Developing a QA/QC Program
for a
Local Agency Annual Emission Inventory

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ABSTRACT

As new Clean Air Act standards come into effect, many new agencies will be facing the challenges of generating emission inventories. Estimation tools and models must be learned and used to generate emission estimates. Assumptions, emission factors, and data sources must be documented. In addition, data must be checked for errors and omissions before it is used for reporting or modeling purposes. This paper will focus primarily on Nashville's Point Source inventory procedures, and will also identify procedures applicable to Area, Mobile, and Non-Road Mobile sources.

Nashville's annual inventory preparation procedures are an ongoing effort reflecting continuing changes in data tools and requirements. Current pollutants include criteria and hazardous air pollutants (HAPs), with added requirements anticipated for $PM_{2.5}$ and ammonia (a $PM_{2.5}$ precursor). All point source emissions estimates are submitted by the permitted sources, and reviewed and input into the database by division personnel. Non-point emissions are estimated by the Air Pollution Control Division using various tools and emission factors. Point source emissions data, along with area and mobile emissions, monitoring data, and other Division activities are published in an annual report.

Computer models, databases and spreadsheets are essential tools for this job. As computer software has made it easier to handle data and calculations, it has also brought new challenges to the task of verifying the accuracy and integrity of electronic data. The tools we use to generate our emissions inventory include the EPA models and emission inventory guidance, i-STEPS® software, the National Emission Inventory Input Format (NIF) database and QA/QC tools, Geographical Information System (GIS) checks for location data, and data review procedures defined by our inventory preparation procedures.

INTRODUCTION

Nashville's emission inventory preparation procedures are an ongoing effort reflecting continuing changes in data tools and requirements. Efficiency and accuracy in handling large quantities of emissions data is critical when operating with limited resources. It is important to have an accurate and timely inventory for the Pollution Control Division's annual report, as well as to satisfy reporting requirements for EPA and data requests for other modeling efforts. Developing a QA/QC program is necessary to ensure that the data quality objectives are being met. It also provides documentation of data handling procedures for third party reviewers and new personnel.

INVENTORY PLANNING AND DATA QUALITY OBJECTIVES

It is important to start the emission inventory process by identifying which pollutants you are interested in. Criteria pollutants (those for which there is a National Ambient Air Quality Standard) include SO_2, NO_2, CO, VOC, lead, PM_{10}, and will also soon include $PM_{2.5}$. Hazardous Air Pollutants (HAPs), or Air Toxics, as defined by the Clean Air Act are also important. In some areas of the country,

additional emphasis is being placed on greenhouse gases, so there may be a need for emissions data for these substances in certain regions.

It is also helpful to identify source categories before beginning the emission inventory process. You will need to look at point, area, non-road, and on-road mobile emissions and identify and document what data will be used and where the data will come from to determine the emissions estimates. Point source emissions can be calculated by the permitted source, or by the emissions inventory personnel. This may be determined by the data quality requirements, and will determine the data required from the point source. Non-point source estimates must be determined based on a small amount of experimental data, which must then be adapted to apply to your area. The methods for calculating these types of emissions are defined in the Emission Inventory Improvement Program (EIIP) and other EPA guidance, and there are usually several options for each source type. In many cases computer models have been developed to perform these calculations. The estimation method used may change from year to year based on new EPA guidance, so it is important to document all sources of estimation methodologies.

Data quality objectives (DQOs) for this type of data are qualitative rather than quantitative. These objectives include providing accurate data to EPA in a timely manner, and providing accurate inventories to the State for modeling and for State Implementation Plan and transportation planning and air quality conformity determinations. Likewise, it is important to avoid resubmitting data because of corrections to data errors, especially after data has been published. This drives the QA/QC program, and helps to determine the level of quality control necessary to have confidence in the emission inventory data. This is balanced by the available resources, since improvements in data quality frequently involve significant increases in resource requirements.

