001	JP	IS		JP		For Planning

CONTENTS

1. EXECUTIVE SUMMARY

Project Management Ltd. (PM) conducted an air dispersion modelling analysis on the emissions from the proposed Waste to Energy plant located in Carranstown, Co. Meath. The modelling was carried out first to determine the appropriate stack height and then to assess in detail the potential impacts arising from emissions from the stack height selected. The cumulative impacts of emissions from the waste to energy plant and two other developments in the vicinity, the existing Platin cement factory and the proposed Marathon power plant were also assessed.

The modelling analysis was carried out to determine the impact of emissions of a number of air substances from the waste to energy plant, namely oxides of nitrogen (NO_x), sulphur dioxide (SO_2), particulates, hydrocarbons, hydrogen chloride (HCl), hydrogen fluoride (HF), Poly-chlorinated dibenzo dioxins (PCDD), Poly-chlorinated dibenzo furans (PCDF) and heavy metals. The plant will also emit minor quantities of carbon monoxide (CO). However due to the relatively low levels of CO emissions and the relatively high air quality standards for CO these emissions are insignificant.

The air dispersion modelling analysis was carried out using the Industrial Source Complex Short Term 3 (ISCST 3) computer model. The model input data included the stack discharge parameters, emission concentrations, receptor locations, five years of Dublin airport meteorological data (1993-1997), building downwash and land use.

Hourly average, daily average and annual average concentrations were calculated. Relevant percentiles of hourly and daily averages were also calculated. Contour plots of the maximum ground level concentrations occurring on and off site were plotted.

A 40m stack height was chosen as being adequate to disperse the atmospheric emissions without causing any undue visual impact. All the maximum predicted ground level concentrations of emissions were found to be below Irish and EU air quality standard limit values and WHO guideline values. The cumulative emissions from the waste to energy plant and the two other developments in the vicinity did not cause the maximum predicted ground level concentrations of emissions to reach air quality standard limit values and guidelines.

2. INTRODUCTION

This report was compiled by Project Management Ltd on behalf of Indaver Ireland to assess the potential impacts on air quality arising from emissions from the proposed waste to energy plant. The modelling analysis was carried out to select the appropriate stack height in the first instance, and then to assess in detail the impact of the emissions from the stack selected.

The proposed site for the waste to energy plant is in Carranstown, Co. Meath. The area immediately surrounding the site is primarily agricultural land with some dispersed housing. The Platin Cement factory is located to the north-east of the development site.

Atmospheric emissions from the proposed waste to energy plant will include the following:

- Oxides of nitrogen (NO_x)
- Sulphur Dioxide (SO_2)
- Particulates (Dust)
- Hydrocarbons (expressed as Total Organic Carbon (TOC))
- Hydrogen Chloride (HCl)
- Hydrogen Fluoride (HF)
- Poly-chloro dibenzo dioxins (PCDD) and Poly-chloro dibenzo furans (PCDF)
- Heavy metals: Cadmium (Cd), Thallium (Tl), Mercury (Hg), Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni), Vanadium (V).

The oxide of nitrogen of primary concern in terms of air quality is NO_2. However, as NO converts to NO_2 in the atmosphere all NO_x emissions are modelled and are compared to NO_2 air quality limits. This is in fact a conservative assessment as all NO_x will not have converted into NO_2 in the time it takes to reach the ground. For example, it is estimated that approximately 50% of NO_x will be NO_2 by the time emissions from a typical combustion plant reach the ground.

Carbon Monoxide emissions are not modelled as the concentration in the plume is low (50 mg/m^3) and the ambient air quality limit value is high relative to that for other substances such as NO_2. For example in a proposal for emission limit values for carbon monoxide (COM (1998)591) the EU proposes a limit of 10 mg/m^3 on ground level CO concentrations. Due to dispersal of the plume the ground level concentrations resulting from the waste to energy plant will be a tiny fraction of this proposed limit.

The cumulative impact of NO_X and SO_2 emissions from the waste to energy plant and two other developments in the vicinity, namely the Platin Cement factory and the proposed Marathon power plant was assessed by carrying out air dispersion modelling for the three combined developments.

The dispersion modelling results are compared with the following air quality standards (AQSs) and guidelines:

- The Air Pollution Act, 1987 (Air Quality Standards) Regulations (SI No. 244 of 1987) which implements EU Directive 80/779/EEC on limit and guideline values for sulphur dioxide and suspended particulates, EU Directive 85/203/EEC on limit and guideline values for nitrogen dioxide, EU Directive 82/884/EEC on a limit value for lead in the air.

- EU Directive 99/30/EC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. The limit values specified in this directive are more stringent than the existing limit values and will start to come into effect from July 2001 and onwards.

- World Health Organisation (WHO) 1999 Air Quality Guidelines for Europe

- The National Authority for Occupational Safety and Health Code of Practice (1999) for the Safety, Health and Welfare at Work (Chemical Agents) Regulations, 1994 (S.I. No. 445 of 1994). Environmental Air Quality Standard (AQS) limit values were not available for a number of emissions, so occupational exposure limits (OELs) were used as a basis for setting limit values. Therefore one fortieth of the OEL was taken as the AQS limit value in accordance with Her Majesty's Inspectorate of Pollution (HMIP) Technical Guidance Note D1: Guidelines on Discharge Stack Heights for Polluting Emissions.

Air Quality Standard (AQS) limit values are often expressed as percentiles which allow the specified Ground Level Concentration (GLC) to be exceeded a set number of times in the monitoring period, e.g. 99.8th percentile of a years hourly average values (this means that the AQS can only be exceeded for 0.2% of the time or 18 hours per year).

Document Lead Sheet

PM Project No: 002666

Document No: 002666-22-RP-001

INDAVER IRELAND

WASTE MANAGEMENT FACILITY, CARRANSTOWN

ENVIRONMENTAL IMPACT STATEMENT

ATTACHMENTS

CONTENTS

ATTACHMENT 1

INDAVER'S PUBLIC CONSULTATION MATERIAL

3. DISPERSION MODELLING

3.1 Dispersion Model

Dispersion modelling has been carried out using the Industrial Source Complex (ISC 3) computer model.

ISC 3 is a Gaussian dispersion model, which represents the plume as having a normal distribution in both the horizontal and vertical directions. The short term model (ISCST 3) predicts average concentrations over 1 hour, 24 hour and annual periods and percentiles thereof. The model allows for the effects of general plume rise, stack tip downwash and building downwash.

3.2 Meteorological Data

The meteorological data required by the dispersion model is wind speed, wind direction, Pasquill-Gifford stability category, boundary layer height and ambient temperature. The stability category and boundary layer height are used to characterise the turbulence within, and the height of the lower levels of the atmosphere.

Extremely unstable conditions can cause plume looping and elevated concentrations close to the stack. Under stable conditions elevated concentrations can occur due to the emissions being trapped below the boundary layer. Neutral conditions, characterised by cloudy skies and strong winds, are most favourable for dispersion due to the mechanical mixing of the lower atmosphere. The wind direction determines the direction in which the plume is blown, and for a particular stability, higher wind speeds will result in reduced plume rise so causing the plume to reach ground level closer to the stack with elevated emission concentrations. The boundary layer height determines the total vertical distance over which the plume may spread.

Five years (1993-1997) of Meteorological data for Dublin Airport was obtained from Trinity Consultants (the producers of the model). The data obtained consists of hourly values of wind speed, wind direction, air temperature, stability category and mixing height. Wind direction is converted to a flow vector (the direction toward which the emission moves) by adjusting the direction by 180 degrees.

3.3 Building Downwash

Air streams blowing across buildings can become disrupted, with turbulent eddies occurring downwind in the building wake. If an emission point is sufficiently close to a building, then the plume may become entrained in the turbulent eddies of the building wake. This entrainment can cause plume downwash resulting in elevated emission concentrations close to the emission point.

The ISC model interprets the influence zone of each building for a given wind direction to be the area included by the rectangle described by the location 5 building lengths (L) downwind, 2L upwind and 0.5L in the crosswind direction from the building. This has been updated by the Building Profile Input Program (BPIP) which was used in this modelling analysis. BPIP uses the arc of the original 5L limit line as the downwind structure influence zone (SIZ) boundary.

The BPIP programme determines a building height and a projected width for the dominant structure for each 10° of azimuth about each source for use as input to the ISCST 3 program.

The main buildings on the proposed site were included in the modelling analysis which were the Furnace building (30m), Flue Gas Treatment building (25m), Waste Acceptance Hall (25m), Warehouse (9m) and Administration building (7.5m).

Elevated terrain may increase the ground level concentrations by reducing the vertical dimension within which the plume can disperse. In this case since the change in terrain within the vicinity of the site is not significant enough to influence plume dispersion, terrain has been considered flat for the model.

This is in accordance with the USEPA guidelines where it is recommended that terrain be considered simple (or flat) if the ground level does not exceed the height of the stack within the vicinity of the stack. In order to ensure that the slope of the ground on the site does not influence dispersion of the emissions, a check run was carried out where the stack and buildings are 10m below the surrounding levels. This yielded identical results as for flat terrain, and confirms that the slope of the site does not affect dispersion of emissions.

3.4 Land Use

To calculate ground level concentrations, either rural or urban dispersion parameters must be specified for the model. In the rural mode, the model uses the Pasquill-Gifford dispersion coefficients and rural mixing heights. In the urban mode, the model uses Briggs urban dispersion coefficients and urban heights. USEPA guidelines were used to determine whether the area is urban or rural.

According to these guidelines if the land use categories within a circle of 3 km radius comprise less than 50% of the following categories: heavy or medium industrial, commercial or multi family residential, the area should be classified as rural. It was found that this is the case at the proposed site and rural dispersion parameters were chosen.

3.5 Stack Discharge Parameters and Emission Data

There will be one main stack on site through which atmospheric emissions will be discharged. It is assumed that the emission from the stack will be continuous.

The waste to energy plant can operate over a range of loads, and with a corresponding range of discharge parameters. Preliminary model runs indicated that the maximum GLCs occurred for maximum loading (ie. 120% of nominal capacity). These discharge parameters were used in the analysis and therefore the worst case parameters, i.e. those that would lead to the highest ground level concentrations, are used in the modelling analysis.

The stack parameters, emission concentrations and mass emission rates used in the modelling assessment are shown in Tables 3.1 and 3.2.

Table 3.1 Stack Discharge Parameters (at 120% of Nominal Load)

Discharge Parameters	
Stack Location (NG Co-ordinates)	306200E, 270910N
Stack Internal Diameter (m)	2.0
Exit Temperature (K)	373
Flow Rate (Nm^3/s dry gas, 11% O_2)	41.94
Flow Rate at discharge conditions (m^3/s at 100 °C, 8% O_2, 21% H_2O)	64.5
Exit Velocity (m/s)	20.5

Table 3.2 Emission Data

Emission	Emission Concentration Limit at 273 K (mg/Nm^3)	Emission Rate (g/s)
NO_x (as NO_2)	200	8.389
SO_2	50	2.097
TOC	10	0.419
Total Dust	10	0.419
HCl	10	0.419
HF	1	0.042
Dioxins (PCDD) & Furans (PCDF)	0.01 (ng/m^3)	0.42 (ng/s)
Cd & Tl	0.05	0.002
Hg	0.05	0.002
Sum of 9 Heavy Metals: Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V	0.5	0.021

The emission concentrations in the flue gas will not exceed the limits specified in the amended proposal for a European Parliament and Council Directive on the Incineration of Waste (98/0289). Indeed the dioxin emission concentrations, at 0.01 ng/m^3, will be only 10% of the EU Limit (0.1 ng/m^3) and the hourly NO_x concentration will not exceed 200 mg/m^3, compared to the EU ½ hourly limit of 400 mg/m^3.

For the purposes of the air dispersion modelling certain emissions are grouped together (eg. cadmium and thallium or the sum of 9 heavy metals) as the emissions are grouped together in this manner in the proposed Directive.

