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Air Quality Studies
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April 1, 2013

Mr. Casey Houweling
President
Houweling Nurseries Ltd.
2776 – 64th Street
Delta, B.C. V4L 2N7

Dear Mr. Houweling:

Re: Predicted Ambient Air Quality from a Dispersion Model Screening Evaluation of the Proposed Houweling Nurseries Ltd. Energy Project at Delta B.C.

The Houweling Nurseries Ltd. (Houwelings) greenhouse grown crop facility located in Delta, B.C. is planning to upgrade their hot water system which is currently operated through the use of the existing natural gas fuelled boilers. The current boiler system is used to provide hot water to the greenhouses and is an integral part of this facility's crop growth. Houwelings is planning the commissioning a new 8.68 megawatt (MW) natural gas fuelled energy system project (the Project) at their site in Delta, B.C. to replace the existing boiler system.

The proposed Project is a dual, natural gas fuelled reciprocal (piston) engine system for the cogeneration of heat for hot water to the greenhouses, and the generation of electricity for either internal use and/or for sale to the electrical grid. The current natural gas fuelled boilers which fall under regulation rather than permit are proposed to remain only as supplemental units after the upgrade is completed. They would only be used if needed and likely infrequently during limited conditions for engine maintenance or their other down times, during extended power outages when electricity export is not possible, and if and when the engine heat capacities are not sufficient to supply the heat requirements of the facility.

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The use of the supplemental units will likely be infrequent since there is a very large hot water tank on the site which under most circumstances will have sufficient capacity to cover the cogeneration down times. In other words, the current existing natural gas fuelled boilers are not intended for continuous use after the commissioning of the proposed Project. The legacy wood chip fuelled boilers formerly at this location have been completely decommissioned and removed from the Houwelings site.

From an air quality perspective, the operation of the proposed cogeneration energy system rather than the operation of the existing natural gas boiler system and especially the wood chip fuelled legacy boilers is expected to result in lower total air contaminant emissions to the atmosphere from the Houwelings facility. This is due to the improved control of the fuel combustion and the treatment of the exhaust gases with the proposed Project.

The main components of the proposed Project are two natural gas fuelled engines with systems attached to each for generating electrical power, a cooling system to dissipate engine heat and to provide hot water to the greenhouses when needed, two nitrogen oxides (NO_x) air emission control systems to treat the each engine exhaust prior to potential partial diversion to the greenhouses for crop growth enhancement due to the increased carbon dioxide (CO_2) content or exhaust to the atmosphere, the electrical connection system for providing surplus power to the grid, and the shuttering of the existing natural gas fuelled boilers and the full decommissioning of the wood fuelled legacy boilers. The generated electricity, net of the cogeneration and the greenhouse systems' own needs, will be sold to BC Hydro.

The proposed energy system uses twin natural gas fuelled reciprocating engines. The exhaust gas NO_x will be controlled using a selective catalytic reduction (SCR) system prior to the exhaust gas's release to the atmosphere either through a stack attached to each SCR system or to the greenhouses for CO_2 growth enhancement. For this air quality evaluation, the NO_x emitted will be converted to nitrogen dioxide (NO_2) as the applicable air quality objectives are in terms of NO_2 rather than NO_x. NO_2 is the air contaminant of interest for the proposed Project as the

other products of natural gas combustion are not expected to be significant when compared to their respective air quality objectives.

This report presents the predicted ambient air quality based on the screening level air dispersion modelling of the nitrogen oxides exhaust emissions from the two stacks of the proposed Project's cogeneration system. After a brief review of the predicted air quality conclusions at the end of this prologue, this report is comprised of an introduction that briefly sets the context for the Project from an air quality perspective, the air dispersion modelling approach, the emission parameters used for the modelled estimates of ambient concentrations, the maximum predicted ambient air quality for NO_2 and the conclusions from these modelled predictions.

The proposed cogeneration Project system's NO_2 emissions (when 100% of the emitted NO_x are conservatively converted to NO_2) are predicted to meet the most stringent applicable ambient air quality objectives at all modelled off-site locations by a significant margin for the total predicted concentrations including background from the maximum emission scenario and a potential maximum operation of 8,760 hours per year. The modelled off-site locations of interest include those in the near field such as the nearest Houwelings fence line, the nearest residential neighbours, and the site of the maximum prediction. Far field locations of interest include those for the nearest residences in the communities of Beach Grove, Ladner and Tsawwassen, and the Delta Hospital.

Of note is that the maximum 1-hour, 24-hour and annual average modelled predictions presented are for a worst case prediction and are not those expected on a continuous basis. For example, the maximum 1-hour average prediction at a specific off-site location only occurs during the worst case meteorology concurrent with the maximum expected emissions. If either the meteorological or the emission parameters differ then the highest hourly average prediction is lower and/or would occur at another location.

The worst case 24-hour average predicted concentration would only occur if the predominant winds that day were consistently in a direction from the stack to the location of the off-site maximum and if they were concurrent with an entire day of maximum NO_x emissions from the proposed cogeneration system. These conditions are unlikely to be constant over any extended time frame. Similarly for annual averages, the maximum predicted NO_2 concentrations from the Project's stack emissions are expected to be conservative on these bases.

The screening model predicted that the near field off-site maximum 1-hour, maximum 24-hour and highest 1-year average total concentrations including background, for ambient NO_2 from the proposed cogeneration Project's NO_x emission control system stack air emissions, are 95.7 micrograms per cubic metre ($\mu g/m^3$), 63.7 $\mu g/m^3$ and 25.6 $\mu g/m^3$, respectively, at a distance of 310 metres (m) from the proposed stack. All of these maxima are well below their most applicable ambient criteria with the background as the most significant contributor to the total and are based on the potential worst case NO_x emissions at the cogeneration equipment manufacturer's "not to exceed" value of 5 parts per million by volume (ppm_v) at 15% oxygen (O_2) and dry.

