

Operation Manual

RFInvestigator-FM

Version 2.6

by
Joseph M. DiPietro PE
and
Marshall Sutherland

with
Alexandra Johnson, Jennifer Hickman,
and Shayna Sutherland

Copyright 1997, 2002 by rfEngineers, Inc.
Copyright 2002, 2005 by rfSoftware, Inc.
1213 NW 16th Avenue
Gainesville, Florida 32601
USA

All rights reserved. No part of this book may be reproduced, in any form or by any means, without the written permission of rfSoftware, Inc.

The names of all products and services mentioned in this book are the trademarks or service marks of their respective companies or organizations.

Printed in the United States of America

Contents

INTRODUCTION TO RFINVESTIGATOR V2.6.....	11
Minimum Computer System Requirements.....	13
Processor Type and Speed	13
Operating System.....	13
Disk Space	13
RAM	13
Video Display	13
Recommendations for Better Performance	13
Installing rfInvestigator.....	14
The Installer program.....	14
MDAC and DCom	14
Activating rfInvestigator	15
3-second Data.....	15
Census Block and Demographic Data	16
Supplemental Maps.....	16
Program and Database Updates	17
Updating rfInvestigator	17
Updating the Master Database if you don't have Database Builder	17
Installing an Updated Master Database	17
Installing other Databases	17
Initial Settings	17
The Program Folder	19
The rfSoftware Folder.....	19
The Database Folder	19
The Resources Folder	19
The Jobs Folder.....	20
Other Folders used by rfInvestigator.....	20
The System Folder	20
The Cache Folder.....	20
Uninstalling rfInvestigator	21
DbBuilder (Database Builder)	21
Installing DbBuilder.....	21
First Look	22
rfInvestigator Main Form.....	22
Pop-Up Menus	22
Help Files	22
Build and Open Your First Job	23

Investigating Your First Job.....	24
What's New in rfInvestigator Version 2.5	26
Automatic Program Updates.....	26
Improved TOPO! Map Support	26
Improved Automatic DA design tool.....	26
New Resolutions for PL Server	26
Optional Advanced Features in rfInvestigator Version 2.5	26
One-Click Site Information.....	26
M3 Ground Conductivity Boundaries.....	26
ESRI Shape Files	27
Map Labels.....	27
Pathloss Profiles.....	27
Export Propagation Jobs to Other Mapping Programs	27
Adjustable Line Weights.....	27
Audemat-Aztec Field Survey Analysis.....	28
Adjustable Job Scan Range.....	28
Contour Calculator.....	28
Close-Up Window	29
Manual Contours.....	29
What's New in rfInvestigator Version 2.6	31
FCC Monitoring Stations.....	31
Quiet Zones.....	31
Airports and Runways.....	31
County and State Names.....	31
Copy Map to Clipboard	31
Export Map Layers	31
Population Count with Block Level Census Data.....	31
Census Demographics.....	31
TV Channel 6 Interference Analysis.....	31
Registered Tower Display.....	31
JOBS	33
Job Fundamentals.....	34
Overview.....	34
Parts of a Job.....	34
Valid Range of a Job.....	34
Types of Analysis	34
Opening an Existing Job.....	35
Building a New Job	35
The Build-New-Job Process	35
Other Methods of Building a Template Job.....	35
The Job Map.....	36

Overview.....	36
Types of Stations.....	36
Proposed Station Control	36
Affected Station Control.....	37
Analysis/Underlay and Vector Controls	37
The Job Map Pop-Up Menu.....	38
Map Options Control	38
The Mouse Information Bar.....	39
The Map Close-Up Window	39
The One-Click Site Information Window.....	40
The Map Center Information Window	40
Controlling Colors	41
Controlling Line Weights	41
The Job Grid	42
Overview.....	42
Manipulating Columns.....	42
The Fields Selector	43
The Pop-Up Menu.....	43
The Contour Manager.....	44
Overview.....	44
Contour Groups.....	44
Adding a Proposed Station at Map Center.....	44
Adding Affected Stations.....	44
Adding Stations from the Grid.....	44
The Pop-Up Menu.....	45
Contour Options.....	45
Printing Maps and Grids.....	46
Terrain Data	46
30 and 3 second DEM's	46
1 second High-Res and 1/3 second Ultra High-Res DEM's.....	46
Data Sources	46
Population Data.....	47
Population Distribution on a Grid.....	47
LULC Data	47
User Underlays	47
Overview.....	47
Registering an Image	48
Displaying User Underlays.....	48
Job Analysis.....	49
73.207 Overview.....	49
73.215 Overview.....	49

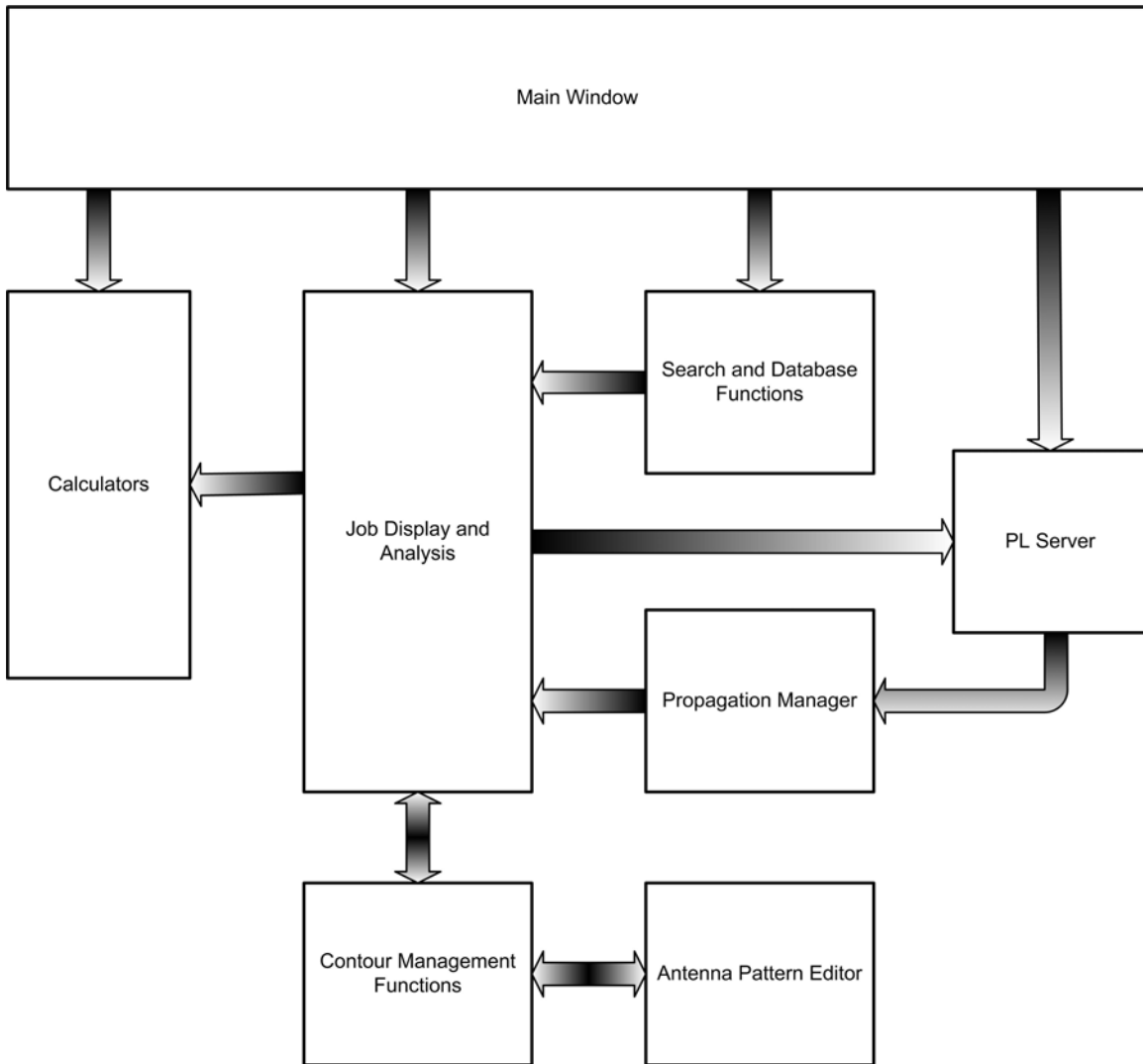
NCE Overview	50
Auto Scan.....	50
Range and Clearance.....	50
City of License	51
Translators and Boosters	52
Introduction.....	52
How to Place a Translator or Booster.....	52
What-If's.....	53
CONTOURS	55
The Contour Manager.....	56
Overview.....	56
Proposed Stations.....	56
Overview.....	56
Job Center	56
Existing Stations	56
Affected Stations	57
Overview.....	57
Job Center	57
Existing Stations	57
Types of contours	57
City Grade.....	57
Protected/Interfering Pairs	57
70, 60, 54dBu.....	57
Grade A/B.....	58
User Defined.....	58
Manual Contours - <i>Advanced Feature</i>	58
Adding the Job Center to the Contour List.....	58
Overview.....	58
8 Radial HAT's.....	58
Site Elevation and Antenna Height.....	59
Selecting Antenna and Max ERP.....	59
Selecting Contour Type	59
User Defined Contours	60
Adding the Short (Affected) Stations to the Contour List	60
Overview.....	60
Contour Options.....	61
Overview.....	61
Contour Options.....	61

Contour Editor	62
Overview.....	62
General.....	62
Antenna.....	62
HAT Radials	63
Appearance	63
Pop/Area	63
Census Blocks and Demographics.....	64
Counting Census Blocks.....	65
Selecting/Creating/Editing Antenna Patterns	66
Overview.....	66
Pattern, Grid and Contour Views.....	66
Saving and Exporting a Finished Pattern.....	67
Design Controls	67
The Automatic Antenna Tuner	67
Designing a Booster with the Automatic Antenna Tuner:.....	69
Manual Contours - Advanced Feature	71
Overview.....	71
Lines and Circles.....	71
12-Point Contours.....	72
Manual Contour Files	72
CALCULATORS.....	75
The Terrain Profiler	76
Overview.....	76
Job Map ‘Rubber-Band’ Lines.....	76
The Lat-Lon Calculator.....	76
Profiler Options Screen.....	76
Profiler Controls.....	77
The Link Budget Tool.....	78
Overview.....	78
Terrain Roughness Calculator.....	79
Overview.....	79
Terrain Roughness: Standard Radials Dialog.....	79
Terrain Roughness: Special Radial Dialog.....	79
Max ERP Calculator.....	80
Lat/Lon Calculator	80
SEARCHING FOR DATA.....	83
Basic Searches	84

Overview.....	84
Starting a Basic Database Search.....	84
Selecting a Database	84
Searchable Fields	84
Searching by Multiple Fields	84
Wildcard Searches, *,?, #.....	84
The Data Display Screen	85
Overview.....	85
Sorting Data	85
Changing Displayed Fields and Field Order.....	85
Exporting Data to a CSV File	86
SQL Basics.....	86
What is SQL?.....	86
Data Manipulation Language.....	86
Accessing the Query Manager	86
Building Queries	87
Saving Queries	89
The Master Database.....	89
Overview.....	89
Data Tables and Fields.....	90
Database Options	90
Naming Convention.....	90
The Database Folder	90
Building a Master Database.....	91
The Local Database.....	91
Overview.....	91
Data Tables, Records and Fields.....	91
Finding Records in the Local/Master Database.....	91
Searching For Records.....	91
Sorting Records.....	92
Manipulating Records.....	92
The Job Database.....	93
Overview.....	93
The Job Information Table.....	93
Adding Markers to a Job.....	93
Editing Markers in the Job.....	94
Sending Markers to the Master (Local) Database.....	94
Exporting Data	94
CSV File Format	94
Data Available for Export.....	95

ADVANCED TOPICS: PROPAGATION	97
Overview	98
Creating Path-loss Files.....	98
Overview.....	98
Propagation Queue File Control	98
Adding a New Station.....	99
Station Settings	99
Model Settings	99
Boundary Settings.....	100
Bins	100
Templates	100
Building the Path Loss File.....	101
Creating Propagation Files	101
Overview.....	101
The Propagation Manager.....	101
Coverage	102
Best Server.....	102
Interference	102
Building the File	102
Propagation Display and Analysis.....	103
Overview.....	103
Coverage/Best Server Tab	103
Interference Tab	103
APPENDIX A	105
Projecting a Curved Surface onto a Flat Screen.....	105
Overview.....	105
Transverse Mercator	105
FCC Rules: 73.208.....	106
Limits of the Job Map.....	106
Underlay Maps.....	106
APPENDIX B	107
Definition of Antenna Height.....	107
APPENDIX C	109
External Queue File Format	109

Introduction to rfInvestigator V2.6



Minimum Computer System Requirements

Processor Type and Speed

Minimum:	Pentium II 300 MHz
Recommended:	Pentium IV 2 GHz or better

Operating System

Partial Support with:

Windows 98 Second Edition (Version 4.10.222)
Windows ME (Version 4.90.3000)
Windows NT Service Pack 4 (Version 4.0.1381)

Full Support with:

Windows 2000 (Version 5.0.2195)
Windows XP (Version 5.1.2600)
Windows Server 2003 (Version 5.2.2600 & up)

Disk Space

1 GB without **DbBuilder**, 1.7 with **DbBuilder** (Database Builder).
Up to an additional 3 GB is needed for Census Block and Demographics.
Up to an additional 80 GB may be needed for TOPO maps.

RAM

Minimum:	128 MB, 256 MB for Windows XP
Recommended:	512 MB or more.

Video Display

Minimum:	800 x 600 - 16-bit color
Recommended:	1024 x 768 or better – 24-bit color

Multiple monitors are strongly recommended.

Recommendations for Better Performance

As with most applications, additional memory and/or CPU power will result in improved performance. In particular, additional disk space will permit rfInvestigator to cache a significant amount of commonly used data.

To improve performance in an existing computer we recommend:

- First: add disk space, (a bigger, faster hard drive)
- Second: add memory, and
- Third: upgrade your processor.

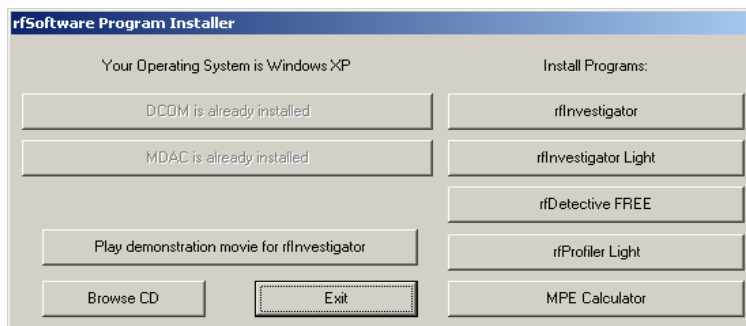
Ask **rfSoftware** about designing and building a high-performance computer, with **rfInvestigator** preinstalled, for you.

Installing rflInvestigator

All **rfSoftware, Inc.** programs have an automatic installer. Should you encounter any problems, Email support@rfsoftware.com or call 352-336-7223. *Be sure to **close** all other rfSoftware programs.* If this is not done, it is possible your installation will not be successful. Use your Task Manager to insure that the RFS Autoupdater and Pathloss Server are not running in the background.

The Installer program

Inserting the **rflInvestigator** CD in your computer will auto-run the Program Installer. Should the auto-run not start the installer, navigate to the CD then launch the application called **Install.exe**.



The installer will test the system for necessary prerequisite files. More information about these files can be found below in the **MDAC and Dcom** section. Once these files are installed, you may proceed with the main program installation by clicking the **rflInvestigator** button.

****IMPORTANT NOTE:** To install software on a computer running Windows NT, Windows 2000 and some versions of Windows XP you must be logged in with **Administrator privileges**.

After installation is complete, press the **exit** button. You may need to reboot your computer after installing **rflInvestigator**. The installer will notify you if a reboot is necessary.

MDAC and DCom

The Installer Program tests your system for the presence of MDAC and DCom. These programs are Microsoft extensions to the Windows™ Operating System and are not part of **rflInvestigator**. They are needed to perform various database access functions. If they are already installed then the buttons will be grayed out. If they are not, pressing the **Install DCom** and/or **Install MDAC** buttons will install these programs on your computer. After installing MDAC and/or DCom you will need to reboot your computer before proceeding to the **rflInvestigator** Install process.

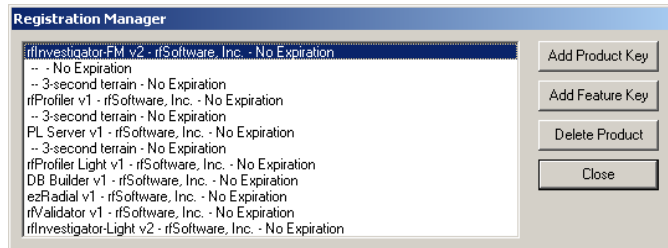
Since MDAC and DCom are Microsoft products, **rfSoftware** has no control over changes and upgrades to these programs. Therefore, it is strongly suggested that you check for operating system critical updates after installing MDAC and /or DCom and before proceeding to install **rflInvestigator**.

Activating rfInvestigator

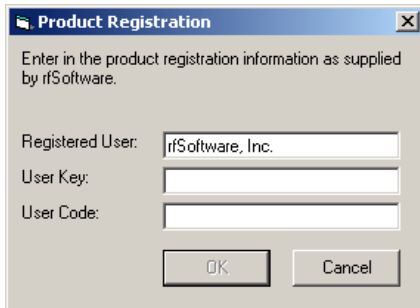
It is strongly suggested that you perform a manual update prior to launching rfInvestigator for the first time. The latest update can be found on-line at <http://www.rfsoftware.com/rfi/downloads.shtml>.

The first time **rfInvestigator** runs you will be presented with the Registration Manager.

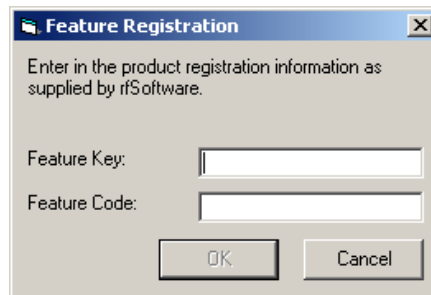
The Registration Manager displays the program name, owner and expiration date of all **rfSoftware** products installed and registered on your computer.



Click the **Add Product Key** button to open the Product Registration dialog.



You will receive registration information by email. Enter the indicated information exactly as it appears in the Registration email. To minimize the possibility of error we recommend you copy and paste the information from the email message.



Advanced features are included with the purchase of Version 2.6. To activate them you should click the **Add Feature Key** button to open the Feature Registration dialog.

Enter the indicated feature information exactly as it appears in your Registration email.

****IMPORTANT NOTE:** If you have purchased any optional features such as 3-second terrain, or Census Blocks you will need to register these using the supplied *Feature Key* and *Feature Code* information.

3-second Data

If you purchased the optional three arc-second terrain data, you will have received a separate CD containing the data.

The three arc-second terrain data may be placed on any available system disk. The recommended location is:

C:\Program Files\rfsoftware\resources\ter3sec

however; it may be placed on another drive, one with more available disk space, for example.

Accessing the data across a network, or reading it directly from the CD will work in most cases. Problems could occur in such a configuration if there are excessive system delays when reading the data.

Regardless of where you place the data, be sure to point to the appropriate data folder in Options – Folders – Terrain, USGS 3-sec.

Census Block and Demographic Data

If you purchased the optional Census Block or Demographic data, you will have received a separate CD containing the data.

The Census Index file, **C2KGeo.mdb**, must be placed in the resources folder.

The Census Block data may be placed on any available system disk. The recommended location is:

C:\Program Files\rfsoftware\resources\P1

The Demographic data may be placed on any available system disk. The recommended locations are:

C:\Program Files\rfsoftware\resources\P4\, ...P5, etc.

however; they may be placed on another drive, one with more available disk space, for example.

Accessing the data across a network, or reading it directly from the CD will work in most cases. Problems could occur in such a configuration if there are excessive system delays when reading the data.

Regardless of where you place the data, be sure to point to the appropriate data folder in Options – Folders – Census Blocks, and Options – Folders – Census Demographics.

Supplemental Maps

County and state boundaries are available from both the 1990 and the 2000 census. 1990 Census Maps are in NAD-27, 2000 Census Maps are NAD-83.

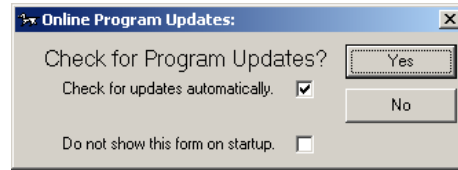
The State Line Maps are stored in the file “*stmaph.dat*” and the County Line Maps in “*comaph.dat*”.

The program looks for these files in the Resources folder. The 2000 Census Maps are installed by default. Should you need to use the 1990 maps close all rfSoftware programs on your computer. Replace the **stmaph.dat** and /or **comaph.dat** files in **C:\program files\rfSoftware\Resources** with the ones from your installation CD then restart the program to load the new maps.

Program and Database Updates

Updating rfInvestigator

When you launch the program, the Online Program Updates dialog will appear. It is necessary to be on line in order to check for and download updates. The **first time** you launch the program *it is advised that you select Yes* to be sure you have the most recent version of the program. If you prefer not to see this dialog every time you start the program, check the “**Do not show this form on startup**” box. To check for updates at anytime simply select Help--Updates from the drop down menu.