One of the input parameters to the dispersion model is the emission rate (g/s) of the substance. As there are several different substances with different emission rates, for the purposes of running the model a Unity Value (ie. 1 g/s) was input into the model. The results were then multiplied by the appropriate emission rate to determine the maximum predicted ground level concentration for each individual emission.

4. STACK HEIGHT DETERMINATION

4.1 Screening Analysis

The stack height screening analysis was carried out using a 3.5 km (east) x 2.5 km (north) grid as it was found in an initial analysis that the maximum ground level concentrations occurred within 1km of the stack.

The grid used consisted of 3640 receptor points spaced at 50m intervals. Five years (1993-1997) of meteorological data for Dublin airport was used in the screening analysis. The stack height was assessed at 5m intervals from 35m to 45m.

The highest concentration of any emitted pollutant from the stack will be NO_X (modelled as NO_2) and therefore the stack height determination was carried out with respect to NO_X emissions. The maximum 99.8th percentile hourly average ground level NO_2 concentrations were calculated for the range of stack heights.

4.2 Assessment of Results and Stack Height Selection

The results are shown in Figure 4.1. The new 99.8th percentile (not to be exceeded for more than 18 hours per annum) limit value as per EU Directive 99/30/EC is also indicated on Figure 4.1 for reference.

As can be seen in Figure 4.1 the maximum ground level concentration of NO_2 decreases steadily as the stack height increases.

At forty metres the maximum ground level concentration is less than half that for a 35m stack. It is also well below the new limit value.

Although the concentrations arising from a 45m stack are lower again, as choosing the stack height is based on the conflicting objectives of providing adequate pollutant dispersion without creating any undue visual impact, it was decided that a 40m stack would best meet both of these objectives. The detailed assessment was therefore carried out on a 40m stack.

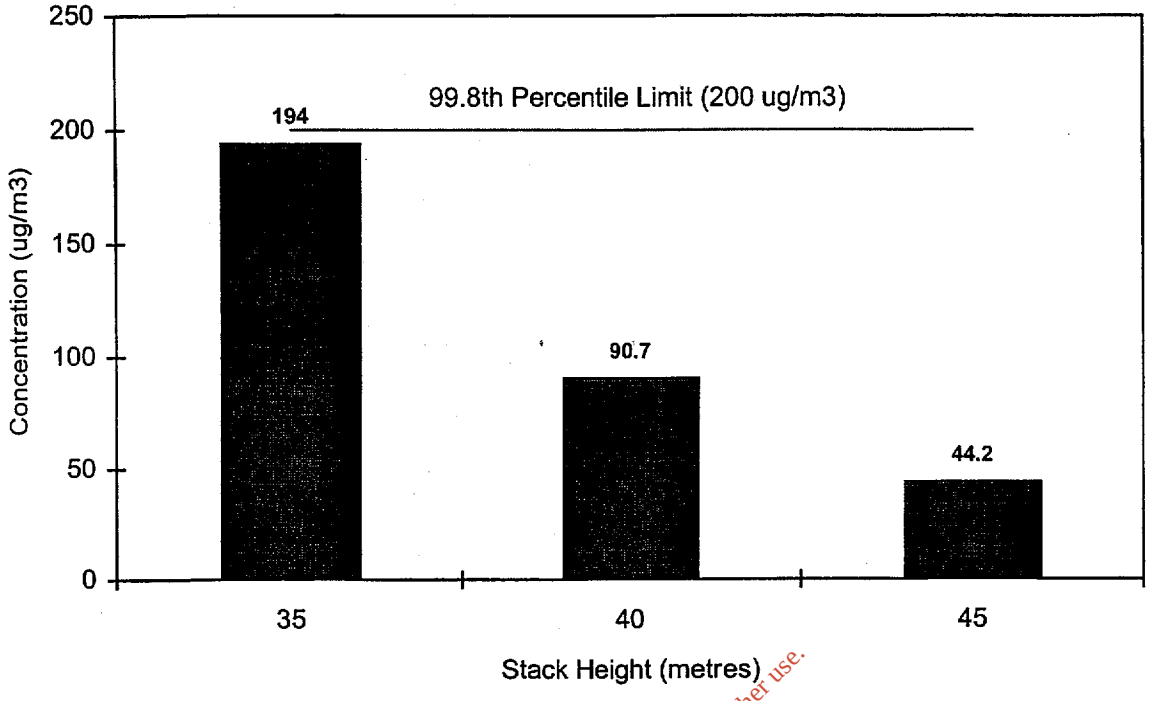


Figure 4.1: Maximum 99.8th Percentile Hourly Average Ground Level Concentrations of NO_2

5. ASSESSMENT OF IMPACTS FROM A 40M STACK

5.1 Dispersion Modelling

The stack discharge parameters used in the detailed assessment are as listed in Tables 4.1 and 4.2. The grid used in the analysis was a 3.5km (east) by 2.5km (north) grid. The grid has the stack located approximately in the centre and consists of over 3,640 receptor points within the grid, maximising the resolution and accuracy of the modelling.

Hourly sequential meteorological data has been used in ISCST 3 to generate predictions of the full range of maximum hourly, daily and yearly averages and percentiles thereof for comparison with all relevant Air Quality Standards (AQSs) and guidelines.

The buildings, terrain and land use are as detailed in Section 3.

The maximum predicted Ground Level Concentrations (GLCs) of emissions and the relevant air quality standards are presented in Table 5.1. Contour plots of the dispersion modelling results are included in Attachment 1. For individual emissions some of the contour plots require the predicted GLC to be multiplied by the appropriate emission factor as a Unity Value (1 g/s) was used in the dispersion model (refer to Section 3.5).

5.2 Assessment of Results

The maximum predicted ground level concentrations of emissions occur approximately 230m north-east of the stack as shown on the Contour Plots in Attachment 1. The prevailing wind is from a south-westerly direction however occasionally when the wind is blowing from the opposite direction the maximum ground level concentrations can also occur 380m south-west of the stack.

The waste to energy plant will emit higher concentrations of NO_x in the flue gas than any other emission. The oxide of nitrogen of primary concern in terms of air quality is NO_2. However, as NO converts to NO_2 in the atmosphere all NO_x emissions were modelled and are compared to NO_2 air quality limits. This is in fact a conservative assessment as all NO_x will not have converted into NO_2 in the time it takes to reach the ground. The maximum predicted ground level concentrations (GLCs) of NO_2 are well below both existing and the new more stringent Irish and EU AQS limit values. The maximum 99.8th percentile hourly GLC is 45% of the relevant limit value and the maximum annual average value is 13-17% of the relevant limit value.

The maximum predicted GLCs of SO_2 are significantly below Irish and EU AQS limit values (2-9% of limit values) and also well below WHO guidelines (11% of limit value). The maximum predicted GLCs of dust (particulates) are only 1-2% of the relevant Irish and EU limit values.

Environmental AQS limit values are not available for Hydrocarbons (Total Organic Carbon). Therefore an Occupational Exposure Limit (OEL) for toluene was used as a basis for setting an AQS limit value. The predicted maximum hourly average GLC of total organic carbon is 0.05% of the limit value. Similarly there are no AQS limit values available for hydrogen chloride (HCl) and hydrogen fluoride (HF), so OEL's were used to set limit values. The predicted maximum hourly average GLCs of HCl and HF are only 2% and 1% of their respective limit values.

There are no Irish, European or World Health Organisation AQS limit values for dioxins or furans. The WHO expresses a limit value in terms of Tolerable Daily Intake which cannot be directly related to ambient air concentration of dioxins. However the predicted maximum hourly and annual average GLC's of dioxins are 7×10^{-15} g/m^3 (0.007 pg/m^3) and 2.5×10^{-16} g/m^3 (0.00025 pg/m^3) respectively. At these extremely low ambient air concentrations the dioxins/furans will be below the detection threshold for dioxins. (For a more detailed discussion on dioxins see Section 4.4 of the main EIS).

There are no AQS limit values for Thallium (Tl) so the OEL was used to set a limit value. The maximum predicted annual and hourly average GLCs are for the sum of cadmium and thallium. If one assumes that the GLC consisted entirely of either Cd or Tl, the GLCs would be well below the corresponding limit values for the individual metals.

The maximum annual average GLC of mercury is 1×10^{-3} µg/m^3 which is only 0.001% of the limit value.

For the sum of nine heavy metals, OELs were used to set limit values for all of the heavy metals with the exception of lead (Pb). As a conservative assessment the maximum GLC for each heavy metal was predicted based on the assumption that that metal alone is emitted at the concentration limit for the sum of the nine heavy metals. Even based on this assumption, which is unlikely to happen, the predicted GLCs are significantly lower than the AQS limit values.

In summary, atmospheric emissions from the 40m stack of the waste to energy plant do not caused the maximum predicted GLCs of emissions to reach Irish and EU AQS limit values or WHO guidelines.

Table 5.1 Predicted Maximum Ground Level Concentrations of Emissions compared to Air Quality Standards

Emission	Type of Prediction	Maximum Concentration ($\mu g/m^3$)	SI No. 244 of 1987 ($\mu g/m^3$)	% of Limit	Directive 99/30/EC ($\mu g/m^3$)	% of Limit	WHO 1999 ($\mu g/m^3$)	% of Limit	SI No. 445 of 1994 ($\mu g/m^3$)	% of Limit
NO_2	98th Percentile of a Years Hourly Average	**73.65**	200	37	-----	-----	-----	-----	-----	-----
NO_2	99.8th percentile of a Years Hourly Average	**90.65**	----	-----	200	45	-----	-----	-----	-----
NO_2	Annual Average	**5.13**	-----	-----	30-40 (1)	13 - 17	-----	-----	-----	-----
SO_2	99.7th percentile of a Years Hourly Average	**22.47**	-----	-----	350	6	-----	-----	-----	-----
SO_2	Daily Average	**14.10**	-----	-----	-----	-----	125	11	-----	-----
SO_2	98th Percentile of a Years Daily Average	**8.47**	250-350 (2)	2-3	-----	-----	-----	-----	-----	-----
SO_2	99.2th percentile of a Years Daily Average	**10.77**	-----	-----	125	9	-----	-----	-----	-----
SO_2	Annual Average	**1.28**	-----	-----	20 (3)	6	50	3	-----	-----
Dust	98th Percentile of a Years Daily Average	**1.69**	250	1	-----	-----	-----	-----	-----	-----
Dust	90th Percentile of a Years Daily Average	**0.98**	-----	-----	50 (4)	2	-----	-----	-----	-----
Dust	Annual Average	**0.26**	-----	-----	20 (4)	1	-----	-----	-----	-----

Table 5.1....continued

Emission	Type of Prediction	Maximum Concentration ($\mu g/m^3$)	SI No. 244 of 1987 ($\mu g/m^3$)	% of Limit	Directive 99/30/EC ($\mu g/m^3$)	% of Limit	WHO 1999 ($\mu g/m^3$)	% of Limit	SI No. 445 of 1994 ($\mu g/m^3$)	% of Limit
TOC	Hourly Average	**7.12**	-----	-----	-----	-----	1,000 [6]	1	-----	-----
HCl	Hourly Average	**7.12**	----	----	-----	-----	-----	-----	350 [6]	2
HF	Hourly Average	**0.71**	----	-----	----	----	-----	-----	63 [6]	1
PCDD / PCDF [7]	Hourly Average	**7×10^{-9}**	-----	-----	----	----	-----	-----	-----	-----
	Annual Average	**2.5×10^{-10}**	-----	-----	-----	----	-----	-----	-----	-----
Cd & Tl [8]	Annual Average (Cd)	**1×10^{-3}**	-----	-----	----	-----	5×10^{-3}	20	-----	-----
	Hourly Average (Tl)	**0.03**	-----	-----	-----	-----	-----	-----	2.5	1
Hg	Annual Average	**1×10^{-3}**	-----	-----	-----	----	1	0.001	-----	-----
Sum of 9 Heavy Metals [9]	Annual Average (Pb)	**0.01**	2	0.5	0.5	2	0.5	2	-----	-----
	Hourly Average (Sb)	**0.37**	-----	-----	-----	-----	-----	-----	12.5	3
	Hourly Average (As)	**0.37**	-----	-----	-----	-----	-----	-----	2.5	15
	Hourly Average (Cr)	**0.37**	-----	-----	-----	-----	-----	-----	1.25	30
	Hourly Average (Co)	**0.37**	-----	-----	-----	-----	-----	-----	2.5	15
	Hourly Average (Cu)	**0.37**	-----	-----	-----	-----	-----	-----	5	7
	Hourly Average (Mn)	**0.37**	-----	-----	-----	-----	-----	-----	25	2
	Hourly Average (Ni)	**0.37**	-----	-----	-----	-----	-----	-----	2.5	15
	Hourly Average (V)	**0.37**	-----	-----	-----	-----	-----	-----	1	37

Notes:

(1) Limit value of 30 µg/m3 is for the protection of vegetation and limit value of 40 µg/m3 is for the protection of human health.

