Appendix I - Regional Air Impact Modeling Initiative (RAIMI)

1.0 RAIMI Software Description

Part of the grant for the Tonawanda Community Study was to utilize the Regional Air Impact Modeling Initiative software program or RAIMI. When conducting community studies, the use of air dispersion models to predict ambient impacts is important because the costs involved of establishing monitors and analyzing data is limited to specific test methods and overall costs. RAIMI incorporates the Industrial Source Complex Short-Term model (ISCST3) air dispersion model but the RAIMI software program is not just an air dispersion model but a software interface to review and modify data output.

The RAIMI software program was designed by the Compliance Assurance and Enforcement Division of EPA Region 6. The objective of RAIMI software was to model multiple sources within the Houston ship channel area to determine the overall hazard index for various pollutants and/or predict an inhalation excess cancer risk for carcinogens.

The RAIMI software program operates within the framework of Geographical Interface Software (GIS) to produce a finished output which can show ambient concentrations on a map or satellite image. NYSDEC uses the ESRI GIS software ArcMap.[1] The RAIMI software program is designed to display the predicted ambient concentrations (output) to a gridded system overlaid on satellite imagery. By highlighting a specific area within the Study area, in our case a monitor or census tract centroid, the output can describe the maximum concentration predicted for the chosen point(s) for all pollutants modeled, including the hazard index and/or cancer risk. Specific feature of the RAIMI software program is to allow the user to determine each source's contribution to the point or points on the grid selected. Also, to understand the effect of process changes or control strategies on predicted ambient concentrations, the RAIMI software allows the user to make changes to emission input data without having to re-run the air dispersion model.

The RAIMI program utilizes the Industrial Source Complex Short-Term (ISCST3)[2] model for all its point source calculations. The model is incapable of running non-point source (area, volume, etc.) calculations at this time and this will be address in Appendix K as a limitation of the model. The RAIMI modeling performs as a screening tool for multiple air pollution sources.

2.0 Preparation Meteorological Input Data

Five years of meteorological data was required for input into the RAIMI program. In conjunction with the RAIMI program, a software program called AMP-GIS (Air

[1] ESRI®ArcMap 9.3
[2] http://www.epa.gov/scram001/dispersionindex.htm

Modeling Pre-processor-geographic information system) was used to pre-process the data for the air dispersion model run.

As described in the users manual, the AMP-GIS performs three key functions for air modeling within the RAIMI environment: (1) Implements site parameter quantification (surface roughness, urban/rural land use) for each emission source in accordance with RAIMI methods; (2) Prepares source-specific meteorological files using U.S. EPA Meteorological Processor for Regulatory Models (MPRM); (3) Auto-generates air model input files for multiple sources for all four potential contaminant phases to include source-centered universal grid node array with extracted terrain elevations.

The AMP-GIS software incorporates the location of each source with surrounding terrain data from U.S. Geological Survey's digital elevation model (DEM) files to build a universal grid aligned with the longitude/latitude locations specific for DEM files. These files are needed to create the required Industrial Source Complex Short Term (ISCST3) air model input files for volatile and particle species in air modeling. The output grid forms the basis of the 3 km by 3 km grid used to predict ambient impacts at locations with the Study area. The five year meteorological data set used was the upper and lower air data obtained from the Buffalo airport for the years 1986 to 1990.

As part of the Tonawanda Community Air Quality Study, one new meteorological station was deployed and a second station was already in operation at the Tonawanda sewage treatment plant on Two Mile Creek Road. The stations collected one year worth of hourly wind speed data, wind direction data, temperature and dew point data to calculate relative humidity. Data collected by NYSDEC does not meet the quality control specifications established for airport meteorological data but is collected to aid in detecting localized (near source) ambient air pollution impacts. The two meteorological stations were established to determine directionality of monitored air toxic data and results will presented in latter sections. The data was also used to create one-year surface and plot files for use with the Human Exposure Model (HEM3)[3]. HEM3 is an air dispersion model incorporating dispersion modeling with census tract data allowing the user to quantify the number of individuals exposed to a predicted modeled air concentration. HEM3 was used as a second model to be a comparison to the predicted data generated from the RAIMI software program.

3.0 Preparation of Point and Area Input Data for Modeling

Each subsection explains the methods used to identify sources, assign stack parameters, other modeling considerations, and source specific emissions.

DAR staff obtained facility wide information from Title V air permits and Registration certificates for each facility identified in Tonawanda Community Air Quality Study. Title V permits are organized in the following top down order: Facility → Emission Unit → Emission Source → Process. For example, a coal fired power plant (facility) can be divided into multiple emission units, in this example, coal handling system (Emission

[3] http://www.epa.gov/ttn/fera/.html

Unit) and the coal crusher (Emission Source) grinds coal (Process). Emission Points (stacks) are assigned at the emission unit level. In the example, the stack exiting the coal crusher would be the emission point. Stack identification and stack parameters were extracted from the New York State's Air Facility System (AFS) to obtain the necessary stack information such as stack height, exit velocity, temperature and building dimensions. When a facility had numerous emission points, the decision was made to identify one representative emission point to be used for all air contaminant emissions from an individual emission unit. If stack data was unavailable for any facilities, and for the facilities issued a Registration Certificate under 6 NYCRR Part 201, the stack parameters were based upon EPA default assumptions. The emissions used in the modeling were taken from DAR's mandated annual emission inventory statements for the years 2002, 2005 and 2006. The highest of either of three reporting periods was used in the RAIMI software air dispersion model.

To accurately predict ambient air concentrations using air dispersion models for an emission source, it is necessary to correctly locate the emission points at the facility. To facilitate this process, NYSDEC developed a GIS tool called FLIT (Facility Locational Improvement Tool) to expedited this task. With use of FLIT and through the use of orthoimagery and facility plot plans, all emission points (stacks) were properly located at the facilities to be used in the RAIMI software.

4.0 Preparation of Mobile Source Input Data for Modeling

The RAIMI model, as currently designed, is limited to predicting ambient air concentrations for point source data only. HEM3 was chosen to predict ambient air impacts from on-road sources. Non-road sources were not modeled due to the lack of a sufficient local inventory.

The emissions attributed to mobile sources were assigned to the four road classifications, as described in Appendix F, Section 3.0. The individual road classifications were further divided into segments along the road to accommodate for road angle and length. Each segment within a roadway classification was modeled as an area source. Each area source was depicted as a rectangle and based upon the road classification; roadway width was determined by the number of traffic lanes. For an illustration, see Figure I-1 below for the roadway segments.

Ambient concentrations were predicted for six hazardous air pollutants at the four monitoring stations as well as the census tract centroid for each of the nine census tracts in the study area.

Figure I-1 Individual segments within the four major roadway classifications used for modeling on-road mobile emissions with the Human Exposure Model (HEM3)