STANDARD OPERATING PROCEDURES

FOR

DATA MANAGEMENT SYSTEM (DMS)

AQSB SOP 606

Second Edition

MONITORING AND LABORATORY DIVISION

May 2020

Disclaimer: Mention of any trade name or commercial product in this standard operating procedure does not constitute endorsement or recommendation of this product by the California Air Resources Board. Specific brand names and instrument descriptions listed in the standard operating procedure are for equipment used by the California Air Resources Board's laboratory. Any functionally equivalent instrumentation is acceptable.

CALIFORNIA
AIR RESOURCES BOARD

Approval of Standard Operating Procedures (SOP)

Title:	Data Management System (DMS)
SOP:	AQSB SOP 606, Second Edition
Section:	Operation and Data Support Section
Branch:	Air Quality Surveillance Branch (AQSB)
Division:	Monitoring and Laboratory Division (MLD)
Prepared by:	Operation and Data Support Section

Reviewed by:

M Singh

Manisha Singh, Ph.D., Chief
Air Management Branch

4/29/2020
Date:

Approved by:

RLS

Reggie Smith, Manager
Operations and Data Support Section
Air Quality Surveillance Branch

28 April 2020
Date:

Kathleen Gill

Kathleen Gill, Chief
Air Quality Surveillance Branch

05/06/2020
Date:

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

REVISION HISTORY

Edition	Release Data	Changes
First	November 2017	New Document
Second	May 2020	ADA Remediation Added the References section

LIST OF ACRONYMS

AQI	Air Quality Index
AQMIS	Air Quality and Meteorological Information System
AQS	Air Quality System
AQSB	Air Quality Surveillance Branch
CARB	California Air Resources Board
CARBDMS	California Air Resources Board Data Management System Team
CL	CARBLogger
COC	Chain of Custody
CSV	Comma Separated Values File
DBA	Database Administrator
DMR	Code name for the DMS Monthly Data Review Matrix Application
DMS	Data Management System
FDC	Federated Data Center
FTP	File Transfer Protocol; Refer to the FTP Server in this document
GUI	Graphical User Interface
LST	Local Sidereal Time
MDL	Minimum Detection Limit
MO	Monitoring Organization
MS-SQL	Microsoft SQL Server; Relational Database Management System
ODSS	Operation and Data Support Section
Op	Operational
OIS	Office of Information Services
OS	Operating System
PC	Personal Computer /Workstation
POC	Parameter Occurrence Code
PQAO	Primary Quality Assurance Organization
QC	Quality Control
RD	Raw Data (Ambient Data Report Format)
RP	Raw Precision (Precision Report Format)
SFTP	Secure File Transfer Protocol; Refer to the SFTP Server in this document
SOP	Standard Operating Procedure
STI	Sonoma Technology, Inc.
UA	User Account
U.S.EPA	United States Environmental Protection Agency
UCT	Universal Coordinated Time

1.0 GENERAL INFORMATION

The California Air Resources Board (CARB) ambient air monitoring network collects real-time pollutant values and ambient air samples throughout California. The network is designed to ensure the requirements of Clean Air Act are met for California. The data generated from the network are used by multitude of programs, primarily to determine which areas of California are in attainment, or non-attainment of federal and state air quality standards. The data are also used in air quality modeling, agriculture burn programs, and real-time air quality alerts such as the Air Now's Air Quality Index (AQI) Forecast.

This Standard Operating Procedure (SOP) contains general information and procedures used by the Air Quality Surveillance Branch (AQSB) to perform system configuration, general uses, data editing, data review, data validation, and report generation of Data Management System (DMS). In addition, it covers the menu system and provides a description of data validation tools that have been developed to help with the data review process. Finally, a troubleshooting section is provided to answer some of the commonly-encountered issues from using the DMS application.

Note: This SOP references Data Management System (DMS) version 1.2.2.3.

1.1 Purpose of This Guide:

The purpose of this document is to provide a comprehensive overview and instructions for the DMS application. It will describe how to use the various features and functions to better assist users with completing the data review and validation process before the air quality data are released for use by others.

This document is designed to supplement the Sonoma Technology Inc.'s (STI) instruction documents with additional details, explanations, and procedures as implemented by AQSB. It is not the intent of this SOP to duplicate or replace the STI's user manual. These procedures can be adopted by other monitoring organizations (MOs) with any differences documented in an addendum.

1.2 How to Use This Guide:

Note: Due to the wide range of topics for DMS, this document can only cover, in detail, prominent topics within the application. Other topics or features, not covered by this SOP are discussed in the DMS user manual.

A brief description for each section of this SOP is provided below:

Table 1.1. Sections description.

Section	Description
Section 1 – General Information	Overview and descriptions for the DMS application and the overall data flow process.
Section 2 – System Requirements	Operating system, hardware, and software specifications for both the backend and frontend servers.
Section 3 – Getting Started	DMS user account initialization, connection tutorial, and general navigation of the user interface.
Section 4 – DMS The Application	Overview of DMS menu structure, the system conventions, and common terminologies.
Section 5 – Using DMS	Description and instruction on relevant procedures that are used daily by AQSB staff. For example, how to create a time-series graph, how to null code data, and how to create data export.
Section 6 – DMS Data Tools	Overview of the data tools that have been developed for AQSB users to help facilitate the data review and validation process.
Section 7 – Troubleshooting	Solutions and instructions for some of the commonly encountered issues using DMS. Learning how to identify the cause of an issue and what appropriate action to take.

1.3 Overview of DMS

DMS is a Microsoft SQL Server-based data management system that has been developed by STI. The system allows a user to manage, summarize, document chain-of-custody, and disseminate aerometric data. It also streamlines the processing of aerometric data, expands the availability of routine QC, provides data analysis tools, and improves the quality and availability of aerometric data to local districts, the U.S EPA, and the public.

DMS ingests one-minute based data (hourly for some instruments) into its database and will aggregate an hourly average value. If properly configured, it will perform automated quality control checks on aggregated (or imported) hourly data and generate real-time data exports to the U.S.EPA's AirNow

System and the CARB's Air Quality and Meteorological Information System (AQMIS). In addition, it allows users to create manual AQS data exports to the U.S.EPA's Air Quality System (AQS).

DMS currently resides on a virtual server environment maintained at the California's State Tier-1 data center. The actual DMS system is composed of two parts, 1) backend database and 2) the frontend client interface.

The backend database or application called "CARBAQDMS" is where the data get stored and processed. Access to the DMS MS-SQL database is limited to staff with administrative rights which include the Operations and Data Support section (ODSS) of AQSB and the Office of Information Services (OIS) of CARB only.

The frontend client or user interface resides on a terminal server called "ARBFDCTS1". Access to the DMS client is conducted via remote access and allows multiple user connections at the same time. Hosting the DMS client on a terminal server allows updates and maintenance on the client to be performed more efficiently.

1.4 DMS's Role in Data Flow and Process:

Before air quality data can be transmitted to the data clients or submitted to AQS, the data must be acquired from the field and processed into an acceptable form for transmission. Meanwhile, the collected data need to be stored in a place that is secure and readily available for our reviewers to edit and review. Therefore, it is important to have a good data management system in order to handle these tasks flawlessly.

AQSB's data infrastructure consists of two major processes: the data collection process with the actual pollutant monitors and the data logger, and the data management process which involves with the CARB's SFTP and DMS servers.

The entire data management process involves retrieving air quality data from the pollutant monitors, transmitting the data from field stations to headquarters, ingesting the data into a central database, and processing the air quality data into different formats for reporting to different data clients.

The figure below outlines the data collection, transfer, review, and reporting process.

Figure 1.1. AQDMS Data Management Process

For data collection, AQSB utilizes the CARBLogger (CL), a custom-built open-sourced Linux-based data logger, to continuously query each connected monitor, and to record the raw conversations into data values. The instrument raw data will be timestamped by CL, flagged and formatted automatically based on the instruments' state of operation. The flag allows DMS to determine the validity of the collected data. Once the data files are formatted, they get transmitted to the CARB SFTP server. Twice an hour DMS will access and ingest these data files from the CARB SFTP server into its own database.

Note: For specifics on the CARBLogger and how it works, please refer to the CARBLogger SOP.

DMS will process the ingested data files differently, depending on the reporting requirement.

For real-time auto reporting (U.S. EPA's AirNow and CARB's AQMIS), DMS will screen the ingested data through the auto QC checks, then package hourly valid-only preliminary data, and transmit the file back to the CARB SFTP server for real-time data clients to download.

For monthly AQS reporting, the ingested data must be quality-checked and reviewed by staff before it can be submitted to the AQS database. This process is a manual process and data exports include valid data, null codes indicating invalid data, and/or qualifier codes (flags) on associated valid data. This reporting process is conducted per AQSB's annual data review schedule (see sample CY2019 schedule on Appendix A1).

Figure 1.2 should help to visualize the data flow process below.

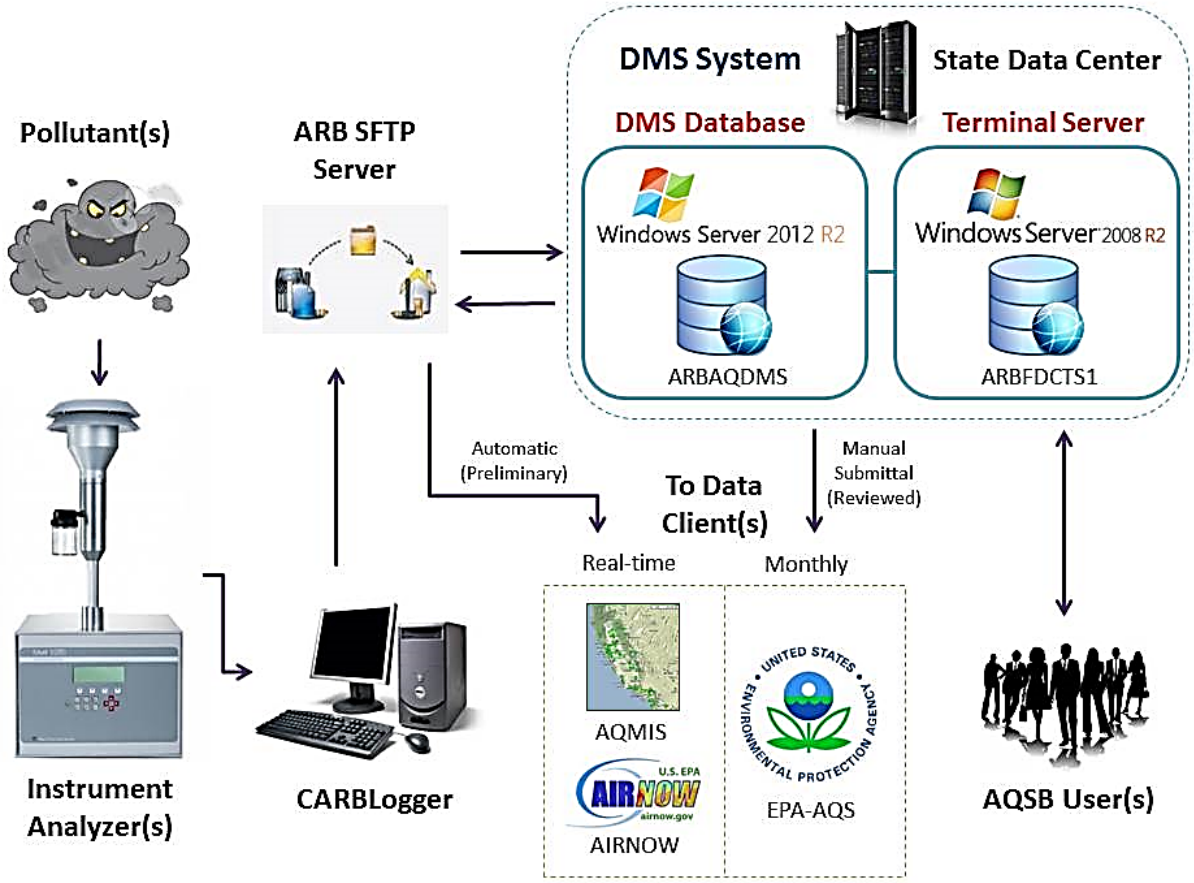


Figure 1.2. The Simplified Data Flow Diagram.

2.0 SYSTEM REQUIREMENTS

2.1 OS Requirements:

The DMS database is compatible with Microsoft SQL Server (MS-SQL) 2005 and above. The DMS graphical user interface (GUI) requires Windows XP, Windows Vista, Windows 7, or Windows 2003 Server and higher.

2.2 Hardware Specifications:

Table 2.1. Hardware Specifications

Item	Server "ARBAQDMS"	Server "ARBFDCTS1"
Type	Virtual Machine	Virtual Machine
Location	Virtual Server at FDC	Virtual Server at FDC
Operating System	Windows Server 2012 R2 Standard	Windows Server 2008 R2 Enterprise
CPU	Intel Xeon E5-2670 @ 2.60 GHz (two processors)	Intel Xeon E5-2665 @ 2.40 GHz (two processors)
Memory	16 GB	20 GB
Storage(s)	C: 60 GB (Local) F: 150GB (DMS Data) I: 10GB (Ingest) K: 75GB (Backup) L: 150GB (Logs) T: 30 GB (Temp)	C: 120 GB (Local)
Network	10 GB/s	1 GB/s

2.3 Software Versions: MS-SQL & DMS:

Table 2.2. Software Versions

Item	Server "ARBAQDMS"	Server "ARBFDCTS1"
Operating System	Windows Server 2012 R2 Standard	Windows Server 2008 R2 Enterprise
Role	Backend SQL Database	Frontend Terminal Client
DMS Version	N/A	v1.2.2.2 (As of March 2017)
MS-SQL Version	SQL Server 2014	N/A

3.0 GETTING STARTED

This section is aimed to provide users with a quick starting guide for the DMS interface. For more thorough description of DMS, please refer to the DMS user manual.

To access the collected data from the air monitoring stations, users will need to connect to the DMS user interface through their PC workstation via the Remote Desktop Connection client.

3.1 Setting up a User Account:

Only authorized AQSB staff are allowed access DMS. A user account and password are needed to log onto DMS. To obtain a new user account, air monitoring managers should contact the ODSS section manager. Once approved, new staff will be assigned a unique DMS username and password for access to DMS.

Note: Staff should initially and periodically change DMS account passwords through the "change password" webpage from the internal DMS homepage. Please refer to section 3.3 of this document.

3.2 Connecting to DMS (via Terminal Server):

Users remotely connect to DMS via a terminal server (ARBFDCTS1).

Note: The current ARBFDCTS1 terminal server can only handle twenty (20) active connections. It is recommended that users log off from the terminal server if he/she will not be using the DMS actively.

To connect to the DMS client, please follow the procedure below; users must have a CARB account in order to get into the CARB domain.

1. From your PC workstation, execute the Remote Desktop Connection client.

2. On the client window, on where the "computer menu" field locates, select the "ARBFDCTS1" option (or manually enter the specific text into the field if it is not already shown), and then select the **CONNECT** button.

3. Following the security window, login with your CARB workstation user id and password.

4. Once connected to the terminal server, from the remote desktop window select the "Start" key at bottom and then select to run the DMS application.

5. On the DMS login window, enter your DMS user name and password on the login screen, then select "OK" to proceed.

6 DMS will become visible after a short loading time, and the DMS user interface should become available.

Note: For graphical instructions on how to connect to DMS from within or outside of CARB domain, please refer to Appendix B1.

3.3 Changing Account Password:

To change a password, users will need to enter their username, existing password and the new one to complete the change request. The password reset interface is located on the DMS Homepage's DMS Menu/Change Password Submenu.

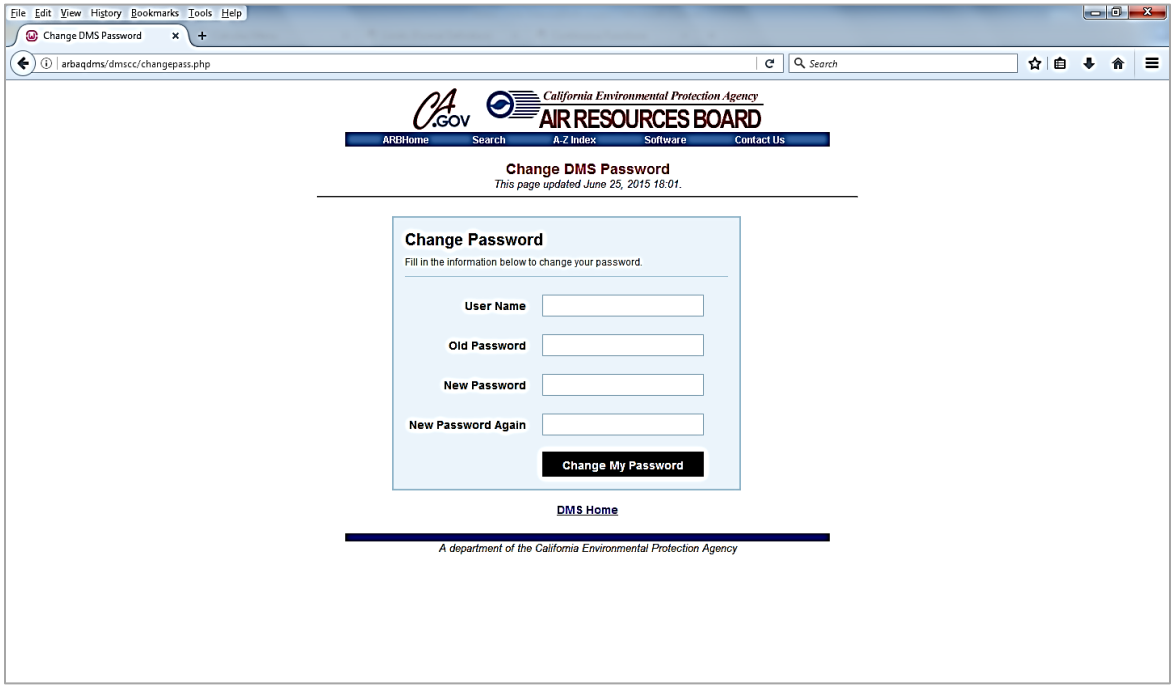


Figure 3.1. DMS Menu / Password Change Submenu

If the old password is lost, please contact CARBAQDMS, and staff will reset their password directly for them.

3.4 General Navigation: DMS User Interface:

After logging into DMS, the DMS client main status screen will become viewable (see figure 3.2). The user interface itself is fairly self-explanatory and has several features to help users to navigate the system.

The user interface is mainly accessible by the mouse. However, there are also keyboard shortcuts available to help navigating DMS more easily. For window or screen sections resizing, if adjustable, it can be completed by clicking and dragging the gray line separating the sections within the DMS screen.

On the top left of the screen there is the Program Menu Bar. The Program Menu Bar is always available on the top from all screens. There are two levels of DMS menus and two system buttons available in the program menu bar; the **FILE** system button, indicated by an open file folder icon, allows users to terminate the current DMS session, and the **HELP** system button, indicated by a question mark, provides access to the DMS user manual.

Note: When the DMS program closes, any unsaved changes will be lost.

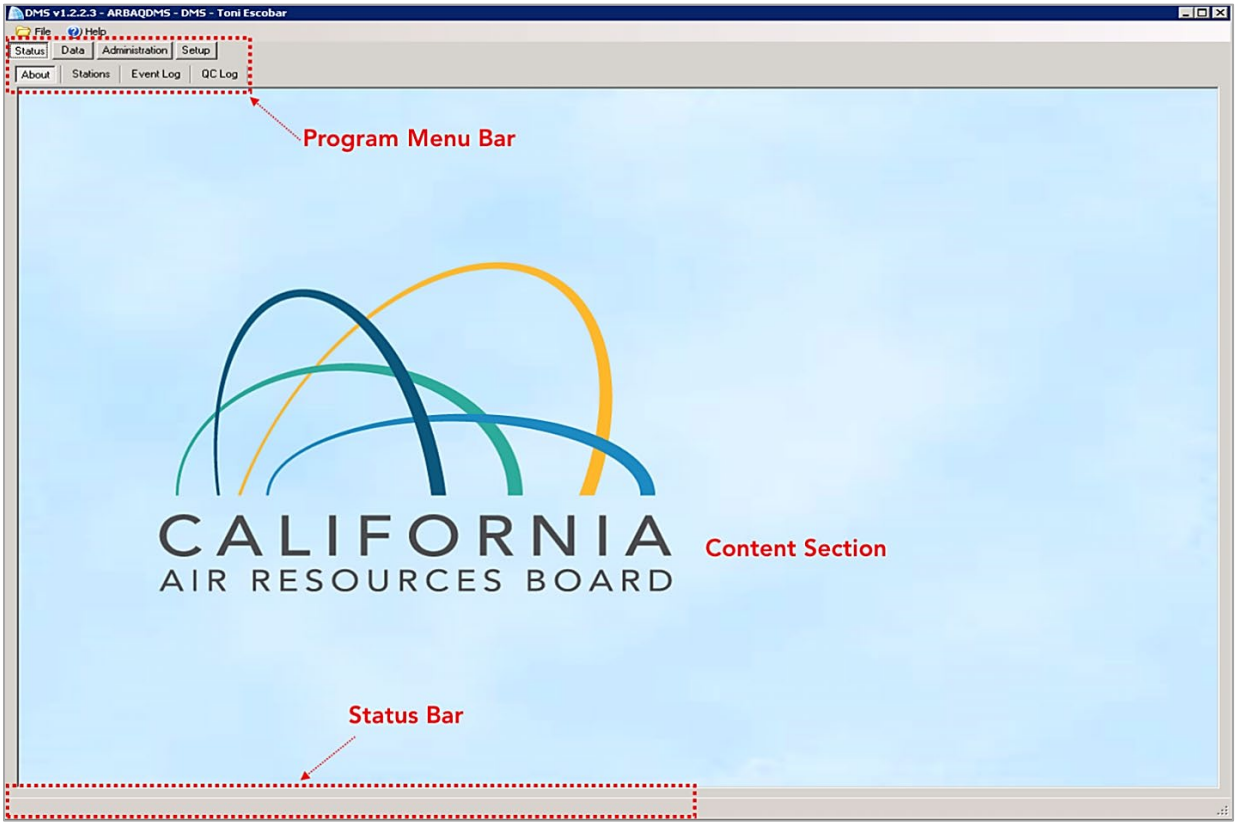


Figure 3.2. DMS User Interface.

DMS utilizes two levels of menu to facilitate access to its different functions: the

main menu and the submenu. (See figure 3.3) On the main menu bar, there are four main tabs. Under each main tab, there is a different submenu bar to provide users access to different system functions and configuration settings.

Note: For details of the DMS submenu and their descriptions, please refer to Section 4.1 in this SOP.

In addition, all screens under the Data tab (except the Import screen) provide a status bar across the bottom of the window to display information pertinent to that particular screen (see figure 3.2).

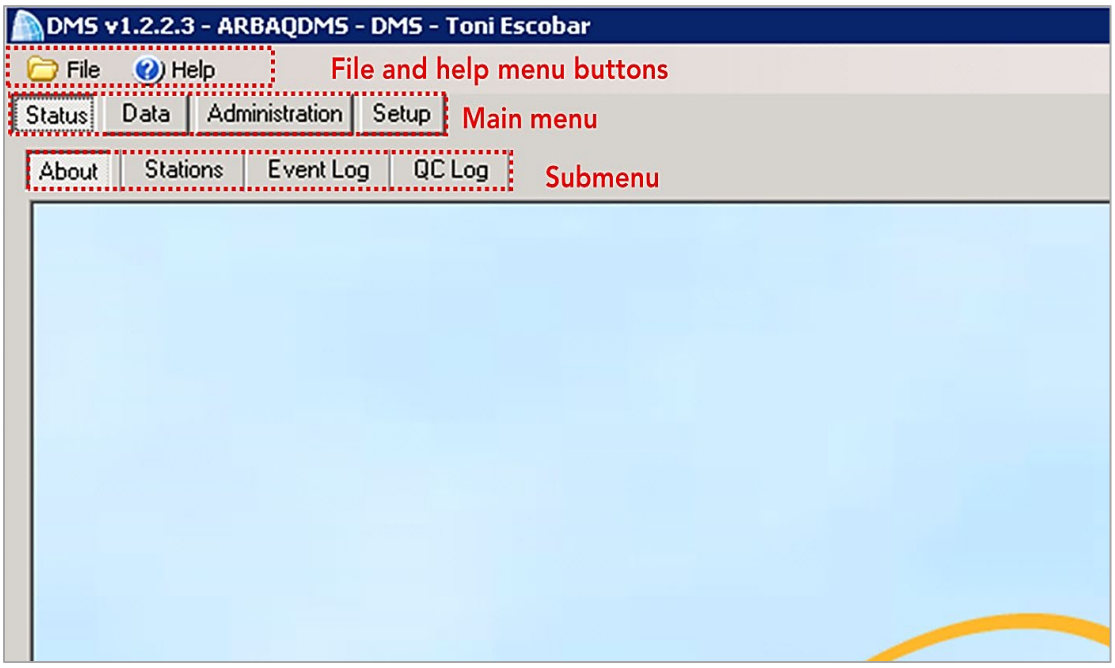


Figure 3.3. DMS Menu Structure

Some Quick Tips:

When a table is opened, the columns can be sorted by clicking on the column headings. The first click will sort the column in ascending order and will be indicated by an "up" arrow in the heading. Clicking it again will sort the column in descending order with the "down" arrow in the heading.

Note: Data from any table in the DMS can be exported via an option on the right-click menu.

When the cursor is moved over to the data points on either the time-series

graph or the scatter plot, individual data points are indicated by a dashed-line square surrounding the point. Simultaneously, the information provided in the status bar will update to reflect the current data point selected.
Many options are available from the Graph menu that appears when the user right-clicks in the Time-Series Graph, Scatter Plot, or Rose Diagram screens on the Data tab. Different functions can be accessed to manage data on the spot; these functions are covered in greater details in sections 4 and 5 of this SOP.

For screens under the Administration/Setup tab, the right-click menu allows users to download the information stored in the table from that screen to an export spreadsheet file (e.g. csv file).

All entries or changes that are made on screens from the Administration/Setup tab can be saved by clicking the **SAVE CHANGES** button from the upper menu bar. Also if users forget to save the changes, they will be reminded by DMS when they navigate to a different screen or attempt to exit the program.

Finally, DMS allows many keyboard shortcuts; these combinations of keystrokes will perform the same function as certain buttons on the DMS screen. Keyboard shortcuts are most useful for functions under the Data tab. Some of the more common functions are listed in Table 3.1 below.

Table 3.1. Keyboard Shortcuts and Functions

Hot Key	Function	Availability
Ctrl + Right arrow	Scroll time frame forward one page	Anytime on Time-Series Graph screen
Ctrl + Left arrow	Scroll time frame back one page	Anytime on Time-Series Graph screen
Ctrl + >	Scroll time frame forward one hour	Anytime on Time-Series Graph screen
Ctrl + <	Scroll time frame back one hour	Anytime on Time-Series Graph screen
Ctrl + Shift + Up arrow	Prior graph	Anytime on Time-Series Graph or Scatter Plot screen
Ctrl + Shift + Down arrow	Next graph	Anytime on Time-Series Graph or Scatter Plot screen
Ctrl + Up arrow	Prior series	When a data series is highlighted
Ctrl + Down arrow	Next series	When a data series is highlighted

Hot Key	Function	Availability
Home	Deselect all series	When a data series is highlighted
F5	Refresh graph	Anytime on the Time-Series Graph screen
Up arrow	Prior graph	When graph name box is in focus
Down arrow	Next graph	When graph name box is in focus
Up arrow	Prior record	When record is selected in data grid
Down arrow	Next record	When record is selected in data grid

4.0 DMS THE APPLICATION

This section will cover the DMS application in detail, including the DMS menu structure, the system conventions and terminologies. Understanding these things will familiarize users with the different functions in this application.

4.1 Overview of DMS Main Menu:

Figure 4.1 below is an overview of the DMS menu structure. Green menus denote functions most frequently used by AQSB users, while gray menus denote functions reserved for DMS administrators only; regular users will not see gray menus on their DMS display.

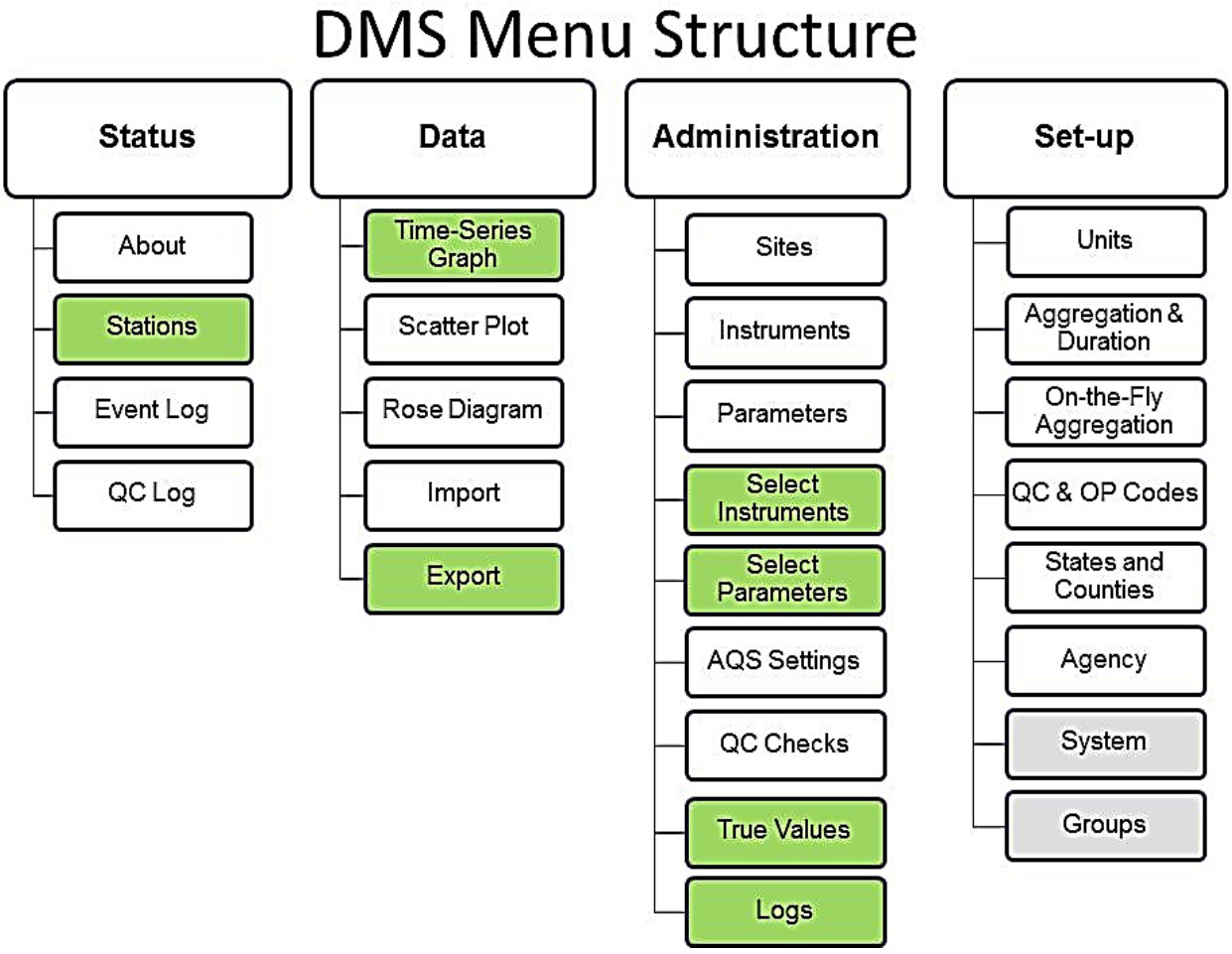


Figure 4.1. DMS Menu Tree

Provided below is a brief description for each of the four main menu tabs and its submenus:

Table 4.1. Menu and submenu description

Menu/Submenu	**Description**
Status:	Includes four sub tabs: [About], [Stations], [Event Log], and [QC Log]. Provides access to summary of the data import status from reporting stations since the last time data were received, system event logs, and the automated QC checks result logs.
Data:	Includes five sub tabs: [Time-Series Graph], [Scatter Plot], [Rose Diagram], [Import], and [Export]. Provides access to the data visualization tools (e.g. time-series graph, scatter plot, and wind rose diagram), data import screen for data ingestion, and data export / report templates.
Administration:	Includes nine sub tabs: [Sites], [Instruments], [Parameters], [Select Instruments], [Select Parameters], [AQS Settings], [QC Checks], [True Values], and [Logs]. Provides access to different administrative screens for the monitoring sites, instruments, and parameters. In addition, allows users to configure the DMS-to-AQS labels conversion, defines the types of automated QC checks, specifies the calibration's true values, and provides a logging system for users to record any site/instrument changes/comments.
Setup:	Includes eight sub tabs: [Units], [Aggregation & Duration], [On-the-Fly Aggregation], [QC and Op Codes], [States and Counties], [Agency], [System], and [Groups]. Provides access to different system setup screens, including the system units, aggregation type and duration, the OC and Op codes, geographical information, and the user's group rights setting, etc.

4.2 DMS User Manual:

The DMS user manual has five (5) major chapters and was drafted when DMS version 1.1.4 was released. Subsequent DMS version releases have been documented by STI through dissemination of release notes. The user manual and the associated release notes document the fundamentals needed to successfully utilize most areas of the DMS application. There are currently seven (7) release notes that supplement the original DMS user manual (v1.1.4.X), for covering DMS updates from versions 1.1.5.X to 1.2.2.X.

There are currently two ways for users to access the DMS user manual, either 1) via the DMS homepage or 2) from the "Help" menu on the DMS client interface.