Point Sources

As a result of the promulgation of the Clean Air Act, the Metro Government of Nashville and Davidson County established a local air program requiring any facility that produces or has the potential to produce any air pollutant to apply for a permit. There are a number of exemptions for specific types of activities or small sources, but many sources are permitted that are well below the reporting thresholds for EPA's reporting requirements. As part of our permit program, we require all permitted sources to submit emission inventory estimations annually. These are currently submitted in hard copy format on forms supplied by the agency. (See Figure 1.) These forms are mailed out and are also available on our website. We also require them to submit supporting data and calculations.

The emissions data submitted by each permitted source is entered into a FoxPro database (i-STEPS®), which stores all process, stack, and emissions information for each facility. For each point source category, (e.g. tank farms, printers, asphalt plants, boilers, etc.) a set of Source Classification Codes (SCCs) is defined to be used for that category. This reduces errors introduced by selection of SCCs by different personnel with varying levels of familiarity with the SCC system. Also, selecting a set group of SCCs allows for automated report generation based on these codes. The SCCs are assigned at the process level, which means that there can be as many SCCs in a facility as there are processes that generate emissions. The use of SCCs allows emissions from multiple sources to be added together within a facility category or source grouping. This includes putting different types of emissions from the same facility in different aggregate categories. For example, one facility may have large boilers permitted, as well as an industrial process. The boilers will have the same SCC as similar boilers from other facilities, and a different SCC than the industrial process, allowing these emissions to be grouped under separate source categories. We subtotal emissions information from various categories for our annual report. This is currently done by hand, but we are developing tools to allow the database to compile this data automatically. SCCs are also used by the database in generating output files in NIF format for submittal to EPA.

Once the data entry is complete, a 10% of the facilities are selected randomly and checked for accuracy. Any errors found are corrected, and any potential error patterns are investigated and corrected as needed. For example, if an SCC is found to be incorrect, any similar facilities will also be checked for SCC errors. The geographical coordinates of each facility are also checked against the geocoding for their street addresses to look for obvious errors. (See Figure 2.) Then National Emission Inventory (NEI) export files are generated from the database and EPA's NIF QA/QC tool is run to check for problems in the data. Any problems identified are documented and corrected. This may be sufficient, or additional checks may be needed as determined by the DQOs.

Figure 1. Example of a point source emissions form.

Point source data procedure:

- Source provides inventory on forms provided - tracked on spreadsheet (converting to database) thru review process
- Check emissions estimations against permit and previous years emissions, make corrections as needed
- Enter data in database
- Data is manually compiled for Annual Report (developing database tools to perform this compilation automatically)
- 10% minimum QC check on randomly selected facilities
- GIS tools used to perform reality check for coordinate errors
- Generate NEI export files
- Use NIF QA/QC program to check for data problems

Area Sources

      Area source emissions estimations are generated for a variety of sources from local data, as well as from national data scaled to apply to Davidson County by population ratios. These are documented in a large Word file that is copied and updated for each year. This document describes how each estimation is calculated, where the data was obtained, and where the guidance and/or emission factors came from. This document provides backup documentation for the data that is entered in the database for transmittal to EPA.

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Area source data procedure:

- Gather data as needed and update Area Source calculations for current year
- Check calculations and enter data in database
- Generate NEI export files
- Use NIF QA/QC program to check for data problems

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      When generating area source emissions, it is important to avoid double-counting sources that may also be included as point sources. Many "area" sources are essentially groups of scattered small point sources, so there is a potential for emissions to be reported from point sources that could also be accounted for in area source emissions estimations. It is also critical to assign appropriate SCCs when entering area source data for submission to EPA, since these codes are used by the database in generating output files, and by EPA in compiling the NEI. All area and mobile sources are assigned 10-digit SCCs to differentiate them from point sources.

Non-Road Mobile Sources

      Non-road mobile source emissions estimations have been calculated much like the area source emissions in the past, with many of the emissions estimates based on EPA's Nonroad Engine and Vehicle Emission Study (NEVES) from 1991, also known as the "33-City Study". We anticipate switching to EPA's NONROAD model for future Non-Road mobile source emissions estimates as the final version of the model becomes available.