The actual total NO_2 concentrations are likely to be lower than these predicted maxima based on the recent experience from identical cogeneration equipment that was installed and currently in operation at another Houwelings facility. During the recent stack testing at this other facility, the measured NO_x emissions were 1.54 ppm_v and 2.56 ppm_v (corrected to 15% O_2 and dry). Hypothetically, if the proposed project emitted NO_x at these levels and the other stack characteristics were the same as during those stack tests, the predicted near field maximum total NO_2 concentrations were slightly lower at 94.5 $\mu g/m^3$ (1-hour average) or 47% of the objective for an hourly average, 63.2 $\mu g/m^3$ (24-hour average) or 32% of the guideline for a daily average, and 25.5 $\mu g/m^3$ (1-year average) or 64% of the objective for an annual average. The two units were modelled individually with their coinciding maxima added together. The background in all of these cases is the also most significant contributor to the total predictions.

The 310 m downwind distance places most of possible locations for the maximum prediction on the Houwelings' facility site which is not considered as ambient air and a location of public access. On-site concentrations fall under the jurisdiction of WorkSafe BC and are beyond the scope of this screening evaluation. However since the maximum modelled predictions meet the most stringent ambient objectives, they would also be expected to meet WorkSafe BC's requirements as they are usually many times greater than Metro Vancouver's ambient criteria.

The other possibilities of finding ambient air at 310 m downwind occur along two partial arcs with one of these starting at a location on the dyke 310 m to southeast of the emission source, out over the mud flats of Boundary Bay and ending on the same dyke 310 m to the east-southeast of the source. The other partial arc starts along the Houwelings property line 310 m to the northeast of the emission source, across an agricultural field north of the Houwelings property, and ending at Houwelings north fence line approximately 75 m east of their office. Of note from the modelling predictions is that the potential maxima occur only along this arc. Other locations both beyond or inside this arc have a lower predicted total ambient NO_2 concentration and would therefore also meet Metro Vancouver's and Environment Canada's ambient criteria.

If the 24-hour average predictions for complex terrain (above stack top) are converted to a 1-hour average, a multiplication factor of four is commonly used. (For simple terrain below stack top, a factor of 2.5 is commonly used). This means that at a far field location 3,800 m downwind and 20 m above sea level corresponding to the rising southeast slope of the community of Tsawwassen, the overall off-site maximum 1-hour average total NO_2 prediction would be 96.2 $\mu g/m^3$ (or 95.6 $\mu g/m^3$ if using the identical equipment stack test data) if derived indirectly from the 24-hour average maximum. This value is slightly higher than the maximum near field prediction noted previously. However, this highest 24-hour average for complex terrain is less than the overall maximum 24-hour average directly predicted by the model for simple terrain (from the maximum 1-hour average) due to the different multiplication factors. For the purposes of this evaluation, the highest annual average is conservatively based on the scaling of the highest 1-hour average maximum prediction.

These modelled predictions conservatively assume that there is a 100% conversion of NO_x to NO_2 and that the hourly, daily and annual average NO_2 background are the higher of the maximum observations between the Metro Vancouver North Delta and South Richmond monitoring stations during 2011. (At the time of this modelling evaluation, 2011 was the most recently year of available and verified Metro Vancouver ambient data). On these bases, the total maximum predictions are 48% and 64% of the Metro Vancouver 1-hour and annual average ambient NO_2 objectives, respectively.

In lieu of an ambient NO_2 objective for a 24-hour average by Metro Vancouver, the Environment Canada guideline was used. The total maximum 24-hour average predicted NO_2 is 32% of that guideline due to the NO_x emissions from the proposed Project. Therefore even with conservative assumptions such as a 100% NO_x to NO_2 conversion, emissions at the manufacturer's maximum specification, worst case meteorology, no plume depletion or meander, using the 100^{th} percentile for short-term background and all of these occurring simultaneously, the modelling still predicts that the applicable criteria are achieved for ambient NO_2 concentrations as a result of the proposed Project's emissions. It should also be noted that for these reasons, the screening model predictions presented in this report are conservative maximum predictions.

1.0 INTRODUCTION

Houweling Nurseries Ltd. (Houwelings) operates a greenhouse grown crop facility located in the Corporation of Delta (Delta), a District Municipality of the Province of British Columbia. The Houwelings facility is located in the south part of Delta and is immediately adjacent to the northwest shore Boundary Bay. The main population centres of Delta nearest to this facility are the communities of Beach Grove, Ladner and Tsawwassen located approximately two kilometres (km), four km and four km to the southwest, northwest and southwest of Houwelings, respectively.

The nearest off-site neighbours include a rural residence near the north boundary and main entrance to the Houwelings property off 64th Street approximately 400 m to the northwest of the proposed emission source and a rural residence across 64th Street approximately 550 m to the west-southwest. Other off-site neighbours in the vicinity of Houwelings include additional rural residences to the north along 64th Street and west along 28th Avenue ranging from approximately 650 m to over 1 km from the proposed source. The nearest location of publically accessible ambient (off-site) air is the dyke 300 m to the southeast of the proposed emission source.

The other activities located in the vicinity of the Houwelings facility are mainly agricultural along with other greenhouse facilities. The nearest part of Highway 17 is approximately 1,300 m to the west while the nearest part of the Canadian National Railway track is approximately 750 m to the north-northwest. There is also the construction of the South Fraser Perimeter Road project adjacent to the rail line. Boundary Bay is located to the east, southeast and south of Houwelings.