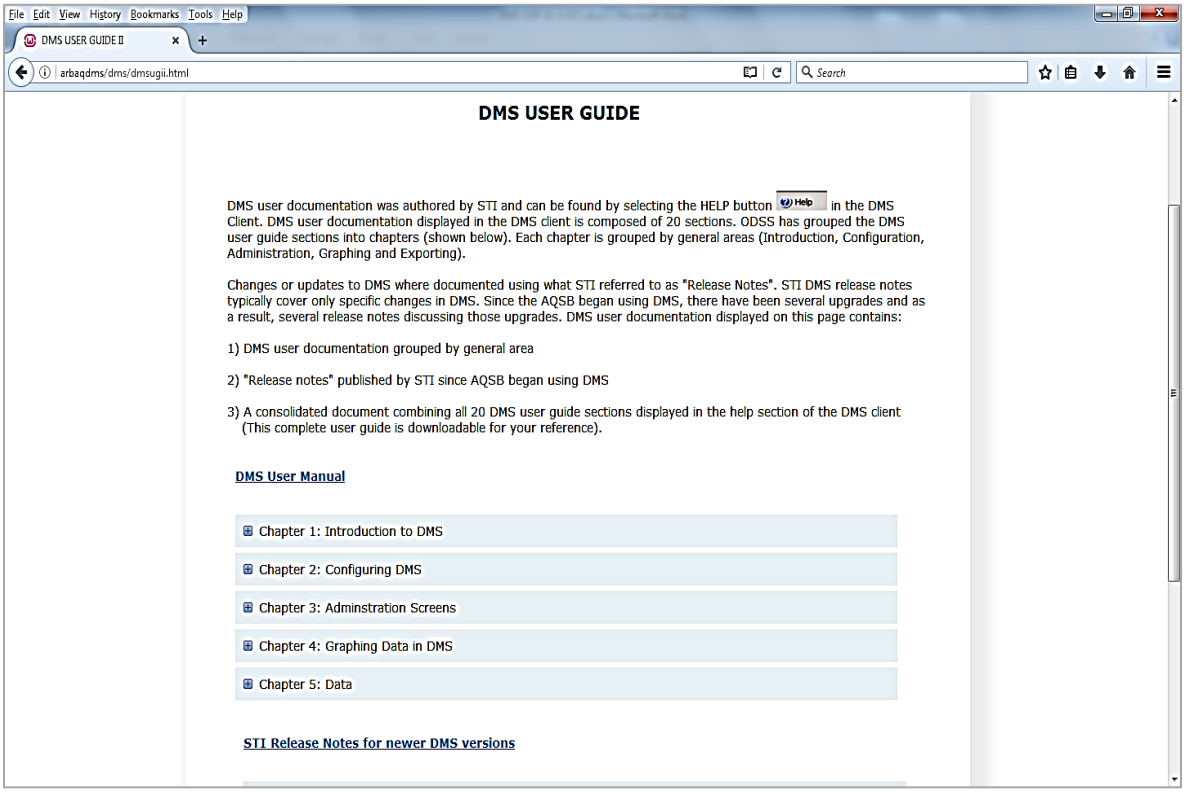


Figure 4.2. DMS User Manual Webpage

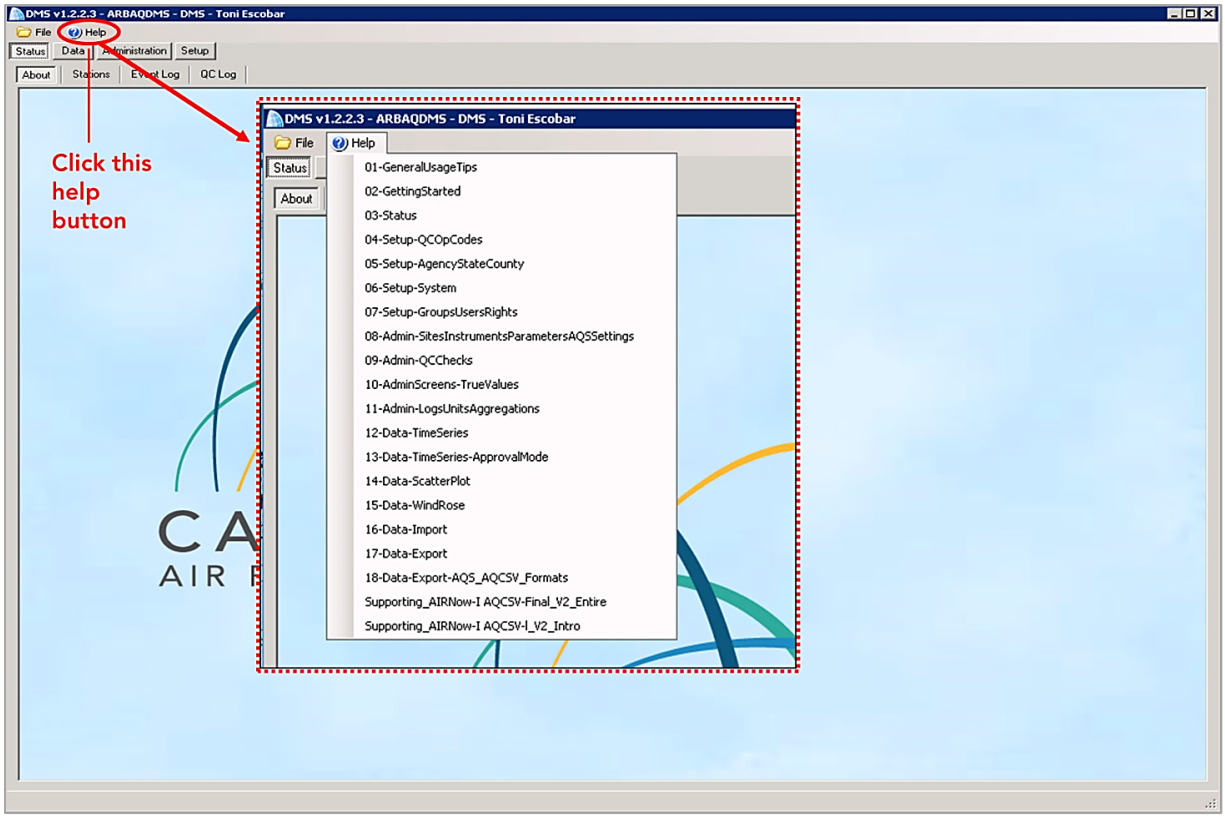


Figure 4.3. Access to the DMS User Manual

Note: The DMS user manual is referenced as it is highly recommended that users of DMS read and understand STI's original instructions regarding the DMS application. This SOP is designed to provide instructions and procedures more relevant to AQSB users for the specific CARB monitoring network. Therefore, there will be minor differences between this SOP and the DMS user manual, and it is not the intent of this SOP to duplicate or replace the DMS user manual.

4.3 DMS Conventions and DB Structure:

The following system conventions and structure of the database should be understood prior to using DMS:

- By default, all users have the public viewing rights, which allow all users to view data from all sites. However, users will need to have special security rights, which require verification before it can be granted, in order to EDIT data for their assigned sites. Security rights are assigned to Groups (not individuals).

- Each applicable data point stored within the DMS SQL Server database is linked to a unique instrument, which has a unique identifier. The unique instrument identifier can be used as an instrument tracking/inventory system for the monitoring network.

- An instrument can only be in one place at a time. Each reporting parameter from the instrument at a site must have a unique name. DMS requires unique site-parameter combinations. This requirement means that COLLOCATED parameters must be named differently in the DMS (e.g., O3, O3_a and O3_b, etc.).

- In DMS the file paths, sites, parameters, instruments, and default field operation (Op) and quality control (QC) codes must be set before the DMS will import data for any given parameter using the basic ingest data format. These settings are configurable on the System screen under the Setup tab and are typically set by DMS administrators.

- DMS requires the QC and Op codes system to be consistent across parameters and instruments. The numbers and specific definitions of the QC and Op codes in the system are user-configured. Further information on these QC and Op codes are provided in the "Setup - QC and Op Codes" section of the DMS user manual or in Appendix C of this SOP.

- Since many DMS calculations and checks are performed upon data import, it is imperative that the particular calculations, Auto QC and hourly/daily aggregation to be performed on a given site and parameter must be configured in the system prior to importing data for that site and parameter.

- Data can be imported into the DMS via a manual process through the user interface or via automated import. Data import is described in detail in the "Data – Export and Data – Import" section of the DMS user manual.

- The sites, instruments, and parameters tables under the Administration tab are able to handle multiple users concurrently. But if multiple users make changes to a same data point, only the last change will be represented in the DMS. And for BEST practices, only one person at a time should modify data for a site/parameter.

- DMS features a cascade delete effect: deletion of a data value associated with other values deletes all dependent data values. For example, deleting an item in the Site or Parameter fields also deletes all the data values associated with that site or parameter. Thus, DMS is set up so that only the database administrator (DBA) can delete DMS data.

4.4 DMS Terminology:

The following are terms typically used when working in DMS. It is helpful to know and understand the following DMS terminologies for the system and database:

Table 4.2. DMS Terminology

Terminology	**Definition**
Aggregation	Types of "on-the-fly" averages conducted by DMS. Hourly data (except BAM data) are aggregations calculated from ingested 1-minute data. Changing the underlying data (one-minute) changes the aggregation value unless data is locked.
Auto QC Checks	Automated quality control routines applied to data which meets or does not meet criteria specified in the DMS Admin's Auto QC table. Currently, CARB performs Auto QC routines to screen for (max high, max suspect, sticking/repeating, MDL and rate of change) aggregated hourly data. For details please refer to Appendix D in this SOP.
Bulk Null Code	A process to semi-automatically apply AQS Null Qualifiers to data which is missing or invalid.
Chain of Custody (COC)	Indicated by the C column in the tabular data window. Shows a record of changes made to data after it has been imported to DMS. Changes made by the system, for example Auto QC, are tracked and logged as a system change.
DMS.cfg File	Dms.cfg is a configuration file used by the CARBLogger "dmsout" process to format data appropriately for DMS. This "tells" CL how to flag the one-minute data.
Groups / Rights	Groups refer to user groups in the DMS application. Rights are delegated and granted permissions for the specific user group so that its users can either access certain functions or features, or execute an administrative task. Groups in DMS: Public, Site Operator, Air Monitoring Section, GHG Stations, and System Admin, etc.

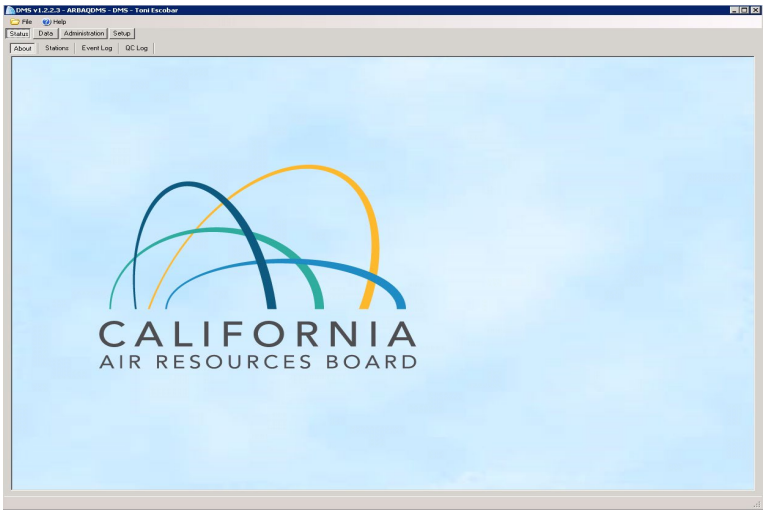
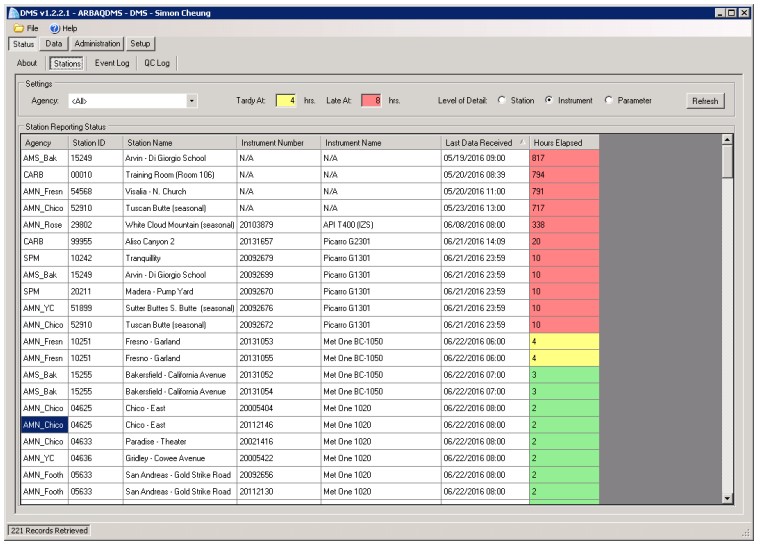
Terminology	**Definition**
Ingest	A process where data is imported or accepted by DMS. Data for CARB's data is ingested to DMS from the CARB SFTP server.
Null and Qualifier Code	Referred to as Qualifiers in AQS. Consist of 4 types: Null code, Quality Assurance code, Information flag, Request for Exceptional Event flag. When data is coded with the invalid QC code, data must be associated with a null code, as it takes the place of data.
Operation (Op) Code	A field operation code relating to the operational status of an instrument. For example, Op Code (0) valid. It is typically set by CARBLogger (i.e. offline, manual calibration, audit, etc.).
Quality Control (QC) Code	A quality control code relating the status of the data. For instance, QC codes 0 through 4 are considered valid. QC codes 5 or higher are considered suspect or invalid.
Reviewed / Locked Data	Indicated by the R or L column in the tabular data window. Indicates whether data has been marked reviewed or locked. COC will also track this change.
Stored Procedure	It is a name collection of SQL statements and procedural logic that is stored in the server database and verified and compiled at execution time. It is typically treated like other database object and controlled through server security mechanism.
True Values	The expected value DMS uses to compare instrument zero, precision or span calibration data to calculate percent from true values. This data is used to generate control charts.

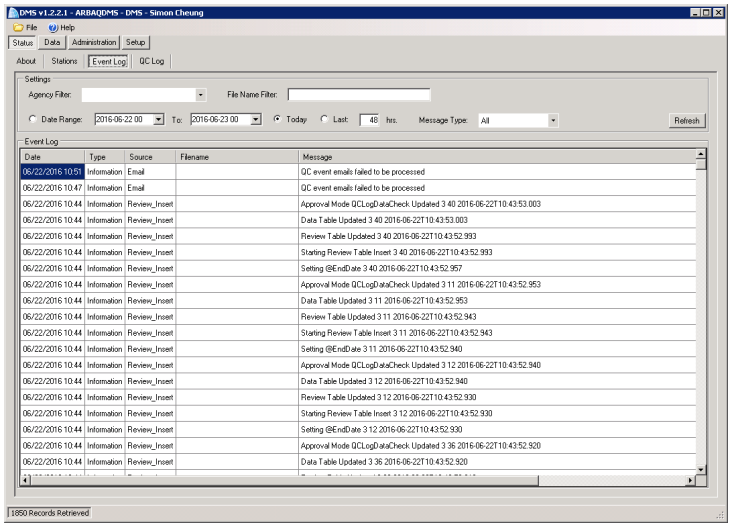
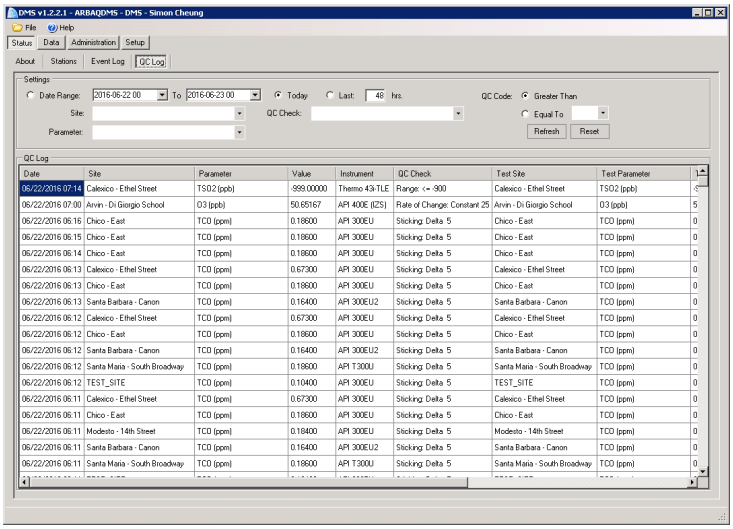
4.5 Status Menu:

The Status Menu provides access to summary of the data import status from reporting stations since the last time data were received, system event logs, and the automated QC checks result logs.

It includes four sub tabs/menus: [About], [Stations], [Event Log], and [QC Log]. Screenshots and descriptions for each submenu are provided in the Table 4.3.

Table 4.3. List of Status Submenus

Screen:	Description:
 a) Home Screen	This is the Home screen for the DMS User Interface.
 b) Stations Screen	The Stations screen provides a summary of the data import status since the last time data were received. Status information can be organized by station, station-instrument, or station-instrument-parameter by selecting the appropriate radio buttons (Station, Instrument, or Parameter) in the Settings area at the top of the screen.

Screen:	Description:
 c) Event Log Screen	The Event Log screen lists all the events captured in the database. Events include but are not limited to, data transaction logs, system settings changes, notification emails, etc.
 d) QC Log Screen	The QC Log screen lists all changes to the data, including data points flagged as failures by the DMS automated QC checks and updates to data values, QC codes and Op codes.

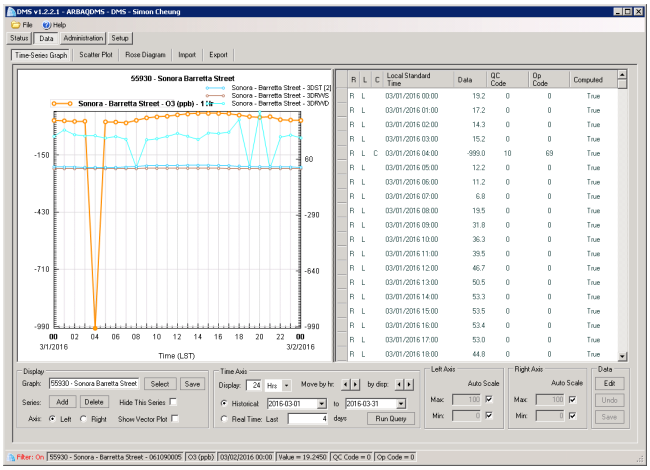
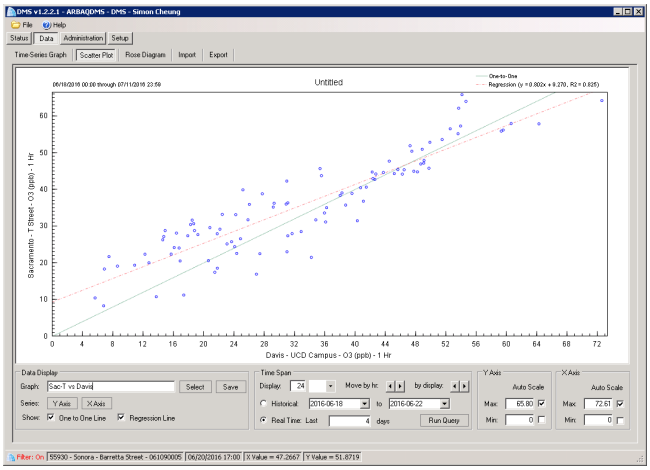
4.6 Data Menu:

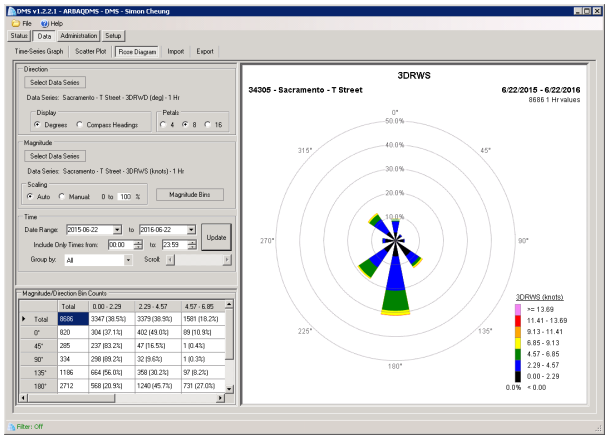
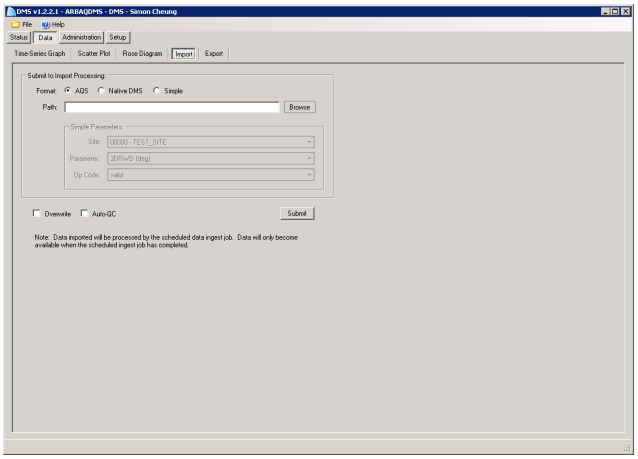
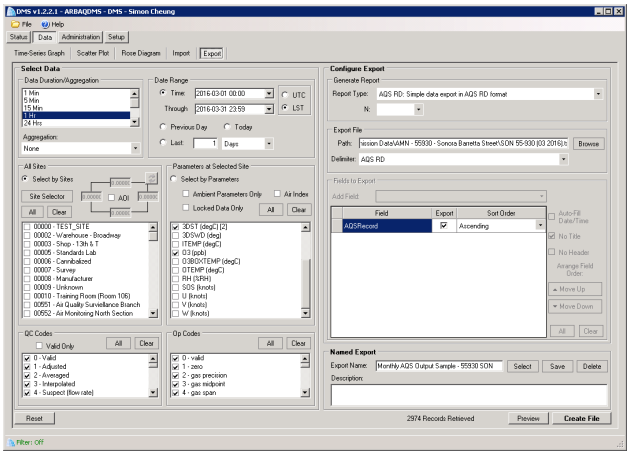
The Data Menu provides access to the data visualization tools, data import screen for data ingestion, and data export / report templates. It allows users the ability to construct various time series, scatter plot or wind-rose graphs for air monitoring data, and also different kinds of data exports.

It includes five sub tabs/menus: [Time-Series Graph], [Scatter Plot], [Rose Diagram], [Import], and [Export]. Screenshots and descriptions for each submenu are provided in the Table 4.4 below.

NOTE: To aid users, there are several graphs and exports (located in the SYSTEM graph/export sections of DMS) to give users an example of what graphs or reports DMS can generate. To save these graphs/exports, change the name of the file and select save. The graph/export will be saved to the user DMS account.

Table 4.4. List of Data Submenus

Screen:	Description:
 a) Time-Series Graph Screen	Time-series graphs are an efficient and effective way to evaluate the validity of ambient aerometric data. They are also useful analysis tools for assessing trends in ambient data, comparing recent data in the context of historical data or expected concentrations, and understanding temporal patterns.
 b) Scatter Plot Screen	Scatter plots are used to compare parameters from two sites or two parameters at the same site. As with the time-series graphs, each user can set up user-specific graph templates for scatter plots. These templates are saved in the user profile and will load upon log-in.

Screen:	Description:
 c) Rose Diagram Screen	Wind rose diagrams help users understand meteorological conditions (wind speed and direction) at monitoring stations and evaluate trends and temporal patterns at different scales. Wind roses display the frequency distribution of wind speed and direction at a particular site. Rose diagrams can also display the relationship between ambient air quality data and wind conditions.
 d) Import Screen	The DMS supports both manual and automated data imports. Five data file formats are accepted by the DMS. Four of the formats can be processed by the automated data import: DMS Native, DMS Full Native, AirNow Air Quality Comma Separated Values (AQCSV), and Air Quality System AQS raw data (RD).
 e) Export Screen	The DMS Export screen is used to export DMS data for (1) performing data analysis in another application, (2) running specialized reports, and (3) creating Air Quality System (AQS) and AirNow data submittal files.

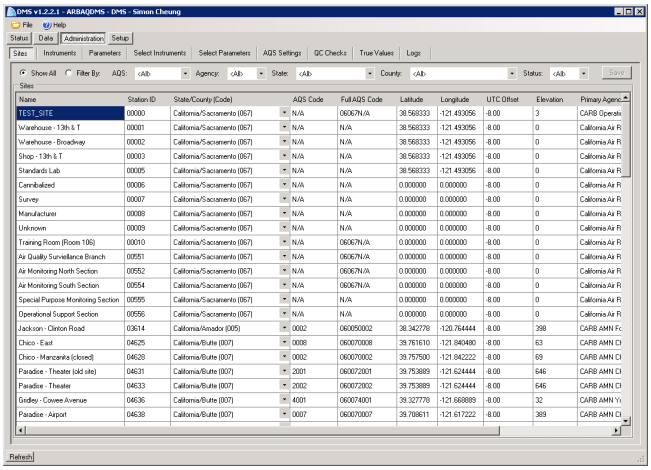
4.7 Administration Menu:

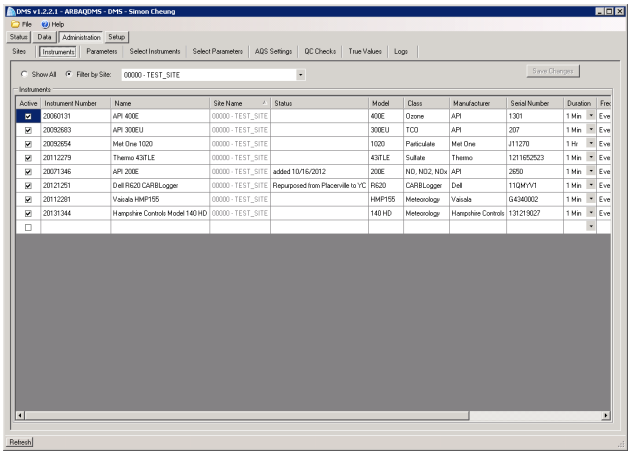
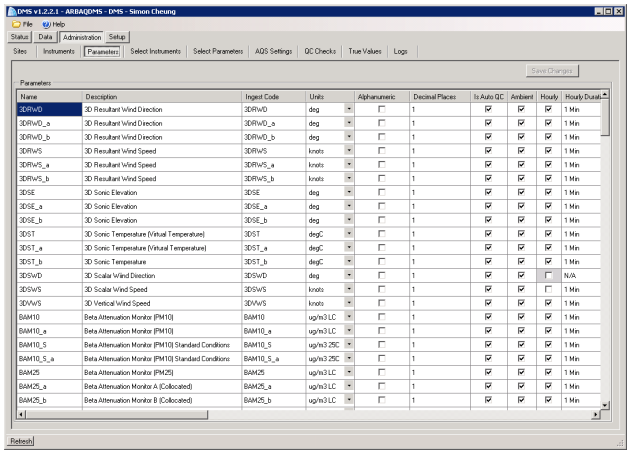
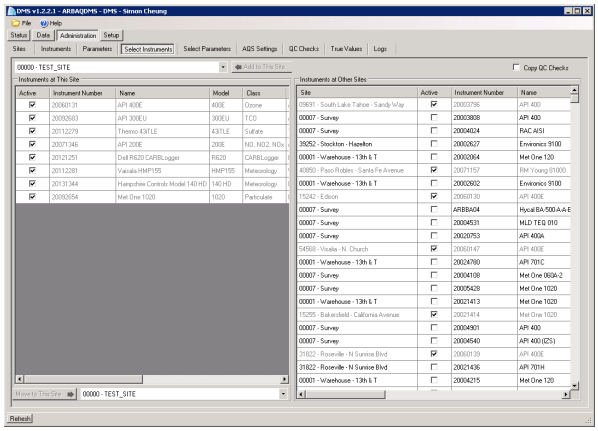
The Administration Menu provides access to nine sub tabs: [Sites], [Instruments], [Parameters], [Select Instruments], [Select Parameters], [AQS Settings], [QC Checks], [True Values], and [Logs]. Screenshots and descriptions for each submenu are provided in the Table 4.5 below.

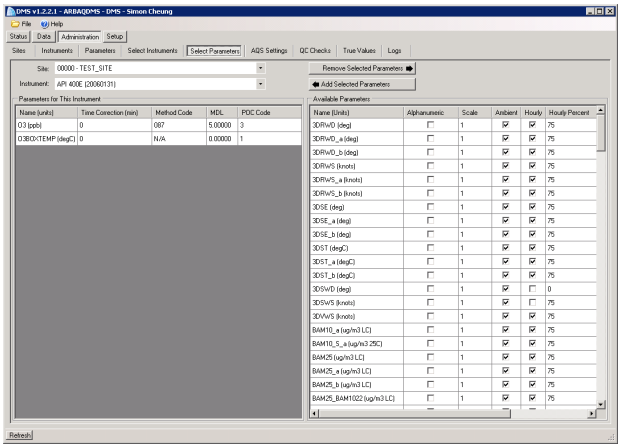
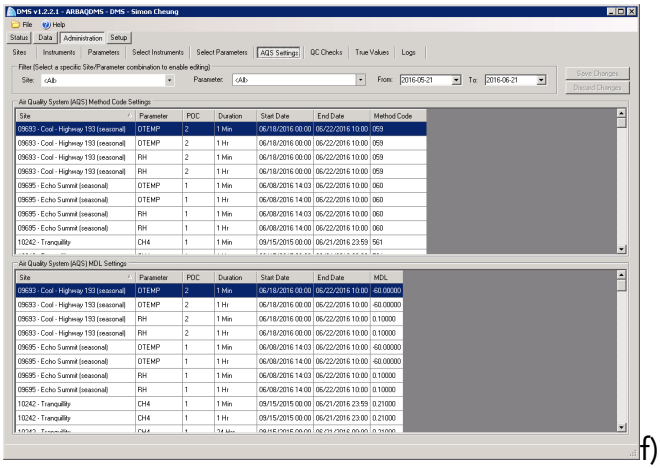
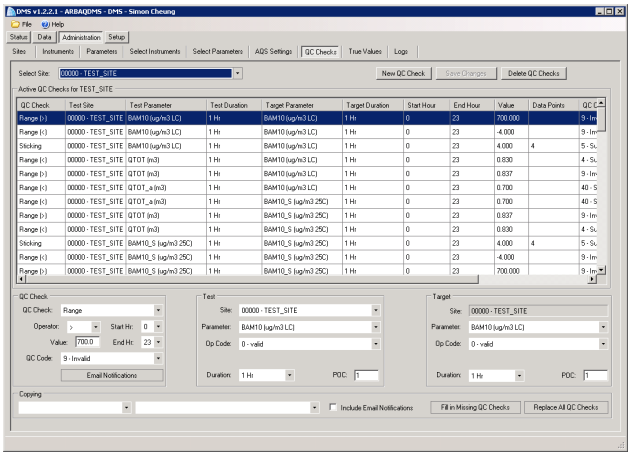
NOTE: While modifications or changes to the [Sites], [Instruments], and [Parameters] fields can be accomplished by any user, changes to these fields should only be done by ODSS staff.

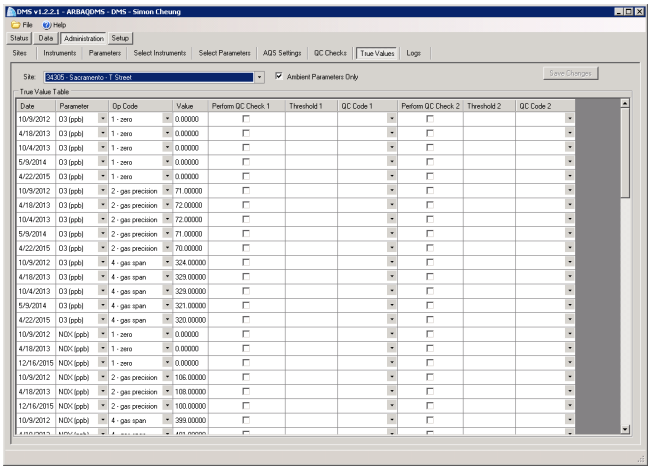
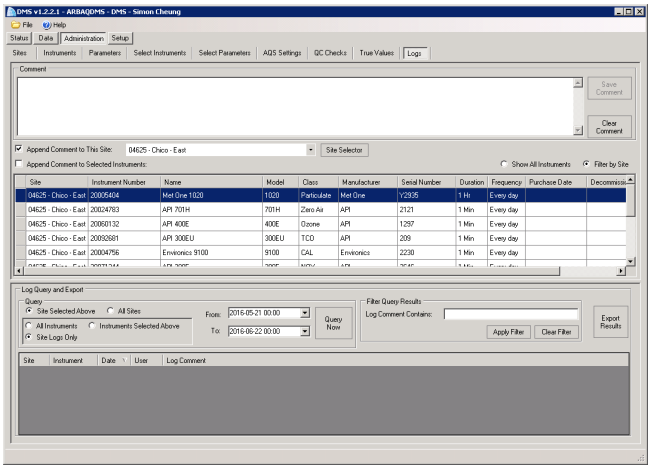
However, [True Values] and [Logs] fields should be used by all users. These fields allow users to specify calibration true (or expected) values, and provide a location for electronic site logging to record any site/instrument comments.

Table 4.5. List of Administration Submenus

Screen:	Description:
 a) Sites Screen	The Sites screen allows users to set up a new monitoring site in DMS. Within the DMS prior to data import, the monitoring network information must be set up correctly. Any site-parameter combination encountered during routine raw data import (in the DMS native format) that is not recognized by the DMS is ignored, and an entry is placed in the event log indicating the missing site and parameter. *** New sites should only be created by DMS admins.

Screen:	Description:
 b) Instruments Screen	The Instruments screen allows users to add an instrument at a monitoring site. The radio buttons allow all instruments in the network to be listed (Show All) or only instruments assigned to a specific site (Filter by Site). *** New instruments should only be created by DMS administrators.
 c) Parameters Screen	The Parameters screen allows users to add parameters to DMS. All existing parameters in the network and supported by the DMS are listed in the first column of the Parameters table. *** New parameters should only be created by DMS administrators.
 d) Select Instruments Screen	The Select Instruments screen allows users to assign an existing instrument to an existing site. The DMS logs each movement of an instrument from site to site; the log comment is stored with the instrument being moved. The two tables on this screen are Instruments at This Site and Instruments at Other Sites.

Screen:	Description:
 e) Select Parameters Screen	The Select Parameters screen allows users to add a parameter to an existing instrument. Each parameter under a given POC may be assigned to one active instrument at each site. If a site has collocated instruments measuring the same parameter, a second parameter with a unique parameter name and ingest code may be added to the parameter list to support DMS ingests.
 f) AQS Settings Screen	The AQS Settings screen allows users to review and edit historical AQS method codes and MDL settings for a specific monitor (a unique combination of site, parameter, POC, and duration). This screen contains the AQS Method Code Settings table and the AQS MDL Settings table, each with fields for Site, Parameter, POC, Duration, Start Date, and End Date. The user can edit the AQS method codes and MDL values for historical data from this screen.
 g) QC Checks Screen	The QC Checks screen allows users to set up automated QC (auto-QC) checks after the sites, instruments, and parameters have been entered into DMS. The auto-QC checks are performed upon data import. And they can be run on air quality and instrument diagnostic data. Each QC check is defined by the specific test type, the input information required for the test, and the action the DMS is to take if the test fails. *** The checks are administered by ODSS.

Screen:	Description:
 h) True Values Screen	The True Values screen allows users to add reference values for instrument performance checks. True values are specific to the site, parameter, date range, and operations (Op) code. The Data Calibration report compares true values to the daily average of the measured values for the site-parameter-Op code combination.
 i) Logs Screen	The Logs screen allows users to create log entries for both sites and instruments. This function enables the users to record any relevant information or observations about the site, instrument, or both.