You will be prompted to install the update when you next close rfInvestigator.

Updating the Master Database if you don't have Database Builder

If you do not have **DbBuilder** registered on your computer you will need to contact **rfSoftware** to obtain a database branded for your serial number.

Installing an Updated Master Database

An updated master database is normally obtained online from:

<http://www.rfsoftware.com/databases/rfInvestigator-FM>.

The database will be in a ZIP file format.

The database MUST be unzipped directly into the database folder. See the instruction included with your zip/unzip utility for information on how to extract a zipped file into a specific folder.

The master database can be identified by its unique file extension of ‘.fmd’. Other files, such as an antenna pattern database or a new sync.bin file, may also be zipped together with a master database. All files should be placed in your database folder. The default database folder is C:\Program Files\rfsoftware\database.

Installing other Databases

Other databases, such as the Antenna Pattern database, Antenna Structure database and Airport database, are normally obtained online from the **rfSoftware** website. Most databases are zipped. See the instruction included with your zip/unzip utility for instructions on how to extract a zipped file into a specific folder. Place the database files in the same folder as the master database.

Initial Settings

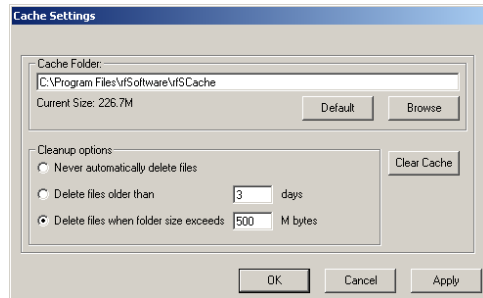
Several programs settings should be reviewed and possibly modified after installing **rfInvestigator**.

Cache Settings

From the Options menu, select Cache....

The Cache Folder should be placed on your computer's fastest internal disk drive.

Under most circumstances the best choice for Cleanup options is "**Delete files when folder size exceeds**" N .



Depending on the speed and available disk space on your computer the value of N should be between set to 100 and 500 Mbytes.

If you set your cache threshold too small, your computer will be deleting data that it may need to reuse. If the cache size is set too large, your computer will waste time searching for data.

If your cache size exceeds the threshold you have set, **rfInvestigator** will begin deleting the older cached files.

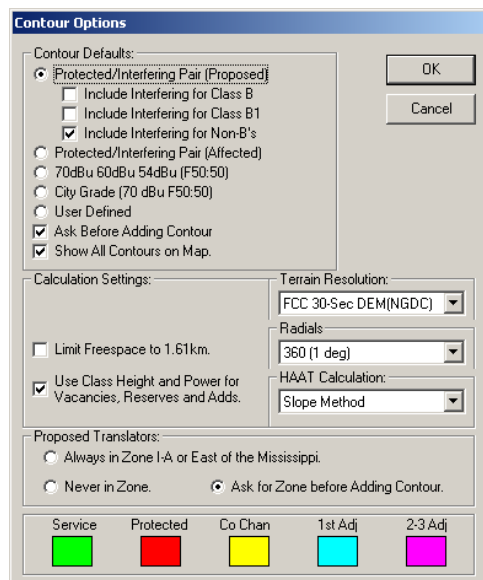
Contour Settings

From the Options menu, select Contours....

Contour **Terrain Resolution** should be set to use either *FCC 30-Sec DEM(NGDC)* or, if you purchased the optional 3-Second terrain data, *USGS 3-Sec DEM(DMA)*.

The FCC currently does not accept the use of GLOBE terrain data for FM contours.

The **HAAT Calculation** method should be set to *Slope Method* for normal use and switched to the much slower *FCC Method* for final calculations.



One arc-second terrain data is available.

Contact **rfSoftware** if you need this resolution of terrain data.

Limiting Freespace to 1.61km.

FCC rules state that under certain conditions the distance-to-contour calculation should stop using the prediction tables and switch to the freespace formula.

Doing this in-accordance-with the rules will produce characteristic "spikes" on the contour. Limiting the freespace calculation to 1.61km (the beginning of the FCC curves) smoothes out the contour. Some engineers claim that the FCC has instructed them to set this freespace limit, in disagreement with the rules. Other engineers claim that the contour is wrong if it does not have the "Spike." In an effort to please both camps, rfInvestigator supports both methods.

Select *Limit Freespace to 1.61km* to have smooth contours that **do not** conform to FCC rules.

Uncheck the box to have “Spiked” contours that **do** follow the FCC rules.

The Program Folder

The rfSoftware Folder

By default, the installer creates an **rfSoftware** folder in **C:/Program Files/rfSoftware/**. You may choose a different folder during installation.

The rfSoftware folder contains program executables; uninstall files, libraries and data subfolders.

The Database Folder

The database folder, **C:\Program Files\rfsoftware\database**, is the default location for the FCC Master Database and antenna pattern files.

The Resources Folder

The resources folder, **C:\Program Files\rfsoftware\resources**, holds a wide range of files and subfolders essential to the operation of **rfInvestigator**.

Subfolders include:

lulc30sec—containing land use/land characteristic data files

m3—containing the M3 and R2 ground conductivity data bases

pop30sec—containing population data files

ter30sec—containing the GLOBE 30-second terrain data files

terFCC30sec—containing the FCC 30-second terrain data files

TOPO!_Maps—containing large-scale reference map files, and optionally

ter3sec—containing three second terrain data

Files include:

MS*.dat – These files contain the FCC Minimum Separation Tables.

***.mdb** – These are the vector map databases. They contain information for drawing roads, railroads, hydrology, and city boundaries.

***MapH.dat** – These are the county and state line files.

tipofday.txt – This is a text file with helpful hints on using rfInvestigator.

Sync.bin – This file contains special keys for synchronizing the program to the various compressed databases.

rfInvestigator.chm – This is the rfInvestigator Help file.

motd.ftx – MOTD, or Message-Of-The-Day, contains the text to various system messages. Since the message text is not stored inside

Investigator they can be easily updated without replacing the program executable.

license.txt – This is a copy of the License Agreement.

places.txt – This file contains a list of places, their locations and populations. This file comes from the National Atlas.

fccdb*.txt – This file outlines the tables and fields in the FCC CDBS

Census2k.mdb – This file provides locations and labels for State and County names.

The Jobs Folder

The jobs folder, **C:\Program Files\rftsoftware\jobs**, is the default location for Job Files, Queries and CSV Files.

Other Folders used by rftInvestigator

The System Folder

The program stores files in various other locations. As with most Windows programs, **rftInvestigator** uses library files (*.dll and *.ocx) stored in the Windows System folder.

The System Folder varies with operating system, but is usually:

C:/Windows/System in Windows 95, 98 or Millennium, and
C:/.../System32 in Windows 2000, XP or NT

The Cache Folder

Some of the files created by **rftInvestigator** are cached in this system Temp folder. These files include:

- *.contour – Contour Information files. Once a contour file is created for a site, new contours can be created and existing contours can be changed very quickly.
- *.ter – Terrain Information files.
- *.pop – Population Information files.
- *.bmp – Terrain Map files.

Any file stored in the *Cache* folder may be deleted as long as **rftInvestigator** is *not* running. If the program needs a deleted file, it will simply recreate that file. However, if you do not delete the files **rftInvestigator** will run significantly faster.

If your disk space used by cached files exceeds a settable threshold **rftInvestigator** will begin deleting the older cached files.

Uninstalling rfInvestigator

Should it become necessary to uninstall the program you should first follow the Windows Add/Remove Programs process accessible via the Windows Control Panel.

If you have no other rfSoftware products on your computer, remove the **C:\Program Files\rfSoftware** folder.

DbBuilder (Database Builder)

If you have purchased a license to **DbBuilder**, you will have received a *User Key* and *User Code* for that product.

Installing DbBuilder

DbBuilder is a behind-the-scenes utility program that will automatically download data from the FCC website and create a database readable by **rfInvestigator**. It is an independent program, so you can continue to use **rfInvestigator** while building a database. Alternatively, **DbBuilder** can run on a second computer so it won't slow down your work.

DbBuilder only needs to be installed if you plan to make your own databases.

Most people choose to download preprocessed databases from the **rfSoftware** website. A processed database is typically less than ten megabytes whereas the raw FCC data is more than forty megabytes.

Processed **rfSoftware** databases are available on-line at:
<http://www.rfsoftware.com/databases/rfInvestigator-FM/>

To use a processed database *you do not need to install the **DbBuilder** program, but **DbBuilder needs to be registered** on your computer.*

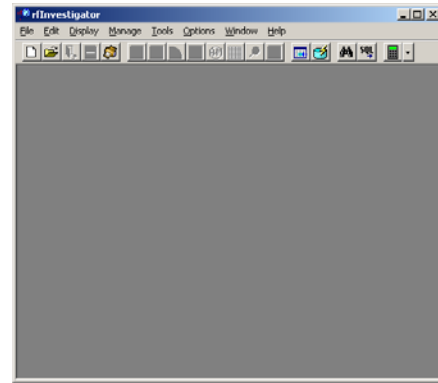
If you choose to install **DbBuilder** simply, navigate to the CD then, execute the program "*installdatabasebuilder.exe*" and follow the directions.

The Master database is a collection of files located in the database folder.

The default database folder is **C:\Program Files\rfSoftware\database**.

First Look

The installation process should have placed an **rflInvestigator** Icon on your computer desktop. Double-clicking on this Icon will launch the program. Alternatively, you can use the **Start** button by selecting: **Start--Program Files--rfSoftware--rflInvestigator**.



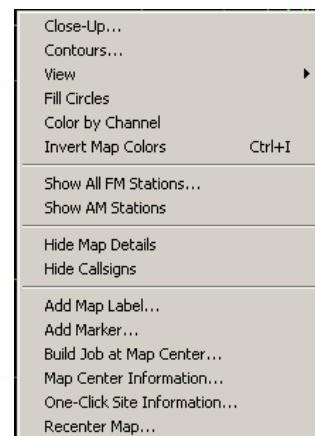
rflInvestigator Main Form

When you launch **rflInvestigator**, the first thing you will see is the Main Form. The Main Form contains drop-down menus and a button-bar for convenient access to various program features. See the section on **Job Map** for more information about buttons and controls.

Pop-Up Menus

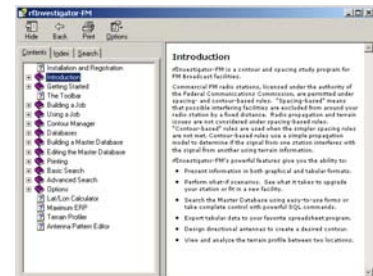
Various different *Pop-up* menus appear throughout the program. Some of the places they will appear from the *Main Program Window*, the *Job Map*, the *Job Grid*, the *Job Grid Headers* and the tabs of different dialog boxes. To access them, first place the mouse pointer in a window or select an item of interest. Then click the right mouse button.

The different Pop-up menus will have short cuts to many of the frequently used tools and additional dialogs.



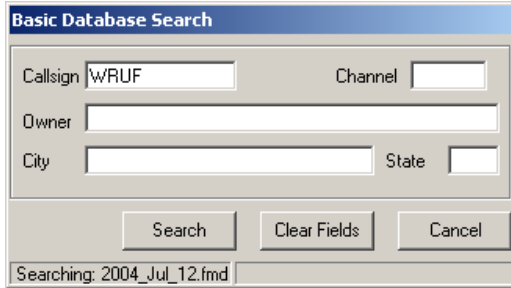
Help Files

Help is available by selecting Contents from the Help menu or by pressing the F1 key. F1 will bring you the help screen appropriate to the current window.



Build and Open Your First Job

The main feature of **rflInvestigator** is Job Analysis. The first step to Job Analysis is building a job. One method for building a job is described below.



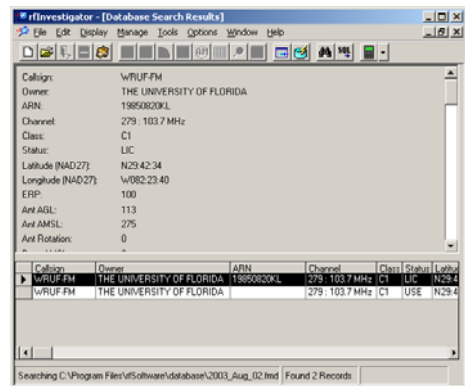
The Basic Database Search dialog box contains the following fields and controls:

- Callsign: WRUF
- Channel: [Empty]
- Owner: [Empty]
- City: [Empty]
- State: [Empty]
- Buttons: Search, Clear Fields, Cancel
- Status bar: Searching: 2004_Jul_12.fmd

From the Main Window's Tools menu select Find: Basic Database Search.... Select a Master Database. After the database is opened, the Basic Database Search dialog will be displayed. Enter the call sign of a station-of-interest, and then click the **Search** button.

The Search Results Window will open listing the database records that matched your search criteria.

Select one of the records from the grid display in the bottom portion of the window. Right-click your mouse and select *Build this Job* from the pop-up menu.



The Search Results window displays the following information:

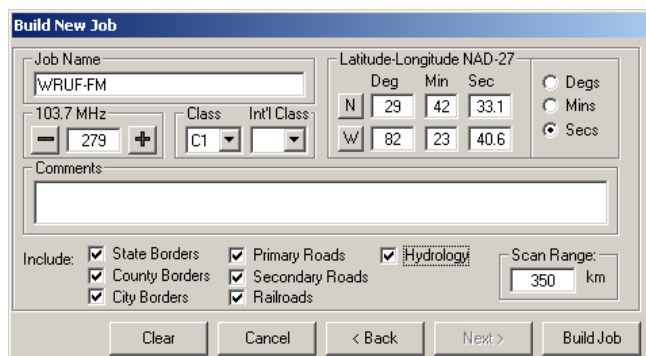
- Callsign: WRUF-FM
- Owner: THE UNIVERSITY OF FLORIDA
- ARN: 19850820K1
- Channel: 279 - 103.7 MHz
- Class: C1
- Status: LIC
- Latitude (NAD27): N29:42:34
- Longitude (NAD27): W082:23:40
- ERP: 100
- Ant AGL: 113
- Ant AMSL: 275
- Ant Rotation: 0

Callsign	Owner	ARN	Channel	Class	Status	Latitude
WRUF-FM	THE UNIVERSITY OF FLORIDA	19850820K1	279 - 103.7 MHz	C1	LIC	N29:42:34
WRUF-FM	THE UNIVERSITY OF FLORIDA		279 - 103.7 MHz	C1	USE	N29:42:34

Searching C:\Program Files\Software\database\2003_Aug_02.fmd Found 2 Records

The Build New Job dialog will be displayed filled out with your chosen stations information.

Click the **Build Job** button. Select a name for the job file and click the **OK** button. The job will build and then open.



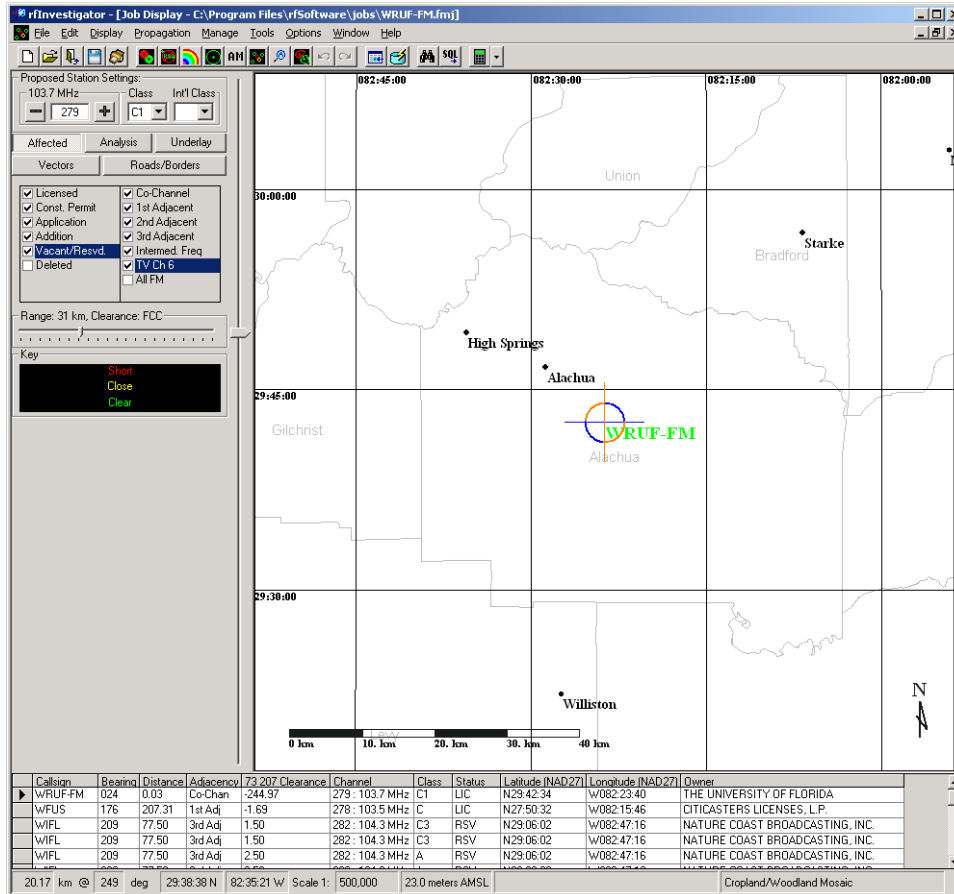
The Build New Job dialog box contains the following fields and controls:

- Job Name: WRUF-FM
- Latitude-Longitude NAD-27: N 29 42 33.1, W 82 23 40.6
- Frequency: 103.7 MHz
- Class: C1
- Int'l Class: [Empty]
- Comments: [Empty text area]
- Include: State Borders, County Borders, City Borders, Primary Roads, Secondary Roads, Railroads, Hydrology
- Scan Range: 350 km
- Buttons: Clear, Cancel, < Back, Next >, Build Job

Investigating Your First Job

Use the Affected, Analysis, Underlay, Vectors and Roads/Borders controls to show and hide various features on the Job Map display.

The vertical slider control on the left-hand side of the map controls the zoom level.



Click and drag a *rubber-band* line on the map to view *range* and *bearing* between two points and display a *path profile*.

Double-click on the map to re-center at the mouse pointer's location.

As you move the mouse about the screen note that the mouse coordinates, elevation and distance/bearing from map center is displayed on the lower task bar.

If you have a three-button mouse press the center button and instantly calculate the Height of Average Terrain for the current mouse position.

These are just a few of the many things you can do with rfInvestigator. To learn more, read on!

What's New in *rfInvestigator* Version 2.5

Automatic Program Updates

rfInvestigator will periodically check the **rfSoftware** website for updates when you are on-line. Program updates can be downloaded and installed with just a few mouse clicks.

Improved TOPO! Map Support

Seamless support for TOPO! Version 2 and Version3. Map layers 1 and 2 are pre-installed for the Continental US and Hawaii.

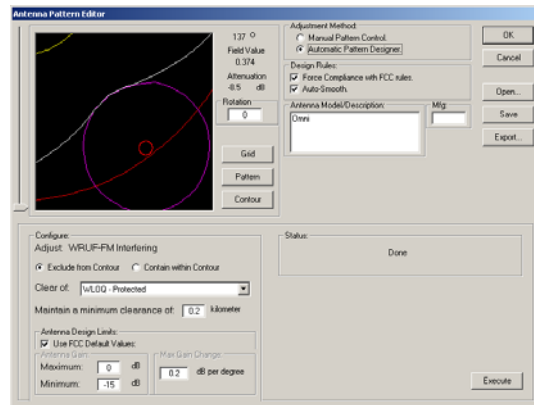
Improved Automatic DA design tool

New pick-and-click auto tuner

User settable design limits.
Automatically adjust a contour to be clear of another contour.

New Booster Feature

Automatically adjust a contour to remain within another contour.



New Resolutions for PL Server

Now build pathloss files with six and nine second resolutions.

Optional Advanced Features in *rfInvestigator* Version 2.5

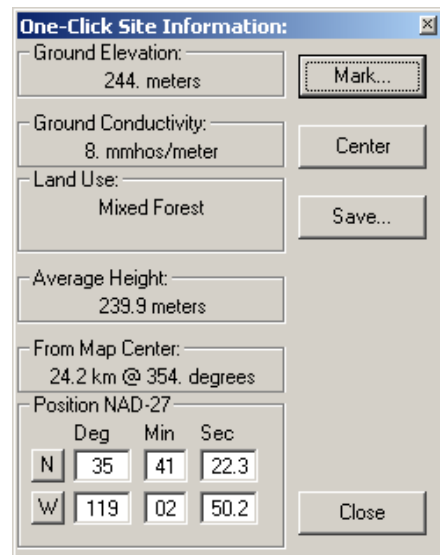
One-Click Site Information

Click the mouse anywhere on the *Job Map* and see a list of information for that site

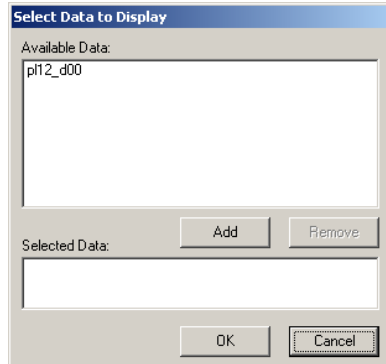
The One-Click dialog is accessible from the Display menu or the *Job Map* pop-up menu.

