International Environmental Database Description (IED)

Database Version: 1.041

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IMPORTANT INFORMATION:
The IED is accessed using a web browser. There are many web browsers now available. Each web browser is a little different. The web pages developed for the IED have been tested using Explorer 9, Firefox-PC, Safari-Mac, and Firefox-Mac Other browsers may or may not work with the IED. In some cases, some of the web pages may work with a browser not listed above while other pages will not work.
It is recommended that one of the four web browsers listed above be used when accessing the IED.

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General Index

Chapter 1
Introduction

Section 1.1: Introduction

The International Environmental Database (IED) has been developed as a tool to record, calculate, and store emissions data as well as to manage source enforcement activities including emission credit exchanges[1]. The IED can be used to assess emissions sources, evaluate their impact on the environment, and, subsequently, improve air quality policies.

The IED actually consists of three separate databases that reside on a single internet server. Thus, the IED is more of a database system; although it will be referred to as a singular database. The reason for the use of three separate databases is to help increase the security of the system. There is a main database, which holds all of the core environmental information, a privileges database, which holds information on the names of approved database users and their privileges in using the system, and an emission credit database, which holds information on emission credits and the history of their creation and ownership.

In the development of the IED, twenty-two goals were established. These are listed in Table 1.1-1.

Table 1.1-1: Goals for the IED

	Goals
1	Allow emissions information related to all local and global pollution problems.
2	Allow information related to product and energy flow for sources.
3	Allow information related to water and solid waste pollution from urban sources.
4	Include information on jobs and equipment cost associated with urban processes.
5	Allow users to keep track of regulated sources.
6	Allow users to keep track of emission credits and emission credit transaction history.
7	Allow users to keep track of regulatory requirements and how they apply to different processes.
8	Allow users to keep track of source inspections and the problems observed and how the problems were resolved.
9	Support present and future emissions estimates related to point sources.
10	Provide air quality modeling inputs related to point sources.
11	Support present and future emissions estimates related to stationary area sources.
12	Provide air quality modeling inputs related to stationary area sources including gridding of the data into predefined grid cells.
13	Support present and future emissions related to on-road mobile sources.
14	Provide air quality modeling inputs related to on-road mobile sources including gridding of the data into predefined grid cells.
15	Support present and future emissions estimates related to off-road mobile sources.
16	Provide air quality modeling inputs related to off-road mobile sources including gridding of the data into predefined grid cells.

[1] Software tools must be developed to support enforcement and credit trading activities. However, the potential for these options was designed into the database. At this point in time, the prime focus of the development of IED has been the development emission inventories for the present and future. A number of software tools are now available to carryout this activity.

17	Support present and future emissions estimates related to biogenic sources.
18	Provide air quality modeling inputs related to biogenic sources including gridding of the data into predefined grid cells.
19	Provide means to estimate cost impacts of proposed control measures along with associated impacts on materials and energy demand.
20	Make database remotely accessible to approved users with appropriate security.
21	Allow for updates to the database remotely by individual pollution sources or relevant government agencies.
22	Support at a minimum Chinese, English, Portuguese, and Spanish in the initial system implementation and allow for the addition of other languages to the system in the future.

Four goals were set for the process of implementing the system. They are:

1. Use easily obtainable, high speed, and low cost database software.
2. Use easily obtainable, high speed internet management software.
3. Use database software that uses reasonably standard SQL syntax so that adaptations will be as easy as possible to other database systems.
4. Design the interfaces to work as broadly as possible across the internet using the Explorer, Firefox, and Safari internet browsers.

With these goals in mind, the MySQL database software was selected for development of the system. MySQL has been proven to be one of the fastest database softwares available. It is available free, uses relatively standard syntax, and interfaces readily to the PHP internet computer language. Both PHP and MySQL can be used with the Windows or Linux server software. Both have been used in implementing IED, but Linux is preferred because it works more seamlessly with PHP and MySQL and is available for free.

Finally, an important aspect of any database system is that it be designed to grow with the user. It is not reasonable that all emissions or energy flow or product flow or many other types of information will be available to the air quality management process at the beginning. Thus, the database system must be designed so that useable results can be achieved when some data may not be readily available.

Section 1.2: Central Database Concept

As discussed in the previous section, the IED is intended to serve several air quality management objectives. The database is arranged into about 90 tables to accomplish the desired tasks. A primary purpose of the database is to manage sources of emissions into the environment. Most of the effort related to this database design to this point in time are directed toward emissions into the atmosphere. However, basic provisions have been made to accommodate emissions into the watershed and solid waste output as well as energy use. These options can be developed in the future along with software to support source enforcement activities and emissions credit trading.

When evaluating emissions into the atmosphere for purposes of making policy decisions, it is important to understand many related factors such as equipment cost, job relationships, energy inputs, and material inputs and outputs relative to the various sources that are operating in an air-shed. This database is designed to hold this type of data and to allow for this information to be summarized for policy makers relative to emission sources to aid them in their decision making.

Emissions trading is becoming more important in the environmental management process along with environmental enforcement activities. This database is intended to support both emissions trading and activities associated with the enforcement of environmental laws and regulations.

It should be noted, however, that the IED at this stage is not intended to accommodate air monitoring data. Air monitoring databases are commonly available at this point in time; so it was not felt that the key efforts related to the database needed to initially accommodate the environmental management data that is often poorly managed in environmental improvement programs.

This database is built around the concept of a Source. A Source as the database understands it can be of many types. It can be a manufacturing facility, a type of area source, a type of off-road mobile source, an on-road mobile source, a natural source of emissions, an owner of an emission credit, or a consultant working in the environmental arena. While the latter two types are not sources in the classical since, it is more efficient to keep their data in the same system. The integration of all types of sources into a standard database design allows the development of standardized evaluation tools that accommodate point sources as well as area and natural sources of emissions.

A Source is envisioned to be made up of one or more processes. In the case of a manufacturing facility such as a cement production plant, the processes will include "materials receiving" of various types, "materials crushing and mixing", "kilns", "final grinding" processes, and "bagging" and there can be others. A simple source might have only one process, but a complex source can have hundreds, maybe thousands, of processes. Figure 1.2-1 illustrates the concept for a point source.

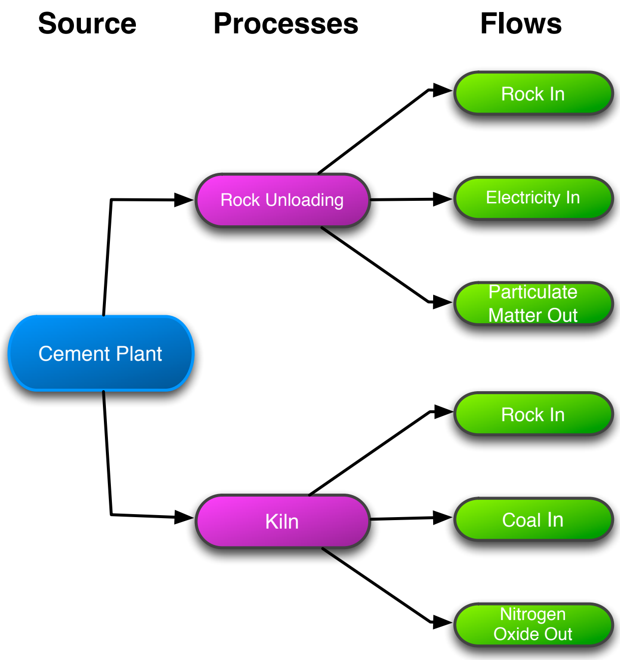

Figure 1.2-1: Basic Concept of the IED Source/Process/Process Flow for a Point Source

Area sources are a little different. When the term Source is used for a fixed area source, the Source refers to the general class of area sources (i.e. a collection of similar type sources) such as the Source Class "potable water heating". There are then processes associated with this Source class. The processes then represent subclasses of this general Source Class. These processes could include "domestic natural gas water heating", "commercial natural gas water heating", "commercial coal fired water heating", and the like.

In the case of off-road mobile sources, the Source (or Source Class) will be groups such as "Construction Equipment" or "Portable Generators". The processes then are the more specific sub-groupings of the larger source class. For example, in the case of the Source Class "Construction Equipment" then a process might be a "power lift" or a "crane".
In the case of on-road mobile, the Source Class might be "on-road passenger vehicle". The processes associated with this class are the various vehicle types that go into the Source Class. This could be something like "1980 and older passenger vehicles". Figure 1.2-2 illustrates the concept as it relates to passenger vehicles.

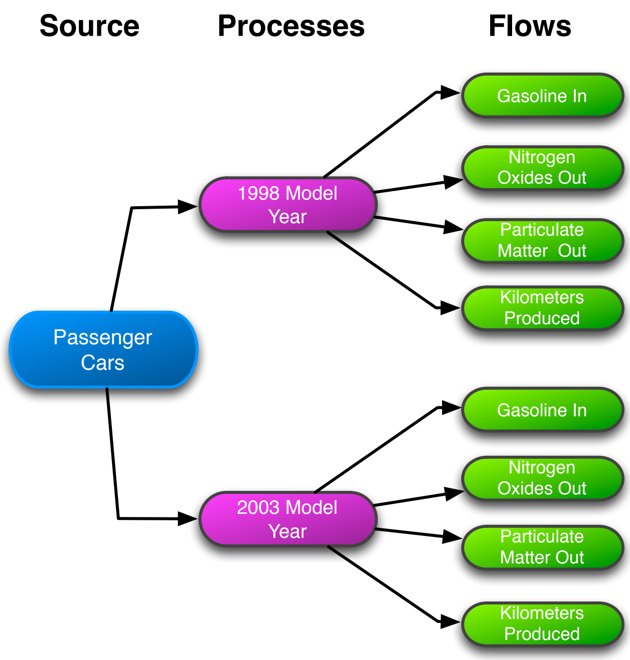

Figure 1.2-2: Source/Process/Process Flow Concept of IED for On-Road Vehicle

Once a process is defined for a Source Class, then the inputs and outputs for that process are important to know. This information is contained in tables in the database.

Additional information is needed for calculations and analysis such as operating schedules, both by season of the year and by hour of the day, potential emission factors, temperatures, wind speeds, maps, and grid systems. Tables for this type of information is also designed into the database.

Section 1.3: Implementation of an Environmental Database System

It might be questioned, why build a standard environmental database system that operates both locally and potentially through the internet? Why not let each location develop its own database system. There is certainly nothing wrong with a location developing its on database system; however, there are many good reasons why it is much more efficient to create a common database system for use in environmental management. First, it saves the database user time in getting a system up and operating. Second, a standardized system allows the database users the opportunity to share software that makes emissions and other calculations, and the calculation software does not have to be reinvented in each location.

Initially, while the database system is being developed, it may be important to restrict the use of the system to a single computer or single office to protect sensitive data. However, with an internet based system, it is possible to more easily share emission factors among the various users and system users do not have to be located at the same facility. This means the local highway department may be able to update the vehicle related information while the health department might be able to update other important information. In the end, all government departments can make use of the same system. Of course, a system used on the internet must have appropriate security built into it to restrict who has access to the system. The IED has been designed with security of data in mind. This is discussed in the next section.

Section 1.4: System Security

An emissions source database system can potentially have many types of users. These users can vary from software developers who are developing new interfaces for the system to data entry personnel who only enter data of a single type. To provide the best security, it is considered best to limit the overall use of the system but also to provide ways to limit user access to subparts of the system. Such limits are needed to prevent the inexperienced user from accidentally deleting or damaging data in the system that they might be unfamiliar with and to prevent the purposeful access of the system to make inappropriate use of the data contained in the IED. Even in cases where the IED is restricted to a single computer it might be possible for persons to accidentally or purposefully damage or access the system if no security is provided.

To address security, the IED is designed so that the system administrator can create an approved user and then restrict that user's access to certain parts of the database system and even limit the user to only certain sources. This reduces the risk of accidental or purposeful damage or data access for the system. Thus, it is possible to give the highway department access only to the on-road mobile sources and other groups only access to certain area sources. It is possible to give a person access to information on only a single source if this is considered to be useful.[2]

The security system designed into the IED is very sophisticated and setup to be impossible to access without an appropriate password.

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[2] In the original design of IED it was thought that the IED could be put onto the internet and individual source owners required to enter their own data to allow a fast input of stationary source data into the system. While there are potential issues with this approach there could be significant advantages in the case where thousands of point sources are being maintained in the system.

Section 1.5: Database Interfaces

The number of interfaces that might be developed for the IED is virtually unlimited. As time progresses, it is possible that hundreds of different types of interfaces might be written to interact with the IED to increase the ease and efficiency of using the system. As noted earlier, as these interfaces are developed, they can be easily adapted to other locations so that different air quality management groups can help one another out by sharing software.

To date, a number of interfaces have been developed to support the use if the IED. They are indicated in Table 1.5-1. (*It should be noted that the security system included in the IED will restrict which of the following interfaces and sources can be accessed by the user depending upon how their user account is designated by the system manager. Thus every user will not see all of the listed interfaces.*)

Table 1.5-1: Presently Available Interfaces for the IED

Interface Name	Purpose
Public Interfaces	
Home	This interface is designed for logging into the system, to provide access for looking up Codes (discussed in the next interface discussion) and for accessing other interfaces when the user is logged in.
Code Lookup	This interface is designed for looking up emission factors, the North American source classification codes, and the International Panel on Climate Change source classification codes.
Source Information	
Calculate Source Flows	This interface is designed for calculating the process flows for sources and processes set up in the IED. It is designed to make hourly, daily, and annual flow (emission) calculations for all sources and different subgroups of sources for the present time (base case) and in the future.
Recall Calculations	This interface is designed for recalling calculations previously made and saved. Once the number of sources in the database becomes large, calculations can take a significant about of time. Thus, there is value in saving the results of key calculations.
Edit Source Data	This interface is designed to edit Source, Process, and Process Flow data. Information on a Source can be accessed and changed with this interface. Sources, Processes, and Process Flows can also be created with this interface.
Data Management	
Technical Information	This interface is provided to allow access to technical data concerning the IED.
Upload Data	This interface is provided to allow the user to upload data to IED tables from information developed in an Excel spreadsheet.
Submit SQL	This interface is provided to allow the user to query and modify the database using SQL commands.
Review Grid Distributions	This interface is provided to allow the user to look at information in the grid related tables found in the database. The user can not edit data with this interface.
Edit Hourly Adjustment Records	This interface is provided to allow the user to edit the hourly adjustment records found in the database. This interface was designed and submitted by a student at Tshinghua University.

Account Management	
General Accounts	This interface is provided to allow the data base user to 1) add new users and to determine what data and interfaces can be accessed by the new user, and 2) to delete or change the permissions of existing users.
Personal Accounts	This interface is provided to allow the user to change their name and password for their own account
Log Out	This interface simply logs the user out of the database and returns them to the Home interface.

A fuller discussion of most of these interfaces can be found in later chapters of this manual.

Section 1.6: Standard Units

The IED provides the necessary information so that outputs can be designed to display in different units in order to support the use of the database in different locations. However, when calculations are made in the database it is handled in pre-defined units. These standardized units for the IED are shown in Table 1.6-1.

Table 1.6-1: Standard Units Used in IED

Unit	Standard	IED Symbol
Area	square meters	m2
Currency	local	---
Cycles	repeats/hour	Cy
Date	Year-Month-Day (e.g. 2009-07-25)	---
Distance	kilometers	km
Electrical Current	amp-hour	amphr
Energy	kilowatt-hour	kWh
Fractions	fraction (not as a %)	---
Length/Height	meter	m
Location	Latitude.Decimal, Longitude.Decimal	---
Radiation	nano-curie	nCi
Rainfall	millimeters	mm
Temperature	degrees Celsius	0
Time	hour	hr
Volume	liters	l
Weight/Mass	kilograms	kg
Year	Four digit year (e.g. 2009)	yr

<u>Chapter 2</u>
Installation

Section 2.1: Web Server Installation

This document describes the installation and configuration of the International Emissions Database (IED) web server and database using the Fedora 19 Linux distribution. Other Linux distributions should also work, and other than the operating system installation, the steps should be very similar. This installation is complex, and care must be taken to follow each step precisely. It is recommended that a person experienced with the installation of servers or similar computer systems be used to carry out the installation.

The data generated by the server is computationally intensive. While the software has no specific hardware requirements and can even be installed on a virtual machine, it is recommended that it be installed on a dedicated machine with at least an Intel I7 quad core processor.

Required Components:

- Network access is required during the process.
- Fedora 19 Linux installation disc. Download Fedora-19-x86_64-netinst.iso from fedoraproject.org and burn it onto a CD. (It should be noted that the fedora website has many download options. Take care to download the option indicated above. Also users should pay attention to burn the .iso file into CD/DVD as an image. Please follow the direction: http://windows.microsoft.com/en-us/windows7/burn-a-cd-or-dvd-from-an-iso-file)
- Obtain from ISSRC the SQL Database archive file and put it on a USB flash drive. (This is the basic initial data for the IED database.)
- Obtain from ISSRC a HTML page and script archive file and put it on the USB flash drive with the SQL Database. (This is the PHP code for the IED system.)
- Obtain from ISSRC the C++ source code for a PHP calculation extension on USB flash drive.
- Define and internet name. Even though this installation may not be on the internet, it works best to define an internet name to be used during installation. The name can be something like “iedxx.org”. The selected internet name must be inserted everywhere in the installation process where the words “*internetName*” are found. Optional: If this installation is to be put onto the internet, then a name must be purchased from a name provider such as “GoDaddy.com” and the purchased name used everywhere the words “*internetName*” are found.
- Optional: Purchase an SSL certificate as discussed later. (This is necessary only when IED system is needed to run on the Internet. And this is a paid service from a certificate authority such as “GoDaddy.com”)

The follow group of names and passwords should be developed at this point for use during the installation. These names should not refer to actual people. These names and passwords should be kept in a secure location and may be needed again in the future. The following table 2.1-1 is provided for recording this information.

Table 2.1-1: Names and Passwords

User Type	User Name*	User Password
Linux Root User	root	
Linux Administrator		
MySQL Root User	root	
IED Main Database User (iedmain)		
IED Credit Database User (iedcredit)		
IED Permissions Database User (iedpriviledges)		
IED Administrator	admin	admin
Internet Name		

*the user name "root" must not be changed.

Summary of Installation– These basic steps are explained in more detail after this summary:

1. Install Linux.
2. Install some additional software packages.
3. Install and configure the database.
4. Install the web pages.
5. Install the PHP extension.
6. Configure the firewall.
7. Configure the web server.
8. Obtain and install an SSL certificate.
9. Restart the web server

Detailed Instructions:

1. Install Linux – (This can be done by erasing the whole drive and installing Linux only or creating a partition and preserving the Windows system if this is desired.)
    a. Insert the Fedora installation disc and start or reboot the machine.
    b. Select **Install Fedora 19**.
    c. Choose your language and click **Continue**.
    d. Set up network access and click **Continue**.
    e. In Date **& Time**, select your time zone.
    f. In **Installation Destination**, make sure the disk you want to install to is checked.
    g. Under **Software**, you may have to wait while the installer retrieves information from the Internet. This may take several minutes.
    h. Click on **Software Selection**. For the **Base Environment**, choose **Xfce Desktop**. For the **Add-Ons**, choose **Administrative Tools**, **C Development Tools and Libraries**, and **System Tools**. Click **Done**.
    i. You may have to wait for the **Software Selection** to do some processing.
    j. Click **Begin Installation**.
    k. Click on **Root Password** to set the root password for the machine. The root user has full access to the machine.
    l. Click on **User Creation** to create a user to administer this machine. Make sure the **Make this user administrator** checkbox is checked.
    m. Wait for the installation to complete.
    n. Remove the installation disc and reboot.
2. Install some additional software packages – Install the mariadb SQL server. Mariadb is derived from MySQL and is compatible with MySQL, but it is developed and maintained independent of Oracle Corporation.
    a. Open a terminal window by right-clicking on the Desktop and selecting **Open Terminal Here**.
    b. Run the command:
    sudo yum install mariadb-server mysql-workbench qt-mysql gedit php mod_ssl php-mysqlnd
    Sudo is a command that runs the rest of the command line as the root user. It will prompt for the user's password. Yum is the program that installs and updates software packages in Fedora Linux. The first time it runs it will prompt for whether it is OK to import RPM-GPG-KEY-fedora-x86_64. This is an encryption key that verifies that the packages to be installed are authentic. Answer **Y** and press the **Enter** key.

c. Run the command:
   sudo yum install qt-devel php-devel
   This will install the packages needed to build the PHP extension that speeds up the emission calculation.

d. Run the command:
   sudo yum install firefox
   This will install the Firefox browser that can be used to access the IED locally.

3. Configure the database:

   a. Run **sudo gedit /etc/my.cnf**. Add **lower_case_table_names=1** to the **[mysqld]** section. Close and save when asked.

   b. Run the following two commands to have the database server start at boot up and to start it now:
   sudo systemctl enable mysqld.service
   sudo systemctl start mysqld.service

   c. Run **sudo mysql_secure_installation**. When asked for a root password, press "Enter" since there is no password for MySQL at this point. When asked whether to create a root password, choose "**y**" for yes and enter a password. This password becomes the root user password for MySQL and should be recorded in a secure location. It will be used in future steps in this installation and other times with the administrator might want to make changes. For all other questions, press "Enter" to accept the default answer.

   d. Insert the USB flash drive containing the SQL database archive. A new window should appear showing the contents of the flash drive. Or open "Home" on the desktop and find it. Right click on the database archive file named ieddatabase.sql and select properties. Note the filepath of the file.

   e. Run **sudo mysql –user=root –password </filepath/ieddatabase.sql** using the filepath from above. You will be asked for the password created in 3c (the root user password).

4. Install the web pages:

   a. Run **cd /var/www** to change to the web server directory.

   b. Find the Location of the archive file of the HTML pages named iedphp.tgz on the USB drive the same way as before.

   c. Run **sudo tar -o -xf /filepath/iedphp.tgz** using the filepath.

   d. Update the Linux file permissions using the following commands:
   sudo chmod -R a-x,o-w,ug+rw ied
   sudo find ied -type d | sudo xargs chmod a+x
   The first command makes the files readable by everyone, but only the owner can modify them. The second command makes the directories readable by everyone. Note that in this context "everyone" refers to users with an account on the server.

In particular, the web server program runs as user "httpd" and needs access to the files.

e. **sudo gedit /etc/php.ini** and make the following changes:
~~max_execution_time = 30~~
max_execution_time = 600
~~memory_limit = 128M~~
memory_limit = 1024M

f. Run the following commands to enable and start the web server:
sudo systemctl enable httpd.service
sudo systemctl start httpd.service

5. Install the PHP extension:

a. Run **cd** without any arguments to change to the user's home directory.

b. Find the Location of the archive of the PHP extension source files named EmCalcPhpExtension.tgz on the USB drive the same way as before.

c. Run **tar -xf / filepath /EmCalcPhpExtension.tgz**, substituting the appropriate Location. Note that unlike before, the sudo command is not used.

d. Run **cd EmissionCalculation** to change to the directory holding the source files.

e. Run **./buildall** to build and install the PHP extension.

6. Configure the firewall for http and https:

a. Right click on the desktop and select **Applications Menu→Settings→Firewall.** (May take entry of the administrator password twice)

b. For **Current View**, select **Permanent Configuration**.

7. Check the boxes for **http** and **https**. [Note: if only local access is desired (i.e. the IED is only to be accessed on the machine where it is installed) do not check these boxes and all other by default checked boxes may be unchecked. This will disallow any outside access and will need to be changed if outside access is desired in the future.]

8. Create Users for each of the three IED MySQL databases.

a. Open MySQL: **sudo mysql –user=root –password**

b. Create Main database user: **create user MainDatabaseUserName@localhost identified by 'MainDatabaseUserPassword';**

c. Create Credit database user: **create user CreditDatabaseUserName@localhost identified by 'CreditDatabaseUserPassword';**

d. Permissions database user: **create user PermissionsDatabaseUserName@localhost identified by 'PermissionsDatabaseUserPassword';**

e. Set privileges for the Main database user: **grant all on iedmain.* to MainDatabaseUserName@localhost;**

f. Set privileges for Credit database user: **grant all on iedcredit.* to CreditDatabaseUserName@localhost;**

g. Set privileges for Permissions database user: **grant all on iedprivileges.* to PermissionsDatabaseUserName@localhost;**

9. SSL Certificates—These instructions create a Certificate Authority and an SSL certificate.

   a. **cd**
   mkdir sslcert
   chmod go-rwx sslcert
   cd sslcert

   b. **openssl genrsa –des3 –out private.key 4096**

   c. **openssl rsa –in private.key –out *internetName*.key**

   d. **openssl req –new –key *internetName*.key –out *internetName*.csr**

   e. Optional: If you want a real certificate for placing the IED onto the internet, send ***internetName***.csr to a certificate authority to get a signed certificate, or continue with following steps to create a self-signed certificate as follows:

   f. **cp /etc/pki/tls/openssl.cnf .**

   g. Open the openssl file: **sudo gedit openssl.cnf** and make the following changes to the local copy of openssl.cnf: In the [CA_default] section, change "dir = ../ ../CA" to "dir = ." Remove the # from in front of the "req_extensions = v3_req" line. Update the countryName_default and similar xxx_default lines.

   h. **openssl genrsa –des3 –out ca.key 4096**

   i. **openssl req –new –x509 –days 3650 –key ca.key –out ca.crt – extensions v3_ca**

   j. **echo 01 >serial**

   k. **touch index.txt**

l. **openssl ca –days 3650 –in *internetName*.csr –out *internetName*.crt –cert ca.crt –keyfile ca.key –outdir . –config openssl.cnf**

m. **sudo cp ca.crt *internetName*.crt *internetName*.key /etc/httpd/conf**

n. **sudo cp ca.crt /var/www/ied/html**

10. Configure the web server for the SSL certificate

    a. Run **sudo gedit /etc/httpd/conf.d/ssl.conf** and make the following changes:

    b. In the “SSL Global Context” section, add
    SSLStrictSNIVHostCheck off

    c. Above the “SSL Virtual Host Context” section, add
    NameVirtualHost *:80
    <VirtualHost :80>
        DocumentRoot “/var/www/ied/html”
        ServerName www. ***internetName***:80
    </VirtualHost>

    d. Update the SSL VirtualHost Context as follows:
    ~~<VirtualHost _default_:443~~
    NameVirtualHost *:443
    <VirtualHost *:443>
    ~~#DocumentRoot “/var/www/html”~~
    DocumentRoot “/var/www/ied/html”
    ~~#ServerName www.example.com:443~~
    ServerName www. ***internetName no “.org” or “.com”***.local:443
    ~~SSLCertificateFile /etc/pki/tls/certs/localhost.crt~~
    SSLCertificateFile /etc/httpd/conf/ ***internetName***.crt
    ~~SSLCertificateKeyFile /etc/pki/tls/private/localhost.key~~
    SSLCertificateKeyFIle /etc/httpd/conf/ ***internetName***.key

    If the user has a real SSL certificate then the following changes must be made. Otherwise, no change needs to be made:
    ~~#SSLCertificateChainFile /etc/pki/tls/certs/server-chain.crt~~
    SSLCertificateChainFile /etc/httpd/conf/gd_bundle.crt
    (note that the line above applies to a certificate provided by the GoDaddy certification service. If the SSL certificate is purchased from another certification service, the “/gd_bundle.crt will likely be different)

    e. If you have purchased an SSL certificate, insert the USB flash drive containing the SSL files. A new window should appear showing the contents of the flash drive. Right click on one of files and select properties. Note the Location and Name of the file.
    Run **sudo cp / filepath /Name /etc/httpd/conf/** using the Location and Name from above. Do this for the SSL certificate file, the SSL key file, and the SSL

certificate chain file. The SSL key file should be kept secret. Run the following commands to make sure it is owned by and readable only by the root user
sudo chown root.root /etc/httpd/conf/ *internetName*.key
sudo chmod u=r,go-rwx /etc/httpd/conf/ *internetName*.key

11. Run **sudo gedit /etc/hosts** and add ***internetName no ".org" or ".com"*.local** to the end of the line that contains 127.0.0.1.
12. Restart the web server:
    a. Run **systemctl restart httpd.service** to restart the web server with the current settings.

It may be necessary to turn off and restart the computer for the installation to work properly.

Section 2.2: PHP Configuration

Once the PHP software has been installed and the pages put in place, an IED specific PHP configuration file named "configuration.php" will be located in the library directory at the top level of the website (var/www/ied/library/configuration.php). Using a text editor, values in this file may be changed to alter the functionality of the IED. For the IED to have access to the databases, the MySQL user names and passwords that were created earlier will have to be entered here.

As shown in the screenshot example below, the file contains a series of variables and their associated values. In the example, the variables are shown in orange inside of single quotes, their associated values are different colors depending on their type, and the green text contains short descriptions of the variables and their possible acceptable values.

After opening the file, locate the following lines and enter the MySQL user names and passwords that were created earlier inside of the '' marks:

define('MAIN_DB_NAME','iedmain');
define('MAIN_DB_USER','*mainUserName*');
define('MAIN_DB_PASSWORD','*mainUserPassword*');
define('CREDIT_DB_NAME','iedcredit');
define('CREDIT_DB_USER','*creditUserName*');
define('CREDIT_DB_PASSWORD','*creditUserPassword*');
define('PERMISSION_DB_NAME','iedprivileges');

define('PERMISSION_DB_USER','*privilegesUserName*');
define('PERMISSION_DB_PASSWORD','*privilegesPassword*');

After making these changes, the IED will function as configured, however, many installations will prefer changing a few of these settings. Some other variables that may be valuable to change upon installation are:

DEFAULT_LANGUAGE, ADDRESS_FORMAT to match the IED's country/language.

ALLOWED_NETWORK to match the scope of usage. I.E. is the IED to be used on an individual machine, a local network, or as a traditional website. Note: the server OS (Linux) will have additional settings that should be made in this category as was explained in the installation section.

INCLUDE_MAIN_EMAIL, MAIN_EMAIL_ADDRESS to put a "help" email on every page if the IED is to be a traditional web application and an email address will be available to answer questions.

MAIL_SERVER, MAIL_USERNAME, MAIL_PASSWORD, MAIL_SUBJECT, MAIL_TEXT will be needed only if it is desirable for the General Accounts page to be able to email the names and passwords of new accounts to those for whom an account was created. If this is the case, an email account must be created for the server to use and it's setting stored in these variables.

Many other values may be changed as needed such as altering the home page image or the map coloring, but the implications of the more technical changes should be understood before making them.

```php
<?php

/*----------------------------------------------------------------------*/
/* settings to allow for easy transfer and customization of the website */
/*----------------------------------------------------------------------*/

// the version number for the site as a whole
setConstant('VERSION_NUMBER','0.65');

// the default language for the site ('En','Sp','Po','Ch')
setConstant('DEFAULT_LANGUAGE','En');

// the address input format (on the source entry page)
setConstant('ADDRESS_FORMAT','us'); // options: 'us','chile','turkey','mexico','brazil','china'

// sets whether the server is capable of SSL (if not, all transactions are insecure, so hopefully
this is always true)
setConstant('SSL_AVAILABLE',true);

// sets whether to allow outside requests - 'a' = all, 'l' = local network only, 'n' = no outside
access
setConstant('ALLOWED_NETWORK','a');

// sets whether to display the account name of the logged in user in the side menu
setConstant('SHOW_ACCOUNT_NAME',true);

// the image name/size for the front page
setConstant('HOME_PAGE_IMAGE','globe.jpg'); // file should be in the images folder
setConstant('HOME_PAGE_IMAGE_WIDTH',600);   // width of image should be in pixels and 660 or less

// sets whether the lowest value in the map display is show as the lowest color or as no color
setConstant('CLEAR_LOWEST_MAP_COLOR',true);

// sets the minimum and maximum lengths of a code finder code (only used to decide when to display
the "path" button)
setConstant('MIN_CODE_LENGTH',3);
setConstant('MAX_CODE_LENGTH',35);

// sets whether the webmaster/help email address should be included at the bottom of pages and what
that address is
setConstant('INCLUDE_MAIN_EMAIL',true);
setConstant('MAIN_EMAIL_ADDRESS','iedhelp@issrc.org');

// useful during development
setConstant('ALLOW_MULTIPLE_DATABASE_SQL',false); // sets the SQL page to allow all databases on the
server to be accessable
setConstant('SPECIAL_HEADER',false);              // sets the header sizes correctly for the special
metropolis header
setConstant('HEADER_SUBFOLDER','central');        // sets the header to come from the set for a given
site
('central','chongqing','guadalajara','metropolis','mexicocity','saopaulo','shanghai','southcoast','san
joaquinvalley','istanbul')
setConstant('SHOW_PAGE_LOAD_TIMES',false);        // sets whether the time a page took to create
shows at the bottom of the page
setConstant('CALC_SHOW_PHP_ERRORS',false);        // display php errors and warnings during the
calculation (applies to edit page as well)
setConstant('CALC_SHOW_JS_XML',false);            // display the full return XML in the calculation
(this is a debugging setting only)
setConstant('CALC_USE_C_CODE',true);              // use the C++ version of the calculation or the
PHP version
setConstant('DISPLAY_INCOMPLETE_PAGES',false);    // allow access to pages that are currently under
construction
setConstant('DOC_TYPE','xmlt');                   // sets the Doctype for website rendering
experimentation (html5,xmls,xmlt)

// flow calculation values
setConstant('MAX_SIMULTANEOUS_FLOWS',3);      // sets how many simultaneous threads the flow
calculation will use (larger numbers may allow for faster calculations, but will consume more server
processing)
setConstant('FLOW_TIMEOUT_TIME',120);         // seconds to wait before giving up on a flow calculation
(this should be over the maximum flow calculation time or server processing will be wasted and the
calculation will take longer)
setConstant('DEFAULT_SHOW_ERRORS',true);      // sets wheter errors are shown by default
setConstant('DEFAULT_SHOW_COLORS',true);      // sets wheter the grid is colored by default
setConstant('DEFAULT_COLOR_LOGGIE',false);    // sets whether the grid is colored logarithmically by
default
setConstant('ABBREVATE_UNITS',true);          // sets whether unit names are abbrevated (i.e. 'km' or
```

```
'kilogram')
setConstant('CALC_DEFAULT_HOUR',12);         // the hour that the hour select starts on
setConstant('CALC_DEFAULT_YEAR',2010);       // the year that the year select starts on (this might
should be changed to always equal the current year)
setConstant('STORAGE_NUMBER_ROUNDING',5);    // the number of digits to which stored calculation
values are rounded (smaller values save storage space and speed saving/loading)
$Calc_Years_Constant =
array(2008,2009,2010,2011,2012,2013,2014,2015,2016,2017,2018,2019,2020,2025,2030,2050); // the
available years in the year selects

// recall calculation values
setConstant('MAX_GROUP_TIME',43200); // the maximum seconds allowed from first calc to last to label a
group with a single time

// edit page values
setConstant('EDIT_MIN_SEARCH_LENGTH',2);   // the minimum number of characters to be an accetable
search string
setConstant('SEARCH_EVERY_KEYPRESS',true); // sets whether the search fires on every keypress on
just on input exit

// login values
setConstant('MIN_PASSWORD_LENGTH',3);   // minimum allowed characters for a password
setConstant('MIN_NAME_LENGTH',1);       // minimum allowed characters for a login name
setConstant('MAX_NAME_LENGTH',40);      // maximum allowed characters for a login name (should match
database field size)
setConstant('TIMEOUT_TIME',10800);      // seconds allowed to be inactive and remain logged in
setConstant('COOKIE_TIME',604800);      // seconds to tell the user's browser to keep the login
cookie
setConstant('WRONG_PASSWORD_LIMIT',10); // the maximum number of wrong passwords before an account
lock
setConstant('ALLOW_CALCULATIONS',true); // sets whether individual source owners can run calculations
on their own sources/processes
setConstant('USE_IP_IN_SESSION',true);  // sets whether to tie a login to a single I.P. address -
this is better as it is more secure, but caused problems in one odd case where a hotel's connection
was jumping between I.P.s

// MySQL database information
setConstant('MAIN_DB_NAME','x');
setConstant('MAIN_DB_USER','x');
setConstant('MAIN_DB_PASSWORD','x');
setConstant('CREDIT_DB_NAME','xxxx');
setConstant('CREDIT_DB_USER','xxxx');
setConstant('CREDIT_DB_PASSWORD','xxxx');
setConstant('PERMISSION_DB_NAME','x');
setConstant('PERMISSION_DB_USER','x');
setConstant('PERMISSION_DB_PASSWORD','x');

// encryption salts
setConstant('SALT00','xxxx');
setConstant('SALT01','xxxx');
setConstant('SALT02','xxxx');
setConstant('SALT03','xxxx');
setConstant('SALT04','xxxx');
setConstant('SALT05','xxxx');
setConstant('SALT06','xxxx');
setConstant('SALT07','xxxx');
setConstant('SALT08','xxxx');
setConstant('SALT09','xxxx');
setConstant('SALT10','xxxx');
setConstant('SALT11','xxxx');

// accounts page values
setConstant('GENERATED_PASSWORD_LENGTH',8);   // sets the length of all automatically generated
passwords on the accounts page
setConstant('AUTO_GENERATE_PASSWORD',false);  // sets whether to automatically fill in a random
password
setConstant('DEFAULT_USE_EMAIL',false);       // sets whether the 'use email' box is checked by
default

// outgoing email settings
setConstant('DEFAULT_SEND_EMAIL',true);           // sets whether the 'send an email' box is checked
by default
setConstant('MAIL_SERVER','smtp.issrc.org');      // the email server used for outgoing email
setConstant('MAIL_USERNAME','server@issrc.org');  // the email account's username
setConstant('MAIL_PASSWORD','xxxx');        // the email account's password
setConstant('MAIL_SUBJECT','New IED Account');    // the subject line of the 'new account' email
setConstant('MAIL_TEXT',                          // the text of the 'new account' email (note: [|
```

```
name|], [|password|], and [|info|] will be replaced and these markers should not be changed or
repeated)
'An account has been created for you at the IED Website:

User Name:   [|name|]
Password:   [|password|]

To reach this site, navigate to www.iedcentral.org and enter your user name and password. Once you
have logged in, you may select "Account Management" from the side menu and change both the user name
and password.

Your reasons for signing in should be described in more detail here.

For any questions, you may contact the person who has created your account:

[|info|]');

// this is being used during development instead of a straight 'define' to allow for site specific
overriding defines
function setConstant ($name,$value) {if (!defined($name)) define($name,$value);}

?>
```

Section 2.3: Log In to Base Account

To use the software locally (on the machine where it is installed), enter ***internetName no ".org" or ".com"*****.local** into the Firefox browser.

If desired, security for local access can also be enhanced by creating a second user account that does not have administrative permissions. This account should then be used unless machine configurations need to be done. An account without administrative permissions will not be able to use the "sudo" command to do machine configurations.

The IED is automatically assigned a single root "top level" account to which all privileges are assigned. By default the account name is: **admin** with the password **admin**. For security purposes this name and password should be changed immediately using the "personal account" page accessed through the side menu.

Chapter 3
Getting Started

Section 3.1: Setting Up Users

Your account must be approved for editing and creating user accounts to be able to set up accounts with IED. If you are approved, the "General Accounts" tab will show on the IED sidebar. Once logged into the IED website click on the "General Accounts" tab on the left to create a new user. In this interface, click on the "new account" button and this will bring up the first of two steps in creating a user. The first section is simple to follow. It requires a user name, password, name, email, and phone number. The user name, password, and name information are required, while the rest is optional. If you do not have a user name preference, clicking the "use email" box next to the user name blank will automatically make the email address the user name. User names must be unique. If the selected user name is already taken an error message will appear. If there is no password preference, clicking the "random" button will generate a random password. Once all information is entered, click "create." If you would like an email with the user name and password sent to the new user, check the "send an email to account recipient" box.

The second section deals with the account in more detail. Each new user is automatically assigned "general user" permissions. However, within this second section the account creator has the option of expanding permissions. Under the Account Permissions header select either a preset permissions category or look through each permissions group and make the appropriate selection. Once all selections have been made, click on the "change" button. It is important to note that, for security reasons, a user may only assign permissions to another user up to their own level of permissions. This restriction is in place so that lower level users cannot create a new account with higher permissions and thereby gain greater access to the IED than was intended.

Below permissions is a section titled Sources. The intent of this area is to allow the creator to assign one or more sources to a user. This is useful because, although a user may be a coworker, a user may also be more remote and it is desired to limit this user's access to IED. For example, a government entity may be using the IED, but rather than having a government employee enter all of a source's data, a new user can be set up for, say, a cement plant employee and they would be able to enter all of their own data. The cement plant user would <u>not</u> be able to see or alter any other data in the IED. Multiple sources may be assigned to a single user.

Once a new user is created, this user is ready to begin working with the IED. In the event that their information needs to be accessed again by the person who added them, go back to the "General Accounts" page. At the top of the page there is a drop down menu that lists all users. Select the appropriate user and click "get." This will bring up the user's information which can then be viewed and altered.

Section 3.2: Checklist for Setting up Database for a Region

A Checklist for Setting Up Information in the IED for a Region

Setting up the IED for an urban area can be a complex process. However, it is more manageable if steps are taken down an orderly path. This checklist is intended to help the user to go through the process of setting up the IED for a region. Of course, the experienced user does not have to follow the process as described; or it may be appropriate to just jump in at some point down the list if the IED is already partially set up.

There are two sets of data that must be created for the IED to be appropriately used. The first set of information to be established is the regional information. The second set of information that must be established is the source information. Both sets of information are needed to have a fully operative IED database. The order in which these two sets of data are created is not critical. The IED will not work properly until both sets of data are completed. There is default data provided in IED to help the user get a quicker start.

Before using this checklist, the user should become familiar with use of the Submit SQL and Upload Data input pages, which are discussed in Chapter 4.

Entering General Regional Information

Since the IED is set up to calculate flows (air pollution and other flows) over a region, it is essential that key regional information be set up in the database. This data should be as accurate as possible but it does not have to be perfect. It can be modified and added to in the future. However, in the case of the basic regional information, care should be taken to get it as correct as possible at the start. At this point in time, the regional information and much of the other critical data must be uploaded from an Excel file once it has been developed using the Upload Data input page. There is an editor specifically for the source data, which is also discussed elsewhere.

Step 1: The regional description table is probably the best place to start when setting up the IED. This table is called RegionalGridInfo. It requires an abbreviation for the region, a name for the region, the latitude and longitude of the southwest corner of the region, the size of the grids used for the region, the number of rows in the grid system, the number of columns in the grid system, and the name of the file that contains a map of the region. This map should be a jpeg file that is no more than 1000 pixels wide and 600 pixels tall and compressed to be about 300 kilobytes.

Step 2: Once the RegionalGridInfo table is set up, the remaining grid tables should be at least particially set up. There are five tables in the IED that contain grid information. They are the EnviroGridDistribution, the FixedGridDistribution, the GrowthGridDistribution, the HourlyGridDistribution, and the SeasonalGridDistribution tables. Appendix G contains a discussion of the FixedGridDistribution, SeasonalGridDistribution, HourlyGridDistribution, EnviroGridDistribution, and GrowthGridDistribution tables. These tables will be discussed in this Step and the next several steps. The grid information is set up the same in all of the tables. The first column contains a grid key, the second column contains an abbreviation for the applicable region, the third and fourth columns contain an indicator of the grid row and then an indicator for the grid column. It does not matter for the IED how the rows and columns are numbered, but care must be taken to include all rows and columns in the region and once a numbering system is set up to be consistent with the data being entered so that it is in a consistent row/column set up for all of the tables. It is recommended for consistency to set the rows and columns for all grid tables by selecting a row and then incrementing the column as shown below for a grid with only 5 columns:

Table 3.2-1: Example Layout of Rows and Columns

Row	Column
0	0
0	1
0	2
0	3
0	4
1	0
1	1
1	2
1	3
1	4

The FixedGridDistribution table is a good table to start with. This table primarily holds the information that is used to distribute the emissions over the region. Appendix A should be referred to for details about any of the tables discussed here or in the next Steps. It can also be a significant challenge to determine which grid cells to enter the data into since this information may not exist in the grid format the user sets up in the IED. A software that works on PC and Mac computers as well as Linux computers has been developed to facilitate creating the needed data for the IED. This software can be obtained for free from ISSRC.

The FixedGridDistribution table can hold 41 metrics and it is possible to add additional columns in the future if 41 is not enough. There are five metrics that are valuable to include or might be considered essential in the FixedGridDistribution table. They are as follows:

-Population by grid cell
-Passenger car driving distribution by grid cell
-Truck driving distribution by grid cell
-Bus driving distribution by grid cell
-Road class distribution by grid cell

Information such as Population by grid cell, Passenger car driving distribution by grid cell and so can be placed in any column in the table; however, for consistency, it is recommended to use the columns as shown in the MetricDescription table. If the columns are not used as described in the MetricDescription table, then the definition of the columns in the MetricDescription table should be changed to be consistent with how the data is entered there. The Road class distribution by grid cell must, however, be placed in the column marked as "RoadClass". This issue is further discussed below.

It is possible to use the passenger car driving distribution to distribute all on-road vehicle emissions at the beginning, but in the long run, it will be better to have driving distributions for all of the key on-road mobile sources since their distribution will vary depending upon the type of mobile source. Over time, it will be useful to put housing distributions and other business related distributions into this table. It is common, in this table, for many of the metrics to be "normalized" for a column. That is, the user needs to make the sum of the column add up to one. It is not absolutely necessary to do this since the IED calculation program will normalize the columns in any case before the data is used, but it can be a good way to check the reasonableness of the data in some cases. However, this does not apply to the RoadClass column in the FixedGridDistribution table. On the other hand, the population values are normally not normalized. As noted above, the column titles in the FixedGridDistribution table have generic names. The user needs to refer to the MetricDescription table to establish the purpose of each column in this table. Once a column purpose is defined for a region, it must be appropriately used in the other tables in the database where this metric is referenced.

Table 3.2-2: Typical Column Metric Assignment

ColumnTitle	Purpose of Column
FxMetric01	Unity Distribution (all ones)
FxMetric02	Office space in grid cell
FxMetric03	Fraction of passenger vehicle driving in grid cell
FxMetric04	Fraction of truck driving in grid cell
FxMetric05	Fraction of bus driving in grid cell
FxMetric06	Population in grid cell
FxMetric07	Housing units in grid cell
FxMetric08	Airplane operations in grid cell
FxMetric09	Ship operations in grid cell
FxMetric10	Train operations in grid cell
FxMetric11	Water cover percentage in grid cell
FxMetric12	Agricultural land percentage in grid cell
FxMetric13	Retail Gasoline Outlets
RoadClass	Information about the class of roadways in each grid cell

The assignment of road classes must be done in concert with the special corrections process, which is discussed in Step 9. If the user is going to use the special corrections presently set up in the IED, then only five road classes are available for assignment. One road class is assigned to each grid cell. The present IED road classes are defined in the RoadClasses table. They are shown below: (see Step 9 for further discussions on this subject)

Table 3.2-3: Road Class Descriptions

RoadClassKey	Road Class Description
2001	Predominated by Rural Roadways
2005	Predominated by Residential Roadways
2009	Predominated by Urban Roadways (Arterials and Side Streets)
2013	Predominated by Rural Highways
2017	Predominated by Urban Highways

Step 3: The next table to address is the EnviroGridDistribution table. This table contains the regional information related to temperature, humidity, wind speed, and other important environmental information for the region. This table is different from the FixedGridDistribution table in that the purpose of each column is specified and data in the columns is actually a reference or pointer to information actually located in the HourlyAdjustments table. This is done in order to support hourly temperature, humidity, wind speed, and other important environmental data used to make emission estimates. Technically, there can be a different temperature distribution for each grid cell in the HourlyAdjustments table, but this is normally a waste of time. Due to the limited size of regions, it is possible to define only one to five temperature distributions for a region. For example there could be temperatures for the central city, temperatures in the suburbs, temperatures in the rural areas, or temperatures at high altitude. The data for these temperature regimes are placed in the HourlyAdjustments table but the reference to indicate which row (set of values) to use in the HourlyAdjustments table. As noted earlier, Appendix E should be consulted relative to the grid tables and Appendix F relative to the HourlyAdjustments table. If the driving pattern emission adjustments developed for the IED are to be used then it is imperative that the temperatures and humidity be established for the grid cells in the region since the calculation process refers to these values.

Step 4: The next table to address is the SeasonalGridDistribution table. This table contains information on how the activity of the source should be spread over the grid for the eight seasons in the IED. The SeasonalGridDistribution table does not directly contain seasonal grid distribution data. Like the EnviroGridDistribution table discussed above, this table contains references (pointers) to data located in the SeasonalAdjustments table. The SeasonalGridDistribution table allows the IED user to provide different seasonal patterns for different activity distribution. An important distribution to consider in this case might be emissions from vegetation. Emissions from different grid cells might have different seasonal distributions. Vegetation in higher altitude areas or areas in some sort of rain shadow could have a different seasonal distribution in different grid cells. Another example is recreation. Diesel engines in a ski area will run primarily in the winter in grid cells with a ski area located there.