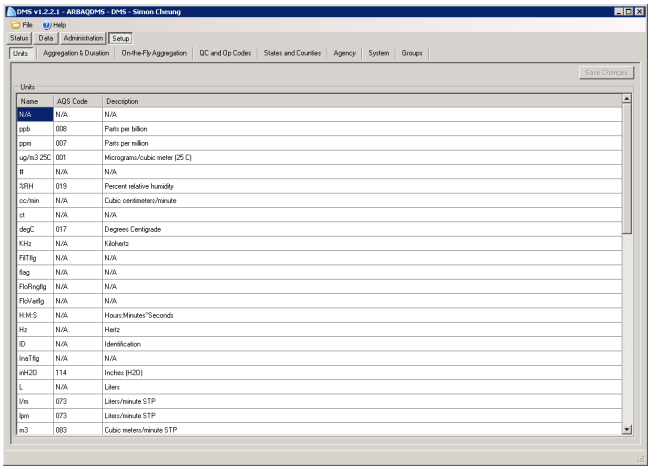
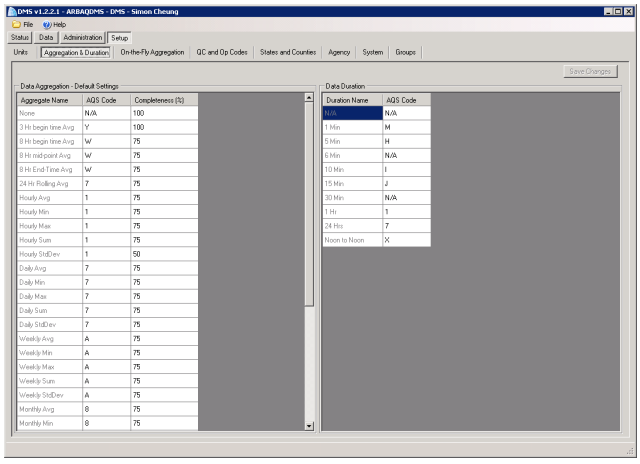
4.8 Set-Up Menu:

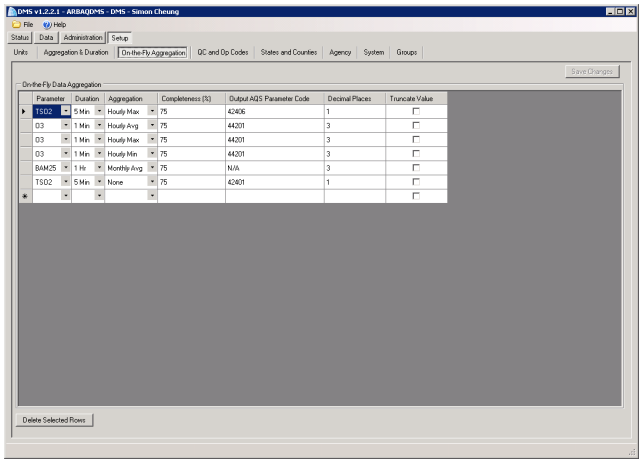
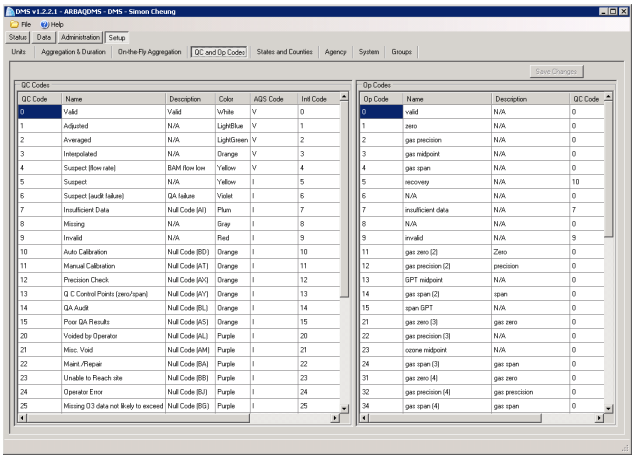
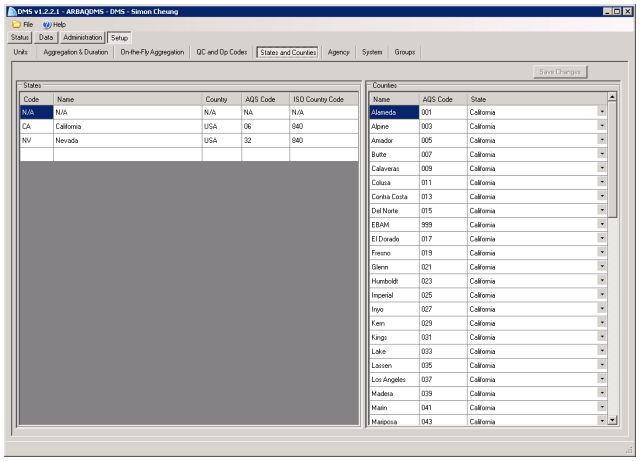
The Set-Up Menu provides access to different system setup screens, including the system units, aggregation type and duration, the OC and Op codes, geographical information, and the user's group rights setting.

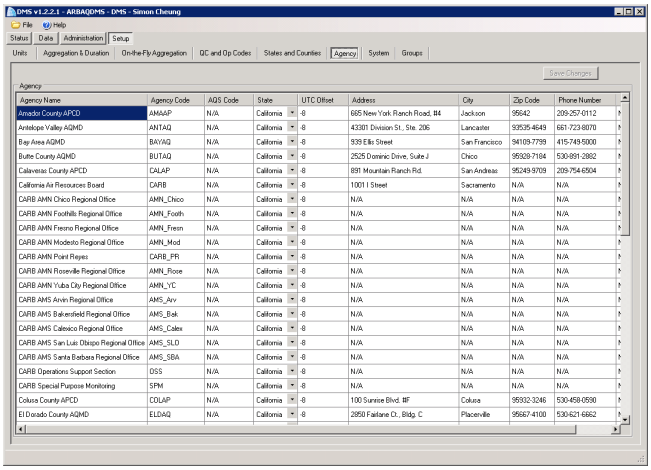
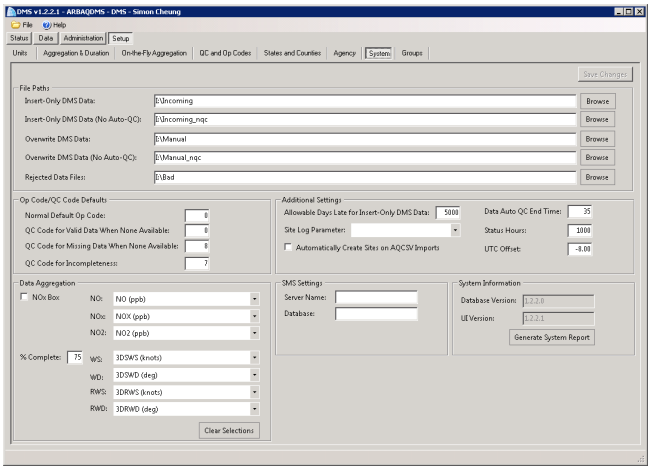
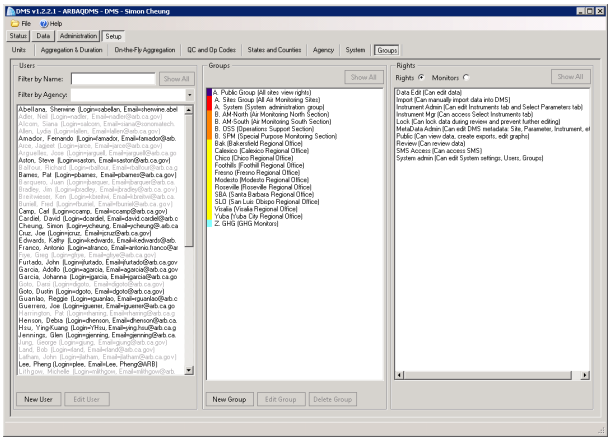
It includes eight sub tabs/menus: [Units], [Aggregation & Duration], [On-the-Fly Aggregation], [QC and Op Codes], [States and Counties], [Agency], [System], and [Groups]. Screenshots and descriptions for each submenu are provided in the Table 4.6.

NOTE: Since this SOP is intended for the non-administrator users whom do not require access to this part of the system, details, such as specific features, rules, setup procedures and setting changes, will not be included in this document. However, if you are interested in these details, they are available in the Setup sections of the DMS user manual.

Table 4.6. List of Setup Submenus

Screen:	Description:
 a) Units Screen	Units to be supported by the DMS are added in the Units screen on the Administration screen. Incoming data must be assigned the correct units in the Parameters screen on the Administration tab. All standard Air Quality System AQS units are available in the DMS.
 b) Aggregation & Duration Screen	The types of aggregations currently supported by the DMS are shown in the Aggregation & Duration screen. As listed, the DMS currently supports 3-hr and 8-hr begin time running averages, 8-hr mid-point average, as well as daily, weekly, monthly, quarterly, and yearly aggregations (including minimum, maximum, average, sum, and standard deviation).

Screen:	Description:
 c) On-the-Fly Aggregation Screen	The On-the-Fly Aggregation Screen allows users to setup the spontaneous aggregations that they would like the DMS to calculate for specific parameters using particular data durations and data completeness criteria. The data calculated on the fly are not stored in the database, and therefore they cannot be subjected to the auto-QC checks or the application of DMS QC or AQS qualifier/null data codes.
 d) QC and Op Codes Screen	The QC and Op Codes screen allows users to define the Op codes imported with the raw sampling data and the QC codes that indicate data quality. Op codes provide information on instrument conditions during field sampling, while the associated QC codes indicate the overall validity of the collected data.
 e) States and Counties Screen	The States and Counties screen allows users to specify information regarding the states and counties relevant to the data contained in the database. Only users with System Admin rights can edit this table.

Screen:	Description:
 f) Agency Screen	The Agency screen allows users to specify information regarding the air quality management agency or agencies relevant to the data contained in the database. All locations are associated with an agency.
 g) System Screen	The System screen allows administrators to control different aspects of the DMS system configuration. The screen's four sections are File Paths, Op Code/QC Code Defaults, Data Aggregation, and Other Information.
 h) Groups Screen	DMS users, groups, and rights settings can be managed via the Groups screen here. All DMS users must be assigned to a user group. DMS rights, or permissions, are listed in the Rights table on the right side of the screen. The rights available in the DMS are fixed, but the rights assigned to a given group are configurable.

5.0 USING DMS

5.1 Introduction and Table of Quick Reference:

This section covers general tasks most will users perform in DMS. Some of these tasks include, but are not limited to, how to create a time-series graph, how to null code or bulk null code the invalid data points, and how to create data reports/exports.

This SOP provides a generic description of how to accomplish the task, but will not specifically address a particular policy or procedure. For example, it describes how to apply a null code to an invalid data point but does not describe what specific null code should be applied.

Understanding these tasks will provide users the necessary tools and skills for completing their data review duties on DMS, and helps reduce mistakes that might have otherwise resulted from misuse of DMS. The following table provides a quick reference to all the tasks that will be covered in this section, and the cross-sectional reference to the DMS user manual.

Table 5.1. Table of Quick Reference

MENU	SOP SECTION	TASK DESCRIPTION	SOP PAGE	DMS SECTION
Status	5.2	Initial Account Login	41	02
	5.3	Checking Station Status, Event / QC Logs	42	03
Data	5.4	Viewing / Creating a Time Series Graph	44	12 & 13
	5.5	Reviewing and Editing Data	47	12
	5.6	Null, Qualifier, and Bulk Null Coding	53	12
	5.7	Chain of Custody Review	58	12
	5.8	Creating Other Plots (Scatter Plot & Wind Rose Diagram)	59	14 & 15
	5.9	Importing Data (Back Poll or Re-send Data)	65	16
	5.10	Creating an Export Report	68	17
	5.11	Exporting Monthly Precision Report	73	17
	5.12	Exporting Percent Data Capture Report	76	17

MENU	SOP SECTION	TASK DESCRIPTION	SOP PAGE	DMS SECTION
Administration	5.13	Setting up a Site / Instrument / Parameter	78	08
	5.14	Select Instrument (Moving an Instrument)	80	08
	5.15	Select Parameter (Setting a Parameter)	82	08
	5.16	Setting up Auto QC Checks	84	09
	5.17	Updating True Values	88	10
	5.18	Updating Site Logs (for Documentation)	89	11

5.2 Initial Account Login:

Note: To connect to DMS, login to terminal server. Refer to the instructions in section 3.2 of this SOP.

Once connected to the terminal server, double-click on the ***DMS.exe*** icon to launch the database login window. The server name and database connection for the DMS user interface are indicated at the top of the login window (See figure 5.1). If the connection [DMS-ARBAQDMS-DMS] is correct, enter the user name and password into the respective fields and then click **OK** to initiate the DMS session.

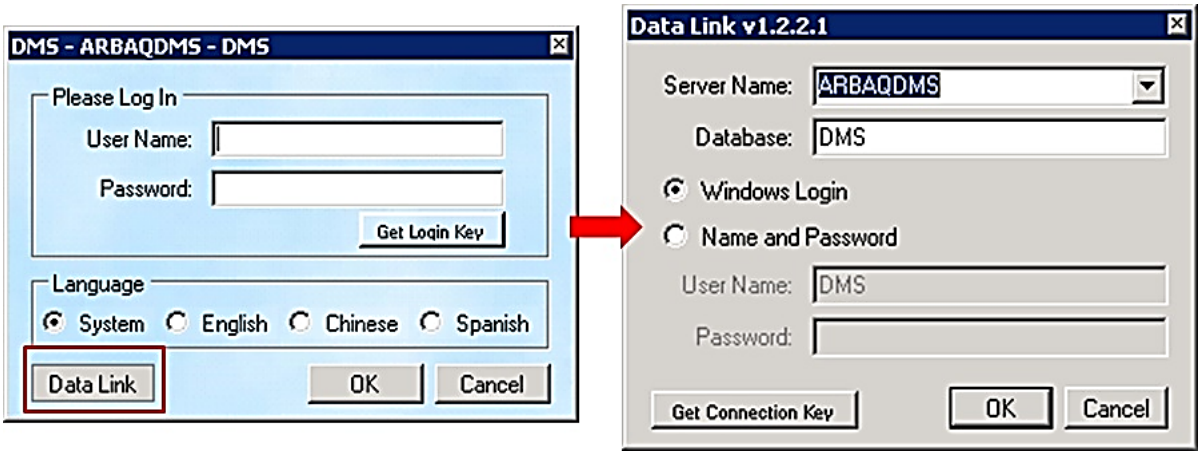


Figure 5.1. Initial DMS Login Window and Data Link Setup

If the connection is not shown correctly, it can be corrected. To update the connection, click on the **DATA LINK** button from the login window to access

the Data Link properties window. For users who connect to a single DMS database, the Data Link properties need to be set up only once. However, the database connection can be changed at any time before launching the DMS session.

1. To correct the server name on which the database is located, enter the "ARBAQDMS" directly into the **Server Name** box.

2. Then enter the "DMS" into the **Database** box.

3. Two authentication options are available: **Windows Login** or **Name and Password**. If the **Windows Login** option is selected, DMS will use the same name and password that is used to log in to the terminal server to start the DMS. And for the **Name and Password** option it allows users to create their own database login credentials.

4. Once the connection is updated, click **OK** to return to the DMS user interface login window.

5.3 Checking Station Status, Event / QC Logs:

Checking Station Status

An important feature of DMS is the display of stations status. To view stations status information, go to the **[Stations]** screen under the **[Status]** menu.

Status information can be organized by station, instrument, or parameter, by selecting the appropriate radio buttons in the Settings area at the top of the screen. When a button is selected, the table will display the appropriate columns, as exampled in the figure 5.2 below. Additional columns or content, (i.e., instrument or parameter columns), can be shown as well when the Instrument or Parameter button is selected instead.

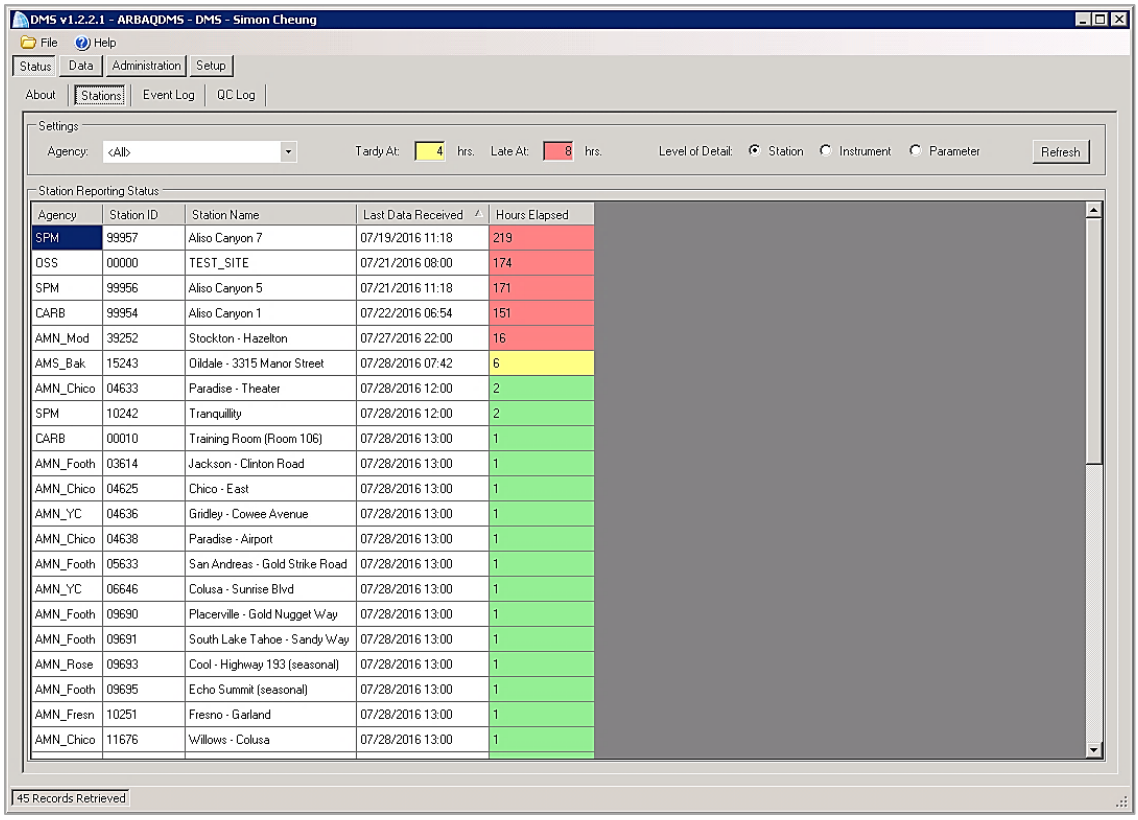


Figure 5.2. Station Status Display

In the Station Reporting Status table, the Last Data Received column will list the date-time stamp for the last minute of data that are successfully imported and stored into the DMS database. Depending on the timestamp, rows will be color-coded differently; yellow indicates “tardy” data, red indicates “late” data, and green indicates “current” data. The threshold for these categories can be updated in the dialog boxes at the top of the screen (i.e., the “Tardy At” and “Late At” fields), and then click on the **REFRESH** button to update the table.

To filter the station status information by agency or regional distinction, users may use the agency filter dropdown at the top left of the settings panel. And to sort / group the tabular data by agency or timestamp, users can click on the column headers from the table to list the data by either descending or ascending alpha-numerical order.

Checking Event / QC Logs

Event or QC logs can be viewed by selecting the **[Event Log]** or **[QC Log]** screen under the **[Status]** menu. The basics are the same as checking the station status information.

Event Log

The **[Event Log]** screen lists all the events captured in the database. The event log displays four possible event categories: 1) failure, 2) Error, 3) Information, and 4) Success.

- Failure – invalid or corrupted file, file could not be found, etc.
- Error – database system error at the program level (usually issues for the DBA)
- Information – all imported files; record of imported data
- Success – something the system produces (e.g., sending data to AIRNow)

QC Log

The **[QC Log]** screen lists all changes to the data, including data points flagged by the DMS automated QC checks and updates to data values, QC, and/or Op codes.

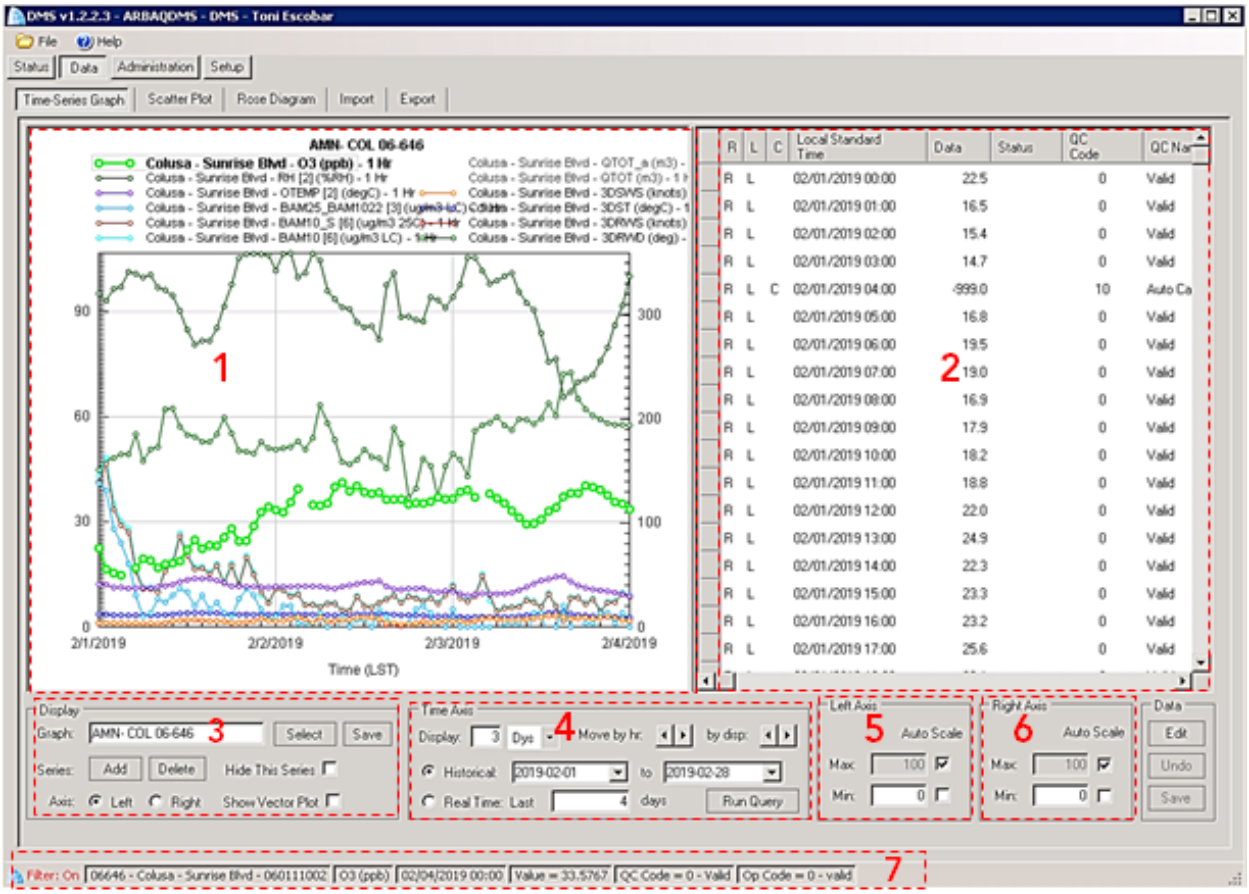
If users are interested to view the logs collected during the current day, they can select the Today radio button in the settings area, then click on **REFRESH** to view the updated settings. Similarly, events logged from the present back to a specific hour can be shown by selecting the Last radio button and entering the desired number of hours.

These logs table can also be filtered by date range, and/or (site, parameter, QC check, and QC code, if available) using the dialog boxes at the top of the screen.

Finally, the **RESET** button can clear and restore all selected criteria or filter parameters to the default settings and records.

5.4 Viewing / Creating a Time Series Graph:

A primary feature of DMS is the ability to graphically display data. To view data in DMS, user will either need to create a custom graph in the **[Data] - [Time Series Graph]** portion of system or open an existing system graph from the available options.



Item #	Description
1. Graph Display	Displays site and parameter series selected in the display window
2. Tabular Display	Displays active (bolded) data series selected in the graph display
3. Display Window	Allows user to select graph to display and configure sites or parameters
4. Time Axis Control	View period (time) of graph series
5. Left Axis Control	Sets range for parameter on left side of axis
6. Right Axis Control	Sets range for parameters on right side of axis
7. Information Bar	Displays info regarding a selected data point in the tabular display

Figure 5.3. Time Series Display

To View Graphs

1. Select **[Data]** and then the **[Time Series Graph]** tab on the program menu bar.

2. In the Data Display Window, click on the **SELECT** button. Choose from a system graph or previously saved user's graph. System graphs are saved in the DMS database and are available upon log-in.

Note: System-graph templates are default to all users, however, only the System Admins can modify them.

3. The chosen graph will be displayed in the Display Window with the default graph settings, such as time axis of 24-hr, display 4 days before today and auto-scale axis, etc., or with the last saved settings.

4. When a graph series is selected in the display, data will be viewed on both a tabular and graphical representation simultaneously.

5. To access a specific timeframe of data, select the **HISTORICAL** button in the Time Axis Control area, then type or select from the popup calendar the desired timeframe for display.

6. Select the **QUERY NOW** button. The tabular and graphical displays will be updated for the desired period of time.

To Create Graphs

1. To generate a new graph, right-click in the Graph Display area and choose **NEW GRAPH**. Name the new graph and click the **OK** button.

2. In the Data Display window, click the **ADD** button to select the data series to be graphed. A new window will open showing all available data series. Users must specify a data duration (minute, hourly etc.), site, and parameter.

3. Data series can be chosen by site or by parameter using the radio selection buttons at the top of the dialog. If a site is selected first, only the parameters available for that site will be shown; if a parameter is selected first, only the sites that measure that parameter will be shown. Sites are listed by CARB site number and parameters are listed in alphabetical order.

4. Press the **CTRL** key while clicking the traces of interest to select multiple parameters for a given site or multiple sites for a given parameter. After the site(s) and parameter(s) have been selected, click the **OK** button.

5. A new graph will be displayed in the Display Window with the default graph settings; time axis of 24-hr, display 4 days before today and auto-scale axis.

6. The series shown on the graph are listed above it on the right or left according to the axis on which they are graphed. Graph settings can be modified in several ways.

7. Designate whether the active series is to be plotted on the right or left axis by selecting the appropriate **AXIS** button (Left or Right).

8. To delete a series, activate the series to be deleted and click the **DELETE** button in the Data Display area.

9. Graphs axis will default to Auto scale (graph axis based on min/max value in graphs range). Axis scales can be changed by typing a number into the Max and Min fields in the Left Axis and Right Axis controls at the bottom-right of the screen.

10. Data shown on the graph can be filtered either by QC code and/or Op code, through the Filter Data function from the right-clicking context menu. When data are filtered, an indicator will be shown on the bottom left of the screen in at information bar.

11. To save a graph, right-click and choose **Save Graph**, or click the **SAVE GRAPGH** button in the Data Display area next to the name of the graph. The graph will be saved to the User's Graph templates.

12. To save a graph as an image, right-click and choose **Save Graph Image to File**. Graphs can be saved in GIF, BMP, PNG, and TIFF formats. Name the graph image file and click **OK** when decided. Unless a file path is provided in the file name dialog box, the graph will be saved in the DMS Program Directory.

5.5 Editing and Reviewing Data:

The most time AQSB staff will spend using DMS will be in reviewing and editing data. For detailed guidance regarding AQSB policy when editing, reviewing and validating data, users should reference to AQSB SOP 610 (DATA REVIEW AND VALIDATION).

To Edit Data

Note: Before editing any data, please unselect the "Show Abbreviated Data" option from the tabular data display screen. In the abbreviated data mode, null coding will not display and data are not allowed any edits.

Note: If the **L** column shows the "L" symbol in front of a data point, it indicates that data point is locked and does not allow any edits. To edit that data point, users will need to unlock the data point first.

There are two primary methods for editing data within DMS,

(1) Point-by-Point editing, or
(2) Bulk editing.

1) Point-by-Point Editing (Edit Data in Time Series Graph):

Note: Please note that only one data series is editable at a time using point-by-point editing.

While viewing data in a time series display, data can be edited through the Point-by-Point Editing method. The selected editable series will show a thicker line style on the time-series graph and in the legend of the time-series display. To edit more than one data series at a time, see the Bulk Data Editing in the following section.

To select a data series for editing, click on the series you would like to edit in the legend. The activated series becomes bold and data values are shown in the tabular data view on the right side of the screen.

To select a specific point, click the data point on the graph or click the corresponding row in the data table. The data point will be highlighted to indicate that it has been selected.

After the data point is selected, right click to display the graph menu. The data value, QC code, or Op code can be changed via the right-click menu on the Time-Series Graph screen.

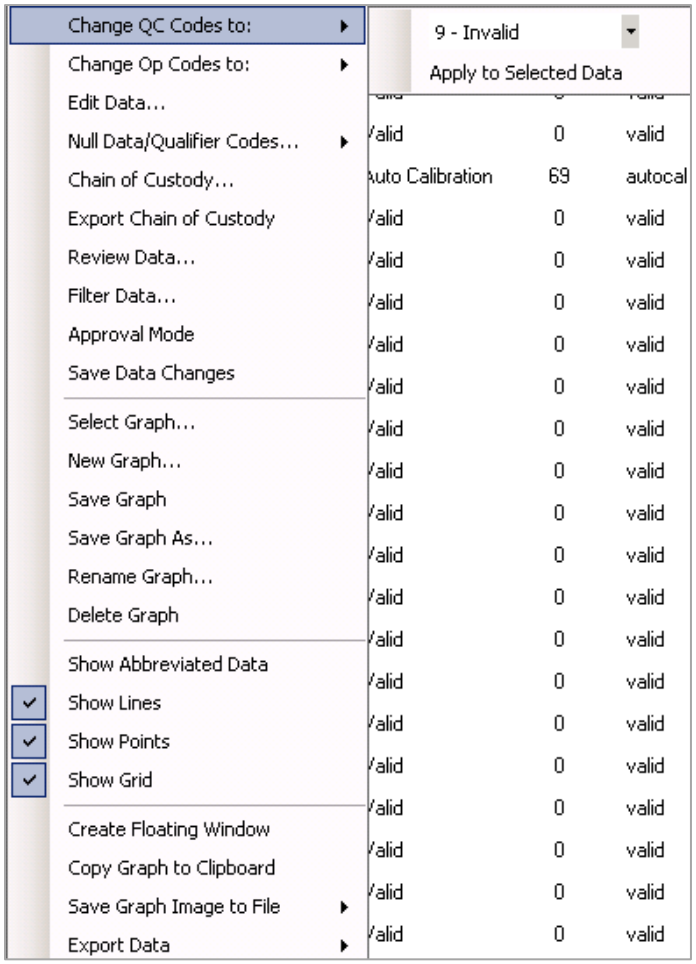


Figure 5.4. The Right Click Graph Menu

To change QC code for the data point, choose **Change QC Codes to:** on the right-click graph menu and select the new QC code from the resulting drop-down menu. Finally, click **Apply to Selected Data**.

To change multiple data points to a new QC simultaneously, select a range of data points within the graph itself (via the mouse left-click selection, click and drag over the desired points) or by choosing multiple rows from the table on the right. Then follow the same steps as described above for changing the QC code for one data point. Also one can use the same procedure to change the Op codes by selecting the **Change Op Codes to:** option from the menu instead.

Single data values can be edited by clicking the **Value** field in the tabular view and then manually updating the data value there, or by selecting the **Edit Data** option from the right-click graph menu.

NOTE: Locked data and computed data points, including on-the-fly aggregates, cannot be edited.

Changes to the data values and associated QC and Op codes can be saved or reversed. Users may select the **Undo** button located below the data table on the Time-Series Graph screen to reverse any data, QC code, or Op code changes. To save the data, QC code, or OP code changes, the user may select **Save Data Changes** from the right-click graph menu, or click the **Save** button below the data table on the right side of the Time-Series Graph screen.

A Log Comment dialog box will appear and show users an option to submit a comment for the changes made to the data. Select the **Enter Comment** button to save the data changes. To exit without saving changes, select **Cancel Save and Undo Changes**.

Note: whenever the database is re-queried, such as when toggling between saved graphs, users will be prompted to save their changes.

2) Bulk Editing (Edit Data in Time Series Graph):

To edit multiple data values at once, right-click and select **Edit Data** from the graph menu or click on the **Edit** button in the lower-right corner of the screen to open the Edit Data dialog box. Multiple data series can be edited simultaneously through the Edit Data window (see Figure 5.5 below).

All data series on the current time-series plot are listed in the **Select Series to Edit** box on the top of the Edit Data dialog window. Click on the series you want to edit. The selection can include anywhere from one to all of the series on the plot. When editing data, the **Functionality** box allows for two options: **Edit Data in Memory** or **Edit to Database**.

- **Edit Data in Memory** allows the user to apply the changes and still have the option of reversing them by clicking the **Undo** button. This operation gives the user the opportunity to see the changes in the plot and confirm that the appropriate changes are applied. As the name suggests, the function uses the computer's memory resources. If a large amount of data is selected for editing (i.e., greater than 4,000 records) the **Edit Data in Memory** option is disabled.

- **Edit to Database** directly works faster, but the changes cannot be reversed via the **UNDO** button because they are saved immediately to the DMS database.

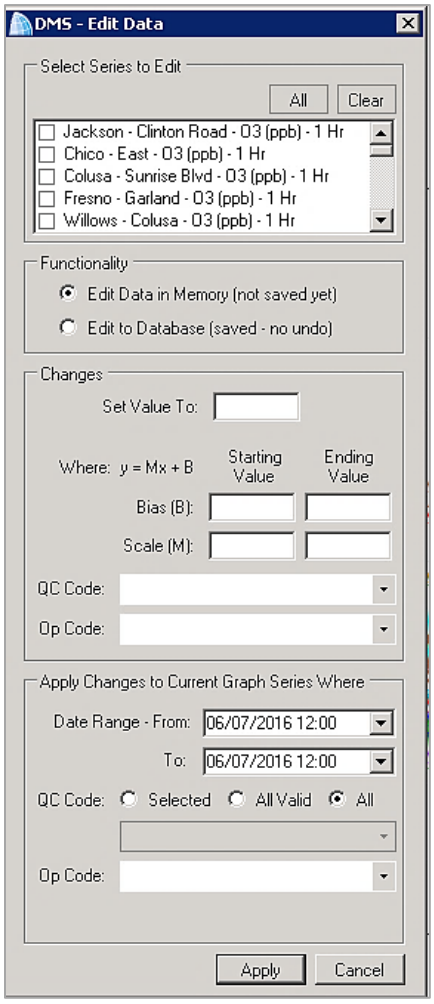


Figure 5.5. The DMS Edit Data Window

Periodically, a user may wish to change a specific data value or apply a slope/intercept correction to the data. The Changes section allows a user to set a data point to a uniform value, or apply bias and scale values to the data.

- **Bias** is an additive offset factor (intercept).
- **Scale** is the multiplicative adjustment factor (slope).

Starting and ending values are designated for both the bias and scaling factors. DMS will linearly interpolate between the start and end bias and/or scaling values. When an ending value is not entered, the end bias or scaling value defaults to the start values for the most common application of calibration adjustments or routine data offsets. The linear interpolation capability is supported by the DMS to correct gradual drifts in an instrument's calibration record or zero values.

QC and/or Op code change(s) may be applied to selected data with or without changing the values of the data. Choose a new QC and/or Op code from the drop-down menu(s).

The options in the **Apply Changes to Current Graph Series Where** box allow users to filter the data in the data series (or multiple data series) to be edited by date range, QC code, and Op code. Data edits can be filtered on QC code to apply to:

1) Only the desired QC code that is selected from the drop-down menu,
2) All valid QC codes (validity is specified on the **Setup–QC and Op Codes** screen), or
3) All data records regardless of QC code.

Users can also select a specific Op code from the **Op Code** drop-down menu as the filter. Click **Apply** to store the changes to the unlocked data within the specified date range and/or QC and Op codes.

If the functionality option **Edit Data in Memory** is selected, users can preview the changes made to the data in the time-series graph and may later save or undo edits, as they can when doing point-by-point editing.

To Review Data

NOTE: It is AQSB policy that prior to reporting data for record, ALL hourly data subject to submittal to the U.S. EPA's AQS is marked reviewed and locked.

NOTE: Only users with the "Review" DMS right can mark data as reviewed. And only users with the "Lock" DMS right can designate data as locked and subsequently unlock the data, if needed.

1. To review a specific data series on a time-series graph, select the series and then choose the data records to review. To review all series on a time-series graph, be sure that no series or data records are selected then right-click and select the **Review Data** option.