M3 Ground Conductivity Boundaries

Select **M3 Data** from the *Job Map* Vectors tab to display conductivity boundaries. Use the One-Click Site Information tool to identify the conductivity value within a particular boundary.



ESRI Shape Files



Shape files are a standard format for vector mapping information. Simply place any lat/lon referenced set of shape files in the .../rfSoftware/Shapefiles/ folder.

Select ESRI Shape Files... from the Manage menu to display a list of available shape files. Select or deselect files as desired.

Finally, select *Shapefiles* from the *Job Map Vectors* tab.

Map Labels

With the new Map Labels tool, you can place and move labels on the *Job Map* and independently set font type, size and color.

You activate the Map Labels dialog by selecting Labels... from the Edit menu or by selecting Add Map Label... from the *Job Map Pop-Up* menu.

While the Map Labels dialog is active, labels can be dragged and dropped around the *Job Map* using the mouse.



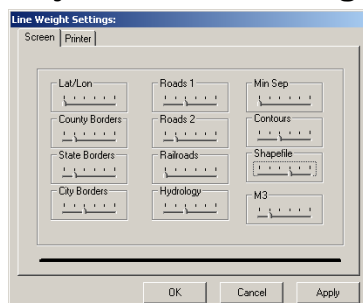
Pathloss Profiles

Define a radial path using the Lat/Lon or Rubber-Band tool then export the predicted pathloss and signal strength for points along the path.

Export Propagation Jobs to Other Mapping Programs

Select Export: Coverage to CSV... from the Tools menu to send the current propagation job to a standard map file format. This feature is also available from the Coverage Manager pop-up menu.

Adjustable Line Weights

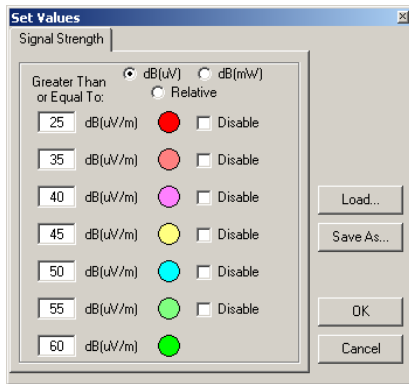


Now set the line weight for any vector. Video screen line weights and printer line weights are set with Independent controls.

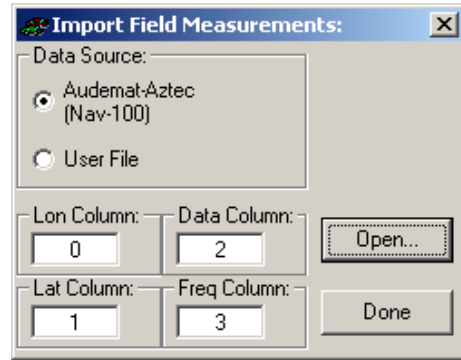
Access the Line Weight Settings dialog from the Options menu.

Audemat-Aztec Field Survey Analysis

Import *Audemat-Aztec* files or user-defined files from other field measurement systems.

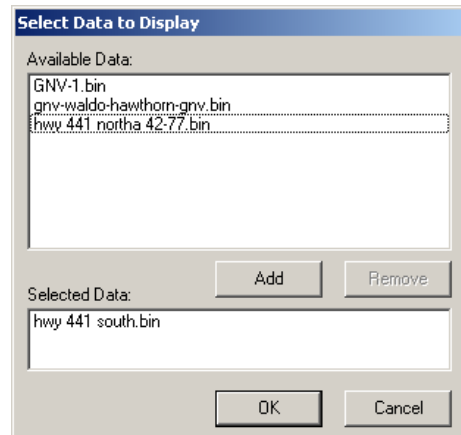


Set signal strength ranges and colors for each analysis.

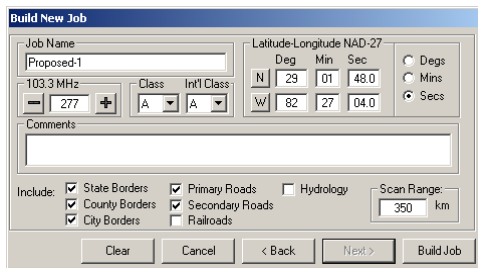


Selectively display data by moving files back and forth between the Available and Selected data windows.

The Available Data window will only display files that are within the current job view.



Adjustable Job Scan Range

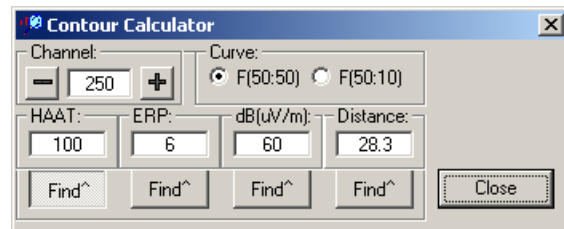


The Build New Job dialog now has user definable scan range.

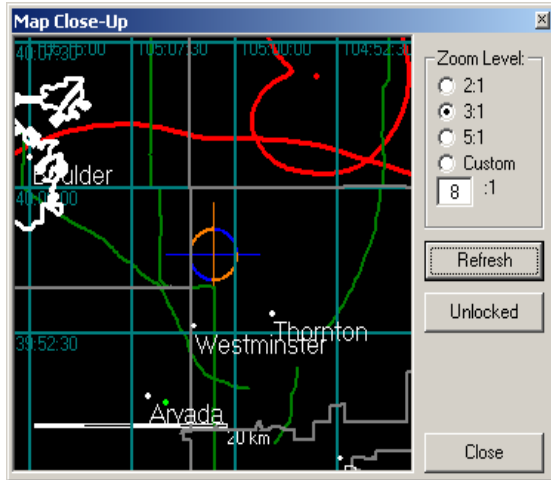
You decide which vector maps to include or leave out of a job.

Contour Calculator

Click the appropriate **Find^** button to lock any one of four parameters. Vary the three unlocked settings and instantly calculate the value of the locked parameter.



Close-Up Window



The close-up window is a resizable, floating map window that displays a close-up view of the region surrounding the current mouse position. The close-up view automatically updates as the mouse moves around the screen.

You can access the close-up window from the main menu by selecting **Display--Close-Up...**, or by right-clicking on the map and selecting **Close-Up...** from the Pop-Up menu.

Manual Contours

With manual contours, you can draw shapes on the Job Map. Circles can be drawn by specifying a center point and radius. Lines use a starting point and a bearing and length.

Simple polygons can be created by specifying the distance-to-contour for 12 evenly spaced points.

Distance-To-Contour (km):			
0-degrees:	90-degrees:	180-degrees:	270-degrees:
5.0	5.0	5.0	5.0
30-degrees:	120-degrees:	210-degrees:	300-degrees:
5.0	5.0	5.0	5.0
60-degrees:	150-degrees:	240-degrees:	330-degrees:
5.0	5.0	5.0	5.0

A more complex shape can be created using up-to 360 distance-to-contour values specified in a text file.

What's New in *rfInvestigator* Version 2.6

FCC Monitoring Stations

Display the location of monitoring stations requiring protection under 73.1030(c).

Quiet Zones

Table Rock and the National/Naval Observatory quiet zones are displayed on the map making compliance with rule 73.1030(a) and (b) a snap!

Airports and Runways

All public airfields and designated runways can be displayed on the map. An indispensable aid when searching for new tower sites.

County and State Names

A great help for those of us who struggled a bit in geography class!

Copy Map to Clipboard

Handy when making custom reports with your favorite word processor. You will wonder how you got by without it!

Export Map Layers

With one click of your mouse you can export a collection of bitmaps each containing a different layer of map information. Import these layers into your favorite graphics program to create presentation quality maps.

Population Count with Block Level Census Data

Population counts using the most detailed data available from the US Census. Uses approximately 8,500,000 discrete population blocks. Demographics by-Race included. (optional feature)

Census Demographics

Choose any of the hundreds of demographic breakdowns defined by the US Census. Filter your population counts by the demographic boundaries. (optional feature)

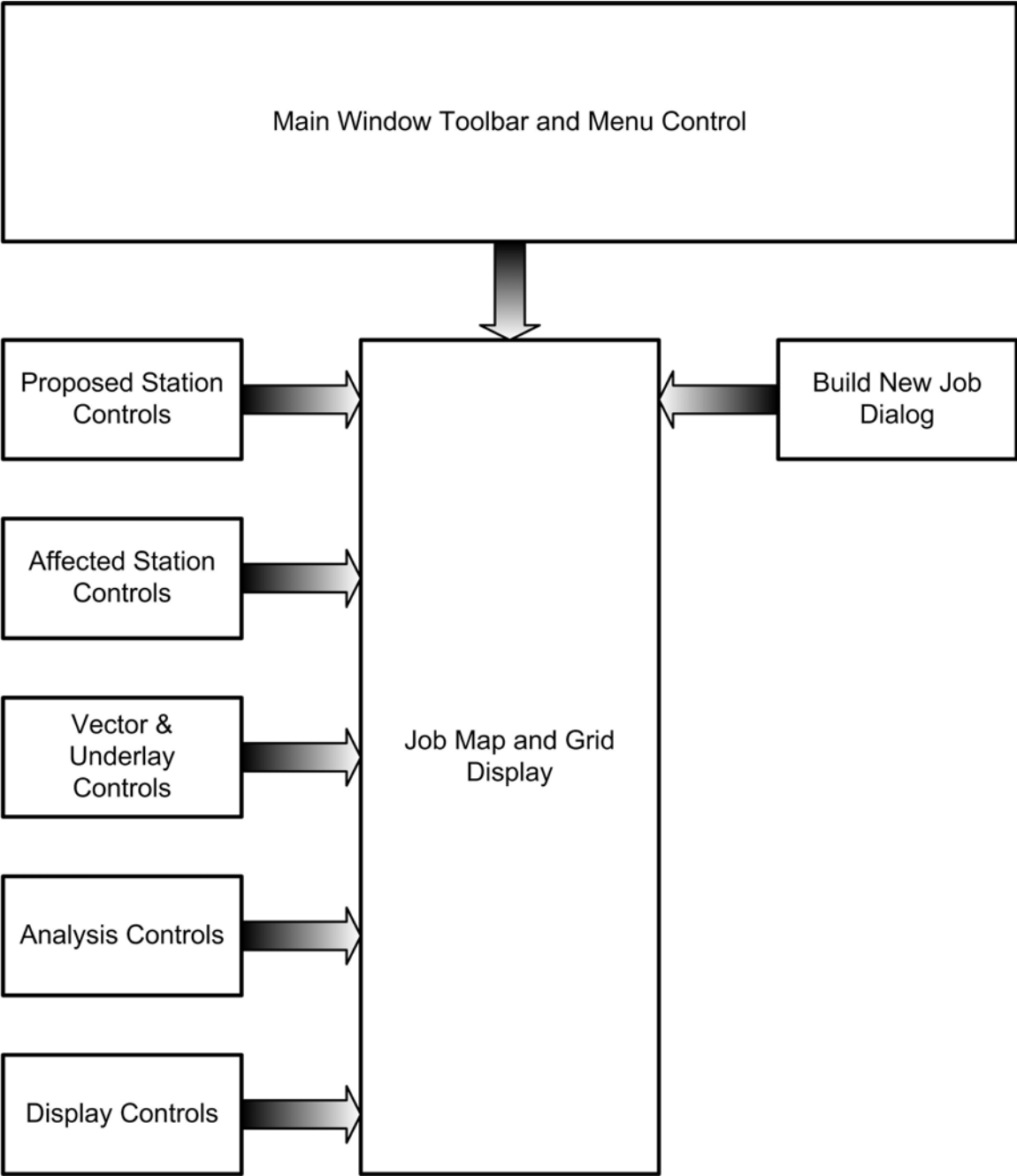
TV Channel 6 Interference Analysis

Fully automatic analysis and population count in accordance with 73.525. (optional feature)

Registered Tower Display

Invaluable when searching for new sites. Filter by height and distance. (optional feature)

Jobs



Job Fundamentals

Overview

A Job is a subset of the master database. While the master database contains station information for all regions under FCC jurisdiction, a job contains data for a radius of from 150 to 1500 kilometers from the *Job Center*. This job radius or *Scan Range* is a user settable parameter.

In addition to FCC data, a Job contains map data. Depending upon the type of map data and assuming the default *Scan Range* of 350km, information stored in a job is limited to 100 to 450 km from the *Job Center*.

Using a *Scan Range* of 350km, jobs contain sufficient data for the study of a class C station within 60 km from the *Job Center* (49 km if near an international border). Lower powered classes can be studied further from the *Job Center*.

Parts of a Job

Each Job has a *Job Center*, a set of coordinates specified by Longitude/Latitude. When **rflInvestigator** builds a Job, data is gathered for a defined distance in all directions from the *Job Center*.

The fundamental purpose of a Job is to model a hypothetical or *Proposed* station and analyze its interactions with the surrounding *Affected* stations. The *Job Channel* and *Class* represent the Proposed station's channel and class. Unlike the *Job Center*, the Job Channel and Class can be changed without rebuilding the Job.

Valid Range of a Job

A Job has boundaries that limit its range of validity. These boundaries vary with the Scan Range, Job Class and the type of analysis being performed.

A default Job includes:

- Station Information, FM, AM and TV-6 within 350 km of Job Center
- Roads, Rails and Hydrology within a minimum of 50 km of Job Center
- State Borders for State center points within 700 km of Job Center
- County Borders for County center points within 475 km of Job Center
- Markers and Place Names within 350 km of Job Center
- City Boundaries a minimum of 50 km from the Job Center

Types of Analysis

rflInvestigator provides for several types of analysis within a Job.

- 73.207 Minimum Separation
- 73.215 Minimum Separation
- 73.333 Contours
- Propagation Coverage
- Propagation Interference
- Propagation Best Server
- Field Measurements

Opening an Existing Job



An existing Job can be opened by pressing the **Open Job** button, selecting **Open Job** from the **File** menu or right clicking on the **Main Form** and selecting **Open Job** from the pop-up menu.

The **File** and pop-up menus also allow you to select one of the five most-recently-used Jobs to open.

Building a New Job

The Build-New-Job Process



The build-new-job process can be started by pressing the **Build New Job** button, selecting **New Job...** from the **File** menu or right clicking on the **Main Form** and selecting **Open Job...** from a *pop-up* menu.

A new Job requires the following information:

- Data Source; an rfInvestigator Master Database
- Channel; an integer between 200 and 300
- Class; A, B, B1, C, C0, C1, C2, C3, L1, L2, DB or DX
- Job Center; specified by Longitude/Latitude
- Job Name

The information can be entered from scratch by selecting *Enter latitude and longitude* from the **Build New Job** screen, or an existing station can be used as a template to supply the required information.

A station can be designated a template by entering its callsign or entering a City-of-License and picking the station from a list.

You can use the *Include* and *Scan Range* controls to select what kind of information to save in the job and how far out to search for stations.

Other Methods of Building a Template Job

A new job can be build from search results. Perform a *Basic Search*, select a station from the search results, then right-click to activate the pop-up menu and select **Build This Job**.

Build This Job is also accessible from a *pop-up* menu on the *Job Grid*.

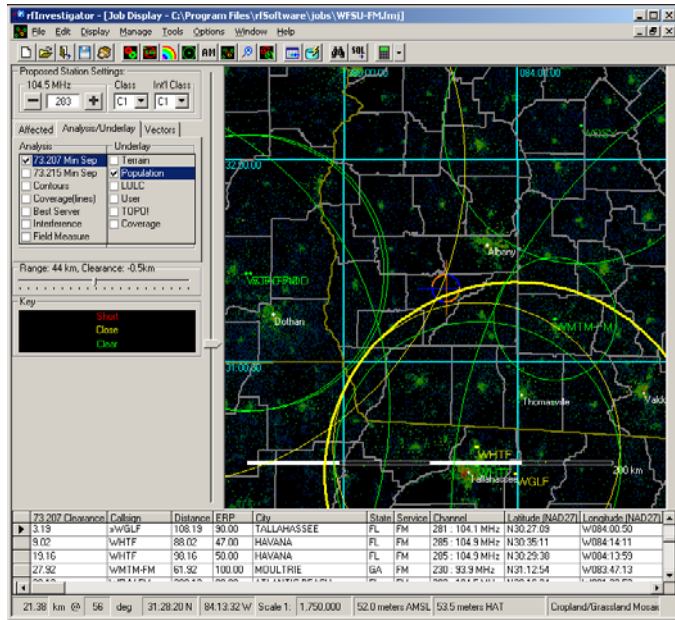
Right clicking on the *Job Map* activates a *pop-up* menu with the option **Build Job at Map Center**.

The Job Map

Overview

The most complex part of a Job is the *Job Map*. The Map provides a graphical view of interactions between a *Proposed* and the various *Affected* stations.

The Map also provides positional references such as Latitude/Longitude lines, State, County and City boundary lines, Markers, Roads, Railroads and Hydrology.



Finally, the Map can display *Underlays* of Population distribution, Land Use Land Characteristic (LULC), Topographic Maps, Longley-Rice Coverage, Terrain or User Defined bitmaps. These underlays may only be displayed one at a time.

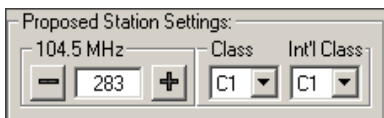
For an explanation of how maps Project a Curved Surface onto a Flat Screen see Appendix A.

Types of Stations

A *Proposed* station could be either a new station or, a modified existing station. There should be only ONE Proposed station in any given Analysis.

Affected stations are all FM, AM and TV6 stations and FM allocations affected by; and in the vicinity of; the Proposed station.

Proposed Station Control



The Job Class, International Job Class, and Job Channel controls located near the upper left-hand corner of the *Job Map* comprise the Proposed Station Control.

Affected Station Control

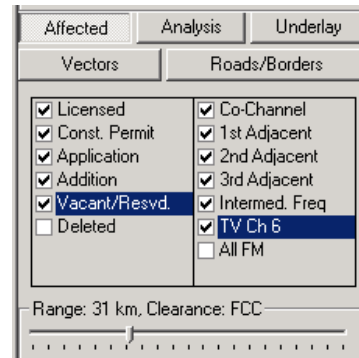
The Affected Station Control is located immediately below the Proposed Station Control.

The Display Status Control allows you to display or hide Affected stations based on their status, such as *Licensed*, *Construction Permit* or, *Application*.

The Show Channels Control allows you to display or hide Affected stations based on their frequency relationship to the Proposed Station.

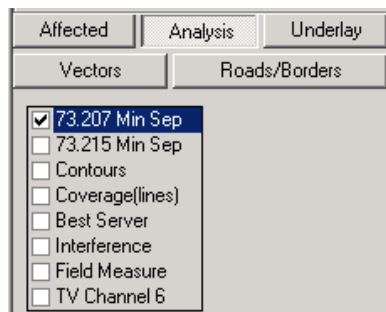
The Range Control controls the number of existing stations and allotments that are displayed beyond the range of Affected Stations.

The Clearance label indicates if actual FCC or deminimus separation values are being used to designate a station or allotment as Affected.

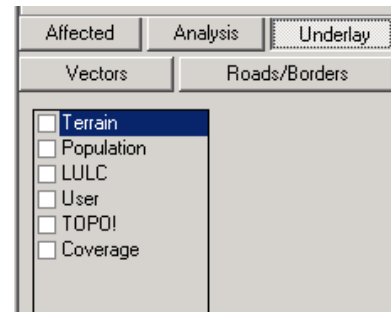


Analysis/Underlay and Vector Controls

The Analysis/Underlay and Vector Controls are tabbed windows underneath the Affected Station Control.

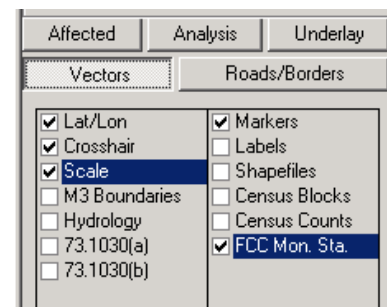


The Analysis Control allows you to display FCC Minimum Separation rings, Contours, Field Measurement data or, using the optional PL-Server tool, Longley-Rice Coverage, Best-Server or Interference analyses.

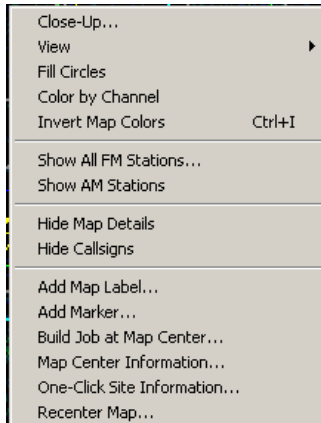


The Underlay Control is used to select from various bitmaps. Only one underlay can be displayed at a time. In order to display Topographic and other USGS maps you will require the appropriate TOPO! Data. This data is sold by National Geographic and is available through **rfSoftware** as well as many map and sporting goods stores. One set of TOPO! Maps is included with rfInvestigator.

The Vector Control allows you to display or hide various map references such as roads, markers, city boundaries, etc.



