Air Quality Study

REMASCO Proposal Kingsville

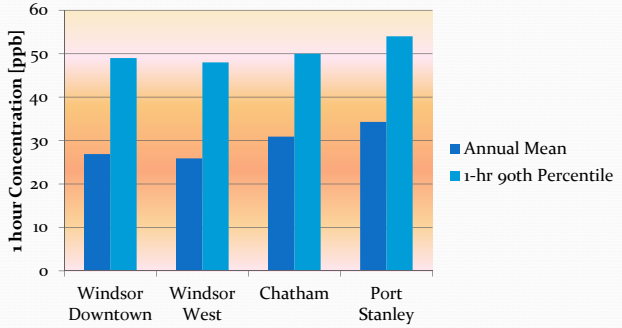
Introduction

- Considered:
  - Existing Conditions
    - Ambient air quality data
    - Local sources
  - Emission Test Data from REMASCO
- Modelled Existing and REMASCO sources to:
  - Determine Cumulative Effects of Project
  - Point of Impingement Results for REMASCO
    - Compared POI values to Standards
    - Transferred results to Human Health Risk Assessment

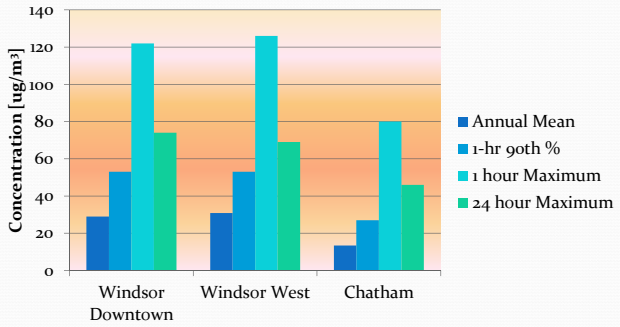
Existing Air Quality

- Southwestern Ontario under influence of trans-boundary flow of contaminants results in elevated levels of ozone [O_3], fine particulate [$PM_{2.5}$], oxides of nitrogen [NO_x]
- Local sources: building heating; power generation; vehicles; and, industrial processes also contribute to Air Quality conditions
- Ministry of Environment [MoE] monitors
  - O_3, $PM_{2.5}$, NO_x in Windsor and Chatham
  - O_3 and $PM_{2.5}$ in Port Stanley

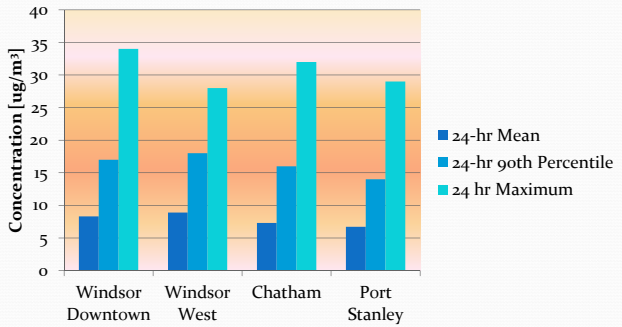
Ozone Data for 2008



Oxides of Nitrogen as NO_2



Fine Particulate [$PM_{2.5}$]



Emissions Data

- REMASCO has been tested since operations started
  - April 2008; May 2009; April, July & Dec 2010
- Testing parameters set by MoE Guideline A-7 and listed in the Certificate of Approval issued to REMASCO by MoE.
- Testing completed by Independent Testing Firm
- Testing Firm obtains approval for testing from MoE
- Testing is witnessed by MoE who also review the final report
- Data for REMASCO emissions for this study from 2010 Report

Emissions for Existing Sources

- Cumulative Assessment considered other greenhouse heating systems:
  - Various fuels used in these facilities (wood, oil, coal, natural gas)
  - No controls required on these facilities
  - No testing done on these facilities
- Used literature data to estimate emissions
- Emissions from existing facilities compared to REMASCO on the basis of energy generated [mass/MMBtu input]