On-Road Mobile Sources

      EPA's Mobile model is used to estimate mobile source emissions based on vehicle miles traveled. We are currently transitioning from Mobile 5a to Mobile 6, which involves significant changes.   For the 2001 inventory year, we are using Mobile 5a, and will run Mobile 6 for comparison purposes to prepare to phase out Mobile 5b for the 2002 inventory year. This model is complex and requires data from a number of sources, including vehicle mix data, speeds on various types of roadways, fuel Reed Vapor Pressure (RVP) and ambient temperatures, local vehicle inspection and maintenance programs, etc. All input data needs to be documented in detail so that the calculations and assumptions can be checked, and so that they will be consistent from year to year. Emissions estimates calculated based on the Mobile model output are also entered into the database, using the appropriate SCCs, and can be exported in NIF format for submittal to EPA's NEI. However, due to the nature of the Mobile model, input files and backup documentation will also be required when submitting the emissions data.

Database QA/QC Tools

The database we use is a software package called i-STEPS®, but other agencies have developed their own databases for emissions inventory purposes. Several key features of the database provide important QC tools in our data management process. The database has action tracking features that allow users to see when a data entry was last updated and by whom. This allows us to screen all of the active facilities to see if they have had their process emissions updated for the current calendar year. The database also has built in data validation and features such as drop-down boxes that limit the entries for many fields. The database also has a utility that generates output files in EPA's NEI Input Format, which allows us to easily create data files for submittal to EPA. It also allows us to use EPA's NIF QA/QC tool, which is another way to validate the data.

Figure 2. Point source coordinate reality check using GIS tools.
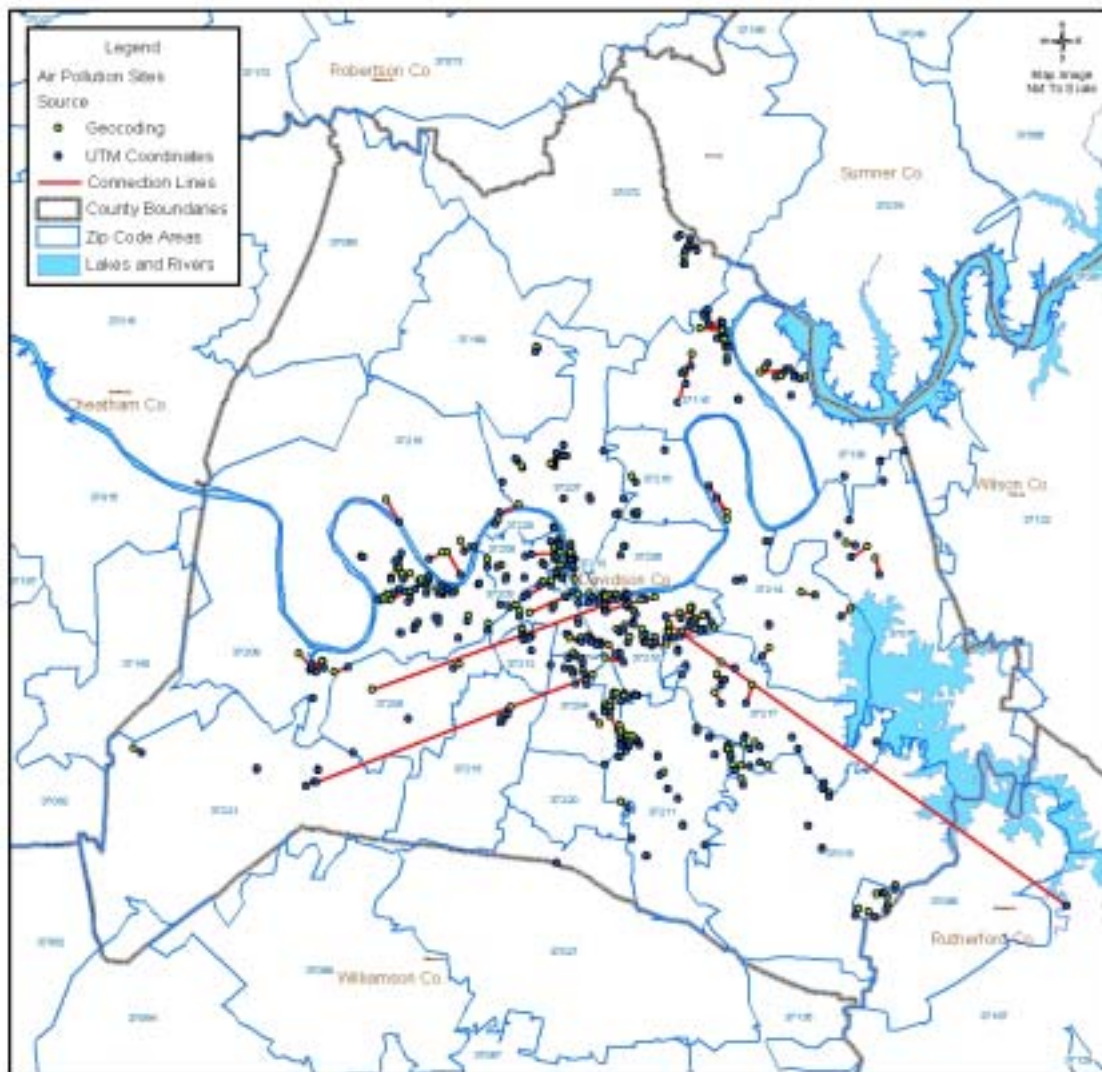
Geographic Information System QA/QC Tools