The Job Map Pop-Up Menu



Right clicking on the map will cause a pop-up menu to appear.

From this menu you can access many of the commonly used controls including; The Contour Manager, Add Marker, What-If, Recenter Map and Close-Up Dialogs. The pop-up menu also duplicates some of the frequently used buttons from the tool bar.

Map Options Control

The Map Options Dialog controls display of many reference items such as roads, railroads, etc.

Map Options can be accessed from Options--Map... on the drop-down menu.

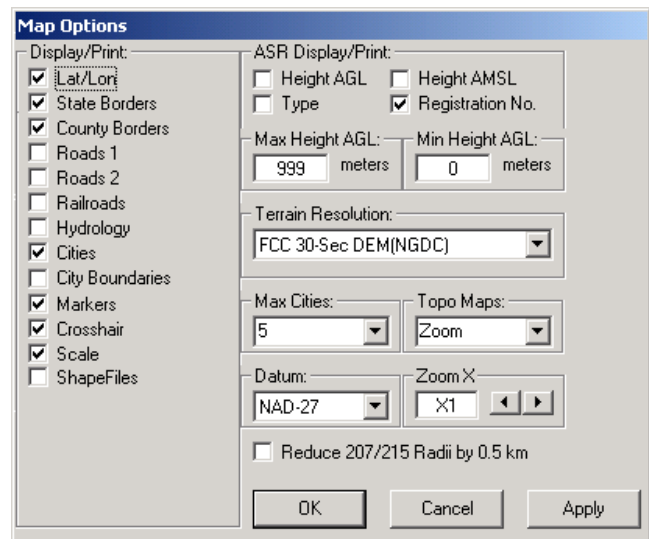
The upper limit of named places displayed on the *Map* is controlled by the Max Cities Control.

The Terrain Resolution Control selects the data source used for *Terrain Underlays*.

Checking the *Reduce .207 Radii by 0.5 km* box will change the 73.207 analysis to deminimus values instead of actual FCC values.

The ZoomX control is used to pre-scale the Map Zoom control.

The ASR Display control allows you to limit displayed towers by height.



The Mouse Information Bar

The *Mouse Information Bar* is located at the bottom of the *Main Screen*.

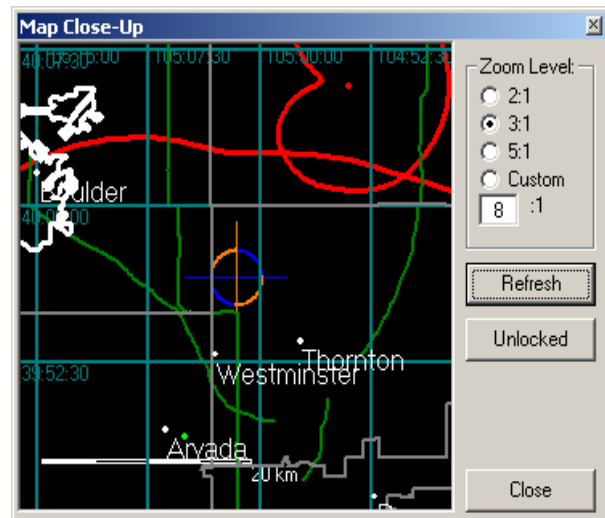


The first two readings indicate the **Range** and **Bearing** to the Mouse Pointer from the Center of the Map, third, and fourth are the **Latitude** and **Longitude** of the Mouse Pointer, fifth is the **Map Scale**. The sixth indicator displays the height **AMSL** (Above Mean Sea-Level) at the Mouse Pointer position. The seventh and eight panes are dynamic and display different types of information depending where the mouse is located and which underlays are displayed.

The Map Close-Up Window

The Map Close-Up window is a resizable, floating map window that displays a close-up view of the region surrounding the current mouse position. The close-up view automatically updates as the mouse moves around the screen.

You can access the close-up window from the main menu by selecting **Display--Close-Up...** or by right clicking on the map and selecting **Close-Up...** from a *Pop-Up* menu.



When the Map Close-Up window is displayed, the Rubber-Band feature of the left mouse button is disabled. By clicking the left mouse button, the Map Close-Up window can be **'frozen'** at a particular location. This allows you to move the mouse pointer off the map and onto the Close-Up Window. If you click the left mouse button again, the Map Close-Up window will unfreeze.

Clicking the **Refresh** button on the Map Close-Up window will cause the map to regenerate with increased detail. Pressing the **Locked/Unlocked** button will also freeze or unfreeze the Close-Up display.

The One-Click Site Information Window

The One-Click Site Information window reports various kinds of information for a selected point on the job map. When the One-Click window is active, left-clicking once anywhere on the map will place a mark at that location. The One-Click window will display data for that point.

Position NAD-83			
	Deg	Min	Sec
N	34	20	24.2
W	117	32	52.6

Pressing the **Mark** button will allow you to place a marker at the current point.

Pressing the **Center** button will re-center the job map at the current point.

Pressing the **Save** button will allow you to save the One-Click Site Information to a text file.

Access the window from the *Job Map Pop-Up Menu* or from the Main Menu Display--One-Click Site Information....

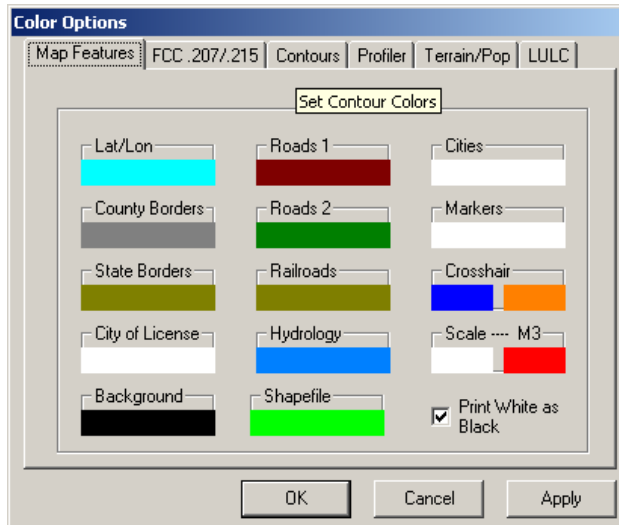
The Map Center Information Window

The Map Center Information Window reports various kinds of information for the current *Map center*.

Access the window from the *Job Map Pop-Up Menu* or from the Main Menu Display—Map Center Information....

- Lat/Long [NAD83]:			
	Deg	Min	Sec
N	34	11	19.0
W	117	24	00.0

Controlling Colors



The Color Options Dialog can be accessed from the drop-down menu by selecting *Options—Colors...*

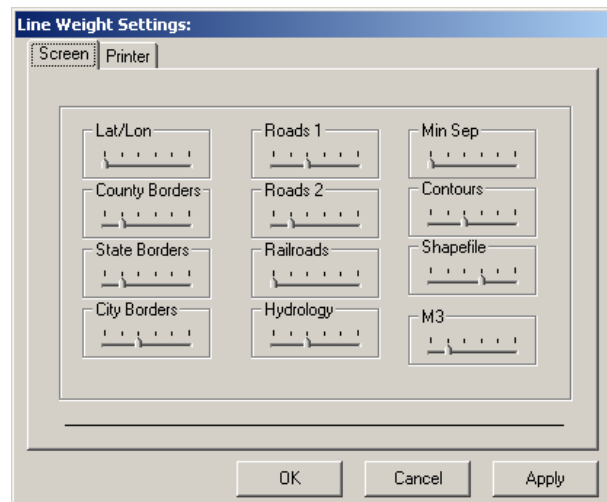
Clicking on a color will allow you to change the color for the associated feature.

Controlling Line Weights

The Line Weight Settings Dialog can be accessed from the drop-down menu by selecting *Options—Line Weights...*

Adjusting a slider will allow you to change the line weight for the associated feature. The line at the bottom of the dialog represents the line weight chosen.

Separate controls are provided for screen and printer line weights.



The Job Grid

Overview

Call sign	Latitude	Longitude	City	State	Service	Channel	Class	Intl Cl	Status	73 207 Min	73 215 Min
KBZG	N34:25:48	W111:30:16	PAYSON	AZ	FM	282 : 104.3 MHz	C		CP	290	270
KBZG	N34:25:48	W111:30:16	PAYSON	AZ	FM	282 : 104.3 MHz	C	C	LIC	290	270
KPBZ	N34:42:52	W112:31:33	CHINO VALLEY	AZ	FM	280 : 103.9 MHz	C3	B	LIC	96	90
KZUL-FM	N34:33:06	W114:11:37	LAKE HAVASU CITY	AZ	FM	283 : 104.5 MHz	C2		LIC	188	176
	N31:51:53	W112:46:30	SONOITA	SO	FM	282 : 104.3 MHz	B	B		270	0
KZZP	N33:20:04	W112:03:35	MESA	AZ	FM	284 : 104.7 MHz	C	C	LIC	105	99
	N35:12:27	W112:37:49	ASH FORK	AZ	FM	285 : 104.9 MHz	A		ADD	95	89
KEDJ	N33:23:59	W111:26:45	GILBERT	AZ	FM	280 : 103.9 MHz	C2		APP	105	96
KEDJ	N33:23:59	W111:26:45	GILBERT	AZ	FM	280 : 103.9 MHz	C2		APP	105	96
KPTY	N33:14:50	W111:31:49	GILBERT	AZ	FM	280 : 103.9 MHz	C2		LIC	105	96
KPTY	N33:14:50	W111:31:49	GILBERT	AZ	FM	280 : 103.9 MHz	C2	B	LIC	105	96
K228DF	N34:29:20	W112:32:15	PRESCOTT	AZ	FM	228 : 93.5 MHz	D	D	LIC	0	0
K285CW	N34:29:20	W112:32:15	PRESCOTT	AZ	FM	285 : 104.9 MHz	D	D	LIC	0	0

The *Job Grid* provides details on the various Affected stations. Additional stations may also be listed depending on the Range setting.

Manipulating Columns

The order of stations on the *Job Grid* is controlled by first clicking on a column heading and then right clicking and selecting the desired *sort order* from a pop-up menu.

The station separation rings on the *Job Map* are drawn in the reverse order of stations on the *Job Grid*. This is important when displaying filled circles, as the last station drawn will appear on top.

Individual columns can be resized by placing the mouse on the right-hand edge of the column heading and click-dragging the mouse.

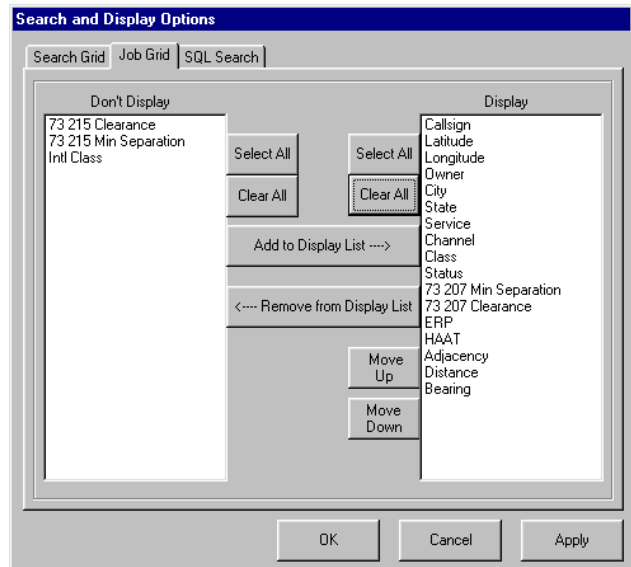
The Fields Selector

The fields displayed on the Job Grid and the order of the columns is controlled from the Search and Display Options Control.



The Search and Display Options Control can be accessed by pressing the **Select Fields** button, selecting **Tools--Options--Display Fields...** from the drop-down menu or, right clicking on the *Job Grid* and selecting **Change Displayed Fields** from the pop-up menu.

Select the *Job Grid* tab. Two windows are displayed, **Don't Display** and **Display**. Fields listed in the **Display** window will appear on the Data Display Screen in the order that they are listed.

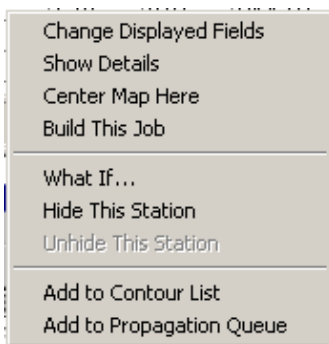


Select one or more fields in the **Display** window and change their position in the list with the **Move Up** and **Move Down** buttons.

To remove a field or fields from the **Display** window, select one or more fields in the **Display** window and click the **Remove from Display List** button.

To add a field or fields to the **Display** window, select one or more fields in the **Don't Display** window and click the **Add to Display List** button.

The Pop-Up Menu



Selecting a station from the *Job Grid* and then right clicking will bring up a *pop-up* menu.

This menu allows easy access to many of the most frequently used functions.

The Contour Manager

Overview

The Contour Manager allows you to add, delete and edit 73.333 contours.

The Contour Manager can be accessed by pressing the *Contour Manager* button on the button bar, selecting *Edit—Contours...* from the drop-down menu or, right-clicking on the *Job Map* and selecting *Contour Manager...* from the *pop-up* menu.



ID	Curve	dBu	Resolution	Color
STAT:VAC	Protected	60	FCC-30	Cyan
STAT:VAC	Interfering	54	FCC-30	Red
Station1	Protected	60	FCC-30	Magenta
Station1	Interfering	100	FCC-30	Red
Proposed	Protected	60	FCC-30	Red
Proposed	Int:CoChar	40	FCC-30	Yellow
Proposed	Int:1st	54	FCC-30	Cyan
Proposed	Int:2-3rd	100	FCC-30	Magenta
station-2	Interfering	60	FCC-30	Red

Contour Groups

Contour Groups can be created, renamed or deleted by right-clicking the mouse on the Contour Group Tabs and selecting from the *pop-up* menu. Use Ctrl-V, Ctrl-C or the *pop-up* menu to copy and paste contours between groups.

Adding a Proposed Station at Map Center

Click the *Map Center* button to begin the process of adding a hypothetical station located at the center of the map to the list of contours.

A series of dialog screens will appear to gather the information necessary to define the proposed station.

The process of adding this type of station is covered in more detail in **Creating and Managing Contours**.

Adding Affected Stations

Click the *Shorts* button to begin the process of adding all the possible Affected stations to the list of contours.

A series of dialog screens will appear to gather the information necessary to define the Affected station(s).

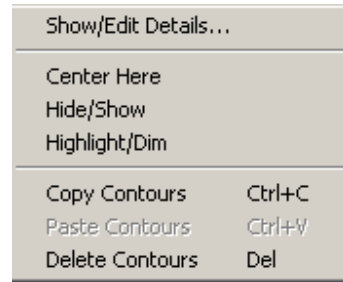
Adding Stations from the Grid

A station on the *Job Grid* can be added to the contour list as Affected station, or in the case of a station co-channel with the Job, as a Proposed station.

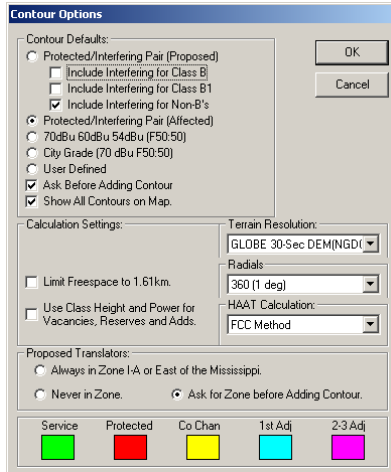
Select the station to be added from the *Job Grid*. Right-click and select *Add to Contour List* from the pop-up menu. A series of dialog screens will follow to gather the information necessary to define the new contour.

The Pop-Up Menu

Right clicking on the Contour Manager will bring up a pop-up menu. The menu allows you to access the Contour Editor, Hide/Show or Delete a contour, or recenter the map.

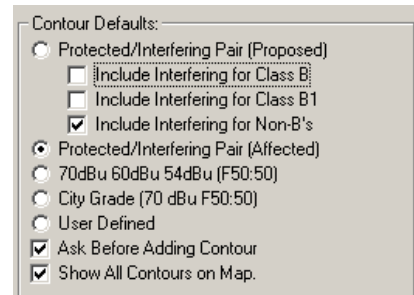


Contour Options



The Contour Options screen can be accessed by pressing the *Options* button on the *Contour Manager* or, selecting Options--Contours... from the Main Menu.

Contour Default settings control the state of several parameters used in contour calculations.



The Radials control allows you to select the number of evenly spaced radials used to display each contour. The minimum number of radials is 8 and the maximum is 360. 360 radials are always used to **CALCULATE** contours. The Radials Control only affects how the contour is **DISPLAYED**.

The HAAT Calculation control allows you to select between two different methods of determining height from the *Digital Elevation Model (DEM)*.

- The “**FCC Method**” uses 4 points from the DEM to perform a linear interpolation of height.
- The “**Slope Method**” uses an array of 25 or more points from the DEM to predict height based on how the surrounding terrain changes.

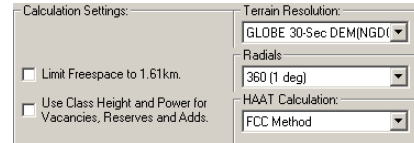
The slope method, which is significantly faster than the FCC method, should be used for initial searches and what-if’s.

FCC Rules require that linear interpolation methods be used for computer-determined heights. Therefore, all fine-adjustments and exhibits for submittal to the FCC should use the slower **FCC Method** of calculation.

Changes made on the Contour Options screen will not affect existing contours. Changes made here will be reflected only in new contours.

Limiting Freespace to 1.61km.

FCC rules state that under certain conditions the distance-to-contour calculation should stop using the prediction tables and switch to the freespace formula. Doing this in accordance with the rules will produce characteristic “spikes” on the contour. Limiting the freespace calculation to 1.61km (the beginning of the FCC curves) smoothes out the contour. Some engineers claim that the FCC has instructed them to set this freespace limit, in disagreement with the rules. Other engineers claim that the contour is wrong if it does not have the “Spike.” In an effort to please both camps, rfInvestigator supports both methods.



Select *Limit Freespace to 1.61km* to have smooth contours that **do not** conform to FCC rules.

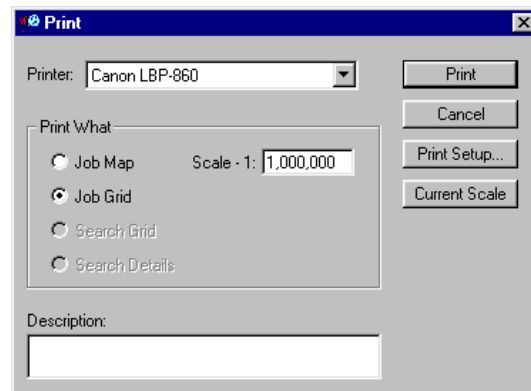
Uncheck the box to have “Spiked” contours that **do** follow the FCC rules.

Printing Maps and Grids

The *Job Map* and *Job Grid*, as well as *Search* information can be sent to any printer or plotter installed on your Windows system.



Access the print dialog by pressing the **Print** button from the button bar, select **File--Print...** from the drop-down menu or press Ctrl-P.



Terrain Data

30 and 3 second DEM's

Terrain data is stored as a Digital Elevation Model or DEM. The DEM is a two-dimensional computer array (like putting graph paper over the terrain).

Standard Terrain elevation data is available for rfInvestigator in 30 and 3 arc-second resolutions for most areas of the World.

1 second High-Res and 1/3 second Ultra High-Res DEM's

NED and finished SRTM are available in High-Res and Ultra High-Res for select areas of the United States. The availability and extent of this data changes day-to-day. Contact **rfSoftware** if you require high and ultra-high resolution for **rfInvestigator**.

Data Sources

The 30-second data was obtained from the FCC, and originally came from NOAA's National Geophysical Data Center (NGDC). This data has a vertical resolution of 10 meters. Coverage is limited to the continental United States.

The 3 arc-second DEM provides coverage for all of the contiguous United States and Hawaii. The elevation model was obtained from the US Geological Society's EROS Data Center. This data has a vertical resolution of 1 meter.

The alternative 30-second data is the *Global Land One-km Base Elevation (GLOBE)* database. This is supposed to be the latest and best 30-second terrain data available from NGDC. Worldwide data is available. *rflInvestigator* includes GLOBE data for most of North America. It has a vertical resolution of 1 meter.

****IMPORTANT NOTE:** There have been questions about the acceptance of GLOBE data by the FCC since, in some regions; it differs significantly from the old 30 second DEM.

The Shuttle Radar Topography Mission (SRTM) successfully collected Interferometric Synthetic Aperture Radar (IFSAR) data over 80 percent of the landmass of the Earth between 60 degrees North and 56 degrees South latitudes in February 2000. This data is selectively available in Raw and Finished form in 3-second and 1-second resolution for use by *rflInvestigator*.