2. In the Review Data dialog box, the Select Series to Review box displays each series to be reviewed. By default, if no series were selected before opening the Review Data dialog box, all series on the graph will be listed. Selected series are indicated with a check. Users may uncheck a series or use the **ALL** and **CLEAR** buttons to either choose or clear all series, respectively. Additional detail is provided in parentheses to indicate whether any data

records in a series in the selected date range have already been reviewed or locked.

3. Users should enter comments in the **Note** box during data review. These comments will become part of the chain of custody and a part of the data record.

4. Enter the **Date Range** for the data records being reviewed in the Mark as Reviewed box. By default, if no series or data records were selected before opening the Review Data dialog box, the date range is the entire date range queried on the time-series graph, except for data from the current day. If the user selects the **Review by Display** option, the **Date Range** will reflect the data displayed on the time-series graph.

5. Users may lock records by clicking the **Lock Records** box. Locked records are no longer available for editing.

6. Click the **SAVE** button to complete the data review.

7. Reviewed data records are indicated with an "R" at the beginning of the data records in the data table. Locked records are indicated with an "L" in the same area of the data table.

NOTE: Should the need arise to re-edit locked data, data must first be unlocked. To unlock data, simply select data which has been previously locked and right click to display the Review Data option window. Uncheck the Lock Records box and then click Save to store the changes.

NOTE: Data reviewers are required to lock only the hourly data. Minute data are not required to be locked but it is okay to do so. Periodically, DMS purges unlocked historical data, and only locked data will be archived. And for all applicable sites, the 5 minute averages for trace level SO2 should be reviewed and locked as well.

5.6 Null, Qualifier, and Bulk Null Coding:

DMS distinguishes air quality data from QC data using QC and Op codes. Therefore, it is important that users should know what codes are applied under different operating conditions.

Operational and QC codes

The status of data contained in DMS is indicated by the corresponding Op or QC code. Op codes provide information on instrument conditions during field sampling (e.g., when instruments are in self-check or error modes and when calibrations are occurring). Likewise, QC codes provide information on the validity of data (e.g. when a data value is invalid due to insufficient data). Only data associated with the **Normal Default Op and QC Code (0, 0)** are considered normal ambient data and are included in higher-level averages. Data associated with invalid Op and QC codes are not included in any higher-level data averages.

The **[QC and Op Codes]** screen under the **[Setup]** tab defines the field Op codes imported with the raw sampling data and the QC codes that indicate data quality. Op and QC codes should only be modified, changed or updated by the database administrator (DBA).

The severity of QC codes sets the priority for the DMS auto-QC checks and determines which QC code takes precedence when multiple QC codes are applicable. The severity of the DMS QC codes is determined as a combination of the valid data indicator and the numerical value of the QC code. The higher the QC code, within the Valid/Invalid QC code sets, the higher the severity.

Only one QC code is stored with each data point at a time. QC codes resulting from the DMS auto-QC process will overwrite any QC code assigned upon import (based on the QC code-Op code relationships). Likewise, a QC code applied to a data point during manual QC will overwrite any QC code applied previously. All changes made to the QC code assigned to a data point are recorded in the DMS chain of custody (COC) log.

Null and Qualifier Coding

Null data and qualifier codes can be applied to data in DMS to support data reporting to AQS. Null data codes are intended to provide a reason for missing or invalid data values. To apply a null code, a data record must have an invalid QC code assigned to a data value.

Qualifier codes are meant to be informative and act as flags to the data. They are descriptive and provide information such as quality assurance purposes, describe field issue (i.e. high winds) or may be used to request exclusion for the data being exported to EPA's AQS.

1. To begin null or qualifier coding, first select the data series (or multiple series) and data points to be assigned qualifier codes or null code under

your graph display window. Use the right-click command to access the graph menu and choose the **Null Data/Qualifier Codes** option, as shown in Figure 5.6 below.

NOTE: Null Data/Qualifier Codes option can only be selected when the full data table is shown (i.e. the Show Abbreviated Data option in the right-click graph menu is not checked). The Abbreviated Data mode is set to speed up the viewing of time-series, scatter, and wind/pollution rose plots. The abbreviated data set is used by default for time-series plots.

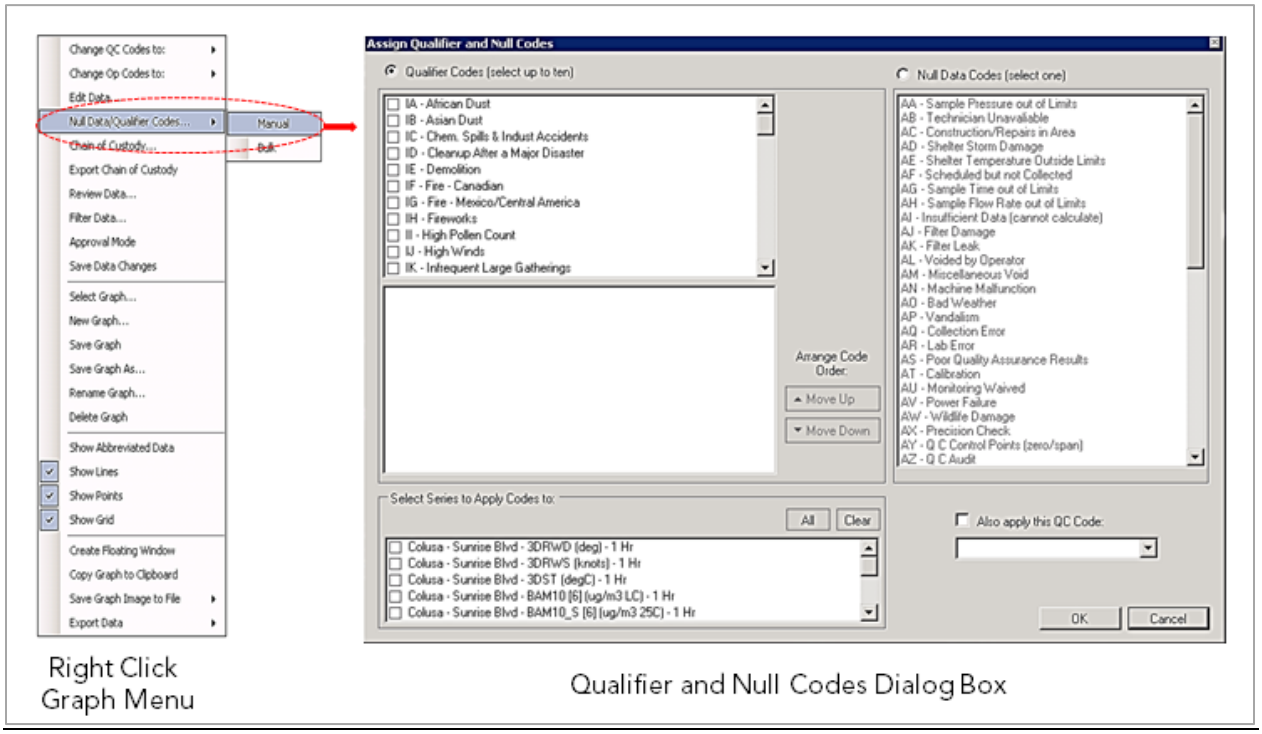


Figure 5.6. Getting to the Qualifier and Null Codes Dialog Box

2. Choose to assign either Qualifier Codes or a single Null Data Code by selecting the appropriate radio button dial at the top of the dialog box. Either a null data code or qualifier codes may be assigned, but not both.

    - Up to ten qualifier codes may be selected by clicking the desired code(s) in the list on the left side of the dialog box. The selected codes will appear in the box below the list; rearrange their order using the Move Up and Move Down buttons.

- Select the appropriate null data code in the list of options on the right side of the dialog box. Only one null code can be applied to a data value.

3. Users may apply a QC code by selecting one from the drop-down list at the bottom of the dialog box. By default, an invalid QC code must be applied when a null data code is assigned. According to the AQS Raw Data (RD) format, a null data code indicates an invalid data value.

4. Click the **OK** button to assign the selected qualifier codes or null data code.

NOTE: Qualifier and null data codes cannot be assigned to locked data or computed data (i.e. on-the-fly aggregates).

5. Once an edit is saved, DMS null code changes will be stored and create a chain of custody log. The COC saves the original and edited value, any changes to the Op/QC/Null codes, and reason for the edit. DMS then time and date stamps the entry and notes the user id of the person who performed the edit.

Bulk Null Coding

The Bulk Null Code function allows users to insert new null data records and apply Null Codes to multiple invalid data records at one time. This function relies on Null Code mapping to QC and Op Codes, which means default Null Codes can be set for each QC or OP code. The QC and Op Codes mapping has been set by CARBAQDMS Team.

The DMS Bulk Null Coding algorithm assigns Null Codes in the following three ways:

1. New missing data records are created and assigned the missing data Null Code. The default missing Null Code assigned by the CARBAQDMS team in DMS is the null code **(AI – Insufficient Data)**.

2. Invalid, unlocked hourly data records with no 1-minute data and no current Null Code assignment will be assigned the Null Code that is mapped to the invalid QC Code or Op Code for that data record **(AI – Insufficient Data)**.

3. Invalid, unlocked hourly data records with 1-minute data and no current Null Code assignment will be assigned the **most frequently occurring Null Code** mapped from the 1-minute data QC Codes or Op Codes.

For example, QC code 10 (auto calibration) is mapped to Null Code **(BD)** and QC Code 22 (maintenance/repair) is mapped to Null Code **(AN)**. If an hour with less than 45 minutes of valid data (30 minutes of valid data, 18 minutes of QC Code 10 data, and 12 minutes of QC Code 22 data), then the hourly value will be assigned with the null code **(BD)**, the most frequently occurring invalid QC code.

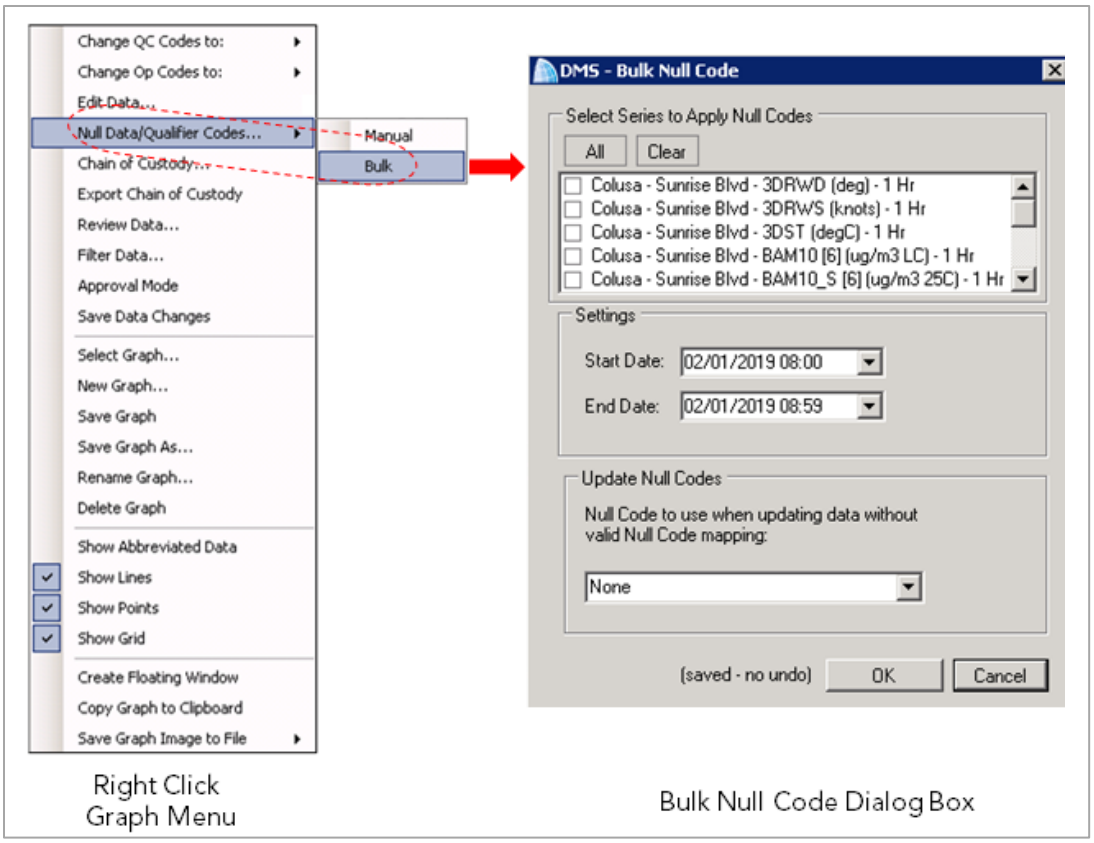


Figure 5.7. Getting to the Bulk Null Code Dialog Box

The Bulk Null Code function may be accessed through the right-click menu on the time-series graph. Show Abbreviated Data must be unselected in order to access this function:

From the Bulk Null Code dialog box, users select the data set(s) to which to apply the function, the date range, and the Null Code to use when there is no QC or Op Code mapping available. **Null Code mappings based on QC Code always take precedence over those based on Op Codes, if both exist for the same data record**. Event Log records are generated when this function is executed, logging the count of changed records. Individual data point changes are logged in the Chain of Custody.

NOTE: Null Codes can be removed by reapplying a valid QC Code.

Appendices C1-C5 in this document includes all the QC, Op, Null, and Qualifier Codes that are currently available in the DMS. Station operators and data reviewers should use good judgement when selecting the best combination of QC/Op/Null/Qualifier codes to best describe any conditions that may arise. Be aware that DMS runs routines that may automatically apply various QC and Op codes to the gaseous analyzer data for conditions such as high rates of change, insufficient data, or automated QC sequences. Appendix C5 lists some of the common QC/Op/Null code combinations that have been regularly used for different station operations.

5.7 Chain of Custody Review:

Any modifications made to the data are documented and retained in the DMS Chain of Custody (COC) table. Each data point that has undergone a change of value or been assigned a new QC or Op code has its own chain of custody (or history). A data point with a COC record is marked with a "C" in the data table.

The user may view the COC either by selecting the row(s) of data or data point(s) that have been modified, right-clicking the selection, and choosing **Chain of Custody**, or by double-clicking on the row of data selected in the tabular data view. Double-clicking to view the COC will only work if one row, or data point, is selected.

NOTE: Changes to data must be saved before the Chain of Custody window will open.

1. The Chain of Custody window (refer to Figure 5.8 below) contains two boxes (Chain of Custody box and Review box). The entries in the Chain of Custody box indicate:

    - QC check date and time
    - Name of the user who modified the data
    - Target site and parameter, instrument model, and data record date and time
    - New value, new QC code, and new Op code
    - Old value, old QC code, and old Op code
    - Comments (any notes added when the data changes were saved)
    - Automated QC check type, test site, parameter, and value

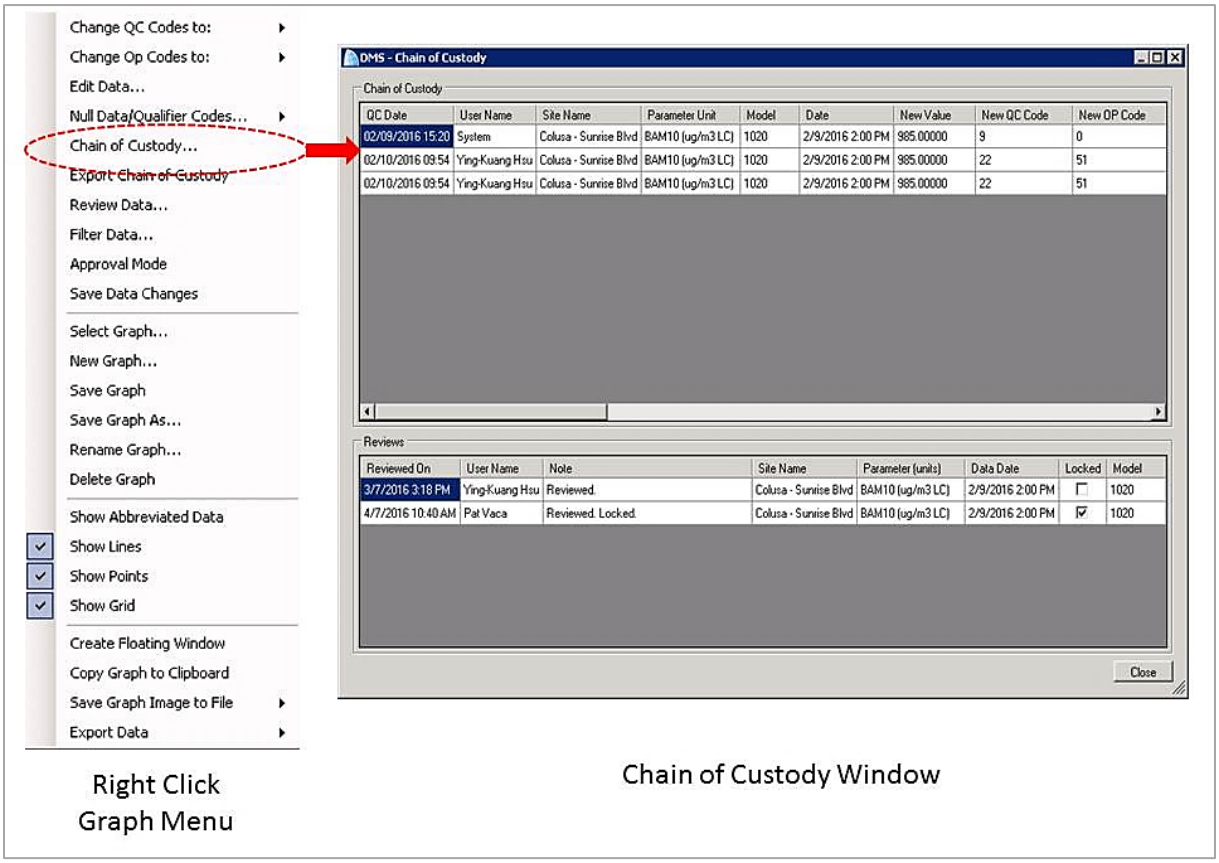


Figure 5.8. Getting to the Chain of Custody Window

2. Entries in the Reviews box indicate when the data were reviewed, who the reviewer was, and if the data are locked.

3. Users may right-click in either the Chain of Custody or Reviews boxes to export the contents in either tab-delimited or comma-separated value (CSV) format. Alternatively, the user can select **Export Chain of Custody** from the right-click graph menu.

5.8 Creating Other Plots (Scatter Plot & Wind Rose Diagram):

Scatterplots

Scatter plots are generally used to compare parameters from two sites or two parameters at the same site. Similar to time-series graphs, users can set up their own specific scatter plot templates. These templates will be saved in the user profile and will load upon log-in.

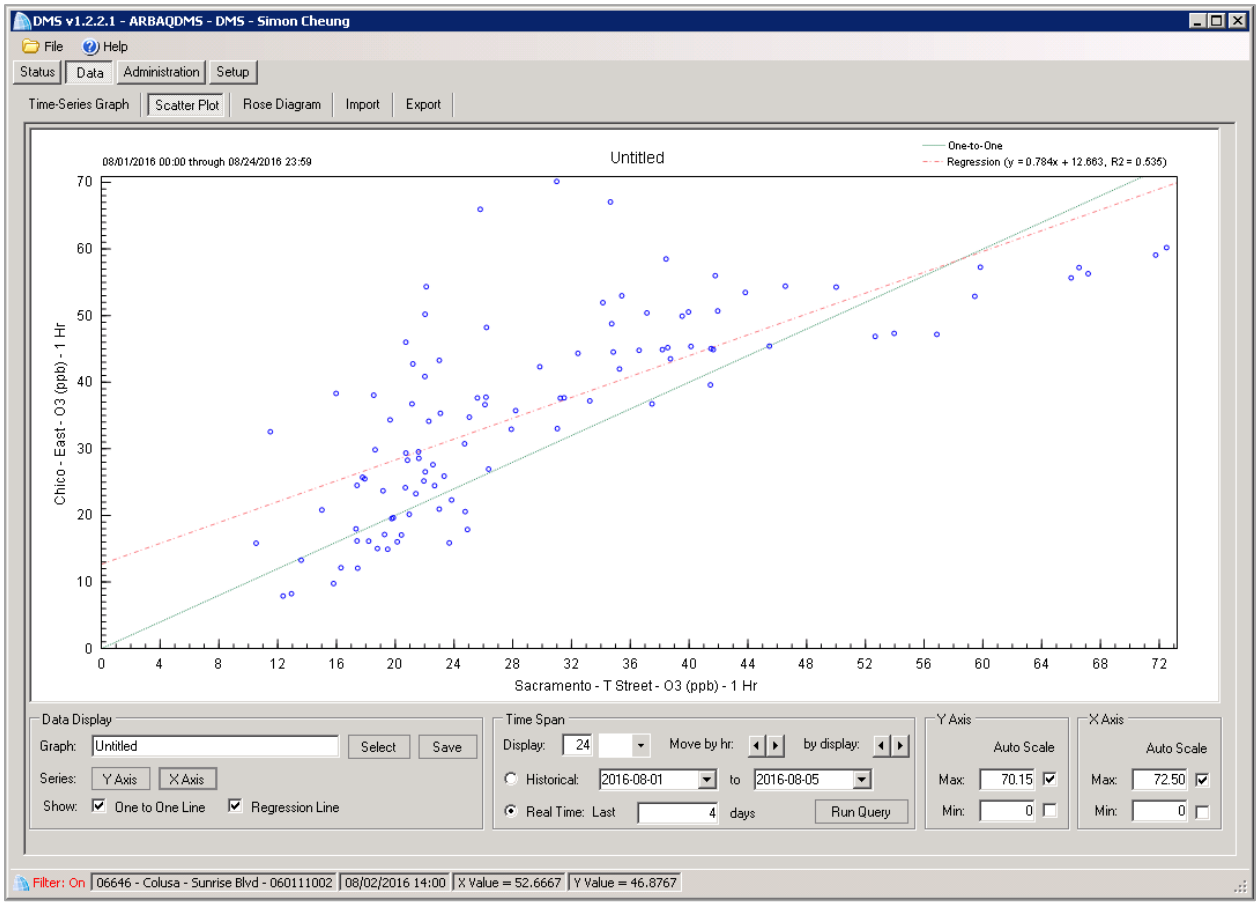


Figure 5.9. Sample Scatter Plot

Scatter Plot Setup and Appearance

1. To create a scatter plot, first go to the **[Scatter Plot]** screen under the **[Data]** menu. From the right-click graph menu, select **New Graph**. Give the graph a unique name and click **OK** to begin building your plot.

2. After naming the graph, the user will be prompted to select the data series to be plotted on the y-axis and then will be prompted again to choose the data series to be plotted on the x-axis. One site or parameter will be graphed per axis. The user may also change the series plotted on either axis by clicking the **Y Axis** button or the **X Axis** button in the Data Display area at the bottom of the screen. A new window will open with all the available sites and parameters.

    - Users must select the **data site**, **parameter**, and **duration**. Data under different durations can be selected for the x- and y-axes. However, only data with the same time stamps will be plotted, i.e., if one-minute CO

data are selected for one axis and hourly CO data are selected for the other axis, the hourly average CO value will be plotted against the first one-minute CO value in each hour.

- Data may also be aggregated to show other durations of interest; the underlying duration of the data is selected first, and then the aggregate of interest can be applied to the duration selected.

- Data series can be chosen by **Site** or by **Parameter** using the radio selection buttons at the top of the dialog. If a site is selected first, only the parameters available for that site will be shown; if a parameter is selected first, only the sites measuring that parameter will be shown. Sites are listed in order of site number, and parameters are listed in alphabetical order.

- Optionally, the sites list may be filtered by AQS Code, Agency Code, State, and/or Active status via drop-down menus in the Filter By box at the bottom of the window.

- After a site, parameter, and duration have been selected, click **OK**.

- Follow the same procedure to create a series for the other axis.

3. Similar to the time-series graph, users can modify scatter plot settings.

    - Axis scales can be changed by typing numbers into the **Max** and **Min** fields in the **Y Axis** and **X Axis** areas at the bottom-right of the screen.

    - The time axis is set differently depending on whether the real-time or historical data review settings are checked. Under historical review, the time axis (and the amount of data to query from the database) is controlled by entering the start and end dates. The real-time review setting was designed for routine QC of the most recent day's raw data. Under real-time review, the time axis is controlled by specifying the number of days to review, counting back in time from the current date.

    - Data shown on the graph can be filtered on the basis of either QC code or Op code by right-clicking and selecting **Filter Data** from the context menu. When data are filtered, an indicator is shown in the status bar at the bottom-left of the screen.

4. To save the graph with all the template settings, right-click and choose **Save Graph**, or click the **SAVE** button in the Data Display area in the bottom-left corner of the user interface, next to the name of the graph.

- When the Graph Name box is selected, a user can scroll up or click the up arrow key to switch to the prior graph, or scroll down or click the down arrow key to view the next graph. At any time when viewing the scatter plot, a user can press **Ctrl-Shift-Up Arrow** to view the prior graph or **Ctrl-Shift-Down Arrow** to view the next graph.

- Users may also choose a stored graph by clicking the **Select** button in the Display area at the bottom of the screen. Each individual user can view the plots created and saved by the system administrator or by the user.

- As in the Time-Series Graph screen, an un-editable floating graph can be made from the current scatter plot by selecting **Create Floating Window** from the right-click graph menu.

5. To save a graph as an image, right-click and choose **Save Graph Image to File**. Graphs can be saved in the following formats: GIF, BMP, PNG, and TIFF. Name the graph image file, specify location to save the graph, and click **OK**.

Rose diagrams

Wind rose diagrams can help users understand meteorological conditions (wind speed and direction) at monitoring stations and evaluate trends and temporal patterns at different scales. Wind roses display the frequency distribution of wind speed and direction at a particular site. Rose diagrams can also display the relationship between ambient air quality data and wind conditions.

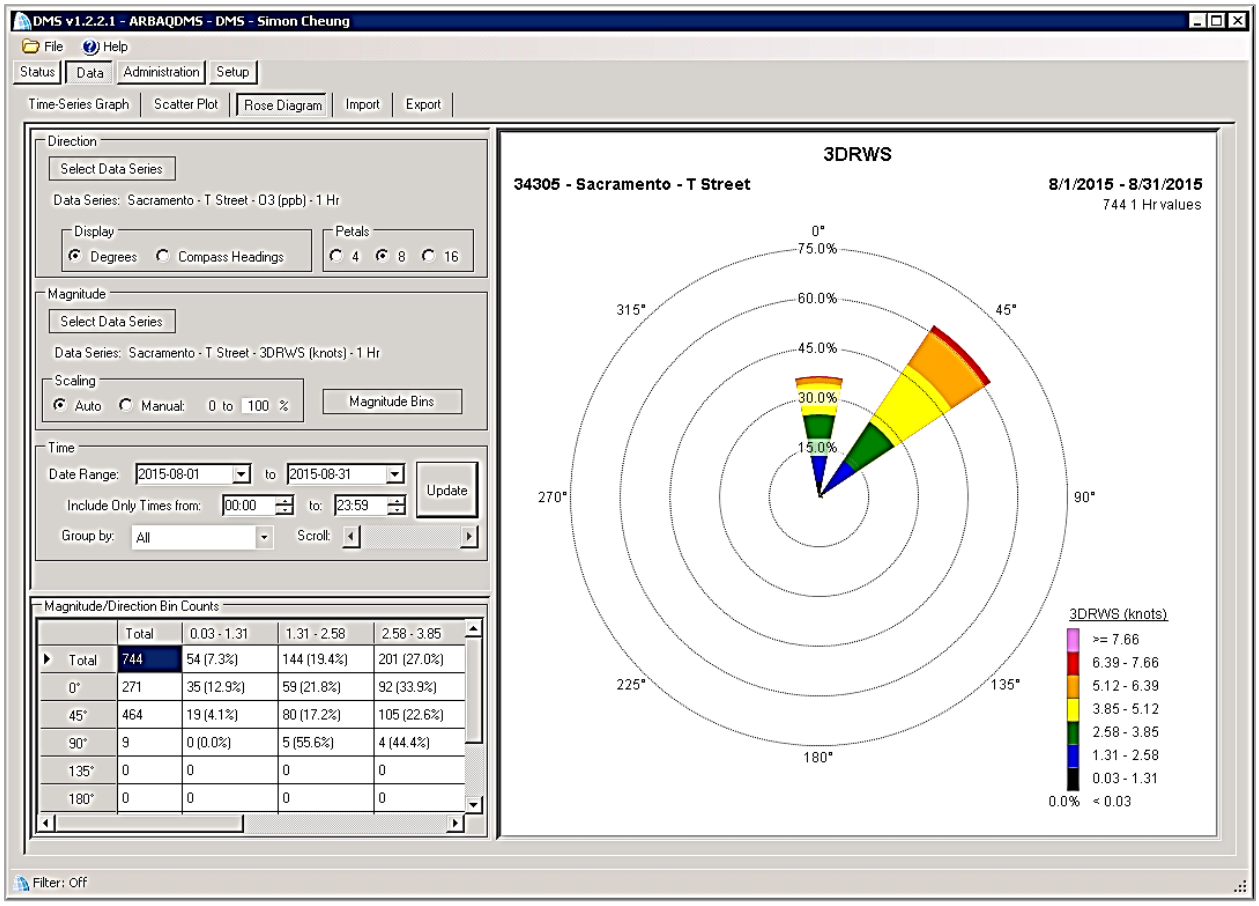


Figure 5.10. Sample Wind Rose Diagram

Rose Diagram Setup and Appearance

To set up rose diagrams, click the **[Rose Diagram]** screen under the **[Data]** tab. Unlike other DMS graph templates, rose diagram templates are not stored in the DMS database.

1. In the Direction box, click the **SELECT DATA SERIES** button to choose a **Site**, **Parameter**, **Duration**, and optionally **Aggregation** of the direction component to be displayed.

    - On the rose diagram, direction is displayed as a triangle, or "petal," that corresponds to the compass direction from which the wind originates (0-360 degrees). In the Petals box, specify the number of petals used to bin the dataset (4, 8, or 16). In the Display box, choose **Degrees** or **Compass Headings** to label the direction.

- The size of the petal indicates the frequency as a percentage of the winds from the queried dataset that originate from that range of directions.

2. In the Magnitude box, click the **SELECT DATA SERIES** button to choose the same **Site**, **Parameter**, **Duration**, and optionally **Aggregation** of the magnitude component to be displayed. Typically, the wind speed parameter is selected. Alternatively, an ambient air quality parameter may be chosen.

    - On the rose diagram, the magnitude component (wind speed or pollutant concentration) is displayed using magnitude bins that are assigned unique colors on the petal. Click the **MAGNITUDE BINS** button to open a new window from which users can choose to auto scale the magnitude bins or input preferred ranges. The range included in each bin and the color it is assigned are shown in the legend. To exclude calm winds, set the lowest magnitude bin greater than the calm wind threshold. The percent of data below the lowest magnitude bin is also indicated in the legend.

    - The frequency of wind speeds occurring in each magnitude bin is indicated as a percentage of the total dataset. Percentages are indicated as circular radial lines. The extent of the radius (maximum percent) to be shown can be specified in the Scaling box. Users may specify either **Auto** or **Manual** scale. If **Manual** is selected, users must provide a maximum percentage (the default is 100%).

3. In the Time box, specify the date range and times to be included on the rose diagram. Once direction, magnitude, and time period are selected, click the **UPDATE** button to display the rose diagram.

    - The Time box also provides several **Group By** options. The default is **All**, which displays all values in the queried time period on one diagram. Additional options (Day, WD/WE, Month, Year) divide the time period included in the diagram by the **Group By** selection. For example, if WD/WE is selected, the queried time period will be divided into values measured on a weekday (M-F) or weekend (Sat, Sun). Users may scroll through the two wind roses using the scroll bar in the Time box.

    - Magnitude is indicated as the title of the diagram. The site is displayed in the upper-left corner of the diagram space, and the date range and number of values are shown in the upper-right corner.

4. The Magnitude/Direction Bin Counts matrix is on the lower-left portion of the Rose Diagram screen. Except for the Total column, which shows total

sample counts for each direction bin, each cell in the table shows the number of samples that fall within the corresponding magnitude bin (wind speed or concentration) in the column headings and the corresponding wind direction in the row headings, as well as the percentage of samples in each magnitude bin for every direction.

5. Data shown on the graph can be filtered on the basis of either QC code or Op code by right-clicking and selecting **Filter Data** from the graph menu. When data are filtered, an indicator is shown in the left portion of the status bar at the bottom of the screen.

6. To save a diagram as an image, right-click and choose **Save Graph Image to File**. Graphs can be saved in the following formats: GIF, BMP, PNG, and TIFF. Name the graph image file, specify the location to save the graph, and click **OK**.

    - As is possible from the Time-Series Graph screen, an un-editable floating graph can be made of the current image shown on the Rose Diagram screen by selecting the **Create Floating Window** from the right-click Graph menu.

5.9 Importing Data (Back Poll or Re-send Data):

Back Poll Request

Should air quality data expected to be in DMS but is not found in DMS, and the missing data are still available in CARBLogger or in the instrument's memory, a backpoll request can be submitted to the CARBAQDMS email address to backfill the data gap.

Should data not back filled after the backpoll request, contact ODSS staff for updates. Typically, a back poll request requires ODSS staff to remotely connect to a site's CARBLogger and re-query specific instrument(s) in order to retrieve the missing data.

Currently, DMS supports both automated and manual data imports. There are five data file formats that are accepted by DMS: DMS Native, DMS Full Native, AirNow Air Quality Comma Separated Values (AQCSV), Air Quality System AQS raw data (RD), and Simple Incoming RD.

Automated Import

For automated data import, data files to be processed are placed in a network directory (i.e. ingest directory) accessible to the SQL Server Job. The directory

paths are defined on the **[System]** screen under the **[Setup]** tab. Files are processed as scheduled by the SQL Server Job. Only the DMS database administrator (DBA) can alter the schedule of the automated imports.

A data file with any extension (e.g., txt, csv, dat, min) can be placed in the DMS ingest directory. A DMS process will read and test the import file data for validity.

Data files must contain at least three lines of data and no more than two records in the file may contain formatting errors. The DMS deciphers the data format being processed by trial and error. Once the DMS fails to process three records due to formatting issues, the system attempts to process that same data file using an alternate data ingest format.

The DMS sends the data file to the Rejected Data directory (as specified in the **[System]** settings) once the DMS fails to read the file using the automated data ingest formats supported by the automated import process.

Manual Import (via Simple Data Format)

Note: Due to the complexity of the data structure in DMS, manual data imports should be generated and processed by ODSS staff only.

The DMS supports manual import of simple format data file (as shown in figure 5.12). Only the site, parameter, and Op code need to be assigned to the incoming simple format data for it to be imported. Sample simple data are shown below. The simple file format is tab delimited.

```
01/10/08    09:00:00    76.1
01/10/08    09:01:00    76.3
```

1. To manually import data into DMS, first go to the **[Data]-[Support]** screen.

2. Select the import file format; the default option is **AQS**. Change it to **Simple**.

3. Click the **Browse** button to identify the path of the data import file location.

4. Select the specific site, parameter, and Op code for the importing data.

5. Check the **Overwrite** and/or **Auto-QC** boxes depending on your need. Descriptions for each option are included in this section of SOP.