2.0 MODELLING APPROACH

2.1 DISPERSION MODEL SELECTION

The U.S. EPA SCREEN3 air dispersion model was used to predict the ambient concentrations of nitrogen oxides (NO_x) from Houwelings proposed energy system stack emissions. NO_x is defined as all forms of nitrogen oxides and includes the individual components of nitric oxide (NO), nitrogen dioxide (NO_2), and nitrous oxide (N_2O). Nitrogen dioxide (NO_2) is the component that is regulated and is the air contaminant of interest for this air dispersion modelling screening evaluation. The SCREEN3 model is suited for a screening analysis of air emissions from identical sources such as the proposed energy system stacks and is capable of predicting ambient air quality on simple (below stack top) or complex (above stack top) terrain.

SCREEN3 is considered by the British Columbia Ministry of Environment (MOE) as a core screening model for single source situations as stated in their modelling guidance document

(Guidelines for Air Dispersion Modelling in British Columbia, BC MOE, March 2008). SCREEN3 generally provides conservative predictions of air quality (i.e., it tends to over-predict) for down wind locations from the air emission source.

The SCREEN3 model is also capable of incorporating the effects of aerodynamic downwash on the ambient air quality predictions. In the proximity of the leeward side of significant structures, aerodynamic downwash effects tend to draw plumes emitted from stacks downward towards the ground, and thereby increasing nearby ambient concentrations from such a plume. A review of the existing and proposed structures at the Houwelings site was conducted to determine the most significant aerodynamic structure with respect to the proposed energy system stack. That review was based on field observations, Google Earth™ satellite images and general site plan information. The main greenhouse structures that surround the proposed emission source were determined as the most significant aerodynamic structures. Due to the extended coverage of the greenhouses' footprint, the maximum length and width of these structures was set to 200 m as dimensions greater than 200 m do not have any additional effect on downwash in SCREEN3 for these structures. The structure height for downwash was set to 5.3 m above ground level.

A limitation of the SCREEN3 model is that it is only capable of predicting 1-hour average concentrations on low or simple terrain, and 24-hour average concentrations on elevated or complex terrain. SCREEN3 was set to model the flat geography surrounding the vicinity of the Houwelings facility as simple terrain and the higher elevations of Tsawwassen as complex terrain. Since the relevant Metro Vancouver ambient objectives for NO_2 are expressed as 1-hour and annual averages and Environment Canada has a 24-hour average guideline, conversion factors were applied to the maximum 1-hour and/or 24-hour average predictions to determine the maximum predictions for the other time averaging periods. The conversion factors used were a multiplier of 0.4 for converting 1-hour averages to 24-hour averages for simple terrain and 0.25 for complex terrain, and a multiplier of 0.08 for converting hourly values to annual averages for all terrain. These conversion factors were obtained from the MOE guidance document.

The Rural dispersion option parameter was selected for this SCREEN3 study since the greenhouse facility and its nearby lands are surrounded by farms. The use of the Rural option is conservative compared to the use of the Urban option since with the absence of structures, ground turbulence is reduced which in turns reduces plume dispersion. For a three km radius surrounding the proposed stacks, the land is primarily farmland or is ocean.

2.2 METEOROLOGICAL DATA

The SCREEN3 model uses an internal database of meteorological conditions that represents all of the typical and possible combinations of wind speed and atmospheric stability (i.e., the atmosphere's ability to disperse air contaminants).

2.3 RECEPTOR LOCATIONS

Receptors or locations where ambient predictions are made by the SCREEN3 model were selected on the following bases. The automatic distance array feature of the SCREEN3 model was used to characterize the receptors downwind from the proposed Houwelings energy project stacks towards the nearest neighbours and nearby communities. Receptors with 100 m spacing from 100 m downwind to 3000 m downwind, 500 m spacing from 3000 m downwind to 6000 m downwind, and an extra receptor at 50 m downwind, and all at the same elevation as the proposed stack base were modelled. A finer spacing is not required for determining the highest prediction since the SCREEN3 model seeks the maximum concentration and downwind distance for simple terrain when using the automatic distance array.

As discussed in the following sections, the maximum prediction from SCREEN3 occurs well within the distance to the furthest modelled receptor. Therefore the receptor array selected for the air quality evaluation of emissions from the proposed Houwelings energy project is appropriate.

Other discrete receptor distances and elevations for the following locations of interest from the proposed energy system stack were either manually entered into or at a distance automatically generated by the model: the nearest fence line to the north, west and southeast, the nearest first, second and third neighbours to the northwest and west, the nearest residences of Beach Grove and Tsawwassen, and the Delta Hospital in Ladner. As was the case for the automated distance array, the elevation of the stack base was assumed for these discrete receptors. The southeast property line of the Houwelings facility along the dyke was considered as the nearest location from the proposed Project for off-site ambient air (i.e., the nearest location of public access).

Rising terrain features are located to southwest of the Houwelings facility in the community of Tsawwassen. The complex terrain was modelled by using discrete receptors at 10 m elevation intervals from 20 m above sea level (ASL) to 70 m ASL. The distance to each complex terrain elevation level was based on the shortest distance to each level from the proposed Project's stacks. These distances to the nearest elevation levels for complex terrain were estimated from Google Earth™ data.

On-site locations are not considered as ambient and would be subject to Workers' Compensation Board (WCB) WorkSafeBC occupational health guidelines. An evaluation of the on-site air quality is beyond the scope of this evaluation.