(2) Limit value of 250 $\mu g/m^3$ applies when corresponding percentile of suspended particulates >150 $\mu g/m^3$ and limit value of 350 $\mu g/m^3$ applies when corresponding percentile of suspended particulates ≤ 150 $\mu g/m^3$.

(3) Limit value is for the protection of ecosystems.

(4) Directive 99/30/EC sets limit values for PM_{10} (particulate matter ≤ 10 µm in diameter) rather than all particulate matter. After the limit values have been implemented in Member States they will be reviewed and more stringent limit values may be applied as part of Stage 2 of the Directive.

(5) Limit value is for Toluene which can be used as a standard for measuring Total Organic Carbon (TOC). The limit value is a 1987 WHO guideline and is based on an averaging time of 30 minutes.

(6) Limit value is derived by dividing the Occupational Exposure Limit (OEL) by a factor of 40

(7) There are no air quality standard limit values for dioxins and furans. The 1999 WHO guidelines expressed a limit for dioxin like compounds in terms of Tolerable Daily Intake in TEQ/ kg bwd (Toxic Equivalent uptakes per kilogram of body weight per day). The Tolerable Daily Intake for dioxin like compounds is 1-4 TEQ/ kg bwd.

(8) The maximum predicted annual and hourly average GLCs are for the sum of Cd & Tl. The WHO annual average limit value is for Cd. The hourly average limit value is for Tl and was derived by dividing the Occupational Exposure Limit (OEL) by a factor of 40.

(9) The maximum predicted annual and hourly average GLCs are for the sum of the nine heavy metals. The limit values for all of the heavy metals with the exception of Pb are derived by dividing the Occupational Exposure Limits (OELs) by a factor of 40.

6. POTENTIAL FOR CUMULATIVE IMPACTS ON AIR QUALITY

6.1 Point Sources of Atmospheric Emissions

Two other developments in the vicinity of the proposed waste to energy plant, the existing Platin Cement factory and the proposed Marathon Combined Cycle Gas Turbine power plant, can be considered significant point sources of atmospheric emissions. Platin Cement factory is located approximately 750m north east of the proposed development site and the Marathon power plant will be located on a site across the R152 road to the south-east of the proposed development site.

Atmospheric emissions from all three developments could potentially give rise to a cumulative impact on ground level concentrations of NO_2 and SO_2. Therefore air dispersion modelling was carried out to assess the cumulative impact of the waste to energy plant and the two other developments on ground level concentrations of these emissions.

Details on atmospheric emissions for Platin cement factory were obtained from the Platin Cement IPC licence application and details on atmospheric emissions for the Marathon power plant were obtained from the Marathon Environmental Impact Statement (EIS). The stack parameters and emission data for these two sources are summarised in Tables 6.1 and 6.2 below. The emission data was input into the model together with the emissions data for the waste to energy plant. Emission data for operation on distillate oil for the Marathon power plant was used in the model as higher levels of emissions occur than when operating on natural gas.

Table 6.1: Stack Parameters and Emissions Data for Platin Cement factory

Parameter	Kiln1	Kiln2
Stack Location	306523E, 271756N	306493E, 271083N
Stack Height (m)	106.7	103.3
Stack Diameter (m)	2.3	3.7
Temperature (K)	513	397
Exit Velocity (m/s)	12.06	11.233
Volume Flow (Nm^3/hr)	96,000	299,000
Actual Volume Flow (m^3/hr)	180,396	434,180
Emission Concentration (mg/Nm^3)		
SO_2	4,000	4,000
NO_x	1,800	1,800
Emission Rate (g/s)		
SO_2	107.6	335.13
NO_x	48	149.5

Table 6.2: Stack Parameters and Emission Data for proposed Marathon power plant

Discharge Parameters	
Stack Location (NG Co-ordinates)	306780E, 270785N
Stack Height (m)	49.9
Stack Internal Diameter (m)	7.0
Exit Temperature (K)	369
Flow Rate (Nm^3/s dry gas, 15% O_2)	503
Flow Rate (m^3/s at discharge conditions)	681
Exit Velocity (m/s)	17.695
Emission Concentration (mg/Nm^3)	
Operation on Distillate Oil	
SO_2	140
NO_x	120
Emission Rates (g/s)	
Operation on Distillate Oil	
SO_2	70
NO_x	60.53

6.2 Assessment of Results

The results of the cumulative impact modelling together with the relevant air quality standards are presented in Table 6.3.

The results indicate that the cumulative impact of emissions from the proposed waste to energy plant, Platin cement works and the proposed Marathon power plant do not cause the predicted maximum GLCs of NO_2 and SO_2 to reach Air Quality Standard limit values or guidelines.

Due to the height of the stacks and discharge temperature from Platin cement factory the maximum predicted GLCs of NO_2 and SO_2 from the cement factory occur approximately 5-6 km north-east of the factory and therefore do not coincide with the maximum GLCs of emissions from the proposed waste to energy plant or the Marathon power plant.

The maximum predicted GLCs from the waste to energy plant usually occur approximately 230m north-east of the stack. The maximum predicted GLCs from the Marathon power plant occur approximately 270m north-east of the Marathon stack and do not coincide with the maximum GLC's from the waste to energy plant as illustrated in Figures 13 & 14 in Attachment 1.

The maximum 99.8th percentile hourly average GLC of NO_2 is 72% of the relevant Irish and EU limit value. The maximum 99.7th percentile hourly average GLC of SO_2 is 71% of the relevant Irish and EU limit value.

It should be noted that the contribution from the Marathon power plant is based on the plant running on distillate oil (rather than natural gas) which results in much higher emissions of NO_2 and SO_2. According to the Marathon EIS , distillate oil will be used as a backup fuel and therefore will be used infrequently if at all, so that during normal operation on natural gas much lower levels of NO_2 and SO_2 will be emitted and consequently any cumulative impact will be greatly reduced.

Furthermore, the cumulative modelling is based on the worst case discharge conditions occurring at the three plants at the same time and also at the same time as the worst case meteorological conditions. The maximum predicted GLCs are therefore based on a worst case scenario which is unlikely to arise and the modelling is therefore very conservative.

In summary, the cumulative atmospheric emissions from the waste to energy plant, Platin cement factory and Marathon power plant will not cause ground level concentrations of NO_2 and SO_2 to reach Air Quality Standard limit values or guidelines.

Table 6.3: Predicted Maximum Ground Level Concentrations of NO_2 and SO_2 resulting from Cumulative Emissions

Emission	Type of Prediction	Maximum Concentration ($\mu g/m^3$)	SI No. 244 of 1987 ($\mu g/m^3$)	% of Limit	Directive 99/30/EC ($\mu g/m^3$)	% of Limit	WHO 1999 ($\mu g/m^3$)	% of Limit
NO_2	98th Percentile of a Years Hourly Average	**74.2**	200	37	-----	-----	-----	-----
NO_2	99.8th percentile of a Years Hourly Average	**143.65**	----	-----	200	72	-----	-----
NO_2	Annual Average	**5.89**	-----	-----	30-40 (1)	15 - 20	-----	-----
SO_2	99.7th percentile of a Years Hourly Average	**247.9**	-----	-----	350	71	-----	-----
SO_2	Daily Average	**101.7**	-----	-----	-----	-----	125	81
SO_2	98th Percentile of a Years Daily Average	**48.76**	250-350 (2)	14-20	-----	-----	-----	-----
SO_2	99.2th percentile of a Years Daily Average	**76.29**	----	-----	125	61	-----	-----
SO_2	Annual Average	**4.55**	-----	-----	20 (3)	23	50	9

(1) Limit value of 30 $\mu g/m^3$ is for the protection of vegetation and limit value of 40 $\mu g/m^3$ is for the protection of human health.

(2) Limit value of 250 $\mu g/m^3$ applies when corresponding percentile of suspended particulates >150 $\mu g/m^3$ and limit value of 350 $\mu g/m^3$ applies when corresponding percentile of suspended particulates ≤ 150 $\mu g/m^3$.

(3) Limit value is for the protection of ecosystems.

7. CONCLUSIONS

The stack height screening exercise has demonstrated that a 40m high stack will adequately disperse atmospheric emissions of emissions from the waste to energy plant without causing undue visual impact. Air dispersion modelling has shown that atmospheric emissions of emissions from the waste energy plant will not result in the maximum ground level concentrations of these emissions reaching Irish and EU air quality standard limit values or WHO guidelines.

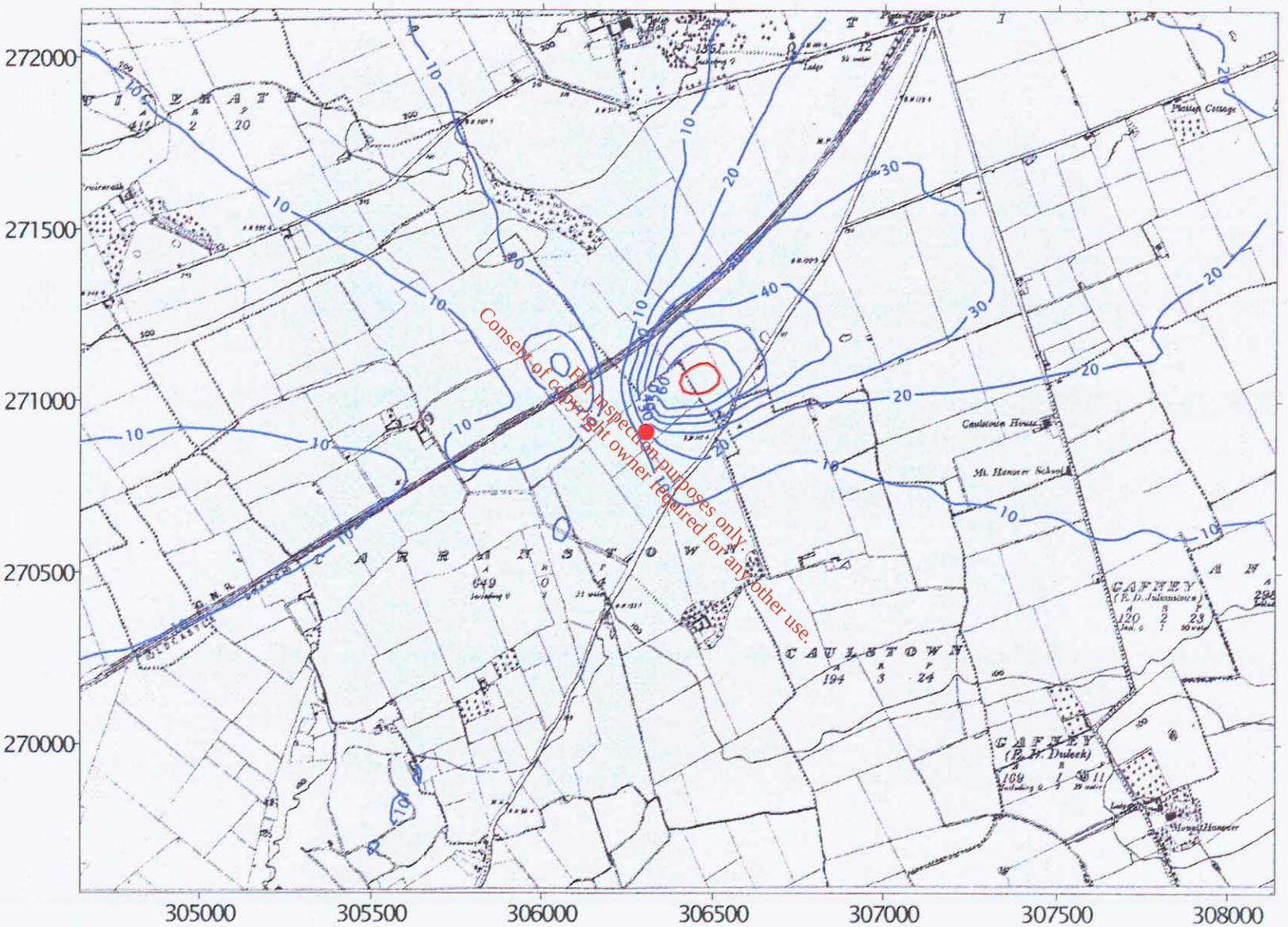
The cumulative atmospheric emissions from the waste to energy plant, Platin cement works and the proposed Marathon power plant will not cause ground level concentrations of NO_2 and SO_2 to reach the relevant air quality standard limit values and guidelines.