We are also able to use GIS tools to perform automated reality checks on our point source geographical coordinates in the database. The database coordinates are plotted along with coordinates generated by GIS based on the street address of the facility. The pairs of points are plotted on the same

map and connected by a line. Lines that appear to be longer that what would be expected from minor estimation discrepancies are investigated for data errors and corrected as needed.

CONCLUSIONS

Developing a consistent and well-documented emission inventory procedure allows the emission inventory to be generated by updating and improving the previous years inventory. This approach also allows new EPA guidance, improved estimation techniques, and lessons learned to be incorporated into the emissions estimation process in a timely manner. It is important to incorporate QA/QC procedures into the emissions inventory process in order to have confidence in the data generated.   Useful QA/QC tools include EPA's NIF QA/QC tool, GIS location verification, and database tracking to ensure completeness of data. Generating emission inventories is a complex and evolving process. By setting a standard format and procedure for collecting and generating emission inventory data, and using this procedure annually, it is possible to generate a reliable emission inventory with a reasonable amount of effort.

RESOURCES

Emission Inventory Improvement Program (EIIP) Documents, EPA emissions estimation software, and other emissions inventory tools and guidance can be found on the AirCHIEF website at http://www.epa.gov/ttn/chief/

The MOBILE6 and NONROAD Models and related guidance can be found at http://www.epa.gov/otaq/models.htm

The National Emission Inventory (NEI) and related documents can be found at http://www.epa.gov/ttn/chief/net/index.html

The National Emission Inventory Input Format (NIF) and NIF QA/QC tool can be found at http://www.epa.gov/ttn/chief/nif/index.html

i-STEPS® information can be found at http://www.i-steps.com/index0.html

Metro Public Health Dept. of Nashville and Davidson County, Pollution Control Division forms and Annual Reports can be found at http://healthweb.nashville.org/Downloads/pollution_downloads.html

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Table 1. Summary of data and emission factor sources for non-point emissions.