6. Click **Submit** to initiate the import.

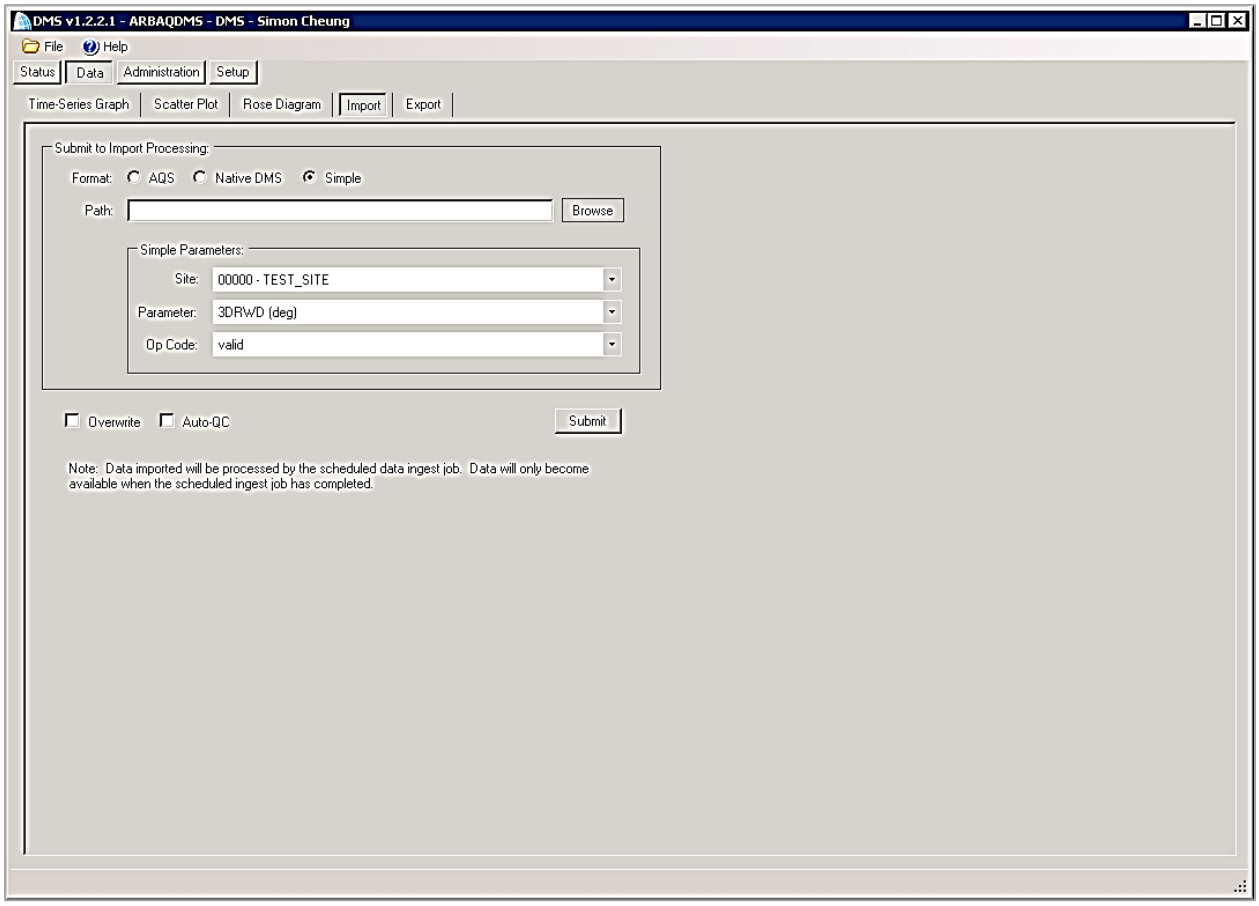


Figure 5.11. The Manual Data Import Screen

There are other import formats available, such as AQS raw data (RD) and Native DMS, however, the Simple data format is the simplest style with single site-parameter format and is recommended by ODSS.

If the **Overwrite** checkbox is selected, any data imported with an existing date-time stamp will overwrite the data already in the DMS for that site and parameter.

If the **Auto-QC** check box is selected, the imported data are subjected to all automated QC checks set up for that site and parameter.

Data are temporarily stored upon import in a table and processed according to the normal automatic data processing schedule designated by the DBA.

Note: Overwriting data during either automated or manual imports is recorded in the DMS Chain-of-Custody.

5.10 Creating an Export / Report:

The DMS **[Export]** screen under the **[Data]** tab is used to export DMS data for:

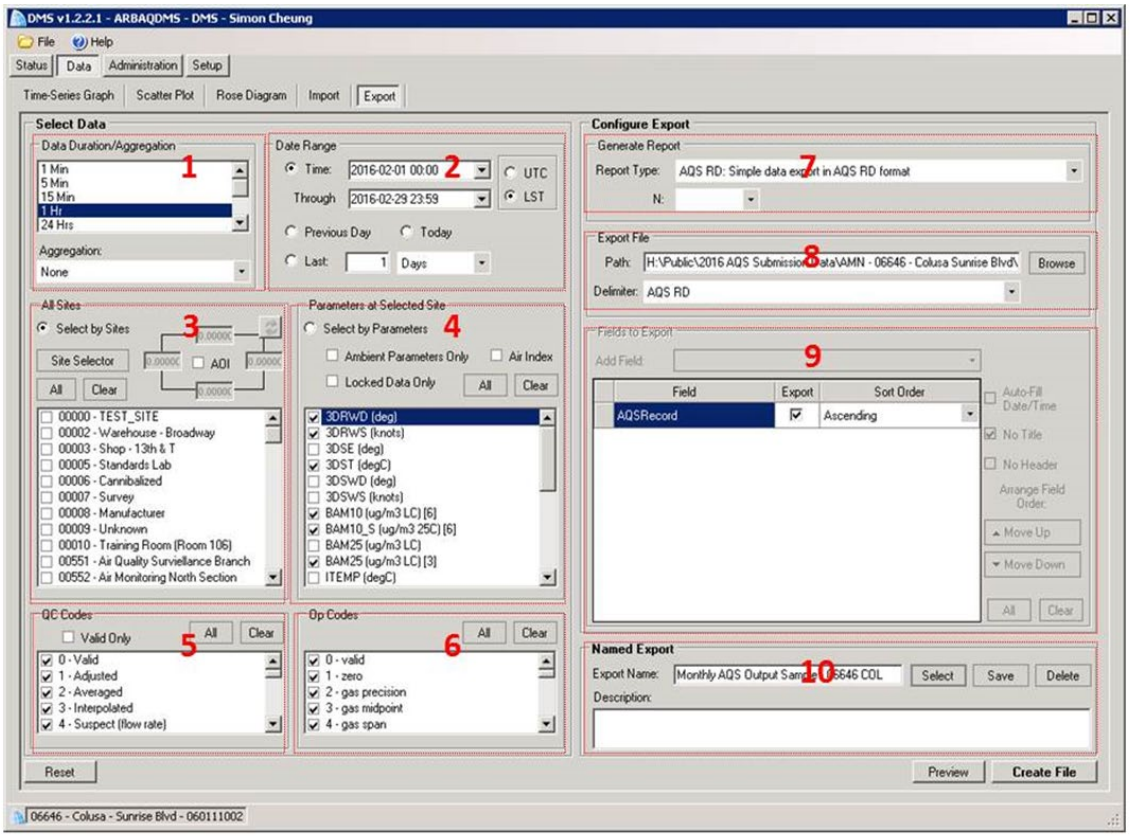
1) Performing data analysis in another application,
2) Running custom exports and reports
3) Creating AQS and AIRNow data submittal files.

The **[Export]** screen (Figure 5.13 below) is arranged in sequence to guide users through different options to filter the data and conclude with export of a data file. Initially, only the Select Data/Data Duration box is active; as more selections are made, additional portions of the screen will be activated.

To Select Data

1. In the **Data Duration** portion of the **Select Data** box, users must specify the data duration to be exported. Raw sub-hourly durations are available as well as aggregate durations, depending on the settings in the **[Parameters]** screen from the **[Administration]** tab. For example, if the Hourly field is activated in the Parameters table, then 1-hr averages will be available for export.

2. Once the **Data Duration** has been selected, the **Date Range** box will become active. Users then need to specify the time period (in either UTC or LST) of data to be exported. Optionally, users may select the 'Previous Day' or specify a desired quantity of prior hours or days in the box for the **Last** option.



Item #	Description	Item #	Description
1.	Data Duration	6.	Op Codes (for filtering)
2.	Date Range	7.	Configure Export (Report Type)
3.	Site Selection	8.	Export File Name & Format
4.	Parameter Selection	9.	Exported Fields & Ordering
5.	QC Codes (for filtering)	10.	Name of (Saved) Export & Description

Figure 5.12. The Export Configuration Screen

3. Users must specify the sites and parameters to be exported. Data can be selected based on sites or parameters by activating the appropriate Select by Sites or Select by Parameters button.

    a. If **Select by Sites** is chosen, select the sites to include by checking the appropriate boxes in the list of sites. Users may also click the Site Selector button to launch a window with filter options to aid in finding the sites of interest. Only parameters available at the selected sites will be shown in the parameters list.

b. If **Select by Parameters** is chosen, select the parameters to include; only sites at which these parameters are measured will be displayed in the sites list. The Ambient Parameters check box filters the parameters listed based on the settings in the [Parameters] screen on the [Administration] tab.

c. Any data available for the selected sites and parameters will be exported. The status bar at the bottom of the screen provides information about a single site-parameter pair when it is highlighted.

4. The data set to be exported can be filtered using the QC Codes and Op Codes boxes. By default, all codes are included. Select the Valid Only box to include only valid QC codes (valid codes are specified in the **[QC and Op Codes]** screen from the **[Setup]** tab). Optionally, check the appropriate boxes from the list of codes.

To Configure Export

Once the desired data set is selected, users must configure the export file. In the Export File box, specify the file path and file name, either by entering it manually or by clicking the **BROWSE** button and navigating to the data file to be exported.

1. Several file format options are available from the Format drop-down list. The standard formats include comma separated values (CSV), tab-delimited text, and pipe delimited (|).

2. Map, AQS, and AQCSV are specialty formats. The AQS format matches the raw data (RD) format used by EPA AQS. The AQCSV format is used for data submitted to AIRNow.

3. The **Fields to Export** box provides a list of fields available for export. It also explains the options on the **[Export]** screen by reviewing the data fields returned from different export combinations.

4. Available fields in the list are specific to the export file format and any selected report/metric combinations.

5. The fields exported can be limited by unchecking the box next to the field name.

6. The exported data records may be sorted using the options in the Sort Order column (ascending, descending, none).

7. The order of the fields can be rearranged by selecting a field from the list and using the Arrange Field Order options to move the field up or down.

The **Configure Export** box also contains an Auto-Fill Date/Time option that exports data with continuous time stamps even if data are missing. When applied, the record that is labeled missing will be supplied a null value. The Auto-Fill Date/Time option is checked by default for basic exports and is disabled for Reports; it will not return a record if the QC code violates the users' selections, such as if the Valid Only QC code option is selected.

Note: The configured export template can be saved for future use again. For details on how to save the export template, please continue reading this section "To Configure Named Export".

To Preview and Export File

1. Click the **PREVIEW** button to view the file-export results. The **Export Preview** dialog opens to show the data that will be returned based on the specified export settings.

2. Click **Create File** to export the specified data records.

To Generate Reports

Different report options are available for export depending on the selected data duration, aggregation type, and the metrics report type.

1. The Aggregation drop-down list provides different levels of aggregation based on the data duration chosen in the Select Data box: 1-hr, 3-hr, and 8-hr running average durations can be aggregated to a Daily value. Weekly, monthly, quarterly, or yearly aggregates can be calculated from the 24-hr data duration.

2. Selecting an Aggregation option without an associated metric provides the following default statistics: mean, peak, and standard deviation. For example, to export the daily maximum values, select 1 Hr in the Data Duration field and Daily in the Aggregation drop-down menu; then export the data to the file.

3. The same drop-down menu provides different options to create reports based on statistics such as the mean, minimum value, peak value, and standard deviation, etc.

4. The Report Type (Metrics) drop-down list specifies the type of report to be exported. Some common reports are described below.

5. The **N** box specifies a value threshold for data included in the report; the units of the N value differ by the metric selected. Examples are provided in the Metrics descriptions below.

Type of Summary (Metrics) Reports

The Generate Report Box with the Metrics report options allows user to view and export data in a specialized report format. Some commonly-used summary reports are described below; the fields included in each report are identified in the 'All fields available from DMS exports' table from the DMS user manual.

Table 5.2. Summary Reports available in DMS

Field	**Description**
Rank:	This report organizes data from maximum to minimum. If a Group By option is specified, the report provides the mean, peak, or standard deviation of the chosen data. The N value for the Rank report is the rank that will be provided in the report. All rankings are output when N is set to zero or is left blank.
Percentile:	This report shows where data values fall by percentile. The N value for the Percentile report is the percentile returned in the report. All percentiles are output when N is set to zero or is left blank.
Data Count:	This report shows all records within a set threshold value (N). The N value for the Data Count Report sets an upper limit for data to be reported based on the percent deviation. Only data not exceeding the N value are output in the report.
Calibration:	This report checks the accuracy of the instrument. The **[True Values]** table under the [Administration] tab is used for comparison. The N value for the Calibration report sets a lower limit for data to be reported based on the percentage deviation.

Field	Description
Data Capture:	This report shows data completeness for the expected date range. The N value for the Data Capture report sets an upper limit for data completeness to be returned in the report. Only data sets that are less complete than the N value will be output in the report.
COC Detail:	This report shows site/parameter history for the expected date range, including data value changes, QC and Op code changes, and results of the automated QC checks.
COC Summary:	This report shows site/parameter history for the expected date range, including data value changes, QC, and Op code changes summarized by users who made the change, the action taken, and the date changed.

To Configure Named Export

Export configurations can be saved for repeated use by creating a named export. Named exports are user specific; users can view and/or modify only the named exports they have created.

1. To save export settings, specify an Export Name in the Named Export box under the **[Export]** screen.

    - Optionally, provide a description of the export in the Description box. Click the **SAVE** button to save the named export.

2. To modify or delete a previously saved export, select the named export from the drop-down list in the Named Export box. Make any changes to the export settings and click the **SAVE** button to re-save, or the **DELETE** button to permanently delete the selected named export.

5.11 Exporting Monthly Precision Report:

Monthly Precision report checks the accuracy of the instrument by comparing measured values to the true values from the calibration cylinder specified in the True Values table in DMS. The report exports the measured value, true value, and percent deviation of the measured value from the true value.
Note: To aid users, ODSS has pre-built a system export (located in the Named Export section of the **[Export]** screen) to provide users a template of Monthly Precision report. Users may edit the template and save the modified export settings to its own DMS account.

The following steps are used to generate the Monthly Precision report from scratch for a typical site. For demonstration, only one ozone parameter will be selected. For more parameters, simply check and select additional parameter boxes from the parameters selection box.

1. Go to the **[Data]-[Export]** screen, under the **Data Duration / Aggregation** box, select the **1 Min** option from the list. Leave the Aggregation box blank.

2. In the **Date Range** box, select the date and time range for the report period, typically the start and end of a month.

3. Under the **Select by Sites** box, pick a site for your report. In the example shown, Chico-East (04625) was selected.

4. In the **Parameters** selection box, select a parameter associated from the instrument of interest for the true values comparison. In this case, the **O3 (ppb)** was selected.

5. On the right side of the screen, under the **Generate Report** box, select **Calibration (N): % Difference from True** from the dropdown list box. You may leave the N field blank. The N value for the Calibration report is used to set a lower limit for data to be reported based on the percent deviation.

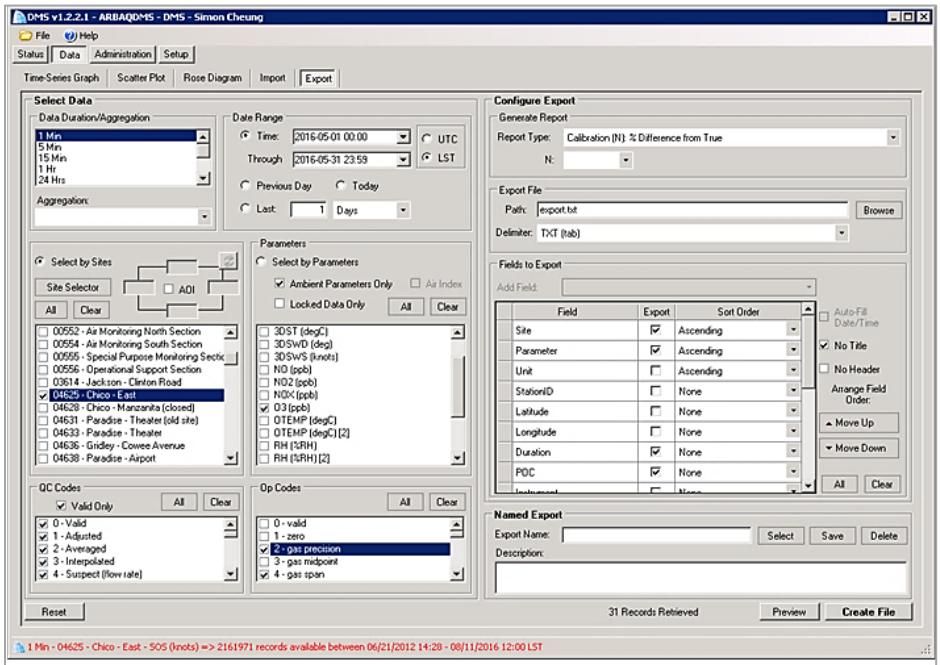
6. In the **Export File** box, you may specify the file save location, or leave it as default. Note that the default report location is typically located in the local DMS program folder. For the delimiter type, leave as default selection **TXT (Tab)**, as it will create a tab delimited txt export file.

7. Back to the **QC Codes** area, select the **Valid Only** check box. And then in the **Op Codes** area, select **ALL the Gas Precision and/or Gas Span options** from the list.

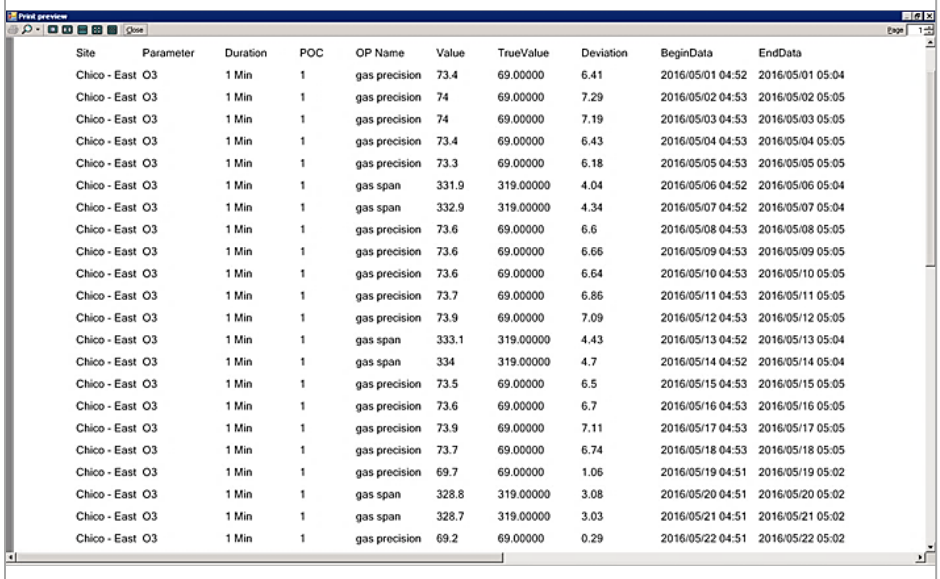
8. In the **Fields to Export** box, user may want to deselect some of the fields from the displayed report, since all fields are selected by default. For a precise report, besides the site / parameter / date columns, it should include the calibration type, the averaged calibration value, the true value, and the percent deviation value.

9. To preview the report, click the **PREVIEW** button; to save the report, click the **CREATE FILE** button; to store the export setting, enter an export name and then click the **SAVE** button in the **Named Export** area from the bottom of the screen.

Historically, the acceptable range of percent deviation is within 10% of the true value. If that limit is exceeded, the data reviewer will need to examine and invalidate those exceedances from the calibration data for the reported instrument.



a) Report Setup in [Export] Screen



Site	Parameter	Duration	POC	OP Name	Value	TrueValue	Deviation	BeginData	EndData
Chico - East	O3	1 Min	1	gas precision	73.4	69.00000	6.41	2016/05/01 04:52	2016/05/01 05:04
Chico - East	O3	1 Min	1	gas precision	74	69.00000	7.29	2016/05/02 04:53	2016/05/02 05:05
Chico - East	O3	1 Min	1	gas precision	74	69.00000	7.19	2016/05/03 04:53	2016/05/03 05:05
Chico - East	O3	1 Min	1	gas precision	73.4	69.00000	6.43	2016/05/04 04:53	2016/05/04 05:05
Chico - East	O3	1 Min	1	gas precision	73.3	69.00000	6.18	2016/05/05 04:53	2016/05/05 05:05
Chico - East	O3	1 Min	1	gas span	331.9	319.00000	4.04	2016/05/06 04:52	2016/05/06 05:04
Chico - East	O3	1 Min	1	gas span	332.9	319.00000	4.34	2016/05/07 04:52	2016/05/07 05:04
Chico - East	O3	1 Min	1	gas precision	73.6	69.00000	6.6	2016/05/08 04:53	2016/05/08 05:05
Chico - East	O3	1 Min	1	gas precision	73.6	69.00000	6.66	2016/05/09 04:53	2016/05/09 05:05
Chico - East	O3	1 Min	1	gas precision	73.6	69.00000	6.64	2016/05/10 04:53	2016/05/10 05:05
Chico - East	O3	1 Min	1	gas precision	73.7	69.00000	6.86	2016/05/11 04:53	2016/05/11 05:05
Chico - East	O3	1 Min	1	gas precision	73.9	69.00000	7.09	2016/05/12 04:53	2016/05/12 05:05
Chico - East	O3	1 Min	1	gas span	333.1	319.00000	4.43	2016/05/13 04:52	2016/05/13 05:04
Chico - East	O3	1 Min	1	gas span	334	319.00000	4.7	2016/05/14 04:52	2016/05/14 05:04
Chico - East	O3	1 Min	1	gas precision	73.5	69.00000	6.5	2016/05/15 04:53	2016/05/15 05:05
Chico - East	O3	1 Min	1	gas precision	73.6	69.00000	6.7	2016/05/16 04:53	2016/05/16 05:05
Chico - East	O3	1 Min	1	gas precision	73.9	69.00000	7.11	2016/05/17 04:53	2016/05/17 05:05
Chico - East	O3	1 Min	1	gas precision	73.7	69.00000	6.74	2016/05/18 04:53	2016/05/18 05:05
Chico - East	O3	1 Min	1	gas precision	69.7	69.00000	1.06	2016/05/19 04:51	2016/05/19 05:02
Chico - East	O3	1 Min	1	gas span	328.8	319.00000	3.08	2016/05/20 04:51	2016/05/20 05:02
Chico - East	O3	1 Min	1	gas span	328.7	319.00000	3.03	2016/05/21 04:51	2016/05/21 05:02
Chico - East	O3	1 Min	1	gas precision	69.2	69.00000	0.29	2016/05/22 04:51	2016/05/22 05:02

b) Sample of Monthly Precision Report

Figure 5.13. Setup and Preview of Monthly Precision Report

5.12 Exporting Percent Data Capture Report:

The Percent Data Capture report shows data completeness for the expected date range. The report exports the number of records, expected records, and percent of data capture for selected parameters at a site for a given date range.

The following steps are used to create and export the percent data capture report following the previous example in section 5.11. This time multiple parameters are selected to be included into the report.

1. Go to the **[Data]-[Export]** screen, under the **Data Duration / Aggregation** box, select the **1 Hr** option from the list. Leave the Aggregation box blank.

2. In the **Date Range** box, select the date and time range for the report period; note that a data capture report is typically on a monthly basis.

3. Under the **Select by Sites** box, pick a site for your report. In the example shown, Chico-East (04625) was selected.

4. In the **Parameters** selection box, select the parameters monitored at the site. In this case, the **MET, BAM10, BAM25, TCO, NO2, and O3** are selected. Make sure to select parameters with the correct POC number. Check with the **[Select Parameters]** section from this document if you need help to locate the correct POC number for the parameters.

5. On the right side of the screen, under the **Generate Report** box, select **Data Capture (N): % and record count** from the dropdown list box. You may leave the N field blank.

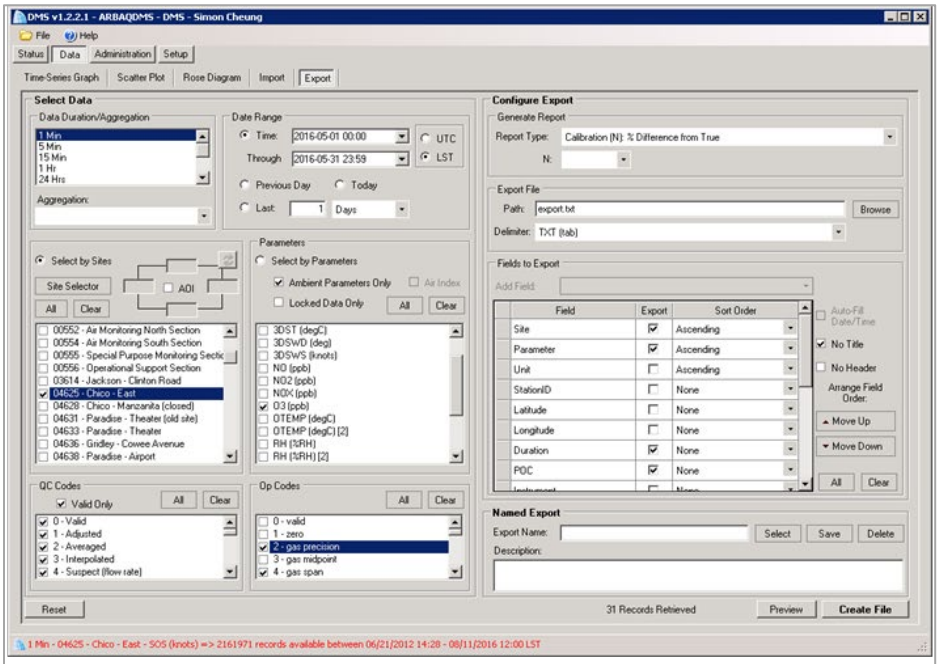
6. In the **Export File** box, you may specify the file save location, or leave it as default. Note that the default report location is typically located in the local DMS program folder. For the delimiter type, leave as default selection **TXT (Tab)**, as it will create a tab delimited txt export file.

7. Back at the **QC Codes** area, select the **Valid Only** check box. And then in the **Op Codes** area, click the **ALL** button to select **all the Op options** from the list.

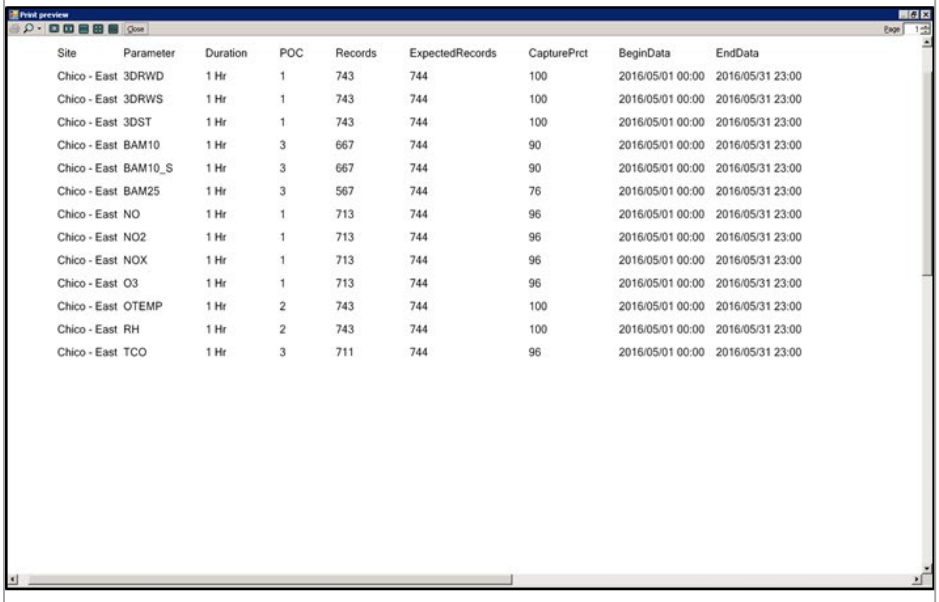
8. In the **Fields to Export** box, users may want to deselect some of the fields from the displayed list, since all fields are selected by default. In this case, we have selected the site / parameter / date combinations, plus the records, the expected records, and the capture percent.

9. Users may now choose to preview the report by clicking the **PREVIEW**

button; to save the report by clicking the **CREATE FILE** button; or to store this export setting into a named export by entering an export name and clicking the **SAVE** button in the **Named Export** area on the bottom of the screen.



a) Report Setup in [Export] Screen



b) Preview of Percent Data Capture Report

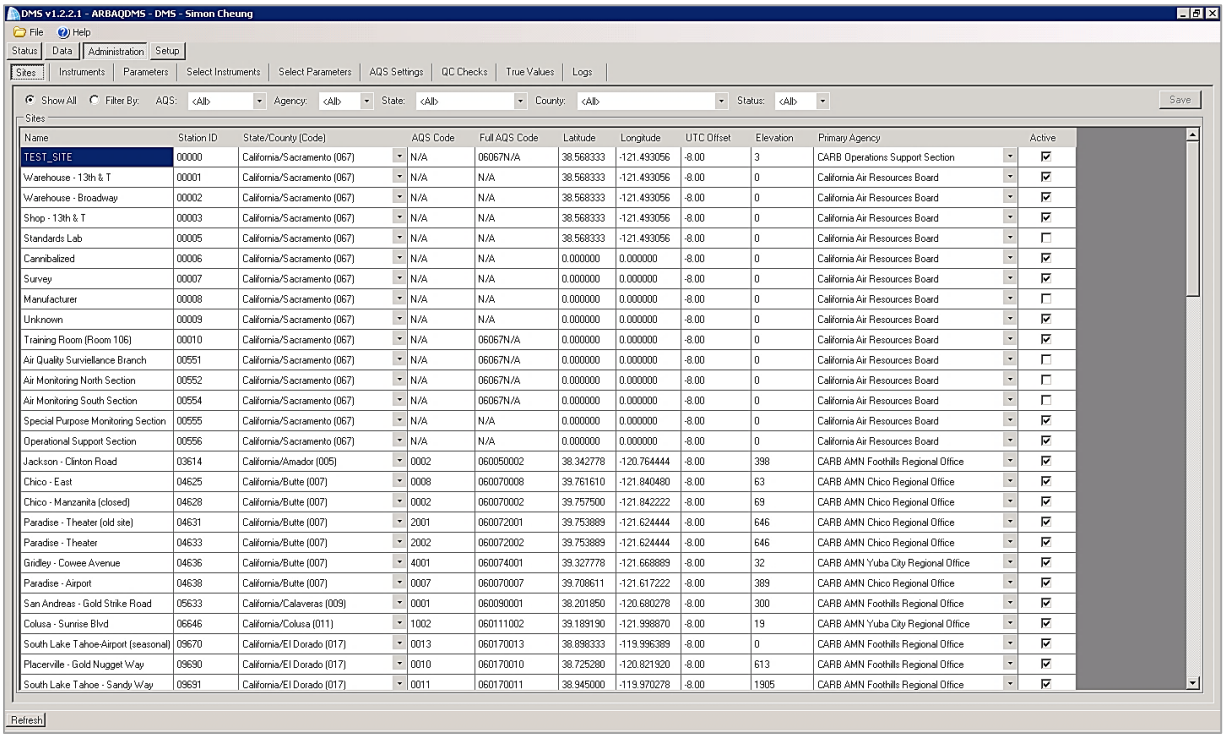
Figure 5.14. Setup and Preview of Percent Data Capture Report

5.13 Setting up a Site / Instrument / Parameter:

Note: Due to the complexity and standardization of operations, it is recommended that entries to DMS's Site, Instrument, or Parameter tables be handled by DMS administrator only. **If users need to update or add settings to the site, instrument or parameter tables in DMS, please contact CARBAQDMS for assistance.**

Note: Only an overview of these setup tasks will be covered in here.

The monitoring network information must be set up within the DMS prior to data import. Any site-parameter combination encountered during import that is not recognized by the DMS will be dropped, and an entry will be placed in the event log indicating the missing site and parameter.



Name	Station ID	State/County (Code)	AQS Code	Full AQS Code	Latitude	Longitude	UTC Offset	Elevation	Primary Agency	Active
TEST_SITE	00000	California/Sacramento (067)	N/A	06067N/A	38.568333	-121.493056	-8.00	3	CARB Operations Support Section	☑
Warehouse - 13th & T	00001	California/Sacramento (067)	N/A	N/A	38.568333	-121.493056	-8.00	0	California Air Resources Board	☑
Warehouse - Broadway	00002	California/Sacramento (067)	N/A	N/A	38.568333	-121.493056	-8.00	0	California Air Resources Board	☑
Shop - 13th & T	00003	California/Sacramento (067)	N/A	N/A	38.568333	-121.493056	-8.00	0	California Air Resources Board	☑
Standards Lab	00005	California/Sacramento (067)	N/A	N/A	38.568333	-121.493056	-8.00	0	California Air Resources Board	☐
Cannibalized	00006	California/Sacramento (067)	N/A	N/A	0.000000	0.000000	-8.00	0	California Air Resources Board	☑
Survey	00007	California/Sacramento (067)	N/A	N/A	0.000000	0.000000	-8.00	0	California Air Resources Board	☑
Manufacturer	00008	California/Sacramento (067)	N/A	N/A	0.000000	0.000000	-8.00	0	California Air Resources Board	☐
Unknown	00009	California/Sacramento (067)	N/A	N/A	0.000000	0.000000	-8.00	0	California Air Resources Board	☑
Training Room (Room 106)	00010	California/Sacramento (067)	N/A	06067N/A	0.000000	0.000000	-8.00	0	California Air Resources Board	☑
Air Quality Surviellance Branch	00551	California/Sacramento (067)	N/A	06067N/A	0.000000	0.000000	-8.00	0	California Air Resources Board	☐
Air Monitoring North Section	00552	California/Sacramento (067)	N/A	06067N/A	0.000000	0.000000	-8.00	0	California Air Resources Board	☐
Air Monitoring South Section	00554	California/Sacramento (067)	N/A	06067N/A	0.000000	0.000000	-8.00	0	California Air Resources Board	☐
Special Purpose Monitoring Section	00555	California/Sacramento (067)	N/A	N/A	0.000000	0.000000	-8.00	0	California Air Resources Board	☑
Operational Support Section	00556	California/Sacramento (067)	N/A	N/A	0.000000	0.000000	-8.00	0	California Air Resources Board	☑
Jackson - Clinton Road	03614	California/Amador (005)	0002	060050002	38.342778	-120.764444	-8.00	398	CARB AMN Foothills Regional Office	☑
Chico - East	04625	California/Butte (007)	0008	060070008	39.761610	-121.840480	-8.00	63	CARB AMN Chico Regional Office	☑
Chico - Manzanita (closed)	04628	California/Butte (007)	0002	060070002	39.757500	-121.842222	-8.00	69	CARB AMN Chico Regional Office	☑
Paradise - Theater (old site)	04631	California/Butte (007)	2001	060072001	39.753889	-121.624444	-8.00	646	CARB AMN Chico Regional Office	☑
Paradise - Theater	04633	California/Butte (007)	2002	060072002	39.753889	-121.624444	-8.00	646	CARB AMN Chico Regional Office	☑
Gridley - Cowee Avenue	04636	California/Butte (007)	4001	060074001	39.327778	-121.668889	-8.00	32	CARB AMN Yuba City Regional Office	☑
Paradise - Airport	04638	California/Butte (007)	0007	060070007	39.708611	-121.617222	-8.00	389	CARB AMN Chico Regional Office	☑
San Andreas - Gold Strike Road	05633	California/Calaveras (009)	0001	060090001	38.201850	-120.680278	-8.00	300	CARB AMN Foothills Regional Office	☑
Colusa - Sunrise Blvd	06646	California/Colusa (011)	1002	060111002	39.189190	-121.998870	-8.00	19	CARB AMN Yuba City Regional Office	☑
South Lake Tahoe-Airport (seasonal)	09670	California/El Dorado (017)	0013	060170013	38.898333	-119.996389	-8.00	0	CARB AMN Foothills Regional Office	☑
Placerville - Gold Nugget Way	09690	California/El Dorado (017)	0010	060170010	38.725280	-120.821920	-8.00	613	CARB AMN Foothills Regional Office	☑
South Lake Tahoe - Sandy Way	09691	California/El Dorado (017)	0011	060170011	38.945000	-119.970278	-8.00	1905	CARB AMN Foothills Regional Office	☑

Figure 5.15. The Sites Setup Screen

Setting up a new site in DMS:

To check an existing monitoring site, go to the **[Sites]** screen under the **[Administration]** tab. All existing sites in the network will be listed. The filter bar above the site list allows users to filter down the list by **Air Quality System (AQS) code**, **Agency**, **State**, **County**, and/or **Status**.