In the early development of an IED inventory, it might be logical to not use the SeasonalGridDistribution table since a variance by grid cell by season is not a common occurrence in many regions for the significant sources of emissions. It is possible in the IED to assign a single set of seasonal adjustments to a process flow directly if there is no variation in the different grid cells. For example, driving may change in winter compared to summer or on the weekend compared to weekdays in the same amount in all grid cells. Thus, the use of the SeasonalGridDistribution table is not called for if the user can live with the seasonal adjustments being the same in all grid cells. It is also possible to work around the SeasonalGridDistribution table in some cases to accomplish a similar result. For example, for the ski area example discussed earlier, a column in the FixedGridDistribution table can be set up to indicate the distribution of ski area emissions and a direct reference can be made to the SeasonalAdjustments table in the ski area related process flows to get a useful result. (This is a good time to note that it is often possible to produce useable results with the IED by approaching the calculation from different concepts.)

Step 5: The next table to consider is the HourlyGridDistribution table. The HourlyGridDistribution table is exactly analogous to the SeasonalGridDistribution table. It serves as a table of pointers in this case to the HourlyAdjustments table. Also, as with the SeasonalGridDistribution table, it may be that the need to use the HourlyGridDistribution table in the early implementation of an IED database is low. The HourlyGridDistribution table is used to assign different hourly distributions to different grid cells. The most likely case where the HourlyGridDistribution table might be needed is to distribute the amount of driving in different grid cells to different hourly distributions. For example, the hourly distribution of driving in the central city might be different from the hourly distribution of driving in the suburbs as cars may leave the suburbs earlier and arrive back home later than is the case of the central city. If this is significantly the case, then the HourlyGridDistribution table is available to account for these differences. If not, then a direct reference can be made to the HourlyAdjustments table and the HourlyGridDistribution table can be left blank at first.

Step 6: The final grid distribution table to consider is the GrowthGridDistribution table. This table is used in cases where growth in the region might be different in different grid cells. For example, it might be clear that housing growth will be greater in one area of the region than the other areas. In this case, if housing growth is an important consideration in the analysis of flows of interest then the GrowthGridDistribution table should be used to indicate these differences. The use of the GrowthGridDistribution table is exactly analogous to the seasonal and hourly grid tables discussed above. The GrowthGridDistribution table houses references (pointers) to the GrowthMetric table that are used in growth calculations. As before, this is a good table to consider skipping in the first implementations of the IED. There is an alternative way to assign a growth to a process if that growth is to be the same for all grid cells.

Step 7: The next tables to consider are the SeasonalAdjustments, HourlyAdjustments, and GrowthMetric tables. If the previously discussed grid distribution tables are needed then they will contain references to these tables and the references must be created. If the grid distribution tables are not used at first, then these tables will be referenced directly. In either case the growth and other values need to be created. The IED, as initially set up, contains a number of generic seasonal, hourly, and growth adjustments that might be adequate for the user. However, the IED user should be cautious to ensure that the generic values found in these tables are appropriate for their region. The tables contain descriptions of the purpose intended for each of the adjustments in the tables. Again, the user should ensure that the generic values are appropriate to their region before using them. If they are not appropriate, the user can feel free to modify them appropriately and then reference them as needed or add new ones.

Step 8: The user now should address the core tables in the database. These are the SourceOverview, ProcessBase, and ProcessFlow tables. These tables are discussed in Appendix H and a second checklist for these tables is shown below. These are the tables that contain the key information for making flow estimates using the IED. The SourceOverview should be addressed first and the sources to be considered should be indicated here. The ProcessBase table should be addressed next to indicate the process associated with the sources in the SourceOverview table. And last the ProcessFlow table should be addressed to indicate the process flows for each of the processes in the ProcessBase table. These three tables are all linked and will contain references to the grid and adjustment tables discussed in the previous steps. They will potentially also include references to the emission factor table. To have a meaningful inventory the user should include on-road and off-road mobile sources, fixed area sources, and point sources in the IED. While a specific input page has been developed to enter source related data, it is often easier to develop the data in an Excel spreadsheet and then upload the data to the IED.

Step 9: The special corrections should be considered next. At this stage, special corrections are only intended for on-road mobile sources, but the IED is able to accommodate area or point sources later if the need arises. The special corrections for mobile sources depend upon a driving pattern indicator and a road class indicator. In addition to the five road classes (see table in step 2), there are presently four driving patterns where emission corrections have been developed (free flow, moderate flow, medium congestion, heavy congestion) for each of the five road classes discussed earlier. These 20 options are shown below:

Table 3.2-4: Driving Patterns in the Provided IED

DrivingPatternKey	Pattern Description
1001	Free Flow--Rural Roadway
1005	Moderate Flow--Rural Roadway
1009	Medium Congestion--Rural Roadway
1013	Heavy Congestion--Rural Roadway
1017	Free Flow--Residential Roadway
1021	Moderate Flow--Residential Roadway
1025	Medium Congestion--Residential Roadway
1029	Heavy Congestion--Residential Roadway
1033	Free Flow--Urban Roadway
1037	Moderate Flow--Urban Roadway
1041	Medium Congestion--Urban Roadway
1045	Heavy Congestion--Urban Roadway
1049	Free Flow--Rural Highway
1053	Moderate Flow--Rural Highway
1057	Medium Congestion--Rural Highway
1061	Heavy Congestion--Rural Highway
1065	Free Flow--Urban Highway
1069	Moderate Flow--Urban Highway
1073	Medium Congestion--Urban Highway
1077	Heavy Congestion--Urban Highway

As discussed earlier, the IED already contains a set of special corrections for mobile sources that can be found in the SpecialCorrections table. These correct for the flow (emissions or fuel flow) for a range of temperature and humidity conditions over twenty driving and congestion types. These are generic corrections and should be reasonably accurate for the IED user. However, it is possible for the advanced IED user to develop an entirely new set of special corrections if needed. If the user plans to use the already prepared generic special corrections then the user must address only one table and this is the DrivingPatterns table.

The DrivingPatterns table requires a start year and an end year for each row of data. This allows the user to assign different driving patterns for different analysis periods in the future. For example, the driving might be more congested in the future or maybe less congested with different road use policies. The DrivingPatterns table next needs to address each RoadClassKey found in the RoadClasses table, and it needs an indication of the region this data applies to. Following this information are Season columns where a pointer is entered that refers to the HourlyAdjustments table. The locations pointed to in the HourlyAdjustments table indicates the driving type for each hour of the day for the specified class of roads. Thus, corrections can be made by season and by hour for emissions from motor vehicles.

The advanced IED user can add more driving patterns as well as road classes, but this requires that the appropriate special corrections be added to the SpecialCorrections table. It is assumed for this discussion that the user will continue with the existing driving patterns and road classes at the beginning. In this case, the DrivingPatterns table does not need to be modified. Instead, the user must trace the pointers in the DrivingPatterns table in the SeasonA1 to SeasonD2 columns and then ensure that the driving patterns indicated in the HoulyAdjustments table are correct for the hours and season indicated.

Entering Source Information

It is important to consider at this point in time that it is best to get a framework set up for the source data for a region. It is not critical that every detail of the data be absolutely correct. This information can and should be improved over time.

Step 1: The SourceOverview table is the best place to start for creating the source information. This table contains basic data for all of the sources in a region including point, area, and mobile sources. Since many subsequent tables refer to the data in this table, it should be set up first. In the case of point and area sources, the definition of a source and then the processes set up for the source is fairly intuitive. However, for the case of mobile sources, this is not the case. Normally, mobile sources are broken into several categories such as Passenger cars, Large Buses, Small Buses, Large Trucks, and so on. However, it is also possible to set up many categories of Passenger cars, Buses, and Trucks if the user feels that it would be useful. There is a specific program to enter point source data that can be found on the opening IED input page.

Step 2: Complete the basic process information for each source. This information goes into the ProcessBase table. As noted in Step 1, the definition of processes for a point source is fairly intuitive; however, this is not the case for mobile sources. In the case of mobile sources, it is necessary to define the processes for this source as a model year normally beginning with 1980 or 1985 and going to 2030 or 2050. This way, meaningful future emission projections can be made.

Step 3: The final set of data needed for sources in a region goes into the ProcessFlow table. This table holds all of the information that describes flows into and out of the processes described in the ProcessBase table.

Step 4: At this stage if the regional information has been set up, the IED should work and make calculations for the base case and make projections to the future for the base case. However, it is normal to have to find and correct input errors in the data before a successful calculation can be made.

Section 3.3: Creating Scenarios

The IED offers the potential to create future scenarios. This is done by creating an alternate process flow that replaces the original process flow. When a calculation is made for the new process flow, the scenario is activated in the calculation interface and the new process flow replaces the old process flow becoming a possible future scenario.

More specifically, a scenario is developed by creating new process flows based on the process flows that are to be replaced. The new process flows contain the new flow information and effective dates for the scenario and is designated in the Scenario column of the ProcessFlow table by a two character designation as a scenario. The meaning of this two character designation in the Scenario column must be entered into the ScenarioDescriptions table. This two character designation must be used for all processes that belong to this scenario. Second, a reference must be made in the ReplacedFlow column of the ProcessFlow table to show the IED which flow is to be replaced in this new scenario. The following paragraphs discuss ways to create process flows for the IED using either the Edit Source Data input page or a series of SQL and data upload commands.
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Alternate 1: Using the Edit Source Data input page

Access the ScenarioDescription table using the Submit SQL page to determine if a scenario name already exists for the case you are developing. If a scenario name does not exist, use the Upload Data page and create a name for the scenario you will develop. Then go to the Edit Source page

Start by selecting a flow to be replaced in a scenario. Click the flow list "+" button and select "copy". This creates a complete copy of the flow. In the copy, select the new scenario and then edit the copy to reflect the changes that would occur in this scenario. Click the "save" button at the bottom of the page upon completion.
============

Alternate 2: Using the Submit SQL and Upload Data page

Access the ScenarioDescription table using the Submit SQL page to determine if a scenario name already exists for the case you are developing. If a scenario name does not exist, use the Upload Data page and create a name for the scenario you will develop. Use the Submit SQL page to download the sources that you intend to replace in the new scenario. Copy the rows from the Submit SQL page into an Excel file. At this point, the flow, dates, and other parameters can be adjusted in the Excel file as discussed below. These newly developed processflows for the scenario of interest can then be entered into the IED using the Upload Data page.

Specifically, once an Excel sheet of process flows for a scenario has been created:

1. Copy the **ProcessFlowID** and paste it into the **ReplacedFlow** field. This will tell the calculation program which process flow will be replaced when this scenario is run.
2. Enter a two-digit indicator in the **Scenario** field to indicate which scenario this new process flow goes with. Remember that '0' is reserved for the base case.
3. Fill in the **FlowStartYear** and the **FlowEndsYear**. There will be years here if the data was copied from the database. However, it is common that the new process flow will have a different effective date. For example, for the case where a control is added to a source in the future. Another case for passenger vehicles is if the rules do not require them into the fleet until some date in the future.
4. A. If an emission factor is not used and a flow is entered, then the new flow can be entered and any changes made to the other fields such as **FixedGridColumn** and such, but this is less likely to be needed. B. If an emission factor is used it will likely be a new emission factor so this will be needed. An emission factor also requires a **KeyFlow**. It is possible, for example with passenger vehicles where the **KeyFlow** is distance driven, that the **KeyFlow** will stay the same. However, there is also the case where fuel is switched that a new **KeyFlow** will have to be created. This is a case-by-case situation.
5. Finally, a new **ProcessFlowID** will need to be assigned to each new process flow. It is common that the new ProcessFlowID be kept in the same numbering range as the original process flow, but it is not necessary. It is also just as valid to find the highest ProcessFlowID presently in the database and just start from there creating new numbers.
6. Once the necessary changes have been made then the data can be copied from the excel spreadsheet and uploaded to the database. If a new KeyFlow is needed then the key flow data must be uploaded.

Section 3.4: Backing Up IED

It is recommended that an occasional backup of the IED data be made. If frequent changes are being made, then the backups should also be frequent. This backup file should be stored on a flash or external drive so that it may be used if the server's hard drive fails or if it is desired to return to a previous data state.

To make a backup of the MySQL data, open a terminal and enter the command:

mysqldump --user=root --password --flush-privileges --lock-all-tables --all-databases >*backupName*.sql

where *backupName* is any appropriate file name for the resulting backup file. A name containing the current date such as *iedBackup_01-01-2014* is often useful. This file will be created in whatever directory the terminal command is executed. After creation, it should be moved to its external storage location.

To resore the MySQL database from a backup file, open a terminal and execute the command:

mysql --user=root --password <*filepath*/*backupName*.sql

where *filepath* is the path from the current directory to the backup file's location and *backupName* is the name of said backup file.

Be advised:

Restoring from a backup will wipe out and replace all data in the database with the exception of any tables that were created after the backup was made (this is uncommon).

To execute either of these commands, the MySQL root user password will need to be entered when prompted (this is the MySQL root password, not the Linux root password).

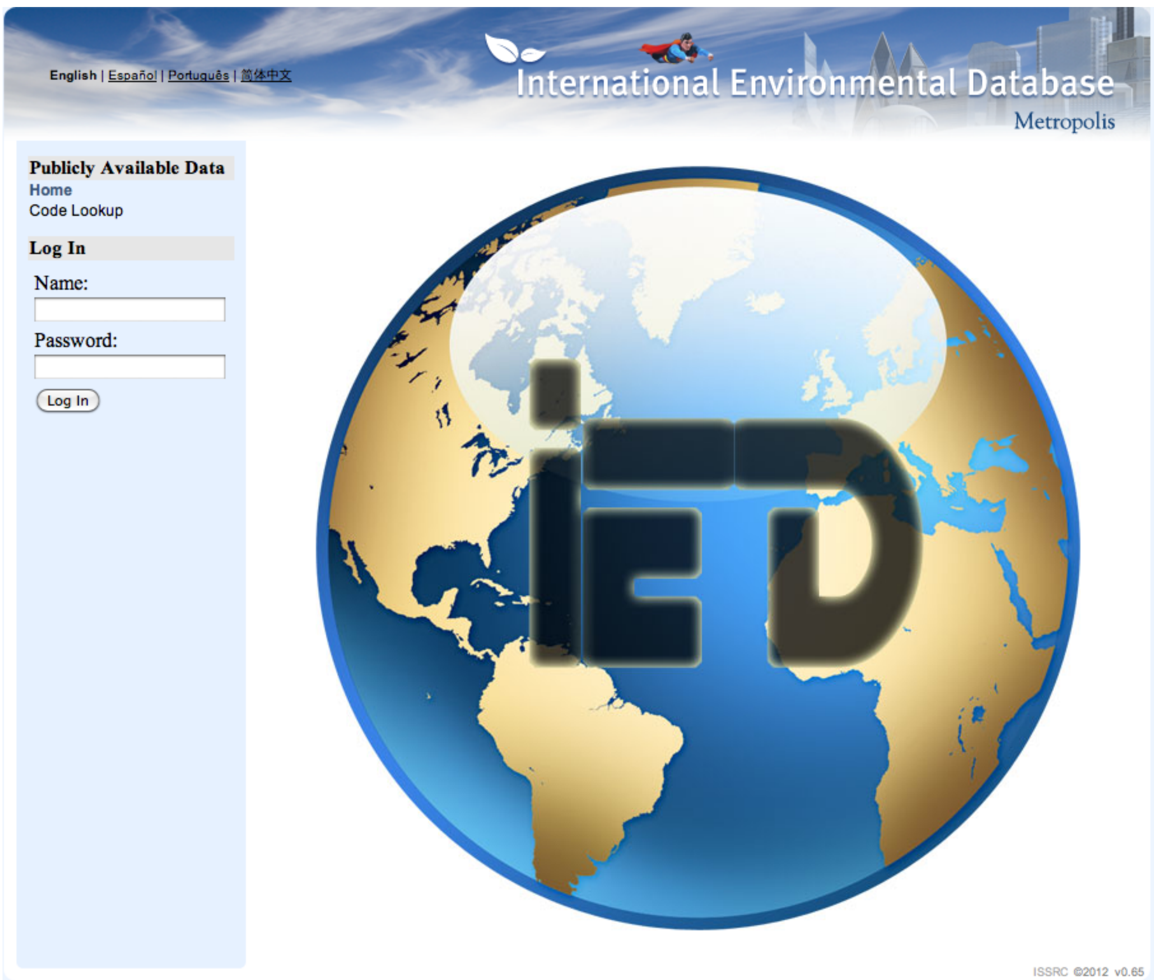
As this backup file contains a complete and unencrypted copy of all IED data, the file should be kept in an appropriately secure location.

Chapter 4
Interacting with the IED through Menu Interfaces

Section 4.1: Introduction to IED Menu Interfaces

The user interacts with the IED through a web browser. The system is designed to operate with most of the common web browsers. The use of a web browser to interact with the IED allows the system to be operated on a single computer, an office's Intranet system, or the full international Internet system with a consistent approach to managing the system.

When the user accesses the IED system, the first page that will be seen is the Home page. The home page is shown below:



At the top left of the page, the language for operation of all of the interfaces can be selected. At this point in time, the IED operates in Chinese, English, Portuguese, and Spanish. The user logs into the system by entering their user name and password as registered with the system. The user name and password are case sensitive.

It is possible to look up emission factors, the North America Industrial Codes, and the International Panel on Climate Change codes without logging into the system. This interface will be discussed in the next section.

Once the user logs into the system they will be presented with a menu of interfaces (pages) on the left side of the page that can be accessed to interact with the IED system. The list of interface options that are presented to a user varies with the access approvals given to the user by the system administrator. The illustration below shows the menu page with all presently available menu options.

Section 4.2: Code Lookup

The code finder interface is designed to help IED users locate appropriate source codes. Government agencies and environmental groups use these codes to classify sources for different types of analysis.

The IPCC code refers to the International Panel on Climate Change code, which has been established for use worldwide in addressing Climate Change. There can be more than one IPCC code for a source in some cases. The NAIC code refers to the North American Industrial Classification code, which is used by Canada, Mexico, and the United States by treaty as well as other countries in the Western Hemisphere and elsewhere by choice to classify businesses. There can also be more than one NAIC code for a source in some cases. The Materials codes were developed by ISSRC specifically for the IED to identify and group specific materials related to emissions, raw material flows, product flows, and energy flows. Some examples of materials with codes are: beef, asbestos, evaporative VOC, NOx, and tires burned. The SCC code refers to the code that indicates the emission factor (flow factor) to be used for a process flow. The SCC code is based on emission factors originally developed by the U.S. EPA, but contains emission factors added by ISSRC. It is also possible for IED users to add their own SCC codes with emission factors. Each code is useful in differing circumstances to assist in identifying and classifying emission sources. The various codes accessed by this page are used by different processes in the operation of the IED.

The Code Lookup page is designed to help the user find the codes needed as easily as possible. This page is the only page that can be looked at without an IED user name and password. A code can be entered into the edit box on the page and information related to that code accessed. If the code is not known, then the user should click on the “search” text to the right of the edit box for the code of interest. This will produce a dropdown menu with a list of options related to the code. The most appropriate option should be selected and the blue check mark next to the dropdown menu clicked. This will produce additional dropdown menus depending upon the number of classification words assigned to the code being looked up. At any time, the red circle to the left of the text can be clicked to revert to an earlier dropdown menu. After the last classification code has been selected, the information about the code of interest will be produced. Figure 4.2-1 shows an IPCC code lookup process.

Figure 4.2-1: Example CODE FINDER Search Result for IPCC Code

When using the "Edit Source Data" page, the user will find that different codes are required in different parts of the data input process. These codes can be accessed directly in the "Edit Source Data" page following the process described earlier.

Section 4.3: Calculate Source Flows

Purpose of webpage

This is one of the key interface pages for the IED. It is used to estimate flows from a source or collection of sources. The flow calculated may be any flow associated with the sources in the database including product flows and energy flows. A key use of this page is to estimate flows into the atmosphere. The page interface is shown in Figure 4.3-1 below:

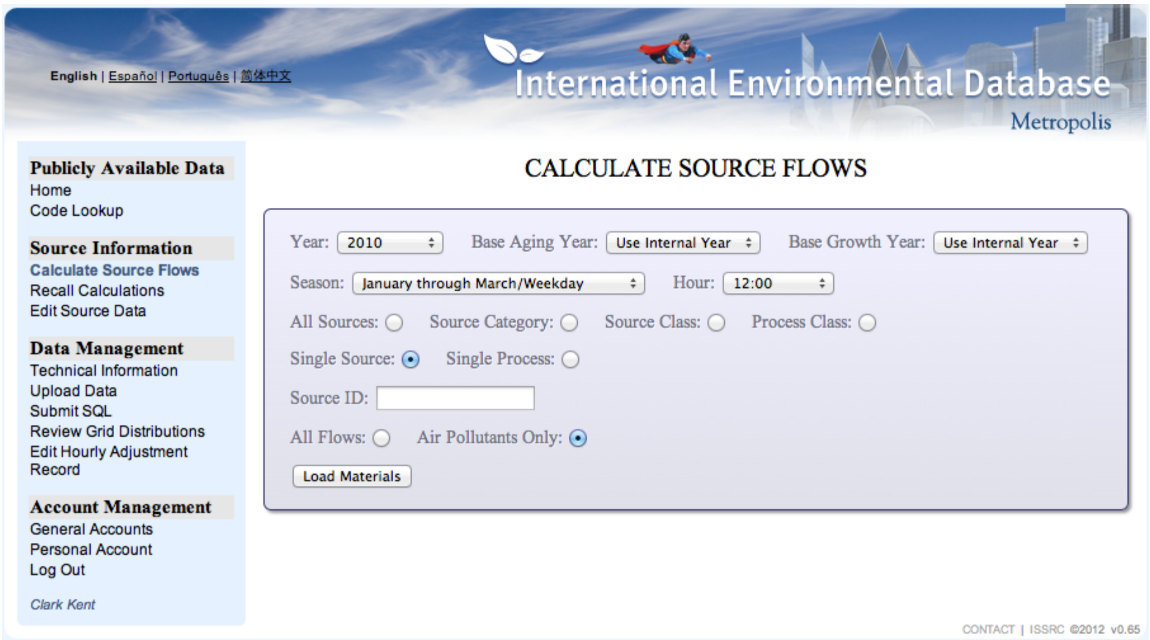


Figure 4.3-1: Calculate Flows Opening Interface

Selection of First Line of Options

The first line of the page contains a drop-down menu designated as “Year”, “Base Aging Year”, and “Base Growth Year”. The user can select a value for each of these drop-down menus or leave them with their default values.

The drop-down menu designated as “Year” is used to select the year that the calculation is to be made for. If a future year is selected then the calculation process can include emission factor aging and growth as designated by the next two drop-down menus.

The “Base Aging Year” drop-down menu is used to indicate where the starting point for aging the emissions will be found. The user can tell the program to use the age indicated with the process flow called in the <u>ProcessFlow</u> table: **YearNew** [1] and in the <u>EmissionFactorFinder</u> table: **YearNew** and **ApplicableYear** by leaving the menu at “Use Internal Year” or the user can designate a year to make the aging from by selecting a year in the menu or the user can select “No Aging”. If “No Aging” is selected then the calculation will not adjust emissions for aging. It should be noted that for the aging calculation to work, an emission factor must be designated for the source and this emission factor must have an “Aging Code Key”. If the emission factor has no “Aging Code Key” then no aging will be calculated for the flow even though aging is indicated in this drop-down menu.

The “Base Growth Year” drop-down menu is used to include growth in the emission calculation. The user can select “Use Internal Year”, can select a specific year to make growth from, or can select “No Growth”. If “Use Internal Year” is selected, then the calculation will use the **YearNew** and **FlowStartYear**[1] in the <u>ProcessFlow</u> table to make the

[1] See the discussion of the Aging and Growth Calculations in Appendix C.

growth calculation. If a specific year is indicated, then that year will be used as the start year. Finally, if "No Growth" is selected, growth will not be calculated. Regardless of what is selected in this drop-down menu, if there is no **GrowthMetricPtr**[1] in the ProcessBase table then no growth will be calculated regardless of what is selected in this drop-down menu.

Selection of Second Line of Options

In the second line of data, the user selects the season and hour of day for which the calculation is made. In the drop-down menu designated as "Season", the user can select one of eight seasons or request an "Annual Total". It is normal to designate four of the eight season options for the weekday and four of the eight season options as weekend. Thus, the user would normally be able to select one of four seasons of the year for the calculation for a weekday or a weekend. If "Annual Total" is selected, then the selection in the "Hour" drop-down menu will not impact the calculation.

In the drop-down menu designated as "Hour", the user can select the hour to be calculated. If a specific hour is selected, then the emission calculation is for the hour indicated in the drop-down menu. This drop-down menu also contains the option "Daily Total". If a season option other than "Annual Total" is selected, then the selection of "Daily Total" will result in a sum of all hours for the day of the season that it is selected.

Selection of Third Line of Options

The third line contains five selection buttons (these are called Radio Buttons in some contexts). The user must select one of these buttons. They are:

All Sources	This calculates the flow associated with all of the sources in a region
Source Class	This calculates the flow associated with a class of sources
Process Class	This calculates the flow associated with a class of processes
Single Source	This calculates the flow associated with a single source
Single Process	This calculates the flow associated with a single process

The default selection is "Single Source". If "Single Source" is selected then the calculation will be for the single source indicated in the next step. Similarly, if "Single Process" is selected then the calculation will be for the single process that is indicated in the next step.

If "Process Class" is selected then a drop-down menu is added below the line of selection buttons when there is more than one region in the database. The same is true if "Source Class" or "All Sources" is selected. If there is more than one region in the database, then the region of interest must be selected from the drop-down menu on the next line.

Also, if "Source Class" or "Process Class" is selected then a drop-down menu is added that allows the user to select the class of sources that are to be calculated. The proper class must then be selected from the "Class" menu.

The user must then select the type of flows to be considered using one of the radio buttons on the fifth line of the web page shown in Figure 9 above. There are two options: "All Flows" and "Air Pollutants Only". As might be expected, if "All Flows" is selected, the program will scan the database for all of the flows associated with the source or process or the sources or process selected with the preceding radio buttons and subsequent designations.

Figure 4.3-2 indicates the Process Flow Calculation page at the next stage of calculation.

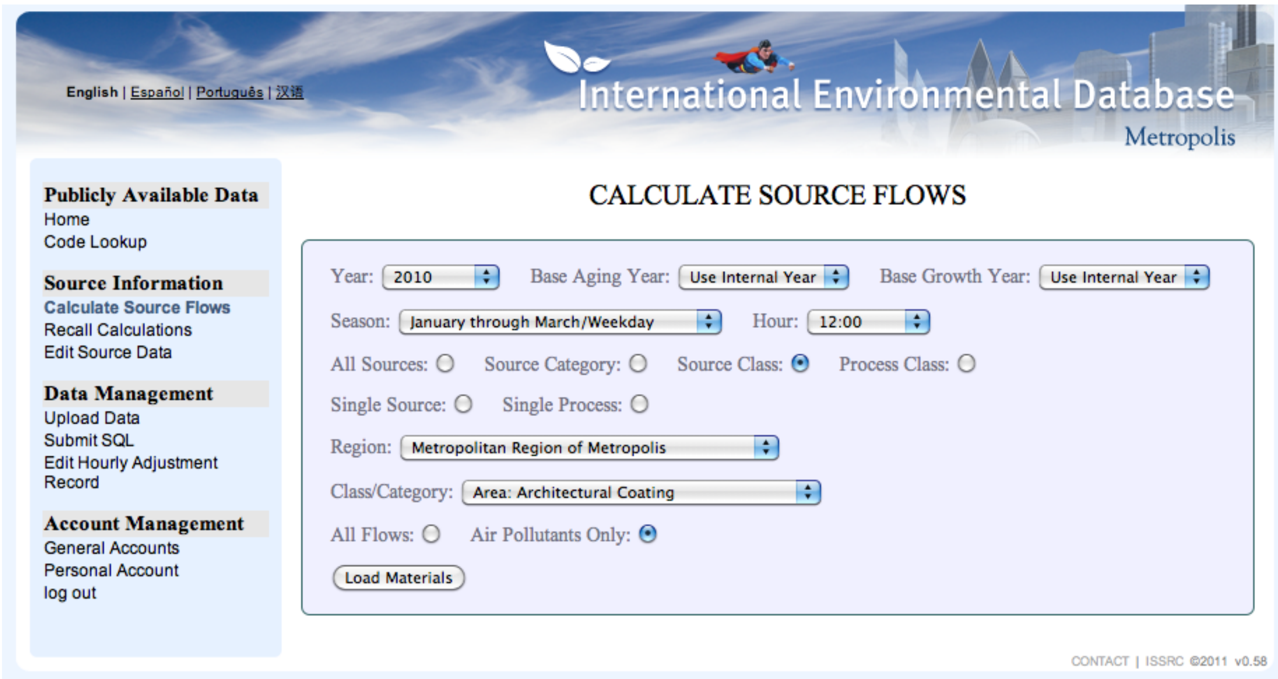


Figure 4.3-2: Second Step in Flow Calculation Process

This leads to a push button shown on line eight of Figure 4.3-2 above labeled "Load Materials". Clicking on this button will create a drop-down menu with all the flows that are available for the source or process or the sources or process selected with the preceding radio buttons. The user should select the flow that is to be calculated from the drop-down menu designated as "Calculate".

Once the preceding steps have been completed, a "Calculate" and "Batch" button will appear. Clicking on the calculate button will normally start the calculation process. However, the IED allows the user to set up calculation scenarios where different types of sources (maybe better controlled sources) can be used to replace existing sources. If these potential calculation scenarios are in the database, then a small window opens showing the allowable scenarios. The checkbox beside a scenario can be selected so that the indicated scenario is included in the calculation. If no scenarios exist or none are selected, then the calculation that results is often called the "base case" calculation. It is also possible to save a calculation for later and then do several calculations over lunch or over night. This is done by creating a batch. Once started, the batch calculation will calculate all of the calculations indicated in the batch file and store them to the server to be reviewed using the Recall Calculations page. Figure 4.3-3 indicates the appearance of the Calculation Page at this stage of the process:

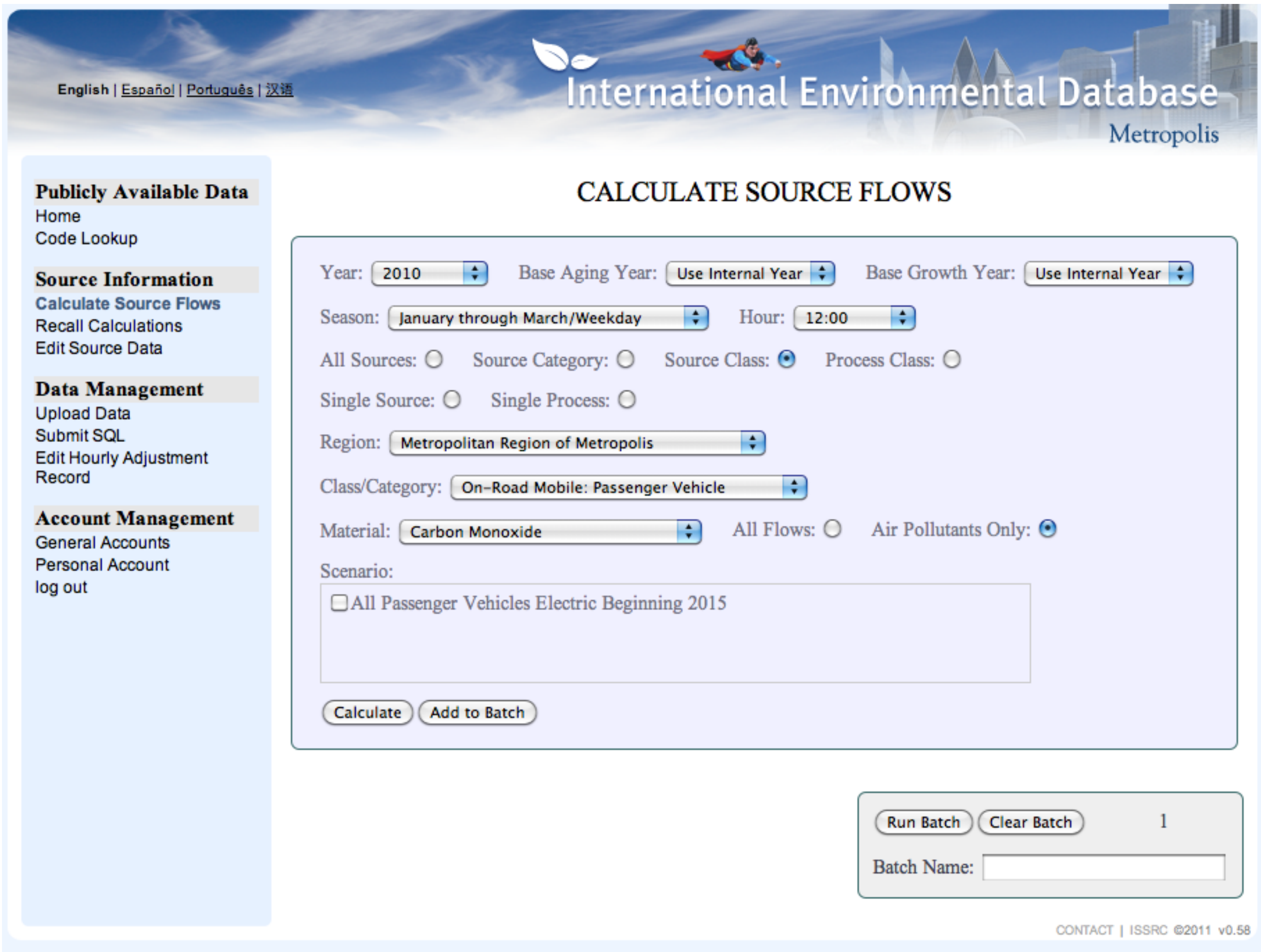
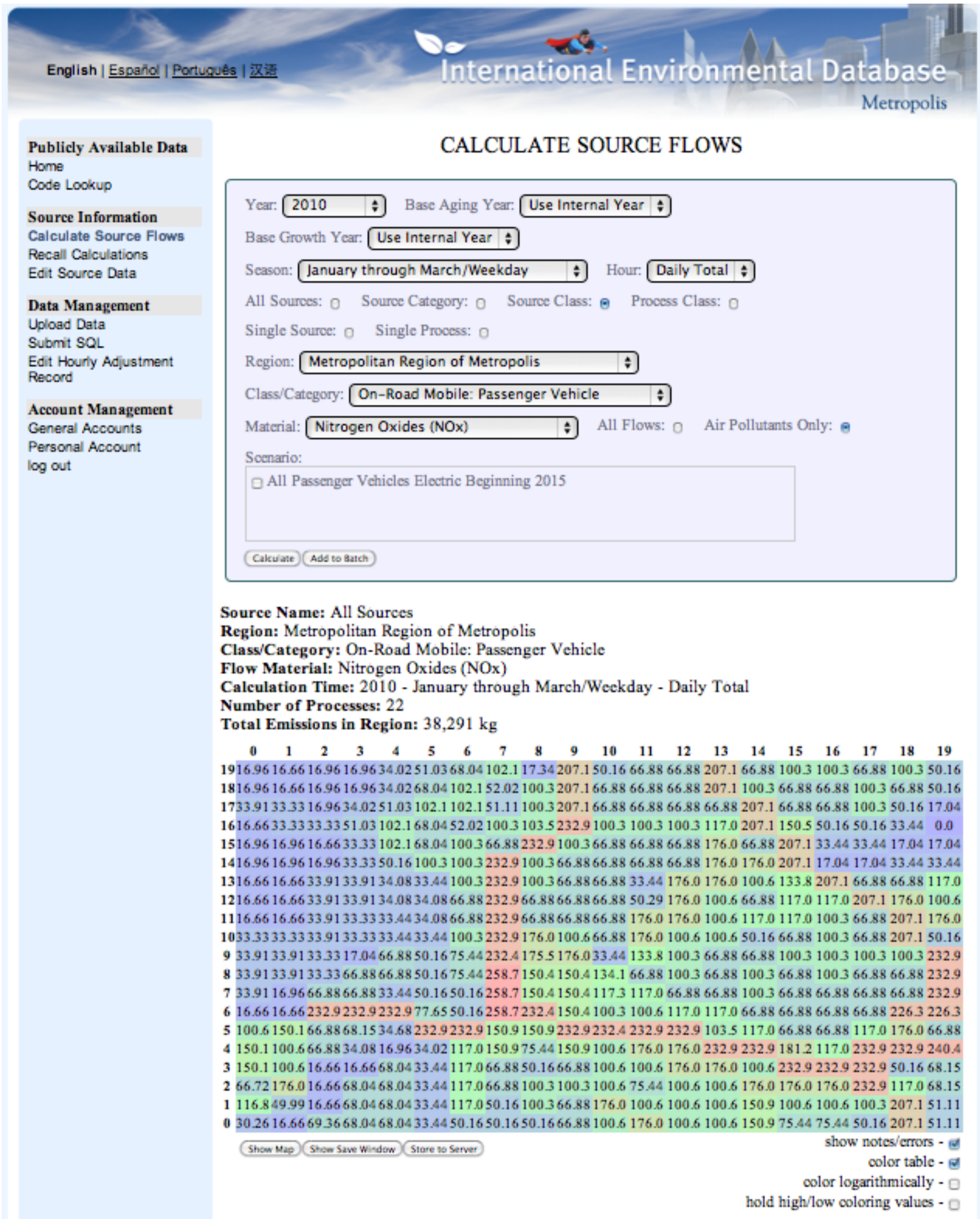


Figure 4.3-3: Third Stage of Calculation Process

Figure 4.3-4 below shows the resulting window from a calculation for Metropolis. As can be seen, the calculation produced a grid showing the emissions from passenger vehicles associated with each 1km by 1km grid in the region. The colors in the grid indicate the intensity of emissions. Red indicates higher emissions and green/blue indicate lower emissions.

Below the grid are two push buttons. Clicking the button called "Show Map" will produce a map of the region covered with the colors that indicate the level of emissions. The actual value associated with a color can be seen in the map by putting the mouse arrow over the color. Clicking on the button called "Show Save Window" produces a window where the information can be selected and then copied. This information can then be pasted into Excel or a text document to save the results of the calculation. The map can also be captured by copying the screen using the Grab program on a Mac or the PrtScn button on a windows machine.



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
19	16.96	16.66	16.96	16.96	34.02	51.03	68.04	102.1	17.34	207.1	50.16	66.88	66.88	207.1	66.88	100.3	100.3	66.88	100.3	50.16
18	16.96	16.66	16.96	16.96	34.02	68.04	102.1	52.02	100.3	207.1	66.88	66.88	66.88	207.1	100.3	66.88	66.88	100.3	66.88	50.16
17	33.91	33.33	16.96	34.02	51.03	102.1	102.1	51.11	100.3	207.1	66.88	66.88	66.88	66.88	207.1	66.88	66.88	100.3	50.16	17.04
16	16.66	33.33	33.33	51.03	102.1	68.04	52.02	100.3	103.5	232.9	100.3	100.3	100.3	117.0	207.1	150.5	50.16	50.16	33.44	0.0
15	16.96	16.96	16.66	33.33	102.1	68.04	100.3	66.88	232.9	100.3	66.88	66.88	66.88	176.0	66.88	207.1	33.44	33.44	17.04	17.04
14	16.96	16.96	16.96	33.33	50.16	100.3	100.3	232.9	100.3	66.88	66.88	66.88	66.88	176.0	176.0	207.1	17.04	17.04	33.44	33.44
13	16.66	16.66	33.91	33.91	34.08	33.44	100.3	232.9	100.3	66.88	66.88	33.44	176.0	176.0	100.6	133.8	207.1	66.88	66.88	117.0
12	16.66	16.66	33.91	33.91	34.08	34.08	66.88	232.9	66.88	66.88	66.88	50.29	176.0	100.6	66.88	117.0	117.0	207.1	176.0	100.6
11	16.66	16.66	33.91	33.33	33.44	34.08	66.88	232.9	66.88	66.88	66.88	176.0	176.0	100.6	117.0	117.0	100.3	66.88	207.1	176.0
10	33.33	33.33	33.91	33.33	33.44	33.44	100.3	232.9	176.0	100.6	66.88	176.0	100.6	100.6	50.16	66.88	100.3	66.88	207.1	50.16
9	33.91	33.91	33.33	17.04	66.88	50.16	75.44	232.4	175.5	176.0	33.44	133.8	100.3	66.88	66.88	100.3	100.3	100.3	100.3	232.9
8	33.91	33.91	33.33	66.88	66.88	50.16	75.44	258.7	150.4	150.4	134.1	66.88	100.3	66.88	100.3	66.88	100.3	66.88	66.88	232.9
7	33.91	16.96	66.88	66.88	33.44	50.16	50.16	258.7	150.4	150.4	117.3	117.0	66.88	66.88	100.3	66.88	66.88	66.88	66.88	232.9
6	16.66	16.66	232.9	232.9	232.9	77.65	50.16	258.7	232.4	150.4	100.3	100.6	117.0	117.0	66.88	66.88	66.88	66.88	226.3	226.3
5	100.6	150.1	66.88	68.15	34.68	232.9	232.9	150.9	150.9	232.9	232.4	232.9	232.9	103.5	117.0	66.88	66.88	117.0	176.0	66.88
4	150.1	100.6	66.88	34.08	16.96	34.02	117.0	150.9	75.44	150.9	100.6	176.0	176.0	232.9	232.9	181.2	117.0	232.9	232.9	240.4
3	150.1	100.6	16.66	16.66	68.04	33.44	117.0	66.88	50.16	66.88	100.6	100.6	176.0	176.0	100.6	232.9	232.9	232.9	50.16	68.15
2	66.72	176.0	16.66	68.04	68.04	33.44	117.0	66.88	100.3	100.3	100.6	75.44	100.6	100.6	176.0	176.0	176.0	232.9	117.0	68.15
1	116.8	49.99	16.66	68.04	68.04	33.44	117.0	50.16	100.3	66.88	176.0	100.6	100.6	100.6	150.9	100.6	100.6	100.3	207.1	51.11
0	30.26	16.66	69.36	68.04	68.04	33.44	50.16	50.16	50.16	66.88	100.6	176.0	100.6	100.6	150.9	75.44	75.44	50.16	207.1	51.11

Figure 4.3-4: Calculation Page Showing a completed calculation for the class Space Heating

The colors generated for the map or for the grid are generated automatically. However, if the user wishes to freeze the colors so that a subsequent calculation for example with air pollution controls included or for emissions in the future to be consistent with the base case, then the "hold high/low coloring values" check box can be selected after the base case calculation. This will freeze the colors as displayed in the base case to allow a visual comparison of emission changes.

There are also options of maps that can be shown with the data overlaid over the map. Figure 4.3-5 shows the result of the preceding data laid over a map.

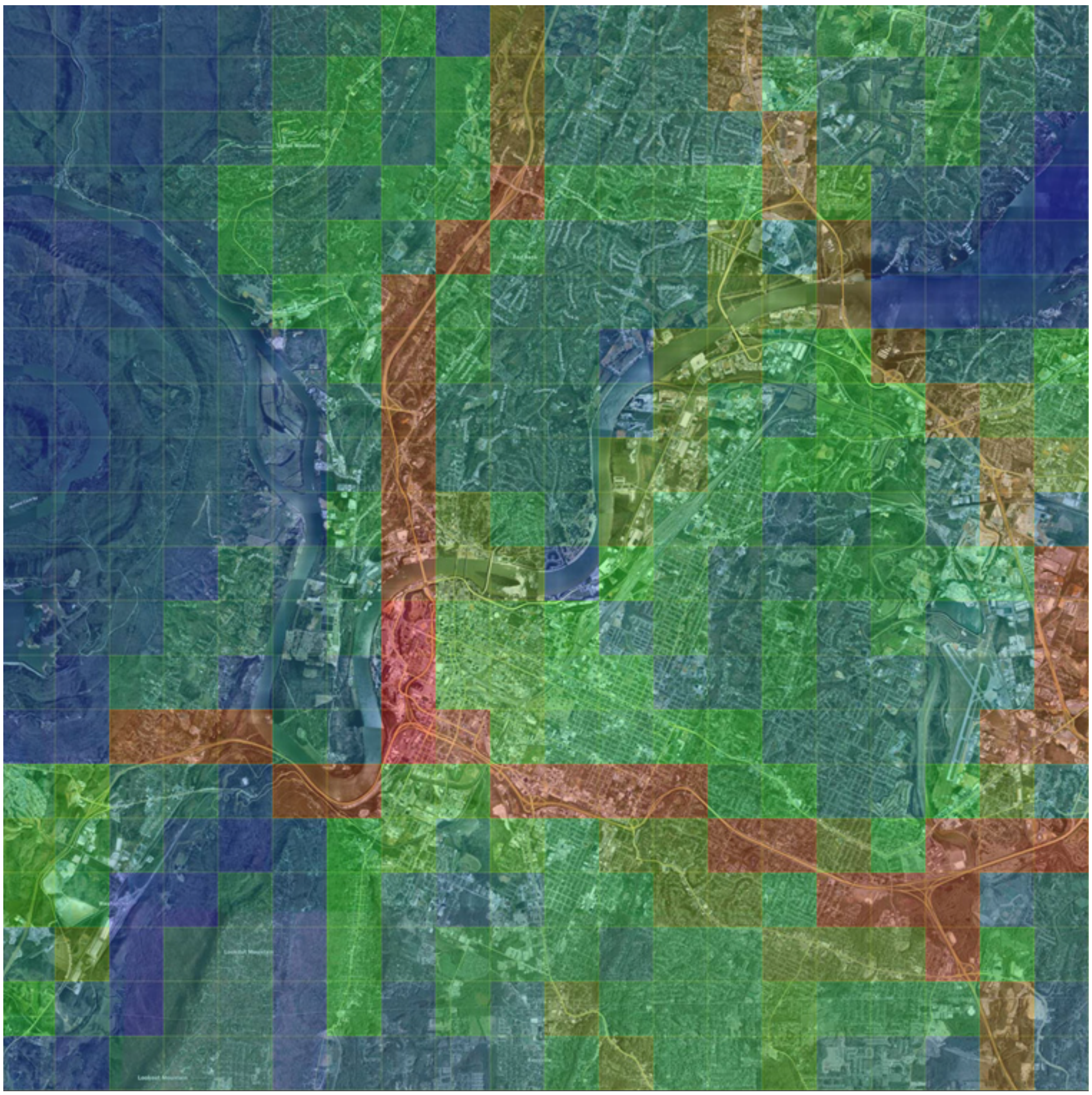


Figure 4.3-5: Calculation Results Laid Over a Map of the Region

Once saved, the calculation results can be recalled and shown on top of various maps stored in the system.

Section 4.4: Recall Calculations

Because calculations of emissions can take a considerable amount of time when many sources and large numbers of grids are involved, the IED provides a way to both store calculations and to run calculations in batches through the night. The results of a single calculation can be stored to the server and reviewed later while the results of a batch calculation are automatically stored to the server. The Recall Calculations page allows the user to recall the results of saved calculations. Figure 4.4-1 illustrates the results of accessing the Recall Calculations page in the case where two sets of calculations have been stored to the server.