Population Data

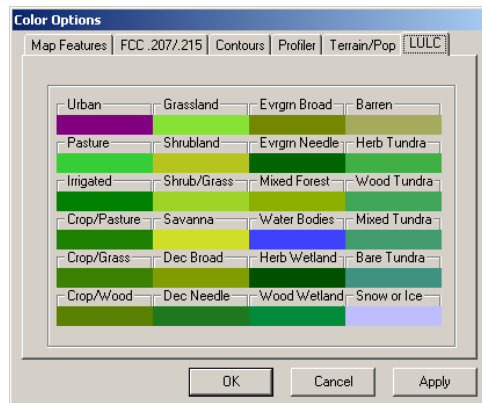
Population Distribution on a Grid

Population data is stored and displayed in much the same way as terrain data. An X, Y grid of points is laid down over the *Job Map*. Each point is assigned a value equivalent to the population surrounding it. The grid can then be color coded to represent population distribution in the same manner as a terrain map represents elevation.

LULC Data

Land-Use Land-Characteristic (LULC) data is stored and displayed in much the same way as terrain data. An X, Y grid of points is laid down over the *Job Map*. Each point is assigned a value equivalent to the use or characteristic. The grid can then be color coded to represent LULC in the same manner as a terrain map represents elevation.

The Colors that represent the various uses and characteristics can be changed by selecting the last tab on the Color Options Dialog then, click on the color box of interest and select a new color.

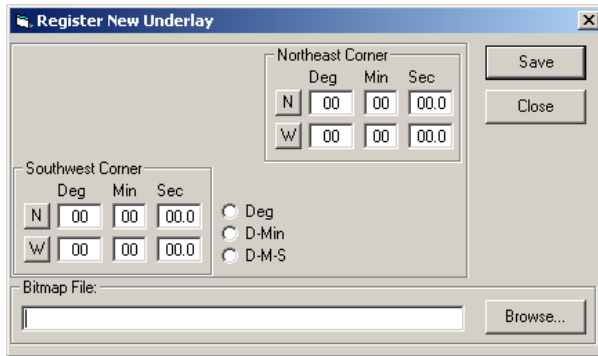


User Underlays

Overview

User underlays provide you a method of placing any bitmap image on the screen. This tool is useful for placing street-maps or satellite images on the *Job Map*.

Registering an Image



In order for the program to be able to display bitmapped images, they must first be registered. Registration is a means of telling the program where the image fits within the map. Images are registered using the Register New Underlay Dialog. This screen is accessed from the Main Menu by clicking Tools--Register Bitmap.... Click the **Browse** button and select the image you wish to display. Enter the

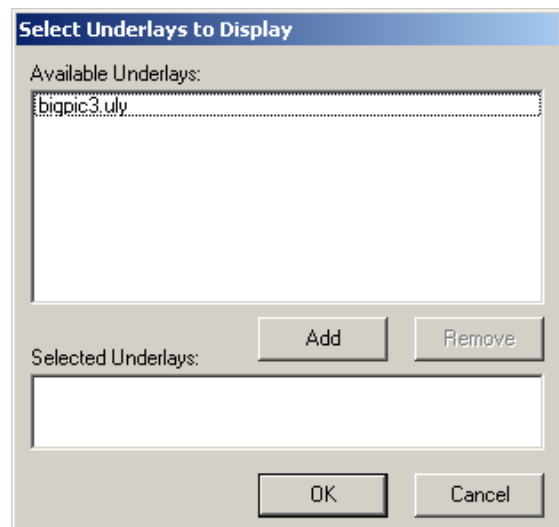
latitude and longitude of the northeast and southwest corner. Then click the **Save** button and assign your new underlay a descriptive name.

Displaying User Underlays

To display a user underlay click *User* on the *Job Map Analysis/Underlay* Tab. This will open the Select User Underlay Dialog.

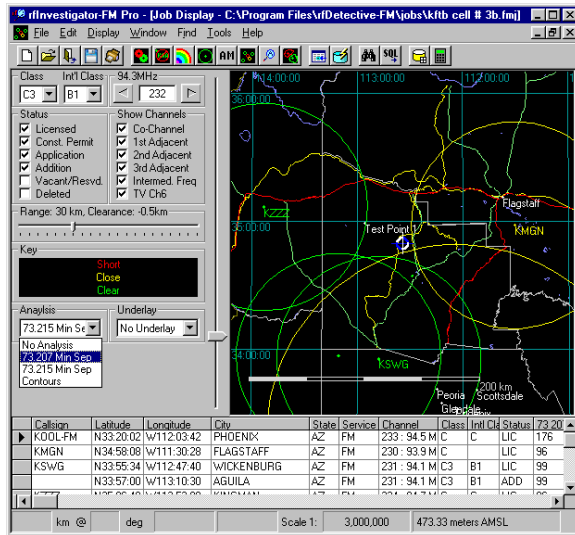
The Dialog will list all underlays that are within range of the current Job Map boundaries. To display an underlay, select it from the Available Underlays list and add it to the Selected Underlays list. This can be done with the **Add** button or by simply double clicking on the item in the list.

Use the same procedure to remove items from the Selected Underlays list.



Job Analysis

73.207 Overview



Rule 73.207 sets forth minimum separation requirements between Proposed stations and Affected stations. These separation values are primarily functions of each stations Class and Channel in relation to each other.

rInvestigator's 73.207 Analysis mode automatically computes and displays these minimum separations as color-coded circles centered on each station. The color-coding can be *by-channel* or *by-clearance*. In the first mode,

the color of each stations ring is dictated by its frequency relationship with the Job Channel. For example, *co-channel* could be red and 1st adjacent yellow.

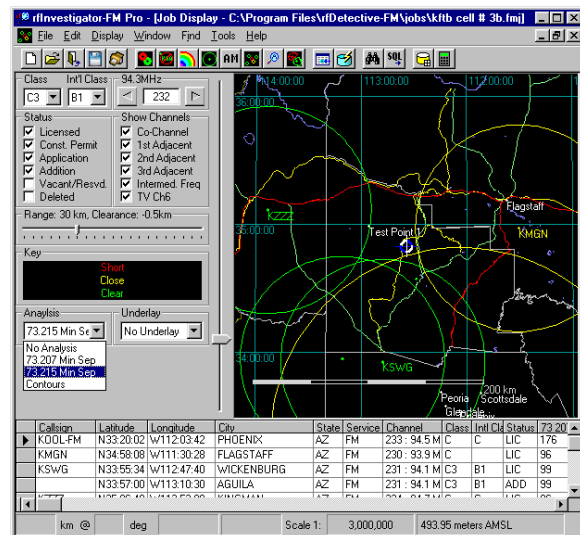
In color *by-clearance* short stations (those whose rings include the Job Center) are red, station rings whose borders are close to Job Center are yellow and those well clear are green.

73.215 Overview

Rule 73.215 allows the *short-spacing* of commercial FM stations if certain conditions are met. These conditions involve minimum separation requirements similar to but less stringent than 73.207, and interfering-protected contours.

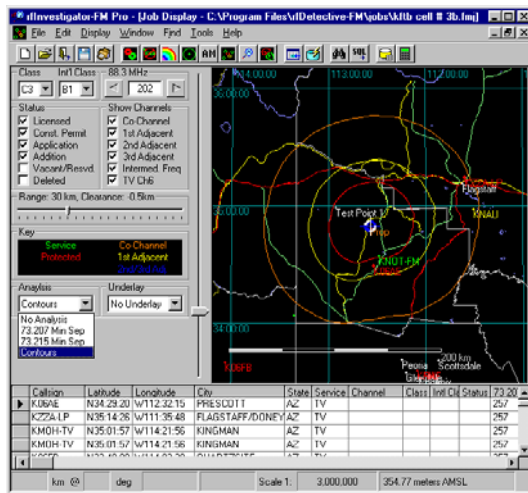
Rule 73.215 cannot be used to obtain a new allotment. It can only be applied to an existing station, application or allotment.

Prior to applying contour rules to a Proposed station, compliance with 73.215 minimum separation must be established. This is done by selecting *73.215 Min Sep* from the Analysis control. The Min-Sep rings are identical in functionality to those used for 73.207.



NCE Overview

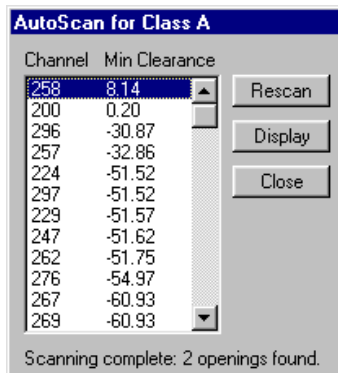
Non-Commercial Educational (NCE) stations are regulated by FCC rules 73.501 through .599 (subpart C). Separation between NCE stations is regulated by contour protection. 73.207 applies to separation from commercial stations.



After verifying 73.207 spacing has been achieved in regard to commercial stations, an NCE analysis can be performed using the contour mode.

The technique of considering only short stations as Affected stations works for NCE since contour protection is not required if .207 spacing exists.

Auto Scan



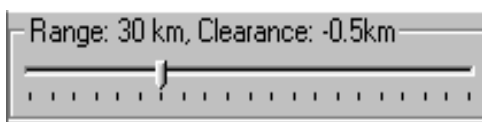
The Auto Scan feature will test every channel as a *Job Channel* using the current *Job Center* and *Class*. The results of the scan are displayed on a table sorted by clearance.

Double-clicking on a channel in the table, or selecting a channel and clicking the *Display* button, will change the *Job Map*, displaying the selected channel as the *Job Channel*.



Range and Clearance

The *Range* slider controls how far from *Job Center* the program will look for *close* and *clear* stations. Setting the range to zero will display only *short* stations.



It is sometimes useful to display *clear* stations when you wish to relocate an existing station, or move a proposed *Job Center*.

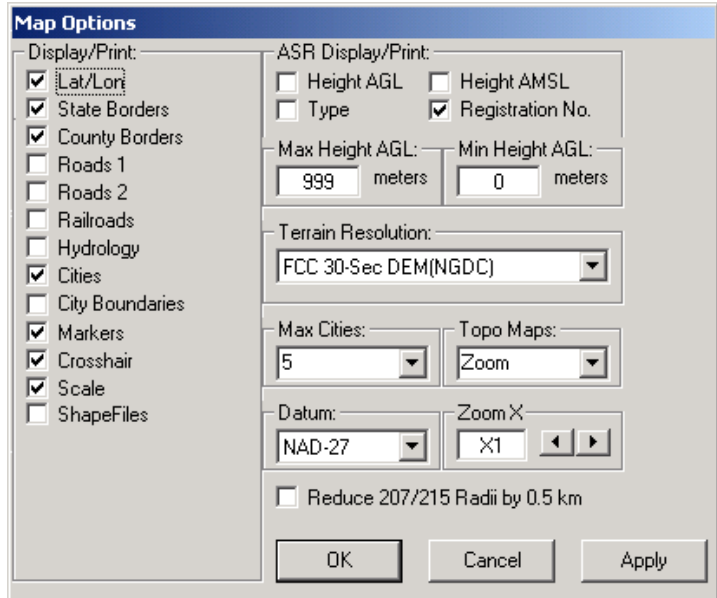
The Clearance status is reported above the Range slider. This parameter is set on the bottom of the Map Options dialog.

Right-clicking on this control will allow you to set it to ranges beyond 100km.

The FCC will allow up-to a one-half kilometer encroachment over the minimum separation line without rejecting an application.

If the Clearance box is unchecked then the rings are drawn to the FCC published values in accordance with rule 73.207.

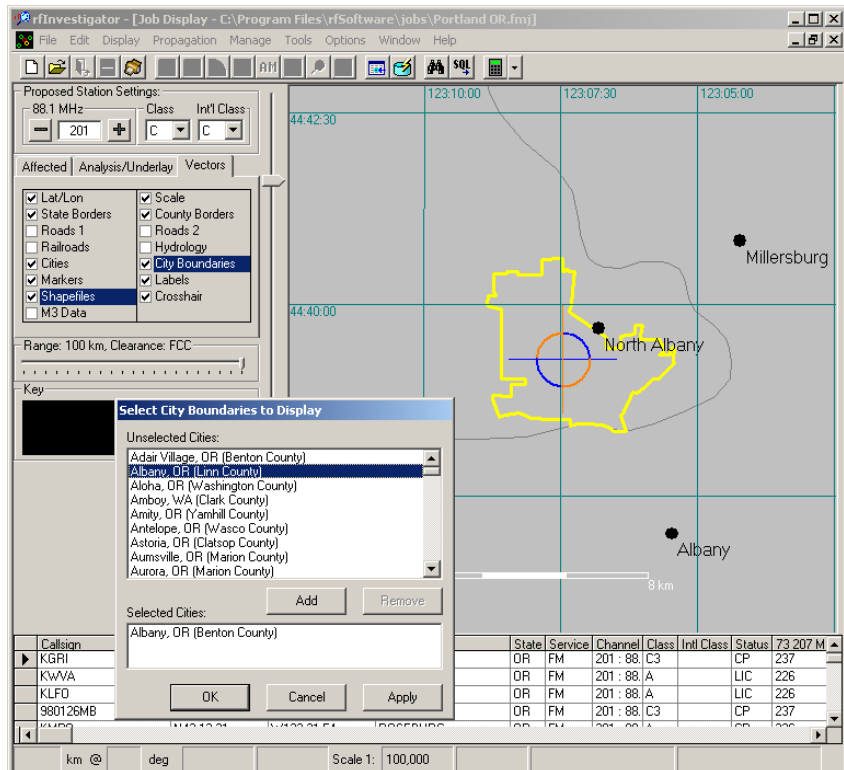
Check the Reduce box and the rings will be reduced in radius by one-half of a kilometer to reflect this tolerance.



City of License

The *City Grade Contour*, which is the 70dBuV 50-50 curve, must cover all of the *city-of-license* for a commercial station and some part of the *city-of-license* for an NCE station.

rfInvestigator uses political borders from the 2000 Census to display *city-of-license*. Select **Edit--City of License...** from the drop-down menu and select the desired city from the list.



Translators and Boosters

Introduction

Translators and Boosters are regulated by FCC rules 74.1201 through 74.1290 (subpart L). Rule 74.1204 deals with protecting existing FM radio stations from new or modified Translators and Boosters.

When used in combination with a thorough knowledge of the rules as they pertain to Translators and Boosters, **rflInvestigator** can be used to demonstrate compliance with the requirements of 74.1204.

Setting the proposed station class to **DX** will cause:

- 73.207 minimum separation rules to be applied for all stations plus or minus 53 or 54 channels from the proposed channel.
- 74.1204(a)(1) through (a)(4) Contour rules to be applied when creating *Short* and *Job Center* Contours.

****IMPORTANT NOTE:** The program applies rule 73.207 in all cases, even though the rule does NOT apply for translators under 100 Watts.

When computing the HAT for a Translator/Booster **rflInvestigator** automatically chooses a 12 radial pattern.

How to Place a Translator or Booster

Placement of Translators and Boosters are controlled by contour protection. Since **rflInvestigator's** Auto-Scan feature works only with minimum separation values Auto-Scan is of limited usefulness in finding sites for translators, but it is a good place to start.

Pick a possible location for the Translator or Booster. For fill-in Translators and Boosters the location must be within the parent station's coverage contour, see 74.1201(g). For non fill-in Translators pick a spot near where you wish to provide coverage, possibly on an existing tower or tall building.

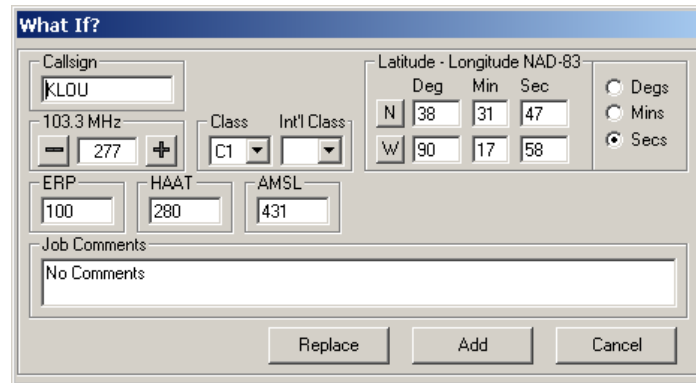
Auto-Scan will tell you where 73.207's IF minimum spacing rules will prevent the placement of a (100 Watt or greater) Translator or Booster. For a Translator, pick a clear channel from the auto-scan list. If a Booster is blocked by 73.207 you must either relocate or reduce power below 100 Watts.

Next, use the *Contour Manager* to build contours for all Short stations. For Boosters and fill-in Translators, you should leave out the parent station. If the proposed location is inside any existing station's protected contour then try the next channel on the list (Translators) or look for a new location (Booster). Once you find a channel/location that is clear of protected contours, add *Map Center* contours and see if it works.

What-If's

The What-If tool allows quick changes to an existing station to test their effect on other stations.

It can be accessed from the *Job Grid* pop-up menu.



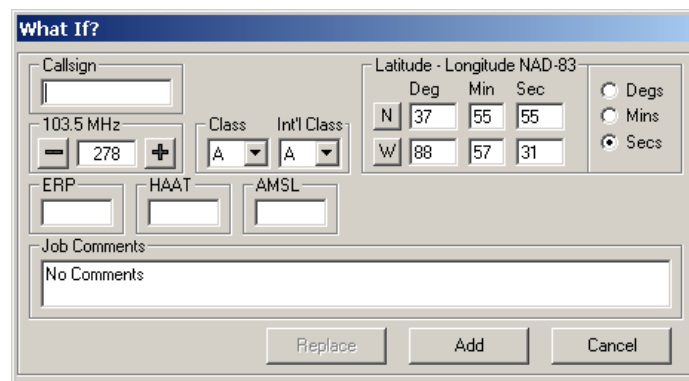
The 'What If?' dialog box is shown with the following fields and values:

- Call sign: KLOU
- Frequency: 103.3 MHz
- Class: C1
- Int'l Class: (empty)
- Latitude: 38° 31' 47" N
- Longitude: 90° 17' 58" W
- ERP: 100
- HAA: 280
- AMSL: 431
- Job Comments: No Comments

Buttons at the bottom: Replace, Add, Cancel.

A second What-If tool is available for adding a new site to the *Job Map/Grid* at *Job Center*. It will open with the job center information loaded.

It can be accessed from the drop-down menu by selecting **Edit—What If....**



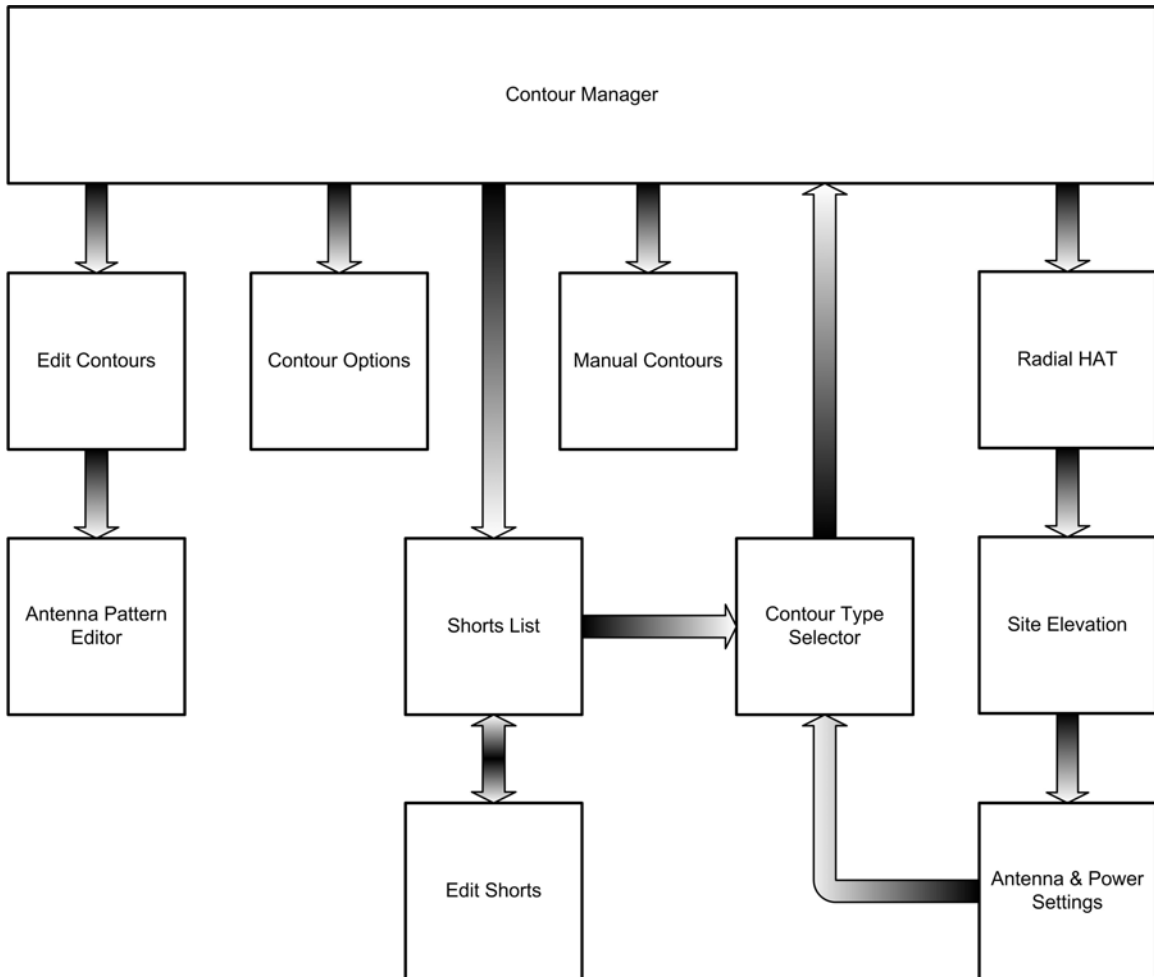
The 'What If?' dialog box is shown with the following fields and values:

- Call sign: (empty)
- Frequency: 103.5 MHz
- Class: A
- Int'l Class: A
- Latitude: 37° 55' 55" N
- Longitude: 88° 57' 31" W
- ERP: (empty)
- HAA: (empty)
- AMSL: (empty)
- Job Comments: No Comments

Buttons at the bottom: Replace, Add, Cancel.