To add a new site in DMS, users will need the name of the site, station ID, state/county code, AQS site ID, the site's coordinates, elevation, UTC time offset, the agency name, and the site activity status. Scroll to the bottom of the table and fill out all fields on the blank row to save the new site information. The site info needs to be configured properly in order for data to be imported into DMS correctly.

Setting up a new instrument in DMS:

To add a new instrument in DMS, go to the **[Instruments]** screen under the **[Administration]** tab. The radio buttons on the top allow all instruments in the network to be listed (**Show All**) or only instruments assigned to a specific site (**Filter by Site**).

To enter a new instrument into DMS, users will follow the same steps as described in setting up a new site. Enter the instrument information to the blank row at the end of the instrument list. Users will need to provide the instrument number, name, status, model, class, manufacturer, serial number, duration/frequency, purchase and decommission dates, and the instrument activity status.

Note: Each instrument must be assigned a site, instrument number, duration, frequency, and activity settings.

Setting up a new parameter in DMS:

To add new parameters into DMS, go to the **[Parameters]** screen under the **[Administration]** tab. All existing parameters in the network that are supported by DMS will be listed in the first column of the **[Parameters]** table.

Note: Units must be present in the **[Units]** screen under the **[Administration]** tab before they can be selected in the Units column of the **[Parameters]** screen.

Note: DMS requires users to provide data in all the fields of a new parameter in the parameter table.

To enter a new parameter, users will need to follow the same steps as previously described for new site / instrument setup. Scroll to the blank row at the bottom of the **[Parameters]** table and enter the parameter info to the available fields on the table. Users will need to provide the parameter name, ingest code, AQS ID, units, decimal places, Auto-QC status, aggregation type, hourly % complete, sub-hourly average and completion rate, and sub-hourly data retention rate, etc.

5.14 Select Instrument (Moving an Instrument):

It is important to understand that instrument tracking is critical in our network operation. When a site operator is to replace or relocate an instrument, the change shall be tracked in DMS as well. This means the site operator will need to update the instrument status in DMS whenever he/she is to make changes to the monitoring instruments at their sites.

To assign an existing instrument to an existing site, go to the **[Select Instruments]** screen under the **[Administration]** tab. DMS will log each movement of an instrument from site to site; the log comment is stored with the instrument being moved.

Figure 5.16 displays the **[Select Instruments]** screen. There are two tables on this screen: Instruments at This Site and Instruments at Other Sites.

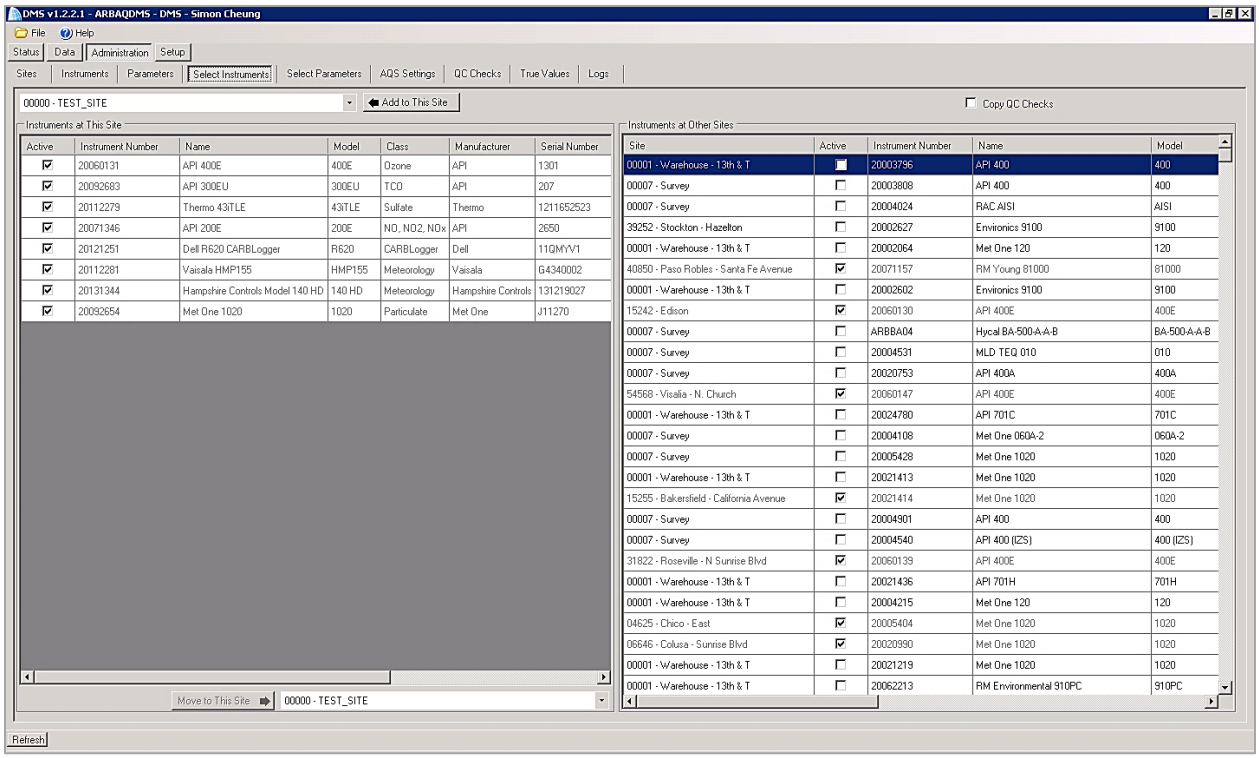


Figure 5.16. The Select Instruments Screen

To assign an instrument to a site, follow these steps:

1. Use the drop-down menu at the top of the screen to select the monitoring site the instrument will be added to. The instruments currently at this site will appear in the Instruments at This Site table.

2. Find the instrument to be added in the Instruments at Other Sites table on the right side of the screen. Click the row of the instrument and then click the **ADD TO THIS SITE** button at the top of the screen. Several rules apply to the movement of instruments. Only instruments in the Instruments at Other Sites table that do not violate these rules can be moved. The other instruments will be deactivated in the table. The **Can Be Added** column in the **Instruments at Other Site**s table (this column is not shown in the screenshot above, but can be accessed by scrolling to the right in the **Instruments at Other Sites** table) will say "True" if an instrument can be moved to a different site.

   The instrument must be inactive before it can be moved. Uncheck the **Active** box to inactivate the particular instrument from this screen. The instrument can also be marked inactive if the site at which the instrument is located is inactive on the **[Sites]** screen or if the instrument is inactive on the **[Instruments]** screen.

   Moving the instrument cannot result in a duplicate parameter at the new site, for instance, moving a collocated unit to the same site already having a primary unit. If the parameter assigned to the new instrument being moved is already assigned to the existing instrument at the site, the new instrument and its parameter must be given a different Parameter Occurrence Code (POC). The POC is either provided with the data via AQS ingests or is assigned in the **[Select Parameters]** screen from the **[Administration]** tab.

3. To move an instrument from the **Instruments at This Site** table to another site, click once on the instrument's row in the **Instruments at This Site** table and use the drop-down menu on the bottom of the screen to choose the site to which the instrument will be moved. Then click the **MOVE TO THIS SITE** button next to the site that was just designated.

4. To copy all the previously used QC checks for that particular parameter just assigned to the instrument, check the **Copy QC Checks** box on the top right corner of the screen before moving the instrument.

Note: When an instrument is moved on the **[Select Instruments]** screen, all parameters associated with that particular instrument will be moved from the old site to the new site as well.

5.15 Select Parameter (Setting a Parameter):

To add a parameter to an existing instrument, go to the **[Select Parameters]** screen under the **[Administration]** tab. Each parameter under a given POC may be assigned to one active instrument at each site. If a site has a collocated instrument measuring the same parameter, a second parameter with a unique parameter name and ingest code may be added to the parameter list to support DMS ingests. Collocated parameter data can be exported using the same AQS parameter code. Alternatively, if data are ingested in AQS format, the **[Select Parameters]** screen will show the different POCs for the duplicate parameters.

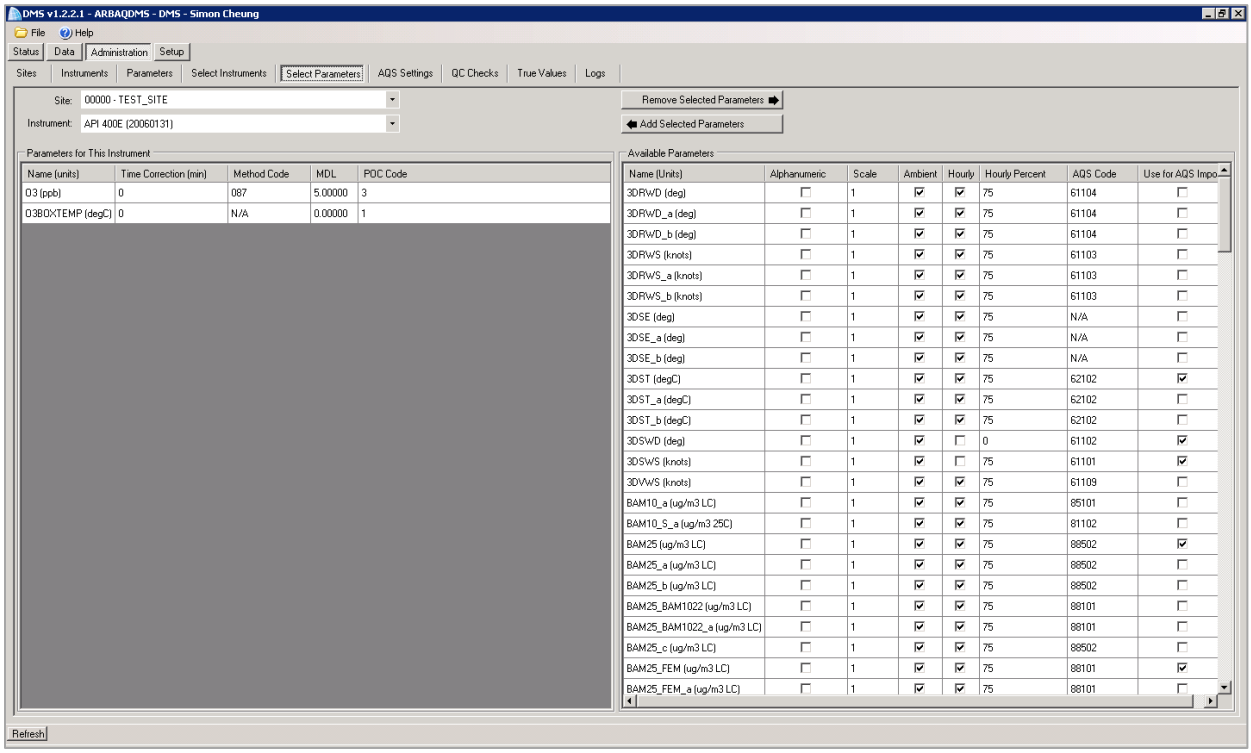


Figure 5.17. The Select Parameters Screen

To add a parameter to an instrument:

1. Use the **Site** drop-down menu at the top of the screen to select the site of the instrument to which parameters are being added.

2. Select an instrument from the **Instrument** drop-down menu. Only instruments that have been assigned to the selected site will appear on the

list. If the desired instrument is not displayed, follow the instruction in the **Instruments and/or Select Instrument** portions from this SOP to set up a new instrument first.

3. Once the site and instrument are selected, the **Parameters for this Instrument** table on the left side of the screen will display all the parameters currently assigned to the chosen site and instrument, as well as the attributes of those parameters. The parameter attributes can be edited and will be automatically saved in the **Parameters for This Instrument** table.

    - The **Time Correction** field is a site- and parameter-specific time correction in minutes that is applied automatically to data imported. Acceptable values range from -32,768 to 32,767. The time correction is applied to the **Date/Time** field for that data point before insertion into the database, as well as to all data imported manually or automatically in the DMS Native, DMS Full Native, and simple import data formats. Time corrections are applied to the hourly date/time prior to the truncation of minutes. The correction is not applied when importing AQS-formatted data records. These DMS import formats are discussed further in the Data Import section of this user's guide.

    - The DMS **Time Correction** setting allows the data import procedure to adjust the date/time record to account for time delays in the measurement and data-collection process. For example, many analyzers and/or data acquisition systems measure pollutant data for some period of time and then report the average value at the end of that interval. Consequently, the value is identified with the ending time of the averaging interval (or later) in the data record. The DMS time correction allows data managers to shift the time stamp back to the beginning of the averaging interval. This is in keeping with standard practice in many environmental databases.

    - **Method Code** indicates the EPA monitoring method code used for reporting data to the AQS.

    - **MDL** stands for Method Detection Limit and is used for reporting data to the AQS. It is specific to the monitoring method and unit of a particular parameter. AQSB uses the Federal MDL as stated in the EPA AQS code list (AQS Code List) for reporting MDL values.

    - **POC Code** is the EPA AQS Parameter Occurrence Code. The POC Code should be consistent with the EPA AQS data-coding manual when used to report data to the AQS.

4. Choose a parameter to add to the selected instrument by clicking the row in the **Available Parameters** table on the right side of the screen. To select multiple parameters at once, hold the Shift key while selecting two rows to select all rows between the two selections or hold the Ctrl key while selecting multiple rows to select noncontiguous rows.

5. Click the **ADD SELECTED PARAMETERS** button to add the selected parameters to the **Parameters for This Instrument** table.

6. To remove parameters from a specific instrument at a site, select the site from the **Site** drop-down menu. On the **Instrumen**t drop-down menu, select the instrument that has the parameter to be removed. Only instruments available at the selected site will be listed on this menu. Select the entire row or rows of parameters to be removed and follow the instructions above. Click the **REMOVE SELECTED PARAMETERS** button to remove these parameters from the selected site and instrument.

5.16 Setting up Auto QC Checks:

To improve the efficiency of data validation and to ensure that the best possible real-time data are reported to stakeholders, DMS utilizes automated quality control checks (Auto QC Checks).

Note: Auto QC checks should be managed and updated by ODSS staff only. Please do not attempt to change the assigned QC checks for your instruments and parameters without contacting CARBAQDMS first.

Note: Auto QC checks are created to aid but not replace the manual data review and editing processes.

DMS automated QC checks operate on hourly data after they are aggregated from incoming minute data. Currently, the U.S. EPA AIRNow system (operating a version of DMS) uses automated QC checks on incoming data for sites throughout the nation.

CARB's DMS system uses similar automated QC criteria as AirNow. Auto QC Checks do not alter hourly data values, and would only change the data points corresponding QC code. All changes made to a data points QC code are recorded in the DMS chain of custody (COC).

Appendix D1 shows a consolidated view of the automated QC criteria implemented by the AQSB. Should the parameters listed meet the corresponding QC criteria; DMS will perform the following automated QC checks:

- Max suspect and max severe checks apply a QC code of 5 (suspect) or 9 (invalid) respectively, when the hourly value exceeds the set limit.

- Rate of change check applies a QC code of 5 (suspect) if the difference between the previous hour and the current hour exceeds the rate of change value.

- Sticking check applies a QC code of 5 (suspect) to data that are the same value for the number of hours specified in the (# of sticking hours) column. The sticking check does not apply to hourly values below the sticking (low value).

- Minimum range check uses the Federal Minimum Detection Limit (Fed MDL) column value to flag hourly values below the negative of the Fed MDL.

In addition, Auto QC Checks have been implemented using diagnostic BAM data. The BAM Q_{tot} (total volume sampled in m^3) value is being screened to automatically validate its corresponding BAM PM Concentration data value.

BAM data outside of the acceptable Q_{tot} limits would be flagged and/or deleted accordingly. For sites operating non-FEM PM25 and PM10 BAMs, DMS will perform automated QC checks as follows:

- Q_{tot} less than 0.167 applies QC code 4 (suspect, flow rate) to corresponding BAM25 and BAM10 value.

- Q_{tot} greater than 0.837 applies QC code 9 (invalid) to corresponding BAM25 and BAM10 value.

For sites operating the PM25 FEM BAMs, DMS will perform automated QC checks as follows:

- Q_{tot} less than 0.167 applies QC code 4 (suspect flow rate) to corresponding BAM25_FEM value.

- Q_{tot} greater than 0.703 applies QC code 9 (invalid) to corresponding BAM25_FEM value.

As stated previously, Auto QC Checks are designed to aid but not replace our data review process. Therefore, **ALL data auto flagged by DMS must be verified and/or confirmed using other available information.**

All data flagged as suspect QC (5) must be either validated or invalidated. If it is determined that data are valid, the corresponding QC code should be changed to 0 (valid). If it is determined that data are indeed invalid, the QC code should remain unchanged and an appropriate Qualifier or Null code should be assigned to the data point. BAM data flagged as QC code 4 (suspect, flow rate) should be edited to apply a qualifier code (W, flow rate average out of spec.) to the associated data point.

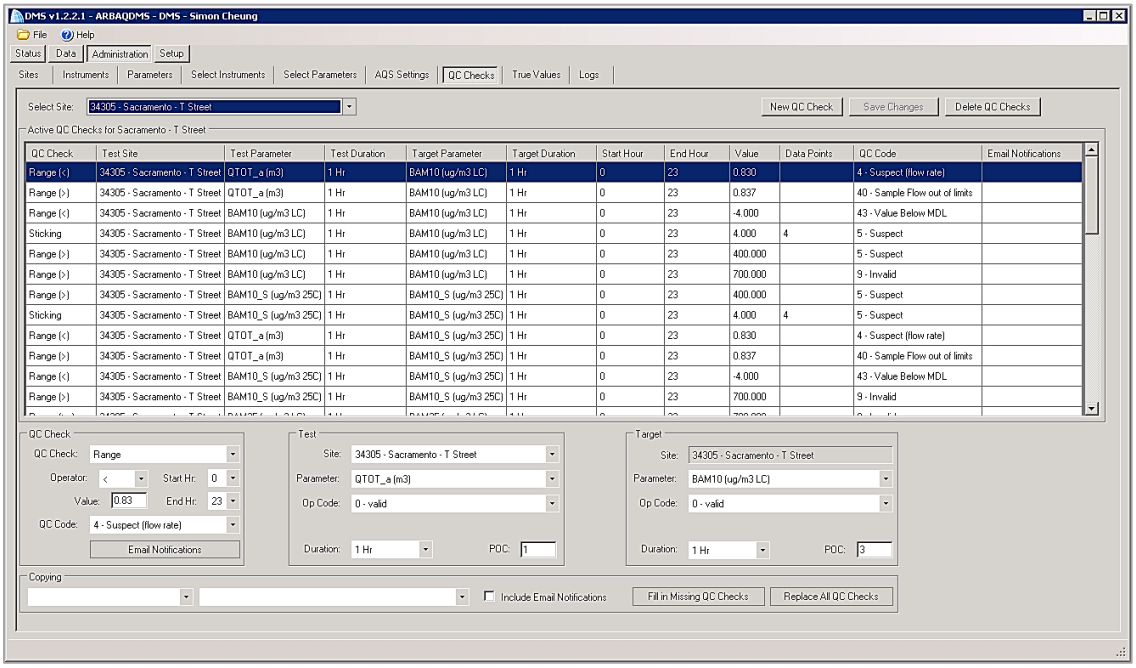


Figure 5.18. Auto QC Checks Setup Screen

To update an existing QC check from the QC checks table:

1. From the **[Administration]**-**[QC Checks]** tab, select a site from the **Select Site** drop-down list at the top of the screen, and then scroll to row of the target QC check.

2. Left click to highlight the row.

3. All pre-existing information (e.g. check type, site, parameter, range, duration, comparison value, and new QC code, etc.) should display on the lower section of the screen.

4. Update the fields as necessary.

5. Click on the **SAVE CHANGES** button to save the update.

To delete an existing QC check from the QC checks table:

1. Starting from the **[Administration]**-**[QC Checks]** screen, select the target site from the **Select Site** drop-down list, then scroll to the row of the target QC check.

2. Click to highlight the row.

3. Click the **DELETE QC CHECKS** button to delete the unwanted QC check.

To add a new QC check to the QC checks table:

Note: It is recommended by ODSS to users, rather than creating a new QC check directly in a new site, duplicate a QC check from an existing site to the new site instead. It will be easier, quicker, and less error-prone. For assistance, please contact CARBAQDMS.

1. From within the same **[QC Checks]** screen, select an existing site that has the QC checks you would like to duplicate from the **Select Site** drop-down list.

2. Scroll to the target QC check row(s). Then left click to highlight the row(s).

3. On the bottom of the screen, select **Copy Selected QC Checks To:** from the **Copying** drop-down list. Then on the nearby drop-down list, select the new site where you would like the QC check(s) to be sent.

4. Click the **FILL IN MISSING QC CHECKS** button to copy the selected QC check(s) to the new site.

After adding a new QC check to a site, please review all the settings of the newly copied QC checks for the new site. Ensure the **POC** setting for the pollutant parameter matches the Parameter setting for that site. Otherwise, QC checks will not be applied to the incoming data. To verify the Parameter settings, go to the **[Select Parameters]** screen under the **[Administration]** tab.

5.17 Updating True Values:

True Values are the expected values that DMS uses to compare instrument zero, precision or span calibration data to calculate percent from true values. The **Data Calibration** report, which is available under the **[Data]**-**[Export]** screen, can compare true values to the daily average of the measured values for the particular site-parameter-Op code combination; the daily average calibration value is compared to the most recent true value entry prior to the date of the average. Using a separate database, ODSS utilizes this data to generate the monthly control charts that are accessible from the DMS homepage.

DMS has been configured in such way that the following Op Codes (1, 2, and 4) are used to designate zero, gas precision and gas span data status respectively. For data to be properly labeled as calibration data, its value must have a QC code (0, valid) assigned.

Users can add reference values for instrument calibrations in the **[True Values]** screen under the **[Administration]** tab. True values are specific to the site, parameter, date range, and Op code.

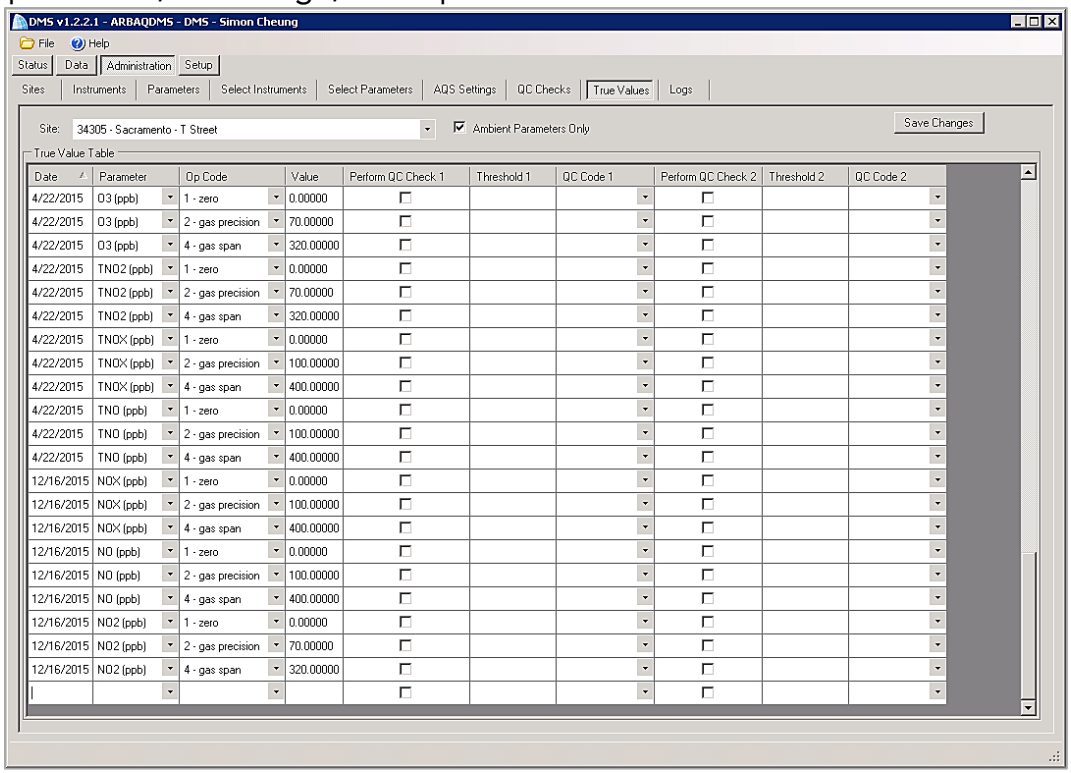


Figure 5.19. True Values Setup Screen

To add a new entry to the True Value table:

1. From the [**Administration]-[True Values]** tab, select a site from the **Site** drop-down list at the top of the screen and then scroll to the blank row at the end of the list. New true values should always be entered in a new row on the True Value table to retain the history of previous values and so that the calibration report can access the correct true values corresponding to the date-time stamp for the data.

2. Enter an entry date for the true value in the first column and select a parameter from the drop-down list in the second column. If the **Ambient Parameters Only** box is checked, only ambient parameters will be shown in the drop-down list. Ambient parameters are identified in the **[Administration]-[Parameters]** screen.

3. Select the appropriate **Op Code** to associate with the true value type, selected from the drop-down list (e.g., zero, span, or precision). The drop-down list will include all available Op Codes in the network, as established in the **[Setup]-[QC and Op Codes]** screen.

    - Enter the true value (expected calibration value) in the **Value** column. The true values expected here are the known concentration values from the calibration system at the individual sites.

4. Click the **SAVE CHANGES** button to store the update.

Note: Do not enter values in the **Threshold 1 - QC Code 1** and **Threshold 2 - QC Code 2** fields as these limits are not used by AQSB.

Note: With the current version of DMS true values entries cannot be deleted from the table; true values that are no longer needed should be overwritten by entering a new replacement date. It is also recommended that only **ONE** Zero true value entry is needed to be entered for each parameter on the table.

5.18 Updating Site Logs (for Documentation):

Site Logs

The **[Site Log]** screen under the **[Administration]** tab is where users can make electronic site log entries. This feature enables users to record any relevant information or observations about a site, an instrument, or both into the DMS database. The **[Site Log]** screen is divided into two sections, 1) the Comments section, and 2) the Log Query and Export Section.

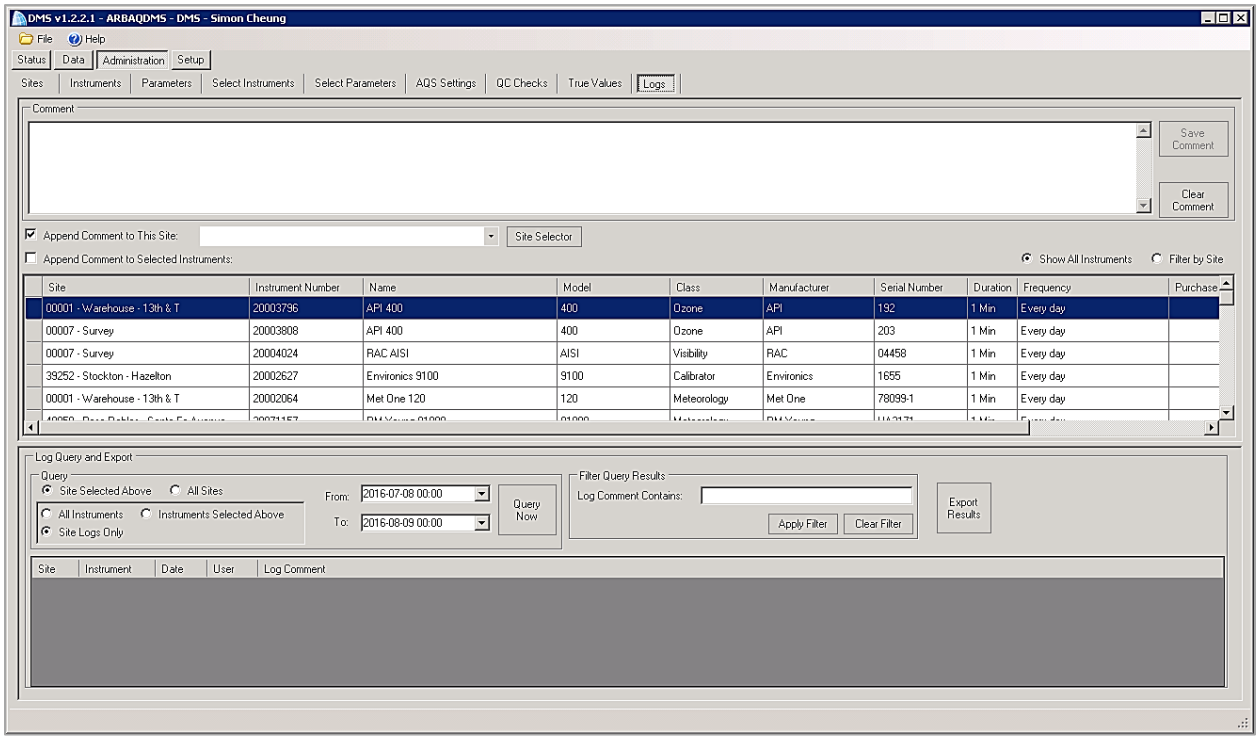


Figure 5.20. The Site Logs Screen

To create a new log entry:

1. First enter a comment in the **Comment Box**. Note that the format of a log entry, specifically its tabs and line breaks, is stored in the DMS database as well. The log export will retain the format of the original log entry.

2. To tag the comment to a site, check the **Append Comment to This Site** box, and use the S**ite** drop down list or the **Site Selector** to identify the target site for comment.

3. To tag the comment to an instrument, first narrow down the list of instruments by selecting a site using the site drop down list or the **Site Selector**, and then check the **Append Comment to Selected Instruments** box. From the instrument list, select one or more (hold down the Ctrl key) target instruments.

4. Alternatively, click on the **Show All Instruments** radio button and select the target instruments from this full list.

5. The comment may also be tagged to both the site and the instruments at the same time by checking both the **Append Comment to This Site** box and the **Append Comment to Selected Instruments** box.

6. Click on the **SAVE COMMENT** button to the right of the **Comment Box** to store the log entry.

Logs stored in the DMS may be queried using filters and keyword search, and the results of the query may be exported:

1. In the **Query** box of the **Log Query and Export** area on the lower part of the screen, define the query by choosing from **Site Selected Above** to **All Sites**, and from **All Instruments**, **Instruments Selected Above**, and **Site Logs Only**. Next, enter a date range for comment query.

2. Click the **QUERY NOW** button to query for the logs that was stored in the DMS database.

3. Each log entry returned by the query contains information for the site, instrument, date and time the log was entered, the user who entered the log, and the comment itself.

4. An entry of a site log will show "0 - No Instrument" in the Instrument field of the results table, if the comment is a general site comment.

5. For export, users can click on the **EXPORT RESULTS** button to export the log query results into a text file.

6.0 DMS DATA TOOLS

This section will cover some of the resources/tools (calibration control chart and monthly data matrix) that are available to AQSB users to aid completing their daily tasks. These resources can be found the DMS homepage.

6.1 DMS Homepage:

The DMS homepage was created by ODSS as an internal one-stop website to provide useful monitoring-related information to all AQSB staff. The website provides updates on the latest development of the AQSB air monitoring and data system (e.g. the CARBLogger, DMS, and AQS), any changes on the Air Web documents or SOPs, and any events that are relatable to our operations. In addition, the website provides connections to other DMS resources and data submission status to assist staff on completing their tasks.

The DMS homepage, as shown in Figure 6.1, contains a straightforward menu system and many quick links for ease of access to the previously mentioned resources/tools. The left of the screen contains links for the calibration control chart, DMS monthly data matrix, and AQS data submittal status, etc. The right side contains links for the Air Web Manual and QA/PQAO information. Updates and current events are posted under the "In the Know – Everyday Issues" section in the middle of the screen.

Another commonly used resource is the "Remote into a CARBLogger" guidance document. CARBLogger allows remote connection by users to perform basic maintenance task. Remote connection to CARBLogger assumes users to know how to use a telnet application called "PuTTY" (see Figure 6.2).

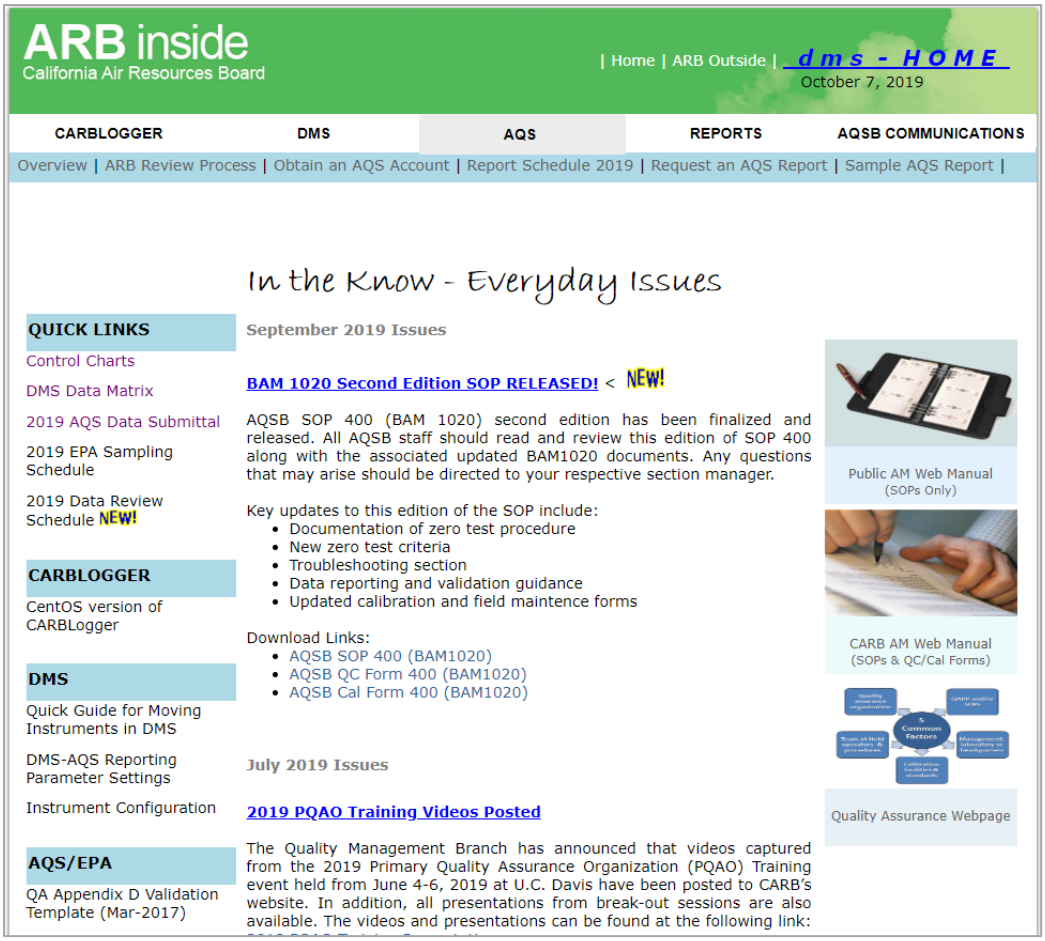


Figure 6.1. DMS Homepage

NOTE: As mentioned in section 5 of this SOP, the DMS user's guide is available from the DMS homepage. This document can be found under the DMS menu and contains information about the DMS application up to version 1.2.2.2.