ATTACHMENT 1

Contour Plots of Predicted Maximum Ground Level Concentrations

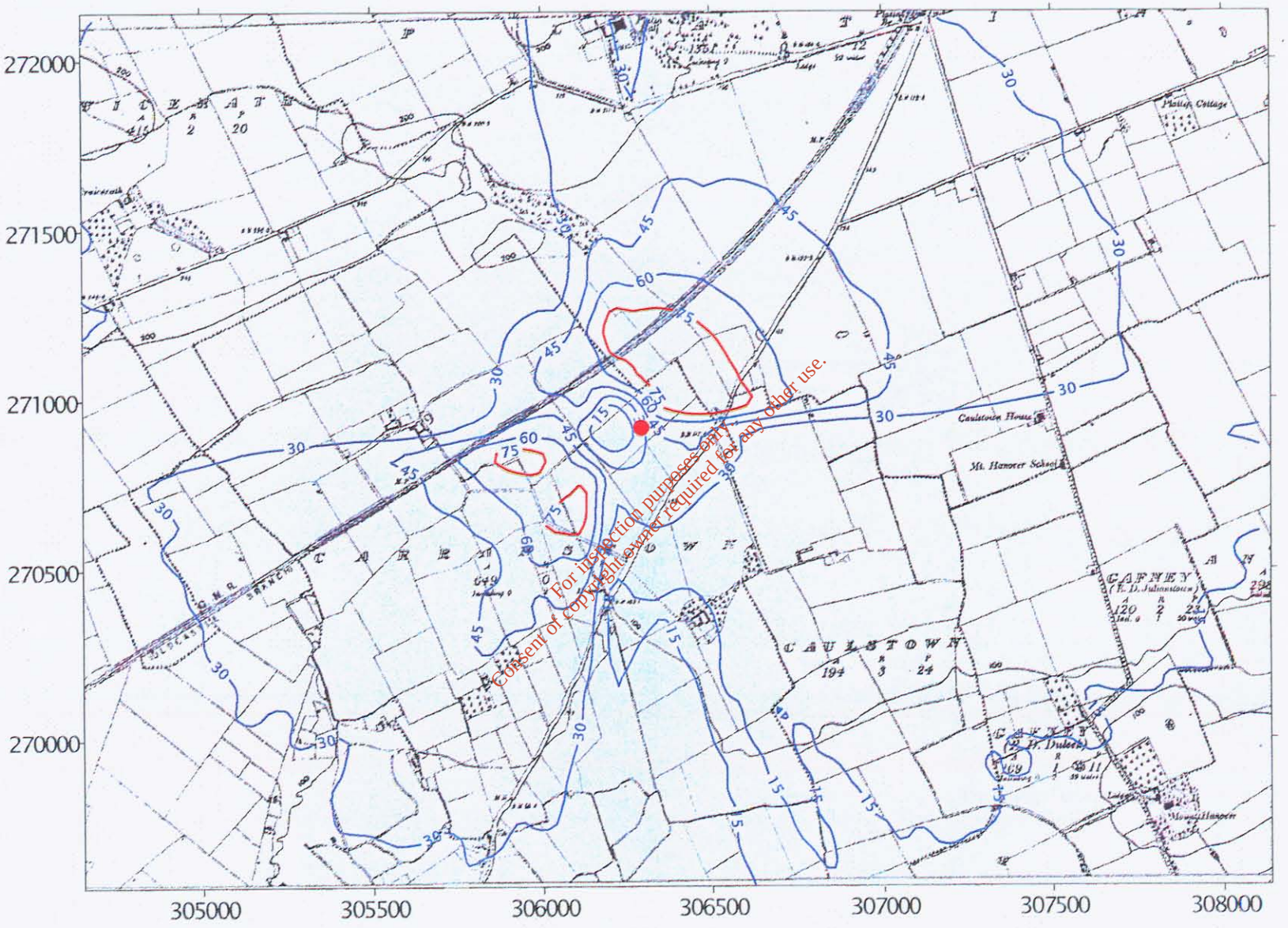
LIST OF CONTOUR PLOTS

Figure 1 – 98th Percentile (Hourly Average) NO2 Ground Level Concentrations (ug/m3) – 5 Years



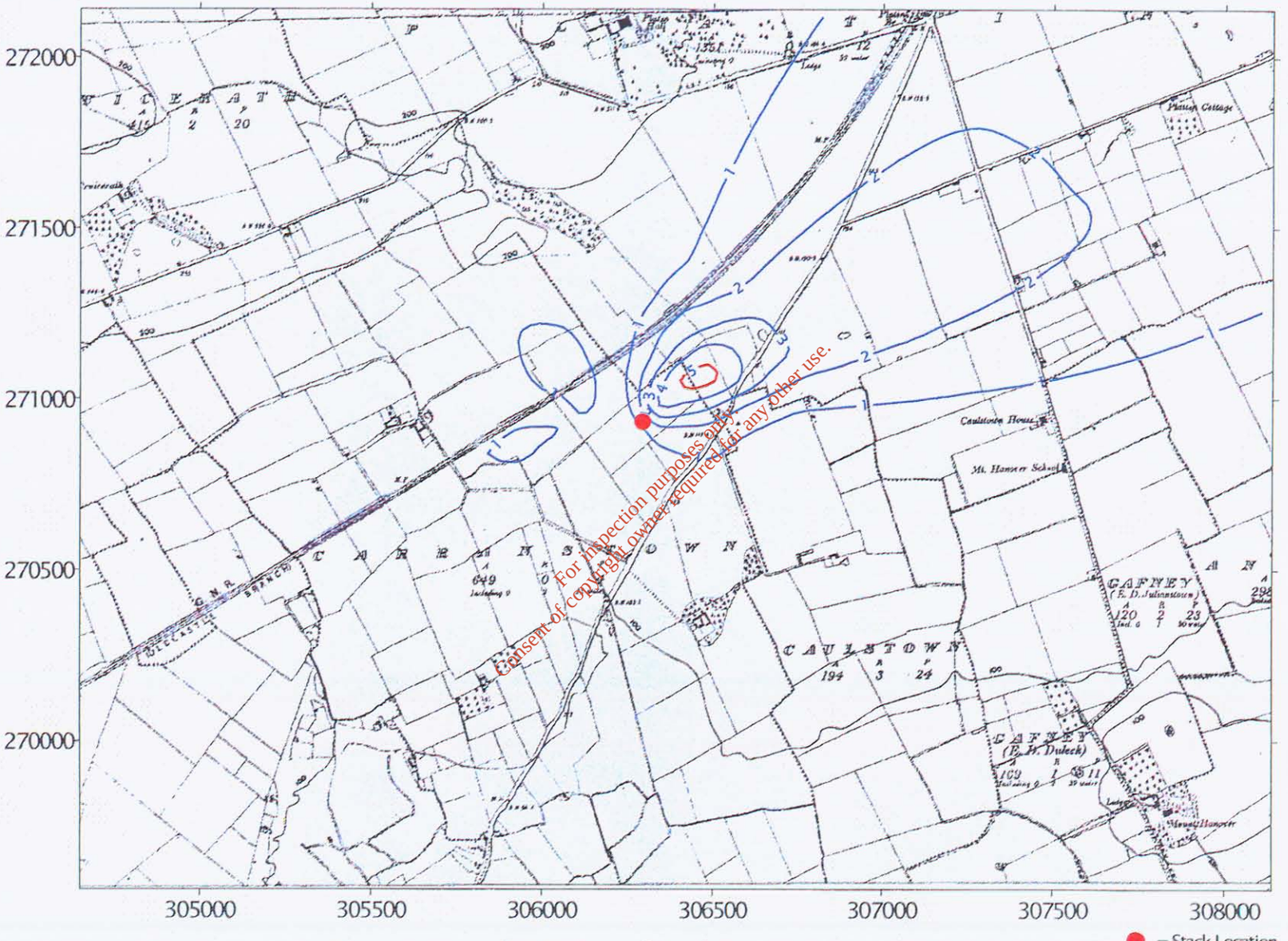
Maximum 98th Percentile NO2 Ground Level Concentration = 73.66 ug/m3 ● = Stack Location

Figure 2 – 99.8th Percentile (Hourly Average) NO2 Ground Level Concentrations (ug/m3) – 5 Years



Maximum 99.8th Percentile NO2 Ground Level Concentration = 90.6 ug/m3 ● = Stack Location