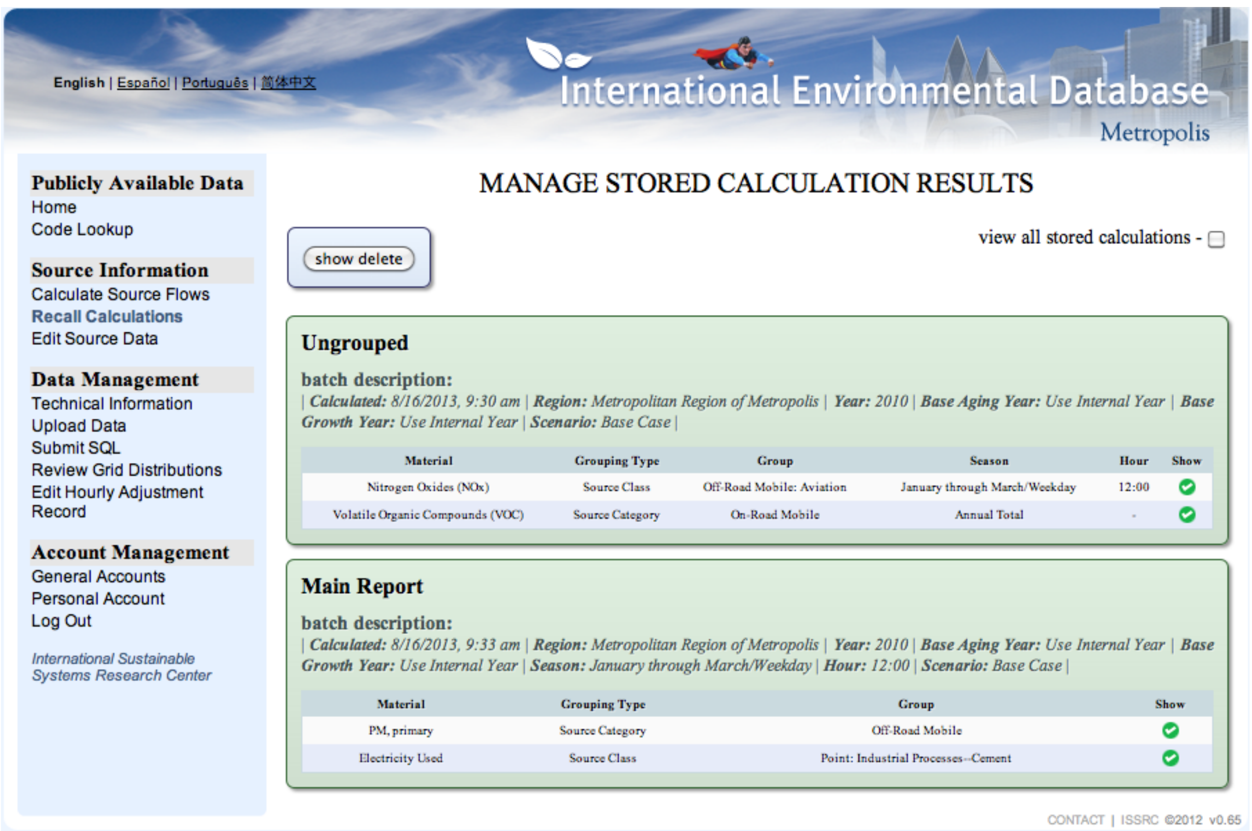


Figure 4.4-1: Results of Selecting the Recall Calculations Page

Information on the saved calculations is shown inside of green boxes. The upper box includes information on calculations that were saved individually by the user. The lower box shows calculations that were saved in a batch calculation process titled "Main Report". The results of these calculations can be reviewed by clicking on the green arrows to the right of each calculation.

For a user with the appropriate permission setting, a check box at the top right side of the page will be visible which allows the user to see calculations run and stored by other users. If this box is checked, all users' stored calculations are shown.

Clicking the "show delete" button on the top left side of the page opens a delete window that can be used to delete calculations from the server as desired. Calculations can be deleted by the time since they were made or by individually clicking the red "x" that appears to the left of each calculation.

Section 4.5: Edit Source Data

The Edit Source Data page is provided to add, delete, and edit source related data. A source consists of basic source information plus process information plus process flow information. For adding extensive source data to the IED, it is probably best to use the Upload Data page, however, for making limited additions or modifications, the Edit Source Data page can be very useful.

When initially accessing the Edit Source Data page, a source box is provided containing a list of all of the sources in the present database that the users may edit. Figure 4.5-1 shows the initial page for the fictitious city of Metropolis with the source box.

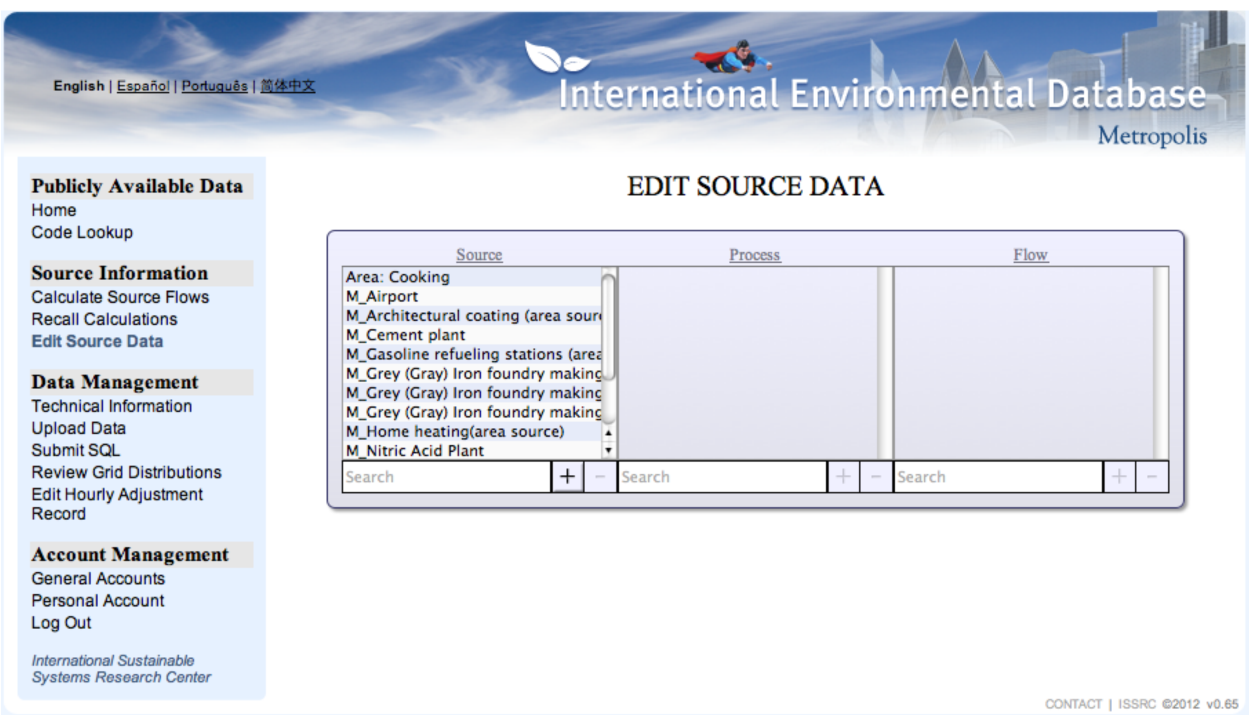


Figure 4.5-1: Initial Edit Source Data Page

A source can be selected in the source box by clicking on the source name. A source can be deleted by selecting the source name and then clicking on the "-" at the bottom of the source column in the box. When deleting a source, the user will be provided with a red warning box where the delete process can be cancelled. Once a source is deleted, the process cannot be reversed! A source can also be added on this page, if the user has the authority to add sources, by clicking on the "+" at the bottom of the source column in the source box. Sources can also be searched for by entering part of the source name in the search edit box at the bottom of the source column in the box.

When a source is selected, all of the data in the IED source table is provided. Also, all processes associated with this source are shown in the column to the right of the source column. The processes and process flows associated with a source are referred to as the "children" of the source and the process flows are the "children" of the process they are associated with. When a source is deleted all of its "children" are deleted as well. Figure 4.5-2 shows the top part of the source edit page with the airport selected. (The lower portion of the page is left out to save space.)

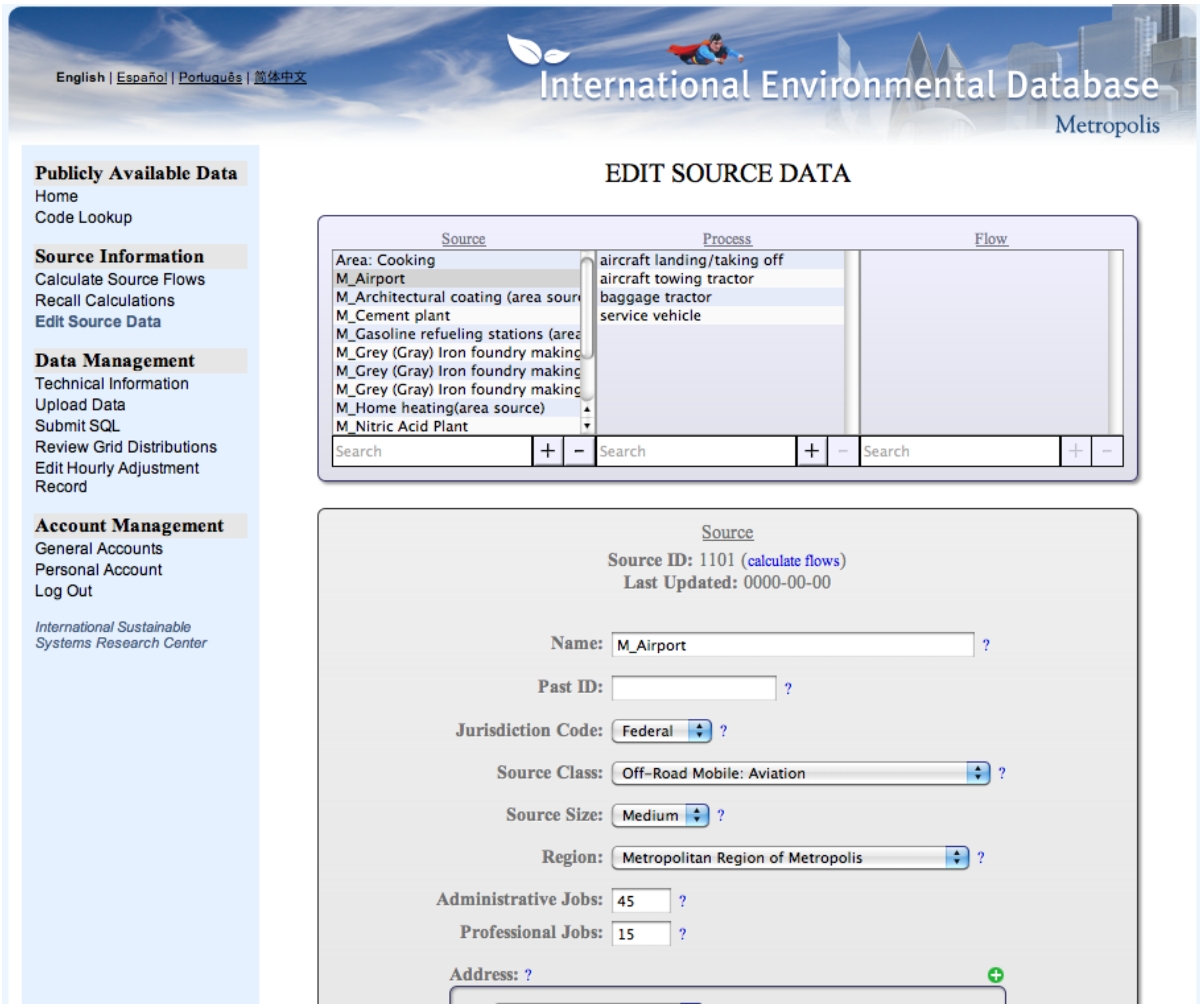


Figure 4.5-2: Top Part of Edit Source Data Page With Source Selected

The question marks to the right of the edit boxes and dropdown menus can be clicked on to get information about editing or adding data. The green circle at the bottom right of Figure 4.5-2 can be used to add addresses for the source. A source can have more than one address. In cases where more than one set of data can be added, the green circle is provided.

If one of the processes names listed in the middle (process) section of the source box is selected, then the information for the process is shown below the source box. An example of a process selected is shown in Figure 4.5-3. As with Figure 4.5-2, part of the page is cut off to save space.

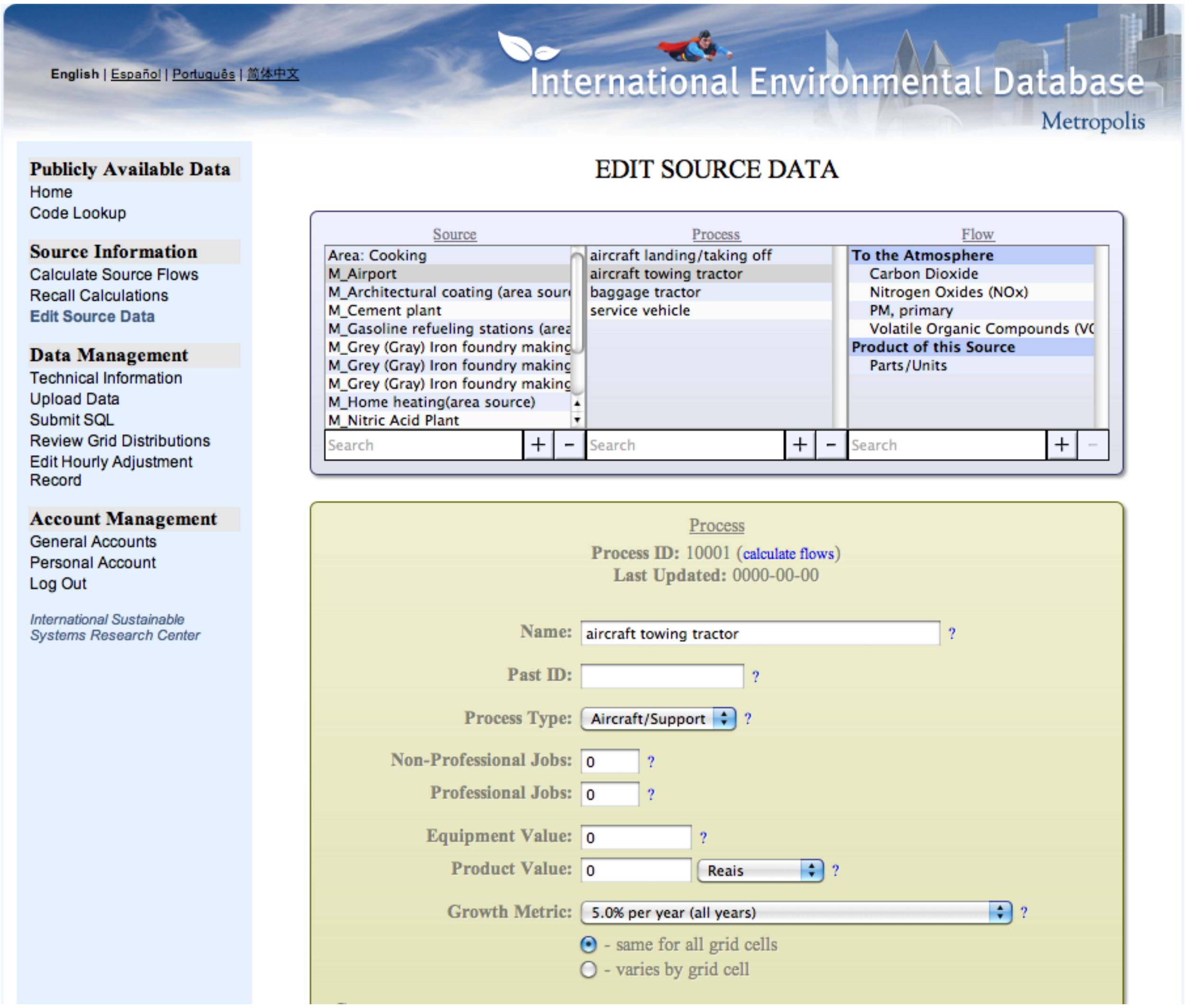


Figure 4.5-3 Top Part of Edit Source Page with Process Selected

With a process selected, the information related to the process is provided and the process flows associated with the process are shown on the right side of the source box. Editing is the same as the case for the source data. The user can click on the blue "calculate flows" text to enter a calculation process for this process. If a process flow name is selected then the information related to the process flow is presented below the source box.

Section 4.6: Technical Information

The technical information page is provided to make available information related to the IED. The information can be downloaded by clicking on the green check mark to the right of an item on the list.

Section 4.7: Upload Data

Purpose of webpage

One of the main challenges of working with a database system is getting data into the system. Uploading data can be very difficult if the user does not have the right tools to perform this task. In some cases, data can be loaded into the database through the use of specific interface pages, such as the input of data for sources and their associated processes and flows. As an alternative to this option, an interface page was developed that can upload data to any IED table after it has been formatted in a spreadsheet program such as Excel. This page was developed in order to provide a method for the experienced user to get data into the database quickly. <u>This data upload program allows free access to the IED and can cause severe damage to the database if used by an untrained person.</u> The page interface is shown in Figure 4.7-1.

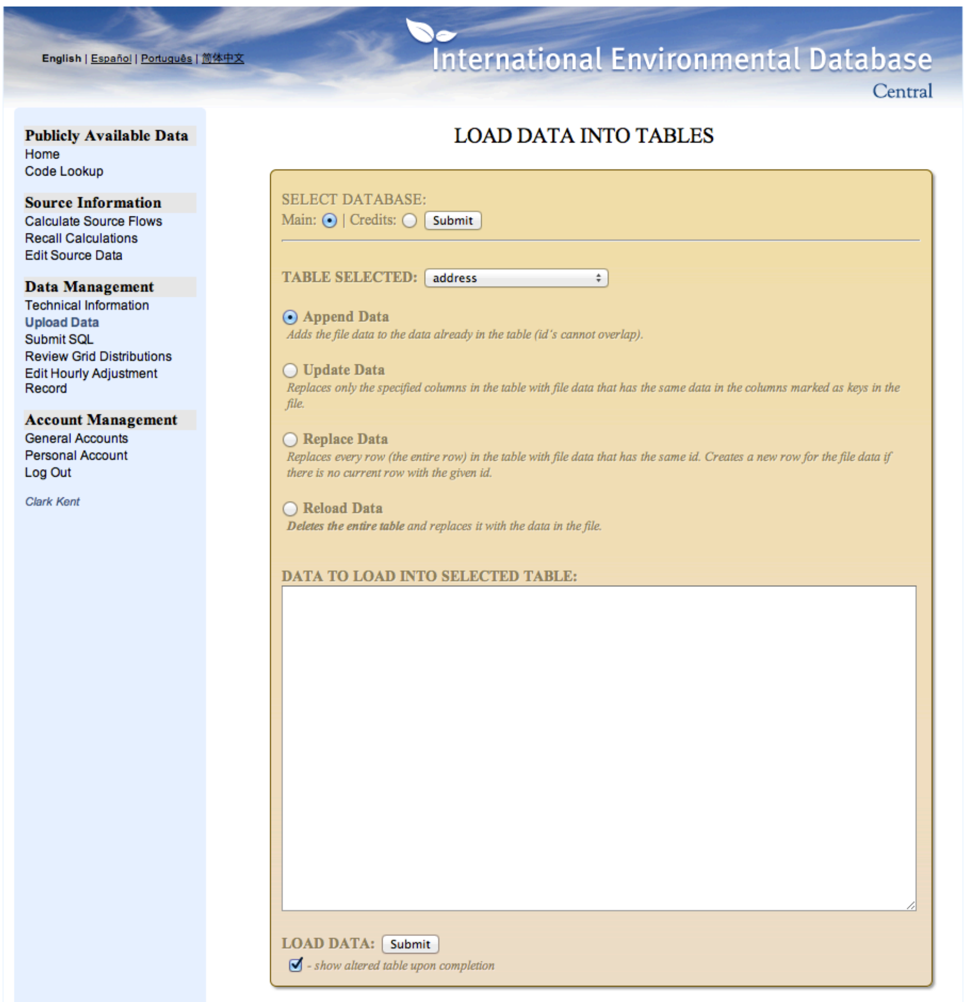


Figure 4.7-1: Data Load Webpage

This page serves as a tool where data can be easily uploaded to the database. Using it the users can Append Data, Update Data, Replace Data and Reload Data. Following are descriptions of each command used on the Upload Data page.

Data Load Webpage Description

As shown on Figure 4.7-1 the Upload Data page includes, from top to bottom, a *Table Selected* dropdown menu, a *Command List* where the user can select the command to be perform and an *Input Area* to load the data.

Table Selected
This dropdown menu is where the user must select the table in which the data will be uploaded. Care must be taken to chose the correct table otherwise data may be damaged.

Command List
On the *Command List* the user can select the command that he wants to be perform with the data that will be uploaded. There are 4 options that are described below.

- ***Append Data***: This command will add the new data to the data already in the table. ID's cannot overlap. If there is an overlap (i.e. the new key field is identical to an existing key field), the data will be rejected and an error message will be produced. This command is usually used to add new data to the database, it will not delete the existing information.
- ***Update Data***: Replaces only the specified columns in the table with file data that has the same data in the columns marked as keys in the file. This command is used to add more information to the data that already exist in the database, how to define the key column will be discussed later in this document. For example, if the data is incomplete on one of its columns this command can be used to complete the data.
- ***Replace Data***: Replaces every row (the entire row) in the table with file data that has the same key field (ID). Creates a new row for the file data if there is no current row with the given ID. This command is used to replace an entire row. Care must be taken to choose the correct ID otherwise data can be lost.
- ***Reload Data***: Deletes the entire table and replaces it with the data in the file. This command must be used only if user wants to delete the entire table and include new data, care must be taken to use this command.

Input Area

The user must enter the data to be uploaded into the *Input Area*, normally this command is applied doing a copy and paste command from a spreadsheet or text program, although it can be done by typing into the text box. However, this approach is very cumbersome. The format of the data to be uploaded will be explained later in this document.

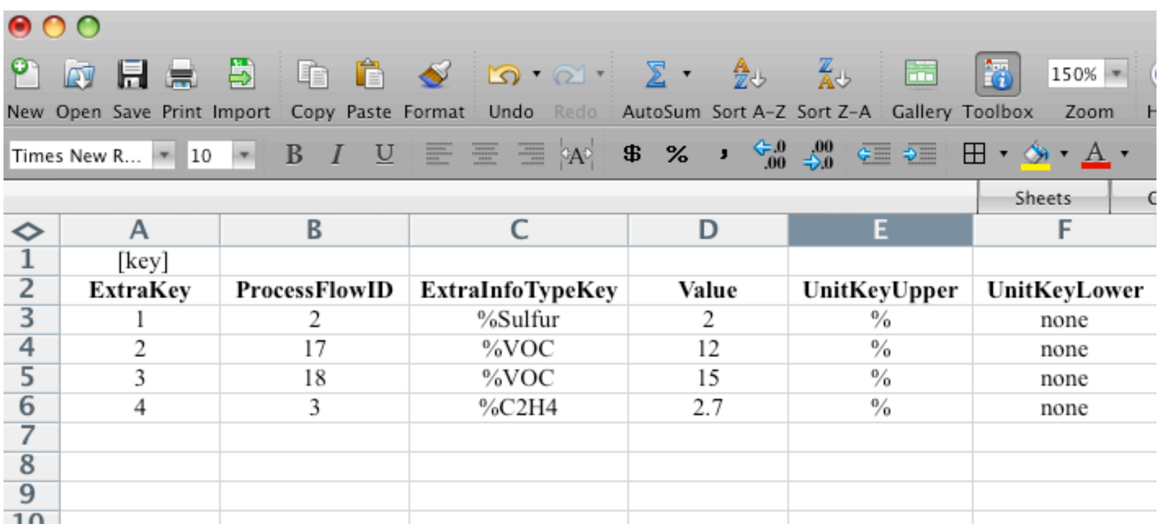
Loading Data

In order to upload the data into the database using the Upload Data webpage the user must follow 3 steps: 1) Set the data format, 2) Define the settings and 3) Upload the data.

Step 1: Data Format

The data to be upload must follow a specific format, the rules to be followed by the user are discussed below:

- The first row will not be included in the upload data, nevertheless it must exist, otherwise the software will skip whatever is in the first row. Also, when the command Update Data is being used, the key column or columns must be marked with the word "*key*" in square brackets ("[key]")[2] on the first row on top of the column selected.
- The second row is the column title row, the names in the second row must match the names on the table where the user want to upload data. The user doesn't necessarily need to include all the columns of the table in the database but the names of the columns that are included will be updated and the data to be updated must exist in the database table selected. If the columns used as keys do not exist in the table then the data will not be updated and an error message will be produced.
- From the third row and beyond, the data to be uploaded should be entered, the only restriction to the data will be the number of characters and the type of input (char, varchar, date, etc.). A description of each table can be found in appendix A.



	A	B	C	D	E	F
1	[key]					
2	ExtraKey	ProcessFlowID	ExtraInfoTypeKey	Value	UnitKeyUpper	UnitKeyLower
3	1	2	%Sulfur	2	%	none
4	2	17	%VOC	12	%	none
5	3	18	%VOC	15	%	none
6	4	3	%C2H4	2.7	%	none
7						
8						
9						

Figure 4.7-2: Example of data to be uploaded on a spreadsheet

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[2] The word "key" is used loosely in this discussion. In SQL, there is normally a column in a table that is designated as the key column. This designation has special meaning in SQL. The word key here does not necessarily mean only the SQL-key column. Any column can be designated with the [key] statement and will be used by the Update process to help select which record or records are to be updated.

Step 2: Define Settings

Once the data is formatted correctly the user must copy the entire table, including row 1, row 2, and the rest of the rows and paste it onto the Input Area.

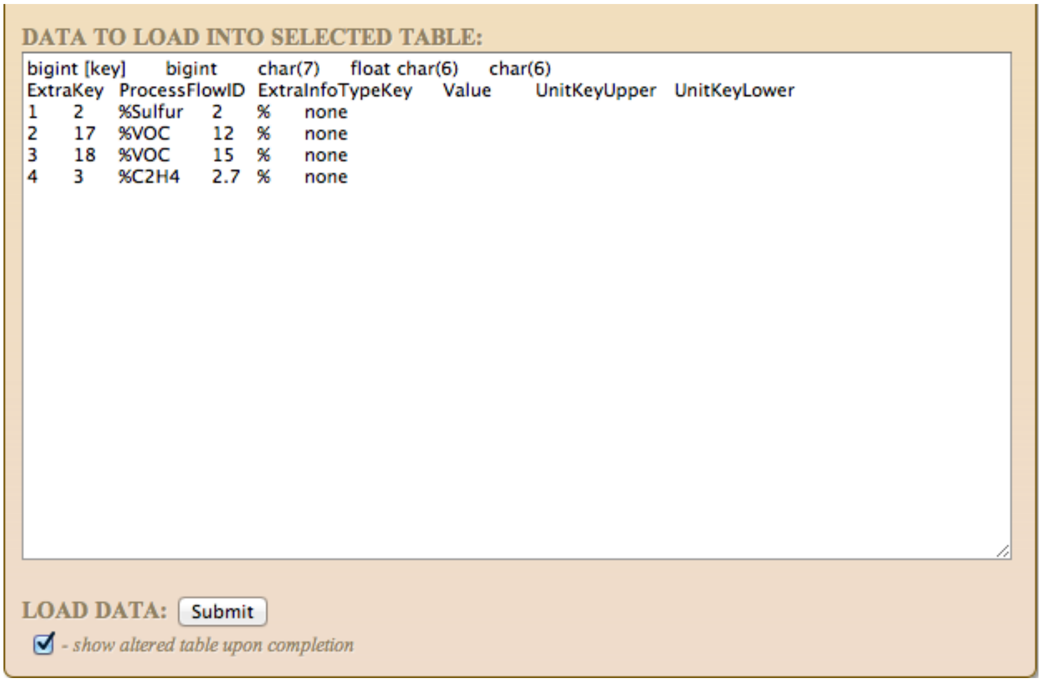


Figure 4.7-3: Example of data on the Input Area

Then the user must select the table where the data will be uploaded from the *Table Selected* dropdown menu and also select one of the commands on the *Command List*.

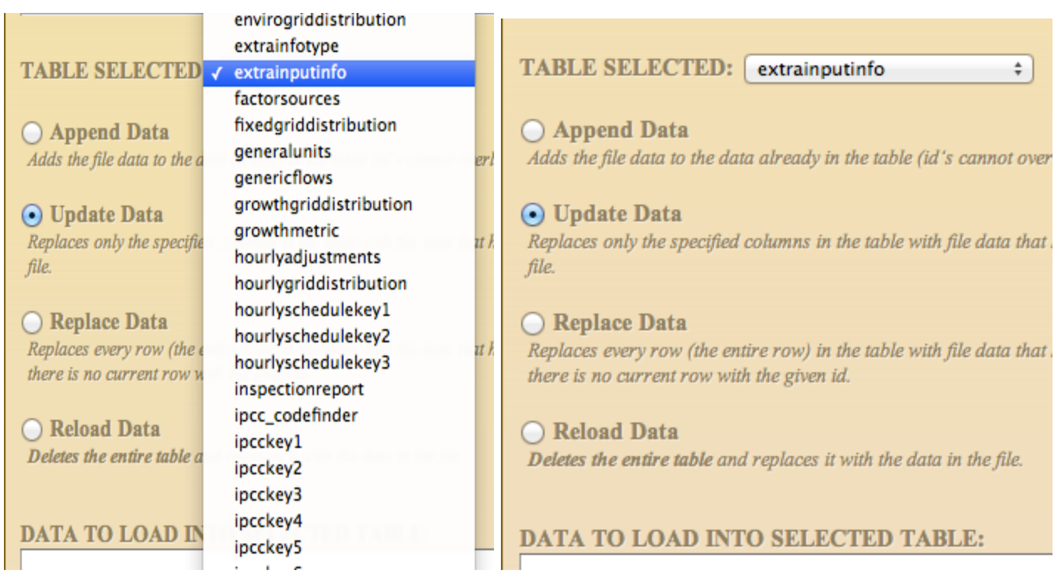


Figure 4.7-4: Example of selected table (left) and selected Command (right)

Step 3: Upload Data (Submit)

Finally, after the selection the user must click the submit button (located below the *Input Area*), if the uploading process was successful the table will be shown at the bottom of the page (Figure 4.7-5), if the uploading process was unsuccessful an error message will appear before the table. *Note: a check box is provided to prevent the output of the resultant table. This can be useful when very large sets of data are being uploaded.*

Table: extrainputinfo
number of rows: 4

row	ExtraKey	processFlowID	ExtraInfoTypeKey	Value	UnitKeyUpper	UnitKeyLower
1	1	2	%Sulfur	2	%	none
2	2	17	%VOC	12	%	none
3	3	18	%VOC	15	%	none
4	4	3	%C2H4	2.7	%	none

Figure 4.7-5: Data Table Upload to the Database

Section 4.8: Submit SQL

Purpose of interface

This page is designed for the user to submit SQL commands directly to the database. Much care must be taken when using this interface since some or all of the information and design of the database system can be damaged or altered using this page. Normally, only the administrator and key developers are given access to this page.

Any MySQL command may be entered on this webpage. The command will be executed and the result (if any exists) displayed. As noted in the preceding paragraph, this is a dangerous webpage! Tables can be destroyed. Even the whole database can be damaged. Thus, care must be taken in the use of this webpage.

View of webpage

Below is a view of the webpage.

Figure 4.8-1: SQL Index Webpage

The following sections describe the elements of the webpage.

Selection of Database

Below the words "SUBMIT QUERY" there are three radio buttons named "Main", "Credits", and "Privileges". These refer to the three databases that are included with the IED. The "Main" database holds all of the main inventory data. The "Credits" database holds all of the data related to emission credits. This database is kept separate for security purposes since emission credits can become valuable and care must be taken as to which persons have access to this data. The "Privileges" database holds information about each of the users of the IED and which webpages and databases each user has access to. The SQL commands are the same with each database.

Figure 4.8-2: Database Selection

Input Area

After selection of database, users can start a query.

If users want to look through the database, users can use the key under the *Input Area*. There are two frequently used selections given under the *Input Area*. The 'Show Tables' can be used to show the total number of tables in this database and all the table names, listed in alphabetical order. The button 'Describe Tables' can be used to get further information about all tables, which includes the column name, type and so on. See the diagram marked below.

Figure 4.8-3: Webpage Commands

If users want to operate on specific tables, commands need to be input into the *Input Area*. Users can input single syntax then click the button 'Submit Query' to get the results. Some of the query samples are shown below the *Input Area*.

Also, some frequently asked questions are listed below:

1. How to show all the data in one table?
   SELECT * FROM *tableName*
2. How to show the structure of table, like columns, type, key?
   DESCRIBE *tableName*
3. How to change column type (in this example from signed to unsigned integer)?
   ALTER TABLE *tableName* MODIFY columnName int unsigned
   Or to change a column name and data type:
   ALTER TABLE *tableName* CHANGE COLUMN oldColumnName newColumnName char(7)
   *when you alter any column, do remember to alter the foreign key that referenced this column at the same time.

Section 4.9: Review Grid Distribution

The purpose of this page is to review data that is stored in the grid tables in the IED on the map of the region. The purpose of this is so that the user can see if the data contained in the grid tables makes sense compared to a map of the region. It is, of course, possible to look at the data in the grid tables using SQL commands if your security authorizes you to access the SQL page, but it is often difficult to look at the data in a table and tell if it is reasonable.

Figure 4.9-1 shows the page used to review the grid data.

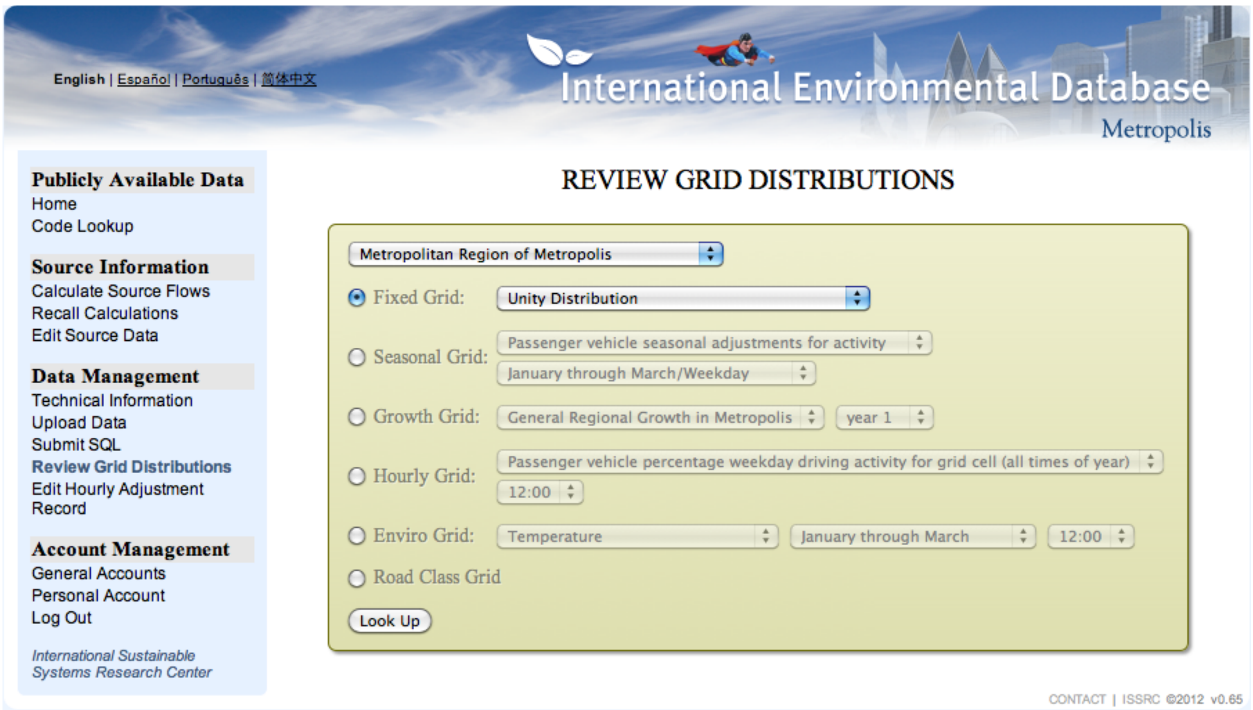


Figure 4.9-1: Grid Table Selection Page for the Review Grid Page

Following this, the user selects the grid table of interest by clicking on the radio circles to the left of the yellow area. When a grid table is selected, a drop-down menu becomes available for that grid table that lists the options (column definitions) for the selected grid table. Once a column is selected, the user should click on the Look Up button at the bottom left of the yellow area. A map will then appear below the yellow rectangle that shows the selected data distributed over a map of the region.

Section 4.10: Edit Hourly and Seasonal Adjustment Tables

TO BE ADDED

Section 4.11: General Accounts

The general accounts page is used to create, edit, and delete IED users. Normally only the IED administrator will have access to this page. Figure 4.11-1 shows the General Accounts page before a user is selected.

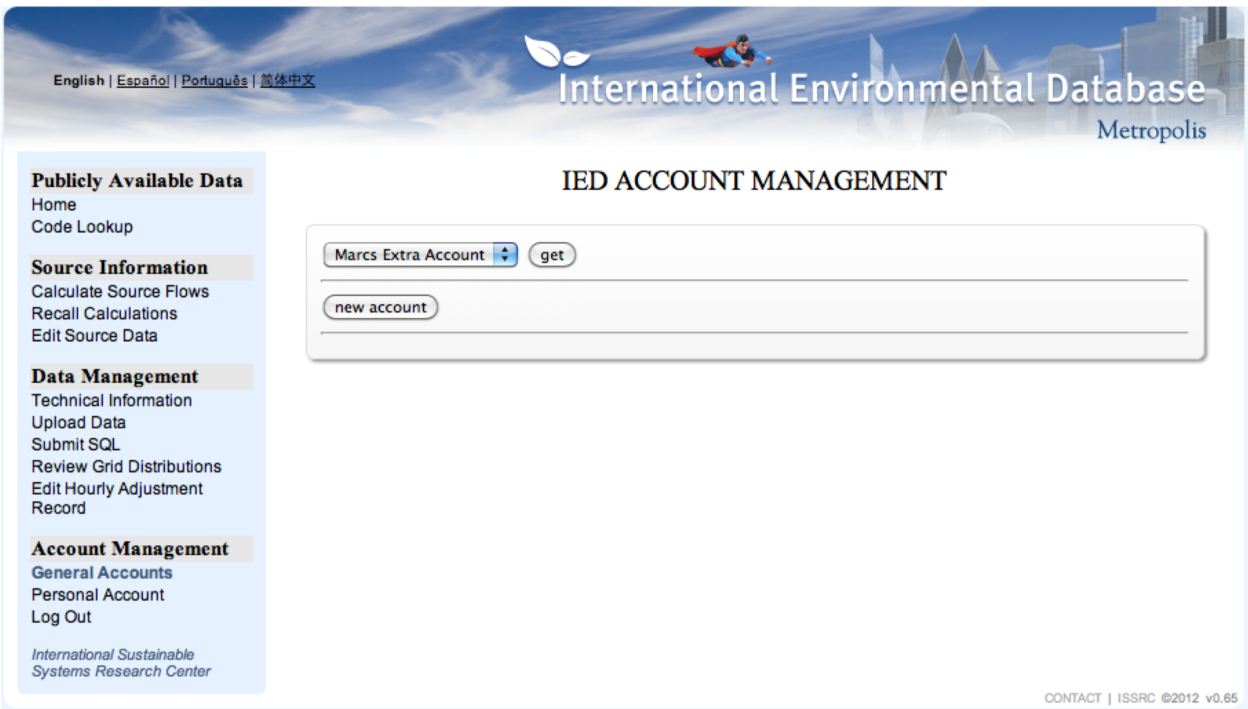


Figure 4.11-1: General Accounts Opening Page

There are two options on this page. The user can select a previously created account and then get that user's data using the "get" button or click on the "new account" button to create a new account. Regardless of the selection, the page will expand allowing the creating, editing, or deletion of the account. The expanded page is shown in Figure 4.11-2. In the case of creating a new account, a smaller menu is produced from entering the account name and other information plus sending an email to the holder of the account notifying them of the formation of the account.

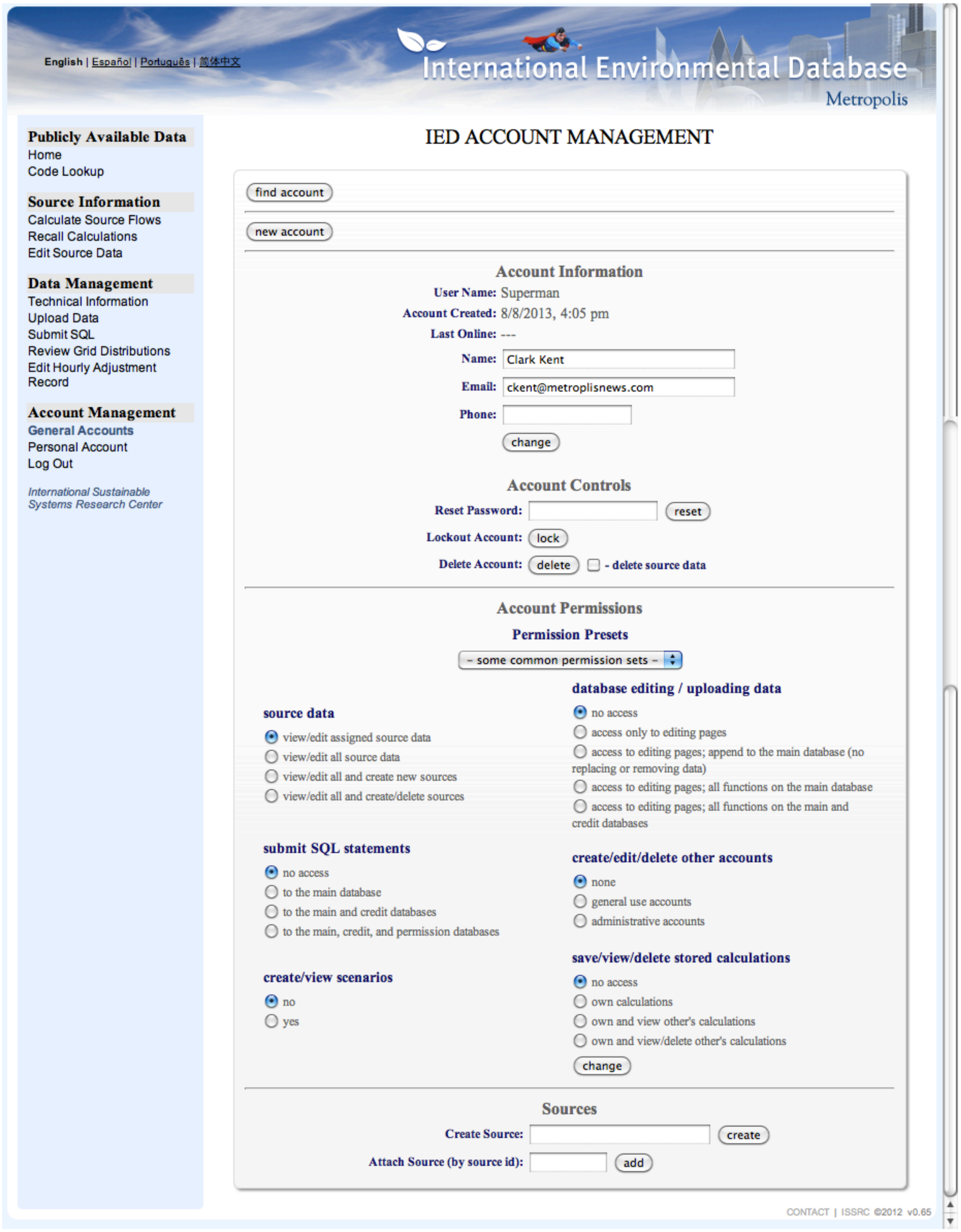


Figure 4.11-2: General Accounts Page Expanded

Once the page is expanded, the user name can be entered or edited along with an email address and other relevant information. In all cases, the "change" button is used to store the data. The account can be locked or deleted in the Account Controls section. At the bottom of the page is the account permissions selection. A standard permissions preset can be selected using the drop-down menu or individual permissions can be set. As noted before, the "change" button is clicked on to save the data.

At the bottom of the page, under the title of Sources, a source can be created and assigned to a user or an existing source can be identified by entering the source id into the "add" edit box. This section is used to restrict an account to a single or limited number of sources for users who are not given "all source" permission. It should be noted that the IED was designed to allow independent industrial users to access and edit just their data to reduce the data management requirements for the group creating the IED. However, there are some additional considerations if this approach is to be taken.

Section 4.12: Personal Account

The personal account page is provided for the user to edit their own account information. The user should modify the information in the appropriate edit field, provide their password and click on the change button. Figure 4.12-1 shows the Personal Account page.

Figure 4.12-1: Personal Account Page

Section 4.13: Logout

The “log out” function appears in the left side menu below the rest of the interface links. Log out is not a page itself, but rather a way to exit your IED account. Logging out is recommended when using a shared computer. For security reasons, an account will be automatically logged out after a set period of time elapses with no activity or with a change of I.P. address (i.e. a computer is moved from an office network to a home network).

Appendices

<u>Appendix A</u>

Description of IED Tables

The IED contains 89 tables in the primary database. These tables are used to store a variety of information that relates to emission sources and how they operate; plus, they contain information related to enforcement of regulations and the exchange of credits.

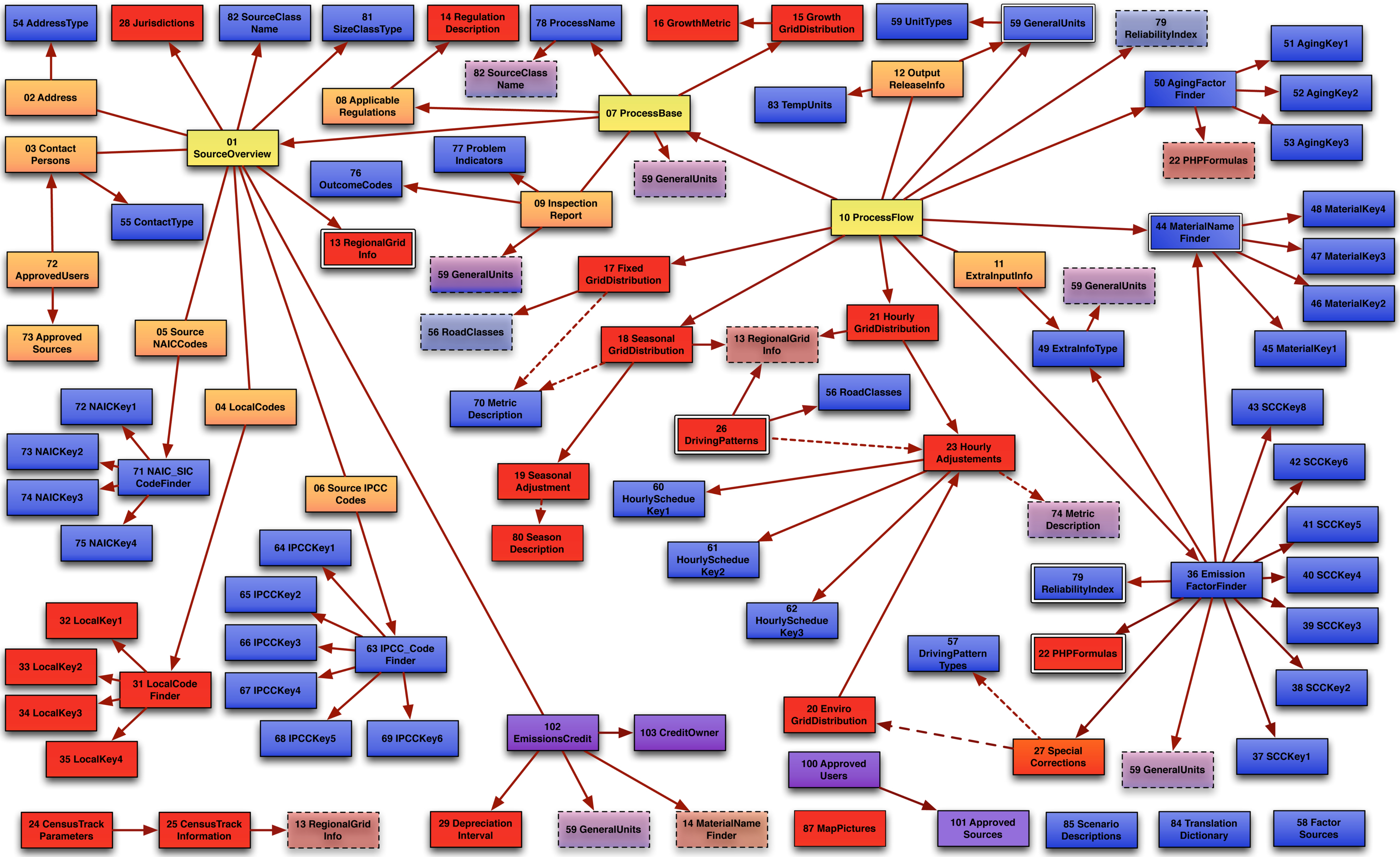
A color syntax has been used at the top of each table description to be a general indicator of the type of information contained in the table. This color syntax is indicated in Table A.1-1.

Table A.1-1: Color Syntax used in the IED Table Descriptions

Table Header Colors
Tables with yellow header (as this line is) are the core source data tables that will be referenced often.
Tables with a gold header color (as this line is) are extensions of the core tables.
Tables with a red header (as this line is) contain data related to the local regions.
Tables with a blue header (as this line is) are important data tables that contain general data that hopefully can be kept consistent in all locations.
Column Definition Colors
The table columns colored brown (as this line is) contain values found in other IED tables. These are often referred to as “foreign keys” although they are not maintained in the database with the typical foreign key constraints.
The table columns colored green (as this line is) are what is known as a "primary key". A primary key is a way to identify each row in a data table. The primary keys must be unique and the database will not allow duplicate values in a primary key column.