NOTE: The Calibration Control Charts and Monthly Data Matrix are the most prominent resources accessible from the DMS homepage. These applications are extremely useful for instrument calibration and data review, and can be found under the Quick Links or the Report menu from the top of the screen. Additional details for these data tools are provided in the following sections.

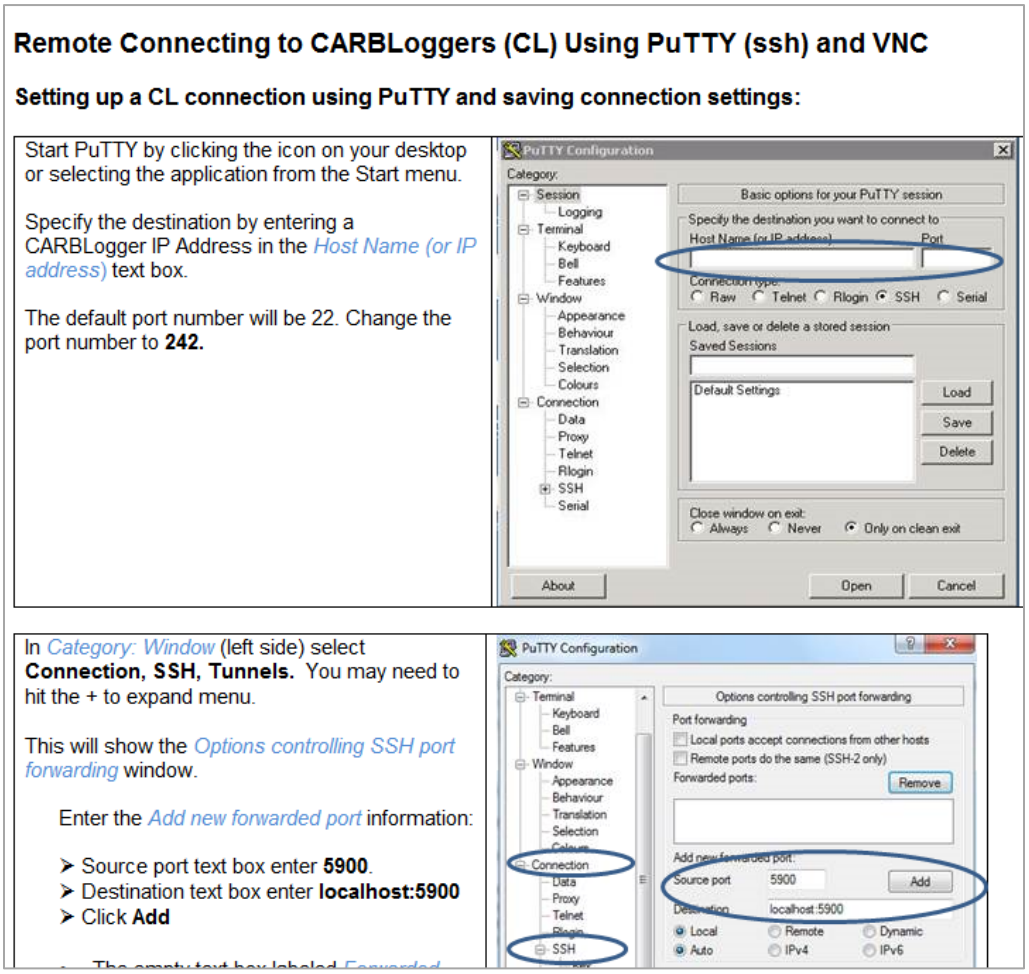


Figure 6.2. How to Remotely Connect to a CARBLogger

6.2 DMS Control Charts:

To assess the performance of network instruments, users can view calibration control charts to visually compare instruments calibration results with the system true values to determine if any corrections are needed for the observed monitoring site and instruments.

Control charts are a daily graph of air monitoring zero, precision and span calibration data spanning one month for the gaseous parameters being monitored at the monitoring station. The gaseous parameters available for generating a control chart are NOx, NO2, NO, O3, CO, and SO2. The graph types available are, 1) Percent from Expected, and 2) Zero offset.

NOTE: The relevancy timeframe for a calibration control chart is currently set at a 90-day period; meaning edits made within the previous 90 days will

be current and reflected on the chart. Any true values updates older than 90 days will not be reflected on the chart. A special request will need to be sent to ODSS in order to refresh updates more than 90 days.

All control charts display a set of upper and lower control limits (UCL and LCL respectively). There are currently 2 types of limits implemented on a control chart 1) warning level (green) and 2) action level (yellow or red). Red is for NOx parameters. When data are within the green lines, it typically means the instrument is operating normally, and the percent difference of daily calibration results with the true values is within 5% of acceptable range. Conversely, when data are above or below the yellow or red lines, it indicates there may be a problem with the instrument or the site's auto calibration system.

Users can access the control chart from the DMS Homepage quick links menu. See figure 6.3 for the control chart interface.

Figure 6.3. Monthly Calibration Control Chart Interface

To create a control chart, select the target criteria: 1) site name, 2) month, and 3) year, from the pull-down boxes. Then press the **SUBMIT** button to render the calibration control chart. A sample calibration control chart for the site Chico - East in March 2019 is shown in figure 6.4 below.

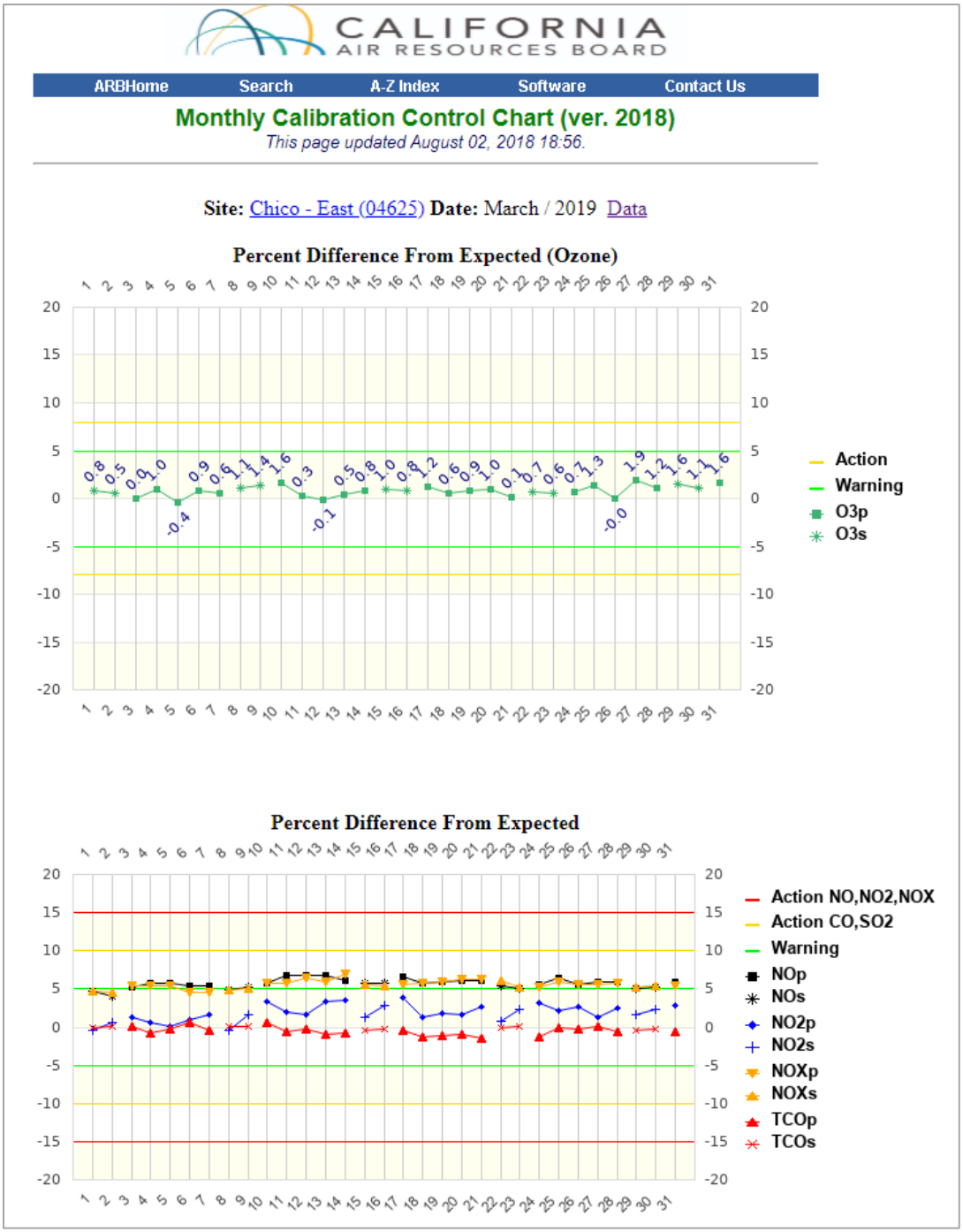


Figure 6.4. Sample Calibration Control Chart

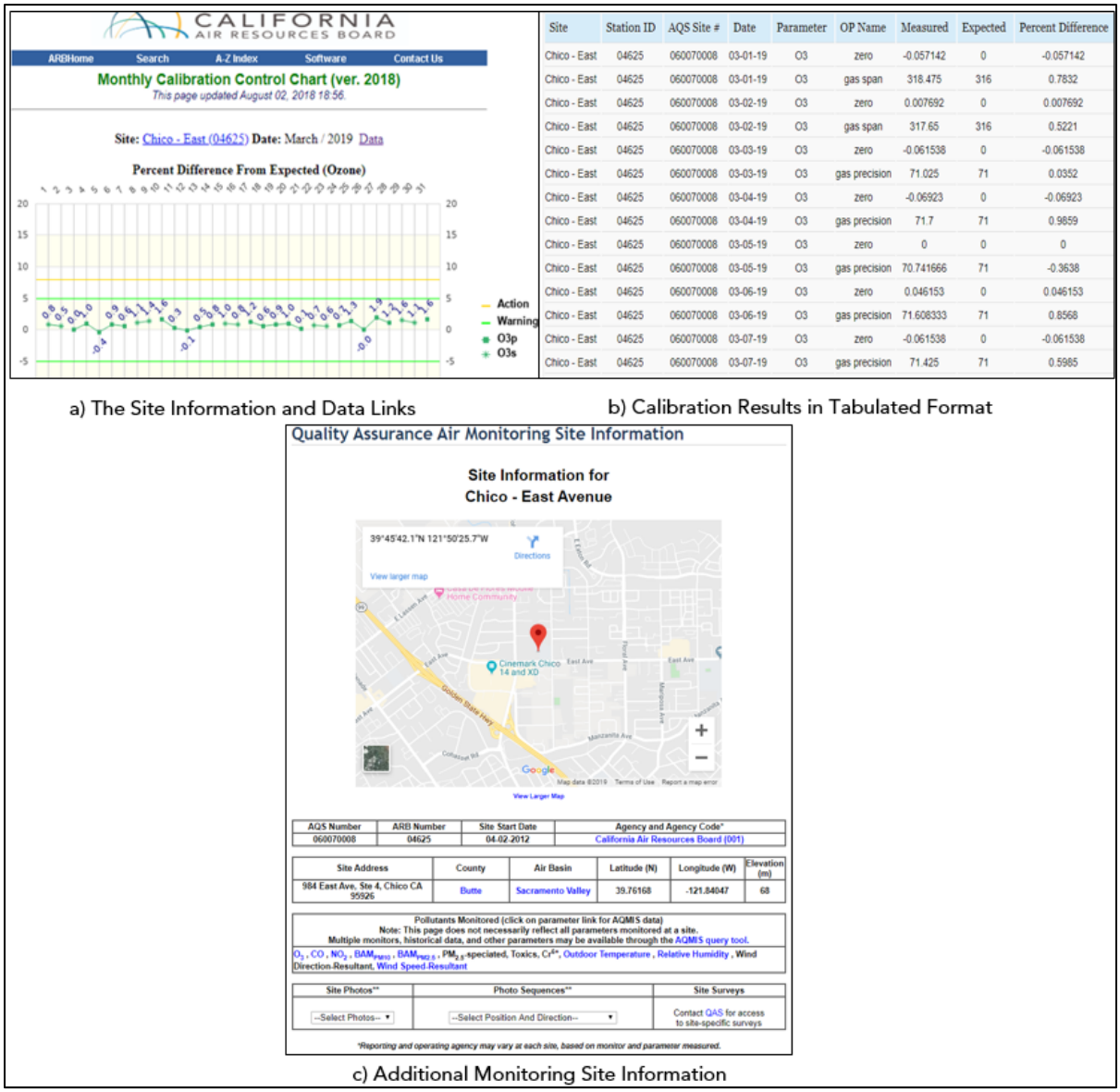
When a user selects a site that does not monitor any of those criteria gaseous pollutants, no control chart will be rendered, and the screen will return the message "No Data Available", as illustrated in figure 6.5 below, for the monitoring station at Gridley.

Figure 6.5. Calibration Control Chart Not Rendered for Gridley

In addition to evaluating nightly calibration results, the control chart screen has some bonus features included (a site information link and a data link). These are illustrated in figures 6.6a to 6.6c on the next page.

The site information link takes the user to the Quality Assurance Air Monitoring Site Information page and provides details such as site address, AQS ID, latitude and longitude coordinates, parameters monitored, site elevation, etc. for the monitoring station.

The data link displays calibration results' "percent difference" from the instrument zero and gas precision/span runs in a tabulated format.



Site	Station ID	AQS Site #	Date	Parameter	OP Name	Measured	Expected	Percent Difference
Chico - East	04625	060070008	03-01-19	O3	zero	-0.057142	0	-0.057142
Chico - East	04625	060070008	03-01-19	O3	gas span	318.475	316	0.7832
Chico - East	04625	060070008	03-02-19	O3	zero	0.007692	0	0.007692
Chico - East	04625	060070008	03-02-19	O3	gas span	317.65	316	0.5221
Chico - East	04625	060070008	03-03-19	O3	zero	-0.061538	0	-0.061538
Chico - East	04625	060070008	03-03-19	O3	gas precision	71.025	71	0.0352
Chico - East	04625	060070008	03-04-19	O3	zero	-0.06923	0	-0.06923
Chico - East	04625	060070008	03-04-19	O3	gas precision	71.7	71	0.9859
Chico - East	04625	060070008	03-05-19	O3	zero	0	0	0
Chico - East	04625	060070008	03-05-19	O3	gas precision	70.741666	71	-0.3638
Chico - East	04625	060070008	03-06-19	O3	zero	0.046153	0	0.046153
Chico - East	04625	060070008	03-06-19	O3	gas precision	71.608333	71	0.8568
Chico - East	04625	060070008	03-07-19	O3	zero	-0.061538	0	-0.061538
Chico - East	04625	060070008	03-07-19	O3	gas precision	71.425	71	0.5985

Figure 6.6. Additional Features from the Control Chart Screen

6.3 DMS Data Matrix:

The Monthly Data Matrix (MDM) is an internal web-based application, which displays DMS tabular data in data matrix format. The application allows users to review air quality data from DMS without connecting to the DMS user interface on the terminal server. This application also improves data visualization by displaying air monitoring data for an entire month and will display statistical information for the chosen site, parameter, and month/year.

The MDM is completely web-base, built on the WAMP platform (Windows, Apache, MySQL, and PHP) with HTML language. The tool can be accessed by using a standard web browser from the DMS Homepage and clicking on the "DMS Data Matrix" link under Quick Links. See figure 6.7 for reference.

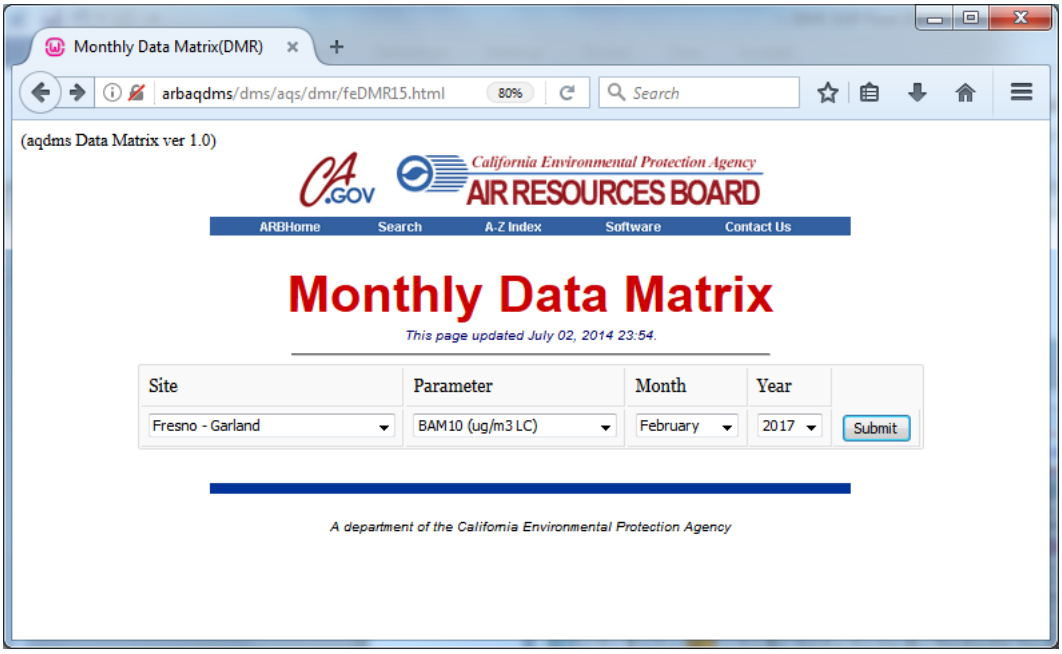


Figure 6.7. Monthly Data Matrix User Interface

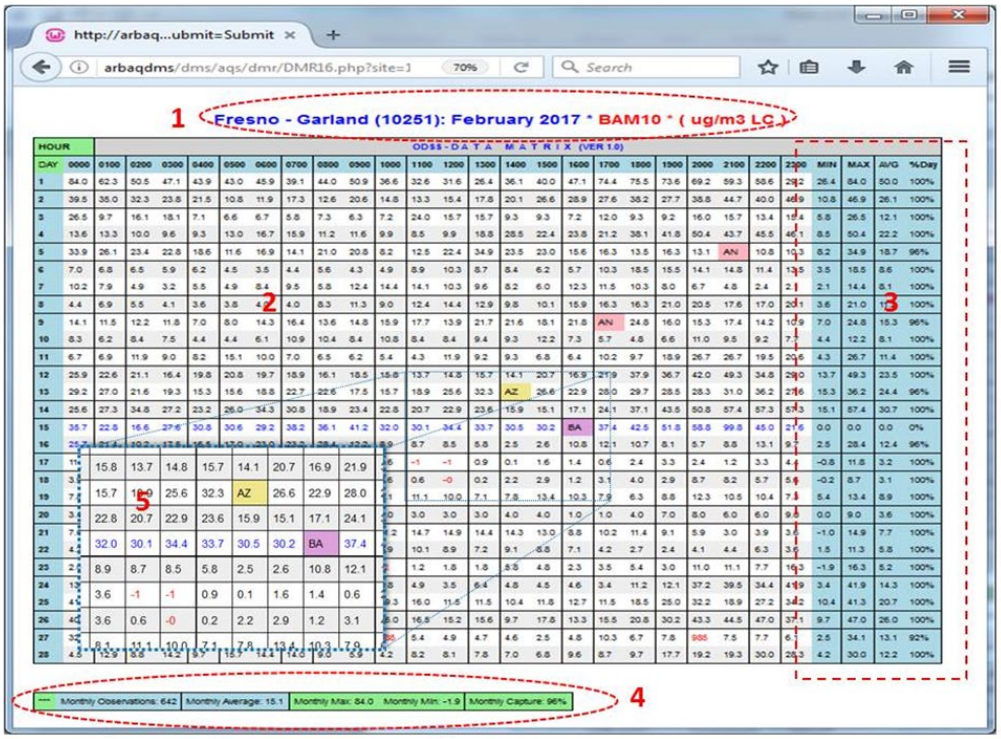
The MDM is easy to use. From the interface, users select the monitoring site, the parameter, the month and the year of interest. Click the **SUBMIT** button to render the data matrix. Figure 6.8 displays a sample of the monthly data matrix.

NOTE: When user selects a criterion from the interface and that criterion is not available from that site, for instance, a pollutant parameter that is not monitored at the site, the monthly data matrix will not be generated.

The header of the data matrix indicates the site, parameter, month, and year of interest. Information is stored in a column-row format; column refers to the hour range, while the row represents the day range.

Hourly values can come in the form of a number or a null code. If a numerical value is shown in color, it means that the observed value is either negative or tied to an invalid QC code. When a data value is null coded, hovering the mouse pointer over the code will prompt the user that additional information is available. Clicking the null code provides the text for the code (i.e. BD – auto calibration).

Whether it is a colored number or null code, this should signal users that the displayed hourly data requires additional review. The site operator or data reviewer will need to verify the suspect data from DMS and take appropriate action (validate/invalidate these data) accordingly.



Item #	Description
1. Title / Header	Displays site, parameter, and month/year selected in the matrix
2. Hourly Values	These are the hourly values for the selected parameter
3. Daily Statistics	Daily maximum, minimum, average, and % completeness
4. Monthly Statistics	Monthly observations, average, maximum, minimum, and % capture
5. Zoomed View	Zoomed view of the hourly values display

Figure 6.8. Sample Data Matrix Results

The right side of the data matrix shows the maximum, minimum, average, and percent capture for the day. Displayed at the bottom of the MDM are monthly statistics for number of observations, average, maximum, minimum, and data capture rate.

7.0 TROUBLESHOOTING

7.1 Introduction:

The troubleshooting section is aimed to provide DMS users the recommended procedures and solutions for some of the common issues that may happen during the use of DMS. Since DMS is a networked system, problems can arise from many different areas. Therefore, it is helpful that users first perform some basic inspection and check methods in attempt to figure out the cause of a problem. If a solution is not found, users may forward the problem to ODSS for further assistance.

Note: The DMS user manual contains information about the use of DMS application. If a particular issue is not covered in this SOP, users should refer to the STI manual as additional reference for troubleshooting issues.

7.2 DMS Client Troubleshooting:

The troubleshooting table below refers to the most common issues and potential solutions that are related to DMS settings and configurations when using the DMS client.

Table 7.1. Common DMS Client Related Issues

Issue	Solution
Can't login to terminal server	Ensure the Remote Desktop Connection is set up to connect to ARBFDCTS1. If the server is not responding, contact ODSS. If your username/password is not accepted, ensure that your username is "carb\username" and your password is correct. If the username and password are correct, contact ODSS for assistance.
Login failure	Verify your username and password. If username/password is lost, contact ODSS staff to generate a new username and/or password. Verify that the "server name" in the "data link" window is ARBAQDMS.

Issue	Solution
Client crashing when editing data	If the client is consistently crashing when editing large amounts of data (large time frames, large amounts of parameters, or a combination of both), reduce the number of data points being processed. DMS is most stable when working with around a week of data and at most 4 or 5 parameters at a time.
Can't move instruments / edit parameters	Ensure that the instrument is inactive prior to moving instrument. If all buttons in the "Select Instruments" tab are locked, contact ODSS to check user groups and permissions on the account.
Instrument does not exist in DMS database	Contact ODSS staff to add the instrument to DMS.
Instrument already assigned to another site	Contact field operator/section manager of site in question to reconcile the instrument location assignments. ODSS can help facilitate reassignment of instruments if the issue extends across multiple sites.
QC checks missing, incorrect, or triggering large amounts of false flags	Contact ODSS for assistance with automated QC Checks.
Nightly calibrations not properly flagged	The nightly calibration flagging routine does not occur until 06:30 PST for Environics 9100 sites. Check calibration values after that time. Likely, the CARBLogger dms.cfg file is not configured properly.
Date range of export changes don't save	Save the altered export with a new name. If the old export name is desired, delete the old export, load the new export, save it with the old name, and then delete the interim export.
DMS client cannot connect to database (ARBAQDMS)	Contact ODSS for assistance.

7.3 Data Outage Troubleshooting:

Data outages can result from failures at any point in the data processing chain. The instrument, CARBLogger, the CARB SFTP Server, and the DMS server are all crucial parts of the data chain and a failure at any point can halt the data process. The following sections contain common issues and possible solutions.

1) All Instruments/Parameters Are Late/Missing at All Monitoring Sites

If all instruments/parameters are late or missing from all CARB monitoring sites, the issue stems from either a failure at the CARB SFTP server or the DMS server. This situation requires intervention from ODSS and/or OIS. Notify ODSS of the issue.

2) All Instruments/Parameters at a Single Site Late/Missing in DMS

The most common reasons and diagnostics/solutions for a single site to have all parameters late or missing from DMS are listed below. When troubleshooting this issue, start at step 1 (most common problem) and progress through the list as necessary. Contact ODSS if you have any issues.

1. Internet connectivity lost/CARBLogger and/or site offline
   Attempt to remotely connect to the CARBLogger. If this fails a site visit is required. If the CARBLogger responds, move to step 2.

2. CARBLogger incorrectly configured
   If the CARBLogger was recently changed there could be configuration problems with the new logger. Refer to the CARBLogger SOP and/or contact ODSS for assistance. If the CARBLogger is correctly configured, continue to step 3.

3. DMS incorrectly configured
   Ensure that the Site is Active in DMS. Contact ODSS for assistance. If all these steps fail, contact ODSS for assistance.

3) Some Instruments/Parameters at a Single Site Late/Missing in DMS

Instrument changes are the most common reasons for missing instruments/parameters in DMS. Either the CARBLogger or DMS can have configuration issues. The steps below outline the most common reasons for this issue. When troubleshooting this issue, start at step 1 (most common problem) and progress through the list as necessary. Contact ODSS if you have any issues.

1. Instrument inactive in DMS

   If an instrument was recently moved in DMS, go to **[Administration]-[Select Instruments]** screen. Select the site from the drop down menu. If the Active checkbox is not ticked for the instrument in question, tick the checkbox. Data will not be ingested into DMS if the Instrument is not active. If the instrument is active, proceed to step 2.

2. Parameters incorrectly configured in DMS

   Go to the **[Administration]-[Select Parameter]** screen. Select the Site and missing Instrument from the drop down menus. Add and configure the parameter if necessary. Ensure that all parameters are assigned to the instrument and that all settings are correct (contact ODSS if correct configuration is unknown). If the parameters are correct, proceed to step 3.

3. Driver missing/mis-assigned on CARBLogger

   Log onto the CARBLogger remotely or locally. Check the **Display Channels** to ensure that all parameters and instruments are being actively polled. Choose **Edit Instruments** and verify that the driver for the missing instrument is present. If not, choose **Add Instruments** to add the appropriate driver. If the driver is present, choose the driver in **Edit Instruments** and verify that the correct serial port is selected. Correct if necessary. If the drivers are present and correctly configured, proceed to step 4.

4. Instrument not properly configured for RS-232 Communication

   Check all cables connecting the instrument to the CARBLogger. The BAM-1020 and API instruments have a hardware switch that allows the instrument to work with either a null modem or straight RS-232 cable. The cabling at air monitoring sites is not standardized and thus an instrument configured for shop testing may not work at the monitoring site. If the instrument driver is properly configured but data appears red in the **Display Channels** screen of CARBLogger, flip the DCE/DTE switch on API instruments or the RS-232 Polarity switch on the BAM-1020. Refer to the manufacturer's manual for additional information if needed. If the instrument still appears red in the **Display Channels** screen after 3-4 minutes, contact ODSS.

5. DMS Config file incorrectly configured on CARBLogger
   If you have added a new instrument or changed an instrument driver, the DMS Config file may not have been configured correctly. Contact ODSS if you are not familiar with the DMS Config file; otherwise check the file for missing parameters. If these steps do not solve the issue, contact ODSS for assistance.

4) Parameters Missing from Time-Series Graph When Not Late/Missing in The DMS Status Screen

When a parameter appears on time in the DMS status screen but does not show up in a time series graph or a report, two likely situations may be the cause.

1. The data points may be invalid and are being filtered out. Add invalid data to the Filter Data settings to see data flagged invalid. Auto QC or the CARBLogger may be automatically flagging data invalid and the filter is screening it from the graph.

2. A POC code change may have occurred. The POC may have been accidently changed during an instrument move or a POC code correction may have been made by ODSS staff. Check the current POC code of the parameter in the **[Select Parameters]** Screen. If this differs from the POC code of the parameter in your time-series graph, contact ODSS to verify the correct POC code assignment and make changes as necessary. To view the data collected under the incorrect POC code, click the add button on the time series graph and add the parameter with the incorrect POC code. POC codes cannot be changed in DMS, so staff must review the data recorded under the wrong POC code. ODSS staff will change the POC prior to AQS submission.

5) Data Gaps Not Filled by Backpoll Request

The backpoll request only fills in missing data if the CARBLogger has collected data but for some reason did not send it to the DMS Server. Data must be present on the CARBLogger for a successful backpoll request. If the backpoll request was not successful, data will need to be backpolled via the internal data-logger of the instrument. Refer to the CARBLogger SOP or contact ODSS for assistance. Some greenhouse gas instrumentation must be backpolled manually and thus these parameters can't be recovered with the automated backpoll request.

Figure 7.1 is the summarized procedural flowchart for the data outage troubleshooting steps covered in the previous paragraphs.

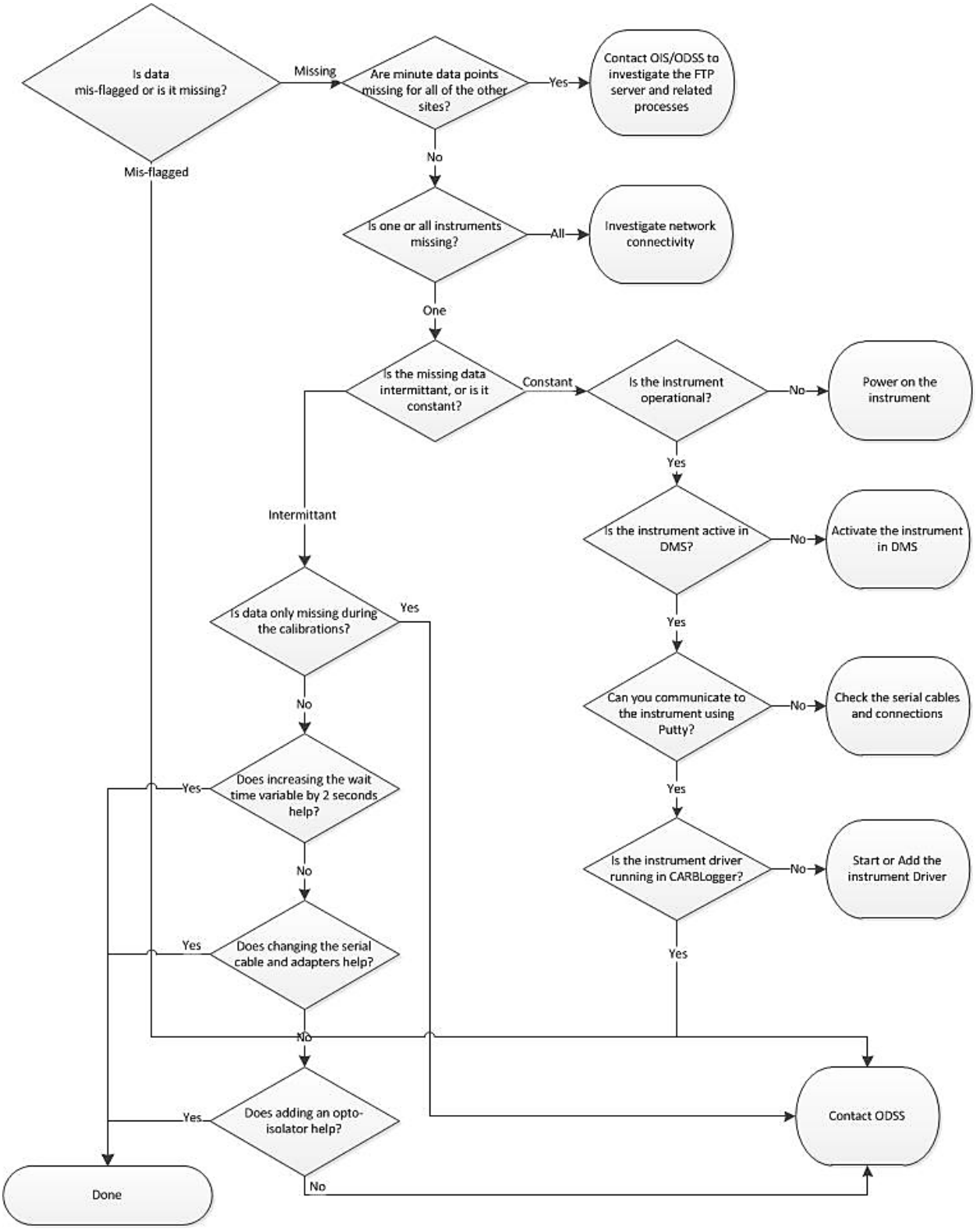


Figure 7.1. Data Outage Troubleshooting Flowchart

REFERENCES

California Air Resources Board, (2018) CARBLogger Standard Operating Procedures. Prepared by the Operations and Data Support Section

California Air Resources Board, (2019) Data Validation and Review Standard Operating Procedures. Prepared by the Operations and Data Support Section

Sonoma Technology Inc., (2011) Data Management System User Guide. Prepared by the Sonoma Technology Inc.