Once the *What-If* station is added it will become part of the job file. A *What-If* station may also be added to the Master Database from the main menu, **Edit--Master Database**. This is useful to correct errors in the FCC database.

Contours



The Contour Manager

Overview

The Contour Manager displays the contents of the various *Contour Groups*.



The Contour Manager can be accessed by clicking the *Contour Manager* button on the button bar, selecting *Manage—Contours...* from the Main Menu or, right clicking on the *Job Map* and selecting *Contour Manager...* from the pop-up menu.

Placing a contour in a *Contour Group* adds that contour to the current Job. *Contour Groups* are saved with *Jobs*.

ID	Curve	dBu	Resolution	Color
STAT:VAC	Protected	60	FCC-30	Cyan
STAT:VAC	Interfering	54	FCC-30	Red
Station1	Protected	60	FCC-30	Magenta
Station1	Interfering	100	FCC-30	Red
Proposed	Protected	60	FCC-30	Red
Proposed	Int:CoChar	40	FCC-30	Yellow
Proposed	Int:1st	54	FCC-30	Cyan
Proposed	Int:2-3rd	100	FCC-30	Magenta
station-2	Interfering	60	FCC-30	Red

Proposed Stations

Overview

A Proposed station is a new or changed FM station. There should be only one Proposed station in a Job.

Job Center

In most cases the *Job Center*, *Job Class* and *Job Channel* will represent the Proposed Station when designing a new facility. Unless the new facility is co-locating with an existing radio station, a *Job Center* will not normally be located at an existing tower site.

A *Proposed Job Center* will rarely be co-located with an Affected FM Station.

Existing Stations

An existing FM station, FM application or FM allotment can be the Proposed station if the purpose of the *Job* is to modify that facility.

A Proposed existing station, application or allotment must be co-channel with the *Job Channel*.

Affected Stations

Overview

An Affected station is an existing FM, AM or TV-6 station, application or FM allotment that may be affected by the Proposed station.

Job Center

The *Job Center* cannot be an Affected station since it does not represent an existing station, application or allotment.

Existing Stations

An existing FM station, application or allotment is an Affected station if it is within the minimum separation distance of the Proposed station as defined by 73.207.

An AM station is an Affected station if it is nondirectional and within 0.8 km, or directional and within 3.2 km, of the Proposed station.

A TV-6 station is an Affected station if it is within the minimum separation distance of a Proposed station on channel 253 as defined by 73.207 or; if it is within the separation distance defined in 73.525 of an NCE Proposed station.

Types of contours

City Grade

A *City Grade* Contour is defined in **rflInvestigator** as a 70dB_{uV} [3.16mV/m] contour read from the FCC's 73.333 50-50 curve.

Protected/Interfering Pairs

With the exception of commercial class B and B1 stations, a *Protected Contour* is a 60dB_{uV} contour read from the FCC's 73.333 50-50 curve. A *Protected contour* for a commercial B station is 54dB_{uV} (50-50) and 57dB_{uV} (50-50) for a commercial B1.

Interfering contours are read from the FCC's 73.333 50-10 curve. The value of the *interfering contour* is a function of the frequency relationship between the Proposed and Affected stations.

An Affected station's *interfering contour* is determined in relation to the *Job Channel*.

Interfering contours for a Proposed station are automatically prepared for all Affected stations.

70, 60, 54dBu

The three most common F(50-50) *coverage contours* can be created with a single click of the mouse.

Grade A/B

The 68 and 47 dBu F(50-50) Protected contours for a TV-Channel 6 station.

User Defined

User defined contours allow you to specify *custom contours* to meet other needs.

Manual Contours - *Advanced Feature*

Manual contours allow you to draw lines and shapes on the screen without regard to power or antenna patterns.

Adding the Job Center to the Contour List

Overview

Click the ***Proposed*** button to begin the process of adding a Proposed station located at the center of the *Job Map* to the contour list.

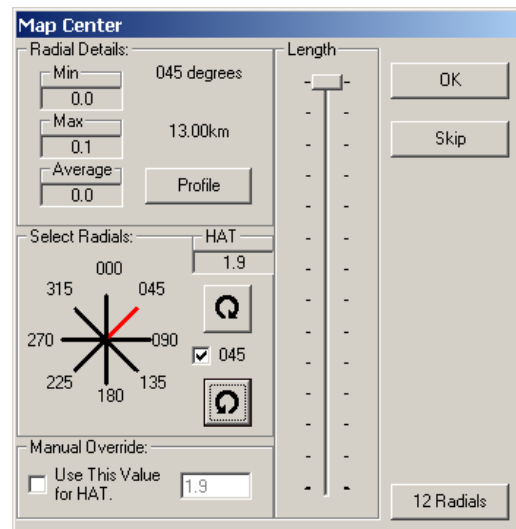
8 Radial HAT's

The first screen to appear will be the 8 Radial HAT dialog. The HAT value is the average of the radial heights of all the 'checked' radials.

This tool allows the tailoring of radial information to meet the requirements of FCC rule 73.313. In order to derive a valid HAT it is important that the user be thoroughly familiar with this rule.

Uncheck a radial in the **Select Radials** box to remove it from consideration.

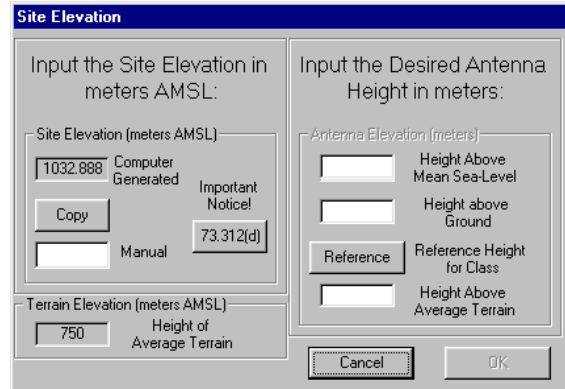
To limit the range of a radial to less than 16 km select the desired radial and adjust the *Length* control.



Site Elevation and Antenna Height

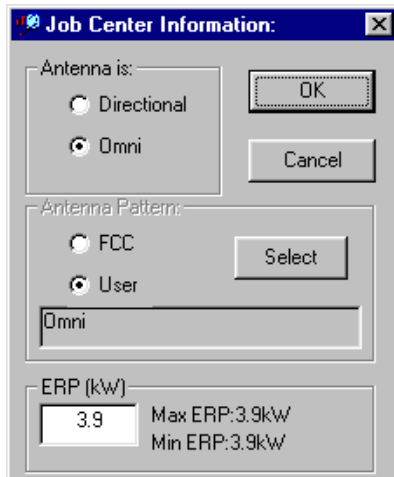
Next, the program will require information about the site elevation and proposed antenna height. FCC rule 73.312(d) contains important information about specifying site elevation. For preliminary evaluation purposes, the *Computer Generated* value can be used for Site Elevation.

Antenna height can be specified in AMSL, AGL or HAAT. See Appendix B for diagram.



The **Site Elevation** dialog box is divided into two main sections. The left section, titled "Input the Site Elevation in meters AMSL:", contains a text box with "1032.888", a "Copy" button, and a "Manual" button. Above the text box is a "Computer Generated" label and an "Important Notice!" label. Below the text box is a "Terrain Elevation (meters AMSL)" section with a text box containing "750" and a "Height of Average Terrain" label. The right section, titled "Input the Desired Antenna Height in meters:", contains three text boxes with labels: "Height Above Mean Sea-Level", "Height above Ground", and "Reference Height for Class". Below these is a "Reference" button and a "Height Above Average Terrain" label. At the bottom right are "Cancel" and "OK" buttons.

Selecting Antenna and Max ERP



The **Job Center Information** dialog box has three sections. The top section, "Antenna is:", has radio buttons for "Directional" and "Omni", with "Omni" selected. There are "OK" and "Cancel" buttons. The middle section, "Antenna Pattern:", has radio buttons for "FCC" and "User", with "User" selected. There is a "Select" button and a text box containing "Omni". The bottom section, "ERP (kW)", has a text box with "3.9" and labels for "Max ERP:3.9kW" and "Min ERP:3.9kW".

If a directional antenna is desired, one may be selected from existing FCC or User designed pattern files.

If a custom designed antenna pattern is needed, select *omni* and use the Antenna Pattern Editor to create a new *User Pattern*.

The *Effective Radiated Power (ERP)* displayed is the maximum value for the specified *Antenna HAAT*. Edit the ERP text box to change the value used for this set of contours.

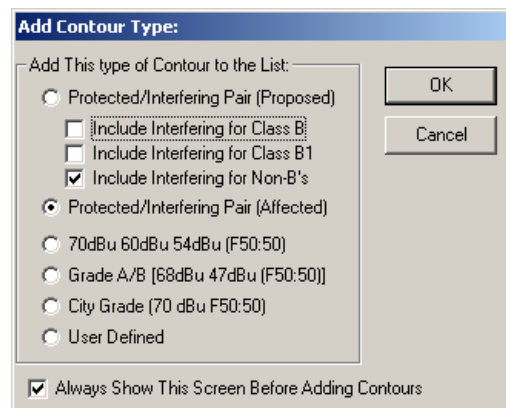
Selecting Contour Type

Select *Protected/Interfering Pair*, *70-60-54*, *City Grade* or *User Defined*.

Appearance of this dialog is optional. Uncheck the box at the bottom of the screen to always use the default contour type.

Default contour type can be set on the Contour Options dialog.

If disabled by unchecking the Always Show... box this screen can be reactivated from the Contour Options dialog.



The **Add Contour Type** dialog box has a title bar and a main area. The title bar says "Add Contour Type:". The main area has a section "Add This type of Contour to the List:" with several options: "Protected/Interfering Pair (Proposed)" (selected), "Include Interfering for Class B" (unchecked), "Include Interfering for Class B1" (unchecked), "Include Interfering for Non-B's" (checked), "Protected/Interfering Pair (Affected)" (selected), "70dBu 60dBu 54dBu (F50:50)" (selected), "Grade A/B [68dBu 47dBu (F50:50)]" (selected), "City Grade (70 dBu F50:50)" (selected), and "User Defined" (selected). There are "OK" and "Cancel" buttons. At the bottom is a checkbox "Always Show This Screen Before Adding Contours" which is checked.

User Defined Contours

If you select *User Defined*, the next screen will prompt you for *Contour location* and *ID* information. Click *Next*.

The dialog box 'User Defined Contours:' contains the following fields:

- Contour ID: Proposed-2
- Chan/Class: 278, A
- Terrain Resolution: USGS 3-Sec DEM(DMA)
- # of Radials: 360 (1 deg)
- Latitude/Longitude: N 37 55 55, W 088 57 31
- Buttons: Next, Cancel

Specify a *curve type*, *signal level* and *color*. Click *Add*. You can continue to add contours for this station. Click *Done* after adding the last contour.

The dialog box 'User Defined Contours:' shows detailed configuration for contour '*Proposed-2':

- Latitude/Longitude: +037:55:55, -088:57:31
- Curve: 50:50, 50:10
- Channel/Class: 278, A
- Signal Level: dB(uV), mV/m
- Radials: 360
- Terrain: USGS
- Color: Red (selected)
- Buttons: Add 1, Done, Cancel

Adding the Short (Affected) Stations to the Contour List

Overview

Short stations are those Affected stations that are *short* to the Proposed station under 73.207 minimum separation rules. Any station that meets .207 spacing is not required to meet contour overlap requirement, so it is unlikely it would be needed in the *Contour List*.

Call	Distance	Azimuth	Class	Adj	ERP	AMSL	HAAT	Ant	Rule
KTHN	163.2	136.8	A	Co-Ch.	3	1375	91	0	207 omni.
KTHN	163.2	136.8	C3	Co-Ch.	0	0	0	0	Use Class Values
KCFP	80.1	161.9	A	1st Ad	0.6	1709	193	0	NCE omni.
KRCC	34.8	181.9	C1	3rd Ad	2.1	2920	687	14616	NCE directional.
KVRH-FM	119.0	239.0	C3	1st Ad	13.5	2393	-200	0	207 omni.
STAT/VAC	119.6	85.9	C2	1st Ad	0	0	0	0	Use Class Values
Proposed	40.1	334.6	C2	Co-Ch.	42	2226	163	0	215 omni.
KJMN	43.5	22.6	C2	Co-Ch.	33	2132	183	0	215 omni.

Buttons: OK, Cancel

Pressing the *Affected* button on the Contour Manager will display a list of all the *short stations*.

The dialog box 'Add Contour Type:' contains the following options:

- Protected/Interfering Pair (Proposed)
 - Include Interfering for Class B
 - Include Interfering for Class B1
 - Include Interfering for Non-B's
- Protected/Interfering Pair (Affected)
 - 70dBu 60dBu 54dBu (F50:50)
 - City Grade (70 dBu F50:50)
 - User Defined
- Always Show This Screen Before Adding Contours
- Buttons: OK, Cancel

The Contour Shorts List Dialog affords you the opportunity to edit or delete stations from the shorts list. Select a station from the list and right click for a pop-up menu.

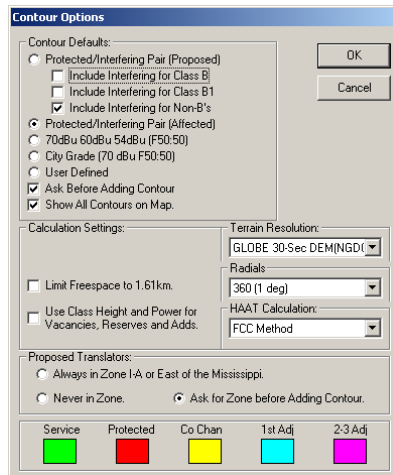
The Add Contour Type Dialog is displayed next. Select the type of contour you wish to add for each short station.

Contour Options

Overview

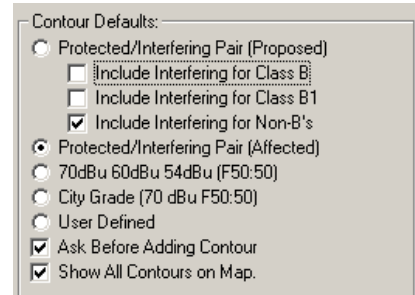
The color settings are for the Proposed station. An Affected station's *interfering contours* will be the same color as the Proposed station's *protected contour*. An Affected station's *protected contour* will be the same color as the Proposed station's channel-related *interfering contour*.

Contour Options



The Contour Options screen can be accessed by pressing the *Options* button on the *Contour Manager* or, selecting Options--Contours... from the Main Menu.

Contour Default settings control the state of several parameters used in contour calculations.



The Radials control allows you to select the number of evenly spaced radials used to display each contour. The minimum number of radials is 8 and the maximum is 360. 360 radials are always used to **CALCULATE** contours. The Radials Control only affects how the contour is **DISPLAYED**.

The HAAT Calculation control allows you to select between two different methods of determining height from the *Digital Elevation Model (DEM)*.

- The “**FCC Method**” uses 4 points from the DEM to perform a linear interpolation of height.
- The “**Slope Method**” uses an array of 25 or more points from the DEM to predict height based on how the surrounding terrain changes.

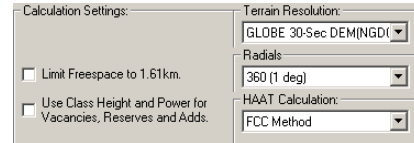
The slope method, which is significantly faster than the FCC method, should be used for initial searches and what-if's.

FCC Rules require that linear interpolation methods be used for computer-determined heights. Therefore, all fine-adjustments and exhibits for submittal to the FCC should use the slower **FCC Method** of calculation.

Changes made on the Contour Options screen will not affect existing contours. Changes made here will be reflected only in new contours.

Limiting Freespace to 1.61km.

FCC rules state that under certain conditions the distance-to-contour calculation should stop using the prediction tables and switch to the freespace formula. Doing this in accordance with the rules will produce characteristic “spikes” on the contour. Limiting the freespace calculation to 1.61km (the beginning of the FCC curves) smoothes out the contour. Some engineers claim that the FCC has instructed them to set this freespace limit, in disagreement with the rules. Other engineers claim that the contour is wrong if it does not have the “Spike.” In an effort to please both camps, rfInvestigator supports both methods.



Select *Limit Freespace to 1.61km* to have smooth contours that **do not** conform to FCC rules.

Uncheck the box to have “Spiked” contours that **do** follow the FCC rules.

Contour Editor

Overview

The Contour Details Dialog can be accessed by selecting a *Contour* on the Contour Manager, right clicking and then selecting Show/Edit Details... from the *pop-up* menu, or you can just double-click on the contour-of-interest in the Contour Manager.



General

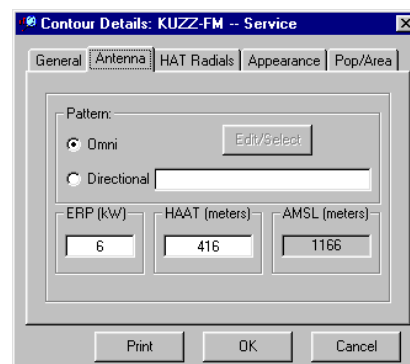
The General Page of the Contours Details dialog displays and allows you to change many details for the *contour-of-interest*. Changing a value and clicking **OK** will cause the contour to be recalculated (if necessary) with the changed value. The Longitude and Latitude of the Contour cannot be changed.

Antenna

Selecting the Antenna Tab at the top of the Contour Details dialog will display antenna and power related information.

All of the information on this page, except for antenna AMSL, can be edited. Changes will immediately be made to the contour-of-interest on pressing the **OK** button.

The Antenna Pattern Editor can be accessed from this page by selecting a *Directional* antenna pattern and pressing the *Edit/Select* button.

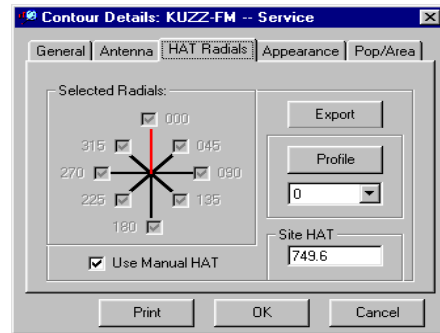


HAT Radials

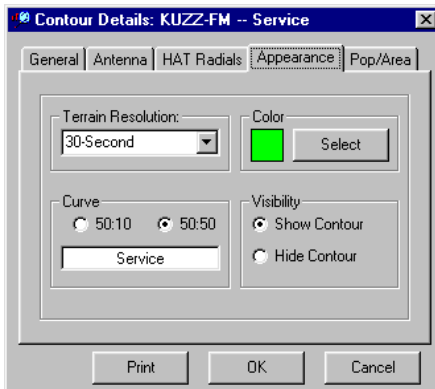
The HAT Radials Page displays which radials were used to determine HAT.

HAT Radials are only created for Proposed Stations. Each radial's profile can be viewed by selecting the desired radial and pressing the **Profile** button.

Site HAT can be changed to a manual value. The contour will be recalculated and redisplayed after clicking the **OK** button. Pressing the **Export** button will send the 8 HAT Radial details to a CSV file.



Appearance



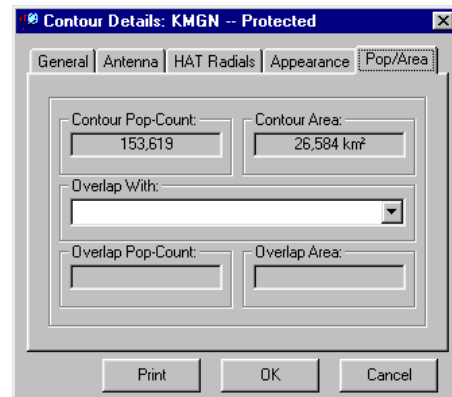
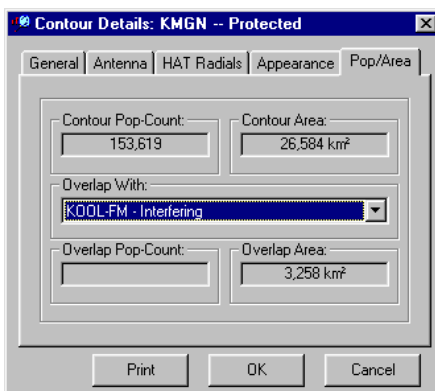
From the Appearance Page you can change the terrain data used to calculate the contour. This will cause the HAT to be recalculated using the new terrain resolution.

You can also change the *curve*, the *curve label* and *show or hide* the contour.

Changes will take effect when the **OK** button is pressed.

Pop/Area

Selecting the Pop/Area tab will calculate and display the population count and area (in km²) contained *within the contour*.