The following pages provide a brief description of each table in the database.

Index of Tables


54 AddressType
28 Jurisdictions
82 SourceClass Name
81 SizeClassType
14 Regulation Description
78 ProcessName
16 GrowthMetric
15 Growth GridDistribution
59 UnitTypes
59 GeneralUnits
79 ReliabilityIndex
51 AgingKey1
02 Address
82 SourceClass Name
08 Applicable Regulations
07 ProcessBase
12 Output ReleaseInfo
83 TempUnits
50 AgingFactor Finder
52 AgingKey2
53 AgingKey3
22 PHPFormulas
03 Contact Persons
01 SourceOverview
77 Problem Indicators
76 OutcomeCodes
09 Inspection Report
59 GeneralUnits
10 ProcessFlow
44 MaterialName Finder
48 MaterialKey4
47 MaterialKey3
46 MaterialKey2
45 MaterialKey1
55 ContactType
13 RegionalGrid Info
59 GeneralUnits
17 Fixed GridDistribution
11 ExtraInputInfo
59 GeneralUnits
72 ApprovedUsers
73 Approved Sources
05 Source NAICCodes
56 RoadClasses
18 Seasonal GridDistribution
13 RegionalGrid Info
21 Hourly GridDistribution
49 ExtraInfoType
72 NAICKey1
04 LocalCodes
70 Metric Description
56 RoadClasses
43 SCCKey8
26 DrivingPatterns
23 Hourly Adjustements
73 NAICKey2
71 NAIC_SIC CodeFinder
74 NAICKey3
75 NAICKey4
06 Source IPCC Codes
19 Seasonal Adjustment
80 Season Description
60 HourlySchedue Key1
42 SCCKey6
74 Metric Description
41 SCCKey5
64 IPCCKey1
61 HourlySchedue Key2
79 ReliabilityIndex
36 Emission FactorFinder
40 SCCKey4
65 IPCCKey2
32 LocalKey1
66 IPCCKey3
63 IPCC_Code Finder
62 HourlySchedue Key3
39 SCCKey3
57 DrivingPattern Types
22 PHPFormulas
33 LocalKey2
31 LocalCode Finder
67 IPCCKey4
38 SCCKey2
34 LocalKey3
20 Enviro GridDistribution
68 IPCCKey5
69 IPCCKey6
102 EmissionsCredit
103 CreditOwner
27 Special Corrections
37 SCCKey1
35 LocalKey4
100 Approved Users
59 GeneralUnits
24 CensusTrack Parameters
25 CensusTrack Information
13 RegionalGrid Info
29 Depreciation Interval
59 GeneralUnits
14 MaterialName Finder
87 MapPictures
101 Approved Sources
85 Scenario Descriptions
84 Translation Dictionary
58 Factor Sources

01	SourceOverview			
4	**SourceID**	int	PK	ID number of the source
50	**SourceName**	varchar(150)		Name of Source
20	**PastSourceID**	varchar(20)		Past ID of the source if needed
5	**JurisdictionCode**	char(5)	FK.28	Government unit that regulates this source
4	**SourceClassKey**	int	FK.82	Indicates the source class this source belongs to
3	**SizeClassCode**	char(3)	FK.81	Indicates the size class of this source
6	**RegionAbbreviation**	char(6)	FK.13	Indicates the region were the source is located
100	**SourceDescription**	text		Describes the source
4	**InitialAddition**	date		Date when source first added to database
4	**AdministrativeJobs**	int		Number of administrative jobs at the source
4	**ProfessionalJobs**	int		Number of professional jobs at the source
4	**RequestForUpdate**	date		The date for a company or agency to update its info
4	**Updated**	date		Date this information was updated
1	**Status**	char(1)		The Status of completion of the row (X,I,C) [currently u

02	Address			
4	**SourceID**	int	FK.01	Source that this address is associated with
45	**Street1**	varchar(90)		Source number and street
45	**Street2**	varchar(90)		Additional street or building information
20	**City**	varchar(30)		Address city
20	**State**	varchar(30)		Address state/province
10	**PostalCode**	varchar(20)		Address postal code
15	**Country**	varchar(30)		Address county
3	**AddressTypeCode**	char(3)	FK.54	Address type code such as Headquarters, plant, etc.

03	ContactPersons			
4	**SourceID**	int	FK.01	Source that this contact is associated with
30	**LastName**	varchar(40)		Contact last name
30	**FirstName**	varchar(40)		Contact first name
30	**Email**	varchar(40)		Contact email address
24	**Telephone**	varchar(24)		Contact telephone number
24	**AltTelephone**	varchar(24)		Contact alternate telephone number
50	**Street1**	varchar(90)		Contact street address
50	**Street2**	varchar(90)		Additional street or building information
25	**City**	varchar(40)		Contact city
25	**State**	varchar(40)		Contact state
15	**PostalCode**	varchar(20)		Contact postal code
20	**Country**	varchar(40)		Contact county
100	**Comments**	text		Provided for any needed comments
25	**ContactPosition**	varchar(40)		Contact position in the company
3	**ContactTypeCode**	char(3)	FK.55	Contact type code such as environmental director

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4

LocalCodes			
LocalCodeKey	int	PK	ID number for this row of data
SourceID	int	FK.01	The source associated with this Local Code
LocalCode	char(8)	FK.31	The appropriate Local Code for this source
OtherCode	char(8)	FK.31	Place holder for a second local code for this source

SourceNAICCodes			
sourceID	int	FK.01	The source associated with this NAIC code
NAIC_Code	int	FK.71	The appropriate NAIC code for this source

SourceIPCCCodes			
sourceID	int	FK.01	The source associated with this IPCC code
IPCC_Code	char(8)	FK.63	The appropriate IPCC code for this source

ProcessBase			Source this process is included with
ProcessID	int	PK	Unique ID number of this process
SourceID	int	FK.01	Source ID that this process relates to
ProcessNameKey	int	FK.78	Process ID for this process
ProcessName	varchar(60)		Name of this process
PastProcessID	varchar(20)		Place for old process ID if needed
ProcessLatitude	char(10)		Latitude of the process (not for area or mobile)
ProcessLongitude	char(10)		Longitude of the process (not for area or mobile)
GrowthMetricPtr	char(10)	FK.16/15	Column name in GrowthGridDist. tbl or int. pointer
Comments	text		Available for any general comments
TotalEquipmentValue	float		Value of all equipment included in this process
TotalNonProJobs	int		Total non-profession jobs included in process
TotalProJobs	int		Total professional jobs included in process
TotalProductValue	float		Valuc of the product output of this process
UnitKey	char(6)	FK.59	Currency for table monetary data
Updated	date		Date this data was most recently updated
Status	char(1)		The Status of completion of the row (X,I,C)

ApplicableRegulations			
ARKey	int	PK	ID number of this regulatory list
ProcessID	int	FK.07	Process that is associated with this row of data
RegulationCode	char(25)	FK.14	The regulation that applies to this process

InspectionReport			
InspectionIdentifier	bigint	PK	ID number for this inspection
ProcessID	int	FK.07	ID number for the process inspection in this row
InspectionDate	date		Date of this inspection
ProblemCode	int	FK.77	ID code for any problem identified in inspection
EmissionOut	float		Emissions out of this process related to inspection
UnitKeyUpper	char(6)	FK.59	Upper units for emissions out
UnitKeyLower	char(6)	FK.59	Lower units for emissions out
OutcomeCode	char(3)	FK.76	The outcome code for this inspection
Comment	text		Place for any comments related to this inspection
Updated	date		Date this information was most recently updated

10	ProcessFlow			
8	ProcessFlowID	int	PK	ID number for this process flow
8	ProcessID	int	FK.07	Process identifier from Table 07
8	ProcessReceiver	int	FK.07/86	Indicates supplier of input or receiver of output
4	MaterialCode	char(15)	FK.44	Indicates the type of input/output material/energy
27	SCCx_Code	char(35)	FK.36	SCCx code for this process (for emission calc)
8	KeyFlow	int	FK.10	Process flow needed to calculate with emission factor
60	EstimationApproach	varchar(100)		Approach to making this flow estimate
4	Flow	float		Flow value (if "-1" an emission factor is used)
3	UnitKeyUpper	char(6)	FK.59	Units of flow for display
4	GenActivityAdj	float		General activity adjustment for flow calculation
6	FlowBasis	char(6)		Em.Basis (HR,DY,YR)+season+hour (e.g. HRD113)
10	FixedGridColumn	char(10)	FK.17	Column name in FixedGridDistr. tbl or "-1" for pt. src.
10	SeasonalGridPtr	char(10)	FK.19/18/22	Column in SeasonalGridDistr. tbl, int. or formula ptr.
10	HourlyGridSeasonA1Ptr	char(10)	FK.23/21	Column-HourlyGridDistr. tbl or int. pointer/Seas. A1
10	HourlyGridSeasonB1Ptr	char(10)	FK.23/21	Column-HourlyGridDistr. tbl or int. pointer/Seas. B1
10	HourlyGridSeasonC1Ptr	char(10)	FK.23/21	Column-HourlyGridDistr. tbl or int. pointer/Seas. C1
10	HourlyGridSeasonD1Ptr	char(10)	FK.23/21	Column-HourlyGridDistr. tbl or int. pointer/Seas. D1
10	HourlyGridSeasonA2Ptr	char(10)	FK.23/21	Column-HourlyGridDistr. tbl or int. pointer/Seas. A2
10	HourlyGridSeasonB2Ptr	char(10)	FK.23/21	Column-HourlyGridDistr. tbl or int. pointer/Seas. B2
10	HourlyGridSeasonC2Ptr	char(10)	FK.23/21	Column-HourlyGridDistr. tbl or int. pointer/Seas. C2
10	HourlyGridSeasonD2Ptr	char(10)	FK.23/21	Column-HourlyGridDistr. tbl or int. pointer/Seas. D2
4	YearNew	year(4)		Year this flow is considered new for growth calculation
4	FlowStartYear	year(4)		Year this process flow started or will start
4	FlowEndsYear	year(4)		End year for this process flow
4	ReliabilityCode	int	FK.79	Reliability of this flow data
50	Comments	varchar(100)		Reserved for a brief comment
4	Updated	date		Date this process flow was last updated
1	Scenario	char(2)		Flow scenario. Zero (0) indicates base case scenario.
	ReplacedFlow	int	FK.10	Index key for ProcessFlow that this replaces
1	Status	char(1)		The Status of completion of the row (X,I,C) [currently unused]

11	ExtraInputInfo			
8	ExtraKey	bigint	PK	ID number for this extra information
8	ProcessFlowID	int	FK.10	Process flow that this extra info applies too
4	ExtraInfoTypeKey	char(10)	FK.49	The type of information that this is
4	Value	float		The value applied to this information
6	UnitKeyUpper	char(6)	FK.59	The upper unit of this information
6	UnitKeyLower	char(6)	FK.59	The lower unit of this information

12	OutputReleaseInfo			
4	ReleaseID	int	PK	ID number for this release
8	ProcessFlowID	int	FK.10	Process flow number this data applies to
4	ControlEfficiency	float		Efficiency of control equipment (if any) on release
4	ControlCost	float		Cost of control equipment (if any) on this release
6	UnitKeyCost	char(6)	FK.59	Cost units
4	ReleaseHeight	float		Height of release of this flow
6	UnitKeyHeight	char(6)	FK.59	Height units
4	ReleaseVelocity	float		Verticle velocity of this release
6	VelocityUnitKeyUpper	char(6)	FK.59	Upper unit for velocity
6	VelocityUnitKeyLower	char(6)	FK.59	Lower unit for velocity
4	ReleaseTemperature	float		Temperature of this release
2	TempUnitsKey	char(2)	FK.83	Units for the release temperature
4	ApplicableDate	date		Applicable date for this information
4	Updated	date		Most recent date info updated

13	RegionalGridInfo			
6	RegionAbbreviation	char(6)	PK	ID code (abbreviation) for region
25	RegionName	varchar(50)		Name of the region in local language
10	SWGridLatitude	char(10)		Southwest corner latitude of grid structure
11	SWGridLongitude	char(11)		Southwest corner longitude of grid structure
4	EW_GridSize	float		Size of grids in EW direction in degrees
4	NS_GridSize	float		Size of grids in NS direction in degrees
4	NumberRows	int		Number of rows of grids (south to north)
4	NumberColumns	int		Number of columns of grids (west to east)
4	GridTilt	float		Tilt in radians of grid (+ counter-clockwise)
100	MapFile	varchar(255)		Name of file that holds map of region

14	RegulationDescriptions			
25	RegulationCode	char(25)	PK	ID code for this regulation
80	TitleEn	varchar(100)		Regulation title in English
200	TxtEn	text		Regulation summary or regulation in English
80	TitleSp	varchar(100)		Regulation title in Spanish
200	TxtSp	text		Regulation summary or regulation in Spanish
80	TitlePo	varchar(100)		Regulation title in Portuguese
200	TxtPo	text		Regulation summary or regulation in Portuguese
80	TitleCh	varchar(100)		Regulation title in Chinese
200	TxtCh	text		Regulation summary or regulation in Chinese
4	ApplicableDate	date		Date that this regulation is applicable
4	ExpirationDate	date		Date this regulation expires
4	Updated	date		Date this information was most recently updated

15	GrowthGridDistribution			
4	GridKey	int	PK	Key number for this grid
6	RegionAbbreviation	char(6)	FK.13	Region where this grid is found
4	GridRow	int		Row for this grid
4	GridColumn	int		Column for this grid
4	GrMetric01	char(10)	FK.16	Growth Metric Number 1
4	GrMetric02	char(10)	FK.16	Growth Metric Number 2
4	GrMetric03	char(10)	FK.16	Growth Metric Number 3
4	GrMetric04	char(10)	FK.16	Growth Metric Number 4
4	GrMetric05	char(10)	FK.16	Growth Metric Number 5
4	GrMetric06	char(10)	FK.16	Growth Metric Number 6
4	GrMetric07	char(10)	FK.16	Growth Metric Number 7
4	GrMetric08	char(10)	FK.16	Growth Metric Number 8
4	GrMetric09	char(10)	FK.16	Growth Metric Number 9
4	GrMetric10	char(10)	FK.16	Growth Metric Number 10

16	GrowthMetric			
10	GrowthMetric	char(10)	PK	Code for the growth metric in this row
4	Age01	float		Value for year 1 cumulative growth.
4	Age02	float		Value for year 2 cumulative growth
4	Age03	float		Value for year 3 cumulative growth
4	Age04	float		Value for year 4 cumulative growth
4	Age05	float		Value for year 5 cumulative growth
4	Age10	float		Value for year 10 cumulative growth
4	Age15	float		Value for year 15 cumulative growth
4	Age20	float		Value for year 20 cumulative growth
30	TxtEn	varchar(100)		English word for this growth metric
30	TxtSp	varchar(100)		Spanish word for this growth metric
30	TxtPo	varchar(100)		Portugues word for this growth metric
30	TxtCh	varchar(100)		Chinese word for this growth metric

17	**FixedGridDistribution**			
4	**GridKey**	int		Key number for this grid
6	**RegionAbbreviation**	char(6)	FK.13	Region where this grid is found
4	**GridRow**	int		Row for this grid
4	**GridColumn**	int		Column for this grid
4	**FxMetric01**	float		Fixed Metric Number 1
4	**FxMetric02**	float		Fixed Metric Number 2
4	**FxMetric03**	float		Fixed Metric Number 3
4	**FxMetric04**	float		Fixed Metric Number 4
4	**FxMetric05**	float		Fixed Metric Number 5
4	**FxMetric06**	float		Fixed Metric Number 6
4	**FxMetric07**	float		Fixed Metric Number 7
4	**FxMetric08**	float		Fixed Metric Number 8
4	**FxMetric09**	float		Fixed Metric Number 9
4	**FxMetric10**	float		Fixed Metric Number 10
4	**FxMetric11**	float		Fixed Metric Number 11
4	**FxMetric12**	float		Fixed Metric Number 12
4	**FxMetric13**	float		Fixed Metric Number 13
4	**FxMetric14**	float		Fixed Metric Number 14
4	**FxMetric15**	float		Fixed Metric Number 15
4	**FxMetric16**	float		Fixed Metric Number 16
4	**FxMetric17**	float		Fixed Metric Number 17
4	**FxMetric18**	float		Fixed Metric Number 18
4	**FxMetric19**	float		Fixed Metric Number 19
4	**FxMetric20**	float		Fixed Metric Number 20
4	**FxMetric21**	float		Fixed Metric Number 21
4	**FxMetric22**	float		Fixed Metric Number 22
4	**FxMetric23**	float		Fixed Metric Number 23
4	**FxMetric24**	float		Fixed Metric Number 24
4	**FxMetric25**	float		Fixed Metric Number 25
4	**FxMetric26**	float		Fixed Metric Number 26
4	**FxMetric27**	float		Fixed Metric Number 27
4	**FxMetric28**	float		Fixed Metric Number 28
4	**FxMetric29**	float		Fixed Metric Number 29
4	**FxMetric30**	float		Fixed Metric Number 30
4	**FxMetric31**	float		Fixed Metric Number 31
4	**FxMetric32**	float		Fixed Metric Number 32
4	**FxMetric33**	float		Fixed Metric Number 33
4	**FxMetric34**	float		Fixed Metric Number 34
4	**FxMetric35**	float		Fixed Metric Number 35
4	**FxMetric36**	float		Fixed Metric Number 36
4	**FxMetric37**	float		Fixed Metric Number 37
4	**FxMetric38**	float		Fixed Metric Number 38
4	**FxMetric39**	float		Fixed Metric Number 39
4	**FxMetric40**	float		Fixed Metric Number 40
4	**RoadClass**	float		The typical street type in the grid cell

18	SeasonalGridDistribution			
4	**GridKey**	int		Key number for this grid
6	**RegionAbbreviation**	char(6)	FK.13	Region where this grid is found
4	**GridRow**	int		Row for this grid
4	**GridColumn**	int		Column for this grid
4	**SnMetric01**	int	FK.19	Seasonal Metric Number 1
4	**SnMetric02**	int	FK.19	Seasonal Metric Number 2
4	**SnMetric03**	int	FK.19	Seasonal Metric Number 3
4	**SnMetric04**	int	FK.19	Seasonal Metric Number 4
4	**SnMetric05**	int	FK.19	Seasonal Metric Number 5
4	**SnMetric06**	int	FK.19	Seasonal Metric Number 6
4	**SnMetric07**	int	FK.19	Seasonal Metric Number 7
4	**SnMetric08**	int	FK.19	Seasonal Metric Number 8
4	**SnMetric09**	int	FK.19	Seasonal Metric Number 9
4	**SnMetric10**	int	FK.19	Seasonal Metric Number 10
4	**SnMetric11**	int	FK.19	Seasonal Metric Number 11
4	**SnMetric12**	int	FK.19	Seasonal Metric Number 12
4	**SnMetric13**	int	FK.19	Seasonal Metric Number 13
4	**SnMetric14**	int	FK.19	Seasonal Metric Number 14
4	**SnMetric15**	int	FK.19	Seasonal Metric Number 15
4	**SnMetric16**	int	FK.19	Seasonal Metric Number 16
4	**SnMetric17**	int	FK.19	Seasonal Metric Number 17
4	**SnMetric18**	int	FK.19	Seasonal Metric Number 18
4	**SnMetric19**	int	FK.19	Seasonal Metric Number 19
4	**SnMetric20**	int	FK.19	Seasonal Metric Number 20
4	**SnMetric21**	int	FK.19	Seasonal Metric Number 21
4	**SnMetric22**	int	FK.19	Seasonal Metric Number 22
4	**SnMetric23**	int	FK.19	Seasonal Metric Number 23
4	**SnMetric24**	int	FK.19	Seasonal Metric Number 24
4	**SnMetric25**	int	FK.19	Seasonal Metric Number 25
4	**SnMetric26**	int	FK.19	Seasonal Metric Number 26
4	**SnMetric27**	int	FK.19	Seasonal Metric Number 27
4	**SnMetric28**	int	FK.19	Seasonal Metric Number 28
4	**SnMetric29**	int	FK.19	Seasonal Metric Number 29
4	**SnMetric30**	int	FK.19	Seasonal Metric Number 30
4	**SnMetric31**	int	FK.19	Seasonal Metric Number 31
4	**SnMetric32**	int	FK.19	Seasonal Metric Number 32
4	**SnMetric33**	int	FK.19	Seasonal Metric Number 33
4	**SnMetric34**	int	FK.19	Seasonal Metric Number 34
4	**SnMetric35**	int	FK.19	Seasonal Metric Number 35
4	**SnMetric36**	int	FK.19	Seasonal Metric Number 36
4	**SnMetric37**	int	FK.19	Seasonal Metric Number 37
4	**SnMetric38**	int	FK.19	Seasonal Metric Number 38
4	**SnMetric39**	int	FK.19	Seasonal Metric Number 39
4	**SnMetric40**	int	FK.19	Seasonal Metric Number 40

19	SeasonalAdjustments			
4	SeasonAdjustmentKey	int	PK	Key for this table
50	TxtEn	varchar(100)		Description of this class in English
50	TxtSp	varchar(100)		Description of this class in Spanish
50	TxtPo	varchar(100)		Description of this class in Portuguese
50	TxtCh	varchar(100)		Description of this class in Chinese
4	SeasonA1	float		Adjustement for this season
4	SeasonB1	float		Adjustement for this season
4	SeasonC1	float		Adjustement for this season
4	SeasonD1	float		Adjustement for this season
4	SeasonA2	float		Adjustement for this season
4	SeasonB2	float		Adjustement for this season
4	SeasonC2	float		Adjustement for this season
4	SeasonD2	float		Adjustement for this season
4	Updated	date		Most recent update

20	EnviroGridDistribution			
4	GridKey	int		Key number for this grid
6	RegionAbbreviation	char(6)	FK.13	Region where this grid is found
4	GridRow	int		Row for this grid
4	GridColumn	int		Column for this grid
4	TempSeasA	int	FK.23	Temperature reference for Seas A
4	TempSeasB	int	FK.23	Temperature reference for Seas B
4	TempSeasC	int	FK.23	Temperature reference for Seas C
4	TempSeasD	int	FK.23	Temperature reference for Seas D
4	HumidSeasA	int	FK.23	Humidity reference for Seas A
4	HumidSeasB	int	FK.23	Humidity reference for Seas B
4	HumidSeasC	int	FK.23	Humidity reference for Seas C
4	HumidSeasD	int	FK.23	Humidity reference for Seas D
4	WdSpdSeasA	int	FK.23	Wind Speed reference for Seas A
4	WdSpdSeasB	int	FK.23	Wind Speed reference for Seas B
4	WdSpdSeasC	int	FK.23	Wind Speed reference for Seas C
4	WdSpdSeasD	int	FK.23	Wind Speed reference for Seas D
4	WdDirSeasA	int	FK.23	Wind Direction reference for Seas A
4	WdDirSeasB	int	FK.23	Wind Direction reference for Seas B
4	WdDirSeasC	int	FK.23	Wind Direction reference for Seas C
4	WdDirSeasD	int	FK.23	Wind Direction reference for Seas D
4	RnFalSeasA	int	FK.23	Rainfall reference for Season A
4	RnFalSeasB	int	FK.23	Rainfall reference for Season B
4	RnFalSeasC	int	FK.23	Rainfall reference for Season C
4	RnFalSeasD	int	FK.23	Rainfall reference for Season D
4	CnpCvSeasA	float		Average Canopy Cover in Seas A
4	CnpCvSeasB	float		Average Canopy Cover in Seas B
4	CnpCvSeasC	float		Average Canopy Cover in Seas C
4	CnpCvSeasD	float		Average Canopy Cover in Seas D
4	CloudCvSeasA	int	FK.23	Cloud Cover reference for Season A
4	CloudCvSeasB	int	FK.23	Cloud Cover reference for Season B
4	CloudCvSeasC	int	FK.23	Cloud Cover reference for Season C
4	CloudCvSeasD	int	FK.23	Cloud Cover reference for Season D
4	Altitude	float		Altitude
4	WaterCover	float		Water Cover Fraction
4	AgriLand	float		Agriculatural Land Cover Fraction

21	HourlyGridDistribution			
4	**GridKey**	int		Key number for this grid
6	**RegionAbbreviation**	char(6)	FK.13	Region where this grid is found
4	**GridRow**	int		Row for this grid
4	**GridColumn**	int		Column for this grid
4	**HrMetric01**	int	FK.23	Hourly Metric Number 1
4	**HrMetric02**	int	FK.23	Hourly Metric Number 2
4	**HrMetric03**	int	FK.23	Hourly Metric Number 3
4	**HrMetric04**	int	FK.23	Hourly Metric Number 4
4	**HrMetric05**	int	FK.23	Hourly Metric Number 5
4	**HrMetric06**	int	FK.23	Hourly Metric Number 6
4	**HrMetric07**	int	FK.23	Hourly Metric Number 7
4	**HrMetric08**	int	FK.23	Hourly Metric Number 8
4	**HrMetric09**	int	FK.23	Hourly Metric Number 9
4	**HrMetric10**	int	FK.23	Hourly Metric Number 10
4	**HrMetric11**	int	FK.23	Hourly Metric Number 11
4	**HrMetric12**	int	FK.23	Hourly Metric Number 12
4	**HrMetric13**	int	FK.23	Hourly Metric Number 13
4	**HrMetric14**	int	FK.23	Hourly Metric Number 14
4	**HrMetric15**	int	FK.23	Hourly Metric Number 15
4	**HrMetric16**	int	FK.23	Hourly Metric Number 16
4	**HrMetric17**	int	FK.23	Hourly Metric Number 17
4	**HrMetric18**	int	FK.23	Hourly Metric Number 18
4	**HrMetric19**	int	FK.23	Hourly Metric Number 19
4	**HrMetric20**	int	FK.23	Hourly Metric Number 20
4	**HrMetric21**	int	FK.23	Hourly Metric Number 21
4	**HrMetric22**	int	FK.23	Hourly Metric Number 22
4	**HrMetric23**	int	FK.23	Hourly Metric Number 23
4	**HrMetric24**	int	FK.23	Hourly Metric Number 24
4	**HrMetric25**	int	FK.23	Hourly Metric Number 25
4	**HrMetric26**	int	FK.23	Hourly Metric Number 26
4	**HrMetric27**	int	FK.23	Hourly Metric Number 27
4	**HrMetric28**	int	FK.23	Hourly Metric Number 28
4	**HrMetric29**	int	FK.23	Hourly Metric Number 29
4	**HrMetric30**	int	FK.23	Hourly Metric Number 30
4	**HrMetric31**	int	FK.23	Hourly Metric Number 31
4	**HrMetric32**	int	FK.23	Hourly Metric Number 32
4	**HrMetric33**	int	FK.23	Hourly Metric Number 33
4	**HrMetric34**	int	FK.23	Hourly Metric Number 34
4	**HrMetric35**	int	FK.23	Hourly Metric Number 35
4	**HrMetric36**	int	FK.23	Hourly Metric Number 36
4	**HrMetric37**	int	FK.23	Hourly Metric Number 37
4	**HrMetric38**	int	FK.23	Hourly Metric Number 38
4	**HrMetric39**	int	FK.23	Hourly Metric Number 39
4	**HrMetric40**	int	FK.23	Hourly Metric Number 40

22	PHPFormulas			
10	**FormulaKey**	char(10)	PK	
80	**TxtEn**	varchar(200)		Description in English
80	**TxtSp**	varchar(200)		Description in Spanish
80	**TxtPo**	varchar(200)		Description in Portuguese
80	**TxtCh**	varchar(200)		Description in Chinese
40	**Formula**	varchar(200)		PHP version of formula
40	**FormulaAlg**	varchar(200)		Algebraic version of formula

23	HourlyAdjustments			
4	**HourlyAdjustmentKey**	int		Hourly Key
4	**HourlyScheduleKey1**	int	FK.60	Pointer to Key word 1 for these corrections
4	**HourlyScheduleKey2**	int	FK.61	Pointer to Keyword 2 for these corrections
4	**HourlyScheduleKey3**	int	FK.62	Pointer to Keyword 3 for these corrections
30	**TxtEn**	varchar(100)		Hourly Class for these corrections in English
40	**TxtSp**	varchar(100)		Hourly Class for these corrections in Spanish
40	**TxtPo**	varchar(100)		Hourly Class for these corrections in Portuguese
30	**TxtCh**	varchar(100)		Hourly Class for these corrections in Chinese
4	**H00**	float		Value for hour 00
4	**H01**	float		Value for hour 01
4	**H02**	float		Value for hour 02
4	**H03**	float		Value for hour 03
4	**H04**	float		Value for hour 04
4	**H05**	float		Value for hour 05
4	**H06**	float		Value for hour 06
4	**H07**	float		Value for hour 07
4	**H08**	float		Value for hour 08
4	**H09**	float		Value for hour 09
4	**H10**	float		Value for hour 10
4	**H11**	float		Value for hour 11
4	**H12**	float		Value for hour 12
4	**H13**	float		Value for hour 13
4	**H14**	float		Value for hour 14
4	**H15**	float		Value for hour 15
4	**H16**	float		Value for hour 16
4	**H17**	float		Value for hour 17
4	**H18**	float		Value for hour 18
4	**H19**	float		Value for hour 19
4	**H20**	float		Value for hour 20
4	**H21**	float		Value for hour 21
4	**H22**	float		Value for hour 22
4	**H23**	float		Value for hour 23
4	**Updated**	date		Most recent update

24	CensusTrackParameters			
4	**ParameterNumber**	int	PK	Parameter number from Census track table
50	**TxtEn**	varchar(100)		Description of parameter in English
50	**TxtSp**	varchar(100)		Description of parameter in Spanish
50	**TxtPo**	varchar(100)		Description of parameter in Portugues
50	**TxtCh**	varchar(100)		Description of parameter in Chinese

25	CensusTrackInformation			
8	**KeyField**	bigint	PK	ID number for this row
10	**CensusTrack**	char(10)		Census track code
4	**Parameter1**	float		Census track parameter
4	**Parameter2**	float		Census track parameter
4	**Parameter3**	float		Census track parameter
4	**Parameter4**	float		Census track parameter
4	**Parameter5**	float		Census track parameter

26	DrivingPatterns			
4	TableKey	int	PK	Key number for this grid cell
4	StartYear	int		Start year for this set of corrections
4	EndYear	int		End year for this set of corrections
8	RoadClassKey	int	FK.56	Type of roadway for these patterns
6	RegionAbbreviation	char(6)	FK.13	Region where this grid is found
4	SeasonA1	int	FK.23	Pointer for season A1
4	SeasonA2	int	FK.23	Pointer for season B1
4	SeasonB1	int	FK.23	Pointer for season C1
4	SeasonB2	int	FK.23	Pointer for season D1
4	SeasonC1	int	FK.23	Pointer for season A2
4	SeasonC2	int	FK.23	Pointer for season B2
4	SeasonD1	int	FK.23	Pointer for season C2
4	SeasonD2	int	FK.23	Pointer for season D2
4	Updated	date		Most recent update

27	SpecialCorrections			
10	CorrectionKey	int	PK	Key for this table
10	SpecialCorrectionKey	char(12)		Key for these corrections (location code + 9 digits)
50	TxtEn	varchar(100)		Description of Special Correction in English
50	TxtSp	varchar(100)		Description of Special Correction in Spanish
50	TxtPo	varchar(100)		Description of Special Correction in Portuguese
50	TxtCh	varchar(100)		Description of Special Correction in Chinese
4	DrivingPatternKey	float	FK.57	Driving pattern code (-1 = not driving pattern)
100	Formula	varchar(200)		Formula for drv. pattrn. adj.(with tem.,hum.,wndsp)
100	Display	varchar(200)		Display version of formula
4	Updated	date		Most recent date this information changed

28	Jurisdictions			
3	JurisdictionCode	char(5)	PK	ID code for this jurisdiction
25	TxtEn	varchar(50)		English word for this jurisdiction
25	TxtSp	varchar(50)		Spanish word for this jurisdiction
25	TxtPo	varchar(50)		Portugues word for this jurisdiction
25	TxtCh	varchar(50)		Chinese word for this jurisdiction

29	DepreciationInterval			
3	DepreciationIntervalCode	char(3)	PK	Depreciation interval ID code
25	TxtEn	varchar(50)		English word for this interval
25	TxtSp	varchar(50)		Spanish word for this interval
25	TxtPo	varchar(50)		Portugues word for this interval
25	TxtCh	varchar(50)		Chinese word for this interval

31	LocalCodeFinder			
4	**LocalID**	int	PK	The ID number for these local codes
4	**LocalKey1Key**	int	FK.32	Keyword 1 reference
4	**LocalKey2Key**	int	FK.33	Keyword 2 reference
4	**LocalKey3Key**	int	FK.34	Keyword 3 reference
4	**LocalKey4Key**	int	FK.35	Keyword 4 reference
8	**LocalCode**	char(8)		Local code
8	**OtherCode**	char(8)		Other Local Code

32	LocalKey1			
4	**LocalKey1Key**	int	PK	Local code keyword numnber 1
30	**TxtEn**	varchar(40)		Keyword in English
30	**TxtSp**	varchar(40)		Keyword in Spanish
30	**TxtPo**	varchar(40)		Keyword in Portuguese
30	**TxtCh**	varchar(40)		Keyword in Chinese

33	LocalKey2			
4	**LocalKey2Key**	int	PK	Local code keyword numnber 2
30	**TxtEn**	varchar(40)		Keyword in English
30	**TxtSp**	varchar(40)		Keyword in Spanish
30	**TxtPo**	varchar(40)		Keyword in Portuguese
30	**TxtCh**	varchar(40)		Keyword in Chinese

34	LocalKey3			
4	**LocalKey3Key**	int	PK	Local code keyword numnber 2
30	**TxtEn**	varchar(40)		Keyword in English
30	**TxtSp**	varchar(40)		Keyword in Spanish
30	**TxtPo**	varchar(40)		Keyword in Portuguese
30	**TxtCh**	varchar(40)		Keyword in Chinese

35	LocalKey4			
4	**LocalKey4Key**	int	PK	Local code keyword numnber 2
30	**TxtEn**	varchar(40)		Keyword in English
30	**TxtSp**	varchar(40)		Keyword in Spanish
30	**TxtPo**	varchar(40)		Keyword in Portuguese
30	**TxtCh**	varchar(40)		Keyword in Chinese

36	**EmissionFactorFinder**			
4	**SCCxIndex**	int	PK	This is the primary key for the table
19	**SCCx_Code**	char(35)		The SCCx code goes here same.
4	**SCCxKey1**	char(7)	FK.37	Key word 1 to find the proper SCC code
4	**SCCxKey2**	char(7)	FK.38	Key word 2 to find the proper SCC code
4	**SCCxKey3**	char(7)	FK.39	Key word 3 to find the proper SCC code
4	**SCCxKey4**	char(7)	FK.40	Key word 4 to find the proper SCC code
4	**SCCxKey5**	char(7)	FK.41	Key word 5 to find the proper SCC code
4	**SCCxKey6**	char(7)	FK.42	Key word 6 to find the proper SCC code
4	**SCCxKey8**	char(7)	FK.43	Key word 8 to find the proper SCC code
10	**MaterialCode**	char(15)	FK.44	Flow material that the emission factor represents
30	**KeyFlowMaterial**	char(15)	FK.44	Material used as key flow to calculate emission rate
30	**CalculationComment**	Text		Available for comment about emission factor
10	**FormulaKey**	char(10)	FK.22	Identifies equation to use in emm. factor calculation
4	**CalFactor1**	float		Emission factor 1 for the calculation
4	**CalFactor2**	float		Emission factor 2 for the calculation
4	**CalFactor3**	float		Emission factor 3 for the calculation
4	**CalFactor4**	float		Emission factor 4 for the calculation
4	**CalFactor5**	float		Emission factor 5 for the calculation
4	**ExtraInfoTypeKey1**	char(10)	FK.49/11	Extra Info needed for the process for calculation
4	**ExtraInfoTypeKey2**	char(10)	FK.49/11	Extra Info needed for the process for calculation
4	**ExtraInfoTypeKey3**	char(10)	FK.49/11	Extra Info needed for the process for calculation
4	**ExtraInfoTypeKey4**	char(10)	FK.49/11	Extra Info needed for the process for calculation
4	**ApplicableYear**	year(4)		Year that this emission factor becomes valid
4	**ReliabilityCode**	int	FK.79	Reliability of this emission factor
6	**OutputUpperUnits**	char(6)	FK.59	Upper units for reporting emission factor
6	**OutputLowerUnits**	char(6)	FK.59	Lower units for reporting emission factor
7	**AgingCodeKey**	char(10)	FK.50	Aging code key for this emission factor
2	**YearNew**	year(4)		Year that the equipment is considered new
12	**SpecialCorrectionKey**	char(12)	FK.27	Special corrections code key (normally for on-road)
4	**Created**	date		Date code was created
4	**Updated**	date		Date code was updated

37	**SCCKey1**			
7	**SCCxKey1**	char(7)	PK	Key for this table (location code+4 numbers)
50	**TxtEn**	varchar(100)		Engish word (word collection) for this key
50	**TxtSp**	varchar(150)		Spanish word (word collection) for this key
50	**TxtPo**	varchar(150)		Portuguese word (word collection) for this key
50	**TxtCh**	varchar(100)		Chinese word (word collection) for this key
4	**Updated**	date		Date that this record was updated

38	**SCCKey2**			
7	**SCCxKey2**	char(7)	PK	Key for this table (location code+4 numbers)
50	**TxtEn**	varchar(100)		Engish word (word collection) for this key
50	**TxtSp**	varchar(150)		Spanish word (word collection) for this key
50	**TxtPo**	varchar(150)		Portuguese word (word collection) for this key
50	**TxtCh**	varchar(100)		Chinese word (word collection) for this key
4	**Updated**	date		Date that this record was updated

39	**SCCKey3**			
7	**SCCxKey3**	char(7)	PK	Key for this table (location code+4 numbers)
50	**TxtEn**	varchar(100)		Engish word (word collection) for this key
50	**TxtSp**	varchar(150)		Spanish word (word collection) for this key
50	**TxtPo**	varchar(150)		Portuguese word (word collection) for this key
50	**TxtCh**	varchar(100)		Chinese word (word collection) for this key
4	**Updated**	date		Date that this record was updated

40	SCCKey4			
7	**SCCxKey4**	char(7)	PK	Key for this table (location code+4 numbers)
50	**TxtEn**	varchar(100)		Engish word (word collection) for this key
50	**TxtSp**	varchar(150)		Spanish word (word collection) for this key
50	**TxtPo**	varchar(150)		Portuguese word (word collection) for this key
50	**TxtCh**	varchar(100)		Chinese word (word collection) for this key
4	**Updated**	date		Date that this record was updated

41	SCCKey5			
7	**SCCxKey5**	char(7)	PK	Key for this table (location code+4 numbers)
50	**TxtEn**	varchar(100)		Engish word (word collection) for this key
50	**TxtSp**	varchar(150)		Spanish word (word collection) for this key
50	**TxtPo**	varchar(150)		Portuguese word (word collection) for this key
50	**TxtCh**	varchar(100)		Chinese word (word collection) for this key
4	**Updated**	date		Date that this record was updated

42	SCCKey6			
7	**SCCxKey6**	char(7)	PK	Key for this table (location code+4 numbers)
50	**TxtEn**	varchar(100)		Engish word (word collection) for this key
50	**TxtSp**	varchar(150)		Spanish word (word collection) for this key
50	**TxtPo**	varchar(150)		Portuguese word (word collection) for this key
50	**TxtCh**	varchar(100)		Chinese word (word collection) for this key
4	**Updated**	date		Date that this record was updated

43	SCCKey8			
7	**SCCxKey8**	char(7)	PK	Key for this table (location code+4 numbers)
50	**TxtEn**	varchar(100)		Engish word (word collection) for this key
50	**TxtSp**	varchar(150)		Spanish word (word collection) for this key
50	**TxtPo**	varchar(150)		Portuguese word (word collection) for this key
50	**TxtCh**	varchar(100)		Chinese word (word collection) for this key
4	**Updated**	date		Date that this record was updated

44	MaterialNameFinder			
	MaterialIndex	integer	PK	Key for this table
10	**MaterialCode**	char(15)		Material Code (location code+ up to 12 other digits)
4	**MaterialKey1**	char(10)	FK.45	Key word 1 for the material
4	**MaterialKey2**	char(10)	FK.46	Key word 2 for the material
4	**MaterialKey3**	char(10)	FK.47	Key word 3 for the material
4	**MaterialKey4**	char(10)	FK.48	Key word 4 for material (name of material)
40	**Updated**	date		Date of most recent update
6	**StdUnits**	char(6)	FK.59	Normal units used for this material

45	MaterialKey1			
10	**MaterialKey1**	char(10)	PK	Key for this table (location code+4 numbers)
30	**TxtEn**	varchar(50)		English word for material 1 key word
30	**TxtSp**	varchar(50)		Spanish word for material 1 key word
30	**TxtPo**	varchar(50)		Portuguese word for material 1 key word
30	**TxtCh**	varchar(50)		Chinese word for material 1 key word
4	**Updated**	date		Date that this record was updated

46	**MaterialKey2**			
10	**MaterialKey2**	char(10)	PK	Key for this table (location code+4 numbers)
30	**TxtEn**	varchar(50)		English word for material 1 key word
30	**TxtSp**	varchar(50)		Spanish word for material 1 key word
30	**TxtPo**	varchar(50)		Portuguese word for material 1 key word
30	**TxtCh**	varchar(50)		Chinese word for material 1 key word
4	**Updated**	date		Date that this record was updated

47	**MaterialKey3**			
10	**MaterialKey3**	char(10)	PK	Key for this table (location code+4 numbers)
30	**TxtEn**	varchar(50)		English word for material 1 key word
30	**TxtSp**	varchar(50)		Spanish word for material 1 key word
30	**TxtPo**	varchar(50)		Portuguese word for material 1 key word
30	**TxtCh**	varchar(50)		Chinese word for material 1 key word
4	**Updated**	date		Date that this record was updated

48	**MaterialKey4**			
10	**MaterialKey4**	char(10)	PK	Key for this table (location code+4 numbers)
30	**TxtEn**	varchar(50)		English word for material 1 key word
30	**TxtSp**	varchar(50)		Spanish word for material 1 key word
30	**TxtPo**	varchar(50)		Portuguese word for material 1 key word
30	**TxtCh**	varchar(50)		Chinese word for material 1 key word
4	**Updated**	date		Date that this record was updated

49	**ExtraInfoType**			
10	**ExtraInfoTypeKey**	char(10)	PK	Key for this table (location code+4 numbers)
20	**TxtEn**	Text		English word for this information
20	**TxtSp**	Text		Spanish word for this information
20	**TxtPo**	Text		Portugues word for this information
20	**TxtCh**	Text		Chinese word for this information
4	**DefaultValue**	float		Default value to be used in calculations
4	**Updated**	date		Date that this record was updated

50	**AgingFactorFinder**			
7	**AgingCodeKey**	char(10)	PK	Key for this table (location code+7 numbers)
7	**AgingKey1**	char(7)	FK.51	Reference to word for Key1
7	**AgingKey2**	char(7)	FK.52	Reference to word for Key2
7	**AgingKey3**	char(7)	FK.53	Reference to word for Key3
40	**TxtEn**	varchar(100)		Description for this category in English
50	**TxtSp**	varchar(100)		Description for this category in Spanish
50	**TxtPo**	varchar(100)		Description for this category in Portuguese
40	**TxtCh**	varchar(100)		Description for this category in Chinese
4	**Age01**	float		Value for year 1 cumulative aging.
4	**Age02**	float		Value for year 2 cumulative aging
4	**Age03**	float		Value for year 3 cumulative aging
4	**Age04**	float		Value for year 4 cumulative aging
4	**Age05**	float		Value for year 5 cumulative aging
4	**Age10**	float		Value for year 10 cumulative aging
4	**Age15**	float		Value for year 15 cumulative aging
4	**Age20**	float		Value for year 20 cumulative aging
10	**FormulaKey**	char(10)	FK.22	Formula to use in liu of age correction factors
4	**Updated**	date		Most recent date this information changed

51	**AgingKey1**			
7	**AgingKey1**	char(7)	PK	Key for this table (location code+4 numbers)
40	**TxtEn**	varchar(100)		Name for Keywords 1 in English
50	**TxtSp**	varchar(100)		Name for Keywords 1 in Spanish
50	**TxtPo**	varchar(100)		Name for Keywords 1 in Portuguese
40	**TxtCh**	varchar(100)		Name for Keywords 1 in Chinese
4	**Updated**	date		Most recent date this information changed

52	**AgingKey2**			
7	**AgingKey2**	char(7)	PK	Key for this table (location code+4 numbers)
40	**TxtEn**	varchar(100)		Name for Keywords 2 in English
50	**TxtSp**	varchar(100)		Name for Keywords 2 in Spanish
50	**TxtPo**	varchar(100)		Name for Keywords 2 in Portuguese
40	**TxtCh**	varchar(100)		Name for Keywords 2 in Chinese
4	**Updated**	date		Most recent date this information changed

53	**AgingKey3**			
7	**AgingKey3**	char(7)	PK	Key for this table (location code+4 numbers)
40	**TxtEn**	varchar(100)		Name for Keywords 3 in English
50	**TxtSp**	varchar(100)		Name for Keywords 3 in Spanish
50	**TxtPo**	varchar(100)		Name for Keywords 3 in Portuguese
40	**TxtCh**	varchar(100)		Name for Keywords 3 in Chinese
4	**Updated**	date		Most recent date this information changed

54	**AddressType**			
3	**AddressTypeCode**	char(3)	PK	ID code for this address type
25	**TxtEn**	varchar(50)		English name of this address type
25	**TxtSp**	varchar(50)		Spanish name of this address type
25	**TxtPo**	varchar(50)		Portugues name of this address type
25	**TxtCh**	varchar(50)		Chinese name of this address type

55	**ContactType**			
3	**ContactTypeCode**	char(3)	PK	ID code for this contact type
25	**TxtEn**	varchar(50)		English word for this contact type
25	**TxtSp**	varchar(50)		Spanish word for this contact type
25	**TxtPo**	varchar(50)		Portugues word for this contact type
25	**TxtCh**	varchar(50)		Chinese word for this contact type

56	**RoadClasses**			
4	**RoadClassKey**	int	PK	Key for road types
30	**TxtEn**	varchar(100)		English for road type
30	**TxtSp**	varchar(100)		Spanish for road type
30	**TxtPo**	varchar(100)		Portuguese for road type
30	**TxtCh**	varchar(100)		Chinese for road type

57	**DrivingPatternTypes**			
4	**DrivingPatternKey**	int	PK	Key for driving types
30	**TxtEn**	varchar(200)		English for driving type
30	**TxtSp**	varchar(200)		Spanish for driving type
30	**TxtPo**	varchar(200)		Portuguese for driving type
30	**TxtCh**	varchar(200)		Chinese for driving type

58	**FactorSources**			
3	**ServerCode**	char(3)	PK	Key code for local server (city)
50	**TxtEn**	varchar(100)		Code Source English
50	**TxtSp**	varchar(100)		Code Source Spanish
50	**TxtPo**	varchar(100)		Code Source Portuguese
50	**TxtCh**	varchar(100)		Code Source Chinese

59	**GeneralUnits**			
6	**UnitKey**	char(6)	PK	Key code for the unit in this row
9	**UnitType**	char(9)	FK.	The type of unit (mass, length, etc)
6	**DesEn**	char(6)		English designation for this unit
20	**TxtEn**	varchar(40)		English title for this unit
6	**DesSp**	char(6)		Spanish designation for this unit
20	**TxtSp**	varchar(40)		Spanish title for this unit
6	**DesPo**	char(6)		Portuguese designation for this unit
20	**TxtPo**	varchar(40)		Portuguese title for this unit
6	**DesCh**	char(6)		Chinese designation for this unit
20	**TxtCh**	varchar(40)		Chinese title for this unit
4	**UnitConversionFactor**	float		Conversion value to the standard unit for this type

59b	**UnitTypes**			
9	**UnitType**	char(9)	PK	Key code for the type of unit
12	**TxtEn**	varchar(25)		English for unit type
12	**TxtSp**	varchar(25)		Spanish for unit type
12	**TxtPo**	varchar(25)		Portugues for unit type
12	**TxtCh**	varchar(25)		Chinese for unit type