2.4 AIR EMISSION PARAMETERS

The proposed Houwelings energy system stack emission parameters for modelling were specified by the project's equipment supplier (GE Energy, February, 2013). The "not to exceed" NO_x emission rate for each of the two units was specified at 5 parts per million by volume (ppm_v) at 15% oxygen and zero moisture (dry). Previous experience with this cogeneration equipment at another Houwelings facility showed that the actual NO_x emissions during stack testing ranged from 1.54 ppm_v to 2.56 ppm_v when corrected to 15% O_2 and dry.

A design stack height of 15.0 m above ground level (AGL), a design exhaust gas exit temperature of 50°C and a design stack diameter of 0.7 m were used for modelling. The 15.0 m AGL stack height is more than 2.5 times the 5.3 m height of the nearby structures and therefore meets the criterion for a good engineering practice stack height. The stack exit velocity of 15.4 m/s for modelling was derived from the maximum design normal air flow of 16,167 normal dry cubic metres per hour (Nm^3/hr) or 18,000 Nm^3/hr if stack gas moisture is included, the stack cross-sectional area calculated from the stack diameter and the site elevation at sea level. Normal conditions were assumed as at one atmosphere pressure, a temperature of 0° Celsius (°C) and dry. These design values are based on the stack exhaust from the proposed Project after NO_x control has been applied.

The energy system stack NO_x emission rate of 0.0461 grams per second (g/s/unit) was calculated from the maximum design normal air flow and the maximum design NO_x emission concentration of 5 parts per million by volume (ppm_v) at 15% oxygen. This NO_x emission rate is the same for the operation of each of the two identical proposed units. Since SCREEN3 can only run a single stack source at a time, the NOx emissions from one stack was conservatively doubled for modelling to 0.0922 g/s. The conservatism is due to modelling the equivalent of two co-located stacks when in actuality, the proposed Project's stacks would be separated by a few metres. The proposed separated stacks would allow for some additional dispersion of the plumes. For optimum efficiency, the proposed energy project is expected to run near full capacity during its operation. For purposes of this air quality evaluation, the proposed energy system is conservatively assumed to run for the entire year or 8,760 hours per year (hr/yr). A tabular summary of the emission parameters used for the air dispersion modelling can be found attached to the end of this report as Table 1.

2.5 EXISTING AIR QUALITY

An estimate of the existing NO_2 air quality for the Delta, B.C. region was determined using the monitored data reports issued by Metro Vancouver for the most recent available year of 2011

(Metro Vancouver, 2012). For background, the higher of the NO_2 measurements from Metro Vancouver's North Delta (T13) and South Richmond (T17) monitoring stations was considered as these monitors are the nearest full time stations to the Houwelings site. For both the 1-hour and annual average background NO_2 concentrations, the maximum observations from T17 were applied to the maximum incremental predictions.

These maximum observations are 89 $\mu g/m^3$ for the 1-hour average background (100^{th} percentile) and 25 $\mu g/m^3$ for the annual average background. The 1-hour average value is very similar to the 88 $\mu g/m^3$ from T13 that was used by Metro Vancouver in their initial review of the proposed Project. The annual average background values were the same at both stations in 2011.

These measurements were published in Metro Vancouver's 2011 Air Quality summary report. The use of the 100^{th} percentile noted above and below can be considered as conservative since the 98^{th} percentile has been used by some jurisdictions for a background level, including Metro Vancouver. For the 24-hour average background NO_2 concentration, the maximum observation (100^{th} percentile) of 61 $\mu g/m^3$ from T13 was conservatively applied to the maximum 24-hour average incremental prediction.

Since the maximum 24-hour average NO_2 measurements were not published in the Metro Vancouver 2011 Air Quality summary report, the monitoring data for T13 and T17 were downloaded from MOE's BC Air Data Archive (Envista). The Envista data were also used to confirm the published 1-hour and annual averages previously mentioned.

The use of these reported measurements of NO_2 concentrations are also slightly conservative since a small component of the observations is due to Houwelings existing operation. That minor component which will be replaced by the increment from the proposed Project is still conservatively included when the observed background are added to the modelled predictions.

3.0 PREDICTED AIR QUALITY

3.1 Maximum Predictions for Ambient NO_2

The SCREEN3 dispersion model using the previously presented stack parameters in Section 2.4, including a stack gas NO_x concentration of 5 ppm_v at 15% O_2 and dry, predicted that maximum off-site incremental concentration of nitrogen oxides (NO_x) from the proposed Houwelings cogeneration project is 7.18 $\mu g/m^3$ for a 1-hour average (converted from a 24-hour average complex terrain prediction). The location of the 1-hour average maximum increment is predicted by the model to occur at a distance of 3,800 m corresponding to the rising terrain in the community of Tsawwassen. (The near field 1-hour average maximum increment is predicted to be 6.69 $\mu g/m^3$. This corresponds to locations along the previously mentioned 310 m partial arcs from the emission source on level terrain). If the overall maximum NO_x increment is conservatively assumed to be 100% nitrogen dioxide (NO_2) and added to the 1-hour average NO_2 background, the maximum total 1-hour average NO_2 prediction is 96.2 $\mu g/m^3$ or 48% of the Metro Vancouver hourly objective of 200 $\mu g/m^3$. The near field maximum total NO_2 is 95.7 $\mu g/m^3$ or 48% of the Metro Vancouver hourly objective.