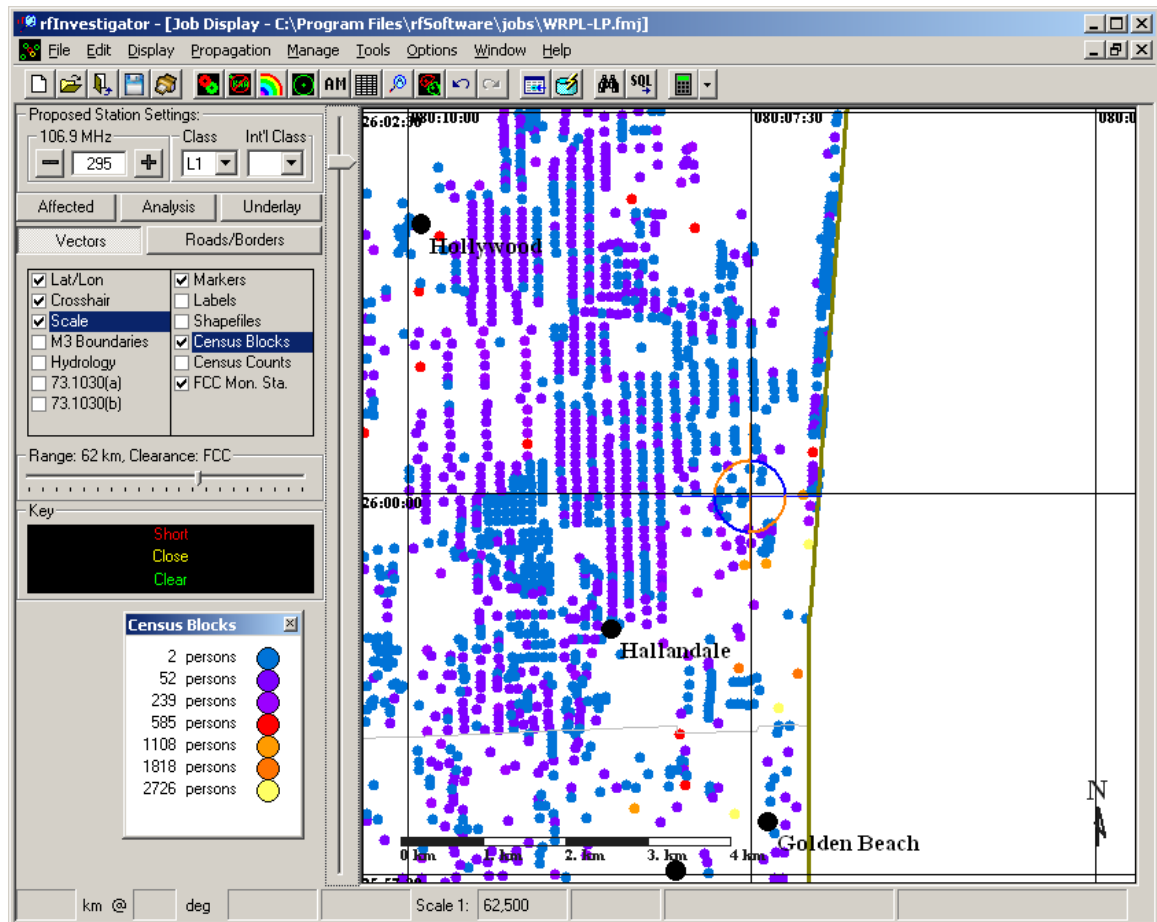
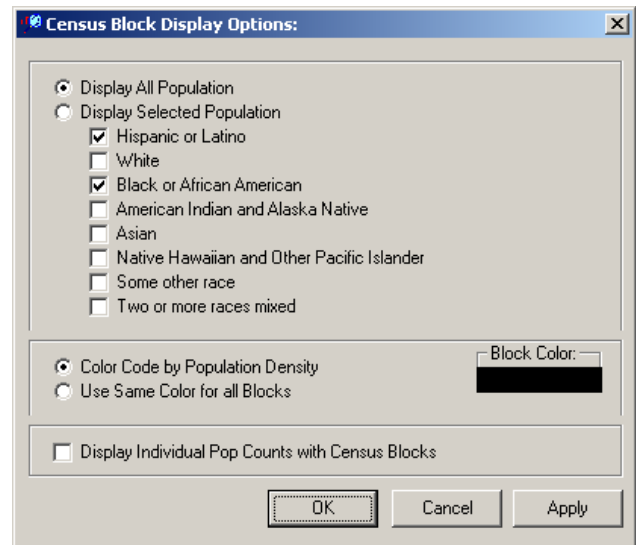
Selecting another Contour from the Overlap With drop-down box will cause the population count and area to be calculated for the *overlap of the two contours*.

Census Blocks and Demographics

If you have the optional Census Block feature then you can display and calculate population using the highest possible resolution of Census data. Use the Census Block Options Dialog to control the type of population to count.

Color coding by density can also be enabled from this dialog.

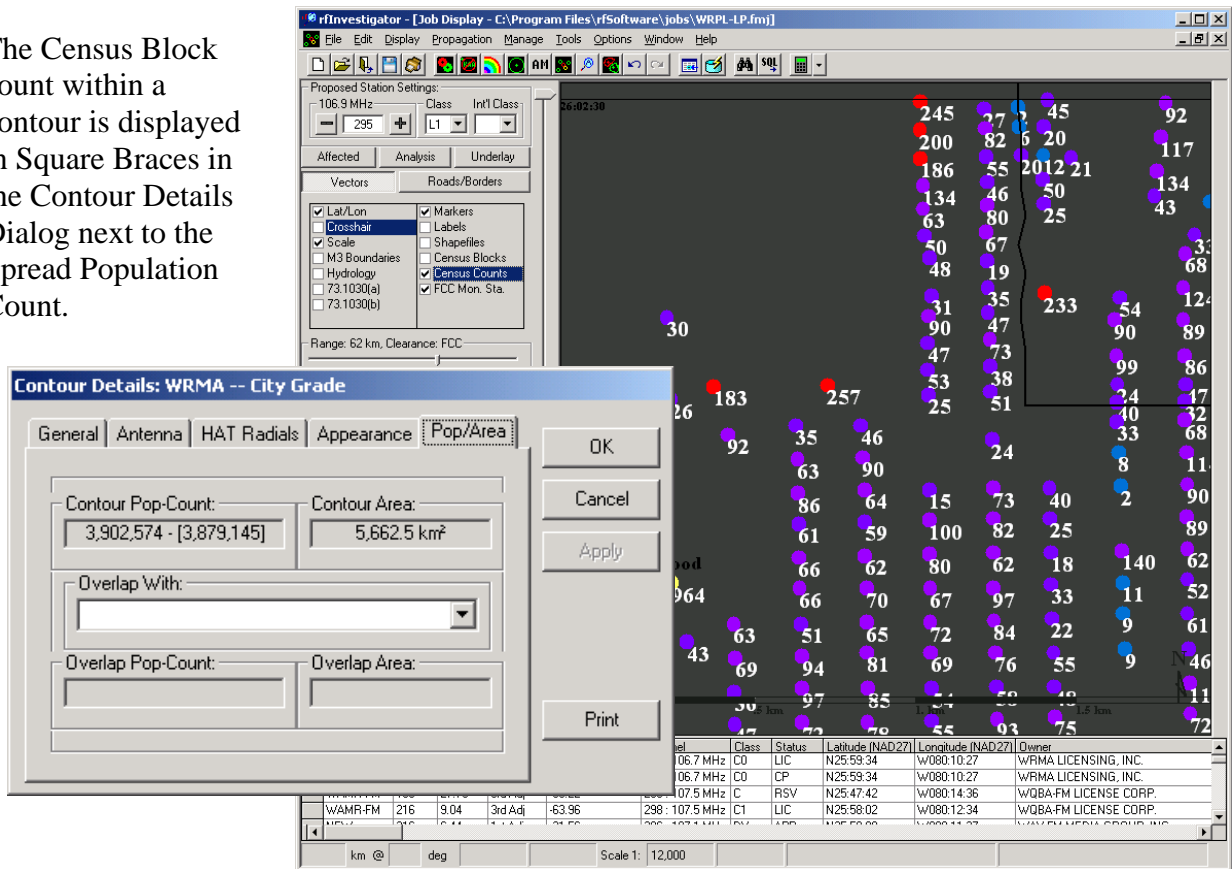
Census Block display is activated from the Vectors Control.



Counting Census Blocks

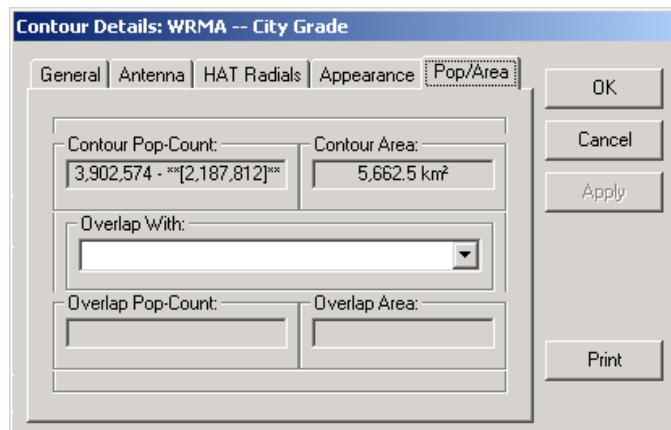
By setting the Map to maximum zoom you can display counts of individual Census Blocks.

The Census Block count within a contour is displayed in Square Braces in the Contour Details Dialog next to the Spread Population Count.



If the Census Block option is set to other than “Display All Population” then the Demographic count is shown with double asterisks.

Census Block Summary and Detailed reports are available by pressing the Print button on the Contour Details Dialog.



Selecting/Creating/Editing Antenna Patterns

Overview

The Antenna Pattern Editor is accessed by pressing the *Edit/Select* button on the Contour Details dialog—Antenna Page.

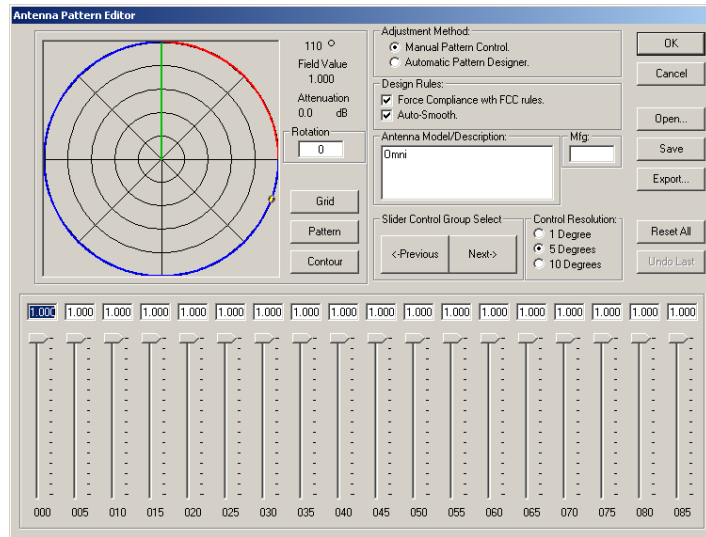
The Editor allows you to use existing FCC or *User patterns*, modify an existing pattern or design an entirely new pattern.

Slider controls are used to vary the antenna gain in any direction in as small as one-degree increments. *Auto-smooth* and *Force FCC compliance* controls keep the design within usable bounds. Select which **Slide Control Group** to adjust with the *<Previous* and *Next>* buttons.

The finished design can be exported to a CSV file for submission to an antenna manufacturer.

Contour View allows you to instantly see the effect of a pattern change on a contour.

Changes made to a pattern will be applied to the current contour when the **OK** button is pressed.

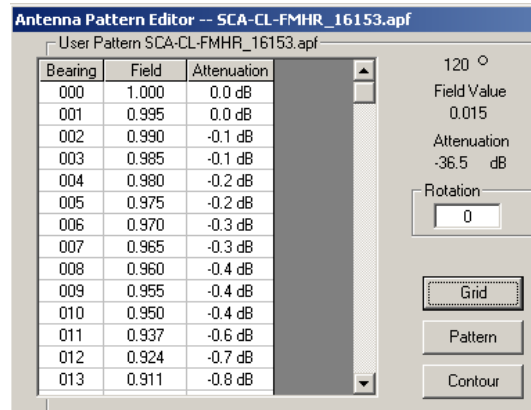


Pattern, Grid and Contour Views

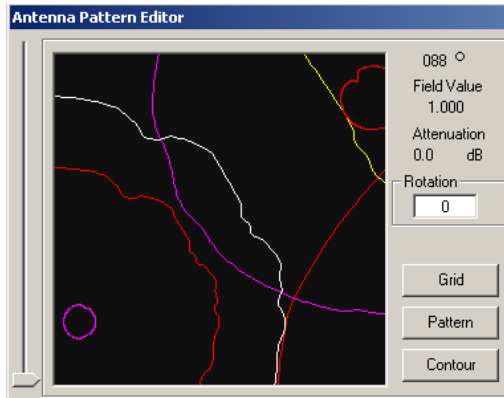
The Pattern View displays the current free-space horizontal antenna pattern. Moving the mouse pointer causes a cursor to track the pattern around the display. The antenna attenuation in *dB* and *Field Value* is displayed for the current cursor position.

Group Select shifts the “red zone” around the display. The red zone indicates the section of the pattern that is under control of the *attenuation sliders*.

The **Grid View** displays a spreadsheet showing Bearing, Field Value and dB Attenuation of the current pattern.



The **Contour View** displays the Job Map and contours.



When the pattern is altered, the effect can instantly be seen by a change in the contour shape.

Saving and Exporting a

Finished Pattern

The tabulated details of the antenna you have designed can be seen on the *grid display*. The *grid lists* *Field* and *Attenuation* values for each degree of antenna azimuth in the horizontal plane.

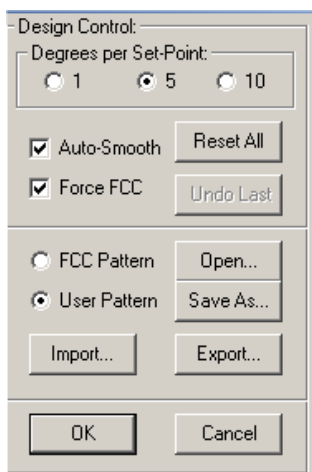
A finished pattern can be saved as a User Pattern. Press the *Save As...* button and assign the pattern a file name. The pattern can now be assigned to other existing contours or used when building new contours.

Pressing the *Export* button will allow you to send pattern design information to a CSV file. An antenna manufacturer will need this data to design an antenna to meet your special needs.

Bearing	Field	Attenuation
000	1.000	0.0 dB
001	1.000	0.0 dB
002	1.000	0.0 dB
003	0.989	-0.1 dB
004	0.966	-0.3 dB
005	0.944	-0.5 dB
006	0.923	-0.7 dB
007	0.902	-0.9 dB
008	0.881	-1.1 dB
009	0.861	-1.3 dB
010	0.841	-1.5 dB
011	0.822	-1.7 dB
012	0.804	-1.9 dB
013	0.785	-2.1 dB

Design Controls

Aids to design include:



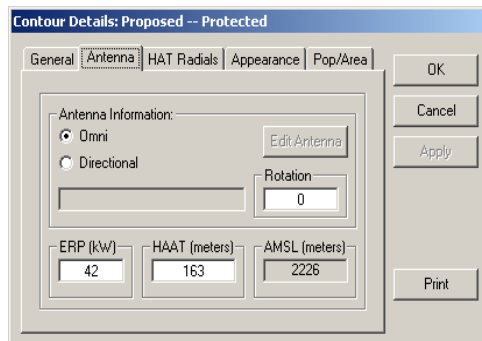
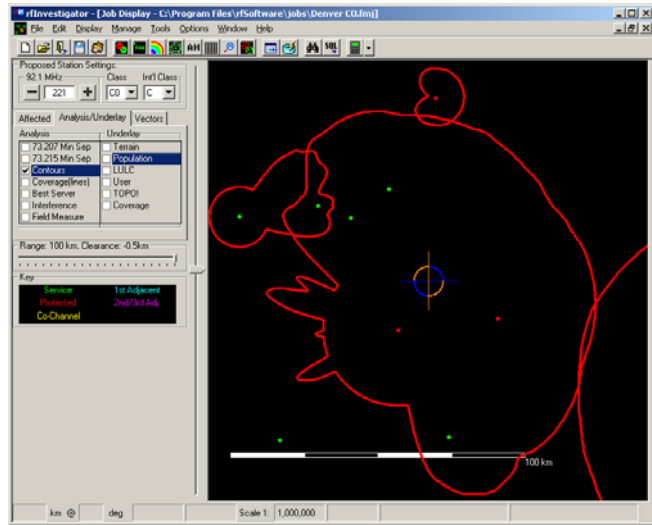
- **Reset All** and **Undo Last** buttons for discarding changes,
- **Degrees per Set-Point** for selecting how many degrees of pattern each slider will affect,
- **Group Select** buttons for determining what part of the pattern is affected by the sliders,
- **Auto-Smooth** to prevent jagged edges,
- **Force FCC** to force the pattern into compliance with FCC rule 73.316(b)(2).
- **Import** for reading antenna patterns from spreadsheets (*.csv) or ERI antenna pattern files (*.fig).
- **Open** and **Save As** for reading and saving antenna patterns in rfSoftware antenna pattern files (*.apf)

The Automatic Antenna Tuner

After filtering out all of the non-overlapping contours and hiding map features, this is what the *Main Job Map* will look like:

Double-Click on the Proposed Station's *Protected Contour* in the Contour manager. This will open the Contour Details Dialog for the selected contour.

Click the Antenna Tab and select a Directional Antenna, then press the *Edit Antenna* Button. The Antenna Pattern Editor will appear. Click the *Contour* Button and zoom out.

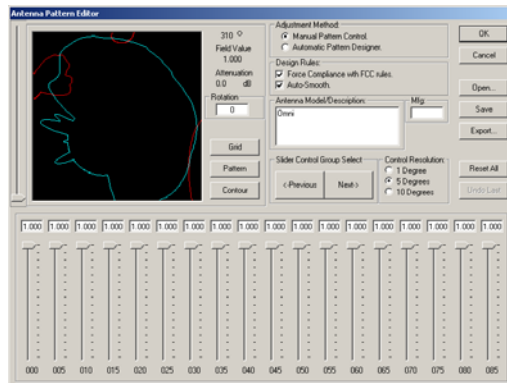
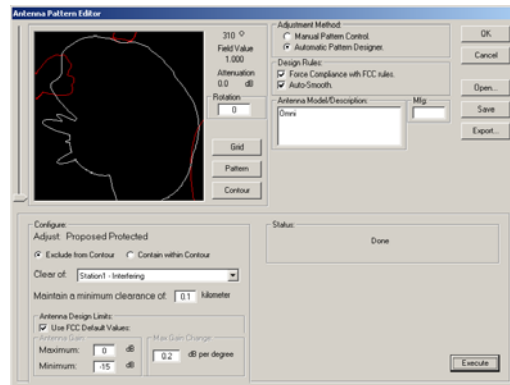


Next, select the Automatic Pattern Designer as your Adjustment Method. Configure the Designer to Exclude the *Proposed Protected Contour* from the Station-1 *Interfering contour*. Use the FCC Default values for Antenna Design Limits. Then Click the *Execute* button.

After a few moments, you will see the *Proposed Station* contour move clear of

the protected station.

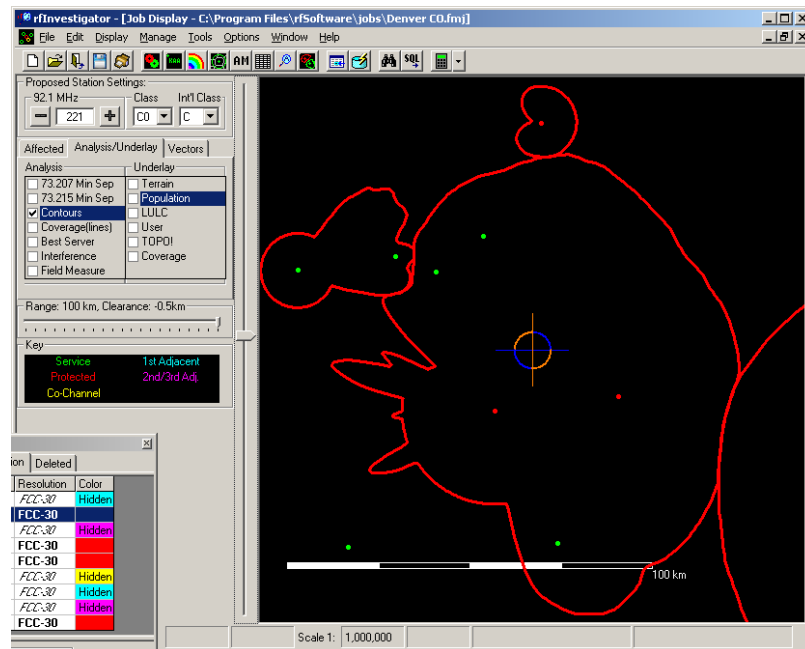
Continue with the DA design by selecting the Vacancy's *Interfering contour* and again click the *Execute* button.



Finally, select the station-2 *Interfering contour* and click *Execute*.