60	**HourlyScheduleKey1**			
4	**HourlyScheduleKey1**	int	PK	Hourly schedule ID code for level 1 words
20	**TxtEn**	varchar(200)		English word for this Hourly schedule key
20	**TxtSp**	varchar(200)		Spanish word for this Hourly schedule key
20	**TxtPo**	varchar(200)		Portuguese word for this Hourly schedule key
20	**TxtCh**	varchar(200)		Chinese word for this Hourly schedule key

61	**HourlyScheduleKey2**			
4	**HourlyScheduleKey2**	int	PK	Hourly schedule ID code for level 2 words
20	**TxtEn**	varchar(200)		English word for this Hourly schedule key
20	**TxtSp**	varchar(200)		Spanish word for this Hourly schedule key
20	**TxtPo**	varchar(200)		Portuguese word for this Hourly schedule key
20	**TxtCh**	varchar(200)		Chinese word for this Hourly schedule key

62	**HourlyScheduleKey3**			
4	**HourlyScheduleKey3**	int	PK	Hourly schedule ID code for level 3 words
20	**TxtEn**	varchar(200)		English word for this Hourly schedule key
20	**TxtSp**	varchar(200)		Spanish word for this Hourly schedule key
20	**TxtPo**	varchar(200)		Portuguese word for this Hourly schedule key
20	**TxtCh**	varchar(200)		Chinese word for this Hourly schedule key

63	IPCC_CodeFinder			
6	IPCC_Code	char(8)	PK	IPCC Code
4	IPCCKey1	int	FK.64	Keyword 1 reference
1	Des1	char(1)		Level 1 Code
4	IPCCKey2	int	FK.65	Keyword 2 reference
1	Des2	char(1)		Level 2 Code
4	IPCCKey3	int	FK.66	Keyword 3 reference
2	Des3	char(2)		Level 3 Code
4	IPCCKey4	int	FK.67	Keyword 4 reference
1	Des4	char(1)		Level 4 Code
4	IPCCKey5	int	FK.68	Keyword 5 reference
3	Des5	char(3)		Level 5 Code
4	IPCCKey6	int	FK.69	Keyword 6 reference
2	Des6	char(2)		Level 6 code

64	IPCCKey1			
4	IPCCKey1	int	PK	ID number for Keyword 1
40	TxtEn	varchar(80)		Keyword in English
40	TxtSp	varchar(80)		Keyword in Spanish
40	TxtPo	varchar(80)		Keyword in Portuguese
40	TxtCh	varchar(80)		Keyword in Chinese

65	IPCCKey2			
4	IPCCKey2	int	PK	ID number for Keyword 2
40	TxtEn	varchar(80)		Keyword in English
40	TxtSp	varchar(80)		Keyword in Spanish
40	TxtPo	varchar(80)		Keyword in Portuguese
40	TxtCh	varchar(80)		Keyword in Chinese

66	IPCCKey3			
4	IPCCKey3	int	PK	ID number for Keyword 3
40	TxtEn	varchar(80)		Keyword in English
40	TxtSp	varchar(80)		Keyword in Spanish
40	TxtPo	varchar(80)		Keyword in Portuguese
40	TxtCh	varchar(80)		Keyword in Chinese

67	IPCCKey4			
4	IPCCKey4	int	PK	ID number for Keyword 4
40	TxtEn	varchar(80)		Keyword in English
40	TxtSp	varchar(80)		Keyword in Spanish
40	TxtPo	varchar(80)		Keyword in Portuguese
40	TxtCh	varchar(80)		Keyword in Chinese

68	IPCCKey5			
4	IPCCKey5	int	PK	ID number for Keyword 5
40	TxtEn	varchar(80)		Keyword in English
40	TxtSp	varchar(80)		Keyword in Spanish
40	TxtPo	varchar(80)		Keyword in Portuguese
40	TxtCh	varchar(80)		Keyword in Chinese

69	**IPCCKey6**			
4	**IPCCKey6**	int	PK	ID number for Keyword 6
40	**TxtEn**	varchar(80)		Keyword in English
40	**TxtSp**	varchar(80)		Keyword in Spanish
40	**TxtPo**	varchar(80)		Keyword in Portuguese
40	**TxtCh**	varchar(80)		Keyword in Chinese

70	**MetricDescription**			
10	**ColumnTitle**	char(10)	PK	Grid column name
40	**TxtEn**	varchar(100)		Metric name for this column in English
50	**TxtSp**	varchar(100)		Metric name for this column in Spanish
50	**TxtPo**	varchar(100)		Metric name for this column in Portuguese
40	**TxtCh**	varchar(100)		Metric name for this column in Chinese

71	**NAIC_SIC_CodeFinder**			
4	**NAICID**	int	PK	The ID number for this set of codes
6	**NAICS_Code**	char(6)		The NAICS code
4	**SIC_Code**	char(4)		The SIC code
4	**NAICKey1**	int	FK.72	Keyword 1 reference
4	**NAICKey2**	int	FK.73	Keyword 2 reference
4	**NAICKey3**	int	FK.74	Keyword 3 reference
4	**NAICKey4**	int	FK.75	Keyword 4 reference

72	**NAICKey1**			
4	**NAICKey1**	int	PK	NAIC/SIC keyword number 1
100	**TxtEn**	varchar(200)		Keyword in English
100	**TxtSp**	varchar(200)		Keyword in Spanish
100	**TxtPo**	varchar(200)		Keyword in Portuguese
100	**TxtCh**	varchar(200)		Keyword in Chinese

73	**NAICKey2**			
4	**NAICKey2**	int	PK	NAIC/SIC keyword number 2
100	**TxtEn**	varchar(200)		Keyword in English
100	**TxtSp**	varchar(200)		Keyword in Spanish
100	**TxtPo**	varchar(200)		Keyword in Portuguese
100	**TxtCh**	varchar(200)		Keyword in Chinese

74	**NAICKey3**			
4	**NAICKey3**	int	PK	NAIC/SIC keyword number 3
100	**TxtEn**	varchar(200)		Keyword in English
100	**TxtSp**	varchar(200)		Keyword in Spanish
100	**TxtPo**	varchar(200)		Keyword in Portuguese
100	**TxtCh**	varchar(200)		Keyword in Chinese

75	**NAICKey4**			
4	**NAICKey4**	int	PK	NAIC/SIC keyword number 4
100	**TxtEn**	varchar(200)		Keyword in English
100	**TxtSp**	varchar(200)		Keyword in Spanish
100	**TxtPo**	varchar(200)		Keyword in Portuguese
100	**TxtCh**	varchar(200)		Keyword in Chinese

76	**OutcomeCodes**			
3	**OutcomeCode**	char(3)	PK	Inspection outcome ID code
20	**TxtEn**	varchar(30)		English word for inspection outcome
20	**TxtSp**	varchar(30)		Spanish word for inspection outcome
20	**TxtPo**	varchar(30)		Portuguese word for inspection outcome
20	**TxtCh**	varchar(30)		Chinese word for inspection outcome

77	**ProblemIndicators**			
4	**ProblemCode**	int	PK	Problem ID code for inspection report
25	**TxtEn**	varchar(50)		English word for this problem
25	**TxtSp**	varchar(50)		Spanish
25	**TxtPo**	varchar(50)		Portuguese word for this problem
25	**TxtCh**	varchar(50)		Chinese word for this problem

78	**ProcessName**			
4	**ProcessNameKey**	int	PK	Process ID numnber
4	**SourceClassKey**	int	FK.82	Source class name for this specific source
100	**TxtEn**	varchar(200)		English description for this area process
100	**TxtSp**	varchar(200)		Spanish description for this area process
100	**TxtPo**	varchar(200)		Portuguese description for this area process
100	**TxtCh**	varchar(200)		Chinese description for this area process

79	**ReliabilityIndex**			
4	**ReliabilityCode**	int	PK	Code to indicate reliability of data
15	**TxtEn**	varchar(20)		English word for code word
15	**TxtSp**	varchar(20)		Spanish word for code word
15	**TxtPo**	varchar(20)		Portugues word for code word
15	**TxtCh**	varchar(20)		Chinese word for code word

80	**SeasonDescription**			
20	**SeasonKey**	char(2)		Season indicator (A1,B1,C1,D1,A2,B2,C2,D2)
40	**TxtEn**	varchar(100)		Name of this season/day in English
50	**TxtSp**	varchar(100)		Name of this season/day in Spanish
50	**TxtPo**	varchar(100)		Name of this season/day in Portuguese
40	**TxtCh**	varchar(100)		Name of this season/day in Chinese
4	**DaysInSeason**	float		Number of days in the season

81	**SizeClassType**			
3	**SizeClassCode**	char(3)	PK	ID code for this size class
25	**TxtEn**	varchar(50)		Size class English word
100	**DescriptionEn**	text		Description of this size class in English
25	**TxtSp**	varchar(50)		Size class Spanish word
100	**DescriptionSp**	text		Description of this size class in Spanish
25	**TxtPo**	varchar(50)		Size class Portugues word
100	**DescriptionPo**	text		Description of this size class in Portuguese
25	**TxtCh**	varchar(50)		Size class Chinese word
100	**DescriptionCh**	text		Description of this size class in Chinese

82	**SourceClassName**			
4	**SourceClassKey**	int	PK	Source class ID number
100	**TxtEn**	varchar(200)		English description for this source class
100	**TxtSp**	varchar(200)		Spanish description for this source class
100	**TxtPo**	varchar(200)		Portuguese description for this source class
100	**TxtCh**	varchar(200)		Chinese description for this source class

83	**TempUnits**			
2	**TempUnitsKey**	char(2)	PK	ID code for temperature units
15	**TxtEn**	varchar(20)		English word for this temperature unit
15	**TxtSp**	varchar(20)		Spanish word for this temperature unit
15	**TxtPo**	varchar(20)		Portugues word for this temperature unit
15	**TxtCh**	varchar(20)		Chinese word for this temperature unit
4	**UnitConvFactor1**	float		Additive Factor (i.e. T=F1+F2*Temp)
4	**UnitConvFactor2**	float		Multiplicative Factor (i.e. T=F1+F2*Tmp)

85	**ScenarioDescriptions**			
1	**ScenarioKey**	char(2)	PK	ID number for this scenario
50	**TxtEn**	varchar(100)		English words for this description
50	**TxtSp**	varchar(100)		Spanish words for this description
50	**TxtPo**	varchar(100)		Portugues words for this description
50	**TxtCh**	varchar(100)		Chinese words for this description
4	**Updated**	date		Most recent date info updated

86	**GenericFlows**			
1	**FlowKey**	char(2)	PK	ID number for this scenario
50	**TxtEn**	varchar(100)		English words for this description
50	**TxtSp**	varchar(100)		Spanish words for this description
50	**TxtPo**	varchar(100)		Portugues words for this description
50	**TxtCh**	varchar(100)		Chinese words for this description

87	**MapPictures**			
6	**RegionAbbreviation**	char(6)	PK	Region that this picture goes with
30	**TxtEn**	varchar(100)		Name of picture in English
30	**TxtSp**	varchar(100)		Name of picture in Spanish
30	**TxtPo**	varchar(100)		Name of picture in Portugues
30	**TxtCh**	varchar(100)		Name of picture in Chinese
15	**MapFile**	char(100)		File name of picture

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StoredCalculations			
calcID	mediumint(10) unsigned	PK	auto_increment
groupName	char(40)		batch name of stored calculation
material	char(15)		
type	char(10)		
typeID	char(12)		
region	char(6)		the selected parameters under
year	smallint(4)		which the stored calculation was
agingYear	smallint(4)		performed
growthYear	smallint(4)		
season	char(2)		
hour	tinyint(2)		
creator	int(10) unsigned		id of user running calculation
creationDate	int(10)		date calculation performed
valueString	mediumtext		XML data of stored results

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StoredCalculationScenarios			
calcID	int	FK.88	
scenario	char(2)		scenarios used in stored calculation

C1

	EmissionsCredit			
8	**CreditCertificateNumber**	bigint	PK	Credit certificant number
4	**SourceID**	int	FK.01	ID of source related to this emission credit
4	**MaterialCode**	char(15)	FK.44	ID code of the material associated with credit
4	**CreditAmount**	float		Magnitude of credit for this source
6	**UnitKeyUpper**	char(6)	FK.59	Upper unit for credit magnitude
6	**UnitKeyLower**	char(6)	FK.59	Lower unit for credit magnitude
4	**CreditDepreciation**	float		Any depreciation associated with this credit
3	**DepreciationIntervalCode**	char(3)	FK.29	Depreciation interval for this credit is applicable
4	**DateCreditGranted**	date		Date that the credit was granted
4	**DateCreditExpires**	date		Date that the credit expires if any
40	**AgencyGrantingCredit**	varchar(60)		Agency granting the credit
1	**CreditState**	char(1)		State of the credit ("n"=normal, "e"=expired)
100	**Comment**	text		Any comment associated with this credit

C2

	CreditOwner			
8	**OwnerKey**	bigint	PK	ID number for this credit owner row
8	**CreditCertificateNumber**	bigint	FK.C1	Credit ID number for this credet
4	**StartOwner**	date		Date when owner acquired this credit
4	**EndOwner**	date		Date when owner released this credit

These tables are located in a separate database related to emission credits for security purposes.

<u>Appendix B</u>
Estimation of Hourly Process Emissions in the IED

Section B.1: General Approach for Estimation of Process Emissions

One of the most important jobs of an emission inventory database is to support the development of an inventory of emissions and possibly other flows of materials or energy that accurately reflects the true emissions, flows, or energy in a region of interest for different locations and times. The development of these emission estimates begins with the estimation of emissions from a single process. A process is any activity that produces emissions and has flows into and out of it. Processes can be man-made or natural, ongoing or single events. Examples of 'processes' include operation of a vehicle, operation of a factory, windblown dust, volcanic eruptions, or painting of houses. The emissions from each process are then added together to produce a complete emission inventory.

For emissions inventory purposes, processes can be a subunit of a point source, area-unit source, or area-scalar source. These three cases are explained in Table B.1-1.

Table B.1-1: General Process Types Used in IED Emission Calculations

Source (Process) Type	Description
Point Source	A process that is considered to exist at a single location or point on the ground.
Area/Units	A collection of processes that are too small to be treated as part of individual point sources but are instead treated as part of a single source spread out over an entire region. These sources are tracked and calculated based on a count of individual units that make up the area source. An example of an area source often treated this way is space heating units but almost any area source can be treated this way if relevant data on the number of units is available for this format.
Area/Scalar	A collection of processes that are too small to be treated as individual point sources but are instead treated as a single source spread out over the entire region. These processes are tracked and calculated based on the creation or consumption of some scalar quantity such as mass, volume, distance, or hours associated with the collection of all of these small point sources in a region. As the case for an Area Source/Units almost any area source can be treated this way if relevant data is available for this format.

The emissions or flow from or to a process are denoted as P(d,h) in this discussion where d denotes the day of the year and h the hour in that day. These flows, which will be referred to as emissions in this discussion, are denoted by P(d,h) and represent the mass per unit time flowing into or out of a process. The units of P(d,h) are always kilograms per hour in IED calculations. A convenient way to calculate P(d,h) is to define an average base emission rate and an adjustment factor as shown in Equation B.1-1 below:

$$P(d,h) = Po * A(d,h) \qquad \textbf{Equation B.1-1}$$

In this case, Po is the average base emission rate in mass per unit time and A(d, h) is an adjustment to the base emission rate to produce the actual emission rate in kilograms per hour. It is convenient to write the emissions in this format because many of the flows associated with a process or even different processes can have the same adjustment factors so that data storage space can be reduced by referencing the same adjustments repeatedly. It should also be noted that for convenience that Po does not have to be in kilograms per hour in the IED. It can be in kilograms per hour, kilograms per day, or kilograms per year. To provide this convenience requires that A(d,h) be defined so that the product Po * A(d,h) produces kilograms per hour. The process to do this will be discussed more later.

In working with sources in a region, it is not always practical to track each individual source. Thus, it is standard practice in inventories to treat the larger sources as, what are called, point sources. These are tracked as individual sources, and used to track smaller sources as a group, which are referred to as area sources. An area source is viewed as a source of emissions spread out over all or part of a region; although in reality, an area source is just a collection of many smaller mobile or non-mobile sources. In order to account for different emission rates in different locations for area sources, the IED divides the region into a grid system. The grid system used in the IED is based on one kilometer by one kilometer grid squares. Thus, in the case of an area source, Equation B.1-1 is rewritten as shown in Equation B.1-2 below:

P(n,m,d,h) = Po * A(n,m,d,h) **Equation B.1-2**

In this case the n and m identify the grid cell of interest and A(n,m,d,h) is an adjustment to produce the area source emissions that occur in the n,m grid cell for the day and hour.

Section B.2: Evaluation of the Base Emission Rate (Po) for a Process

The base emission rate, Po, represents the emissions or flows, in the case of the evaluation of product or energy use, to and from the process in mass or other unit of emissions per unit time. Available data may lead to the base emission rate being more easily recorded as emissions per day or emissions per year or emissions per unit of equipment or emissions per volume, distance, or time of operation. It is also valuable in the case of point sources to track the maximum possible emissions that the process can produce. This is called, in most cases, the "potential to emit" for the process. Thus, there is a need in the database to allow for emissions to be recorded or calculated in more than one way and then to correct the emissions from whatever form they are recorded into actual kilograms per hour. This is done in the database with an additional correction terms as denoted in Equation B.2-1.

Po = Pb * Qr **Equation B.2-1**

> Where Po = overall process emissions (kg/time), Pb = emission rate (mass/time, volume, or other units), Qr = overall quantity of activity to convert emissions to mass/time.

In the IED, Pb will thus be the base emission rate as recorded in the database and Qr is a correction factor to correct the data to actual kilograms per unit time. The term Qr refers to the quantity of activity, and can vary depending upon the process in reference. For example, Qr can be the fraction of maximum rate, or in the case of area sources, the number of units of equipment or volume or other metric to produce the required mass (kilograms) in the IED, when multiplied with Pb.

Referring to the three classes of sources indicated in Table B.1-1, Table B.2-1 provides more specific definitions for the use of the terms Qr relative to Pb.

Table B.2-1: Options for the Terms Pb and Qr in the IED

Process Type	Pb Definition	Qr Requirement
Point Source	Maximum Emission Rate (kg/hr)	Average operating fraction of maximum capacity
	Actual Emission Rate (kg/hr)	1
	Daily Emissions	1
	Total Annual Emissions	1
Area/Units	Actual Emission Rate (kg/hr)	1
	Daily Emissions	1
	Total Annual Emissions	1
	Emissions per unit per hour (kg/hr)	Total number of units in the region
	Emissions per unit per day (kg/day)	Total number of units in the region
	Emissions per unit per year (kg/year)	Total number of units in the region
Area/Scalar	Actual Emission Rate (kg/hr)	1
	Daily Emissions	1
	Total Annual Emissions	1
	Emissions per volume, mass, distance, or other per hour	Hourly volume, mass, distance, or other
	Emissions per volume, mass, distance, or other per day	Daily volume, mass, distance, or other
	Emissions per volume, mass, distance, or other per year	Annual volume, mass, distance, or other

There are two ways to come up with Pb. The most straightforward approach is to simply record Pb as a number in the database. As will be discussed in another appendices discussing the design of the IED tables, there is a location in the database were the Pb for a process can be stored. In cases where emission measurements have occurred at a point source, this is the most accurate way to record the information. However, in many cases with both point sources and especially with area sources, there is no available measured emission rate. In this case, it is standard practice to estimate emissions using an emission factor. This calls for an alternate equation to Equation B.2-1. In this case, Equation B.2-2 is used to estimate emissions.

$$Pb = Emfac * Kf \qquad \text{Equation B.2-2}$$

Where Emfac = emissionfactor in mass/unit key flow
Kf = quantity of key flow

For this case, Emfac is an emission factor derived from the database. The emission factor represents emissions per some metric based on the definition of the emission factor. For example Emfac can be emissions per mass of coal burned or per area of wood treated. Thus, to calculate Pb using an emission factor, the user must know both the emission factor and the amount of the key flow for the process that is used to calculate the emissions. Kf may simply have the value of one or it may be a value to produce the desired Po in the proper units. Table B.2-2 provides some examples for the use of Kf.

Table B.2-2: Examples of the Definition of Kf in the case of a Point Source

Source Type	Emission Factor	Pb Formulation	Value of Kf
Point	Emissions per unit, volume, mass, or energy used or produced	Maximum Emission Rate (kg/hr)	Number of units or volume, mass, or energy used or produced at maximum capacity of the equipment.
		Actual Emission Rate (kg/hr)	Average number of units or volume, mass, or energy used or produced at a defined hour.
		Daily Emissions	Average number of units or volume, mass, or energy used or produced in a day in a defined season.
		Total Annual Emissions	Average number of units or volume, mass, or energy used or produced over the year.
Area/Units or Scalar	Emissions per unit, volume, mass, distance or energy used or produced	Average Emission Rate (kg/hr)	Average number of units or volume, mass, or energy used or produced at a defined hour in the entire region.
		Daily Emissions	Average number of units or volume, mass, or energy used or produced in a day in a defined season in the entire region.
		Total Annual Emissions	Average number of units or volume, mass, or energy used or produced over the year in the entire region.
		Emissions per unit or scalar per hour (kg/hr)	1
		Emissions per unit or scalar per day (kg/day)	1
		Emissions per unit or scalar per year (kg/year)	1

If an emission factor is used in the calculation then the time and space adjustments associated with the Key-Flow are used for the calculations rather than the adjustments directly associated with the flow being analyzed.

In summary, to calculate the base emission rate (Po) one of two formulas must be used, either Equation B.2-1 or Equation B.2-2. This calls for the determination of Qr as well as Pb or Emfac and Kf. The values for the terms Qr must be supplied in the database as described in Table B.2-2 and the type of source for which the calculation is being made must be designated. Combining Equations B.1-1 or B.1-2 with Equations B.2-1 or B.2-2 produce four possible results as shown in Equations B.2-3a through B.2-3d.

$$P(d,h) = Pb * Qr * A(d,h) \qquad \text{Equation B.2-3a}$$
$$P(d,h) = EmFac * Kf * Qr * A(d,h) \qquad \text{Equation B.2-3b}$$
$$P(d,h,n,m) = Pb * Qr * A(n,m,d,h) \qquad \text{Equation B.2-3c}$$
$$P(d,h,n,m) = EmFac * Kf * Qr * A(n,m,d,h) \qquad \text{Equation B.2-3d}$$

There is a special case where the emission factor can vary with the grid cell and the time of day and the time of year. This is the case of the on-road vehicle. The vehicle emission rate changes with traffic congestion, temperature, and humidity. These factors can change by grid cell and time. Since on-road mobile sources are typically so important to a region's emissions, the IED, in this special case, makes corrections to the emission factor based on grid cell and the time as indicated in Equation B.2-3e.

$$P(d,h,n,m) = EmFac(n,m,d,h) * Kf * Qr * A(n,m,d,h) \qquad \text{Equation B.2-3e}$$

As is the case for the other flow calculations, the emission factor is written in the IED as a base emission factor multiplied by an adjustment relevant to the grid cell and time of interest as shown in Equation B.2-3f:

P(d,h,n,m) = EmFc*Sp(n,m,d,h) * Kf * Qr * A(n,m,d,h) Equation B.2-3f

where EmFc is the base emission factor and Sp(n,m,d,h) is a correction factor to the emission factor based on environmental and possibly driving conditions in a grid cell in a season and time of day. It is also possible to have a special correction to a base emission rate for any source even without and emission factor. An example might be bio-emissions or tank farms where temperature and humidity might have a significant impact on emission rates.

Section B.3: Calculation of the Adjustment Factors for a Source

Section B.2 developed equations for a source depending on how the base emission rates where formulated. For example, Equation B.2-3a indicates that:

P(d,h) = Pb * Qr * A(d,h) Equation B.2-3a

The formulation of A(d,h), or A(n,m,d,h) for the case of area sources, depends upon the time basis for Pb * Qr. However, it is convenient to standardize the values of A() to the greatest extent possible. This can be done by interjecting a time correction factor denoted as R into Equations B.2-3a through B.2-3b so that

A(d,h) or A(n,m,d,h) = R * Ab(d,h) or R * Ab(n,m,d,h) Equation B.3-1

Once Po is derived from the database, the value for R and the proper correction factor for the day, hour, and grid cell of interest must be developed from the database. It is also convenient to divide the adjustment factor into two components—a seasonal component and an hourly component. Equation B.3-2 indicates the formulation of A as used in the IED for a point source and Equation B.3-3 indicates the formulation of A used in the IED for an area source.

Ab(d,h,n,m) = S(d) * H(d,h) Equation B.3-2

Where
Ab = activity for specific hour and grid cell
S = seasonal/daily activity distribution for a day in season d
H = hourly activity distribution for an hour h and a day in season d

Ab(d,h,n,m) = Fg(n,m) * S(d,n,m) * H(d,h,n,m) Equation B.3-3

Where
Ab = activity for specific hour and grid cell
Fg = time independent spatial activity distribution, for each grid cell
S = seasonal/daily activity distribution, for each grid cell
H = hourly activity distribution, for each grid cell

As noted above, in the case of Equation B.3-2, the S function is a correction for the day of the year and the H function is a correction for the hour of the year for each day of the year. Thus, different days can have different hourly operational patterns. In the case of Equation B.3-3, the Fg function is a time independent correction for distributing the area source emissions among the grid cells, the S function is a correction for the day of the year of interest with the possibility of a different correction for each grid cell, and the H function is a correction for the hour of the day that is being evaluated with the potential of a different correction for each day and grid cell.

Substituting Equations B.3-2 and B.3-3 into Equations B.3-4a through e produces the final equations for evaluating emissions as used in the IED:

P(d,h) = Pb * Qr * R * S(d) * H(d,h) **B.3-4a**
P(d,h) = EmFac * Kf * Qr * R * S(d) * H(d,h) **B.3-4b**
P(n,m,d,h) = Pb * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m) **B.3-4c**
P(n,m,d,h) = EmFac * Kf * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m) **B.3-4d**
P(n,m,d,h) = EmFac(n,m,d,h) * Kf * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m) **B.3-4e**

Finally, for the case of an emission factor, Equation B.2-3f can be substituted into Equation B.3-4e to produce the most general form of this equation as shown in Equation B.3-5a through d below:

P(d,h) = Pb * Qr * R * S(d) * H(d,h) **B.3-5a**
P(d,h) = EmFc * Sp(d,h) * Kf * Qr * R * S(d) * H(d,h) **B.3-5b**
P(n,m,d,h) = Pb * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m) **B.3-5c**
P(n,m,d,h) = EmFc*Sp(n,m,d,h) * Kf * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m) **B.3-5d**

*[NOTE: In the IED flow calculation function code, the Pb*Qr and the equivalent EmFac*Kf*Qr are denoted $L. The Fg*S*H term is denoted $U. Thus, the Flow(Emission) rate = $L * $R *$U. Please see the addendum at the end of this appendix.]*

Estimating S and H:

The IED divides the year into eight seasons or day types. The user can set a season for the winter, spring, summer, and fall for both a weekday and a weekend creating eight "seasons" in the IED. It is valuable to differentiate between weekdays and weekends in most analyses because the sources of emissions and other flows can differ substantially between weekdays and weekends and in some cases air pollution levels have been found to be worse on weekends than on weekdays. It is also common in some locations to evaluate only two times of the year: winter and summer. This is because most air pollution problems occur in either the winter or the summer with the winds in spring and fall keeping air pollution levels lower. In this case, a winter weekday, a winter Saturday, and a winter Sunday could be set up and then summer weekday, summer Saturday, and a summer Sunday using six of the eight options. The "days" denoted in the previous equations are intended to be representative of a typical day in one of the eight seasons of interest. However, for non-air pollution related analyses, the use of all four seasons is normally best. It is important to note here that regardless of the approach to defining the seasons that all days of the year must be accounted for. Thus, if the year is broken into only four parts as discussed above instead of eight, the user must select the number of days to assign to each season definition and those days must add up to 365. This is needed to support the development of annual emission inventories of flows.

The S functions are maintained in the IED as an eight value set that represent correction factors to adjust the emissions for each of the representative days for the eight seasons. In the case of S for a point source, there is only one value that will ultimately be used for the calculation, and the value does not change with grid cell. In the case of S for an area source, there can be a different seasonal/daily adjustment for each grid cell.

The H functions are maintained in the IED as a set of twenty-four values representing each hour of the day. For H for an area source, there can be a different set of twenty-four values for each grid cell.

The tables that hold the seasonal and hourly values are discussed in other appendices. It suffices here to understand that when the calculation process needs a correction for a certain day or in the case of an area source for a certain day and certain grid cell, a set of eight values are provided that cover the eight seasons. Similarly, when the calculation process calls up a correction for a certain hour and day or in the case of an area source for a certain hour, day, and grid cell that twenty-four values are provided, one for each hour of the day. These eight or twenty-four values are stored in the database as "normalized" sets of numbers. This means that if the values in a set are added up, the values in any set will add up to 1. Put another way, $\sum_{(d=1to8)}S(d) = 1$ and $\sum_{(h=1to24)}H(d,h)= 1$. Since the values in the season set of numbers or the hour set of numbers are assumed to be relatively correct, then the job of the calculation process in the database is to adjust all of the numbers in the normalized sets up or down to make them consistent with the format of the base emission rate.

Calculating R:

The term R can be thought of as a unit conversion to make the multiplying of the season and hour activity values (S,H) and the emissions (Pb,Qr) units into a consistent basis, of mass/time. Because of this, the value of R changes depending upon the input values of Pb and Qr. As discussed in Section B.2 it is useful to allow the database user to input the base emission rate data into the database in different formats for different source types. Equations B.3-3 and B.3-4 must be modified to accommodate these different types of base emission rate formulations. For purposes of this discussion, the base emission rate supplied by the database will be denoted Pb * Qr. Referring to Table B.2-2, Pb * Qr will be actual emissions for an hour for a predetermined season and hour or emissions over a day in one of the seasons or emissions for the year. Depending upon the nature of Pb * Qr, the value of R in Equations B.3-4a through e must be determined. For example, the original Equation B.3-4a is

P(d,h) = Pb * Qr * R * S(d) * H(d,h) where P(d,h) is in mass per hour**.**

For a given d = x, and h= y, then Equation B.3-4a becomes:

Emissions in mass for hour y = P(x,y) = Pb*Qr * R*S(x)*H(x,y).

For calculating emissions for a whole day x, formula B.3-4a becomes:

Emissions in mass per day = $\sum_{(h=1to24)}$[1] $P(x,h) = Pb*Qr*R*S(x)* \sum_{(h=1to24)} H(x,h)$.

Likewise, for a given year, formula B.3-4a becomes:

Emissions in mass per year = $\sum_{(d=1to365)} \sum_{(h=1to24)} P(d,h) = Pb*Qr*R*\sum_d \sum_h [N(d) * S(d) * H(d,h)]$ where N(d) is the number of days in a season and $\sum_{(d=1to8)} N(d) = 365$.

In the case of an area source, the summations must be carried out over all grid cells.

Thus, R can be calculated as follows:

1) Flow Basis in flow per hour for season x and hour y:

$$R = 1/ [S(x)*H(x,y)]$$

or

$$R = 1/ \{\sum_n \sum_m [Fg(n,m) * S(n,m,x)*H(n,m,x,y)]\}$$

2) Flow Basis in total flow per day for season x:

$$R = 1/[S(x)* \sum_h H(x,h)]$$

or

$$R = 1/\{\sum_n \sum_m [Fg(n,m) * S(n,m,x)* \sum_h H(n,m,x,h)]\}$$

3) Flow Basis in total annual flow:

$$R = 1/\{\sum_d \sum_h [N(d) * S(d) * H(d,h)]\}$$

or

$$R = 1/\{\sum_n \sum_m Fg(n,m) * \sum_d \sum_h [N(d) * S(d) * H(n,m,d,h)]\}$$

*[NOTE: As discussed earlier in Section B3 the term $U is used in the IED flow calculation function to equal $U = Fg(n,m) * S(n,m,d,h)*H(n,m,d,h). This equation can be viewed as applying to point sources as well as area sources if Fg(n,m) is viewed to be zero for all grid cells except the grid cell where the point source is located and is equal to one for this grid cell. Similarly, S and H can be assumed for point sources to have no value except in the grid cell where the point source is located. In this sense, R is calculated as* $1/\{\sum_n \sum_m \$U(n,m,x,y)\}$ *for a basis of an hour,* $1/\{\sum_n \sum_m \sum_h \$U(n,m,x,y)\}$ *for a basis of a day, and* $1/\{\sum_n \sum_m \sum_d \sum_h N(d) * \$U(n,m,x,y)\}$ *for a basis of a year for a point or area source.]*

The following paragraphs discuss in more detail the 6 different user provided formulations of Pb*Qr and ways to simplify the calculation:

Case 1. Pb * Qr supplied as actual mass per hour for a specific day=x and hour=y: In this case, the Pb * Qr corresponds to emissions for a specific day and hour. In other words**:**

Emissions in mass for day x and hour y = Pb* Qr

---

[1] The summation $\sum_{(h=1to24)}$ and $\sum_h$ are used interchangeably in the text to shorten the equations. If the range of h or d, in the case of summations over the seasons, is other than over the entire range of values, the range will be indicated.

Also, we know from Equation B.3-4 that:

Emissions in mass for day x and hour y = P(x,y) = Pb*Qr*R*S(x)*H(x,y)

Combining the two equations yields:

$$Pb * Qr = Pb * Qr * R * S(x) * H(x,y)$$

Therefore, one can calculate R as:

$$R = 1/[S(x) * H(x,y)] \qquad \textbf{Equation B.3-6}$$

Case 2. Pb * Qr supplied as a daily total emissions for a specific day=x: In this case, the sum of all emissions over the day x must add up to Pb*Qr. In other words,

Mass emissions per day = Pb*Qr

Also, we know from Equation B.3-4 that:

Emissions in mass per day = $\sum_h P(x,h)$ = Pb*Qr*R*S(x)* $\sum_h H(x)$ for the day x.

Combining the two equations yields:

$$Pb * Qr = Pb * Qr * R * S(x) * \sum_h H(x,h)$$

As indicated earlier, by definition, $\sum_h H(x,h) = 1$. Thus, solving for R,

$$R = 1/S(x) \qquad \textbf{Equation B.3-7}$$

Case 3. Pb * Qr supplied as total annual emissions: In this case, the sum of all seasons and hours must add up to Pb * Qr. However, the IED allows the user to specify the different seasons independently so that they can have a different number of days. For this discussion, the number of days that a season represents will be indicated by N(d). In this case, $\sum_d N(d) = 365$. Another way to say Case 3 is:

Annual Emissions = Pb*Qr

And also, we know from Equation B.3-4 that:

Annual Emissions = $\sum_d \sum_h P(d,h)$ = Pb*Qr*R*$\sum_d$[N(d)*S(d)]* $\sum_h$H(d,h).

Combining the two equations yields:

$$Pb * Qr = Pb * Qr * R * \sum_d \sum_h [N(d) * S(d) * H(d,h)]$$

or

$$\mathbf{R = 1/\{\textstyle\sum_d[N(d) * S(d) * \sum_h H(d,h)]\} = 1/\{\sum_d[N(d) * S(d)]\}} \quad \textbf{Equation B.3-8}$$

Case 4:

In the case of area sources, the base emission rate comes in the same three forms but they will be for the whole region rather than a single grid cell.

Pb * Qr supplied as actual total mass emissions for an entire region per hour for a specific day=x and hour=y: In this case, the Pd * Qr corresponds to emissions for a specific day and hour. In other words:

Mass emissions for day x and hour y for all grid cells = Pb*Qr.

Also, from Equation B.3-4,

Mass emissions for day x and hour y for all grid cells = $\mathbf{\sum_n \sum_m P(x,y,n,m) = Pb*Qr*R*\sum_n \sum_m [Fg(n,m) * S(x,n,m) * H(x,y,n,m)]}$.

Combining the two yields:

$$\mathbf{Pb * Qr = Pd * Qr * R * \textstyle\sum_n \sum_m [Fg(n,m) * S(x,n,m) * H(x,y,n,m)]}$$

or

$$\mathbf{R = 1/\{\textstyle\sum_n \sum_m [Fg(n,m) * S(x,n,m) * H(x,y,n,m)]\}} \quad \textbf{Equation B.3-9}$$

If S and H do not vary with grid cell, then Equation B.3-9 becomes the same as Equation B.3-6. This means that in cases where all grid cells have the name seasonal and daily patterns that the area source can be treated almost like a point source with the exception of the $\sum_n \sum_m$ Fg(n,m) term which always sums to 1.

Case 5.

Pb * Qr supplied as total daily emissions for the entire region for a specific day=x: In this case, the sum of all emissions for all grid cells and over the day x must add up to Pd*Qr. In other words,

Mass emissions per day x for all grid cells = Pb*Qr.

Also, from Equation B.3-4,

Mass emissions per day x for all grid cells = $\mathbf{\sum_n \sum_m \sum_h P(x,h,n,m) = Pb*Qr*R*\sum_n \sum_m [Fg(n,m) * S(x,n,m) * \sum_h H(x,h,n,m)]}$.

$$\mathbf{Pb * Qr = \textstyle\sum_n \sum_m Pb * Qr * R * Fg(n,m) * S(x,n,m) * \sum_h H(x,h,n,m)}$$

As noted earlier, by definition, $\sum_h H(x,h) = 1$. Thus, solving for R,

$$\mathbf{R = 1/\textstyle\sum_n \sum_m Fg(n,m) * S(x,n,m)]} \quad \textbf{Equation B.3-10}$$

And as noted in the previous discussion, if S is the same for a grid cells then the formula is the same as the case for point sources with the exception of the term $\sum_n \sum_m Fg(n,m)$, which sums to 1. Thus, this type of area source can be treated as a point source for the calculation of R in this special case.

Case 6:

Pb * Qr supplied as total annual emissions for all grid cells: In this case, the sum of all seasons and hours and grid cells must add up to Pd*Qr. However, as noted earlier, the IED allows the user to specify the different seasons independently so that they can have a different number of days. For this discussion, the number of days that a season represents will be indicated by N(d). In this case, $\sum_d N(d) = 365$. In other words:

Annual emissions over all grid cells = Pb*Qr

From Equation B.3-4,

Annual emissions over all grid cells = $\mathbf{\sum_d \sum_h \sum_n \sum_m P(d,h,n,m) = Pb*Qr*R*\sum_d \sum_h \sum_n \sum_m [Fg(n,m) * S(d,n,m) * \sum_h H(d,h,n,m)].}$

Combining the two equations:

$$\mathbf{Pb * Qr = Pb * Qr * R * \sum_n \sum_m \{Fg(n,m) * \sum_d [N(d) * S(d,n,m)] * \sum_h H(d,h,n,m)]\}}$$

Solving for R results in Equation B.3-11

$$\mathbf{R = 1/\{\sum_n \sum_m \{Fg(n,m) * \sum_d [N(d) * S(d,n,m)]\}} \qquad \textbf{Equation B.3-11}$$

Repeating earlier statements, in cases where S does not vary with location then Equation B.3-11 is the same as the case for a point source with the exception of the term $\sum_n \sum_m Fg(n,m)$, which equals 1.

The value in defining the Rs in the various equations as discussed above is that the PHP routines can calculate the value of R as long as the database user specifies the form of the base emission rate provided in the database. A place has been made available in the database to specify the format of the base emission rate for this purpose. This leaves flexibility for the user to define their base emission rates in several common formats. All of the seasonal and hourly correction factors add up to 1 and are maintained in the database in this normalized format enabling the use of the same seasonal and hourly adjustment sets for many different point and area source processes rather than creating totally different adjustments sets depending upon the format of the base emission rate. One potential drawback for normalizing the seasonal and hourly adjustment sets is for the case where a business owner might be asked to indicate the seasonal and hourly values for their business. The normalized format could be a little confusing. However, this can be solved by letting the business owner enter the season and hourly sets in any format as long as they are relatively correct and then the PHP code can be used to normalize the data when it is actually entered into the database.

Section B.4: Use of Formulas to Estimate Process Activity

In some cases, it is more appropriate to use environmental information such as ambient temperature to predict source activity. This is normally the case for the activities of the public such as space heating or outdoor activities such as painting. The IED provides an option to use formulas based on environmental data to estimate source activity. In this case, a reference to an equation is placed in the SeasonalGridPtr column for the process of interest. The case for use of an equation follows a similar pattern to the cases referenced earlier. The equation for estimating emissions using a formula is shown below:

For a point source,

$$P(d,h) = Pb * Qr * R * Hg(Tp(d,h), Hm(d,h), Ws(d,h), Wr(d,h)) \qquad \textbf{Equation B.4-1}$$

For an area source,

$$P(d,h)=Pb*Qr*R*Fg(n,m)*Hg(Tp(d,h,n,m), Hm(d,h,n,m), Ws(d,h,n,m), Wr(d,h,n,m)) \qquad \textbf{B.4-2}$$

In this case, the formula Hg is a function of temperature (Tp), humidity (Hm), wind-speed (Ws), and wind-direction (Wr); and each of the environmental variables are, of course, functions of the grid cell, season and hour. As discussed in Section B.3, three cases are allowed in the IED. The calculation of the value of R for each case is illustrated below; although, some of the steps have been left out since they are essentially the same as considered in the previous section.

Case 7: Point Source
Input information (Pb*Qr) represents emissions for a the specific day x and hour y. In this case,

$$R * Hg(Tp(x,y), Hm(x,y), Ws(x,y), Wr(x,y)) = 1 \text{ or}$$

$$R = 1/ Hg(Tp(x,y), Hm(x,y), Ws(x,y), Wr(x,y)) \qquad \textbf{Equation B.4-3}$$

Case 8: Point Source
Input information (Pb*Qr) represents the total emissions for the specific day x. In this case,

$$R * \sum_{h=0 \text{ to } 23} Hg(Tp(x,h), Hm(x,h), Ws(x,h), Wr(x,h)) \text{ must equal 1 or}$$

$$R = 1/\sum_h Hg(Tp(x,h), Hm(x,h), Ws(x,h), Wr(x,h)) \qquad \textbf{Equation B.4-4}$$

Case 9: Point Source
Input information (Pb*Qr) represents the total emissions for the year. In this case,

$$R * \sum_d [N(d) \sum_h Hg(Tp(d,h), Hm(d,h), Ws(d,h), Wr(d,h)) \text{ must equal 1 or}$$

$$R = 1/\sum_d [N(d) \sum_h Hg(Tp(d,h), Hm(d,h), Ws(d,h), Wr(d,h))] \qquad \text{Equation B.4-5}$$

Case 10: Area Source
Input information (Pb*Qr) represents emissions for a the specific day x and hour y for all grid cells. In this case,

$$\sum_n \sum_m R * Fg(n,m) * Hg(Tp(x,y,n,m), Hm(x,y,n,m), Ws(x,y,n,m), Wr(x,y,n,m)) = 1 \text{ or}$$

$$R = 1/\sum_n \sum_m Fg(n,m) * Hg(Tp(x,y,n,m), Hm(x,y,n,m), Ws(x,y,n,m), Wr(x,y,n,m)) \qquad \text{B.4-6}$$

Case 11: Area Source
Input information (Pb*Qr) represents the total emissions for the specific day x for all grid cells. In this case,

$$\sum_n \sum_m \sum_h R * Fg(n,m) * Hg(Tp(x,h,n,m), Hm(x,h,n,m), Ws(x,h,n,m), Wr(x,h,n,m)) \text{ must equal 1 or}$$

$$R = 1/\sum_n \sum_m \sum_h Fg(n,m) * Hg(Tp(x,h,n,m), Hm(x,h,n,m), Ws(x,h,n,m), Wr(x,h,n,m)) \qquad \text{B.4-7}$$

Case 12: Area Source
Input information (Pb*Qr) represents the total emissions for the year for all grid cells. In this case,

$$R * \sum_n \sum_m \sum_d Fg(n,m) * [N(d) \sum_h Hg(Tp(d,h,n,m), Hm(d,h,n,m), Ws(d,h,n,m), Wr(d,h,n,m)) \text{ must equal 1 or}$$

$$R = 1/\sum_n \sum_m \sum_d Fg(n,m) * [N(d) \sum_h Hg(Tp(d,h,n,m), Hm(d,h,n,m), Ws(d,h,n,m), Wr(d,h,n,m))] \qquad \text{B.4-8}$$

Section B.5: Summary of Equations and Variables

Tables B.5-1 and B.5-2 summarize the equations for R and the calculation equations.

Table B.5-1: Equations for the Calculation of R

Case	Source Type	Equation
Case 1, 4, 7, 10: Emissions data supplied as hourly emissions for a specific season and hour	Point Source	$R = 1/[S(x) * H(x,y)]$
	Area Source	$R = 1/\{\sum_n \sum_m [Fg(n,m) * S(x,n,m) * H(x,y,n,m)]\}$
	Formula Point	$R = 1/ Hg(Tp(x,y), Hm(x,y), Ws(x,y), Wr(x,y))$
	Formula Area	$R = 1/\sum_n \sum_m Fg(n,m) * Hg(Tp(x,y,n,m), Hm(x,y,n,m), Ws(x,y,n,m), Wr(x,y,n,m))$
Case 2, 5, 8, 11: Emissions data supplied as daily total for a specific season.	Point Source	$R = 1/S(x)$
	Area Source	$R = 1/\sum_n \sum_m Fg(n,m) *S(x,n,m)]$
	Formula Point	$R = 1/\sum_h Hg(Tp(x,h), Hm(x,h), Ws(x,h), Wr(x,h))$
	Formula Area	$R = 1/\sum_n \sum_m Fg(n,m) * \sum_h Hg(Tp(x,h,n,m), Hm(x,h,n,m), Ws(x,h,n,m), Wr(x,h,n,m))$
Case 3,6, 9, 12:	Point Source	$R = 1/\{\sum_d [N(d) * S(d)]\}$

Emissions data supplied as annual total	Area Source	$R = 1/\{\sum_n \sum_m \{Fg(n,m) * \sum_d[N(d) * S(d,n,m)]\}$
	Formula Point	$R = 1/\sum_d [N(d) * \sum_h Hg(Tp(d,h), Hm(d,h), Ws(d,h), Wr(d,h))]$
	Formula Area	$R = 1/\sum_d [N(d) * \sum_n \sum_m Fg(n,m) * \sum_h Hg(Tp(d,h,n,m), Hm(d,h,n,m), Ws(d,h,n,m), Wr(d,h,n,m))]$

Table B.5-2: Equations for Calculation of Emission Rate[2]

Source Type	Calculation Process	Equation
Point	Measured Emissions / Adjustments in IED Tables	**P(d,h) = Pb * Qr * R * S(d) * H(d,h)**
	Emission Factor / Adjustments in IED Tables	**P(d,h) = EmFac * Kf * Qr * R * S(d) * H(d,h)**
	Measured Emissions / Formula	**P(d,h) = Pb * Qr * R * Hg(T,H,Ws,Wd)**
	Emission Factor / Formula	**P(d,h) = EmFac * Kf * Qr * R * Hg(T,H,Ws,Wd)**
Area	Measured Emissions / Adjustments in IED Tables	**P(n,m,d,h) = Pb * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m)**
	Emission Factor / Adjustments in IED Tables	**P(n,m,d,h)= EmFac(n,m,d,h) * Kf * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m)**
	Measured Emissions / Formula	**P(n,m,d,h) = Pb * Qr * R * Fg(n,m) * Hg(T,H,Ws,Wd)**
	Emission Factor / Formula	**P(n,m,d,h) = EmFac * Kf * Qr * R * Fg(n,m) * Hg(T,H,Ws,Wd)**
On-Road Mobile	Emission Factor / Adjustments in IED Tables	**P(n,m,d,h) = EmFac(n,m,d,h) * Kf * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m)**

It is also important to recall that in the cases where an emission factor is used to calculate Po that the Fg, S, and H adjustments associated with the key flow for the flow of interest are used for calculating the hourly flow rate instead of the adjustments directly associated with that flow. The adjustments directly associated with the flow of interest will be ignored. Normally, it would be expected that the Fg, S, and H adjustments associated with a key flow will be the same as those associated with the related flows.

Table B.5-3 defines the terms in the previous equations and indicates the variable names used in the PHP code for these terms. The PHP code for the emissions calculation can be found at: (/www/var/library/emissionCalculationClass.php).

Table B.5-3: Definition of Terms Used in Calculation of Emissions Rate

Variable	PHP Code Variable	Definition
d	$Season	Indicates the season represented by the day of interest. Has eight values:A1,B1,C1,D1,A2,B2,C2,D2. Meaning of values found in SeasonDescription table.
h	$Hour	Indicates the hour of the day. Has twenty-four values: 00 to 23.
n	$GridRow	Indicates the grid row in the regional grid
m	$GridColumn	Indicates the grid column in the regional grid
P(d,h)	$EmissionRate	The final result of the emissions calculation. Emissions in kilograms/hour for the day d and hour h.
P(d,h,n,m)	$EmissionRate	The final result of the emissions calculation. Emissions in kilograms/hour for the day d, hour h, and cell n,m.