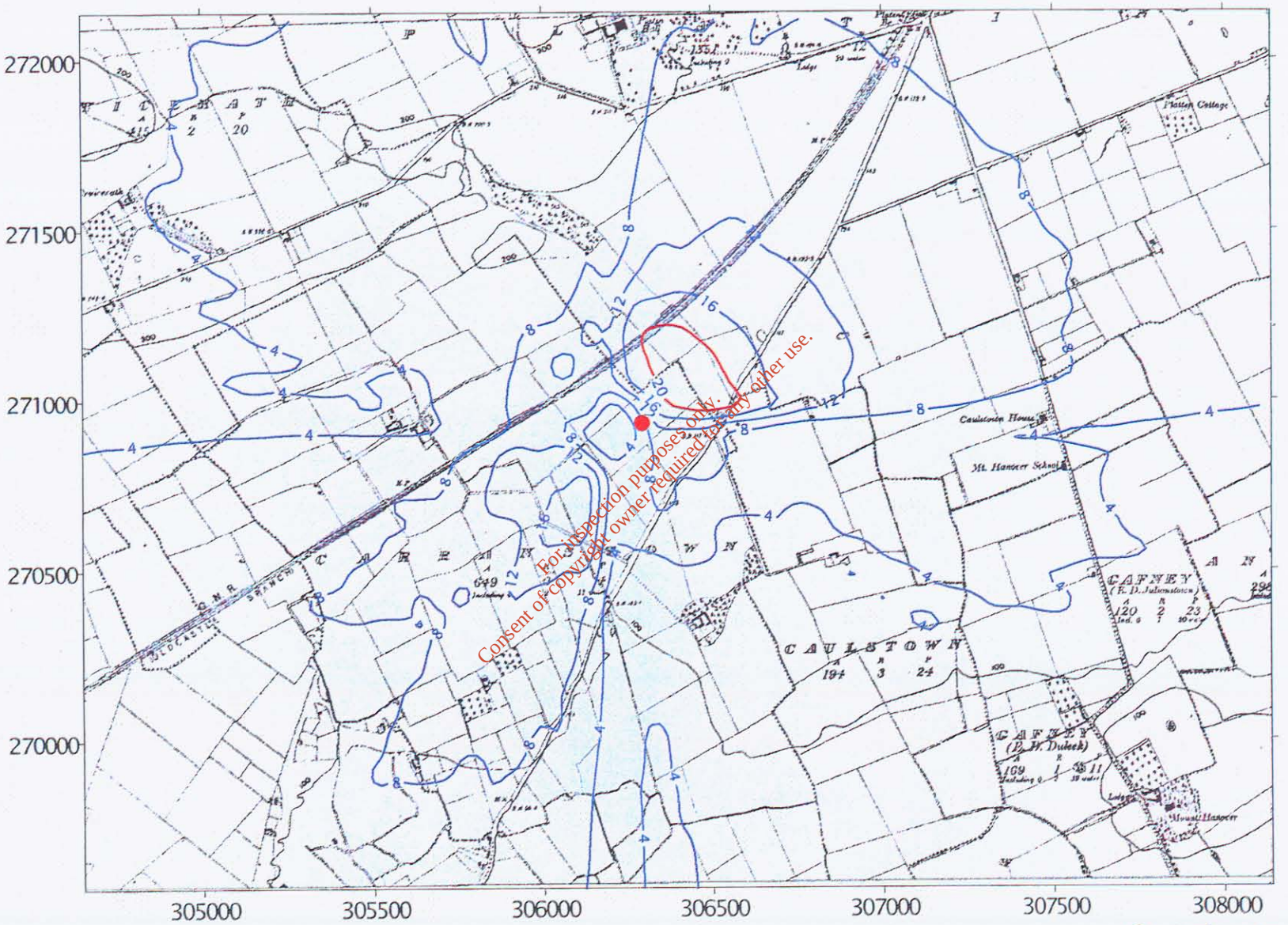
Figure 3 – Annual Average NO2 Ground Level Concentrations (ug/m3) – 5 Years



Maximum Annual NO2 Ground Level Concentration = 5.13 ug/m3

● = Stack Location

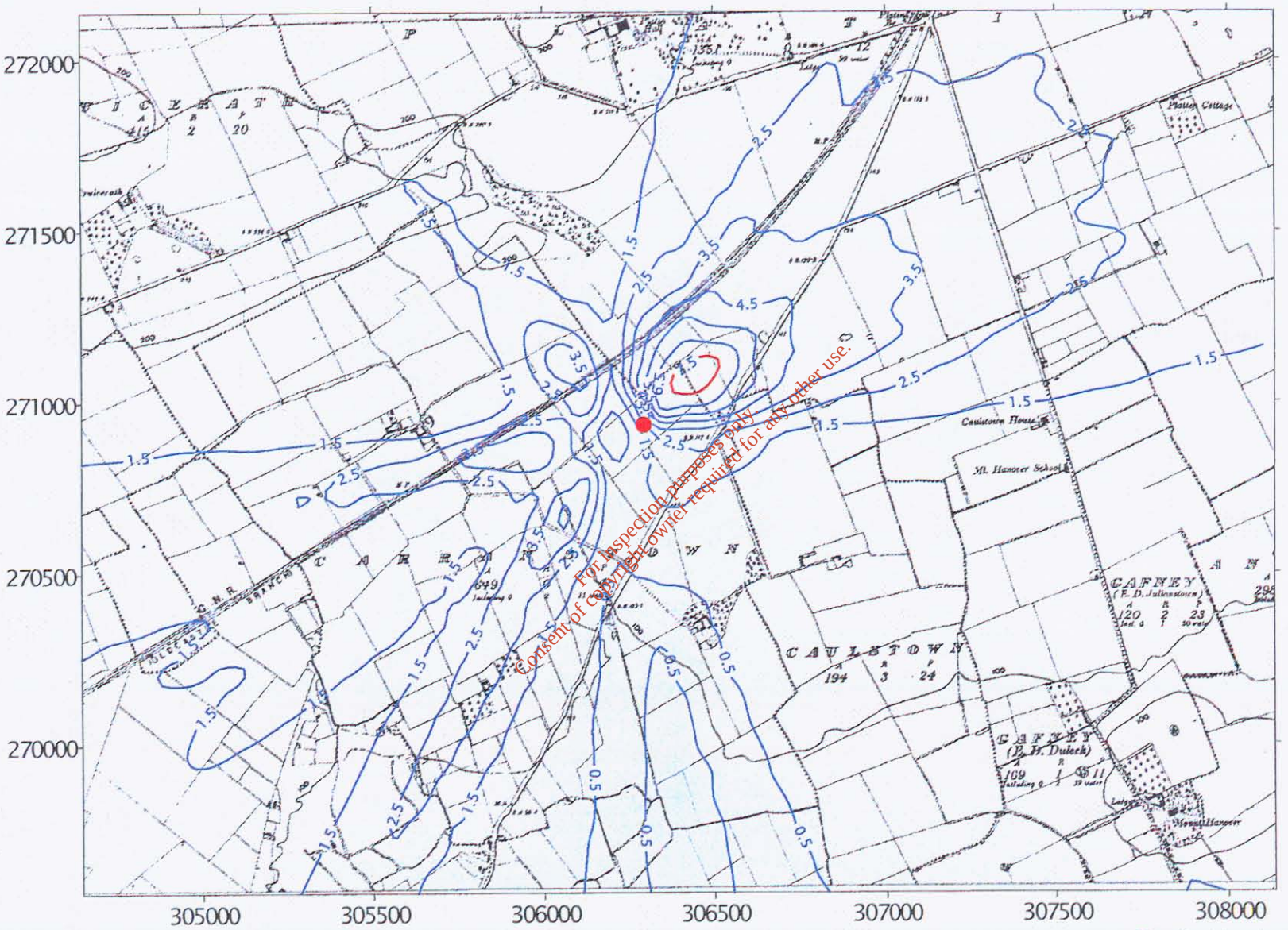
Figure 4 – 99.7th Percentile (Hourly Average) SO2 Ground Level Concentrations (ug/m3) – 5 Years



● = Stack Location

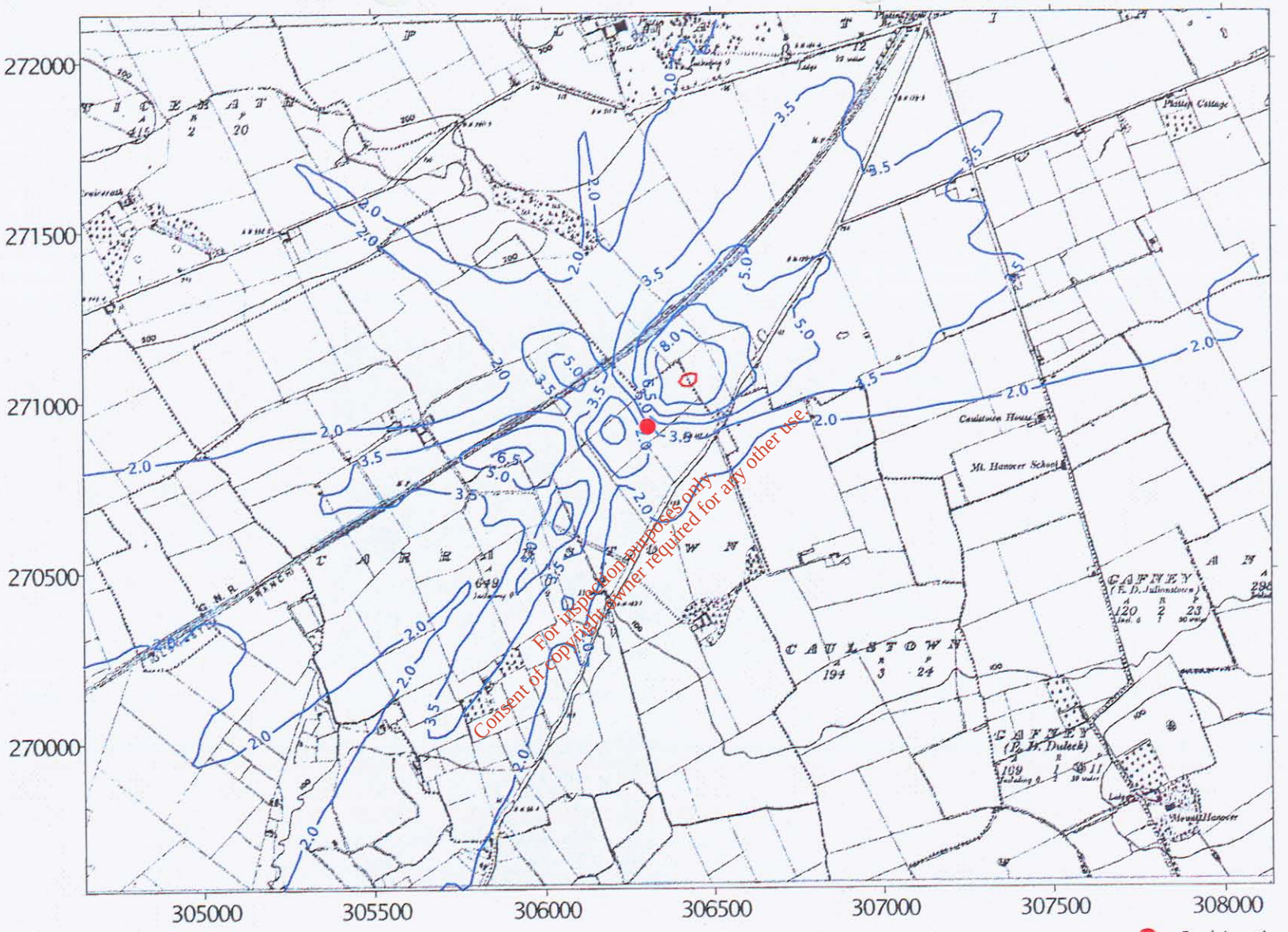
Maximum 99.7th Percentile SO2 Ground Level Concentration = 22.44 ug/m3

Figure 5 – 98th Percentile (Daily Average) SO2 Ground Level Concentrations (ug/m3) – 5 Years