It is expected that this maximum ambient 1-hour average total NO_2 prediction is conservative since the portion of emitted NO_x that is actually NO_2 is typically 10% from a reciprocating engine. Since this near field maximum is predicted to occur during an hourly average wind speed of 2.0 m/s, the transport time is just over 2.5 minutes to the ambient location 310 m downwind. For the far field maximum 1-hour average prediction, the transport time is approximately one hour with a 1.0 m/s wind. In actuality, there would be limited NO_x to NO_2 conversion over these brief time spans. Although a 100% conversion rate is conservatively used for this report, over a 24-hour time period a conversion rate of 75% is often used.

The other hourly average meteorological conditions corresponding to the near field maximum 1-hour ambient prediction are a mixing height of 640 m and a slightly unstable “C” Pasquill-

Gifford atmospheric stability. This maximum 1-hour average prediction is also conservative since the model does not account for plume meander (which increases the transport distance and therefore allows more time for dispersion) and for plume depletion.

Using a factor of 0.4 for simple terrain and 0.25 for complex terrain to convert an hourly average to a daily average, the maximum incremental 24-hour average NO_x concentration is predicted to be 2.7 µg/m^3 for an off-site location. When the 24-hour average NO_2 background of 61 µg/m^3 presented in the previous section is added to the maximum 24-hour average ambient increment, the maximum 24-hour average total NO_2 prediction is 63.7 µg/m^3 and occurs 310 m downwind. Since Metro Vancouver does not have a 24-hour average NO_2 objective, the Environment Canada 24-hour average NO_2 guideline of 200 µg/m^3 was applied for this evaluation. On this basis, the maximum total 24-hour average NO_2 prediction is 32% of that guideline using the conservatively assumed background.

The highest 1-year average incremental ambient NO_x prediction derived from the modelling is 0.57 µg/m^3, when an hourly to yearly conversion factor of 0.08 is applied to the maximum 1-hour average increment predicted by SCREEN3. When added to the 25 µg/m^3 annual average NO_2 background, the maximum total annual average prediction is 25.6 µg/m^3 or 64% of the Metro Vancouver annual average objective. Table 2 presents a summary of the maximum predicted total NO_2 concentrations. The output file from the modelling is attached as Appendix I to the end of this report.

If the stack NO_x emissions for modelling were based on actual measurements from the identical cogeneration equipment operating at another Houwelings facility with all other parameters for the proposed project unchanged; the maximum total predicted NO_2 concentrations would be similar and slightly lower at 95.6 µg/m^3 for a 1-hour average or 47% of the objective, 63.2 µg/m^3 for a 24-hour average or 32% of the guideline, and 25.5 µg/m^3 for a 1-year average or 63% of the objective. These two stacks were modelled individually with the predicted maxima from one stack added to the predicted maxima for the other stack at common locations. Since the

individual maximum predictions occur in slightly different locations of 304 m and 311 m downwind for the two modelled stacks, they were conservatively added together to form an overall maximum. The conservatism is due to the predicted concentration from one stack being lower at the location of the other stack's maximum.

The SCREEN3 dispersion modelling options for determining if either an inversion breakup fumigation concentration value or a shoreline fumigation concentration would be of concern were activated. The model predicted that a potential short-term fumigation concentration for NO_x was essentially zero (i.e., less than 0.0001 µg/m^3) at a distance of 670 m downwind. The model also predicted that there is no potential for a shoreline fumigation since the plume height is below the critical value. The model therefore indicated that it would not perform this calculation.

For all of the other discrete locations of interest listed in Section 2.3, which includes the nearby residences, hospital and other locations along the model generated distance array up to 6,000 m from the proposed Project stack, the expected highest incremental concentrations are less than those predicted for the incremental maximum and therefore results in totals that are below the applicable ambient criteria. As well for those locations in the main populated areas of Beach Grove, Tsawwassen and Ladner, the modelled increments are significantly lower than those predicted at the location of the maximum concentration as a result of the proposed Project. The highest predictions for these locations of interest are illustrated graphically as bar chart figures.

Figure 1 is a bar chart representation of the model predicted, highest 1-hour average total NO_2 concentration for these locations of interest. A line representing the Metro Vancouver 1-hour average NO_2 objective is presented in the figure for comparison. The lower solid part of each bar represents the background portion of the total predicted NO_2 concentration while the upper hatched part represents the predicted maximum increment. Figure 1 shows that maximum total prediction and the highest total predictions at the locations of interest are below the Metro

Vancouver 1-hour average NO_2 objective with background contributing to a significant portion of the total predictions.

Similarly Figure 2 graphically presents the model predicted maximum 24-hour average total NO_2 concentration and the highest predictions for the nearby locations of interest, with an added line representing the Environment Canada 24-hour average guideline. Figure 3 similarly presents the highest annual average total NO_2 predictions at these locations along with the Metro Vancouver annual average NO_2 objective. As is the case for the 1-hour average total NO_2 concentrations, the predicted maximum 24-hour and annual average total NO_2 concentrations are also within their respective objectives with background also contributing to a significant portion of the total predictions.

4.0 CONCLUSIONS

The screening level air dispersion modelling evaluation of the proposed Houwelings cogeneration Project at their Delta, B.C. site predicts that the maximum ambient (off-site) air quality for the maximum 1-hour and annual average total NO_2 concentrations are expected to meet their respective Metro Vancouver objectives at all ambient locations, including the locations of interest (residences) adjacent to the site and those in the nearby communities. For the 24-hour average, maximum predicted total NO_2 concentration is also predicted to meet the ambient 24-hour average guideline of Environment Canada at all ambient locations.

These maximum incremental predictions from the screening model should be viewed in the context that they are for a conservative case operation of the proposed cogeneration Project at the maximum design emissions concurrent with the worst case meteorology and maximum background. These events are not expected to occur simultaneously with any frequency. The conservatism extends to the assumptions of no plume depletion or no plume meander, the 100% conversion of the short-term NO_x concentrations to NO_2 (when the initial NO_2 fraction of NO_x

from reciprocation engines is more likely to be in the range of 10%), the use of a 100th percentile background, and the use of a screening model to determine these maximum predictions.