[2] It is worth noting that the emission factors can also be adjusted for the age of the source and special corrections can be made for example for on-road mobile for congestion and for storage tank VOC emissions for wind and temperature.

Pb	$Pb	Base emission rate for source. Located in ProcessFlow table in column "Flow" or calculated using an emission factor and key flow.
Qr	$Qr	Quantity/Activity adjustment value. Located in ProcessFlow table in column "GenActivityAdj".
R	$R	Units adjustment factor. Calculated by the PHP code.
S(d)	$Sadj [$SourceRow][$SourceColumn][$d]	Seasonal adjustment for the emission rate for the case of a point source for the day d.
S(n,m,d)	$Sadj[$n][$m][$d]	Seasonal adjustment for the emission rate for the case of an area source for the day d and the cell n,m.
H(d,h)	$Hadj [$SourceRow][$SourceColumn][$d][$h]	Hourly adjustment for the emission rate for the case of a point source for the day d, hour h.
H(d,h,n,m)	$Hadj[$n][$m][$d][$h]	Hourly adjustment for the emission rate for the case of an area source for the day d, hour h, cell n,m.
Fg(n,m)	$Fg[$n][$m]	Grid cell adjustment value for the cell n,m.
N(d)	$NumSeasonDays[$d]	Number of days in season d. Can be found in SeasonDescription table column "DaysInSeason".
Emfac	$Emfac	Emission factor for the source of interest.
Kf	$Kf	Key flow for the source of interest.
Hg	$Hg	Formula to calculate activity based environmental conditions. This represents the result from the calculation.
Tp	$Tmp	Ambient temperature in degrees Celsius
Hm	$Hum	Humidity in percent humidity
Ws	$WSp	Wind speed in meters/sec
Wr	$WDr	Wind direction in degrees
Yr	$Yr	Years of aging to be used in aging correction calculation
Ag	$AgC	The aging correction value produced by the aging correction calculation. Used for aging emission factors.
SpCor	$SpCor	The special correction adjustment used typically for mobile sources but available for other sources.

Section B.6: Calculation of Emissions from On-Road Mobile Sources

The calculation of emissions from on-road mobile sources follow the same general process as the calculations for any area source. However, in the case of on-road mobile sources, which are typically the most important source of air pollution in a region, a slightly more complex calculation process is followed. Referring to Equation B.3-4e,

$$P(n,m,d,h) = EmFac(n,m,d,h) * Kf * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m) \qquad \text{B.3-4e}$$

As can be seen in this equation, the emission factor is assumed to be a function of the grid cell in which the calculation is being made. This is particularly true of on-road mobile sources. Traffic congestion (producing different driving patterns) and temperatures can vary from grid square to grid square. A change in driving pattern or temperature will impact the emission factor for a mobile source. In the case of on-road mobile sources, Fg, S, and H are used to adjust the vehicle activity, which is in the case of on-road mobile sources, the distance that is being driven. Kf can be set to one for the case of mobile sources and Qr set to the total distance driven in the selected timeframe. The calculation can be carried out in reverse where Kf is set to the total distance driven in the selected timeframe and Qr set to one in this case. The result of the calculation will be the same in either case, however, it is important that the same approach be used for all mobile sources.

In the case of on-road mobile, EmFac is written,

EmFac(n,m,d,h) = EmFacBase * AgCor * GCor(n,m,d,h) **Equation B.6-1**

where,

EmFacBase = the base emission rate for the vehicle driving under standard driving conditions in a standard driving pattern for the base year of the calculation.
AgCor = the age correction for the emission factor. As a vehicle gets older its emission factor tends to increase. This term corrects for the aging of the vehicle.
GCor(n,m,d,h) = the gridcell correction for the gridcell n,m. This correction depends upon the driving pattern, temperature, and humidity that exists in the gridcell during the season and hour of calculation.

The EmFacBase term is derived from the EmissionFactorFinder table. The process flow (a row in the ProcessFlow table) for the on-road vehicle of interest should contain an SCCx_Code that can be referenced to the EmissionFactorFinder table. Similary, the AgCor term is derived from the AgingFactorFinder table. The EmissionFactorFinder table contains a reference to the AgingFactorFinder table to find the correct aging approach for the vehicle of interest. A base date can be found in the EmissionFactorFinder table in the column denoted 'ApplicableDate'. The function used to calculate the process flow can be told to use the 'ApplicableDate' in the EmissionFactorFinder table or a specific date can be indicated if the user wants a different date for some reason.

The calculation of the GCor term is more complex. Three pieces of information are needed. These are the temperature and humidity in the grid cell at the season and time of interest and the average driving pattern that exists in the grid cell at the season and time of interest. The temperature and humidity information can be determined indirectly from the EnviroGridDistribution table. This table contains a references to the HourlyAdjustment table were actual hourly temperature and humidity values are located. The driving pattern is derived by determining the DrivingClass for the gridcell, which is located in the FixedGridDistribution table, and this DrivingClass is used as a reference in the DrivingPatterns table to find the appropriate formula to calculate the GCor term based on temperature and humidity. The BaseFlowCalculation() function handles these calculations and allows for accurate evaluations if the data located in the various tables is appropriate.

Section B.7: Location of Flow Calculation Values in the IED

The key equations for making a flow calculation for the IED are:

P(n,m,d,h) = Pb * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m) **B.3-5c**
P(n,m,d,h) = EmFc*Sp(n,m,d,h) * Kf * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m) **B.3-5d**
and

$$R = 1/\{\sum_n \sum_m Fg(n,m) * \sum_d \sum_h [N(d) * S(d) * H(d,h)]\}$$

Table B.7-1 below indicates the location of the values needed to make a flow calculation:

Table B.7-1: Location in the IED of Key Flow Calculation Variables

Variable	Variable Variation	Value
Pb	single	ProcessFlow.Flow /w ProcessFlow.ProcessFlowID = ??
Qr	single	ProcessFlow.GeneralActivityAdjustment /w ProcessFlow.ProcessFlowID = ??
Fg	each grid cell	FixedGridDistribution.[ProcessFlow.FixedGridColumn] w/FixedGridDistribution.GridRow = ?? and FixedGridDistribution.GridColumn = ??
S	single	SeasonalAdjustments.Season?? w/SeasonalAdjustments.SeasonalAdjustmentKey = ProcessFlow.SeasonalGridPtr
S	each grid cell	SeasonalAdjustments.Season?? w/SeasonalAdjustments.SeasonalAdjustmentKey = SeasonalGridAdjustments.[ProcessFlow.SeasonalGridPtr w/SeasonalGridAdjustments.GridRow = ?? and SeasonalGridAdjustments.GridColum= ??]
H	single	HourlyAdjustments.H?? w/HourlyAdjustments.HourlyAdjustmentKey = ProcessFlow.HourlyGridSeason??Ptr
H	each grid cell	HourlyAdjustments.H?? w/HourlyAdjustments.HourlyAdjustmentKey = HourlyGridAdjustments.[ProcessFlow.HourlyGridSeason??Ptr w/HourlyGridAdjustments.GridRow = ?? and HourlyGridAdjustments.GridColumn = ??]
Kf	single	ProcessFlow.Flow w/ProcessFlowID = [ProcessFlow.Key Flow w/ProcessFlowID = ??]
N	single	SeasonDescription.DaysInSeason w/SeasonDescription.SeasonKey = ??
EmFc	single	A query must be made on the emission factor finder table to identify five coefficients plus a formula for the coefficients to go into plus the identity of four extra information components that must be found in the ExtraInputInfo table for the source of interest.
Sp	each grid cell	Queries must be made on the EnviroGridDistribution table to get a pointer for the temperature, humidity, and wind-speed in the grid cell of interest for the season of interest. These pointers are used in the HourlyAdjustments table to find the hourly temperature, humidity, and windspeed at the hour of interest. A query must be made to the FixedGridDistribution table in the RoadClass column to get the class of roads in the grid cell of interest. Using the road class a query must be made on the DrivingPattern table for the season of interest to get a pointer to be used in the HourlyAdjustments table that identifies the driving pattern in the grid cell, season, and hour of interest. This driving pattern is used in a query on the SpecialCorrections table to get the formula needed to make the calculation of the special correction using the temperature, humidity, etc.

Appendix C
Calculation of On-Road Mobile Source Emissions

Section C.1: Overview

On-road mobile sources are one of the most important contributors to local, regional, and global air pollution. Thus, it is critical for the IED inventory system to have the capability of producing accurate estimates of on-road mobile source emissions. Unfortunately, the formation of emissions from on-road vehicles is very complex and depends not only on the type of vehicle but how that vehicle is being driven. This means that the IED process for estimating on-road mobile sources emissions must be complex.

While the calculation of emissions from mobile sources is discussed in other Appendices, it is useful to have a special appendix that discusses the key aspects of the calculation process so that the IED user can most effectively use the database system. In addition to this appendix, the reader should also review Appendix B, which discusses the overall emissions calculation process, as well as the other appendices in this manual.

Since on-road mobile sources are a form of area source, their emissions will be distributed over the region of interest. The emissions in a single grid cell follow the standard emission calculation procedure. That is:

$$\mathbf{Q(}r,c,d,h\mathbf{)=Ef(}r,c,d,h\mathbf{)\ *\ A(}r,c,d,h\mathbf{)} \qquad \textbf{Equation C.1-1}$$

Where '**Q**' represents the emissions, '**Ef** 'the emission factor, and '**A**' the activity factor. 'r' represents the row and 'c' represents the column of the grid system while 'd' represents the day of the year (season) and 'h' represents the hour of the day.

The complication in the database is the calculation of the emission factor (**Ef**) and the activity (**A**) to use in the calculation.

Section C.2: Emission Factor

The IED calculates the emission factor as shown in equation C.2-1. As shown, a base emission factor (Efb) is multiplied by a potential emission factor aging correction (Ag), and a correction related to road congestion (Sp). Thus, the emission factor is computed as follows:

$$\mathbf{Ef(}r,c,d,h\mathbf{)=Efb\ *\ Ag(}y_d\mathbf{)\ *\ Sp(}r,c,d,h\mathbf{)} \qquad \textbf{Equation C.2-1}$$

Where y_d represents the difference between the present year and the year specified for the emission factor. The remaining variables are as for equation C.1-1.

The EmissionFactorFinder table includes a formula option (**FormulaKey**) for calculating the base emission factor or a series of calculation factors (**CalFactor1**, **Calfactor2**, . . . **Calfactor5**). It also specifies an aging code pointer (**AgingCodeKey**) and a year (**YearNew**) for the base year for the emission factor. The actual information for aging the emission factor is located in the AgingFactorFinder table. Please see Appendix D for a full discussion of the EmissionFactorFinder table.

The congestion correction (denoted in other appendices as the "Special Correction Factor") is a more complicated process and is determined from a pointer in the **SpecialCorrectionKey** column. The SpecialCorrectionKey refers to rows in the SpecialCorrections table that have the same key. For the case of on-road mobile sources there can be multiple rows with the same **SpecialCorrectionKey**. To specify the specific row to use, the SpecialCorrections table also contains a column for driving patterns (**DrivingPatternKey**) for the case of on-road sources. To determine the DrivingPatternKey, the IED must determine the driving pattern in a grid cell on a season day and for an hour of that day. Since it is possible for driving in the winter season to be different from driving in the summer and driving on the weekend to be different from driving on a weekday, the IED must make provisions for arriving at the proper driving pattern for the road type, season, and hour in a specific grid cell.

In summary for making the congestion correction to the emission factor, the special correction is determined using the **SpecialCorrectionKey** from the EmissionFactorFinder table and along with this key it must determine the driving pattern for the grid cell, season, and hour of interest. This is done through a three-step process. The IED obtains a pointer for the class of roads in a grid cell from the FixedGridDistribution table. Using the road class pointer found in the FixedGridDistribution table, the IED then looks in the DrivingPatterns table for the record with the pointer found in the FixedGridDistribution table. The IED then goes to the column for the season of interest and region of interest to get a general roadclass/conjestion pointer. The roadclass/conjestion pointer is then used with the HourlyAdjustments table to get a final roadclass/conjestion pointer a pointer for the hour of interest. This final pointer is called the "DrivingPatternKey".

This **DrivingPatternKey** is then used with the **SpecialCorrectionKey** derived earlier from the EmissionFactorFinder table in the SpecialCorrection table to determine the formula to use to make the appropriate special correction. The special correction formula found in the SpecialCorrections table may have no variables or can depend upon the temperature, humidity, and wind speed. In the case of mobile sources, the formula uses temperature and humidity. Figure C.2-1 below illustrates this complex search process.

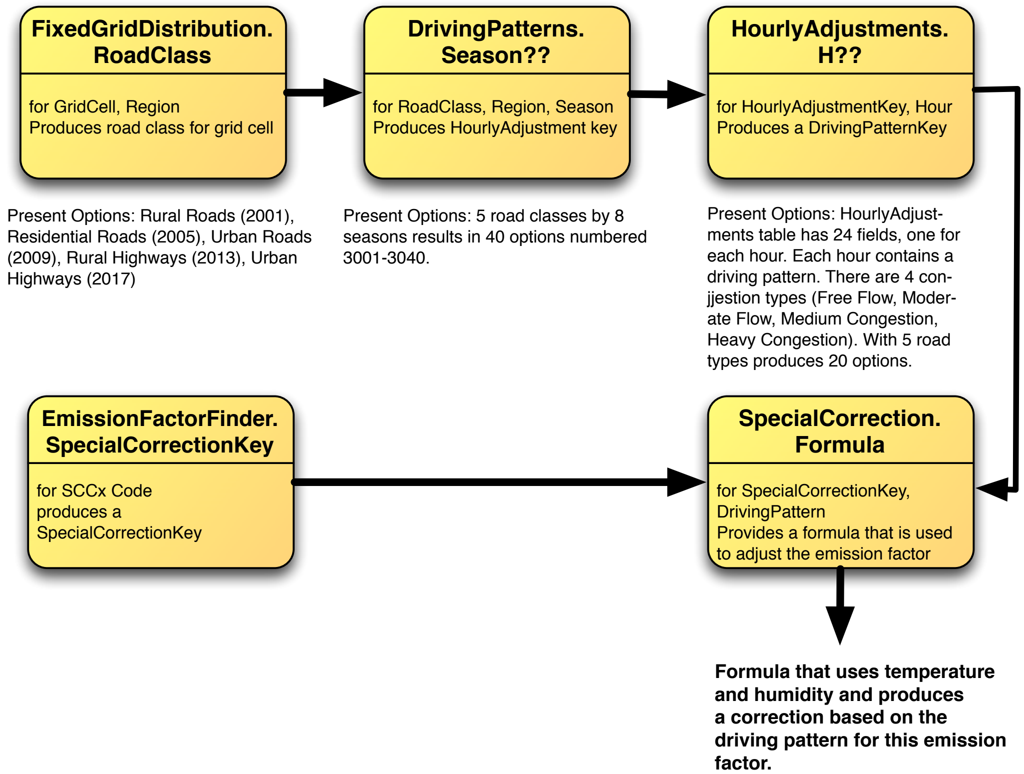

Figure C.2-1: Calculation Flow Chart for the Special Correction Process (Congestion Correction for Mobile Sources) in the IED

With the special correction factor, the base emission factor, and the emission factor aging factor, the IED can determine the appropriate emission factor using equation C.2-1 to use for the grid cell, season, and hour of interest.

Tables C.2-1 and C.2-2 indicate the road classes and driving patterns now set up in the database. There are correction functions for most pollutants for these driving patterns.

Table C.2-1: Road Classes Now In Database

Road Class Index	Description
2001	Rural Roadways: A grid cell in a rural area where the VKT is predominately on non-highway types of roads
2005	Residential Roadways: A grid cell in an area where the VKT is predominately occurring on residential roadways
2009	Urban Roadways: A grid cell in an urban area where the VKT is predominately occurring on non-highway types of roads.
2013	Rural Highways: A grid cell in a rural area where the VKT is predominately occurring on highways.
2017	Urban Highways: A grid cell in an urban area where the VKT is predominately occurring on highways.

Table C.2-2: Driving Patterns Now In Database

Description	DrivingPatternKey
Free Flow--Rural Roadway	1001
Moderate Flow--Rural Roadway	1005
Medium Congestion--Rural Roadway	1009
Heavy Congestion--Rural Roadway	1013
Free Flow--Residential Roadway	1017
Moderate Flow--Residential Roadway	1021
Medium Congestion--Residential Roadway	1025
Heavy Congestion--Residential Roadway	1029
Free Flow--Urban Roadway	1033
Moderate Flow--Urban Roadway	1037
Medium Congestion--Urban Roadway	1041
Heavy Congestion--Urban Roadway	1045
Free Flow--Rural Highway	1049
Moderate Flow--Rural Highway	1053
Medium Congestion--Rural Highway	1057
Heavy Congestion--Rural Highway	1061
Free Flow--Urban Highway	1065
Moderate Flow--Urban Highway	1069
Medium Congestion--Urban Highway	1073
Heavy Congestion--Urban Highway	1077

Section C.3: Activity Factor

At this stage, however, only half of the emissions calculation is completed. The adjusted emission factor has been determined. However, the appropriate vehicle activity (**A(**r,c,d,h**)**) must be determined for the grid cell, season day, and hour of interest. In this case, the activity is broken into three parts as shown in equation C.3-1 below:

$$A(r,c,d,h)=Ao * Fx(r,c) * Sx(r,c,d) * Hx(r,c,d,h) * G(r,c,y_d) \qquad \textbf{Equation C.3-1}$$

Ao is the total activity (in this case kilometers-VKT driven) for the model year of vehicles of interest. This can be found in the ProcessFlow table for the model year of the vehicle group of interest. Fx represents the distribution of the VKT over the grid. This can be found in the FixedGridDistribution table in the column designated for distributing the total kilometers over the region of interest. **Sx** represents the adjustment of the activity for the season of interest. A pointer in the ProcessFlow table (**SeasonalGridPtr**) points to a column in the SeasonalGridDistribution table. The SeasonalGridDistribution table then holds a pointer to the SeasonalAdjustments table where the actual seasonal adjustments are located. **Hx** represents the hourly adjustment for the grid cell of interest. The ProcessFlow table contains a pointer for each season of the year to make the hourly adjustments (**HourlyGridSeasonA1Ptr**, **HourlyGridSeasonA2Ptr**, ..., **HourlyGridSeasonD2Ptr**). This allows for different hourly adjustments for each season; although it is possible to have the same adjustment for each season. The pointer specifies a column in the HourlyGridDistribution table, which then points to the HourlyAdjustments table. The IED allows the possibility to skip directly to the SeasonalAdjustments table and the HourlyAdjustments table if the same seasonal and hourly adjustments are desired for every grid cell. In this case a number is specified in the ProcessFlow table instead of a seasonal or hourly column name. Finally, the growth adjustment **G(r,c,yd)** is determined from a pointer in the ProcessBase table. This pointer is used in the GrowthGridDistribution table to get a pointer to the GrowthMetric table. As for seasonal and hourly adjustments, it is possible to skip the GrowthGridDistribution table by specifying a number instead of column name in the ProcessBase table. In this case, the growth will be assumed to be the same for all grid cells. 'y_d' refers to the difference between the base year and the year the calculation is being made.

It is important to note that for the case of on-road motor vehicles that are divided by model year, that the growth factor is likely negative. This means that the amount of VKT driven by these vehicles decreases each year. The exception is the case where a model year vehicle is being imported into an area at a greater rate than they are leaving the fleet. Table C.3-1 below summarizes the source of the various factors for calculating vehicle activity.

Table C.3-1: Factors in the Calculation of Vehicle Activity

Factor	Step 1	Step 2	Step 3
Ao	ProcessFlow.Flow	none	none
Fx(r,c)	ProcessFlow. FixedGridColumn	FixedGridDistribution. FxMetric??	none
Sx(r,c,d)	ProcessFlow. SeasonalGridPtr	SeasonalGridDistribution.* SnMetric??	SeasonalAdjustments. Season??
Hx(r,c,d,h)	ProcessFlow. HourlyGridSeason??Ptr	HourlyGridDistribution.* HrMetric??	HourlyAdjustments. H??
G(r,c,yd)	ProcessBase. GrowthMetricPtr	GrowthGridDistribution.* GrMetric??	GrowthMetric.Year?to?

*These tables can be skipped by providing a number in the ProcessFlow or ProcessBase table instead of a column name. In this case, the IED will go directly to the Source C table.

Section C.4: Considerations for the IED User

The calculation of on-road emissions is complex in the IED. As noted earlier, this is necessary because of the importance of emissions from on-road vehicles and the complex nature of the formation of those emissions. In order to make sure that the best possible calculations are made for mobile sources, the IED user should make sure that all of the tables used in the emissions calculation are properly set up. The IED calculation function will take care of the rest. Table C.4-1 below indicates the tables that should be checked for appropriate data when setting up on-road mobile sources.

Table C.4-1: Key Tables for Calculation of On-Road Mobile Source Emissions

Table	Used in Calculations Of
AgingFactorFinder	Aging Coeficient
DrivingPatterns	Pointer to HourlyAdjustments table to get proper driving patterns for the hour of interest (not important if there is no special correction pointer in the EmissionFactorFinder table)
EmissionFactorFinder	Emission Factor, Emission Factor Aging, Special Corrections (Driving Pattern)
EnviroGridDistribution	Used to derive temperature and humidity for calculating congestion corrections
FixedGridDistribution	Class of Roads in grid cell and Distribution of VKT over grid cells
GrowthGridDistribution	Pointer to growth factors in GrowthMetric table
GrowthMetric	Factors related to growth of activity of the source over time
HourlyAdjustments	Activity Adjustments by hour and Pointers to Special Corrections (Driving Pattern Corrections)
HourlyGridDistribution	Pointers to hourly adjustments in the HourlyAdjustments table
ProcessBase	Pointer to Growth Adjustments in GrowthMetric table
SeasonalAdjustments	Activity adjustments for the season day of interest
SeasonalGridDistribution	Pointer to the SeasonalAdjustments table
SpecialCorrections	Correction for Driving Pattern Using Formula

Appendix D
EmissionFactorFinder Table

Section D.1: EmissionFactorFinder Table

The EmissionFactorFinder table is one an important tables because it houses all of the basic emission rates for each process. If there is not an emission rate for the process contained directly in the process flow table, all needed emission factors must be entered into this table.

Table D.1-1 indicates the 2nd-8th fields (columns) of the table. They consist of the SCCx code used to identify this emission factor and eight keys. The keys serve no purpose in the calculation process, but help the user sort the emission factors to find the factor of interest. Table D.1-2 indicates how the eight keys are used.

Table D.1-1: Fields 2-8 of the EmissionFactorFinder Table

SCCx_Code	SCCxKey1	SCCxKey1	SCCxKey1	SCCxKey1	SCCxKey1	SCCxKey1	SCCxKey1

Table D.1-2: Examples of Controlling Processes

Key	Key Description	Examples
SCCKey1	Level 1 Categorization	Area Source, Point Source, Biogenic Source, Mobile Source
SCCKey2	Level 2 Categorization	Anthropogenic, Combustion, Industrial, solvent, Natural, on-road mobile
SCCKey3	Level 3 Categorization	Aircraft, Automotive Repair, Kilns,
SCCKey4	Level 4 Categorization	4-Stroke Gasoline, Adhesives, Agricultural equipment, Confined Animal Feeding
SCCKey5	Level 5 Categorization	Sealants, diesel, gasoline
SCCKey6	Source	EPA webfire emission factors, measured data, modeled data
SCCKey7	Control Equipment	uncontrolled, scrubber, electrostatic precipitator, fabric filter
SCCKey8	Pollutant or Material	CO, NOx, PM

Table D.1-3 shows fields 9-11. **Materialcode** refers to the material that this emission factor refers to. **KeyFlowMaterial** refers to the flow that is used with the emission factor to determine the flow (emission) rate. For example, for a coal fired boiler, the **KeyFlowMaterial** could be coal burned, energy input to the boiler, or steam production. This will depend upon the emission factor. This will be discussed further later in this document. The CalculationComment field is used to add any relevant comments about the emission factor.

Table D.1-3: Fields 9-11 of the EmissionFactorFinder Table

materialcode	KeyFlowMaterial	CalculationComment

The next 10 columns of the table define the formula (equation) that is used to calculate the emissions and provides factors for the formula and other information required to carryout a calculation. Table D.1-4 illustrates some of these columns for discussion of the calculation process.

Table D.1-4: Examples of Some EmissionFactorFinder Rows

SCCx Code	KeyFlowMaterial	Formula Key	Cal Factor1	Cal Factor2	ExtraInfo Type Key1
EPA00110100101CO100	Anthracite Burned	ISCE00001	0.0003		
EPA00110100101PM,_conden100	Anthracite Burned	ISCE00003	0.001230001	-0.000369	fuelrate
EPA00110100101PM10,_filt100	Anthracite Burned	ISCE00002	.0005		pAsh
IVE-002DslHvyTkE4-VOC-Mex0001	Distrance driven	ISCE00001	1		

The key flow material, which is the second column listed in Table D.1-4 and noted earlier, denotes the type of flow that is required with the emission factor to make an emission calculation; or in other words, it denotes the bottom units of the emission factor. Data on the amount of flow for the key flow must be located in the ProcessFlow table in order for a calculation to be made. The source of flow for the controlling process is called the "key flow" and is referenced by flows using the emission factor. In the case of an emission factor for particulate matter coming from a boiler, the controlling process is the amount of anthracite coal burned. In the case of an on-road mobile source, the controlling process is the distance driven. For the case of a power plant, it may be the power produced or it may be the fuel burned depending upon the emission factor. For a cement facility the controlling process may be tons cement produced. A list of different potential controlling processes are shown in Table D.1-5 to give an idea of the types of controlling processes used in the table currently.

Table D.1-5: Examples of Controlling Processes

Controlling Process	Types of processes using this Controlling process
Int	Char(15)
Steel Produced	Steel making facility
Distance travelled	Vehicles
Energy Input	Power plant
Batteries Produced	Battery making facility
Wood Burned	wood burning stoves
Hours operated	Construction Equipment

The **FormulaKey** shown in the third column of Table D.1-4 corresponds to the formula used to estimate the emissions. Depending upon the emission factor different equations are used to make the actual calculation. These equations call for different calculation factors. The **calfactor**s, **extrainputinfo**, **outputupperunits** and **outputlowerunits** columns all go together with the **FormulaKey**. The most common formulas are listed in Table D.1-4. A

formulakey indicated by ISCE00001 is the simplest equation (just a single factor) and is used frequently in the table. The equation for ISCE00001 is simply Flow = C1 (or CalFactor1) * Amount of key flow. The formulas available may take advantage of up to 5 calfactors and 4 extrainfo type keys. These nine values are used in the various formulas. The calfactors are static values that are contained in the emissionfactor database. The extrainfoinput values are variables that require additional information for a calculation to be made such as the percent ash or percent sulfur in coal. The extra information types are shown in Table D.1-6 below and are listed in a table called ExtraInfoType. There are 26 extra info types that might be required depending upon the emission factor. If extra information is required for the emission factor, it must be listed in the table called ExtraInputInfo. During the calculation process, if one of the extra input information fields (columns) has an indicator code, that code is looked up in the ExtraInputInfo table combined with the ProcessFlowID of the flow being calculated to get the extra input info needed. The user of the IED must insure that if the emission factor requires extra information that this information is properly entered into the ExtraInputInto table. Several examples of calculating emission factors are listed below.

Example 1. For EPA00110100101CO100, an external combustion boiler,
Formula Key ISCE00001: EmissionFactor = C1
Looking up the values from the emissionfactor table, C1 = .0003
Emissions are .0003 kg CO per kg anthracite burned.

Example 2. For EPA00110100101PM10,_filt100, an external combustion boiler,
Formula key ISCE0002: EmissionFactor = C1*E1
Looking up the values: C1 = .0005 and pAsh is the percent Ash in the coal.
Suppose the user input pAsh as 1% then:
Emissions are .0005*1 = .0005 kg PM10/kg anthracite burned.

Example 3. For EPA00110100101PM,_conden100, an external combustion boiler,
formula key ISCE00003: EmissionFactor = C1*E1 + C2
Looking up the values: C1 = .00123, C2 = -.000369 and E1 = fuelrate.
Suppose the user inputs the fuelrate as 2MMBtu then:
Emissions are .00123*2-.000369 = .002094 kg PM/kg anthracite burned

Table D.1-6: Examples of Formulas used in EmissionFactorFinder

FormulaKey	Emission Factor =
ISCE00001	C1
ISCE00002	C1*E1
ISCE00003	C1*E1 + C2
ISCE00004	C1*E1+C2*C3
ISCE00005	C1*E1+C2*E2+C3*E3+C4*E5+C5
ISCE00006	C1*(E1/12)^C2*(E2/3)^C3)/(E3/0.2)^C4
ISCE00007	C1*(C2*E1+C3+C4)+C5

ISCE00008	C1*C2*E1
ISCE00009	C1*(C2*E1+C3)+C4
ISCE00010	C1*E1*($E2/$E3)^C2
ISCE00011	C1*E1+C2*E2
ISCE00012	C1*E1*(E2/E1)^C2
ISCE00013	C1/E1^C2
ISCE00014	C1*E1^C2
ISCE00015	C1*E1^C2/E2^C3
ISCE00016	C1*E1^C2)/E2^C3
ISCE00033	IF E1<C3,C4, else, C1*E1+C2

Where C1 = CalFactor1, C2 = CalFactor2, etc. and
E1 =ExtraInfo1, E2=ExtraInfo2, etc. in EmissionFactorFinder

Table D.1-7: Examples of ExtraInputTypeKeys used in EmissionFactorFinder

ExtraInfo Type Key	Description of User Input Needed
csulfur	the sulfur content expressed in gr/100 cubic feet of gas vapor.
Dheight	drop height (ft)
fuelrate	fuel rate on a heat input basis (MMBtu), as fired. To convert to lb/ton of lignite coal, multiply by 16 MMBtu/ton.
harea	horizontal area (ft^2)
mvehspeed	mean vehicle speed (mph)
mvehweight	mean vehicle weight (tons)
pCalcium	% calcium content
pCarbon	% Carbon content. If the carbon percentage is not known, a default value of 4600 lb/ton may be used as the emission factor.
pChlorine	weight percent chlorine in fuel
pfinyeast	Final (spike) bakers percent of yeast, "bakers percent yeast," which is an industry term equal to the pounds of yeast per 100 pounds of flour and NOT per 100 pounds of total dough mixture
pinityeast	Initial bakers percent of yeast,"bakers percent yeast," which is an industry term equal to the pounds of yeast per 100 pounds of flour and NOT per 100 pounds of total dough mixture
pMoisture	material moisture content (%)
pSilt	material silt content (%)
pSulfrFuel	% sulfur content in fuel
psulfurOIL	weight % of sulfur in the oil
psulfrtot	sulfur content of the raw material, and the fuel used to fire the kiln
pSulfurDsl	weight % sulfur in diesel fuel
psulfurNG	% sulfur in natural gas
psurMoistr	surface material moisture content (%)
psursilt	surface material silt content (%
spikeTime	Spiking time in hours (to the nearest tenth)
yeasttime	Total yeast action time in hours (to the nearest tenth)
pAsh	% ash content by weight
pAshWet	weight % ash content, wet basis.
pCoalAsh	Coal ash weight percent, as fired
pSulfurWet	weight % sulfur content of the lignite, wet basis.

The **OutputUpperUnits** field (column) indicates the units that will result when the flow calculation is make, and the **OutputLowerUnits** field indicates the units the Controlling Process must be in to get a proper calculation. The **reliabilityindex** refers to the robustness of the emission factor. It is simply to give the user the information on how poor or how good a quality the emission factor is. So, in example 1 (row 1 of Table D.1-1), the emission factor is rated as 1. Looking in Table D.1-8 below, this emission factor is above average, which means multiple controlled in-use emission measurements were conducted on this boiler type to develop the emission factor.

Table D.1-8: Examples of ReliabilityKeys used in EmissionFactorFinder

ReliabilityCode	Description
0	Excellent
1	Above Average
2	Average
3	Below Average
4	Poor
5	Unrated

Finally, the **AgingCodeKey** column supplies a pointer to the AgingFactorFinder table. If there is no pointer in the **AgingCodeKey** column then no aging of the emission factor is carried out. The AgingFactorFinder table describes how the emission factor changes with time. The emission factor aging calculation requires three years to carry out a calculation. The first year is the year that the equipment represented by the emission factor is to be considered as new (YearNew). The second year is the year that the emission factor is defined for (ApplicableYear). The third year needed is the year for which the calculation is being made (CalculationYear). It is possible that the YearNew and the ApplicableYear are the same. However, since the aging of an emission factor is not an exact process, then it is often better to set the emission factor value closer to the value for the base year when calculations are to be made and then to age it from this base year. For example, for a model year 2000 vehicle, the year that the vehicle was new is, of course, 2000. However, emission measurements may have been made in 2010 to establish an emission factor for the vehicle for this later year. Thus, the ApplicableYear for this emission factor would be 2010. It is, of course, possible even with 2010 emission factor data to back calculate (reverse age) the emission factor to the year when the process was new and set the YearNew and ApplicableYear to be the same. This is up to the user.

There is a second reason for setting up the calculation in this manner. It is also possible to create a generic emission factor that will apply to more than one process but still include aging. Using a passenger vehicle again as an example, it is possible that model years 2000, 2001, and 2002 could have the same emission factor, the emission factor just needs to be aged by differing amounts for the different model years. Thus, the emission factor aging calculation uses one of two options.

> Option 1: If an ApplicableYear greater than 1900 and YearNew greater than 1950 are supplied in the EmissionFactorFinder table, then these years are used by the calculation along with the CalculationYear to age the emission factor.
>
> Option 2: If the ApplicableYear is greater than 1900 and the YearNew in the EmissionFactorFinder table is set to zero, then the aging calculation makes use of the YearNew found in the ProcessFlow table. In this case, the emission factor must be defined as for a new source and can be used as a generic emission factor for multiple sources.

The user should consider carefully how an emission factor is set up in cases were the emission factor is to be aged. In general, it is safest to set a separate emission factor for each process with the ApplicableYear and YearNew set in the EmissionFactorFinder table. If the user wishes to set the YearNew to zero in the EmissionFactorFinder table to create a generic emission factor that includes aging, then, as noted above, the emission factor must be set up for the case where the process is new.

The **SpecialCorrectionKey** is set up for on-road motor vehicles. It refers the calculation process to a formula that is used to correct the emission factor for roadway driving conditions. This calculation process is better discussed in Appendix C.

Appendix E

SpecialCorrections, DrivingPatterns, DrivingPatternTypes, RoadClasses Tables

Overview

There are cases where emission factors need to be corrected due to local external conditions. This is particularly true of on-road motor vehicles which pollute in different amounts depending upon the way the vehicle is operated, the temperature the vehicle is operating in, and humidity that the vehicle is operating in. There are other cases such as evaporation from storage tanks and biogenic emissions that might be handled through a special correction process as well. To fulfill this need, the IED contains a SpecialCorrections table that is used to hold PHP scripts that can be used to make these special corrections to emission factors. Since the prime use of these corrections is for mobile sources, the SpecialCorrections table will be discussed along with the associated on-road mobile sources table.

Section E.1: SpecialCorrections Table

The SpecialCorrections table holds formulas to make corrections to the emission factors. The table allows for a different formula for each driving situation that might occur. In the case of non-mobile sources, a "-1" is put in place of the DrivingPatternKey to indicate that this is not a driving pattern. The formulas can be based on local temperature, humidity, and wind speed. The special corrections can also be useful for cases where emissions, such as biogenic VOC or evaporative solvent emissions, change with environmental conditions. As noted earlier, it is primarily used for on-road mobile source emissions, which vary with all three of these parameters. A SpecialCorrectionKey pointer is located in the EmissionFactorFinder table that is used in the SpecialCorrections table along with a driving pattern to select a formula that is used to calculate a correction for the emission factor.

Table E.1-1: Special Corrections Example Rows

Correction Key	Special Correction Key	TxtEn	Driving Pattern Key	Formula
1000	ISC13ButaDsl	Free Flow=>Rural Roadway for Buta/Dsl	1001	$SpCor=1
1001	ISC13ButaDsl	Moderate Flow=>Rural Roadway for Buta/Dsl	1005	$SpCor=1
1002	ISC13ButaDsl	Medium Congestion=>Rural Roadway for Buta/Dsl	1009	$SpCor=1
1081	ISCCO2Dsl	Moderate Flow=>Rural Roadway for CO2/Dsl	1005	$SpCor=2.70832073925357+$Tmp*-0.0085516717007389+$Hum*-4.11841349660593E-18+$Tmp*$Tmp*0.000342453838759201+$Tmp*$Tmp*$Tmp*9.48035907139625E-06+$Tmp*$Hum*1.19516612888344E-19
1086	ISCCO2Dsl	Medium Congestion=>Residential Roadway for CO2/Dsl	1025	$SpCor=5.71414116096446+$Tmp*-0.0240178149777048+$Hum*-5.0688166112073E-18+$Tmp*$Tmp*0.000961799426539165+$Tmp*$Tmp*$Tmp*2.66260817846178E-05+$Tmp*$Hum*1.40607779868641E-19
1087	ISCCO2Dsl	Heavy Congestion=>Residential Roadway for CO2/Dsl	1029	$SpCor=7.96675232795059+$Tmp*-0.0348065228812656+$Hum*-3.16801038200456E-18+$Tmp*$Tmp*0.00139383594128387+$Tmp*$Tmp*$Tmp*3.85864128662256E-05+$Tmp*$Hum*7.49908159299414E-20
1093	ISCCO2Dsl	Moderate Flow=>Rural Highway for CO2/Dsl	1053	$SpCor=0.990409348321215+$Tmp*-0.00196253153695862+$Hum*-4.88401600559037E-19+$Tmp*$Tmp*7.85900677711298E-05+$Tmp*$Tmp*$Tmp*2.17565691368818E-06+$Tmp*$Hum*1.17173149890534E-20

There are different corrections for various pollutants and types of vehicles, as defined by the specialcorretionkey and the txten. Once the specialcorrectionkey is defined, the drivingpattern must be selected, because there is a different correction for each drivingpattern as well. The correctionkey is a unique id for each combination of specialcorrectionkey and driving pattern. The specialcorrection formula (or value) returns a value which is multiplied by the emission rate given in the emissionfactorfinder table. The formula will require the database to look up items like temperature and humidity in the grid cell and hour of day of the calculation before calculating the correction factor.

For mobile sources, the special correction formulas were developed based on five temperature regimes and three humidity regimes using the IVE model. The driving patterns were developed from real world GPS driving patterns to be representative of the described type of driving. Then, the type of vehicle was modeled in the IVE model to give emission points at each of the driving patterns, temperature and humidities. Then a formula was developed for each of these technologies and pollutants. The formula was normalized to the standard conditions (driving = 1053 driving pattern key, which is moderate flow on a rural freeway, temperature = 20 degrees C and humidity =35%). So, for example, since correction key 1093 corresponds to a driving pattern of the standardized value (moderate flow on rural highway), if you use a value of 20 for $Tmp and 25 for $Hum, the formula result will return a value of 1. This should be the case since we defined the emission factor to be at this condition.

Section E.2: RoadClasses, DrivingPatternTypes, DrivingPatterns Tables

The RoadClasses table defines the different classes of roads that are used in the IED. A road class indicates the predominate road type that might occur in a grid cell in a region that will impact the driving pattern. For example, a grid cell with a freeway running through it will have most of the VKT in the grid cell from driving on the freeway with a much smaller percentage of driving on other types of roadways. For this, a road class might be defined called Urban Highways (Freeways) or Rural Highways (Freeways). When an emission calculation is done, the calculation needs to be made in consideration of the fact that 80-90% of the driving in that grid cell will reflect urban highway types of driving patterns. The special correction formula found in the special correction table should then contain the appropriate formulas that apply to driving in a grid cell with this class of roadways. The road classes are user defined. In the present distribution of the IED, there are five classes of roads defined. Of course, as many classes of roads can be defined as wanted, but as discussed in the following paragraphs, the development of special correction formulas increases considerably as more road classes are defined. The present five classes of roadways are shown in Table E.2-1.

Table E.2-1: Road Classes in Base Distribution of IED

Road Class Key	Road Class	Description
2001	Predominated by Rural Roadways	Most of the driving in the grid cell is typically on non-highway types of roadways found in a rural setting.
2005	Predominated by Residential Roadways	Most of the driving in the grid cell is typically on non-highway types of roadways as found in residential areas in suburban and some urban areas.
2009	Predominated by Urban Roadways (Arterials and Side Streets)	Most of the driving in the grid cell is typically on non-highway types of roadways as found in general urban areas in central urban areas. These roadways are often referred to as arterials and side-roads.

2013	Predominated by Rural Highways	Most of the driving in the grid cell is typically on a highway or freeway type of roadway in a rural area.
2017	Predominated by Urban Highways	Most of the driving in the grid cell is typically on a highway or freeway type of roadway in an urban area.
2021	No Roadways	There are no roadways in this grid cell

On each class of roadways, there can exist a variety of driving conditions in different hours of the day and different months of the year. These are denoted as driving patterns. These patterns are user defined but the base distribution of the IED uses four basic driving patterns. These are Freeflow, Moderate, Medium Congestion, and Heavy Congestion. When combined with the five road classes, twenty driving situations result. This is an indication of the complexity that can develop as more road classes and driving patterns are added. Table E.2-2 shows the resulting twenty driving patterns in use in the base IED distribution.

Table E.2-2: Driving Pattern Types in the Base Distribution of IED

Driving Pattern Key	Driving Pattern	Description
1001	Free Flow=> Rural Roadway	Free flow traffic on rural (non-highway) types of roads.
1005	Moderate Flow=> Rural Roadway	Moderate (slight congested) flow traffic on rural(non-highway) road type.
1009	Medium Congestion=> Rural Roadway	Medium congested flow of traffic on rural (non-highway) road type.
1013	Heavy Congestion=> Rural Roadway	Heavily congested flow of traffic on rural (non-highway) road type.
1017	Free Flow=> Residential Roadway	Free flow traffic on residential (non-highway) road type.
1021	Moderate Flow=> Residential Roadway	Moderate (no or slight congestion) flow traffic on residential (non-highway) road type.
1025	Medium Congestion=> Residential Roadway	Medium congested flow of traffic on residential (non-highway) road type.
1029	Heavy Congestion=> Residential Roadway	Heavily congested flow of traffic on residential (non-highway) types of roads.
1033	Free Flow=> Urban Roadway	Free flow traffic on urban (non-highway) types of roads.
1037	Moderate Flow=> Urban Roadway	Moderate (slight congested) traffic flow on urban (non-highway) types of roads.
1041	Medium Congestion=> Urban Roadway	Medium congested flow of traffic on urban (non-highway) types of roads.
1045	Heavy Congestion=> Urban Roadway	Heavily congested flow of traffic on urban (non-highway) types of roads.
1049	Free Flow=> Rural Highway	Free flow traffic on rural highway (freeway) types of roads.
1053	Moderate Flow=> Rural Highway	Moderate (slight congestion) traffic flow on rural highway(freeway) road type.
1057	Medium Congestion=> Rural Highway	Medium congested flow of traffic on rural highway (freeway) types of roads.
1061	Heavy Congestion=> Rural Highway	Heavily congested flow of traffic on rural highway (freeway) types of roads.
1065	Free Flow=> Urban Highway	Free flow traffic on urban highway (freeway) types of roads.
1069	Moderate Flow=> Urban Highway	Moderate (no or slight congestion) traffic flow on urban highway(freeway) road type.
1073	Medium Congestion=> Urban Highway	Medium congested traffic flow on urban highway(freeway) types of roads.
1077	Heavy Congestion=> Urban Highway	Heavily congested traffic flow on urban highway(freeway) types of roads.

Section E.3: DrivingPatterns Table

The DrivingPatterns table contains information to allow the user to determine the driving pattern type that is occurring in each season of the year for each hour of the day. For each road class, the DrivingPatterns table acts as a pointer for each of the eight IED seasons. This pointer is to a row in the HourlyAdjustments table where the driving pattern for each hour of the day can be found. Once the driving pattern key is found, then the SpecialCorrections table can be referenced to find the applicable formula.

The flow calculation supplied with the IED is designed to collect the needed data from the various tables and produce an appropriate emission rate. It is incumbent on the user to make sure that the information in the tables properly reflects the situation in the regions being analyzed. The reader is referred to Appendix B and Appendix C for a discussion of the calculation process in the IED.

Appendix F
SeasonalAdjustments, HourlyAdjustments, AgingFactorFinder, and GrowthMetric Tables

Section F.1: SeasonalAdjustments Table

Some processes will operate on different schedules in different seasons and for different hours of the day. The changes in operational rates of processes during the different seasons and hours must be accounted for in order to provide reliable data on emissions or process flows in and out of the process. The SeasonalAdjustments table is used for the adjustment to the activity for the season of interest. Once you read section F.1 in this appendix, it would be easier for you to understand the SeasonalAdjustments table. It's similar to the GrowthMetric table. The SeasonalAdjustments table provides the basic seasonal adjustment patterns for either SeasonalGridDistribution table or ProcessBase table.

The value derived from SeasonalAdjustments table is used in Equations B.3-2 – B.3-11 in Appendix B. **S()** is the term used for these adjustments in the equations in Appendix B for the seasonal adjustment.

For point sources, the column SeasonalGridPtr in the ProcessFlow table of the IED should be a number (or column name in the Seasonal Grid Distribution table) and then the Season-Adjustment can be derived from the SeasonalAdjustments table based on that number (code).

For area sources, if all the grids have the same Season-Adjustment, then only the code in ProcessBase, SeasonalGridPtr would be used to derive the pattern from the SeasonalAdjustments table. Only in the case when the Season-Adjustment varies from grid to grid, a pointer must be found in the ProcessBase table to find a second pointer in the SeasonalGridDistribution table. In this condition, the first pointer in the ProcessBase table would be a string. Then the second pointer could be used to derive the proper seasonal adjustment values from **SeasonalAdjustments** table. More information can be found in Appendix B.

Table F.1-1 provides an example of how some of the records in the key columns might look in the table (not all columns are included in the example below). As discussed, a season consists of a weekday type as well as the season.

The benefit of including the seasonal/weekday adjustments in a table instead of directly into ProcessFlow table is that the use of a SeasonalAdjustments table reduces the number of different hourly adjustment options that must be maintained in the database since many seasonal adjustments can be used for more than one industry. Finally, it should be noted, that the adjustment values in the SeasonalAdjustments table should be normalized. This means that the sum of the eight adjustment values should add up to one.

Table F.1-1: Examples of Seasonal Adjustments Rows

Season Adjust ment Key	TxtEn	Seaso n A1	Season B1	Season C1	Season D1	Season A2	Season B2	Season C2	Season D2	note
20019	space heating type I	0.263 2	0.210 5	0.157 9	0.000 0	0.000 0	0.000 0	0.131 6	0.236 8	Sum must =1
20123	archite ctural coating type I	0.000 0	0.100 0	0.100 0	0.200 0	0.200 0	0.200 0	0.200 0	0.000 0	Sum must =1
30001	on-road mobile type I	0.200 0	0.200 0	0.100 0	0.100 0	0.100 0	0.100 0	0.100 0	0.100 0	Sum must = 1
30002	off-road mobile type I	0.000 0	0.085 1	0.170 2	0.212 8	0.212 8	0.212 8	0.106 4	0.000 0	Sum must =1
40010	ground cover type I	0.019 2	0.076 9	0.192 3	0.192 3	0.192 3	0.192 3	0.115 4	0.019 2	Sum must =1

Section F.2: HourlyAdjustments Table

The HourlyAdjustments table is used in the same manner as the SeasonalAdjustmensts table to provide activity adjustments for each hour of the day. Most of the calculation and usage are similar to the process used to set the seasonal adjustments. A detailed introduction of hourly adjustments can be found in Appendix B. The following discussions are more cursory.

One thing that should be highlighted here is that care must be taken to avoid double counting adjustments between the seasonal adjustments and hourly adjustments. The approach to setting hourly adjustments changes depending upon the type of source under consideration.

For point sources, it is likely that equipment at a point source will be operated at some consistent level when it is operated so that the hourly adjustments for a point source will be equal numbers and zeros (0).

In the case of area sources, the approach for setting hourly adjustments is different. For area sources that involve units such as space heaters, the seasonal adjustments are set from zero to one depending upon the fraction of units in use each hour. In the case of area sources that involve volumes such as the use of paint, the seasonal adjustments must reflect the fraction of volume that is used during the hour and the fractions over the day must add up to one.

Table F.2-1 provides examples of what some columns in the table might look like for different source types.