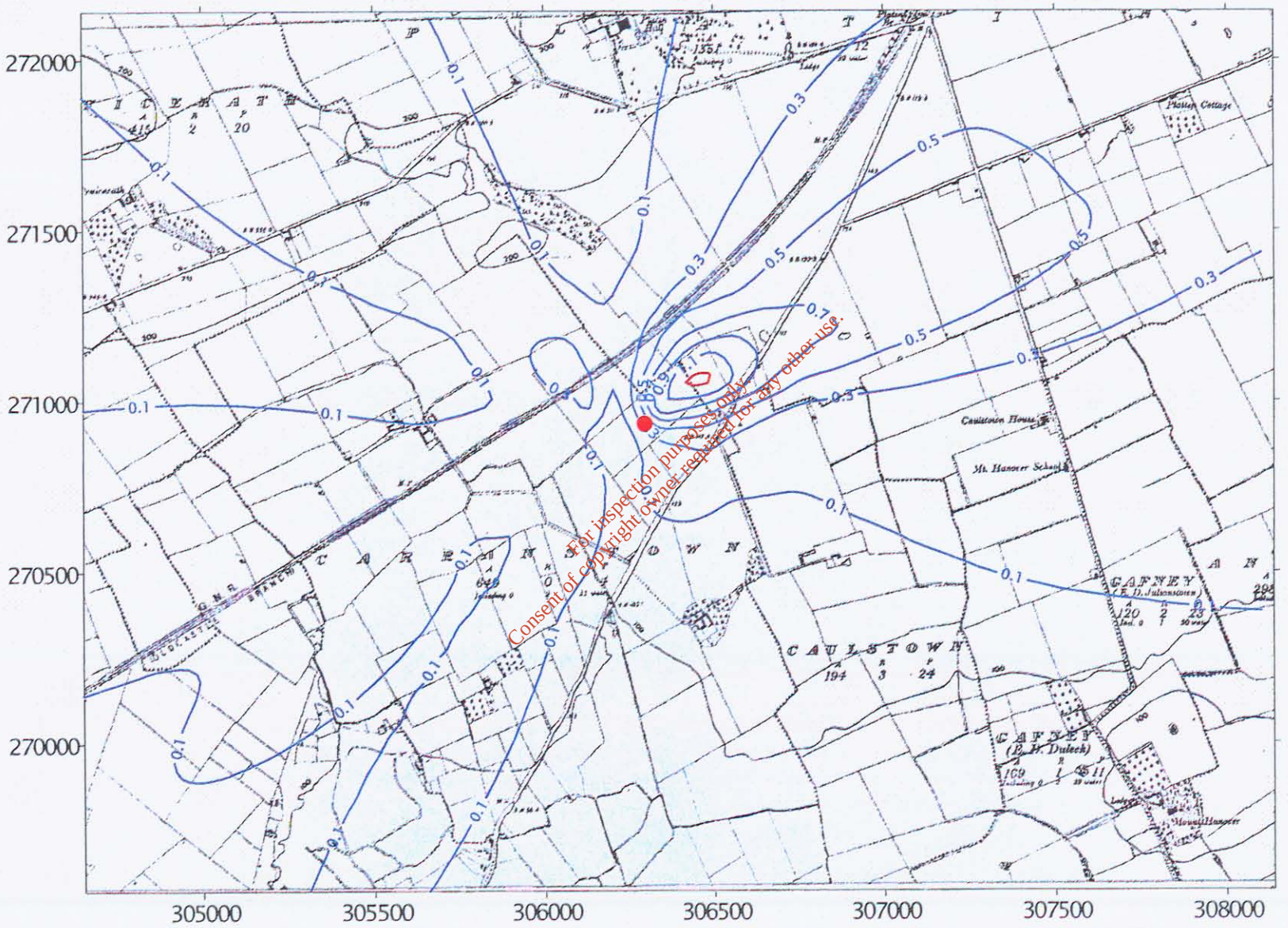
Maximum 98th Percentile Daily SO2 Ground Level Concentration = 8.47 ug/m3

Figure 6 – 99.2th P ntile (Daily Average) SO2 Ground Level Co ntrations (ug/m3) – 5 Years



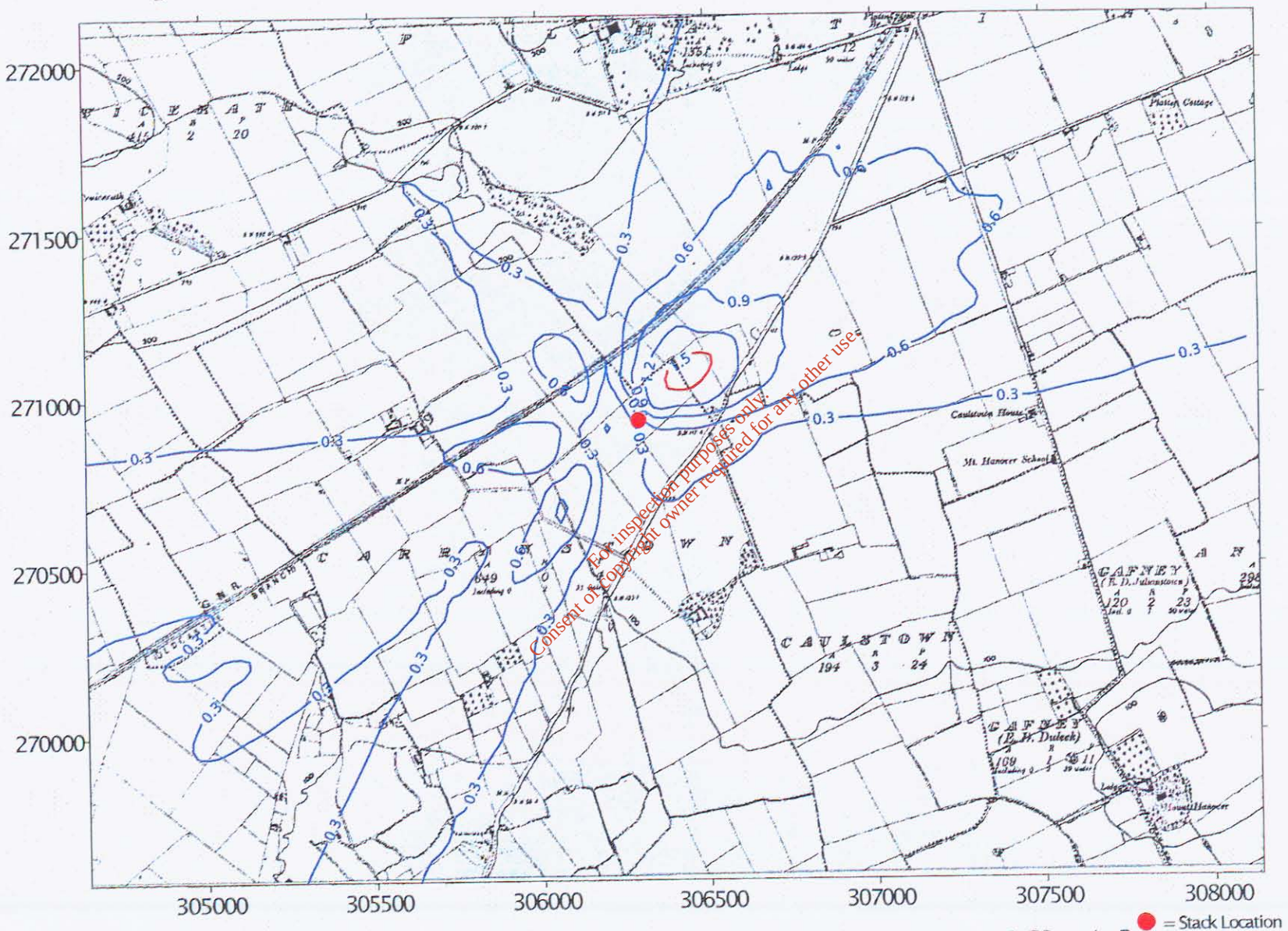
Maximum 99.2th Percentile Daily Average Ground Level Concetration = 10.78 ug/m3 = Stack Location

Figure 7 – Annual Average SO2 Ground Level Concentrations (ug/m3) – 5 Years



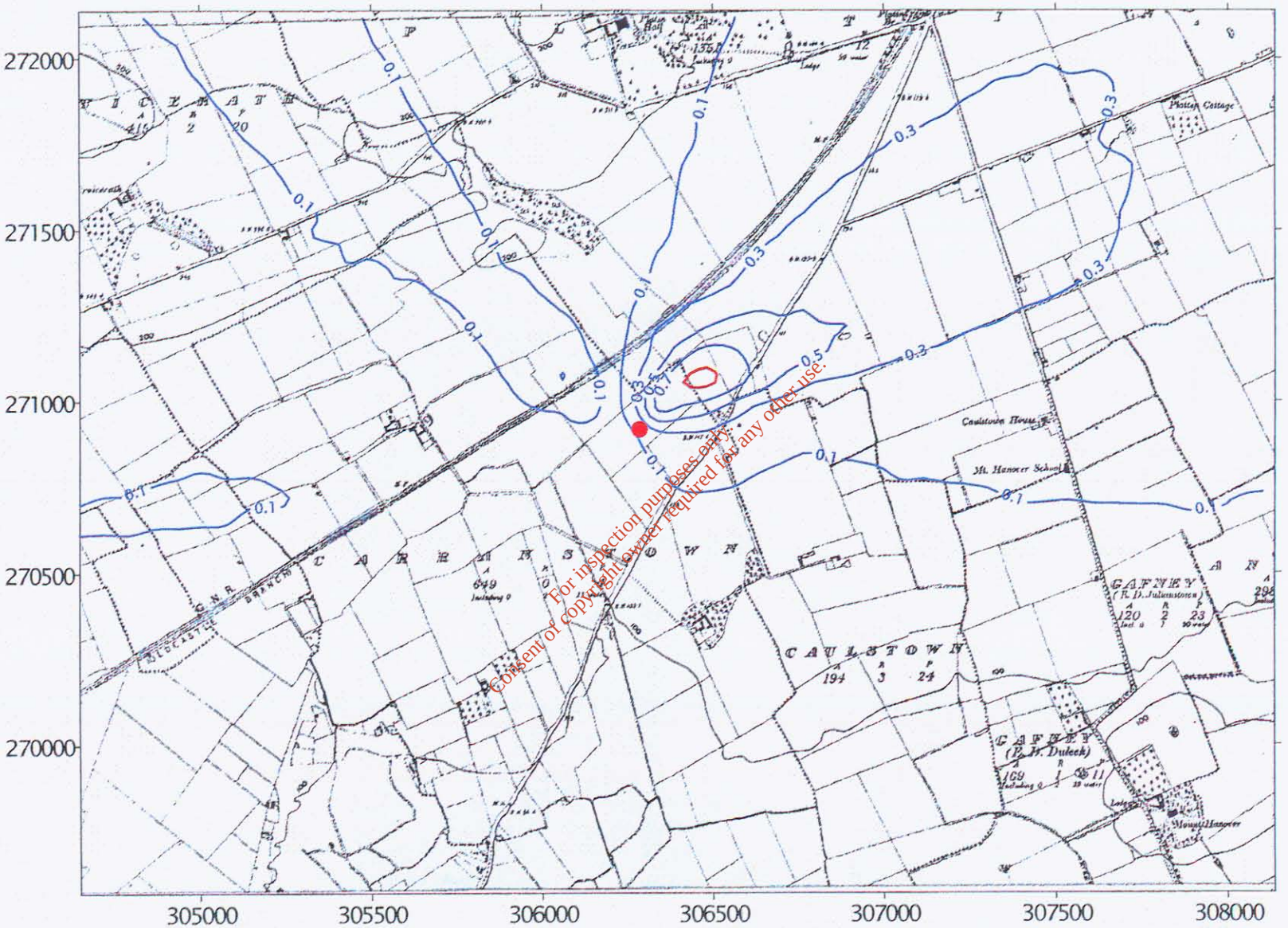
Maximum Annual SO2 Ground Level Concentration = 1.28 ug/m3

Figure 8 – 98th Percentile (Daily Average) Particulate Ground Level Concentrations (ug/m3) – 5 Years