Figure 1 Metals Emission Factor [lb/MMBtu] by Fuel

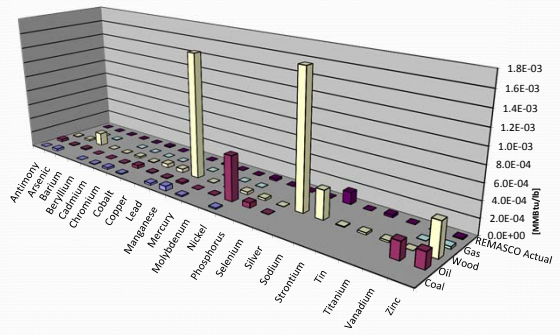


Figure 2 Comparison PCDD/F Emission Factors [lb/MMBtu] by Fuel

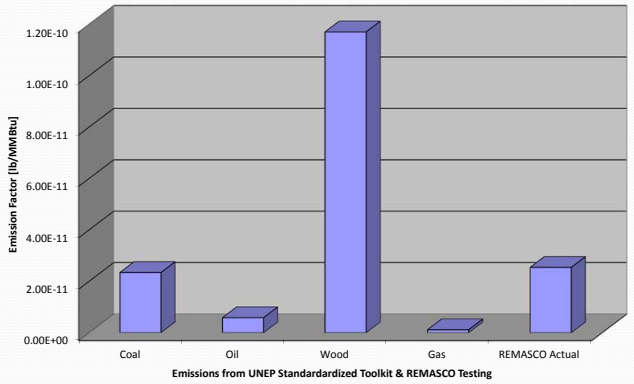
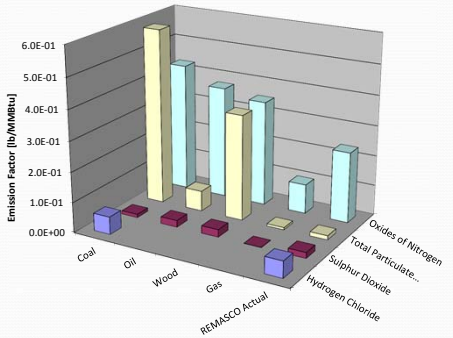


Figure 3 Criteria Contaminant Emission Factors [lb/MMBtu] by Fuel



Proposed Installed Capacity

- Greenhouse heating systems sized for 30 Boiler HP per acre with storage systems
- Electrical needs 10 kWe per acre
- Gasifiers currently sized for 500 Boiler HP each but can be enlarged to 600 Boiler HP each
- Plan for ultimate systems will be 3300 boiler HP at Southshore and 2000 boiler HP at Agriville
- Will NOT operate at maximum output continuously

Operating Scenarios

- Greenhouse heating requirements vary by season
  - January and February 100%
  - March 82%
  - April and December 60 – 70%
  - May, October and November 40 – 50%
  - June – September 27 – 35%
- Co-generation system >90% except July & August 72%
- Emissions related to input levels
  - adjusted emissions to reflect operating situation for both REMASCO and existing greenhouse systems

Modelling Procedures

Computerized model uses wind speed, wind direction, temperature, and solar insolation values to predict TURBULENCE in the atmosphere

Introduce sources into the wind field and the model simulated the EMISSIONS as they are transported downwind

As the emissions are moved downwind the wind STRETCHES the plume in the downwind direction

Atmospheric turbulence SPREADS the plume in the vertical and cross wind directions

These effects REDUCE the CONCENTRATIONS as the plume moves downwind

Modelling Receptors

- Model predicts concentrations at locations
  - Overall 100 m x 100 m spacing over 10 square kilometres centered on a point between Agriville and Southshore
  - Additional receptors around sources with tighter spacing brought total to 11,300 receptors

Study Area showing Sensitive Receptors

Meteorological Data

- Model uses hourly data for 5 years
  - Wind Speed
  - Wind Direction
  - Temperature
  - Solar Insolation
- 365 days per year x 24 hours per day x 5 years = 43,800 hours
- Combined with receptors means nearly 495 million values calculated