Table F.2-1: Examples of Hourly Adjustments Rows

Hourly Adjustment Key	TxtEn	H00	H07	H08	H09	…	H21	H22	H23	NOTE
10001	Furniture Manufacture	0	0	.1	.1	…	.1	0	0	Sum= 1
20019	Space Heating	.1	.1	.08	.07	…	.09	.1	.1	Sum= 1
20123	Architectural Coating	0	0	0.09	.13	…	0.08	0	0	Sum= 1
30001	On-Road Mobile	0.01	0.12	0.15		…	0.07	0.06	0.01	Sum= 1
30002	Off-Road Mobile	0	.08	.1		…	.06	.1	0	Sum= 1
40010	Ground Cover (Low Volatility)	.02	.03	.05		…	.03	.02	.02	Sum= 1

Section F.3: AgingFactorFinder Table

The AgingFactorFinder table is designed to provide actual values on the future trends of an emission factor. It is typical that the air pollution emission factor for a process changes as the source ages. It is also common that the efficiency of equipment decreases with age. Thus, it is likely that there will be the need to change the emission factor as a process ages. The design of the AgingFactorFinder table can be seen in the table design section of this manual as table 50 in Appendix A. The table includes cumulative aging factors for the first five years of a process and for year ten, year fifteen, and year twenty. The user can also make use of a PHP based formula, which can be referenced in the table in place of the set of eight aging values. It is important to emphasize that the values in the table are expected by the software to represent cumulative aging and are entered as fractions.

Three affiliated tables are connected with the AgingFactorFinder table by using the aging keys. These aging keys are used to help the user sort out and more easily find the appropriate aging factors since it is expected that over time, there will be many records in the AgingFactorFinder table. In this latter aspect, there are presently more than 26,000 records in the emission factor table. It is possible, though unlikely, that each emission factor record could have a different aging factor.

The AgingFactorFinder table is referenced in the EmissionFactorFinder table (column **AgingCodeKey**). The aging factor is calculated based on the values in the table plus the values for ApplicableYear and YearNew found in the EmissionFactorFinder table as well as the YearNew found in the ProcessFlow table.

Section F.4: GrowthMetric Table

The GrowthMetric table is designed to provide actual values on the future growth rates of the process. The GrowthMetric table could be thought of as a table that presents several basic scenarios for future, made of several basic trends of change at different years in the future.

The GrowthMetric table offers three different growth values depending upon how far into the future the projection is to be made. The PHP program that is used to make future projections first uses the effective dates of the process flow of interest and then selects the appropriate record from the GrowthMetric table to make the future projections.

The GrowthMetric table may be referenced either from the ProcessBase table (column **GrowthMetricPtr**) or from the GrowthGridDistribution table. For point sources and some area sources, where the growth rate is consistent in all grid cells, the GrowthMetricPtr column in the ProcessBase table is used to hold a pointer to the GrowthMetric table. For many of the area sources, where the growth of an area source varies in different grid cells, there are two steps to derive the growth value in the GrowthMetric table. If the content in GrowthMetricPtr column in ProcessBase table is a string instead of a number, that means it is a reference to a column in a table called GrowthGridDistribution. Then, the column in table GrowthGridDistribution will have another pointer to the GrowthMetric table. In this case, each grid can have a different growth rate; although it is unlikely that this will be the case. It is most likely that some grids will share one growth scenario and other grids will share a different growth scenario.

The GrowthMetric table is an independent table. All the rows in this table are not fixed to any source. This table could be copied and used in different inventories. The connection between the GrowthMetric table and the source/process/flow is the ProcessBase table or the GrowthGridDistribution table.

Of course, the GrowthMetric table is only used for the growth. It is also possible that the emission factor will change as the process ages. Then the EmissionFactorFinder table contains a column with a reference to the AgingFactorFinder table where an adjustment to the emission factor can be found.

Appendix G

FixedGridDistribution, SeasonalGridDistribution, HourlyGridDistribution, PHPFormulas, EnviroGridDistribution, GrowthGridDistribution, and MetricDescription Tables to Support Activity Adjustment Calculations

Section G.1: FixedGridDistribution, SeasonalGridDistribution, and HourlyGridDistribution Tables

The FixedGridDistribution, SeasonalGridDistribution, and HourlyGridDistribution tables are designed to provide information on how area source emissions are to be distributed over the regional grid system.

The IED estimates emissions based on the equation:

Process-Emissions = Emission-Rate * Process-Activity-Adjustment

Where,

Emission-Rate = Emission-Factor * Base-Activity

Process-Activity-Adjustment = Base-Activity-Correction * Season-Adjustment * Hour-Adjustment * GridAdjustment

Grid-Adjustment = Fixed-Grid-Adjustment * Season-Grid-Adjustment * Hour-Grid-Adjustment

A lengthy discussion of the calculation process can be found in Appendix B. The following discussions are more cursory and are intended only to help explain how the grid related tables are organized and why they are set up the way that they are.

The various activity values involved in the calculation of Emission-Rate, Process-Activity, and Grid-Adjustment overlap and can be duplicative. Care must be taken in how they are input into the IED. Obviously, point sources do not require grid adjustments since they exist in only one location. In this case, the Grid-Adjustment variable is set to 1 in the calculation program.

In the case of area sources, the Fixed-Grid-Distribution table is used to make the distribution over the grid system. However, in most cases, the activity for a process varies by the season and/or the hour. If the emissions do not vary by season or hour, then there is no need for the Season-Adjustment, Hour-Adjustment, Season-Grid-Adjustment, or Hour-Grid-Adjustment variables. They are simply set to 1 in the calculation process. If the source emissions do vary by season and/or hour then a decision must be made. If the seasonal and/or hourly variations are the same in all grid cells, then the **SeasonAdjustment** and/or **HourAdjustment** columns in the ProcessBase table are used to indicate the adjustments. On the other hand, if the seasonal and hourly variations do vary by grid cell then the SeasonGridAdjustment and/or HourGridAdjustment tables are used.

In the case where the Seasonal and/or hourly activity varies by grid cell, then it is normal to set the **SeasonAdjustment** and **HourAdjustment** values in the process base table to 1 (or leave them blank) and make the needed corrections using the SeasonalGridDistribution and HourlyGridDistribution tables. In the case where grid adjustments are needed, then the calculation for the Process-Activity-Adjustment is as follows:

Process-Activity-Adjustment = Base-Activity-Correction * Fixed-Grid-Adjustment-*-Season-Grid-Adjustment * Hour-Grid-Adjustment

The Fixed-Grid-Adjustments are for the general distribution of activity by grid cell. An example is the case of space heating units. There are the same number of units in a region in all seasons and at all hours of the day. Thus, the number of heating units in place do not vary by season or hour; although they do vary by grid cell. The issue then is how to distribute the units over the grid. One option is to use the population as an indicator of the number of space heating units in a grid cell. Another option might be the number of residential units in a grid cell. Finally, if there is a direct count of the number of space heating units in each grid cell then a column could be set up called "SpaceHeatingUnits". Whatever indicator is used, the column in the FixedGridDistribution table to use is indicated in the ProcessBase table. An example of how a few rows in the FixedGridDistribution table might look is shown in Table G.1-1.

Table G.1-1: Example of FixedGridAdjustment Table

Key	Region	GridRow	GridColumn	Population	ResidentialUnits
0	Metro1	0	0	15000	5000
1	Metro1	0	1	10000	3000
2	Metro1	0	2	12000	4000

If population is the indicator for distributing the emissions over the grid, then the population column would be used by the calculation program. The fraction of population in each grid cell would be calculated by dividing the actual population in the grid cell by the total population for all of the grid cells in a region. This fraction would then be used as the indicator for the distribution of space heating units. In the IED, the columns in the table shown in Table G.1-1 are not named Population, ResidentialUnits, etc. as shown. They, instead, are given generic names such as **FxMetric01**, **FxMetric02**, etc. and different metrics are assigned to the columns. This allows the user more flexibility in using the database. There are a number of potential indicators that could be used for the various source types. These are shown in Table G.1-2

Table G.1-2: Potential Indicator Data for Each Grid Cell to be Included in the Fixed Grid Table

	Indicator		Indicator
1	Amount: Average income	21	Jobs: Manufacturing jobs
2	Amount: Average residential size	22	Number: Auto body shops
3	Amount: Charcoal sold for fuel	23	Number: Diesel fueled back-up generators
4	Amount: Coal sold	24	Number: Diesel fueled pumps
5	Amount: Diesel fuel sold	25	Number: Residential units
6	Amount: Gasoline sold	26	Number: Restaurants
7	Amount: Kerosene sold	27	Number: Service stations
8	Amount: Natural gas sold	28	Number: Small businesses
9	Amount: Wood sold	29	Number: Storage tanks for volatile organic liquids
10	Area: Forest cover	30	Number: Number of dry-cleaning businesses
11	Area: Agricultural land	31	Population: Persons residing or working in daytime
12	Area: Unoccupied land	32	Population: Persons residing or working over the 24 hour day
13	Area: Water cover	33	Population: Persons with age less than 20 years
14	Distance: Fraction of annual regional driving	34	Population: Persons with age more than 55 years
15	Distance: Length of arterial roadways	35	Space: Office Space
16	Distance: Length of freeways	36	Space: Warehousing space
17	Distance: Length of highways	37	
18	Distance: Length of residential roadways	38	
19	Distance: Length of total roadways	39	
20	Distance: Total length of public transit operations	40	

In the case of the SeasonalGridDistribution table, the purpose of the table is to provide appropriate values that indicate activity adjustments for each season. The SeasonalGridDistribution table actually contains integers (pointers) that indicate a set of eight activity adjustment values (one for each season) that are kept in the SeasonalGridDistribution table. As was the case for the FixedGridDistribution table, the SeasonalGridDistribution table uses columns with generic designations (**SnMetric01**, **SnMetric02**, etc.) that can be used to define the seasonal adjustments for a process.

Table G.1-3 shows some metrics that might be included in the SeasonalGridDistribution table with comments and notes.

Table G.1-3: Potential Metrics for Making Grid Cell Distributions by Season

Metric	Comment	Note
Biogenic: Vegetation (high VOC) in grid cell	The amount of vegetation will change with the season and thus the associated VOC emissions	
Biogenic: Vegetation (low VOC) in grid cell	The amount of vegetation will change with the season and thus the associated VOC emissions	
Biogenic: Vegetation (medium VOC) in grid cell	The amount of vegetation will change with the season and thus the associated VOC emissions	
Energy: Space heating adjustment for grid cell	If there are significant altitude changes within the region then the fraction of heaters in use will vary with grid cell and season	It may be best to create a temperature dependent equation for this.
Driving: Overall weekday driving adjustment for the grid cell	The overall driving can change with the season	
Driving: Overall weekend driving adjustment for this grid cell	The overall driving changes with the season	
Agriculture: General agricultural adjustment for this grid cell	Agricultural operations vary significantly by season	
Burnng Related: Controlled burning adjustment for this grid cell	The amount of controlled burning changes by the season	
Burning Related: Wildfire burning adustment for this grid cell	The number and severity of wildfires changes with the season	
Evaporation Related: VOC evaporation adjustment for grid cell	VOC evaporation is impacted by temperature which changes by season and by altitude	It may be best to create a temperature dependent equation for this.
Agriculture: Water pumping adjustment	The use of water pumps can vary by season and by grid cell, but this may not be too important	
Agriculture: Freeze protection such as smudge pots in grid cell	The need for freeze protection will vary with season and with grid cell	This may not be necessary since a combination of agriculture distribution in the FixedGridDistribution table combined with seasonal adjustments in the ProcessBase table might get the job done.

The HourlyGridDistribution table provides information on how the hourly distribution of information by grid cell. The prime reason that hourly activity for a process might differ between grid cells is the case where altitude will impact the diurnal temperature variations in lower altitude grid cells compared to high altitude grid cells, which might impact the use of heating systems. The major impact will likely be traffic patterns for passenger vehicles, trucks, and buses, which will vary with grid cell. The altitude could also impact cloud cover and rainfall, which could impact biogenic emissions.

Table G.1-4 lists some potential metrics that might be included in the HourlyGridDistribution table with comments and notes.

Table G.1-4: Potential Metrics for Making Grid Cell Distributions by Hour

Metric	Comment	Note
Energy: Space heating adjustment for grid cell	If there are significant altitude changes within the region then the fraction of heaters in use will vary with grid cell and hour	Temperature related impacts might best be handled using temperature data and a formula
Driving: Passenger vehicle use on weekdays	Vehicle driving patterns can vary between different grid cells for different hours of the day.	
Driving: Passenger vehicle use on weekends	Vehicle driving patterns can vary between different grid cells for different hours of the day and weekend patterns are likely different from weekday patterns.	
Driving: Truck use on weekdays	Truck driving patterns can vary between different grid cells for different hours of the day.	
Driving: Truck use on weekends	Truck driving patterns can vary between different grid cells for different hours of the day and weekend patterns are likely different from weekday patterns.	
Driving: Bus use on weekdays	Bus driving patterns can vary between different grid cells for different hours of the day.	
Driving: Bus use on weekends	Bus driving patterns can vary between different grid cells for different hours of the day and weekend patterns are likely different from weekday patterns.	
Evaporation Related: VOC evaporation by grid cell	If there are significant altitude changes within the region then the evaporation rates will change with temperature.	Temperature related impacts might best be handled using temperature data and a formula
Biogenic: Vegetation (high VOC) in grid cell	It is possible that VOC emissions can change with temperature and sunlight. This will vary hourly.	Temperature and sun related impacts might best be handled using temperature and sunlight data and a formula
Biogenic: Vegetation (low VOC) in grid cell	It is possible that VOC emissions can change with temperature and sunlight. This will vary hourly.	Temperature and sun related impacts might best be handled using temperature and sunlight data and a formula
Biogenic: Vegetation (medium VOC) in grid cell	It is possible that VOC emissions can change with temperature and sunlight. This will vary hourly.	Temperature and sun related impacts might best be handled using temperature and sunlight data and a formula

Finally, it is important to note that the IED expects the Seasonal and Hourly adjustments to be normalized. This means that the eight seasonal adjustments in a row will add up to one and that the twenty-four hourly adjustments in a row will add up to one.

Section G.2: Formula Based Grid Adjustments / PHPFormulas / SpecialCorrections

As can be surmised from the previous section, seasonal and hourly grid cell based corrections, although workable, can become complex. The IED offers an alternative to this approach. Formulas based on temperature or sunlight or both or other environmental parameters can be used in place of data queried from tables. The IED offers this option. There are three types of formulas that are found in the PHPFormulas table. These are Emission Factor formulas, Emission Factor Aging formulas, and Activity Adjustment formulas. The type of formula is indicated by the fourth character in the ten character key code. The options are shown in Table G.2-1.

Table G.2-1: Formula Type Indicators

Formula Type	4th Character Indicator	Example of Keycode
Emission Factor	**E**	ISCE000001
Emission Factor Aging Adjustment	**F**	ISCF000009
Activity Correction Formula	**X**	ISCX000024

In the case of emission factors, the formulas in the table must use the character symbols shown in Table G.2-2.

Table G.2-2: Symbols To Be Used in the PHPFormulas Table Related to Emission Factors

Variable	Symbol to Use
Coefficient C1	$C1
Coefficient C2	$C2
Coefficient C3	$C3
Coefficient C4	$C4
Flow Property E1	$E1
Flow Property E2	$E2
Flow Property E3	$E3
Flow Property E4	$E4
Flow Property E5	$E5

The activity adjustment formulas are based on environmental metrics such as temperature or humidity. This data is found in the EnviroGridDistribution table. The EnviroGridDistribution table contains pointers to the temperature, rainfall, and other data that can be used in a formula to estimate space heating use or other emission related processes. The PHPFormulas table contains PHP formulas that use the temperature, humidity, wind speed, wind direction, or other information extracted from the EnviroGridDistribution table to calculate the needed activity adjustments. Use of this approach allows complex formulas based on temperature, humidity, and other variables contained in the EnviroGridDistribution table to be used to estimate emissions. The IED user must of course provide the needed formula in the PHPFormulas table. Table G.2-3 shows the variable names that must be used in the PHP equations used in the PHPFormulas table for activity adjustment formulas.

Table G.2-3: Symbols That Must Be Used in the PHPFormulas Table

Variable	Symbol to Use
Ambient Temperature	$Tmp
Ambient Humidity	$Hum
Ambient Wind Speed	$WdS
Ambient Wind Direction	$WdD
Rainfall	$Rnf
Canopy Cover	$Cnp
Water Cover	$Wtc
Agricultural Land	$Agl
Hourly Grid Adjustment	$Hg
Year or Age	$Yr
AgingFactor	$AgC
Emission Factor	$EmFac

Section G.3: GridGrowthDistribution Table

The GridGrowthDistribution table is used in the same way that the SeasonalGridDistribution, table, discussed in Section 1, is used. The GridGrowthDistribution table contains ten data columns plus columns to define the grid cell of interest. These data columns are named **GrMetricXY** where the XY can be "01" to "10". It is also possible for the user to add columns to this table, if needed, as long as the name protocol is followed. Each of these columns contains a pointer for each grid cell in the region. This pointer is used in the GrowthMetric table to determine a value for the process growth depending upon the year in the future. The IED user would assign different process types to different columns in the GridGrowthDistribution table. As presently configured, for the case of area sources with growth that varies in different grid cells, the growth scenarios for the different processes must be related to one of ten options. Due to the uncertainty involved in future growth projections, the allowance of ten different growth types still allows a good deal of flexibility in defining future growth.

Section G.4: MetricDescription Table

All of the grid distribution tables are made up of a key column plus columns to indicate the region and row and column of the grid cell that the data record applies to. The remaining columns in these tables have standardized names such as HrMetric01 or SnMetric05 or FxMetric03 or GrMetric09. In total, the IED has 130 generically named columns spread among the five grid distribution tables. The MetricDescription table is provided in order to briefly describe the purpose of the different generically named columns.

Appendix H
SourceOverview, ProcessBase, and ProcessFlow Tables

Section H.1: Overview

The SourceOverview, ProcessBase, and ProcessFlow tables represent the core of the IED. These tables contain the data that represent all of the sources of emissions in the region of interest. In addition, the SourceOverview table and its sub tables contain information on persons or businesses that are not the traditional emission sources but are related to the management of air quality such as air quality consulting and owners of emission credits. This latter case will become clear as the tables are discussed.

In the standard process of developing emission inventories, the emission sources are classified either as Point Sources, Area Sources (or Stationary Area Sources), On-Road Mobile Sources, Off-Road Mobile Sources, or Natural Sources. All of these source types are included in the SourceOverview table. All of the just listed sources except the Point Source class are different types of area sources, but it is common and useful to break some of the area sources into related groupings.

In addition to the traditional source types that are included in the tables, owners of emission credits, a class of air quality management persons designated as consultants, and other situations that call for names and addresses will also be treated as a class of sources in the database. These latter source types do not impact the emission inventory, of course, but inclusion of them in these and their associated tables allows a consistent approach to managing the information on emissions in a region. It is also possible in the design of the IED to include water pollution, solid waste pollution, energy flow, and economic information as well as air quality information in the database. This will be discussed further as the various tables are discussed in Section H.2 through Section H.4.

Section H.2: SourceOverview Table

The SourceOverview table is designed to handle the general information about a source class. The columns in the SourceOverview table can be reviewed on page 1 of the database description. This discussion will cover only those columns that are of prime importance to the understanding and use of this table.

The **JurisdictionCode** column is included in the SourceOverview table as a way to indicate the agency that has prime jurisdiction over this source of emissions. In some cases, sources are in the jurisdiction of a federal agency, in other cases they are in the jurisdiction of a state (provincial) agency, and in other cases they are in the jurisdiction of a local agency. The potential jurisdictions related to environmental management are listed in the Jurisdictions table 28 in Appendix A. The IED user can include as many jurisdictions as needed.

The **SourceClassKey** column is used to indicate the class of sources to which the source belongs. This information can be used for a number of purposes including creation of emission inventory summaries or sending out notices to appropriate source types.

The SourceOverview table also includes information on all of the other source classes. Table H.2-1 lists the general types of sources in the SourceOverview table.

Table H.2-1: General Classes of Sources Included in the SourceOverview Table

General Source Class	Description
Point	Includes those sources that are treated independently as a source of pollution
Area	Includes those sources that are stationary but are too small to be classes as a point source
On-Road Mobile	Mobile sources that normally operate on roadways
Off-Road Mobile	Mobile sources that do not normally operate on roadways such as trains and ships
Natural	Sources of pollution that are due to natural actions such as volcanoes and forest fires
Credit Owner	The owner of a pollution credit
Consultant	A person designated to represent a point source or agency in using the database

The SourceClassName table that is associated with the SourceOverview table lists and translates all of the allowed source class names. At the present time there are 58 source class types in the SourceClassName table. The IED user can add classes to the SourceClassName table as needed and refer to them in the SourceOverview table.

The area sources, or stationary area sources as they are sometimes referred to, and the mobile and natural sources are broken into a number of related sub-classes. There is no generally accepted definition of an area source so sources included in an emission inventory as an area source can vary from location to location. In general, area sources are those sources too small to be classified individually in an emissions inventory. A local air quality management program can define the types of sources that it would like to have in its area source database.

It should be noted that the various source classes will be broken into sub-classes called processes that are indicated in the ProcessBase table discussed later in this Appendix. As an example, a Cement plant, which is almost always treated as a point source, will have a number of processes associated with it such as the clinker kiln and the clinker grinder and many others. Area sources will also have sub-classes that show up in the ProcessBase table. For example, in the class of Space Heating there will be sub-classes (referred to as processes) such as Residential Space Heating, Commercial Space Heating, and such.

The area source classes typically used in emission inventories for an "Area" source are shown in Table H.2-2.

Table H.2-2: Area Source Classes Recommended for the IED

Area Source Class	Description
Area: Agricultural	All processes associated with the growing and raising of agricultural and crops with direct emissions except for equipment on any farms that are treated as off road or large farms that are treated as a point source.
Area: Architectural Coating	All processes related to coating buildings and other architectural units
Area: Bonding	All processes related to bonding materials together using a glue or mastic except for sources classified as a point source.
Area: Burning	All processes related to burning materials in the open.
Area: Cold Cleaning	All processes related to commercial or residential solvent cleaning except for dry cleaning and any process classified as a point source.
Area: Construction and Demolition	All non-mobile emissions from construction and demolition activities.
Area: Consumer Products	All processes related to the use of consumer products other than architectural coating even at sources classified as a point source.
Area: Cooking	All home or commercial operations associated with cooking food except for those sources classified as point sources.
Area: Other Fuel Combustion	Any stationary fuel combustion that is not associated with cooking, construction, or space heating/cooling such as backup generation, distribution electricity generation that is not a point source.
Area: Laundering	All operations associated with solvent cleaning of clothing except for the case where a source is classified as a point source.
Area: Food and Textile Processing	All operations associated with the processing and storage of food or textiles, such as fermentation of wine and processing of olive oil, except for those sources classified as a point source.
Area: Fugitive Dust	All operations associated with mechanical dust creation due to construction, road use, or other general processes that create fugitive dust except where it occurs from an operation classified as a point source.
Area: Internal Combustion Engine	All operations associated with internal combustion engines that are not classified as a point source or not included in agricultural category.
Area: Fuel Storage and Processing	All operations associated with petroleum and natural gas storage, handling, processing, and transmission that are not classified as a point source.
Area: Paving and Roofing	All operations associated with asphalt paving new or existing roadways, or roofing
Area: Pesticides & Fertilizers	All operations associated with the use of pesticides and fertilizers
Area: Printing	All operations associated with printing except for the case of sources treated as a point source.
Area: Product Coating	All area sources related to commercial coating operations that are too small to be classified as a point source.

Table H.2-2: Area Source Classes Recommended for the IED (continued)

Area Source Class	Description
Area: Sewage Treatment	All operations related to sewage treatment, such as incineration, except for sewage treatment plants and landfills that are treated as a point source.
Area: Space Heating	All operations intended for space heating except those space heating operations that are treated as a point source.
Area: Vapor Degreasing	All operations associated with vapor degreasing except for the sources treated as a point sources
Area: Waste Disposal	All operations associated with waste disposal except for the sources treated as a point source, sewage treatment,
Area: Water Heating	All operations associated with water heating except for the sources treated as a point source.
Area: Windblown Dust	All area source emissions associated with windblown dust except at facilities that are treated as a point source.

On-road mobile sources are typically broken into four classes. They are shown in Table H.2-3.

Table H.2-3 Classes Typically Associated with On-Road Mobile Sources

On-Road Mobile Source Class	Description
On-Road Mobile: Passenger Vehicle	Refers to all four wheel vehicles used normally to carry passengers. Light trucks that are more often used to carry passengers are typically included in this class as well.
On-Road Mobile: Heavy Truck	Refers to heavy duty trucks typically with 10-18 wheels used to carry freight in a region
On-Road Mobile: Medium Truck	Refers to medium sized trucks typically with 6-8 wheels used to carry freight in a region
On-Road Mobile: Small Truck	Refers to medium sized trucks typically with only 4 wheels
On-Road Mobile: Regular Bus	Refers to standard sized buses that are typically used to carry passengers in a region.
On-Road Mobile: Mini Bus	Refers to smaller buses that typically carry 12-25 persons.
On-Road Mobile: Two-Wheel Vehicle	Refers to all two-wheel vehicles (motorcycles)
On-Road Mobile: Three-Wheel Vehicle	Refers to all three-wheel vehicles except for the case of three-wheel trucks that are used in China. These trucks are included in the truck category.

Off-Road mobile sources comprise a broad range of vehicle types. The typical classes included in an inventory for these types of vehicles are shown in Table H.2-4:

Table H.2-4 Classes Typically Associated with Off-Road Mobile Sources

Off-Road Mobile Source Class	Description
Off-Road: Agricultural Equipment	Refers to mobile sources used on farms such as tractors
Off-Road Mobile: Aviation	Refers to airplanes and the ground service equipment used with them
Off-Road Mobile: Construction Equipment	Refers to all equipment used in construction
Off-Road: Commercial/Industrial	Refers to all mobile equipment used at commercial or industrial facilities such as fork lifts.
Off-Road Mobile: Rail	Refers to trains and the lift and other service equipment associated with trains
Off-Road Mobile: Seaports	Refers to ships and the lift and other service equipment associated with ships and shipyard activities
Off-Road Mobile: Recreational	Refers to recreational vehicles including off-road land vehicles and boats
Off-Road: Other	Any mobile source not included in the other classes, such as emissions from extended idling and generator use at truck stops.

Table H.2-5 indicates the source classes often associated with natural sources. Geologic sources are listed as a class, but many of them would not normally be included in an inventory except the case where they would be active daily or weekly over a long time period. Natural events that occur irregularly over a span of years are not normally considered as part of the inventory.

Table H.2-5 Classes Typically Associated with Natural Sources

Off-Road Mobile Source Class	Description
Natural: Fires	Refers to natural fires not induced by man-made actions such as clearing land
Natural: Land	Refers to emissions that develop from the elements on the land, not exacerbated by human activities, such as natural windblown dust from desert sand desert sand, N20 emissions from soil, and geologic emissions from volcanoes
Natural: Vegetation	Refers to VOC emissions from naturally occurring vegetation
Natural: Water	Refers to emissions from or into bodies of water (primarily related to greenhouse emissions)
Natural: Other	Any natural emissions not included in the other classes

The **SizeClassCode** column is used to indicate the size class that a source might belong to. It is only relevant to point sources. In the United States, more stringent laws are applied to larger sources. Thus, at least in the U.S., there is a need to indicate the size class of the source. This may be useful in other countries as well. The different size classes to be used in a database are listed and translated in the SizeClassType table. Any number of size classes can be included in the SizeClassType table and referred to in the SourceOverview table.

The **RegionAbbreviation** column is used to indicate the region in which the source is located. This allows for a single database to include data on more than one region in a country. The regions of a country that are included in the database are listed in the RegionalGridInfo table. These regions can then be referred to in the SourceOverview table.
The remaining columns in the SourceOverview table are straightforward. The definitions found in the database description on page 1 indicate a brief definition for each column.

The **Status** column is used by some of the IED programs to determine if the data in a row of the table is complete. There are three options for the **Status** column. One option is "C" to indicate that the data in the row is complete. A second option is "I" to indicate that the data in the row is incomplete. A third option is "X" to indicate that the data in the row should be considered deleted.

Section H.3: ProcessBase Table

The ProcessBass table is used to hold information regarding the processes associated with a source. The key data columns for this table will be discussed in this section. As discussed in Section H.2, a source can be a point or area type of source, and forty-seven (47) source types were identified in Tables H.2-2 through H.2-5. Each of these source types have sub-categories, which are referred to in the IED as processes. The ProcessBase table contains information about these processes. Each record (row) in the ProcessBass table must have the **SourceID** that this record refers to. The second column is for this purpose. The third column in the ProcessBass table asks for the **ProcessNameKey**. The **ProcessNameKey** refers to the process type. These options are listed and translated in the ProcessName table.

As noted in the previous paragraph, there are forty-seven source types. Since each source type will have several process types associated with it, there will likely be several hundred process types listed in the ProcessName table. Tables H.3-1a through H.3-1e indicate some likely process types that will go with each source type.

Table H.3-1a: Process Sub-Classes for Area Source Types

Source Type	Process Type	Source Type	Process Type
Area: Agricultural	Agricultural/Irrigation	Area: Cold Cleaning	Cold Cleaning/Methylene
Area: Agricultural	Agricultural/Fugitive Dust	Area: Cold Cleaning	Cold Cleaning/Naphtha
Area: Agricultural	Agricultural/Other	Area: Cold Cleaning	Cold Cleaning/Other
Area: Agricultural	Agricultural/Vegetation Emissions	Area: Cold Cleaning	Cold Cleaning/Toluene
Area: Architectural Coating	Architectural Coatings/Solvent Based	Area: Cold Cleaning	Cold Cleaning/Trichloroethane
Area: Architectural Coating	Architectural Coatings/Unspecified	Area: Cold Cleaning	Cold Cleaning/Unspecified
Area: Architectural Coating	Architectural Coatings/Water Based	Area: Construction/ Demolition	Demolition-Construction/Commercial
Area: Bonding	Bonding/Solvent Based	Area: Construction/ Demolition	Demolition-Construction/Other
Area: Bonding	Bonding/Unspecified	Area: Construction/ Demolition	Demolition-Construction/Residential
Area: Bonding	Bonding/Water Based	Area: Construction/ Demolition	Demolition-Construction/Unspecified
Area: Burning	Burning/Forest or Range Management	Area: Consumer Products	Consumer Products/Aerosol
Area: Burning	Burning/Residential or Commercial	Area: Consumer Products	Consumer Products/Non-Aerosol
Area: Burning	Burning/Structural Fires	Area: Consumer Products	Consumer Products/Pesticides

Area: Cold Cleaning	Cold Cleaning/Alcohol	Area: Consumer Products	Consumer Products/Unspecified
Area: Cold Cleaning	Cold Cleaning/ Chlorofluorocarbons	Area: Cooking	Cooking/Charbroiling

Table H.3-1b: Process Sub-Classes for Area Source Types

Source Type	Process Type	Source Type	Process Type
Area: Cooking	Cooking/Deep Fat Frying	Area: Fuel Storage and Processing	Storage/Unspecified
Area: Cooking	Cooking/Other	Area: Fugitive Dust	Fugitive Dust/Aggregate Crushing
Area: Cooking	Cooking/Unspecified	Area: Fugitive Dust	Fugitive Dust/Asphaltic Concrete
Area: Food and Textile Processing	Fermentation/Bakeries	Area: Fugitive Dust	Fugitive Dust/Concrete Mixing
Area: Food and Textile Processing	Fermentation/Breweries	Area: Fugitive Dust	Fugitive Dust/Farm Operations
Area: Food and Textile Processing	Fermentation/Wine	Area: Fugitive Dust	Fugitive Dust/Metal Grinding
Area: Food and Textile Processing	Fermentation/Wine Aging	Area: Fugitive Dust	Fugitive Dust/Paved Roads
Area: Food and Textile Processing	Food or Textile/Storage	Area: Fugitive Dust	Fugitive Dust/Sand and Gravel
Area: Fuel Storage and Processing	Refueling/Diesel Vehicles	Area: Fugitive Dust	Fugitive Dust/Surface Blasting
Area: Fuel Storage and Processing	Refueling/Gasoline Tanks	Area: Fugitive Dust	Fugitive Dust/Unpaved Roads
Area: Fuel Storage and Processing	Refueling/Gasoline Vehicles	Area: Fugitive Dust	Fugitive Dust/Wood Processing
Area: Fuel Storage and Processing	Refueling/Other Tanks	Area: Fugitive Dust	Fugitive Dust/Construction
Area: Fuel Storage and Processing	Refueling/Refined Oil Tanks	Area: Internal Combustion Engine	I.C. Engine/Diesel
Area: Fuel Storage and Processing	Refueling/Unspecified	Area: Internal Combustion Engine	I.C. Engine/Natural Gas
Area: Fuel Storage and Processing	Natural Gas Transmission	Area: Internal Combustion Engine	I.C. Engine/Other Fuels
Area: Fuel Storage and Processing	Storage/Gasoline	Area: Internal Combustion Engine	I.C. Engine/Propane
Area: Fuel Storage and Processing	Storage/Other	Area: Internal Combustion Engine	I.C. Engine/Unspecified
Area: Fuel Storage and Processing	Storage/Refined Oil	Area: Laundering	Dry Cleaning/Perchloroethylene

Table H.3-1c: Process Sub-Classes for Area Source Types

Source Type	Process Type	Source Type	Process Type
Area: Laundering	Dry Cleaning/Petroleum Solvent	Area: Product Coating	Coating/Semiconductor
Area: Laundering	Dry Cleaning/Unspecified	Area: Product Coating	Coating/Unspecified
Area: Other Fuel Combustion	Fuel Combustion/Electricity Generation	Area: Product Coating	Coating/Wood Products
Area: Other Fuel Combustion	Fuel Combustion/Other	Area: Sewage Treatment	Sewage Treatment
Area: Paving and Roofing	Paving/Cutback Asphalt	Area: Space Heating	Commercial Space Heating/Coal
Area: Paving and Roofing	Paving/Emulsified Asphalt	Area: Space Heating	Commercial Space Heating/Natural Gas
Area: Paving and Roofing	Paving/Hot-Mix Asphalt	Area: Space Heating	Commercial Space Heating/Oil
Area: Paving and Roofing	Paving/Other	Area: Space Heating	Commercial Space Heating/Other Fuel
Area: Paving and Roofing	Paving/Road Oils	Area: Space Heating	Commercial Space Heating/Propane
Area: Paving and Roofing	Paving/Unspecified	Area: Space Heating	Commercial Space Heating/Unspecified
Area: Paving and Roofing	Roofing/General	Area: Space Heating	Commercial Space Heating/Wood
Area: Pesticides & Fertilizers	Pesticides/Agriculture	Area: Space Heating	Residential Space Heating/Coal
Area: Pesticides & Fertilizers	Pesticides/Commercial	Area: Space Heating	Residential Space Heating/Natural Gas
Area: Pesticides & Fertilizers	Fertilizer/General	Area: Space Heating	Residential Space Heating/Oil
Area: Printing	Printing	Area: Space Heating	Residential Space Heating/Other Fuel
Area: Product Coating	Coating/Auto Refinishing	Area: Space Heating	Residential Space Heating/Propane
Area: Product Coating	Coating/Fabric Coating	Area: Space Heating	Residential Space Heating/Wood
Area: Product Coating	Coating/Marine Refinishing	Area: Vapor Degreasing	Vapor Degreasing/ Perchloroethylene
Area: Product Coating	Coating/Other	Area: Vapor Degreasing	Vapor Degreasing/ Trichloroethane

Table H.3-1d: Process Sub-Classes for Natural and Off-Road Mobile Source Types

Source Type	Process Type	Source Type	Process Type
Natural: Fires	Natural Forrest or Prarie Fires	Off-Road Mobile: Recreational	Recreational Water Equipment/4-Stroke
Natural: Land	Natural Soil Released Emissions	Off-Road Mobile: Recreational	Recreational Water Equipment/2-Stroke
Natural: Other	Natural/Other	Off-Road Mobile: Seaports	Ship Emissions
Natural: Vegetation	Natural/VOC from Vegetation	Off-Road Mobile: Seaports	Ship Support Emissions
Natural: Water	Natural Water Released Emissions	Off-Road Mobile: Seaports	Ship Idling
Off-Road Mobile: Aviation	Aircraft	Off-Road: Agricultural Equipment	Agricultural Equipment (Mobile)
Off-Road Mobile: Aviation	Aircraft/Support	Off-Road: Commercial/Industrial	Commercial/Industrial (Mobile)
Off-Road Mobile: Construction Equipment	Off-Road/Construction Equipment	Off-Road: Other	Logging
Off-Road Mobile: Rail	Rail	Off-Road: Other	Mining
Off-Road Mobile: Rail	Rail/Support	Off-Road: Other	Lawn and Garden
Off-Road Mobile: Recreational	Recreational Land Equipment/4-Stroke	Off-Road: Other	Extended On-Road Truck Idle
Off-Road Mobile: Recreational	Recreational Land Equipment/2-Stroke	Off-Road: Other	Refrigeration

Table H.3-1e: Process Sub-Classes for On-Road Mobile Source Types

Source Type	Process Type	Source Type	Process Type
On-Road : Heavy Truck	Euro6/Diesel	On-Road : Medium Truck	Euro0/Gasoline
On-Road : Heavy Truck	Euro5/Diesel	On-Road : Mini Bus	Euro6/Diesel
On-Road : Heavy Truck	Euro4/Diesel	On-Road : Mini Bus	Euro5/Diesel
On-Road : Heavy Truck	Euro3/Diesel	On-Road : Mini Bus	Euro4/Diesel
On-Road : Heavy Truck	Euro2/Diesel	On-Road : Mini Bus	Euro3/Diesel
On-Road : Heavy Truck	Euro1/Diesel	On-Road : Mini Bus	Euro2/Diesel
On-Road : Heavy Truck	Euro0/Diesel	On-Road : Mini Bus	Euro1/Diesel
On-Road : Medium Truck	Euro6/Diesel	On-Road : Mini Bus	Euro0/Diesel
On-Road : Medium Truck	Euro5/Diesel	On-Road : Mini Bus	Euro6/Gasoline
On-Road : Medium Truck	Euro4/Diesel	On-Road : Mini Bus	Euro5/Gasoline
On-Road : Medium Truck	Euro3/Diesel	On-Road : Mini Bus	Euro4/Gasoline
On-Road : Medium Truck	Euro2/Diesel	On-Road : Mini Bus	Euro3/Gasoline
On-Road : Medium Truck	Euro1/Diesel	On-Road : Mini Bus	Euro2/Gasoline
On-Road : Medium Truck	Euro0/Diesel	On-Road : Mini Bus	Euro1/Gasoline
On-Road : Medium Truck	Euro6/Gasoline	On-Road : Mini Bus	Euro0/Gasoline
On-Road : Medium Truck	Euro5/Gasoline	On-Road : Passenger Vehicle	<1990
On-Road : Medium Truck	Euro4/Gasoline	On-Road : Passenger Vehicle	1990
On-Road : Medium Truck	Euro3/Gasoline	On-Road : Passenger Vehicle	1991
On-Road : Medium Truck	Euro2/Gasoline	On-Road : Passenger Vehicle	1992
On-Road : Medium Truck	Euro1/Gasoline	On-Road : Passenger Vehicle	1993

Table H.3-1e: Process Sub-Classes for On-Road Mobile Source Types

Source Type	Process Type	Source Type	Process Type
On-Road : Passenger Vehicle	1994	On-Road : Regular Bus	Euro2/Propane
On-Road : Passenger Vehicle	1995	On-Road : Regular Bus	Euro1/Propane
On-Road : Passenger Vehicle	1996	On-Road : Regular Bus	Euro0/Propane
On-Road : Passenger Vehicle	1997	On-Road : Regular Bus	Euro6/CNG
On-Road : Passenger Vehicle	1998	On-Road : Regular Bus	Euro5/CNG
On-Road : Passenger Vehicle	1999	On-Road : Regular Bus	Euro4/CNG
On-Road : Passenger Vehicle	2000	On-Road : Regular Bus	Euro3/CNG
On-Road : Passenger Vehicle	2001	On-Road : Regular Bus	Euro2/CNG
On-Road : Passenger Vehicle	2002	On-Road : Regular Bus	Euro1/CNG
On-Road : Passenger Vehicle	2003	On-Road : Regular Bus	Euro0/CNG
On-Road : Passenger Vehicle	2004	On-Road : Regular Bus	Euro6/CNG
On-Road : Passenger Vehicle	2005	On-Road : Regular Bus	Euro5/CNG
On-Road : Passenger Vehicle	2006	On-Road : Regular Bus	Euro4/CNG
On-Road : Passenger Vehicle	2007	On-Road : Regular Bus	Euro3/CNG
On-Road : Passenger Vehicle	2008	On-Road : Regular Bus	Euro2/CNG
On-Road : Passenger Vehicle	2009	On-Road : Regular Bus	Euro1/CNG
On-Road : Passenger Vehicle	2010	On-Road : Regular Bus	Euro0/CNG
On-Road : Regular Bus	Euro6/Diesel	On-Road : Small Truck	Euro6/Diesel
On-Road : Regular Bus	Euro5/Diesel	On-Road : Small Truck	Euro5/Diesel
On-Road : Regular Bus	Euro4/Diesel	On-Road : Small Truck	Euro4/Diesel
On-Road : Regular Bus	Euro3/Diesel	On-Road : Small Truck	Euro3/Diesel
On-Road : Regular Bus	Euro2/Diesel	On-Road : Small Truck	Euro2/Diesel
On-Road : Regular Bus	Euro1/Diesel	On-Road : Small Truck	Euro1/Diesel
On-Road : Regular Bus	Euro0/Diesel	On-Road : Small Truck	Euro0/Diesel
On-Road : Regular Bus	Euro6/Diesel	On-Road : Small Truck	Euro6/Diesel
On-Road : Regular Bus	Euro5/Diesel	On-Road : Small Truck	Euro5/Diesel
On-Road : Regular Bus	Euro4/Diesel	On-Road : Small Truck	Euro4/Diesel
On-Road : Regular Bus	Euro3/Diesel	On-Road : Small Truck	Euro3/Diesel
On-Road : Regular Bus	Euro2/Diesel	On-Road : Small Truck	Euro2/Diesel
On-Road : Regular Bus	Euro1/Diesel	On-Road : Small Truck	Euro1/Diesel
On-Road : Regular Bus	Euro0/Diesel	On-Road : Small Truck	Euro0/Diesel
On-Road : Regular Bus	Euro6/Propane	On-Road : Small Truck	Euro6/Gasoline
On-Road : Regular Bus	Euro5/Propane	On-Road : Small Truck	Euro5/Gasoline
On-Road : Regular Bus	Euro4/Propane	On-Road : Small Truck	Euro4/Gasoline
On-Road : Regular Bus	Euro3/Propane	On-Road : Small Truck	Euro3/Gasoline
On-Road : Regular Bus	Euro2/Propane	On-Road : Small Truck	Euro2/Gasoline
On-Road : Regular Bus	Euro1/Propane	On-Road : Small Truck	Euro1/Gasoline
On-Road : Regular Bus	Euro0/Propane	On-Road : Small Truck	Euro0/Gasoline
On-Road : Regular Bus	Euro6/Propane	On-Road : Three-Wheel Vehicle	On-Road/3-Wheel/4-Stroke
On-Road : Regular Bus	Euro5/Propane	On-Road : Three-Wheel Vehicle	On-Road/3-Wheel/2-Stroke
On-Road : Regular Bus	Euro4/Propane	On-Road : Two-Wheel Vehicle	On-Road/3-Wheel/4-Stroke
On-Road : Regular Bus	Euro3/Propane	On-Road : Two-Wheel Vehicle	On-Road/3-Wheel/2-Stroke

The forth and fifth columns are used to record a process name and any past process identification code that the process may have had. The sixth and seventh columns record the latitude and longitude of the process. The eighth column is for a pointer to the GrowthMetric table or the GrowthGridDistribution table that describes the growth of the source in the future. If an integer is placed in this column then this refers to one of the growth rows in the GrowthMetric table. If the string “GrMetric01”, “GrMetric02”, up to “GrMetric10” this refers to a column in the GrowthGridDistribution table. The column referenced will hold integer pointers to the GrowthMetric table so that different grid cells in a region can have different growth rates. This can only apply to area sources since a point source will exist in only one grid cell.

The remaining columns in the ProcessBase table are self explanatory with one exception—the Status column. The Status column is used by some of the IED programs to determine if the source data is up-to-date and complete. There are three options for this column. A “C” indicates that the data in this row is complete. An “I” in this column indicates that the data in this row is incomplete. An “X” in the column indicates that this row of data should be considered deleted. There is a brief description with the table layouts in the main body of this manual. The status column is not used by any interfaces at this point in time.

Section H.4: ProcessFlow Table

The ProcessFlow table is designed to hold information related to the flows of materials and energy into and out of the process including pollution into the air, water, or landfills. The table contains either emission factors for estimating flow or actual flow rates. A process flow also has an associated beginning and ending date that can be used to indicate future flow rates, a beginning date for making emission factor aging calculations, and seasonal and hourly adjustments.

The reader can get an overview of the table by looking at Table 10 in Appendix A. There is a **ProcessFlowID** column that serves as the primary key for the table. The second column, **ProcessID**, links the flow to the process that the flow is leaving or coming to. The third column (**ProcessReceiver**) indicates where the flow comes from or where it is going. In some cases, this will be another process in the facility. In this case, the value in this record will be the **ProcessID** for the source to which this output is going. Table H.4-1 presents other values that should be placed in the column if the flow is coming from or going to a location outside of the facility. These values indicate where the flow is going and are used in the various PHP routines to determine if, for example, the flow is air pollution.

Table H.4-1: Codes for Use in the ProcessReceiver Column to Indicate Material Flow

Code	Purpose of Code
1	Flow is going out of the process to the atmosphere
2	Flow is going out of the process to the sewer system
3	Flow is going out of the process to the rainwater sewer system (if separate from the sewer system)
4	Flow is going out of the process and onto the ground
5	Flow is going out of the process and into a stream or lake
6	Flow is going out of the process and is transferred to a standard landfill
7	Flow is going out of the process and is transferred to a hazardous materials landfill
8	Flow is going out of the process and is waste that is being transferred to another company. In this case, the name and address of the company should be placed in the comment column.
9	Flow is a completed product that is going outside of the facility.
10-100	Not used at this time.
101	Flow is into the process from outside of the facility.
102	Flow is into the process from outside of the facility and is 100% recycled material.
103	Flow is into the process from outside of the facility and is 100% renewable.
104-1000	Not used at this time.

The fourth column contains the **MaterialCode**. This code indicates the type of material that is flowing. Energy such as electricity is considered a material as used in this context. The potential material codes that can be used in this column can be found in the MaterialNameFinder table.

The fifth column contains the **SCCx_Code**. This code indicates the emission factor that goes with this process and material. The available SCCx codes are located in the EmissionFactorFinder table. At this point in time, there are about 28,000 emission factors in the table. If an appropriate emission factor does not exist for this process and material then an emission factor must be developed and added to the EmissionFactorFinder table or the actual flow rate must be entered in the **Flow** column, which is discussed later in this section. There must either be an SCCx code in the table or a flow value in the **Flow** column for each pollutant of interest in order to develop an appropriate emission inventory.

The sixth column contains the **KeyFlow** code. This is only needed if an emission factor is to be used to calculate the flow. The key flow is an integer that points to the process flow that is required in order to make an emissions calculation from an emission factor. This comes from the fact that with an emission factor that the emission rate is calculated using the equation:

Er = Emfac *Kf[1] **Equation H.4-1**

In Equation H.4-1 above, the term Emfac indicates the emission factor, which is derived using the SCCx code found in the **SCCx_Code** column and the term Kf refers to key flow rate for the process found in the **KeyFlow** column presently being discussed. Thus, in order to use an emission factor, a key flow must be designated and a record for this key flow created in the ProcessFlow table. If there is no emission factor for this process, then the key flow is unnecessary as well.

[1] The calculation process is discussed in Appendix B.

The seventh column (**Estimation Approach**) is available to add a comment about the approach used to estimate this process flow and is not involved in any actual calculations.

The eighth column is the **Flow** column. As noted earlier in this section, every process flow must have an emissionfactor/keyflow or it must have a value in the flow column. If an emission factor/keyflow is to be used to get the emission rate, then a negative one (-1) must be placed in the **Flow** column. If a value other than a negative one is placed in the column, this value will be used to estimate the flow rate for this process flow.

The value placed in the **Flow** column is linked to the values used in the **GenActivityAdj** column (see Section B.2 of Appendix B for a discussion of the GenActivityAdj and how it is used relative to the Flow).