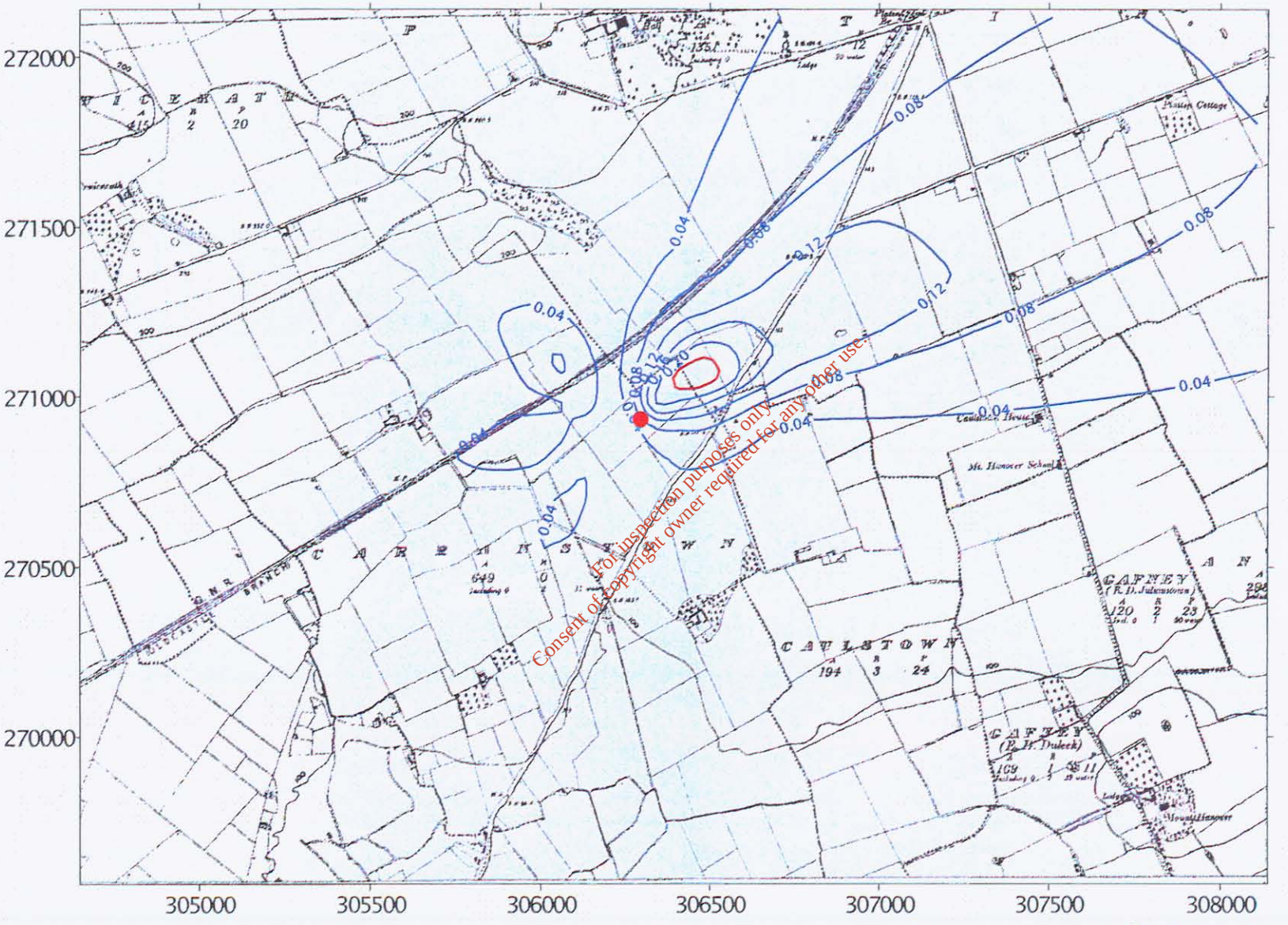
Maximum 98th Percentile Daily Particulate Ground Level Concentration = 1.69 ug/m3

Figure 9 – 90th Percentile (Daily Average) Particulate Ground Level Concentrations (ug/m3) – 5 Years



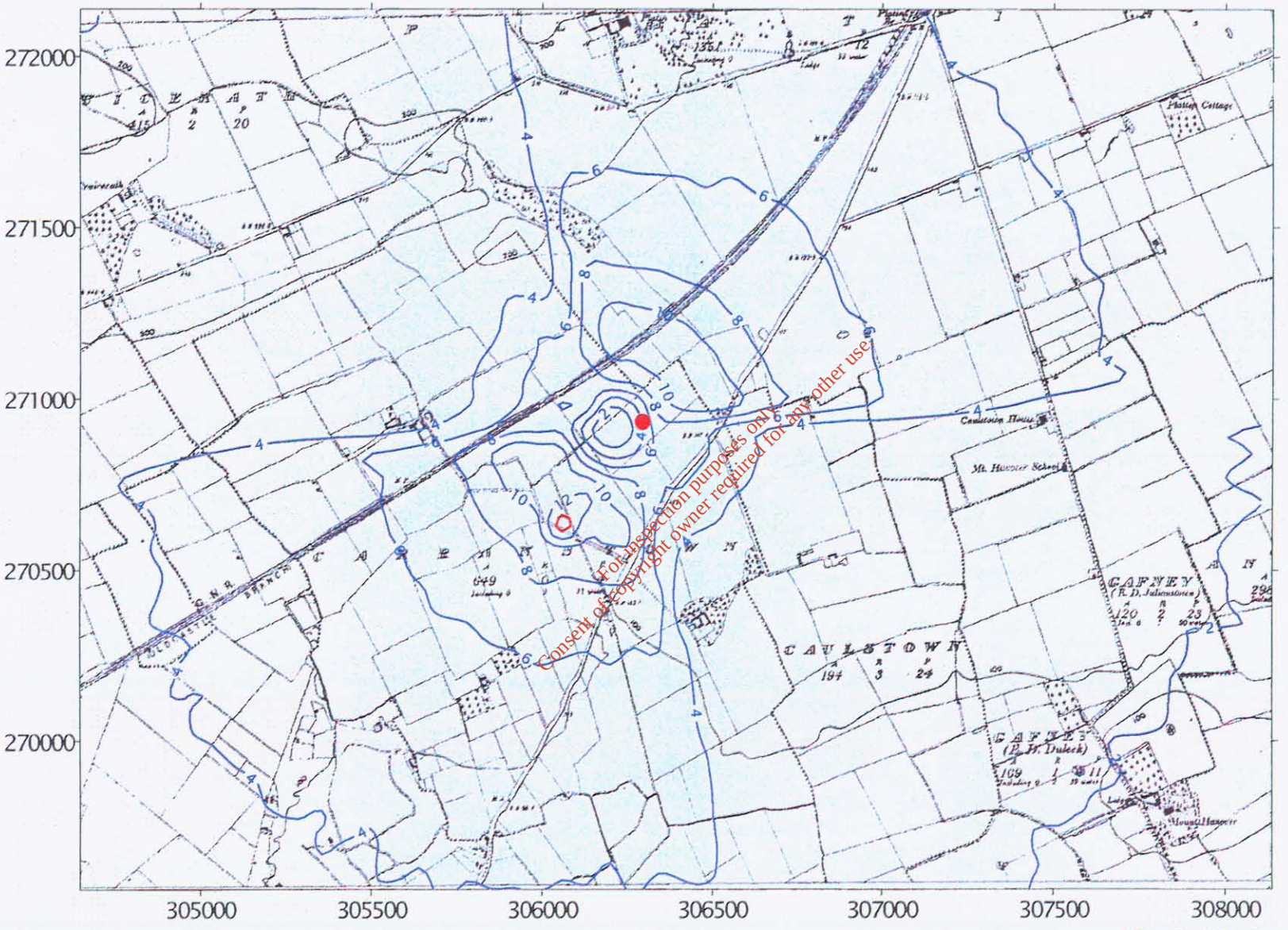
Maximum 90th Percentile Daily Ground Level Concentration = 0.98 ug/m3

Figure 10 – Annual Average Particulate Ground Level Concentrations (ug/m3) – 5 Years



Maximum Annual Average Particulate Ground Level Concentration = 0.26 ug/m3

Figure 11 – Hourly Average Unity Ground Level Concentrations (ug/m3) – 5 Years



Conversion Factors:

TOC = Unity x 0.419

HCl = Unity x 0.419

HF = Unity X 0.042

PCDD/CDF = Unity x 4E-10

Cd + Tl = Unity x 0.002

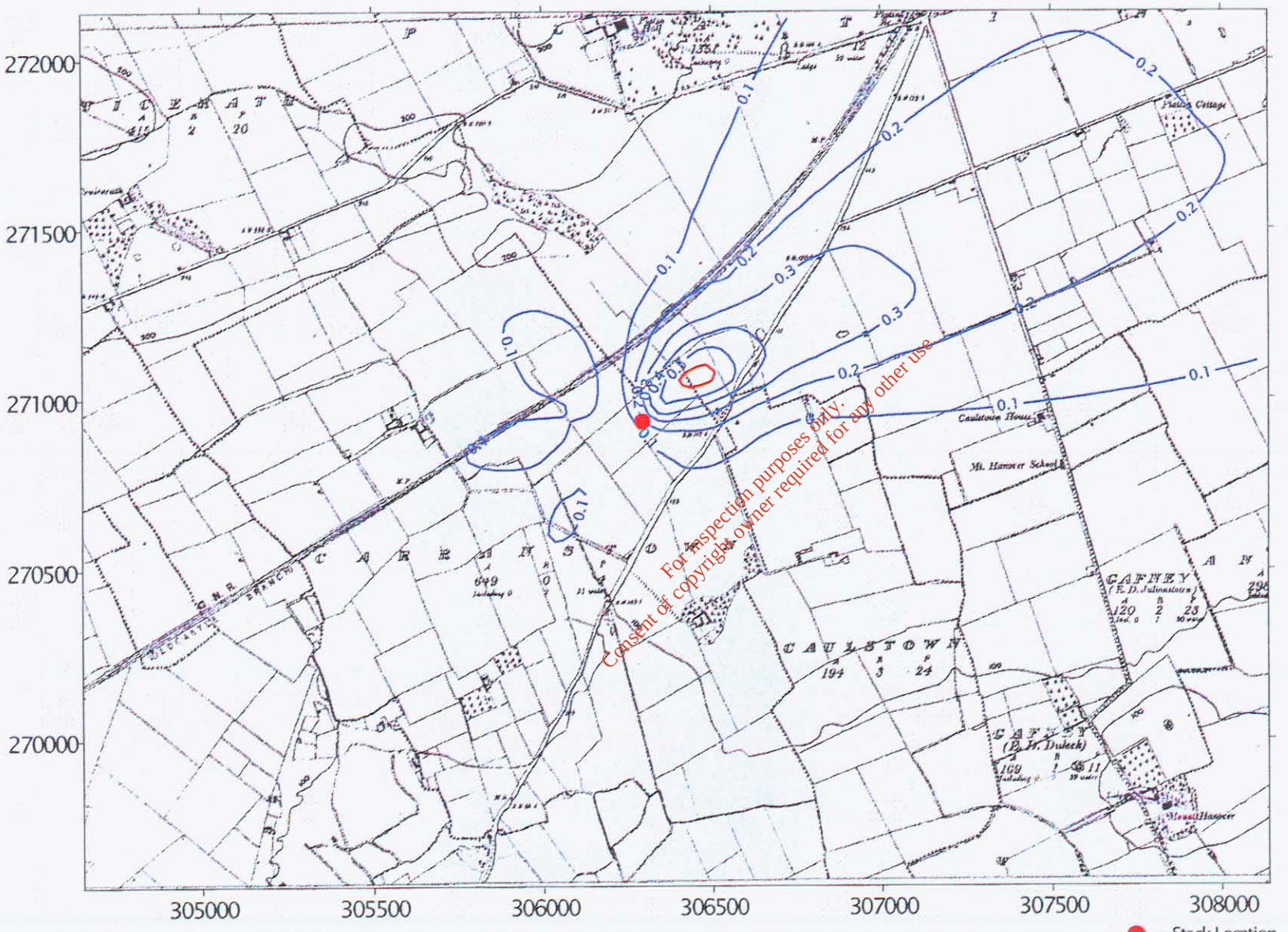
Hg = Unity x 0.002

Sum 9 HM = Unity x 0.021

● = Stack Location

Maximum Hourly Average Unity Ground Level Concentration = 16.70 ug/m3

Figure 12 – Annual Average Unity Ground Level Concentrations (ug/m3) – 5 Years



Maximum Annual Average Ground Level Concentration = 0.61 ug/m3

Conversion Factors

TOC = Unity X 0.419

HCl = Unity X 0.419

HF = Unity X 0.042

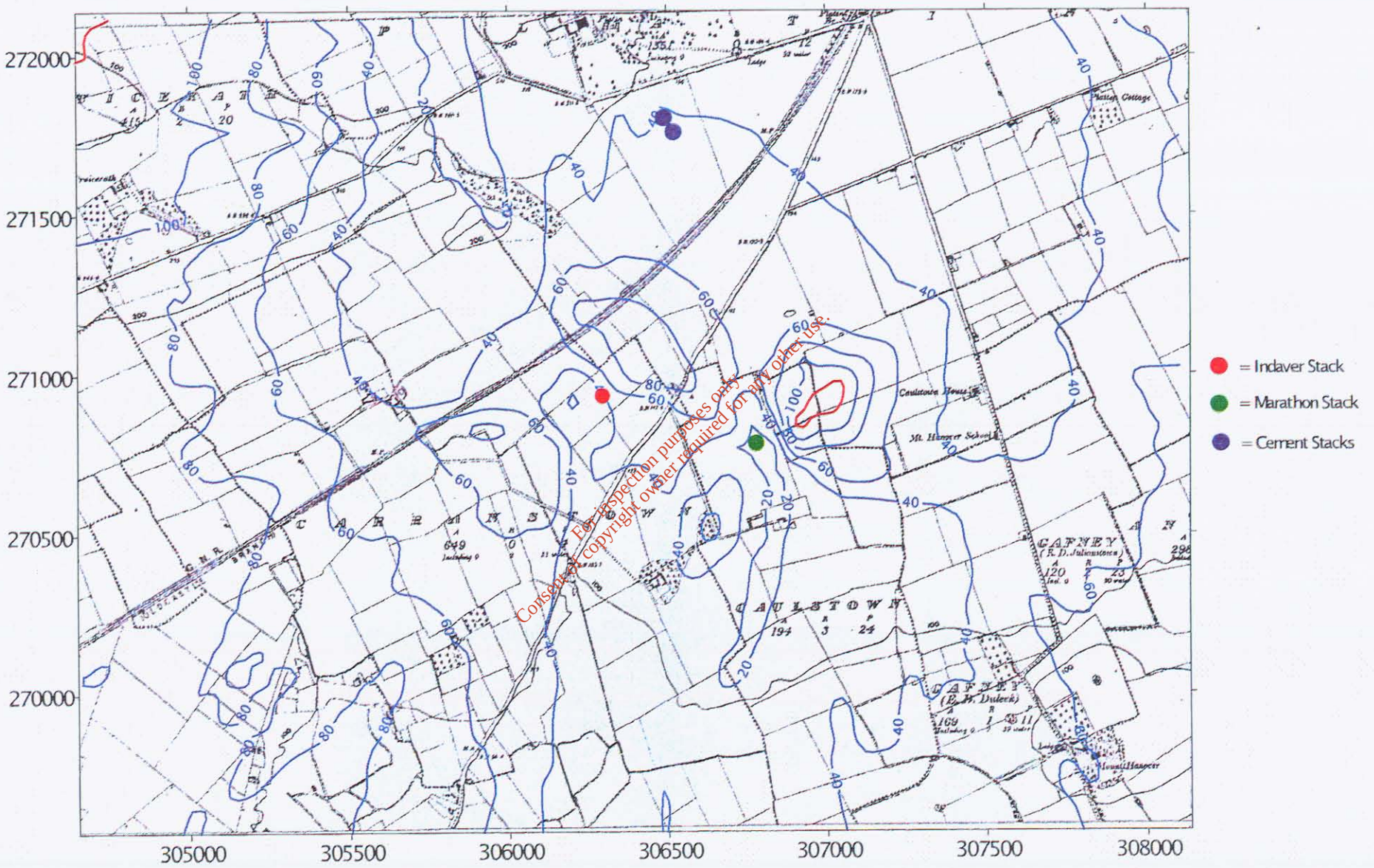
PCDD/CDF = Unity X 4E-10

Cd + Tl = Unity X 0.002

Hg = Unity X 0.002

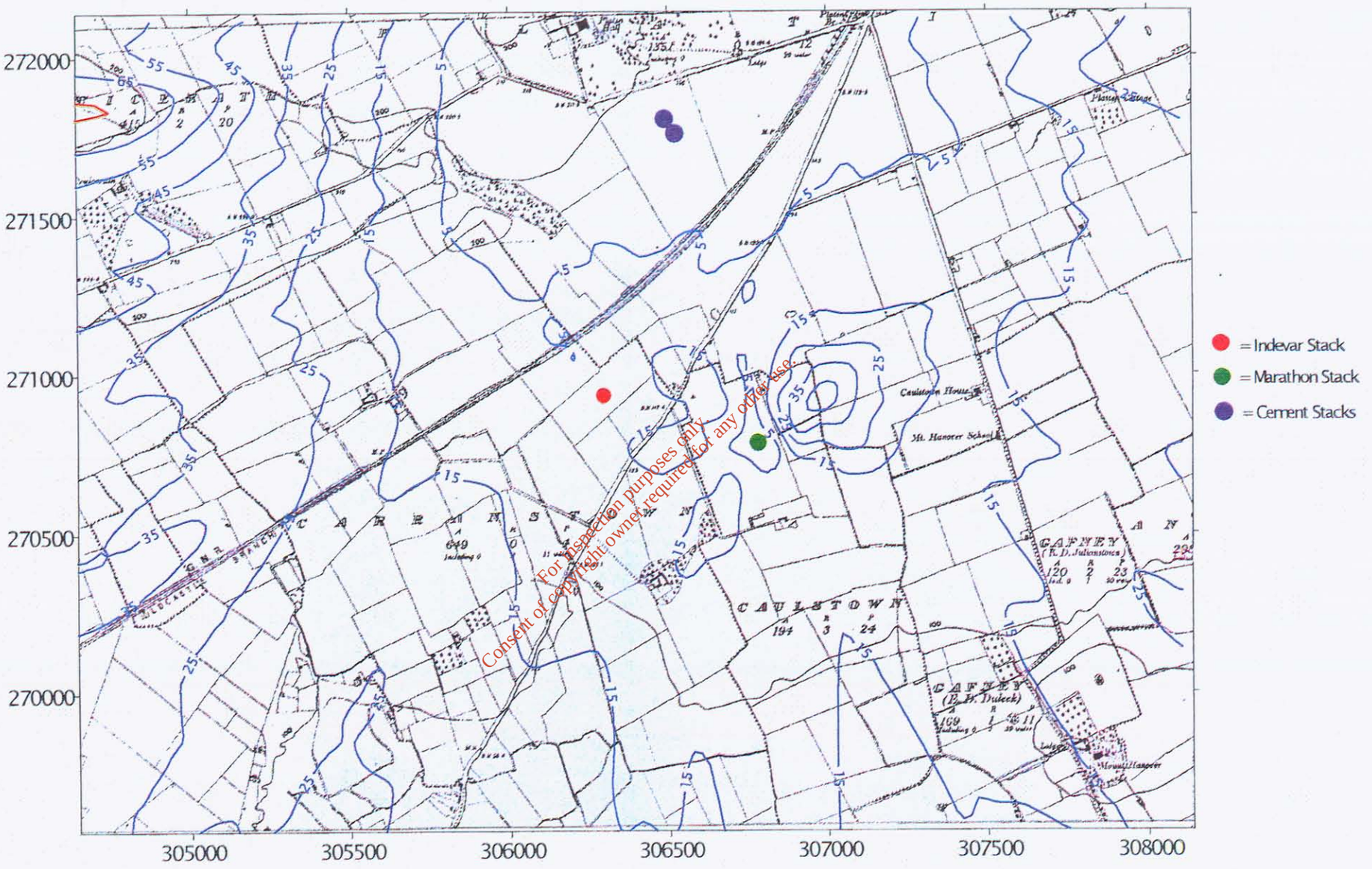
Sum 9 HM = Unity X 0.021

Figure 13 – 99.8th Percentile (Hourly Average) Cumulative NO2 Ground Level Concentrations (ug/m3) – 5 Years



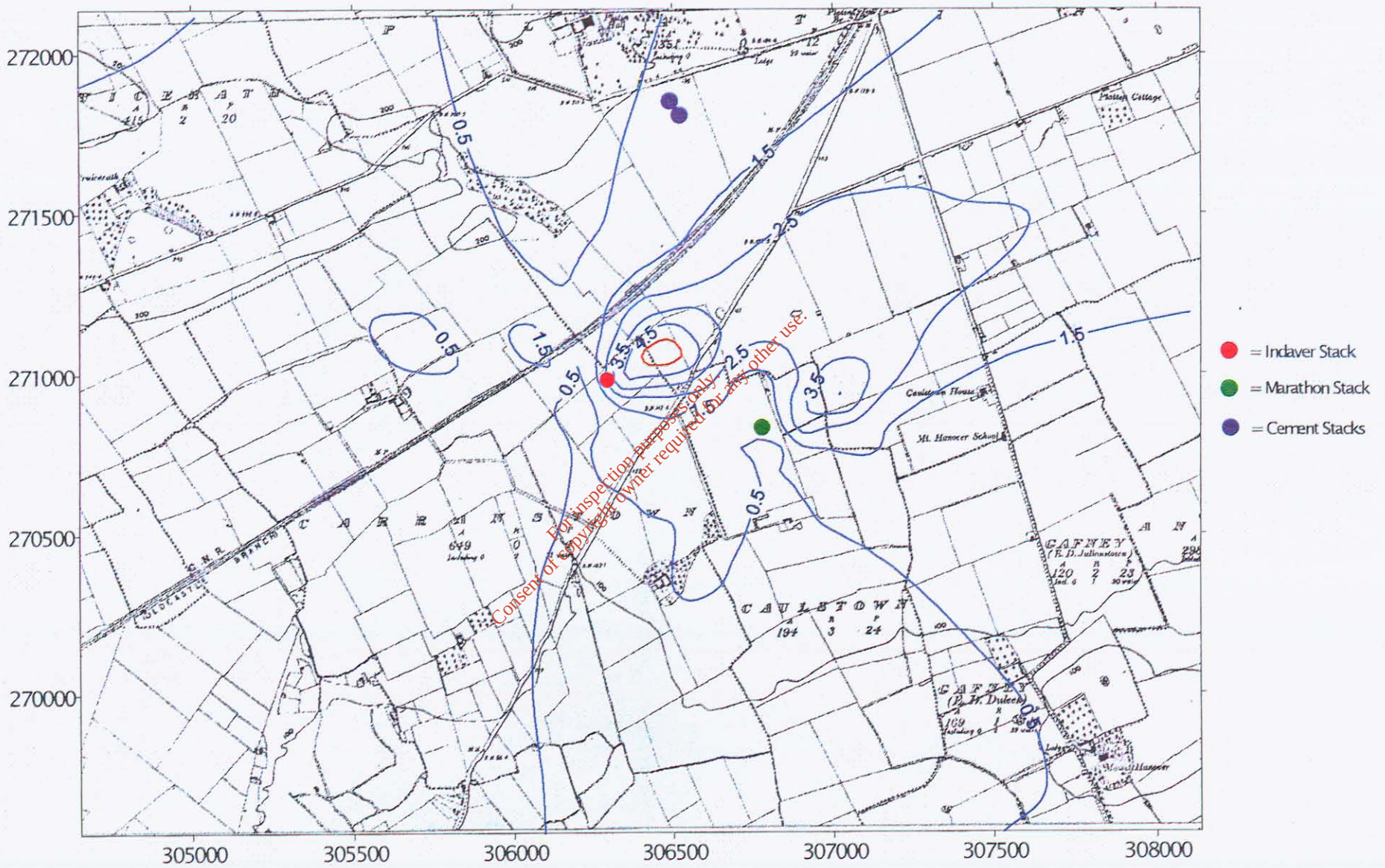
Maximum 99.8th Percentile Hourly Cumulative NO2 Ground Level Concentration = 144 ug/m3

Figure 14 – 99.2th Percentile (Daily Average) Cumulative SO2 Ground Level Concentrations (ug/m3) – 5 Years



Maximum 99.2th Percentile Daily Cumulative SO2 Ground Level Concentration = 76.29 ug/m3

Figure 15 – Annual Average Cumulative NO2 Ground Level Concentrations (ug/m3) – 5 Years



Maximum Annual Average Cumulative NO2 Ground Level Concentration = 5.9 ug/m3