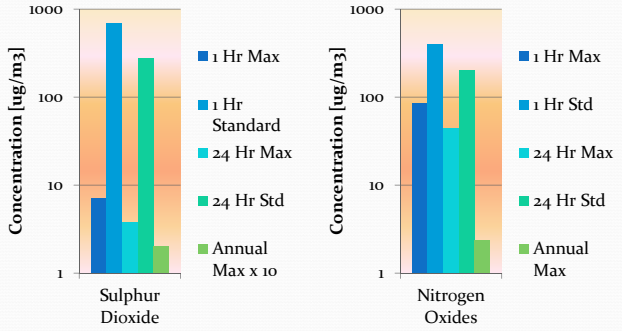
Sources

- REMASCO sources
  - 3 stacks at Southshore
  - 2 stacks at Agriville
- Existing Greenhouse Sources
  - 25 greenhouse complexes included
  - Size of boiler input based upon area of greenhouse
  - Assumed large diameter low velocity exhaust point
- Sources modelled at different rates for all each month

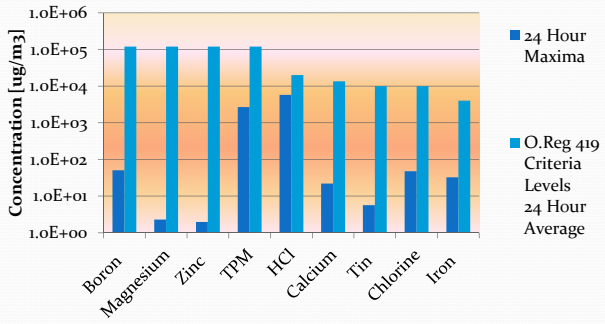
Results

- Generates a value at each receptor for each hour
- Data is used to define:
  - The maximum hourly value at each receptor
  - The maximum 8 hour, 24 hour averages at each receptor
- Model allows comparison of effects of different groups of sources – REMASCO and the existing greenhouses
- Given the amount of data generated typically reduce to maximum values at each receptor and plot results as lines of equal concentration [isopleths]
- Values transferred to Intrinsik for HHRA

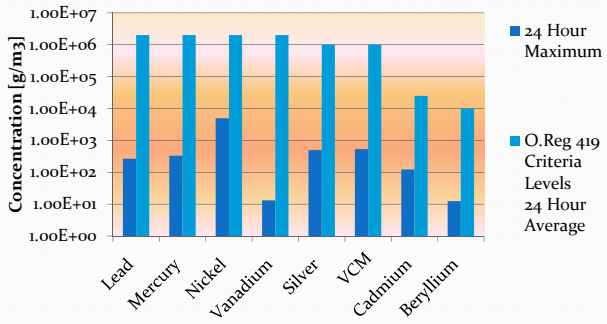
Results Compared to Standards



Results 24 Hour Maxima



Results 24 Hour Maxima



REMASCO Results Summary

- Maxima predicted for all contaminants were below the applicable guideline value for both 1 hour and 24 hour averages:
  - NOx values closest to standard at 21 – 22% both 1 hour and 24 hour averages
  - Sulphur Dioxide and Particulate matter 1 – 2% of standard
  - HCl at the emission limit of A-7 produces 24 hour average that is 29% of the standard
- Maxima occur on Site at Southshore – values at sensitive receptors are lower

Sensitive Receptors

- At the sensitive receptors specific values were determined for the maximum value over the period
- Since the absolute maxima for all receptors is on the Southshore site
  - Not surprising maxima at the sensitive receptors are all lower than those shown previously
  - The further the sensitive receptor is from the REMASCO sites the lower the maximum concentration
- Can conclude levels at sensitive receptors low compared to standards

Upset Conditions

- Sometimes people suggest that stacks are sampled under ideal conditions
- This implies that worse emission levels could be missed by testing – typically these would be UPSETS
- This effect was evaluated at the Sensitive Receptors for all contaminants using US EPA approaches:
  - Increase in hourly emission rate 10 times except NOx at 2.15 times and SO_2 at 7 times
  - Daily and Annual values 2.8 times the hourly emission rate

Results Upset Conditions

- All results at the sensitive receptors under upset conditions were less than the MoE guideline values:
  - NOx hourly maxima was 33% of standard
  - HCl hourly maxima was 41% of the standard
  - NOx daily maxima was 7% of the standard
- Can conclude that even under Upset conditions the concentrations are below the MoE guideline values