The ninth and tenth columns indicate the upper and lower units for the flow that the user wants the values reported in. The actual flow values in the table are maintained as kilograms per unit time. These two columns are consulted only to convert the data to units for viewing by the IED user.

The **FlowBasis** column indicates the time frame of the flow data. This is discussed extensively in Appendix B, but it is useful to summarize the discussions here. The flow values for different source types are often determined in different timeframes. For example, the flow rate for one point source process might be per hour for a specific hour of the day and time of the year. For a different source, it might be determined as the total daily flow rate for a specific day of the year. In many cases it is supplied as an annual flow rate. The IED will accommodate any of these three timeframes. In order to make the appropriate calculations, the computer functions used to calculate the flow rate must know the time basis for each flow rate. This is the purpose of the **FlowBasis** column. A six-digit acronym is used to indicate the basis for the information recorded in the **Flow** column. This acronym must be viewed two digits at a time. The first two digits refer to the timeframe of the flow. The timeframe can be one hour (denoted: HR), one day (denoted: DY), or one year (denoted: YR). If the timeframe is one hour, then it must be denoted which day and which hour the flow represents. The second two digits denote the day (i.e. day in a season) that the data represents and the third set of two digits denote the hour that the data represents. In the case of the flow data representing the data as a daily total, then the day (i.e. day in a season) that the data represents must be denoted using the second two digits. Of course, in this case the hour does not matter. Finally, if the data is an annual total, the day and hour are of no importance. For example,

- a FlowBasis='HRA214' indicates that the flow data is for one hour for a day in the A2 season and hour 14:00.
- a Flow Basis='DYC100' indicates that the flow data is for one day for a day in the C1 season. The hour does not matter.
- a Flow Basis='YR0000' indicates that the flow data is for the whole year. The day and hour indicators have no meaning in this case.

Table H.4-2 indicates the designations for the various seasons in the IED.

Table H.4-2: Designations for the Seasons in the IED

Season Designation	Description	Season Designation	Description
A1	A weekday in Season A. Season A is often made to be January-March	C1	A weekday in Season C. Season C is often made to be July-September
A2	A weekend in Season A	C2	A weekend in Season C
B1	A weekday in Season B. Season B is often made to be April-June	D1	A weekday in Season D. Season D is often made to be October-December
B2	A weekend in Season B	D2	A weekend in Season D

The GenActivityAdj column allows a field in the database for an adjustment to the flow value that might be needed to generally correct the data. This adjustment is denoted Qr in the discussion of the calculation process in Appendix B. Table H.4-3 indicates recommended values:

Table H.4-3: Options for the Terms Pb and Qr in the IED

Process Type	Value in Flow Field	Value in GeneralActivityAdj Field
Point Source	Maximum Emission Rate (kg/hr)	Average operating fraction of maximum capacity
	Daily Total Emissions	1
	Total Annual Emissions	1
Area/Units	Actual Emission Rate (kg/hr)	1
	Daily Total Emissions	1
	Total Annual Emissions	1
	Emissions per unit per hour (kg/hr)	Total number of units in the region
	Emissions per unit per day (kg/day)	Total number of units in the region
	Emissions per unit per year (kg/year)	Total number of units in the region
Area/Scalar	Actual Emission Rate (kg/hr)	1
	Daily Emissions	1
	Total Annual Emissions	1
	Emissions per volume, mass, distance, or other per hour	Hourly volume, mass, distance, or other
	Emissions per volume, mass, distance, or other per day	Daily volume, mass, distance, or other
	Emissions per volume, mass, distance, or other per year	Annual volume, mass, distance, or other

Columns thirteen through twenty-two are used to distribute the emissions over the grid system and to make seasonal and hourly adjustments to the data. The **FixedGridColumn** is used to indicate (i.e. point to) a column in the FixedGridDistribution table that is to be used to distribute emissions over the region of interest. Population is a metric that is often used to distribute emissions over a region. Thus, one of the forty columns in the FixedGridDistribution table can be used to indicate the population in each grid cell in the region. The pointer in the ProcessFlow table can be set to indicate the column in the FixedGridDistribution table that contains the population data. This information will then be used in subsequent calculations to distribute area source emissions over the regional grid system. There are many metrics that are useful for distributing emissions over a region. Table H.4-4 indicates some useful metrics that might be placed into the FixedGridDistribution table and then referenced in the **FixedGridColumn** in the ProcessFlow table. Of course, a point source does not need to be distributed over the grid system. In this case, the FixedGridColumn should be set to "-1".

Table H.4-4: Examples of Possible Metrics Used to Distribute Area Source Emissions

Metric for FixedGridDistribution Table Column	Metric for FixedGridDistribution Table Column
Population	Number Industrial Units
Number Residential Units	Railway Location
Number Business Units	Average Income
Roadway Type	Wastewater Treatment Plants
Airport Location	Number of Restaurants
Area of Agricultural Land	Area of Parks
Area of Water	Area of Landfills

The **SeasonalGridPtr** column (column fourteen) points either to the SeasonalAdjustment table or the SeasonalGridDistribution table. The **SeasonalGridPtr** provides a pointer to get an adjustment to the flow for each of the eight seasons shown in Table H.4-2. In the case of a point source or an area source where seasonal emission variations are the same for all grid cells, the **SeasonalGridPtr** is an integer that is used in the SeasonalAdjustments table to get eight adjustments to correct the flow data for each of the seasons. In the case of an area source where the seasonal variation of emissions are different in different parts of the region, the **SeasonalGridPtr** is entered as a string value that points to a column in the SeasonalGridDistribution table. The values for the string version of the **SeasonalGridPtr** are “SnMetric01” to “SnMetric40”.

Columns fifteen through twenty-two contain pointers that are used to make hourly adjustments. There is a separate field for each season so that different seasons can have different hourly adjustments. This is particularly important in the case of weekend operations compared to weekday operations. The syntax is the same as the case for the **SeasonalGridPtr** column. An integer value in the **HourlyGridSeasonA1Ptr** indicates a column in the HourlyAdjustments table that contains adjustments for each of the twenty-four hours. A string value (i.e. “HrMetric01” to “HrMetric40”) in the **HourlyGridSeasonA1Ptr** column indicates a column in the HourlyGridDistribution table. Thus, the IED offers a way to have a different hourly distribution for each season of the year and for each grid cell in the region. Of course, many sources will have the same hourly distribution over all weekday seasons and weekend seasons regardless of location, but there will be cases where there might be variations by season and by grid cell.

The IED offers an additional opportunity for improving the accuracy of seasonal and hourly adjustments. A formula based on temperature, humidity, wind speed, and wind direction can be used to make seasonal and hourly corrections. This is noted in the **SeasonalGridPtr** column. If the pointer in the **SeasonalGridPtr** column is not an integer and does not start out “SnMetric” then it is assumed to be a pointer to a row in the PHPFormulas table. This table can contain a bit of PHP script that will calculate seasonal and hourly activity based on some or all of the environmental factors: Temperature, humidity, wind speed, and wind direction.

Columns twenty-three, twenty-four, and twenty-five are four digit years that are used to indicate when the flow is new and when the flow is considered to be active (valid). The **YearNew** column is used in the activity growth and emission factor aging calculation. This year indicates when the process should be considered to be new for purposes of calculating activity growth and emission factor aging. It is likely that the YearNew and the FlowStartYear are the same in many cases. They are allowed to be different so that different processes can use the same growth metric. It is also important to allow them to be different for the case where a Scenario is being created so that a process might have control equipment added in the future and a new process is created with a **FlowStartYear** that corresponds to the year when the control equipment has been added.

The **FlowStartYear** column indicates the year that the process flow becomes active (starts). This value is made available so that flows that will begin in the future can be accommodated in the database. The **FlowEndsYear** column indicates the year that the process flow ceases to be active (ends). The **FlowStartYear** in combination with the **YearNew** is used to calculate the growth adjustment for a processflow, and in the cases where the emission factor has no applicable year, it is the default starting date used to calculate the aging of the emission factor. The reader is referred to Appendix I for a discussion of the calculation of the growth and aging for a process.

The **ReliabilityCode** in the twenty-sixth column indicates how reliable the information for this flow is. There is room for a comment (**Comment**) in the twenty-seventh column and the most recent date that the process flow was adjusted is contained in the twenty-eighth column (**Updated**).

The twenty-ninth column (**Scenario**) and thirtieth column (**ReplacedFlow**) are used for the case where scenarios are to be included in the database. A scenario is used to indicate future control options or policy choices that can be used to project future emissions. The **Scenario** column is set to 0 for the base case. Any one to two character codes (except zero) can be used to indicate a future scenario. The purpose of the scenario should be described in the ScenarioDescriptions table. The **ReplacedFlow** column indicates the flow that the scenario is replacing. If the scenario causes a new flow, it should be left blank. Finally, the thirty-first column is the **Status** column. It is used to indicate the completeness of the row of data in the table. An "I" indicates that the record is incomplete and a "C" indicates that the record is complete. An "X" can also be entered to indicate that the process flow should be considered deleted.

Appendix I
Growth and Aging Estimation

Section I.1: Introduction

Over time, the flows into and out of a process will likely change. These changes can be positive (i.e. increase) or negative (i.e. decrease). The change can be brought on by growth or decline in the industry or by aging of the process equipment causing it to become less efficient. Change can also be caused by improvements to the process equipment or, of course, by a combination of all of these events. The IED provides two ways to make growth projections for a process flow. In the first approach, new process flow records are created to represent operations in the future. The second approach is to use aging and growth factors to approximate future changes. The two approaches are discussed in the following sections, and the different approaches can, in some cases, be used at the same time for different flow parameters. It is important to note that the use of growth or aging factors cannot account for overt changes to the process equipment such as efficiency improvements or the addition of control equipment. These can only be handled using the first alternative, which is the creation of future process flows for a process.

The key information relative to growth and information about a flow into or out of a process is housed in the ProcessBase and ProcessFlow tables, which are discussed in detail in Appendix H. The reader should review this appendix to get a more complete understanding of these specific tables.

Appendix B discusses the process for estimating process output—especially air pollutants and an understanding of this calculation procedure is necessary to a full understanding of the growth adjustment process. Equation B.3-4b and B.3-4e from Appendix B are shown below:

P(d,h) = EmFac * Kf * Qr * R * S(d) * H(d,h) **B.3-4b**
P(n,m,d,h) = EmFac(n,m,d,h) * Kf * Qr * R * Fg(n,m) * S(d,n,m) * H(d,h,n,m) **B.3-4e**

Equation B.3-4b is for a point source and Equation B.3-4e is for an area source.

All of the factors in Appendix B, Equation B.3-4b are discussed in detail in Appendix B. A review of this Appendix by the reader might be helpful to understanding the following discussions. The next five paragraphs summarize the meanings of the factors in Equation B.3-4b.

In equations B.3-4b and B.3-4e above:

- **d** refers to a day in one of four seasons on a week day or weekend day (eight values).
- **h** refers to the hour of the day (24 values).
- **n** refers to the grid row for a grid system laid over the region of interest.
- **m** refers to the grid column for a grid system laid over the region of interest.
- **P(d,h)** refers to the process flow into or out of a process in mass, volume, energy or units per hour depending upon the type of flow.
- **Emfac** refers to the emission factor for the process output. As equipment ages, it typically becomes less efficient. In many cases, this reduction in efficiency will increase the flow of some materials associated with the process (normally materials coming into the process and

going out as waste), and the reduction in efficiency may decrease the flow of the finished product materials going out of the process.

- **Kf** refers to the key flow from the process that indicates the emissions when multiplied with the emission factor.
- **Qr** is an adjustment to the process activity to reflect changes in the use patterns of the process of interest. In the case of area sources, Qr might increase over time as the population increases or as economic improvements result in increases. Similarly, the interest in the output of a process may decline over time as technology and public interests change. Thus, Qr can increase or decrease with time.
- **S** and **H** represent seasonal and hourly adjustments for the process. This may or may not change over time.

The basic fact to draw from this discussion is that the EmFac, Kf, and Qr are likely to change over time and this change and should be included in projections of emissions. The IED provides an approach to include these changes in the calculation of flows. The change in the value of EmFac is referred to as "aging". The change in the value of Kf and Qr is referred to as growth. Aging and growth can be either positive or negative.

Section I.2: Creation of Additional Process Flows to Estimate Future Operations

The most straightforward and rigorous way of accounting for the change in process flows over time in the IED is to simply create additional process flow records for a process that represent future operations of the process. Each record in the ProcessFlow table has a field that indicates the year when the process flow is valid. The column containing this field is called the FlowStartYear. This field is used to indicate when a process flow becomes valid. Before the FlowStartYear, a process flow is considered to be zero. The ProcessFlow table also contains records in a column called FlowEndsYear. This field is used to indicate when a process flow will cease to operate. For years after the process flow ends, the process flow emissions will be considered to be zero.

The downside for the use of addition flows to project future flows is the fact that there will likely be thousands of process flows in the regional database that would require the creation of new future process flows in order to carry out a complete future inventory. It is likely that this approach will be used only for the major inventory updates or for large sources of emissions rather than for every process in the database. It should be considered that if individual point source operators are required to create future process flows for their process upon occasion and different government agencies are assigned the job of addressing the future of the various area sources, the work of creating a set of future process flows could be spread over a number of persons and the creation of many additional process flows could be accomplished without too much stress.

The use of modified process flows for future or past years as a way of projecting future emissions will be a case-by-case decision by the managing government agencies, but this approach will produce the most accurate future projections.

Section I.3: Use of Internal Growth Projections

It should be emphasized for this case that the use of the internal growth projections process is only for estimating gradual growth and aging of a process that will naturally occur over time. The estimation of flow changes for incremental changes to a process such as the addition of control equipment or modifications of the process equipment must be addressed as described in Section I.2.

The ProcessBase table provides a column called **GrowthMetricPtr** to indicate a reference to a growth rate. The actual growth rate values are stored in a table named GrowthMetric. The **GrowthMetricPtr** column is used to provide a pointer to growth rates that represent projected growth for the source over future years. The GrowthMetric table allows for eight cumulative growth rates. These eight growth rates cover the first five years of growth (year 1, year 2, year 3, year 4, year 5) plus a rate for year 10, year 15, and year 20. Obviously, growth projections become more speculative as time progresses, but there is often a need to project emission inventories five, ten, twenty, and thirty years into the future.

The **GrowthMetricPtr** as discussed in the previous paragraph is a ten-character string that refers to a growth rate in the GrowthMetric table of the database. There can be as many different sets of growth rates as needed to properly project emissions for a region. There is also the possibility that in the case of an area source that the growth rate for a source can vary in different parts of the region. Thus, it is also desirable to accommodate this regionally variable growth rate. This is done in the IED by allowing the GrowthMetricPtr in the ProcessBase table to identify a string in the GrowthMetric table or a string in the GrowthGridDistribution table. The IED software looks in the GrowthGridDistribution table if the pointer in the ProcessBase table is a string beginning with "GrMetric". If the **GrowthMetricPtr** begins with "GrMetric", then a table called GrowthGridDistribution will be consulted. This table provides a pointer to the GrowthMetric table that can be different for each grid cell in the region. Thus, different growth rates can be accommodated in different parts of a region. The strings in the GrowthGridDistribution table refer to rows in the GrowthMetric table.

Normally, it is expected that the some sets of growth adjustments will be applied to many sources rather than clog the database with an individual set of growth adjustments for each source. However, the database will support a specific set of growth adjustments for each process if found necessary by the user.

In using a single set of growth adjustments for multiple processes, consideration should be given to how those growth adjustments are applied. If the growth of a process activity is always linear, then the application is simple. However, this is rarely the case. Growth often varies with the age of the process. Older processes will likely not grow in use as fast as newer processes. A special case of the use of growth estimates is with respect to the projection of on-road vehicle emissions. A 2005 vehicle fleet will likely not grow going into the future for two reasons. First, since there are no more 2005 vehicles being produced, they will actually decrease in activity as they are damaged and removed from the fleet. Second, drivers do not operate older vehicles as much as they do newer vehicles. These two facts result in a negative growth rate when looking at a single model year of on-road passenger vehicles. It is also found to be normal that the negative growth in vehicle activity is very low for the first few years of vehicle life and then accelerates as the vehicle ages. Thus, the growth process is non-linear. To accommodate this situation in the IED to allow the same set of growth factors to be used for multiple model years, the growth calculation process must know the year when the activity of the vehicle is set in the database; plus, the growth calculation process must know when the process was considered to be new. The year considered to be new is called the "YearNewGrowth" in the actual PHP code. The value is located in the ProcessFlow table in the column designated **YearNew**. The year that the vehicle activity is set to is considered to be the year designated as **FlowStartYear** in the ProcessFlow table. The user must take care that the activity in the flow column or related to the emission factor in the ProcessFlow table is correct for the year indicated in the **FlowStartYear** column and that the **YearNew** column reflects the year that the process is to be considered new for purposes of making the growth projection.

Finally, it is worth repeating that the growth values in the GrowthMetric table are expected to be cumulative. Thus a process that grows in the first year by 3% will contain 0.03 in the **Age01** column and a process that grows by 58% by the tenth year will have a 0.58 in the **Age10** column of the GrowthMetric table. The growth calculation process will add a one to the values in the growth metric table and multiply them by the activity values derived from the calculation to get the age-adjusted calculation. The mathematical process used for growth in the IED is shown below:

$$ACTIVITY = ACTIVITY_{FlowStartYear} * [GROWTH_{YearNewProcessFlow=>CalculationYear} / GROWTH_{YearNewProcessFlow=>FlowStartYear}]$$

YearNewProcessFlow: This is the ProcessFlow.YearNew value (i.e. value found in the **YearNew** column in the ProcessFlow table).

FlowStartYear: This is the ProcessFlow.FlowStartYear value (i.e. value found in the **FlowStartYear** column in the ProcessFlow table).

Section I.4: Use of Emission Factor Aging

As discussed in Section I.1, it is also possible that the emission factor or emission rate will change as the process ages. Depending upon the process flow being evaluated, this aging adjustment can result in an increase or decrease in flow. The EmissionFactorFinder table contains a column with a reference to the AgingFactorFinder table where an aging adjustment to the emission factor can be found. The AgingFactorFinder table and the GrowthMetric table have similar formats and both use cumulative aging. In the case where an emission factor is used to estimate emissions from a process, the aging correction found in the EmissionFactorFinder table referenced in the ProcessFlow table is used to estimate aging. In the case where an emission rate is used rather than an emission factor no aging correction will be made. For these cases, the aging will have to be integrated into the growth calculation.

As was the case for the growth adjustments, the information in the AgingFactorFinder table is used to calculate an aging adjustment, which is multiplied by the emission factor for the process flow to create an aging adjustment to the emission factor. The IED calculation process is designed so that the same aging factors can be used for multiple processes. This is accomplished the same way as is discussed in the growth projects in the previous section. The calculation process used for emission factor aging is shown below:

$$EMISSIONFACTOR = EMISSIONFACTOR_{ApplicableYear} * [AGINGFACTOR_{YearNewProcessFlow=>CalculationYear} / AGINGFACTOR_{YearNewEmissionFactorFinder=>ApplicableYear}]$$

ApplicableYear: This refers to the EmissionFactorFinder.ApplicableYear value (i.e. the value in the **ApplicableYear** column of the EmissionFactorFinder table).

YearNewProcessFlow: This is the ProcessFlow.YearNew value (i.e. value found in the **YearNew** column in the ProcessFlow table).

YearNewEmissionFactorFinder: This is the EmissionFactorFinder.YearNew value (i.e. value found in the **YearNew** column in the EmissionFactorFinder table).

The ApplicableYear value is found in the EmissionFactorFinder table in the column designated **ApplicableYear** and the YearNewEmissionFactorFinder is found in the EmissionFactorFinder table in the column designated as **YearNew**. YearNewProcessFlow is found in the ProcessFlow table in the column designated as **YearNew**.

It might seem strange to the user that there are two new years (one for growth and one for aging) and two base years (one for growth and one for aging) in the database. This is done in order to increase the flexibility for the use of correction factors and emission factors in the database. There may be occasions when the growth and aging factors need to be defined based on different sets of years from one another. One occasion is when an emission factor or growth factors needs to be applied to several processes. In this case it might be useful to define the years differently. It is acceptable, of course, for the two YearNews in the two tables to be the same and the ApplicableYear and FlowStartYear to be the same. Finally, it is important to note that if the ApplicableYear is left as zero in the EmissionFactorFinder table that the aging calculation will use the FlowStartYear in the ProcessFlow table in place of the ApplicableYear to make the aging calculation. All of these options are provided to allow as much flexibility as possible for the user to mold the IED to their purposes.

Appendix J
Key IED Functions

Section J.1: BaseFlowCalculation($ProFloID,$CalcType, $Season, $Hour, $GridRow, $GridColumn, $BaseYearEmm, $BaseYearGrw, $CalculationYear)

Function Purpose: To calculate the amount of flow for a past, present, or future time for the year, for a season day, or for an hour. The function will also calculate the conversion constant for a flow if needed. The function calculates the flow for a single grid cell.

Table J.1-1: Inputs

Symbol	Type	Description
$ProFloID	integer	This is the ID number for the flow of interest. Found in the ProcessFlow table as "ProcessFlowID"
$CalcType	string	This is the calculation type that is desired. There are two options. The calculation type can be "RCalc" to calculate the conversion constant or "FlowCalc" to calculate the flow rate.
$Season	string	This is the season day of interest. There are nine options "A1" or "A2", "B1" or "B2", "C1" or "C2", "D1" or "D2", and "-1". The letter indicates the season of interest (which is user defined) and the number refers to a weekday or weekend day (which is user defined). If a "-1" is supplied, the function will calculate the annual total.
$Hour	integer	This is the hour of the day to be calculated. There are twenty-five options. They are "0-23" for the hours of the day an "-1". The use of a value from "0" to "23" refers to the hour of the day to be calculated. If a "-1" is supplied, the function will calculate the total flow for the day for the season indicated in the $Season input. However, a "-1" in the $Season input will produce an annual total regardless of the value supplied for $Hour.
$GridRow	integer	This is the grid row to be calculated. It must be a value between 0 and the number of grid rows minus 1. In the case of a point source, only the grid row and grid column containing the source will produce a non-zero value.
$GridColumn	integer	This is the grid column to be calculated. It must be a value between 0 and the number of grid colunns minus 1. In the case of a point source, only the grid row and grid column containing the source will produce a non-zero value.
$BaseYearEmm	integer	This is the base year to use for aging the emission factor. As equipment gets older, its flow for the same input conditions can change. This input sets the base year to make an emission factor aging calculation. This input can be any four digit year greater than "1950" or it can be a "0" or "-1". If a year is entered then the aging calculation for the emission factor will be made from the year supplied in this input to the calculation year value discussed below. If a "0" is supplied, no aging will be calculated. If a "-1" is supplied, then the "ApplicableYear" field in the EmissionFactorFinder table will be used to make the aging calculation. Often, this will be set to "-1" since the "ApplicableYear" field in the EmissionFactorFinder table will contain the best year for calculating the emission factor aging. However, if the "ApplicableYear" value for the emission factor might be wrong for a particular case, then the user can supply their on year. Note that if the emission factor does not have an "AgingCodeKey" then this input will be ignored. No aging is calculated for cases where an emission factor is not used.
$BaseYearGrw	integer	This is the base year to use for calculating growth or decline of the flow to or from a process over time. This input sets the base year to make a growth calculation. This input can be any four digit year greater than "1950" or it can be "0" or "-1". If a year is entered then the growth calculation will be made between the year supplied and the calculation year discussed below. If a "0" is supplied, no growth will be calculated. If a "-1" is supplied then the "FlowStartYear" in the ProcessFlow table will be used to calculate growth. Growth will only be calculated if there is a valid "GrowthMetricPtr" in the ProcessBase table. Otherwise, this input will be ignored.
$CalculationYear	integer	This is the year that the calculation is made for. It should be greater than "1950".

Outputs: The program returns a floating point value. This value will correspond to the requested flow output or the R constant value. If there is a problem found in the data to make the necessary calculation, then the program will return a "-1" value to signal that the calculation could not be completed.

There are two global variables that are modified by this function and available to the user. They are called $ERR and $NOTE. These variables contain data about any errors or notes that are relevant to the calculation being made. These global variables automatically exist when the "sharedEmissions" file is included in the webpage.

Special Considerations: This function creates a static array denoted $U[][][][]. This array has an element for each grid cell in the region being calculated and for each of the eight season days and twenty-four hours. Thus, the $U array will contain 192*Number-of-Grid-Cells elements. In cases where a region might have 15,000 grid cells, which is the case for the Sao Paulo metropolitan area, this array will contain almost 2,900,000 elements (~12 megabytes) and thus represent a significant load on the web server. There are two other arrays that are created that will contain 8*Number-of-Grid-Cells and 24*Number-of-Grid-Cells, which may co-exist with the $U array for a period of time on the server. No more than two of the arrays will co-exist at any one time during a calculation.

Section J.2: ISCFormat($Nm,$ThousandsSep,$DecimalSep)

Function Purpose: To create a string from a number with a reasonable number of decimal places for air pollution work and with the appropriate separators for the country of interest.

Table J.2-1: Inputs

Symbol	Type	Description
$Num	float	This is the number to be converted into a formatted string
$ThousandsSep	string	There are two separator options are: "." (period) or "," (comma). The decimal separator should be the other separator option from the one selected.
$DecimalSep	string	There are two separator options are: "." (period) or "," (comma). The thousands separator should be the other separator option from the one selected.

Outputs: The program returns a string with 4-8 characters. The output will correspond to the number that was entered with the appropriate separators as indicated in the inputs. The output follows the following conventions:

Table J.2-2: Outputs

Number Value	Decimal Places	Number Value	Decimal Places
less than 0.01	7	less than 100	3
less than 0.1	6	less than 500	2
less than 1	5	less than 1000	1
less than 10	4	greater than or equal to 1000	0

Special Considerations: None

Section J.3: ISCGridFormat($Nm,$ThousandsSep,$DecimalSep)

Function Purpose: To create a string from a number with a reasonable number of decimal places and appropriate separators for use in a grid or table with limited room.

Table J.3-1: Inputs

Symbol	Type	Description
$Num	float	This is the number to be converted into a formatted string
$ThousandsSep	string	There are two separator options are: "." (period) or "," (comma). The decimal separator should be the other separator option from the one selected.
$DecimalSep	string	There are two separator options are: "." (period) or "," (comma). The thousands separator should be the other separator option from the one selected.

Outputs: The program returns a string with 3-7 characters. The output will correspond to the number that was entered with the appropriate separators as indicated in the inputs. The output follows the following conventions:

Table J.3-2: Outputs

Number Value	Decimal Places	Number Value	Decimal Places
less than 0.01	5	less than 10	2
less than 0.1	4	less than 100	1
less than 1	3	greater than or equal to 100	0

Special Considerations: None

Section J.4: DetermineSourceGridCell($Lat,$Long,$Reg)

Function Purpose: To determine the grid cell that a source is located in.

Table J.4-1: Inputs

Symbol	Type	Description
$Lat	float	This is the latitude of the source. This value can be found in the ProcessBase table in the column denoted "ProcessLatitude.
$Long	float	This is the longitude of the source. This value can be found in the ProcessBase table in the column denoted "ProcessLongitude.
$Reg	string	This is the region where the source is located.

Outputs: This function returns an associative array with three elements. One element is denoted 'GridRow' (an integer), the second element is denoted 'GridColumn' (an integer), and the third element is denoted 'Valid' (a Boolean). In the case of the element 'Valid' a true indicates that a valid grid row and column was found in the region of interest. A false indicates that no valid grid row or grid column was found in the region of interest.

Special Considerations: None.

Section J.5: getValidProcessFlowIds ($year, $identifier, $materialId, $actionType)

Function Purpose: To produce a list of process flows for a specified material and identifier that are valid for the year of interest.

Table J.5-1: Inputs

Symbol	Type	Description
$year	integer	This is the year of interest to select process flows. (A process flow has a start year and an end year. The flow is not valid outside of these years.)
$identifier	integer	This is a process ID or a source ID depending upon the action type that is requested.
$materialId	string	This is the ID for the material of interest.
$actionType	string	This indicates what group of process flows are to be identified. A value of "all" will return all process flows from all sources that represent the material ID supplied. The $identifier value is ignored. A value of "single" will produce all process flows for the Source identified by the $identifier input that represent the material ID supplied. Any other input supplied will produce all flows for a process identified by the $identifier value that represent the material ID supplied.

Outputs: This function returns a two dimensional array with the number of rows equivalent to the number of process flows that are associated with the request. The second dimension is an associative array with two elements: 'id' is the process flow id from the ProcessFlow table and 'name' is the process name from the ProcessBase table.

Special Considerations: None.

Section J.6: getValidMaterialNames ($identifier, $actionType, $materialType, $abbreviateUnits = false)

Function Purpose: To produce a list of material names and associated default units for a specified material, identifier, and action type.

Table J.6-1: Inputs

Symbol	Type	Description
$identifier	integer	The ID associated with a Source or Process depending upon the action type selected.
$actionType	string	If the string 'all' is input here , then all materials associated with the supplied material type are produced. If the string 'single' is input here, then all materials associated with the Source with the Source ID denoted by $identifier are returned. Any other value here will produce the materials associated with the Process with the Process ID denoted by $identifier.
$materialType	string	This input can have two values. One value is 'all', which will produce all materials associated with the $actionType input. The other value is 'air', which will return the materials that are indicated as air pollutants. [in the future this function must be modified to produce water pollutants and landfill pollutants as well as air pollutants]
$abbreviateUnits	boolean	This input indicates if the units return from the function should be the full name of the standard units or the abbreviation of the units. A true indicates that the abbreviation should be used. A false indicates that the full name should be used.

Outputs: This function returns a two dimensional array with the number of rows equivalent to the number of process flows that are associated with the request. The second dimension is an associative array with three elements: 'code' is the material code, 'name' is the translated name of the material, and 'units' is the default units for this material.

Special Considerations: None.

Section J.7: getGridInformation ($region)

Function Purpose: To provide information concerning the grid system associated with the input region.

Inputs

Symbol	Type	Description
$region	string	The ID associated with the region of interest.

Outputs: This function returns an associative array with six elements. 'latitude' is the latitude of the southwest corner of the grid system, 'longitude' is the longitude of the southwest corner of the grid system, 'ewSize' is the east/west grid size for 1 km in degrees latitude, 'nsSize' is the north/south grid size for 1 km in degrees longitude, 'numRows' is the number of rows (north/south) in the grid system, and 'numColumns' is the number of columns (east/west) in the grid system.

Special Considerations: None.

Appendix K
RegionalGridInfo Table and Regional Maps

Section K.1: Selection of a Regional Grid

The grid system chosen for a region must be rectangular and the grid cells must all be square and equal in size. The grid cells that are typically used in air pollution work vary from 1 km X 1 km to 4 km X 4 km. The grid system selected will be used to spatially distribute emissions and to create the outputs for air quality modeling and other analysis. Smaller grid cells will, of course, produce more detailed analyses. Thus care should be taken to select an appropriate grid. If a region is broken into smaller grids, the calculation will take longer. As an example, for the case of on-road motor vehicle, a grid system of 142 X 115 grid cells, which is the grid size used for Mexico City, will take around 2 to 2.5 hours to calculate a complete set of on-road mobile source emissions because of the complexity of the on-road mobile calculation. As a rule of thumb, a 2.6 gigahertz computer with 8 gigabytes of RAM and at least three processors available can process about 169 grid cells per second for on-road mobile sources. Thus, to handle 30 model years of passenger vehicles for the case of 16,330 grid cells requires the processing of 489,900 (30 X 16,330) grid cells, which will take about 2900 seconds (48 minutes) to complete. Add trucks and buses and the calculation time increases to 2.4 hours. While the time can be long, the results can be more accurate if care is taken to properly set up the base data.

Section K.2: RegionalGridInfo Table

The RegionalGridInfo table holds the key information concerning the grid systems to be used in the IED. This table is composed of 10 columns. The table column names with data type are shown in Table K.2-1.

Table K.2-1: Column Names and Data Type for RegionalGridInfo

	Field	Data Type
1	RegionAbbreviation	char(6)
2	RegionName	varchar(50)
3	SWGridLatitude	char(10)
4	SWGridLongitude	char(11)
5	EW_gridsize	float
6	NS_gridsize	float
7	NumberRows	int(11)
8	NumberColumns	int(11)
9	GridTilt	float
10	MapFile	varchar(255)

There can be more than one grid system in a single IED; although if the user chooses to use more than one grid system, then it should be recognized that the SourceOverview, ProcessBase, and ProcessFlow tables become complicated with mixtures of sources and processes from the multiple regions.

The grid can be set up to run north and south and east and west (the normal way), but it can also be tilted if this is useful for a region. The angle of the tilt of the grid system is measured relative to the equator with positive angles meaning that the grid is rotated in a counter-clockwise direction and negative angles meaning that it is rotated in a clockwise direction. The values of the angles must be entered into the table in radians. Figure K.2-1 illustrates three possible grid systems.

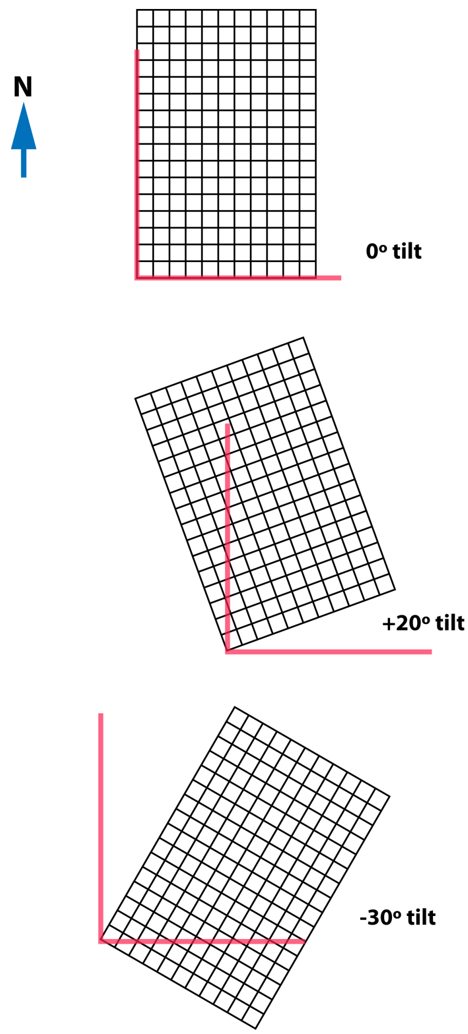

Figure K.2-1: North South Grid Plus Two Tilted Grids

Table K.2-2 indicates the purpose of each of the columns in the RegionalGridInfo table.

Table K.2-2: Descriptions of RegionalGridInfo Table Columns

Field	Description
RegionAbbreviation	This is the abbreviation that is to be used in the SourceOverview table to indicate the region where the source is located. It must be 6 characters or less.
RegionName	This is the name of this region. It can be up to 50 characters long.
SWGridLatitude	This is the latitude of the south-west corner of the grid system in degrees using decimals (not degrees, minutes, and seconds).
SWGridLongitude	This is the longitude of the south-west corner of the grid system in degrees using decimals (not degrees, minutes, and seconds)
EW_gridsize	This is the average distance in kilometers per degree longitude for the grid system. This is normally taken at the center of the grid system.
NS_gridsize	This is the average distance in kilometers per degree latitude for the grid system. This is normally taken at the center of the grid system since it will vary slightly between the bottom and top of the grid system.
NumberRows	This is the number of rows in the grid. Rows run from the bottom (south) to the top (north) of the grid and the first (bottom/left) grid cell is 0,0.
NumberColumns	This is the number of columns in the grid system. Columns run from the left (west) to the right (east) of the grid and the first (bottom/left) grid cell is 0,0.
GridTilt	This is the tilt of the grid in radians (not degrees). A positive value indicates that the grid is rotated counter-clockwise. A negative value indicates that the grid is rotated clockwise. The value must be between -1.553 and + 1.553 radians. In reality, if the tilt is greater than ±0.7854 radians (±45º) then the grid rows and columns can be swapped and a negative tilt angle used instead.
MapFile	This column is no longer used in the IED. Instead a table called MapPictures is used so that there can be many different pictures in the IED for making various comparisons.

The IED allows the user to use multiple maps for a region. The names of these maps and their file titles are listed in the MapPictures table. As an example, it is useful to have a map that illustrates the roadways to consider on-road mobile source emissions. It can also be useful to have a map that illustrates population density to compare emissions and population. The user can likely think of other maps where the overlay of emissions might provide some useful insight.

The maps generated to be used in the IED must conform to the specifications as listed below:

1. Pictures used with the IED must match the grid system. If not, the colored overlay will not properly fit onto the map. This means that if the grid has 75 rows and 90 columns then the picture must be 1.2 times (90/75) as wide as it is tall.
2. Pictures used with the IED must have an even number of pixels for each grid cell. The picture could have 10, 11, 15, 20, or other even pixels per grid. The number of pixels chosen impacts the size of the file and the detail of the map. Thus a balance must be taken between the time it takes to transfer the map and the detail included in the map. In the example case, if 20 pixels per grid cell are selected, the map pictures should be constructed to be 1800 X 1500 pixels each.

3. It is best to put the pictures into the database in the jpeg format. Jpeg files are compressed and the level of compression can be adjusted to lower file size if the user has an appropriate picture manipulation program such as Photoshop. A file size of 400- 500K loads reasonably quickly and has been found to be a good size.

Appendix L
Data Set Up Summary

The following steps outline a process for setting up the data in the IED. It is recommended that this process be carried out for each class of source and then repeated for additional source classes. Trying to add many source classes at one time makes the job too complex. It is reommended that on-road passenger vehicles be completed first, then trucks, then buses, then off-road mobile, stationary area, and point sources. Each step can involve a significant investment of time. The explanations assume that the user is familiar with the IED.

Step	Action	Comment
1	**Set Up Regional Grid Table**	Only one row of data is required. This does not need to be repeated in future steps.

2	**Set Up FixedGridDistribution table**	Set up the RegionAbreviation and Rows and Columns for the region of interest and remove all data in the table since it will have no relevance to the new region. Add data to columns in the FixedGridDistribution that will be needed in the IED calculations for the class of sources presently being added. Certain columns have been assigned to certain sources in the base IED. While this can be changed, it is recommended that the user keep the present assignments and add data to other columns as needed. If any columns such as FxMetric02 refering to Office space in grid cell is not referenced in any source tables it may be left blank. Below are the present column assignments.
		FxMetric01=Unity Distribution // FxMetric02=Office space in grid cell // FxMetric03=Passenger vehicle percent driving in grid cell
		FxMetric04=Truck percent driving in grid cell // FxMetric05=Bus percent driving in grid cell // FxMetric06=Population in grid cell
		FxMetric07=Housing units in grid cell // FxMetric08=Airplane operations in grid cell // FxMetric09=Ship operations in grid cell
		FxMetric10=Train operations in grid cell // FxMetric11=Water cover percentage in grid cell // FxMetric12=Agricultural land percentage in grid cell
		FxMetric13=Retail Gasoline Outlets
		It is possible that other distribution metrics will be needed. For example, in Beijing some trucks are not allowed downtown until night time but are allowed in areas outside of the downtown. This may result in a distinct distribution of driving for these trucks where more driving for these trucks occurs outside of the downtown compared to smaller trucks. Thus, FxMetric14 could be set up to properly distributes the driving for these special vehicles while FxMetric04 is used for trucks that are free to drive over the whole region. It is also possible that truck driving can be distributed the same as passenger vehicle driving. In this case, data is only needed in the FxMetric03 column and this data is referenced for trucks as well. These decisions will be unique to each city. If data is added to a column in addition to the 13 columns listed above then the name of the data in this column must be added in the **MetricDescription** table.
		The RoadClass field (column) must also be filled with data if on-road vehicles are to be included in the database. Consult Table C.2-1 in the users manual to see the codes for the roadway types to be entered into the grid cells.

3	**Set up the SeasonalAdjustments table.**	The seasonal adjustments are intended to adjust the flows for each season of the year. 8 seasons are defined in the IED. The seasons are defined in the SeasonDescription table. They are normally used as A1: winter weekday, A2: winter weekend, B1: spring weekday, B2: spring weekend, C1: summer weekday,C2: summer weekend,D1: fall weekday, and D2: fall weekend. This table can hold adjustments for many types of activity adjustments. The base IED contains the adjustments shown below. Of course they may not be accurate for your location and must be changed to fit your situation if the IED flow calculation is to produce meaningful results. 0 -- All Seasons Set to Zero // 1 -- Constant Operations at All Times // 3001 -- Driving Adjustments for all of city--Passenger Fleet 3050 -- Driving Adjustments for all of city--Truck Fleet // 3060 -- Driving Adjustments for all of city--Bus Fleet // 4001 -- Airplanes--All Year/All Locations 4002 -- Trains--All Year/All Locations // 4003 -- Ships--All Year/All Locations // 5000 -- Only Week Day Operations 5001 -- Auto Repair // 5002 -- Only Week End Operations // 6010 -- Surface coating

		There are many other possible seasonal adjustments that may be needed for the source class that is being added. It is possible that the passernger car or truck fleet operates differently in different locations at different times of the year. For example, a ski operation near the edge of the region might be running diesel generators during the winter and on the weekends in the spring and fall. Thus, a row of data should be created for this situation if the user intends to include these sources in the IED. The values in the SeasonalAdjustments table must add up to 1 to produce accurate results. A number is assigned to each of the seasonal adjustments in the table. These numbers may be referred to in the **ProcessFlow** and **SeasonalGridDistribution** tables.

4	**Set Up SeasonalGridDistribution table**	Set up the RegionAbreviation and Rows and Columns for the region of interest and remove all data in the table since it will have no relevance to the new region. The seasonal grid distribution table is used to set up seasonal adjustments to the activity of a source for different parts of the region. The actual adjustments are defined in step 3 above. The purpose of this table is to assign the adjustments defined in step 3 to the different grid cells in the region. Likely the most important difference will be between the weekday and weekend activities. In the simplest case, the same adjustments can be assigned to every grid cell. Each field (column) in the table refers to a different type of activity. Below is shown how the fields (columns) are assigned in the base IED. If the user wants the same seasonal distribution in every grid cell, it is also possible to not use a column in this table but to directly refer to the number of the seasonal adjustment in the ProcessFlow table and the adjustment will be applied equally to all grid cells. Present assignments of table fields (columns) is shown below:
		SnMetric01=Passenger vehicle seasonal adjustments for activity // SnMetric02=Truck fleet seasonal adjustments for activity // SnMetric03=Bus fleet seasonal adjustments for activity SnMetric04=Airplane operations seasonal adjustments for activity // SnMetric05=Ship operations seasonal adjustments for activity // SnMetric06=Train operations seasonal adjustments for activity
		There are 40 fields (columns) in this table. Each field can reference a different source type. More columns can be added if 40 is not enough. However, it is likely that less than 20 fields will be needed. If data is added to a column, the user should make sure that the name of that data is entered in the appropriate place in the **MetricDescription** table.

5	**Set Up GrowthMetric table**	The growth metric table is used to project how a process will change in magnitude into the future. For the case of service stations, the numbers might grow. For the case of a model year of a vehicle, the numbers will decrease. The growth information for the class of sources being entered should be edited or added to the **GrowthMetric** table. The ProcessBase table refers to the data in this table directly or indirectly through the **GrowthGridDistribution** table discussed in the next step. There are a number of growth options in the table in the base IED. Some of these may work for the user. However, it is simple to growth information that more directly fits a specific location.

6	**Set Up GrowthGridDistribution table**	Set up the RegionAbreviation and Rows and Columns for the region of interest and remove all data in the table since it will have no relevance to the new region. This table is for the case where growth is different in the different parts of the region. A different growth metric can be assigned to each grid cell in the region in this table if this is desired. The growth metrics defined in step 5 above are referenced in this table. If the user wants the growth to be the same in all grid cells, then the number of the growth metric set up in step 5 can be placed in the **ProcessBase** table. However, if different growth metrics are desireable for different grid cells then the user enters the appropriate growth metrics in a column in this table and references the column in the **ProcessBase** table. The present assignment of fields in this table is shown below: GrMetric01=General Growth in the Region Other columns can be set up to represent growth of on-road driving in different parts of the region. If a new column is set up, it should be indicated in the **MetricDescription** table.

7	**Set Up the HourlyAdjustments table**	This table contains a wide variety of information and is one of the more difficult to set up. The table contains adjustments for each of the 24 hours of the day. Further, these adjustments can be of three types. (1) fractions for the purpose of adjusting VKT or other source activity. these fractions should add up to 1. (2) Environmental parameters such as temperature, humidity, wind speed at different locations in the region. (3) Driving pattern references to indicate the type of driving during each hour of the day. The user will need to determine what hourly adjustments are needed for the source class under consideration. In the case of service stations it might only be the fraction of fuel dispensed each hour. In the case of on-road motor vehicles it would certainly be the fraction of driving in each hour of the day. Also, in the case of on-road motor vehicles, the driving adjustment formulas require the temperature and humidity. Thus, temperature and humidity data should be added for the different parts of a region as necessary. Also in the case of on-road motor vehicles, the road congestion at different hours needs to be added as it applies to different parts of the region.

8	**Set Up the HourlyGridDistribution table**	Set up the RegionAbreviation and Rows and Columns for the region of interest and remove all data in the table since it will have no relevance to the new region. This table allows the user to specify different hourly adjustment factors created in step 7 to different grid cells in the region. This can be important for differentiating between activities on weekends compared to weekdays as well as how activites might change in different parts of a region for different hours of the day. For example, passenger vehicles will often be on the road earlier in the morning in the suburbs on weekdays whicle the traffic peaks may be different toward the city center on weekdays. All of the areas of the region may have similar VKT adjustments for the weekend. This is a decision local to the region of interest. The present definitions of the fields is shown below:
		HrMetric01=Passenger vehicle percentage weekday driving activity for grid cell (all times of year) // HrMetric02=Passenger vehicle percentage weekend driving activity for grid cell (all times of year) // HrMetric03=Truck percentage weekday driving activity for grid cell (all times of year)
		HrMetric04=Truck percentage weekend driving activity for grid cell (all times of year) // HrMetric05=Bus percentage weekday driving activity for grid cell (all times of year) // HrMetric06=Bus percentage weekend driving activity for grid cell (all times of year)
		HrMetric07=Airplane percentage operations for grid cell (all seasons) // HrMetric08=Ship percentage operations for grid cell (all seasons) // HrMetric09=Train percentage operations for grid cell (all seasons)
		It is possible to create many metrics to reflect, for example, how trucks are managed in Beijing or how street cleaning is carried out. Use additional columns to define data and add data to the columns defined above as appropriate. It is important to modify the definitions for the various columns in the **MetricDescription** table.

9	**Set Up the EnviroGridDistribution table**	Set up the RegionAbreviation and Rows and Columns for the region of interest and remove all data in the table since it will have no relevance to the new region. This table is designed to specify the relevant environmental data such as temperatures, humidities, wind speeds and so on. This table references data in the **HourlyAdjustments** table discussed in step 7. A region can have the same temperatures over the whole region, or the temperatures can vary in different parts of a region. The user enters references to data in the **HourlyAdjustments** table into this table to specify hour temperatures vary over the day in different grid cells. The fields (columns) of the table specify the type of data that should go into the table. The letters A,B,C,D refer to the four seasons used in the IED. The definitions are the same as those defined in the **SeasonDescription** table. At this point in time, the only parameters that are being used in calculations are temperature and humidity. However, it is possible that windspeed could become important in the case of organic liquid storage or agricultural dust if the user wanted to set this up in the IED.

10	**Set Up the SourceOverview table**	The user should clear the existing data from the **SourceOverview** table and add the data relevant to the source class being added. The clearing can be carried out through an SQL command or can be accomplished if data is uploaded into the database. This table is normally relatively easy to build requiring a limited amount of information to get the IED working. In subsequent steps care should, of course, be taken to insure that the existing data in the table is not deleted when new data is added.

11	**Set Up the ProcessBase table**	The user should clear the existing data from the **ProcessBase** table the first time the data addition process is carried out. This data contains general information on the processes associated with the source class of interest. In the case of on-road mobile sources, the processes are defined as model years. Thus model years from about 1985 to 2030 or 2050 should be added depending upon the extent of projections to be done. This table contains the reference to the growth metric that is to be used. The reference can be to a number, which will send the calculation process to the **GrowthMetric** table or it can be a column name, which will send the calculation process to the **GrowthGridDistribution** table.

12	**Set Up the ProcessFlow table**	The user should clear the existing data from the **ProcessFlow** table the first time the data addition process is carried out. Most of the key calculation information is located in the **ProcessFlow table**. It is in this table that emission factor is assigned or a flow is set, the fixed grid distribution is selected for area sources, the seasonal adjustments are assigned, and the hourly adjustments are assigned.

13	**Return to Step 2 to add a new class of sources.**	

Notes