Yours sincerely,

Ross Nogami, P.Eng.

cc: - E. Kuntz, Houweling Nurseries Ltd.
A. Ram, Houweling Nurseries Ltd.

Encls.: Table 1 - Stack Parameters for Air Dispersion Modelling
Table 2 - Maximum Predicted Air Quality
Figure 1 - Comparison of the Predicted 1-hour Average Total NO_2 at Selected Locations to the Metro Vancouver Ambient Objective
Figure 2 - Comparison of the Predicted 24-hour Average Total NO_2 at Selected Locations to the Environment Canada Ambient Guideline
Figure 3 - Comparison of the Predicted 1-year Average Total NO_2 at Selected Locations to the Metro Vancouver Ambient Objective
Appendix I – SCREEN3 modelling output file

Table 1 Proposed Cogeneration System Stack Parameters for Dispersion Modelling

Parameter	Units	Model Input
Stack temperature	K	323
	°C	50.0
Ambient temperature	K	293
	°C	20.0
Stack exit velocity	m/s	15.4
Stack diameter	m	0.7
Stack height	m	15.0
Emissions		
Nitrogen Oxides (NO_x)	g/s	0.0922[(1)]

Note: 1. The modelled NOx emission rate is for 2 co-located cogeneration units.

Table 2 Maximum Predicted Ambient Total Nitrogen Dioxide (NO_2) Concentrations

Air Contaminant	Averaging Period	Most Applicable Government Ambient Objective or Guideline[(1)] ($\mu g/m^3$)	Screening Model Total Ambient Concentration[(2)] ($\mu g/m^3$)	Maximum Concentration to Objective Ratio (%)
Total Including Background				
Nitrogen Dioxide	1 Hour	200[(3)]	96.2	48
	24 Hour	200[(4)]	63.7	32
	Annual	40[(3)]	25.6	64

Notes:

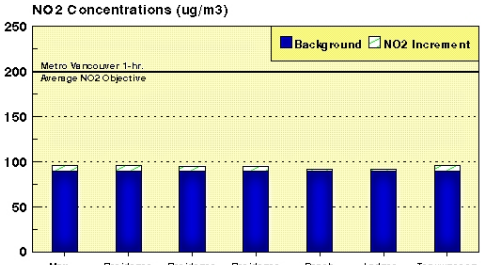
1. The most applicable government ambient objective or guideline refers to the most stringent applicable criterion, if there is more than one from different agencies.

2. The maximum ambient total concentration includes background. The 1-hour and 24-hour average backgrounds are assumed to be 89 $\mu g/m^3$ and 61 $\mu g/m^3$ respectively, while the annual average background is assumed to be 25 $\mu g/m^3$.

3. Metro Vancouver's 1-hour average NO_2 objective of 200 $\mu g/m^3$ is more stringent compared to Environment Canada's guideline of 400 $\mu g/m^3$ and Metro Vancouver's annual average NO_2 objective of 40 $\mu g/m^3$ is more stringent compared to Environment Canada's guideline of 60 $\mu g/m^3$.

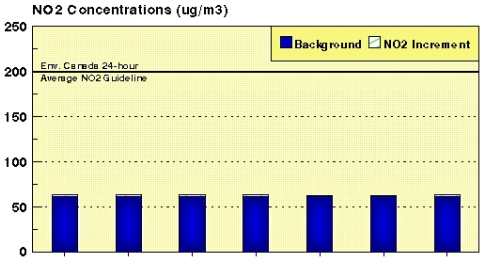
4. Environment Canada's 24-hour average NO_2 guideline of 200 $\mu g/m^3$ is used in lieu of a Metro Vancouver objective for this time average.

Figure 1 - Predicted Maximum 1-hour Average Total NO_2 Concentrations at Selected Receptor Locations of Interest



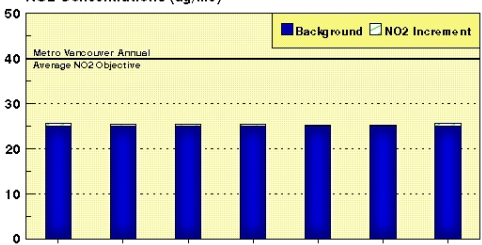
Notes- 1. The locations of the three nearest neighbours are presented.
2. Background 1-hour average NO2 assumed as 89 ug/m3.
3. Higher prediction from simple and complex terrain presented.

Figure 2 - Predicted Maximum 24-hour Average Total NO_2 Concentrations at Selected Receptor Locations of Interest



Notes- 1. The locations of the three nearest neighbours are presented.
2. Background 24-hour average NO2 assumed as 61 ug/m3.
3. Conversion factor applied to highest 1-hour average predictions for simple terrain.

Figure 3 - Predicted Highest Annual Average Total NO_2 Concentrations at Selected Receptor Locations of Interest



Notes- 1. The locations of the three nearest neighbours are presented.
2. Background annual average NO2 assumed as 25 ug/m3.
3. Conversion factor applied to highest 1-hr average predictions for annual averages.

APPENDIX I

SCREEN3 NO_x Modelling Output for Houwelings Nurseries Ltd.

03/30/13
15:36:51

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

PROPOSED HNL COGENERATION PROJECT, NOx MODELLING, 5ppmv/Unit @15% O2

COMPLEX TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	.922000E-01
STACK HT (M)	=	15.0000
STACK DIAMETER (M)	=	.7000
STACK VELOCITY (M/S)	=	15.4000
STACK GAS TEMP (K)	=	323.0000
AMBIENT AIR TEMP (K)	=	293.0000
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	RURAL

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 1.718 M**4/S**3; MOM. FLUX = 26.354 M**4/S**2.