Category	Reference for E.F.	E.F.	Other Data Source(s)
Auto Refinishing	EPA 450/4-91-016 Table 4-10-1	1.7595 Tons VOC/Empl./Yr.	County Business Patterns 2000, SIC 7532 (NAICS 811121) "Top and Body Repair and Paint Shops"
Architectural Surface Coating	EIIP	gal/person * VOC content for two types of paint	2001 County Population (from MPO)
Degreasing - Cold Cleaners	EIIP "Solvent Cleaning" Table 6.5-2	3.6 # VOC/capita/Yr.	2001 County Population (from MPO)
Comm/Cons Solvent Use	EIIP preferred method	6.06 # VOC/capita/yr	2001 County Population (from MPO)
Traffic Markings	EIIP 5.1.3 Alternative Method Three	Extrapolate based on national #'s by population	2001 County Population (from MPO), U.S. Population (www.census.gov), EIIP Table 14.4-1 (#VOC/gal for traffic markings)
Open Burning	AP-42 Tables 2.4-1 and 2.4-5	various E.F.'s and Loading Factors	State Forestry Dept. - (name, phone #) Metro Fire Marshal's annual report (name, phone #)
Agricultural Pesticide Application	EIIP preferred method (crit & Haps)	1.78 # voc/capita/yr	2001 County Population (from MPO)
POTW	AP-42 recommended methodology	.00011 # voc/gal of industrial wastewater flow	MCWWTP used WATER7 to determine their emissions (point source?), (name, phone #) at MCWWTP
Misc. Dust (State Hwy Construction)	EPA emission factor, 1988 adjusted correction factor	1.5 #/T RAP, 0.21 T/acre/month	TDOT (name, phone #)
Misc. Dust (Metro Highway Construction)	1988 adjusted correction factor	1.5 #/T RAP, 0.21 T/acre/month	Metro Public Works - RAP tonnage, (name, phone #) Road projects, (name, phone #)
Construction Losses		.42 T/ac./mo.	Metro codes "Cost of Construction Report" (name, phone #)
Misc. Dust Agric. Tilling	AP-42	.0074 T/acre	Census of Agriculture (1997) www.nass.usda.gov
Dust from Paved Roads	AP-42 13.2.1 "Paved Roads"	E.F. equation	DVMT from TDOT (via MPO)(name, phone #)
Residential Coal Burning	AP-42 Tables 1.1-3, -4, and -11	#/T for criteria Pollutants	Assumption for residential coal use based on 1993 usage from local coal yard
Resid. Oil/Kerosene	AP-42 Table 1.3-1	$\#/10^3$ Gals for crit. Pollutants	1999 "State Energy Data Report" eia.doe.gov/pub/state.data/html/rctn.htm, 2000 census for heating units
Resid. Natural Gas	AP-42 Tables 1.4-1 thru -3	#/MMCF for crit. Pollutants	Local Gas Company - (name, phone #)
Residential LPG	AP-42	$\#/10^3$ Gals for crit. Pollutants	1999 "State Energy Data Report" eia.doe.gov/pub/state.data/pdf/tn.pdf, 2000 census for heating units
Residential Wood Burning	EIIP final method	#/T for criteria Pollutants	Energy Information Admin. (www.eia.doe.gov/index.html) statewide wood usage, county census

Category	Reference for E.F.	E.F.	Other Data Source(s)
			(venus.census.gov/cdrom/lookup - use file STF3A)
C/I & I Fuel Combustion	Point Source inventory		
Non-road Mobile	33-City Study	TPY * % type of fuel	Based on Previous Years Inventories, population increases.
Aircraft Emissions	AP-42 General Aviation E.F., "Speciate"* for HAPS	#/LTO cycle for criteria pollutants	Small Airports, (name, phone #) Major Airport, (name, phone #)
Railroad Emissions - Yard Locomotives	AP-42 Table 6.3 for locomotives	#/Gal for criteria pollutants	CSX Railroad - (name, phone #), "Speciate" for HAPS
Railroad Emissions - Class I Line Locomotives	AP-42 Table 6.1 for locomotives	#/Gal for criteria pollutants	CSX Railroad - (name, phone #), "Speciate" for HAPS
Fuel Burning HAPS (C/I & I and Residential	AP-42 Tables 1.4-4 and 1.4-5 HAPS	#/MMCF or 1000 gals. Or tons (coal)	SIC = 4961, don't double-count point source coal burning emissions
Wood burning HAPS	EIIP Table 2.4.2	#/T burned	
Gasoline Dispensing	HAPS from "Speciate" based on VOC E.I.		Stage I, Stage II, and Tank Trucks in Transit

KEY WORDS

Emission Inventories
QA/QC
Point sources
Estimation tools
Modeling
Databases
NIF
DQO
Inventory planning
SCC