Guideline Values

- Based upon extensive scientific study of effects of contaminants
- Take into consideration typical background levels of contaminants in atmosphere in the province
- Regardless there are questions about the potential effects of adding a new source to emissions in the community
- This is typically called the Cumulative Effect

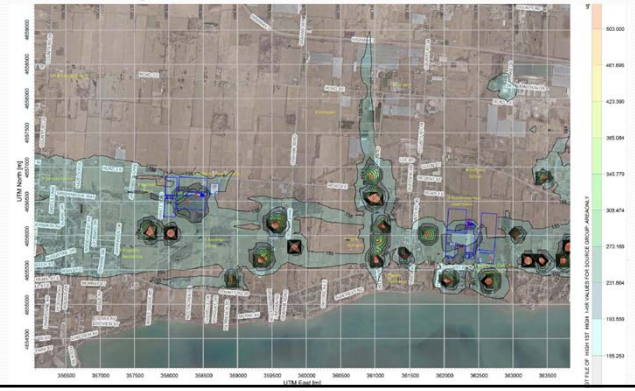
Cumulative Effects Assessment

- Combines:
  - The existing air quality in the community
    - If there is monitoring data in the community this can define the existing air quality
    - If no monitoring use data from other communities and combine with the effects of existing sources in the community
- 90^{th} percentile accepted as a conservative representation of background concentrations
  - Used Chatham and Windsor data
- Need to look at existing major sources - greenhouses

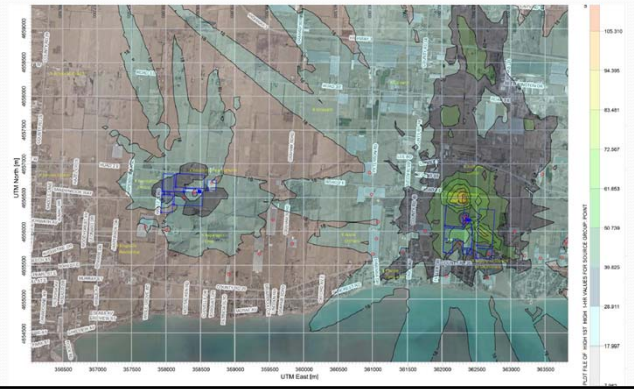
Cumulative Assessment (2)

- Used same computer model
- Modelled NOx and particulate matter emissions for:
  - Existing situation for 25 greenhouse complexes in the study area including existing Southshore and Agriville
  - Future situation replacing Southshore and Agriville existing emissions with REMASCO emissions
- Reviewed output
  - Graphical comparison of levels
  - Numeric comparison at critical receptors for HHRA study