FINAL STABLE PLUME HEIGHT (M) = 36.8
DISTANCE TO FINAL RISE (M) = 151.3

			VALLEY 24-HR CALCS		**SIMPLE TERRAIN 24-HR CALCS**				
TERR HT (M)	DIST (M)	MAX 24-HR CONC (UG/M**3)	CONC (UG/M**3)	PLUME HT ABOVE STK BASE (M)	CONC (UG/M**3)	PLUME HT ABOVE STK HGT (M)	SC	U10M (M/S)	USTK
20.	3800.	1.795	.1382	36.8	1.795	27.4	6	1.0	1.2
30.	5100.	1.324	.1006	36.8	1.324	27.4	6	1.0	1.2
40.	5300.	.9523E-01	.9523E-01	36.8	.0000	.0	0	.0	.0
50.	5700.	.8590E-01	.8590E-01	36.8	.0000	.0	0	.0	.0
60.	6000.	.7987E-01	.7987E-01	36.8	.0000	.0	0	.0	.0
70.	6300.	.7451E-01	.7451E-01	36.8	.0000	.0	0	.0	.0

*** SCREEN3 MODEL RUN ***
*** VERSION DATED 96043 ***

PROPOSED HNL COGENERATION PROJECT, NOx MODELLING, 5ppmv/Unit @15% O2

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	.922000E-01
STACK HEIGHT (M)	=	15.0000
STK INSIDE DIAM (M)	=	.7000
STK EXIT VELOCITY (M/S)	=	15.4000
STK GAS EXIT TEMP (K)	=	323.0000
AMBIENT AIR TEMP (K)	=	293.0000
RECEPTOR HEIGHT (M)	=	.0000
URBAN/RURAL OPTION	=	RURAL
BUILDING HEIGHT (M)	=	5.3000
MIN HORIZ BLDG DIM (M)	=	200.0000
MAX HORIZ BLDG DIM (M)	=	200.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

BUOY. FLUX = 1.718 M**4/S**3; MOM. FLUX = 26.354 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
50.	.4024	1	3.0	3.1	960.0	25.48	14.68	7.80	NO
100.	5.006	1	3.0	3.1	960.0	25.48	27.02	14.27	NO
200.	6.296	2	2.0	2.1	640.0	30.72	36.44	20.72	NO
300.	6.675	3	2.0	2.1	640.0	30.53	34.58	20.81	NO
400.	6.463	3	1.5	1.6	480.0	35.70	45.04	27.10	NO
500.	5.913	3	1.0	1.0	320.0	46.05	55.49	33.63	NO
600.	5.609	4	2.0	2.1	640.0	30.22	42.94	21.65	NO
700.	5.429	4	1.5	1.6	480.0	35.29	49.53	24.72	NO
800.	5.248	4	1.5	1.6	480.0	35.29	55.87	27.40	NO
900.	4.946	4	1.5	1.6	480.0	35.29	62.15	30.03	NO
1000.	4.755	4	1.0	1.1	320.0	45.43	68.68	33.25	NO
1100.	4.561	4	1.0	1.1	320.0	45.43	74.82	35.21	NO
1200.	4.348	4	1.0	1.1	320.0	45.43	80.91	37.12	NO
1300.	4.131	4	1.0	1.1	320.0	45.43	86.95	38.98	NO
1400.	3.917	4	1.0	1.1	320.0	45.43	92.96	40.80	NO
1500.	3.710	4	1.0	1.1	320.0	45.43	98.93	42.57	NO
1600.	3.514	4	1.0	1.1	320.0	45.43	104.85	44.30	NO
1700.	3.329	4	1.0	1.1	320.0	45.43	110.75	46.00	NO
1800.	3.155	4	1.0	1.1	320.0	45.43	116.61	47.66	NO
1900.	2.992	4	1.0	1.1	320.0	45.43	122.44	49.29	NO

2000.	2.905	6	1.0	1.2	10000.0	42.43	64.16	23.00	NO
2100.	2.937	6	1.0	1.2	10000.0	42.43	67.02	23.55	NO
2200.	2.959	6	1.0	1.2	10000.0	42.43	69.86	24.09	NO
2300.	2.972	6	1.0	1.2	10000.0	42.43	72.70	24.62	NO
2400.	2.977	6	1.0	1.2	10000.0	42.43	75.53	25.14	NO
2500.	2.976	6	1.0	1.2	10000.0	42.43	78.34	25.65	NO
2600.	2.969	6	1.0	1.2	10000.0	42.43	81.14	26.15	NO
2700.	2.956	6	1.0	1.2	10000.0	42.43	83.94	26.65	NO
2800.	2.940	6	1.0	1.2	10000.0	42.43	86.72	27.14	NO
2900.	2.920	6	1.0	1.2	10000.0	42.43	89.49	27.62	NO
3000.	2.897	6	1.0	1.2	10000.0	42.43	92.26	28.09	NO
3500.	2.720	6	1.0	1.2	10000.0	42.43	105.94	30.02	NO
4000.	2.540	6	1.0	1.2	10000.0	42.43	119.43	31.82	NO
4500.	2.368	6	1.0	1.2	10000.0	42.43	132.73	33.50	NO
5000.	2.209	6	1.0	1.2	10000.0	42.43	145.88	35.09	NO
5500.	2.063	6	1.0	1.2	10000.0	42.43	158.88	36.61	NO
6000.	1.930	6	1.0	1.2	10000.0	42.43	171.76	38.05	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 50. M:

310.	6.687	3	2.0	2.1	640.0	30.53	35.72	21.47	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
150.	6.252	1	2.0	2.1	640.0	30.72	38.89	21.86	NO
200.	6.296	2	2.0	2.1	640.0	30.72	36.44	20.72	NO
550.	5.764	3	1.0	1.0	320.0	46.05	60.42	36.48	NO
650.	5.494	4	2.0	2.1	640.0	30.22	46.17	23.05	NO
2400.	2.977	6	1.0	1.2	10000.0	42.43	75.53	25.14	NO
4000.	2.540	6	1.0	1.2	10000.0	42.43	119.43	31.82	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

```
**************************************
     *** REGULATORY (Default) ***
    PERFORMING CAVITY CALCULATIONS
  WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
**************************************


 *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
  CONC (UG/M**3)     =    .0000        CONC (UG/M**3)     =    .0000
  CRIT WS @10M (M/S) =   99.99        CRIT WS @10M (M/S) =   99.99
  CRIT WS @ HS (M/S) =   99.99        CRIT WS @ HS (M/S) =   99.99
  DILUTION WS (M/S)  =   99.99        DILUTION WS (M/S)  =   99.99
  CAVITY HT (M)      =    5.30        CAVITY HT (M)      =    5.30
  CAVITY LENGTH (M)  =   33.54        CAVITY LENGTH (M)  =   33.54
  ALONGWIND DIM (M)  =  200.00        ALONGWIND DIM (M)  =  200.00

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S.  CONC SET = 0.0

**************************************
      END OF CAVITY CALCULATIONS
**************************************


 *** INVERSION BREAK-UP FUMIGATION CALC. ***
  CONC (UG/M**3)   =    .0000
  DIST TO MAX (M)  =   669.55

DIST TO MAX IS < 2000. M.  CONC SET = 0.0

***
 PLUME HEIGHT IS BELOW TIBL HEIGHT
 FOR DISTANCE TO SHORELINE OF   150.00 M.
 NO SHORELINE FUMIGATION CALCULATION MADE.
***


     **************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     **************************************

 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   -------   -------
SIMPLE TERRAIN      6.687          310.        0.

COMPLEX TERRAIN     1.795         3800.       20. (24-HR CONC)


************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
************************************************
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03/30/13
15:36:51

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 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***

PROPOSED HNL COGENERATION PROJECT, NOx MODELLING #2, 5ppmv/Unit @ 15% O2

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =        POINT
   EMISSION RATE (G/S)    =      .922000E-01
   STACK HEIGHT (M)       =      15.0000
   STK INSIDE DIAM (M)    =        .7000
   STK EXIT VELOCITY (M/S)=      15.4000
   STK GAS EXIT TEMP (K)  =     323.0000
   AMBIENT AIR TEMP (K)   =     293.0000
   RECEPTOR HEIGHT (M)    =        .0000
   URBAN/RURAL OPTION     =        RURAL
   BUILDING HEIGHT (M)    =       5.3000
   MIN HORIZ BLDG DIM (M) =     200.0000
   MAX HORIZ BLDG DIM (M) =     200.0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


BUOY. FLUX =    1.718 M**4/S**3;  MOM. FLUX =   26.354 M**4/S**2.

*** FULL METEOROLOGY ***

*********************************
*** SCREEN DISCRETE DISTANCES ***
*********************************

*** TERRAIN HEIGHT OF   10. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

  DIST     CONC             U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
   (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   Y (M)   Z (M)  DWASH
-------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
  3000.   4.654        6     1.0    1.2 10000.0   32.43   92.26   28.09    NO

 DWASH=   MEANS NO CALC MADE (CONC = 0.0)
 DWASH=NO MEANS NO BUILDING DOWNWASH USED
 DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
 DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

 ******************************************
 *  SUMMARY OF TERRAIN HEIGHTS ENTERED FOR  *
 *    SIMPLE ELEVATED TERRAIN PROCEDURE     *
 ******************************************

      TERRAIN        DISTANCE RANGE (M)
       HT (M)       MINIMUM     MAXIMUM
      -------      --------    --------
          10.         3000.         --
```

```
**************************************
     *** REGULATORY (Default) ***
    PERFORMING CAVITY CALCULATIONS
  WITH ORIGINAL SCREEN CAVITY MODEL
          (BRODE, 1988)
**************************************


 *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
  CONC (UG/M**3)     =    .0000        CONC (UG/M**3)     =    .0000
  CRIT WS @10M (M/S) =    99.99        CRIT WS @10M (M/S) =    99.99
  CRIT WS @ HS (M/S) =    99.99        CRIT WS @ HS (M/S) =    99.99
  DILUTION WS (M/S)  =    99.99        DILUTION WS (M/S)  =    99.99
  CAVITY HT (M)      =     5.30        CAVITY HT (M)      =     5.30
  CAVITY LENGTH (M)  =    33.54        CAVITY LENGTH (M)  =    33.54
  ALONGWIND DIM (M)  =   200.00        ALONGWIND DIM (M)  =   200.00

CAVITY CONC NOT CALCULATED FOR CRIT WS > 20.0 M/S.  CONC SET = 0.0

**************************************
      END OF CAVITY CALCULATIONS
**************************************


     ************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ************************************

 CALCULATION        MAX CONC    DIST TO   TERRAIN
  PROCEDURE        (UG/M**3)    MAX (M)    HT (M)
--------------    -----------   -------   -------
SIMPLE TERRAIN      4.654         3000.       10.


************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
************************************************
```