APPENDIX A 1. Sample Data Review Schedule (CY2019 Schedule)

2019 Data Review Schedule [1]

MLD- ODSS. Revised 12/06/18 T.E

End of reporting period	Data due to 2nd Level review	Data due to Manager for review	Data due to Brand Chief for review	Data due to MLD- ODSS	Data in AQS
	15 days	35 days	45 days	50 days	60 days
Dec 2018	01/15/19	02/04/19	02/14/19	02/19/19	03/01/19
Jan 2019	02/15/19	03/07/19	03/17/19	03/22/19	04/01/19
Feb 2019	03/15/19	04/04/19	04/14/19	04/19/19	04/29/19
Mar 2019	04/15/19	05/05/19	05/15/19	05/20/19	05/30/19
Apr 2019	05/15/19	06/04/19	06/14/19	06/19/19	06/29/19
May 2019	06/15/19	07/05/19	07/15/19	07/20/19	07/30/19
Jun 2019	07/15/19	08/04/19	08/14/19	08/19/19	08/29/19
Jul 2019	08/15/19	09/04/19	09/14/19	09/19/19	09/29/19
Aug 2019	09/15/19	10/05/19	10/15/19	10/20/19	10/30/19
Sep 2019	10/15/19	11/04/19	11/14/19	11/19/19	11/29/19
Oct 2019	11/15/19	12/05/19	12/15/19	12/20/19	12/30/20
Nov 2019	12/15/19	01/04/20	01/14/20	01/19/20	01/29/20
Dec 2019	01/15/20	02/04/20	02/14/20	02/19/20	02/29/20

[1] These dates may vary slightly from the calculated due dates because of weekends and holidays.

*This is a general schedule only. Current schedule can found on DMS homepage.

APPENDIX B 1. Remote Desktop Connection to DMS.

This document provides basic instructions for users to access DMS database via the remote desktop connection. These instructions assume that the user has the following:

1) A network connection to the CARB network (via the remote access icon, VPN, or from a PC attached to a network supported by CARB OIS).

2) The user account has been added by ODSS in order to access the DMS system.

DMS Connection Procedure (from INSIDE the CARB network)

If you are currently logged into the CARB Domain, ODSS recommends using this procedure for connecting to DMS (in lieu of the desktop client application).

1) On your workstation, click the "**Start**" button, and in the "**Search Programs and Files**" box, type "**remote desktop**". Under "Programs", click the "**Remote Desktop Connection**" icon. To pin the Remote Desktop icon to your task bar, right click on the program and select "Pin to Taskbar".

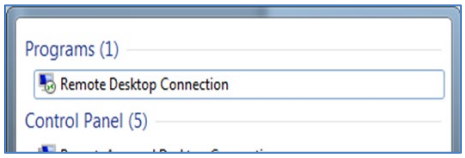


Figure 1: Locate Remote Desktop in Windows

2) On the following window, choose "**Options**" and on the "**Local Resources**" tab to confirm that the "**Printers**" and "**Clipboard**" boxes are checked.

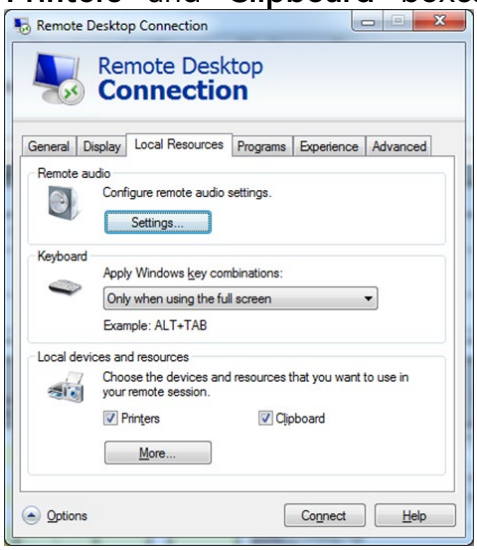


Figure 2: Configure local printers and buffers

3) Then select "**General**" tab, type "**ARBFDCTS1**" into the Computer field and your **CARB Login** information into the User name field.

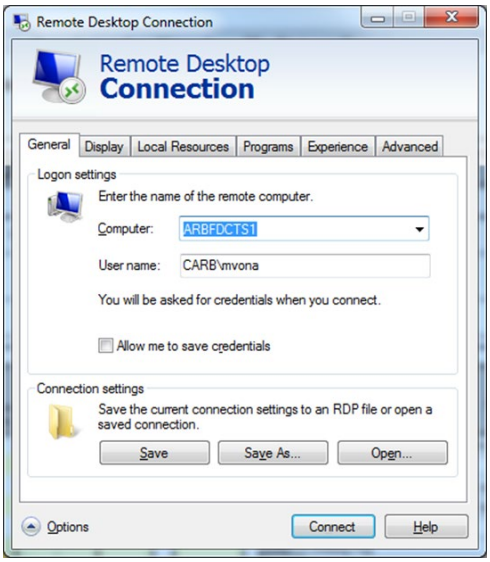


Figure 3: Connect to the terminal server

4) The following dialog will appear. (Remote connection takes approximately 20 seconds):

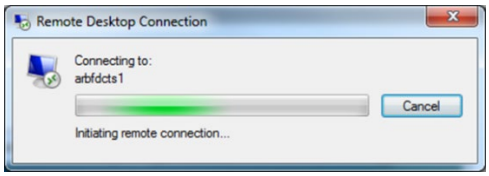


Figure 4: Remote connection initialization

5) Next the Windows Security window will appear. Enter in your **CARB Domain User ID** and **Password**. Select "**Remember my credentials**" to by-pass this step at next login:

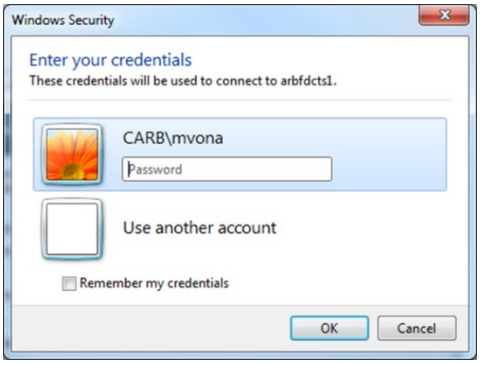


Figure 5: CARB Domain Login

6) You are now logged into a Remote Desktop session. Click on the **Start** button and then select the **DMS** icon at the top of the list. If you do not see the DMS icon, select **ALL PROGRAMS** to look up the DMS application. To pin the DMS icon to your taskbar or desktop, right click the DMS icon and select "Pin to Taskbar" or "Pin to Desktop".

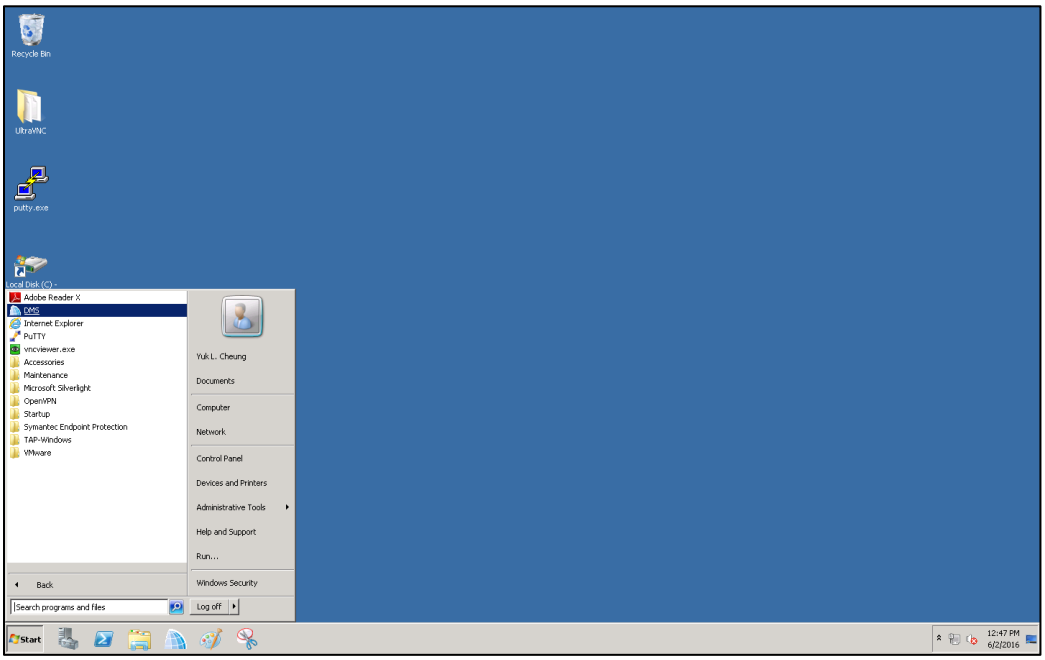


Figure 6: Call up DMS

7) The first time you run DMS from this session, you will receive the **Data Link** dialog box. Enter "**ARBAQDMS**" in the Server Name field, "**DMS**" in the Database field, and **tick the Windows Login** radio button.

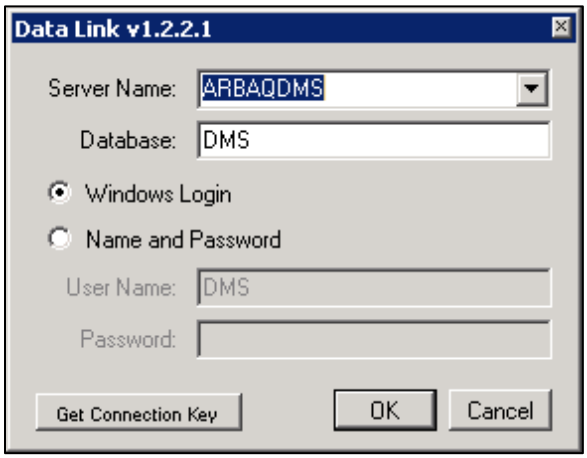


Figure 7: Data Link Configuration

8) The DMS login window will appear. Log into DMS using the assigned **Username and Password** provided by ODSS. To change your login password, send the request e-mail to carbaqdms@arb.ca.gov. The **System** radio button should be selected in the Language window. Select **OK** button.

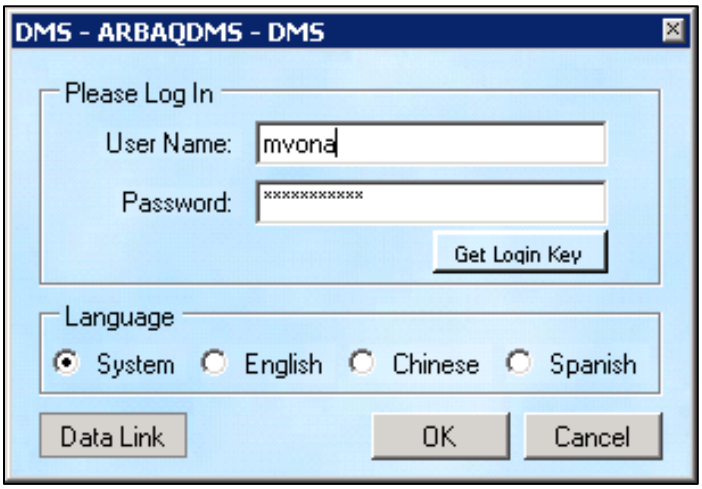


Figure 8: Login to DMS

Remote Access (from OUTSIDE the CARB network only)

If you are not able to log into the CARB Domain, ODSS recommends using this procedure for connecting to DMS. You must open this document electronically to use the below icon, or copy this icon to your desktop. By default, you will be able to copy documents and buffer contents to your local computer. In this mode, however, you may not be able to directly access your printer.

1) Double click the below icon. DO NOT use this icon if you are currently logged into the CARB Domain.

2) The following dialog will appear:

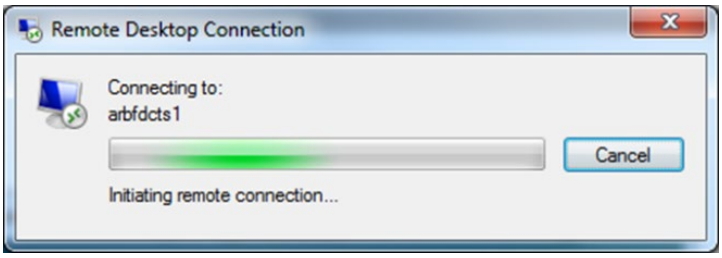


Figure 9: Connecting to the terminal server

3) Enter in your **CARB Domain Username** and **Password**. Select "Remember my credentials" to by-pass this step at next login:

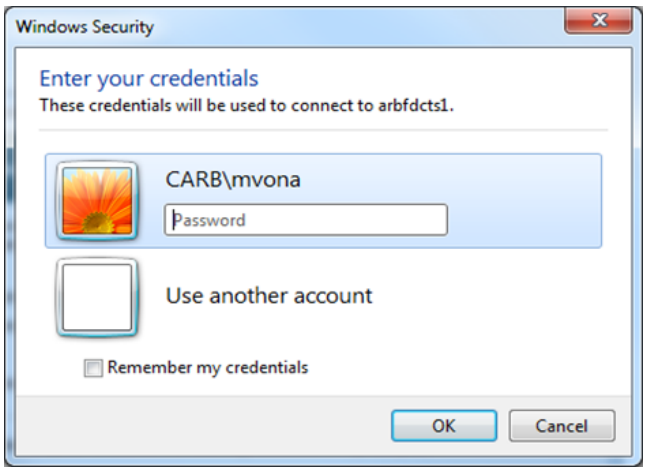


Figure 10: Connecting to the terminal server

4) If you encounter the system's "**Confirm Security Certificate**" window, **click on viewing** the security certificate, and then select **YES** to proceed.

5) You are now logged into a Remote Desktop session. Click on the **Start** button and click on the **DMS** icon at the top of the list. If you do not see the **DMS** icon, select ALL **PROGRAMS**. To pin the Remote Desktop Icon to your taskbar or desktop, right click the DMS icon and select "Pin to Taskbar" or "Pin to Desktop".

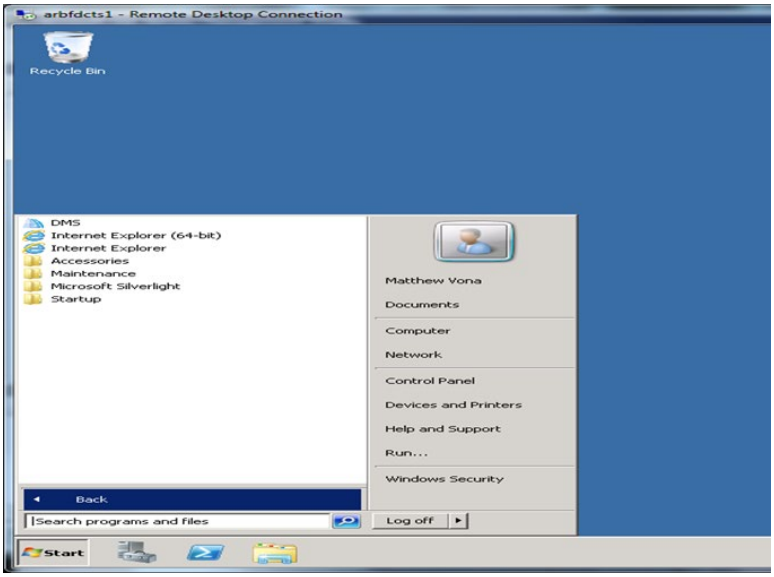


Figure 11: Activate DMS

6) The first time you run DMS from this session, you will receive the **Data Link** dialog box. Enter "**ARBAQDMS**" in the Server Name field, "**DMS**" in the Database field, and **tick the Windows Login** radio button.

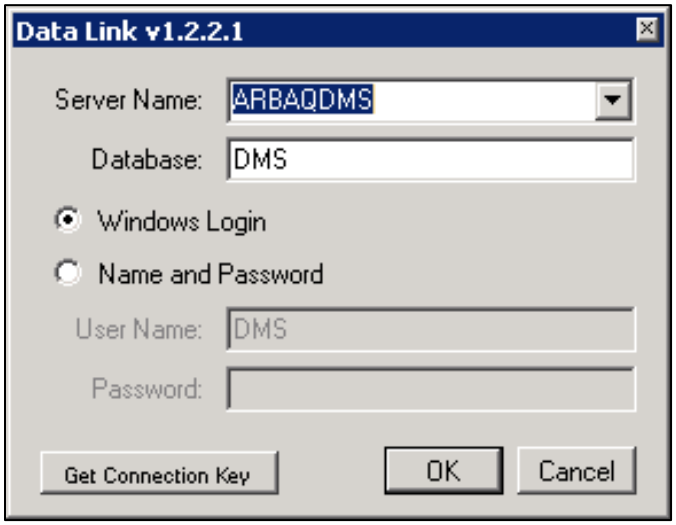


Figure 12: Data Link Configuration

7) The **DMS login** window will appear. Log into **DMS** as you would from inside of CARB domain. To change your login password, send e-mail to carbaqdms@arb.ca.gov.

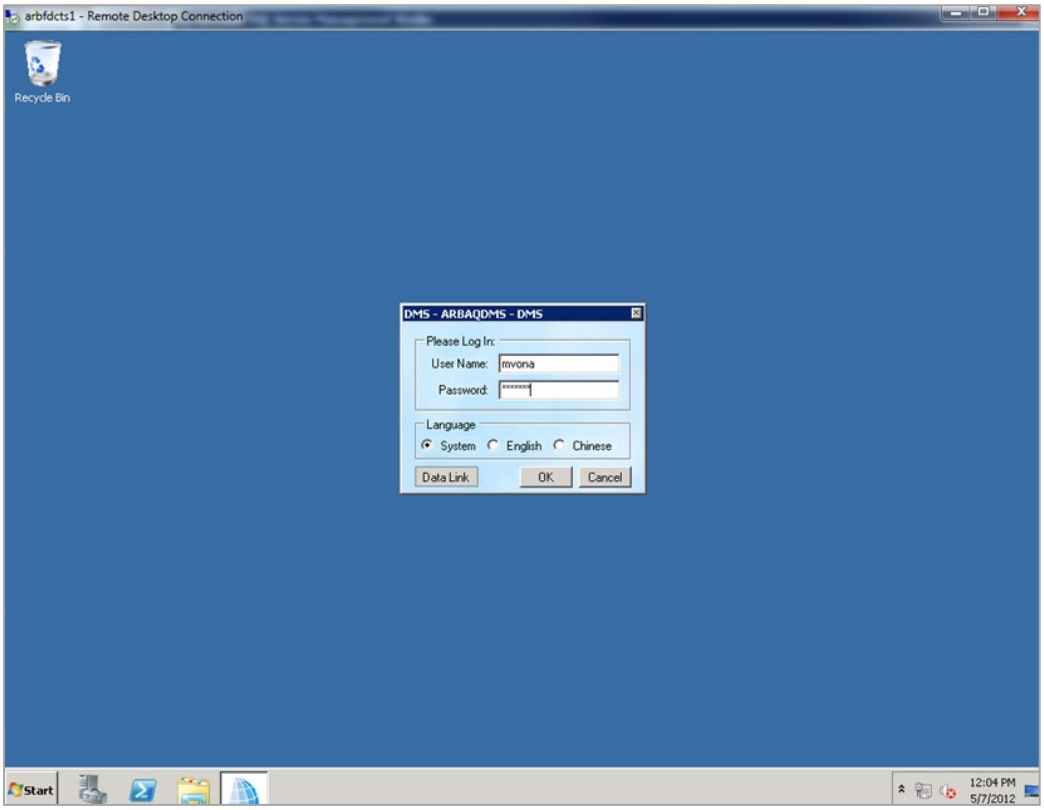


Figure 13: Log into DMS as normal

APPENDIX C 1. List of QC Codes

QC Code	Description
0	Valid Data
1	Adjusted
2	Averaged
3	Interpolated
4	Suspect (Flow Rate)
5	Suspect
6	Suspect (Audit)
7	Insufficient Data
8	Missing
9	Invalid
10	Auto Calibration
11	Manual Calibration
12	Precision Check
13	Zero/Span Check
14	QA Audit
15	Poor QA Results
20	Voided by Operator
21	Misc. Void
22	Maintenance/Routine Repairs
23	Unable to Reach Site
24	Operator Error
25	Missing O3 not likely to exceed
30	Construction/Repair in Area
31	Vandalism
32	Shelter Temp Out of Limits
33	Building/Site Repair
40	Sample Flow Out of Limits
41	Machine Malfunction
42	Site Computer/Logger Down
43	Value Below MDL
44	Power Failure
45	Detection Limit Analysis
46	Low Sample Value
47	Instrument Over Range
99	Test data

APPENDIX C 2. List of OP Codes

Op Code	Description
0	Valid data
1	Zero
2	Gas Precision
3	Gas Midpoint
4	Gas Span
5	Recovery
7	Insufficient Data
8	N/A
9	Invalid data
11	Gas Zero (2)
12	Gas Precision (2)
13	GPT Midpoint
14	Gas Span (2)
15	Span GPT
21	Gas Zero (3)
22	Gas Precision (3)
23	Ozone Midpoint
24	Gas Span (3)
31	Gas Zero (4)
32	Gas Precision (4)
34	Gas Span (4)
40	Instrument Malfunction
41	Instrument Flow Error
42	Instrument Pressure Error
43	Instrument Temperature Error
50	Power Failure
51	Maintenance
52	Instrument Repair
53	Off-line
54	Bad Condition – Valid
55	Bad Condition – Invalid
56	Positive Over Range – Valid
57	Positive Over Range – Invalid
58	Negative Under Range – Valid
59	Negative Under Range – Invalid
60	QA Audit
61	Rate of Change
62	QC Check

Op Code	Description
63	MDL Check
64	BAM Zero Test
65	Autocal – off phase
66	O3 Gen Cal (IZS)
67	TCO Auto Zero
68	Calibration
69	Autocal
99	Test Data
255	Any Op Code

APPENDIX C 3. List of Null Codes

Null Code	Description
AA	Sample Pressure out of Limits
AB	Technician Unavailable
AC	Construction/Repairs in Area
AD	Shelter Storm Damage
AE	Shelter Temperature Outside Limits
AF	Scheduled but not Collected
AG	Sample Time out of Limits
AH	Sample Flow Rate out of Limits
AI	Insufficient Data (cannot calculate)
AJ	Filter Damage
AK	Filter Leak
AL	Voided by Operator
AM	Miscellaneous Void
AN	Machine Malfunction
AO	Bad Weather
AP	Vandalism
AQ	Collection Error
AR	Lab Error
AS	Poor Quality Assurance Results
AT	Calibration
AU	Monitoring Waived
AV	Power Failure
AW	Wildlife Damage
AX	Precision Check
AY	Q C Control Points (zero/span)
AZ	Q C Audit
BA	Maintenance/Routine Repairs
BB	Unable to Reach Site
BC	Multi-point Calibration
BD	Auto Calibration
BE	Building/Site Repair
BF	Precision/Zero/Span
BG	Missing ozone data not likely to exceed level of standard
BH	Interference/co-elution/misidentification
BI	Lost or damaged in transit
BJ	Operator Error

Null Code	Description
BK	Site computer/data logger down
BL	QA Audit
BM	Accuracy check
BN	Sample Value Exceeds Media Limit
BR	Sample Value Below Acceptable Range
CS	Laboratory Calibration Standard
DA	Aberrant Data (Corrupt Files, Aberrant Chromatography, Spikes, Shifts)
DL	Detection Limit Analyses
FI	Filter Inspection Flag
MB	Method Blank (Analytical)
MC	Module End Cap Missing
SA	Storm Approaching
SC	Sampler Contamination
ST	Calibration Verification Standard
TC	Component Check & Retention Time Standard
TS	Holding Time Or Transport Temperature Is Out Of Specs.
XX	Experimental Data

Note: DMS distinguishes air quality data from QC data using QC and Op codes. CARBLogger and DMS automatically apply QC and Op codes to the data to identify each step in the automated QC program. Changing the QC and Op codes for the minute data during the automated QC program run time will result in DMS not recognizing data sequence as QC data. If this occurs, DMS will be unable to upload QC (Precision) data onto EPA's AQS database.

APPENDIX C 4. List of Qualifier Codes

Qualifier Code	Description
IA	African Dust
IB	Asian Dust
IC	Chemical Spills & Industrial Accidents
ID	Cleanup After a Major Disaster
IE	Demolition
IF	Fire - Canadian
IG	Fire - Mexico/Central America
IH	Fireworks
II	High Pollen Count
IJ	High Winds
IK	Infrequent Large Gatherings
IL	Other
IM	Prescribed Fire
IN	Seismic Activity
IO	Stratospheric Ozone Intrusion
IP	Structural Fire
IQ	Terrorist Act
IR	Unique Traffic Disruption
IS	Volcanic Eruptions
IT	Wildfire-U. S.
J	Construction
AA	Sample Pressure out of Limits
AB	Technician Unavailable
AC	Construction/Repairs in Area
AD	Shelter Storm Damage
AE	Shelter Temperature Outside Limits
AF	Scheduled but not Collected
AG	Sample Time out of Limits
AH	Sample Flow Rate out of Limits
AI	Insufficient Data (cannot calculate)
AJ	Filter Damage
AK	Filter Leak
AL	Voided by Operator
AM	Miscellaneous Void
AN	Machine Malfunction

Qualifier Code	Description
AO	Bad Weather
AP	Vandalism
AQ	Collection Error
AR	Lab Error
AS	Poor Quality Assurance Results
AT	Calibration
AU	Monitoring Waived
AV	Power Failure
AW	Wildlife Damage
AX	Precision Check
AY	Q C Control Points (zero/span)
AZ	Q C Audit
BA	Maintenance/Routine Repairs
BB	Unable to Reach Site
BC	Multi-point Calibration
BD	Auto Calibration
BE	Building/Site Repair
BF	Precision/Zero/Span
BG	Missing ozone data not likely to exceed level of standard
BH	Interference/co-elution/misidentification
BI	Lost or damaged in transit
BJ	Operator Error
BK	Site computer/data logger down
BL	QA Audit
BM	Accuracy check
BN	Sample Value Exceeds Media Limit
BR	Sample Value Below Acceptable Range
CS	Laboratory Calibration Standard
DA	Aberrant Data (Corrupt Files, Aberrant Chromatography, Spikes, Shifts)
DL	Detection Limit Analyses
FI	Filter Inspection Flag
MB	Method Blank (Analytical)
MC	Module End Cap Missing
SA	Storm Approaching
SC	Sampler Contamination
ST	Calibration Verification Standard
TC	Component Check & Retention Time Standard

Qualifier Code	Description
TS	Holding Time Or Transport Temperature Is Out Of Specs.
XX	Experimental Data
1	Deviation from a CFR/Critical Criteria Requirement
2	Operational Deviation
3	Field Issue
4	Lab Issue
5	Outlier
6	QAPP Issue
7	Below Lowest Calibration Level
9	Negative value detected - zero reported
CB	Values have been Blank Corrected
CC	Clean Canister Residue
CL	Surrogate Recoveries Outside Control Limits
DI	Sample was diluted for analysis
EH	Estimated; Exceeds Upper Range
FB	Field Blank Value Above Acceptable Limit
FX	Filter Integrity Issue
HT	Sample pick-up hold time exceeded
LB	Lab blank value above acceptable limit
LJ	Identification of Analyte Is Acceptable; Reported Value Is An Estimate
LK	Analyte Identified; Reported Value May Be Biased High
LL	Analyte Identified; Reported Value May Be Biased Low
MD	Value less than MDL
MS	Value reported is 1/2 MDL substituted.
MX	Matrix Effect
ND	No Value Detected
NS	Influenced by nearby source
QX	Does not meet QC criteria
SQ	Values Between SQL and MDL
SS	Value substituted from secondary monitor
SX	Does Not Meet Siting Criteria
TB	Trip Blank Value Above Acceptable Limit
TT	Transport Temperature is Out of Specs.
V	Validated Value
VB	Value below normal; no reason to invalidate
W	Flow Rate Average out of Spec.
X	Filter Temperature Difference out of Spec.

Qualifier Code	Description
Y	Elapsed Sample Time out of Spec.
RA	African Dust
RB	Asian Dust
RC	Chemical Spills & Industrial Accidents
RD	Cleanup After a Major Disaster
RE	Demolition
RF	Fire - Canadian
RG	Fire - Mexico/Central America
RH	Fireworks
RI	High Pollen Count
RJ	High Winds
RK	Infrequent Large Gatherings
RL	Other
RM	Prescribed Fire
RN	Seismic Activity
RO	Stratospheric Ozone Intrusion
RP	Structural Fire
RQ	Terrorist Act
RR	Unique Traffic Disruption
RS	Volcanic Eruptions
RT	Wildfire - U.S.

APPENDIX C 5. Common QC/OP/Null Code Combinations

QC Code	Op Code	Null Code	Description
0	0		Valid Data
10	69	BD	Automated QC check, invalid data
0	1	BF	Automated QC check, valid zero data
0	2	BF	Automated QC check, valid precision data
0	4	BF	Automated QC check, valid span data
10	67	BD	Trace CO auto zero check, invalid data
7	7	AI	Insufficient data
13	64	AY	BAM zero-filter check
11	68	AT	Semiannual multi-point calibration
43	59	BR	Value less than negative MDL
10	63	DL	MDL check
12	62	AZ	BAM bi-monthly flow check or normal maintenance of analyzers
14	60	BL	QA Audit

APPENDIX D 1. List of Automated QC Checks

THIS PAGE IS LEFT BLANK INTENTIONALLY.

DMS Auto-QC Criteria

Parameter	Duration	QC Check	Start Hour	End Hour	Value (ppb)	Data Points	QC Code	Description
Ozone	1 Hr	Range (<)	0	23	-5		43- Value below MDL	Flags values < negative MDL
Ozone	1 Hr	Range (>)	0	23	150		9-Invalid	Flags hourly values > Value as invalid
Ozone	1 Hr	Range (>)	0	23	110		5-Suspect	Flags hourly values > Value as suspect
Ozone	1 Hr	Rate of Change	0	23	25		5-Suspect	Flags hourly value if rate of change is more than 25
Ozone	1 Hr	Sticking	0	23		5	5-Suspect	Flags hourly O3 value if same for 5 consecutive hours
O3 Box Temp	1 Hr	Range (>)	0	23	39.9		32-Shelter Temp	Flags hourly O3 value if box temp more than 39.9

Parameter	Duration	QC Check	Start Hour	End Hour	Value (ppm)	Data Points	QC Code	Description
TCO	1 Hr	Range (<)	0	23	-0.02		43- Value below MDL	Flags values < negative MDL
TCO[5]	1 Hr	Range (>)	0	23	5		9-Invalid	Flags hourly values > Value as invalid
TCO[5]	1 Hr	Range (>)	0	23	3		5-Suspect	Flags hourly values > Value as suspect
TCO [4]	1 Hr	Rate of Change	0	23	1.5		5-Suspect	Flags hourly value if rate of change is more than 1.5 ppm
TCO	1 Hr	Sticking	0	23		5	9-Invalid	Flags hourly TCO value if same for 5 consecutive hours
TCO	1 min	Sticking	0	23		6	9-Invalid	Flags API300EU auto-ref data invalid

Parameter	Duration	QC Check	Start Hour	End Hour	Value (ppb)	Data Points	QC Code	Description
NO/NOx	1 Hr	Range (<)	0	23	-2.7		43- Value below MDL	Flags values < negative MDL
NO/NOx	1 Hr	Range (>)	0	23	500		9-Invalid	Flags hourly values > Value as invalid
NO/NOx	1 Hr	Range (>)	0	23	350		5-Suspect	Flags hourly values > Value as suspect
NO/NOx[4]	1 Hr	Rate of Change	0	23	30		5-Suspect	Flags hourly value if rate of change is more than 30 ppb***
NO/NOx	1 Hr	Sticking	0	23		5	5-Suspect	Flags hourly NOx value if same for 5 consecutive hours
NO	1 Hr	Compare (>=)	0	23			5-Suspect	Flags data if NO values > hourly NOx value for same hour

Parameter	Duration	QC Check	Start Hour	End Hour	Value (ppb)	Data Points	QC Code	Description
NO2	1 Hr	Range (<)	0	23	-2.7		43- Value below MDL	Flags values < negative MDL
NO2	1 Hr	Range (>)	0	23	250		9-Invalid	Flags hourly values > Value as invalid
NO2	1 Hr	Range (>)	0	23	150		5-Suspect	Flags hourly values > Value as suspect
NO2[4]	1 Hr	Rate of Change	0	23	30		5-Suspect	Flags hourly value if rate of change is more than 30 ppb***
NO2	1 Hr	Sticking	0	23		5	5-Suspect	Flags hourly NO2 value if same for 5 consecutive hours

Parameter	Duration	QC Check	Start Hour	End Hour	Value (ppb)	Data Points	QC Code	Description
SO2	1 Hr	Range (<)	0	23	-0.2		43- Value below MDL	Flags values < negative MDL
SO2	1 Hr	Range (>)	0	23	100		9-Invalid	Flags hourly values > Value as invalid
SO2	1 Hr	Range (>)	0	23	50		5-Suspect	Flags hourly values > Value as suspect
SO2	1 Hr	Rate of Change	0	23	25		5-Suspect	Flags hourly value if rate of change is more than 25
SO2	1 Hr	Sticking	0	23		5	5-Suspect	Flags hourly SO2 value if same for 5 consecutive hours

Parameter	Duration	QC Check	Start Hour	End Hour	Value (ug/m3 LC)	Data Points	QC Code	Description
BAM[1]	1 Hr	Range (<)	0	23	-2, -3 or -4		43- Value below MDL	Flags values < negative MDL
BAM[1]	1 Hr	Range (>)	0	23	700		9 - Invalid	Flags hourly values > Value as invalid
BAM[1]	1 Hr	Sticking	0	23	0	4	5 - Suspect	Will flag if hourly value same for 4 consecutive hours
BAM10	1 Hr	Range (>)	0	23	400	5	5- Suspect	Flags BAM10 values >400 as Suspect
Qtot[2]	1 Hr	Range (<)	0	23	<.697		4 - Suspect Flow	Flags BAM_FEM values if Qtot < .697 m3/min
Qtot[2]	1 Hr	Range (>)	0	23	>.703		40-Sample flow out of limits	Flags BAM_FEM values if Qtot > .703 m3/min
Qtot[2]	1 Hr	Range (<)	0	23	<.600		40-Sample flow out of limits	Flags BAM_FEM values if Qtot < .600 m3/min
Qtot [3]	1 Hr	Range (<)	0	23	<.830		4 - Suspect Flow	Flags BAM values if Qtot < .830 m3/min
Qtot [3]	1 Hr	Range (<)	0	23	0.7		40-Sample flow out of limits	Flags BAM values if Qtot > .700 m3/min
Qtot [3]	1 Hr	Range (>)	0	23	>.837		40-Sample flow out of limits	Flags BAM values if Qtot > .837 m3/min

[1] This includes BAM25, BAM25_a, b,c (collocated BAMs), BAM25_FEM, BAMPMC, BAM10 (Actual Conditions), BAM10_S (Local Conditions - units: ug/m3 25C)
[2] Applies to BAM25 FEM samplers
[3] Applies to Non-FEM BAM25 samplers
[4] NOx, NO2, and NO and TCO rate of change for Calexico and Fresno is 60 ppb and 3 ppm respectively.
[5] TCO max suspect and max invalid for Calexico are 5 and 8 ppm.
REMINDER: When copying QC checks from sites, Verify POC settings within QC Checks.

AIRNow's QC Criteria

Parameter	Max Suspect	Max Severe	Rate of Change	# of Sticking Hours	Sticking Value (low value)	Fed MDL
O3 (ppb)	130 (110)	150	40 (25)	5	40 (10)	5 ppb
NOx (ppb)	350	500	30	3	5 (0)	2.7 ppb
NO (ppb)	350	500	30	10	5 (0)	2.7 ppb
NO2 (ppb)	150	250	50	10	0	2.7 ppb
TCO (ppm)	8 (3)	12 (5)	5 (1.5)	15	0	.02 ppm
TSO2 (ppb)	150 (50)	200 (100)	100 (25)	5	5 (0)	.2 ppb
PM25 (ug/m3)	100	200	50	4	10 (0)	2 ug/m3 (3 ug/m3 non-FEM)

*(Red) values in parentheses denote what we implemented in DMS which is a deviation from AIRNow QC Criteria.