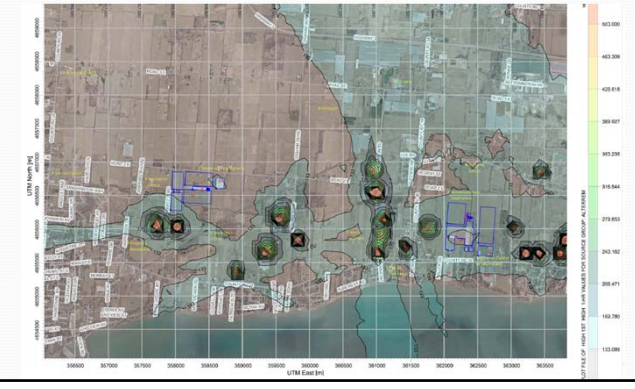
Existing Maximum 1 Hr NOx



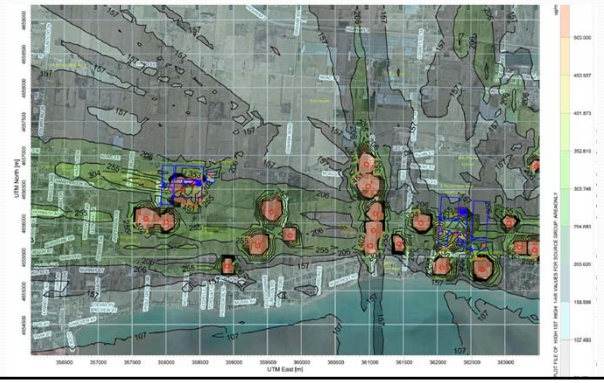
REMASCO Maximum 1 Hour NOx



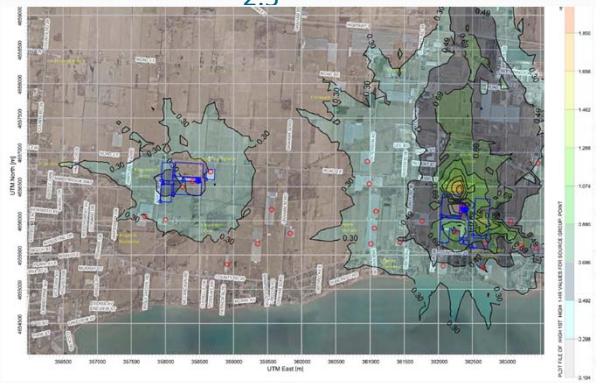
Combined Maximum 1 Hr NOx



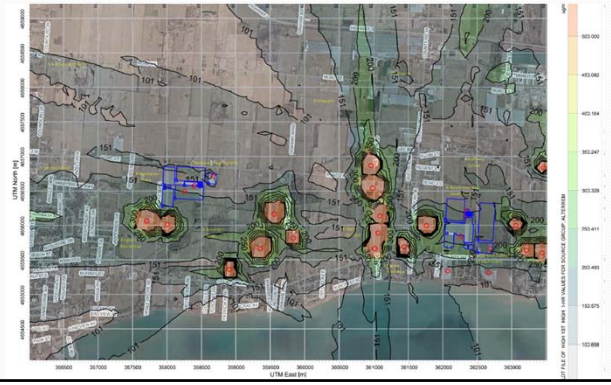
Existing $PM_{2.5}$ Maximum 24 Hr



REMASCO $PM_{2.5}$ Maximum 24 Hr



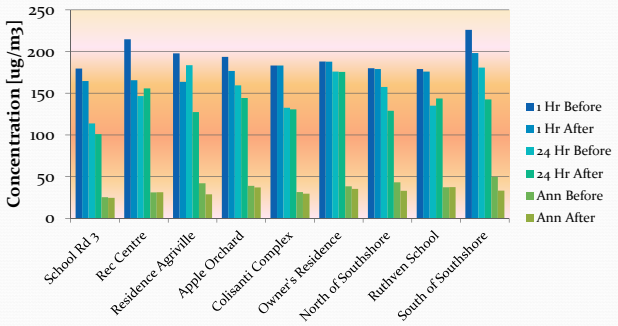
Combined $PM_{2.5}$ Maximum 24 Hr



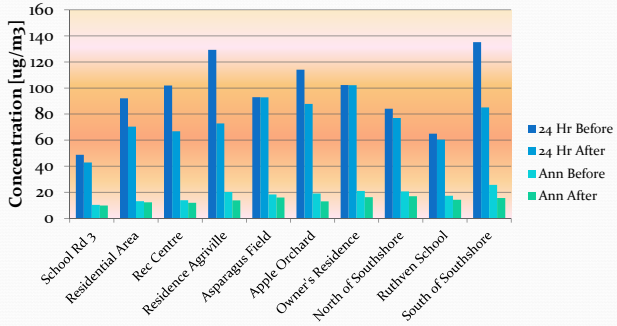
Accounting for Existing Air Quality

- Using the 90th percentile for NOx and $PM_{2.5}$
  - NOx – hourly 40 ug/m³; daily 58 ug/m³; annual 22 ug/m³
  - $PM_{2.5}$ – daily 17 ug/m³; annual 8.2 ug/m³daily
- Add to predicted concentrations
- Consider values at critical receptors

NO_2 Cumulative Results



$PM_{2.5}$ Cumulative Results



Cumulative Conclusions

- NOx levels are consistently below the criteria levels
  - Replacing units at Southshore and Agriville will lower the burden in the community
- $PM_{2.5}$ predictions for existing suggest higher than standards
  - Suggest that emission factors could be refined and revising the source configuration could lower values
  - REMASCO will add negligible quantities to atmosphere since controlled
  - Installing REMASCO units will lower burden