The *Proposed pattern* should now be clear of all prohibited overlap. Type a description in the Antenna Model/Description window and type USER in the Mfg window, then click *Save*. Click *OK* to close the Antenna Pattern Editor.

Then click **OK** to close the Contour Details Dialog. The Main *Job Map* should now look like this:



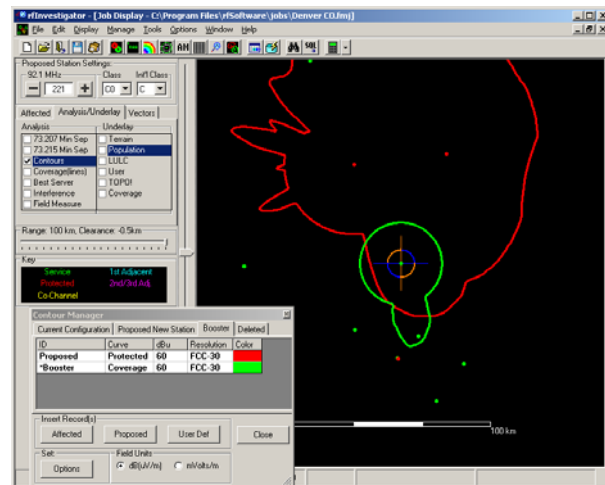
If overlap remains, check to see if any of the adjustments has reached the FCC limit of 15dB of attenuation. If so, a directional pattern will not solve this problem.

Designing a Booster with the Automatic Antenna Tuner:

After you have created contours for your new booster you may need to design a directional antenna to contain the Booster's *60dBu contour* within your stations *protected contour*.

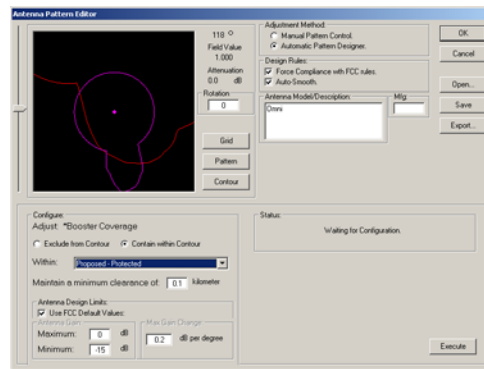
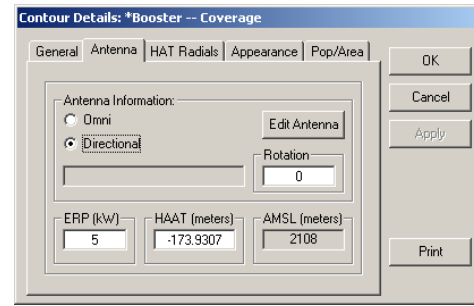
Here is the *Main Job Map* showing your *Protected contour* in red and the proposed *Booster contour* in green.

Double click on the *Booster contour* record on the Contour Manager to access the Contour Details Dialog.



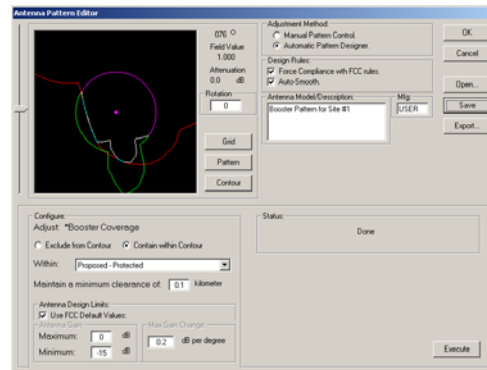
Click the Antenna Tab and select a Directional Antenna.

Click the *Edit Antenna* button to open the Antenna Pattern Editor.

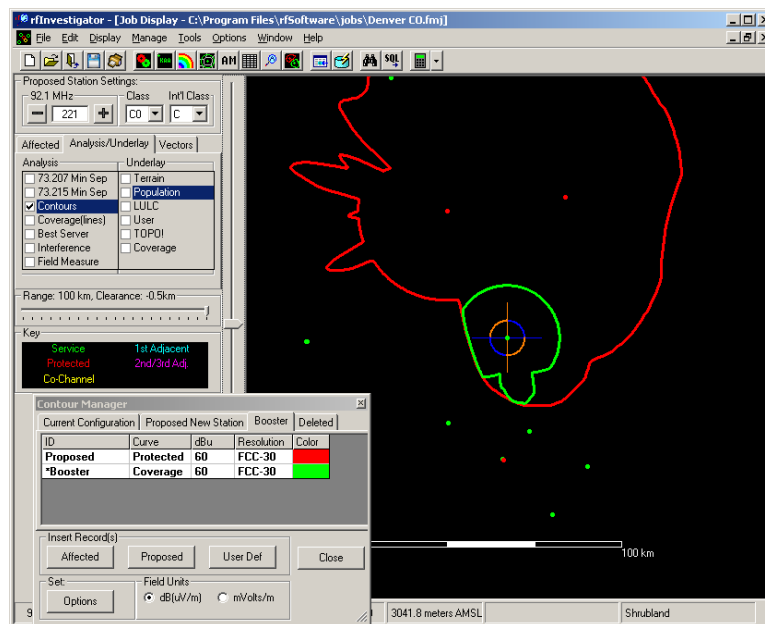


Click the **Contour** Button and select the Automatic Pattern Designer. Configure the Designer to Adjust Booster Coverage *Within the Proposed-Protected Contour*. Then click the *Execute* button.

Save the new pattern, click **OK**, and then click **OK** on the Contour Details Dialog to apply the new pattern to the booster.



The *Main Job Map* should now look like this:



Manual Contours - Advanced Feature

Overview

The Manual Contour control allows you to draw lines, circles and other polygons on the *Job map*. Simple shapes can be created from the Manual Contour Dialog; more complex shapes must be created from data files.

Areas and population counts can be computed within *manual contours* and their overlaps.

Regular contours can be adjusted within or excluded from *manual contours* using the antenna pattern editor.

Manual contours **cannot** be modified by the Antenna Pattern Editor or by adjusting ERP or antenna height.

The Manual Contour Dialog is accessed by pressing the **Manual** button in the Contour Manager.

Lines and Circles

The top section of the Manual Contour Dialog allows you to set a *Contour ID*, *Curve*, *Field* and *Color*. These settings are for reference and identification only and have no effect on the shape of the *Manual contour*.

The Contour Center control sets the reference point for creating the *Manual contour*.

To create a circular contour set the desired *reference ID*, *Curve*, *Field* and *Color*. Set the center of the circle as the *Contour Center*. Set the *Circle radius* and click the **Circle** button. Finally, click the **Apply** button to place the circular contour in the Contour Manager's *Current Group*.

Contour Lines are created in the same fashion. Simply set the *Bearing* and *Length of the line*, click the **Line** button, and then click the **Apply** button.

Contour Center: [NAD83]			
	Deg	Min	Sec
N	35	28	21.0
W	119	01	40.0

12-Point Contours

Twelve-Point contours can be created directly from the Manual Contour Dialog. Click the **12-Point Contour** button to display the Distance-To-Contour array. Set the distance for each of the 12 bearings and click the **Apply** button to send the contour to the Contour Manager.

Tip: The initial value of the 12 bearings can be set with the **Circle** button.

Manual Contour Files

Manual contours using more than 12-points or using bearings other than the 12 evenly spaced bearings specified in the 12-Point array can be created using a contour file.

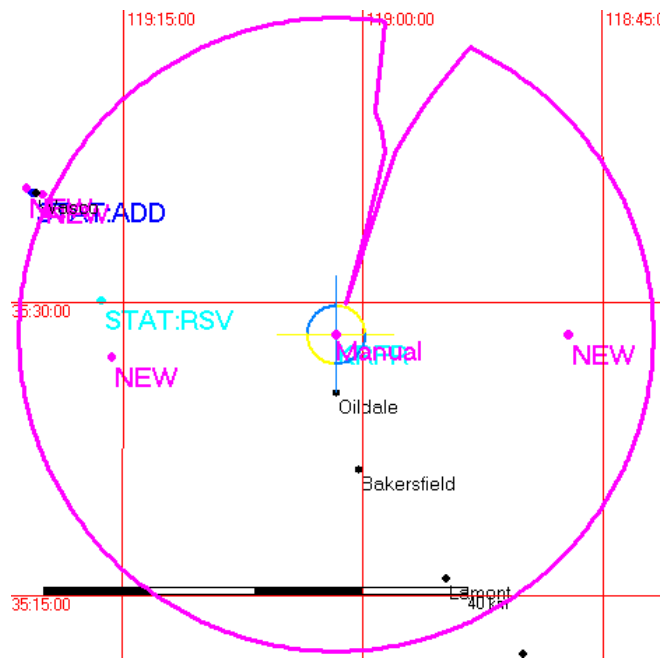
A contour file is a text file listing one bearing and the associated distance-to-contour per line. The bearing and distance can be separated by either a comma or a tab. A blank line will end the contour.

The bearings must be integers between 0 and 359 inclusive. They must be in increasing order.

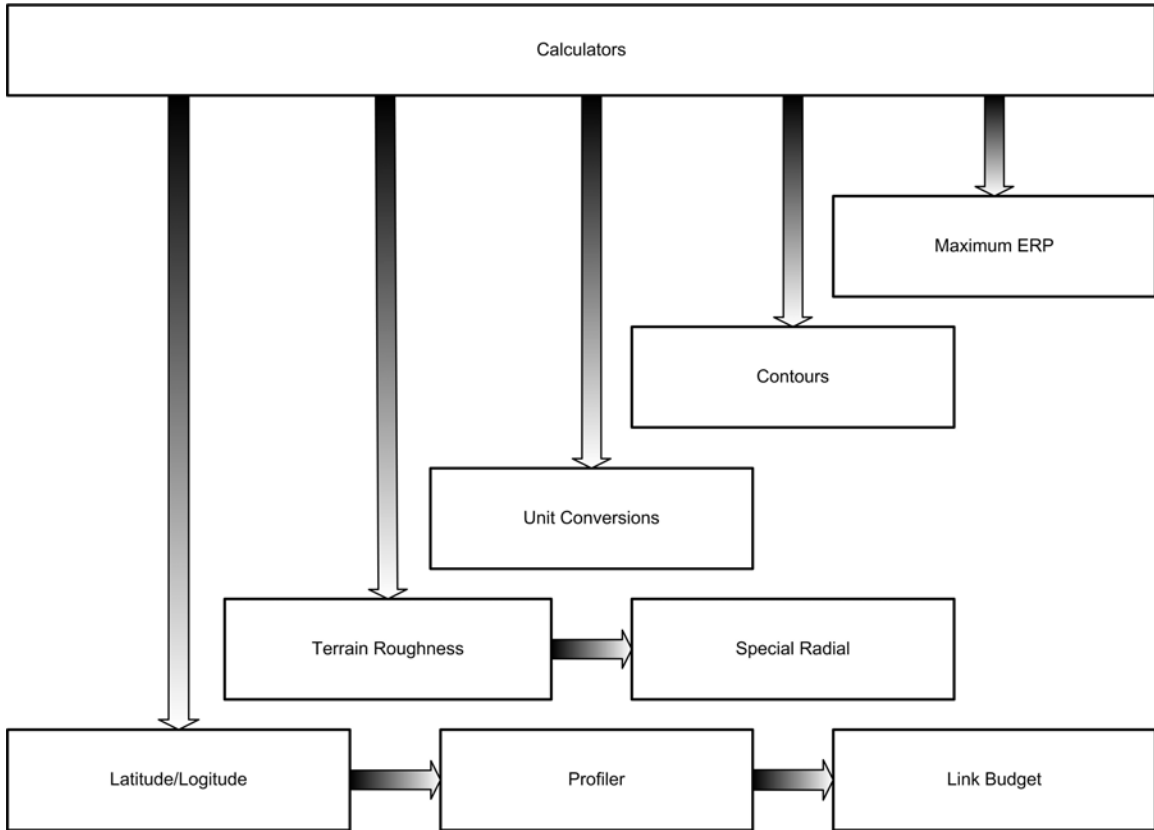
Bearings do not need to be evenly spaced.

The following file will create this contour:

```
0, 30
9, 30
10, 21.5
15, 18
16, 10
17, 3
18, 18.125
25, 30
```



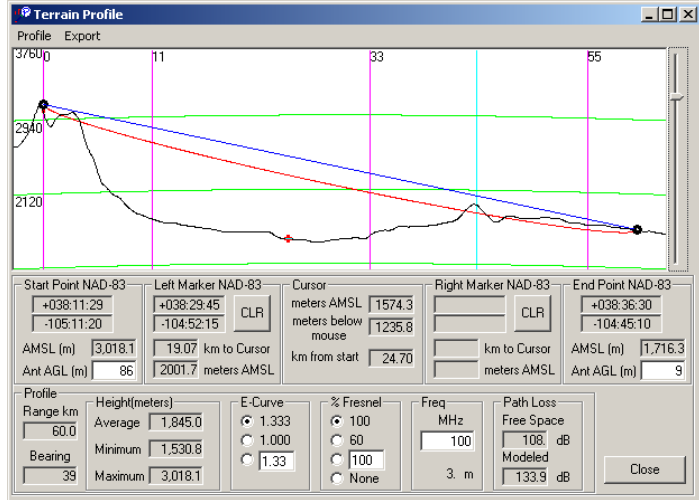
Calculators



The Terrain Profiler

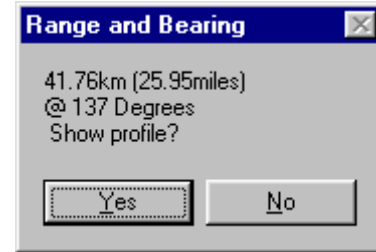
Overview

The Terrain Profiler displays obstructions, caused by changes in ground height and the curve of the earth, between two points. The Terrain Profiler does not take man-made structures or trees into account when determining obstruction heights.

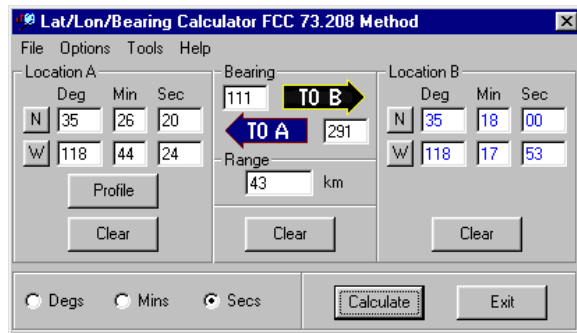


Job Map 'Rubber-Band' Lines

If you Left-Click and drag the mouse across the *Job Map* you will draw a rubber-band line from the point the mouse button was pressed to the point it was released.



The Lat-Lon Calculator



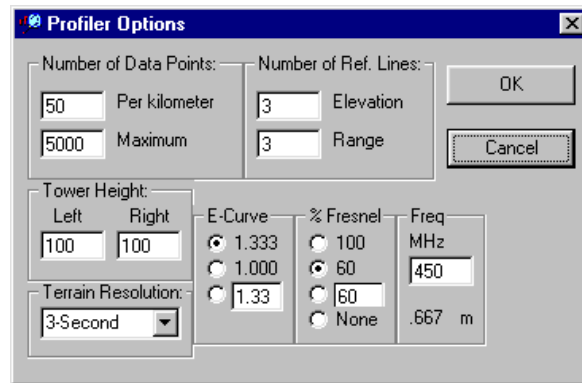
The Terrain Profiler can also be accessed from the *Lat/Lon/Bearing Calculator*. This tool can be accessed by pressing the *Lat/Lon Calculator* button, selecting Tools—Calculators--Lat-Lon Profiler from the drop-down menu or pressing Ctrl-F9.



Profiler Options Screen

The Profile Options screen is accessible from Options--Profiler... on the Main Menu.

The Terrain Resolution control on the Profiler Options screen will have no affect on data used for *Maps* or *Contours*.



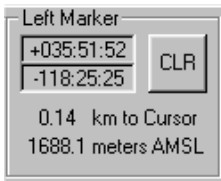
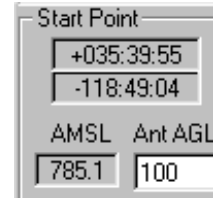
Valid ranges:

- Number of Data Points 20 to 100 per km and 20 to 5000 maximum points.
- Number of Ref. Lines 0 to 20.
- Earth Curvature 0.5 to 5.0.
- Percent Fresnel 0 to 100.
- Frequency 20 to 20,000 megaHertz.

Profiler Controls

The *slider* control located on the right-hand edge of the display can be used to expand the *vertical scale* of a profile.

Start and *End Point* information is in the boxes at each end of the *Profile Display*. *Longitude/Latitude* and *ground elevation* AMSL in meters can be viewed in each box. *Antenna height* above ground in meters can be entered to model a radio path between the points.



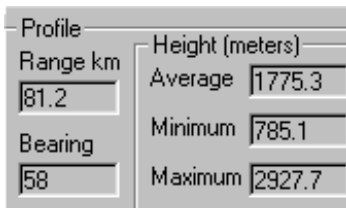
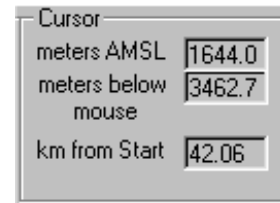
Two *markers* can be placed on the display by clicking the left mouse button in the display window. The first click will place the *Left Marker*; a second click will place the *Right Marker* if the location is to the right of the first marker.

Otherwise, the first marker information will shift to the *Right Marker* box and the new information will appear in the *left* box. In this way the *Left Marker* box will always contain the leftmost marker's information. *Marker Latitude/Longitude*, *height* AMSL and *distance* from cursor appear in the respective *Marker* boxes.

If two *markers* are placed and they are at least one kilometer apart, the view in the *Display Window* can be expanded between the markers. That is, in an expanded view the display will start at the left marker and end at the right marker.

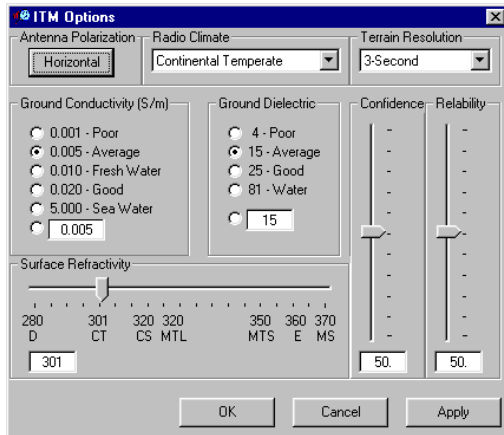
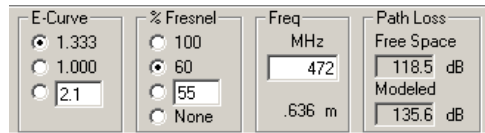
The *cursor* (a red ball) will move along the ground profile line as the mouse is moved across the display window. The *CURSOR* box contains information about its current *height* and *distance* from the starting point.

Additionally, the *vertical distance* between the *cursor* and the mouse *crosshairs* is displayed. This feature is useful for measuring the *vertical distance* between ground level and the *Fresnel zone* or between ground level and the *line-of-sight line*.



The *Profile Summary* box displays the overall length of the profile, the *bearing* of the line from the *start point* to the *end point* as well as the *minimum*, *maximum*, and *average heights*.

To the right of the Profile Summary box are user controls for setting the *Earth curvature*, *percent Fresnel zone* and the *Fresnel frequency*. Selecting None for a Fresnel zone will also turn off the *line-of-sight line*.



An Irregular Terrain Model (ITM) based on version 1.2.2 of the Longley-Rice model has been implemented in **rflInvestigator**. The model is available for use between two fixed points using the Terrain Profiler or for point-to-multipoint analysis using the optional **PLServer** Module.

Set the ITM parameters with the ITM Options control, accessible by selecting Options—ITM from the drop-down menu.

The ITM *path-loss* value is displayed for the current Option settings in the **Path Loss** box.

The *free-space loss* for the same path is also reported, based on:

$$\text{FreeSpaceLoss} = 32.4 + 20 * (\text{LOG10}(d_km)) + 20 * (\text{LOG10}(f_MHz))$$

An array of ITM loss values for Confidence values of 1 to 99 and Reliability values of 1 to 99 can be exported to a CSV file by pressing the *Path Loss* button in the Export box.

A summary of the data used to create the profile as well as *pathloss* and *signal level* information can be exported to a CSV file from the **Export** item on the drop-down menu.

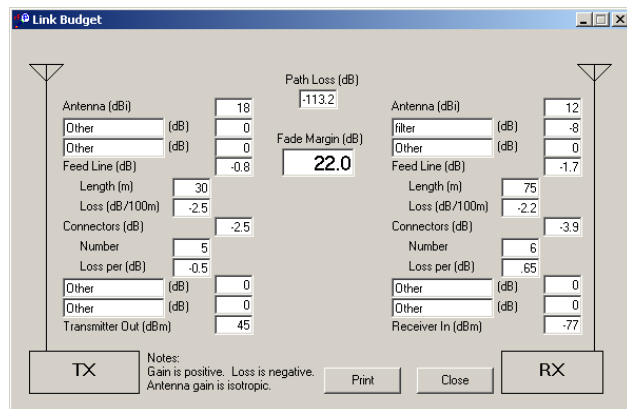
A bitmap image of the *Profile Display* can be created by selecting **Path to BMP...** from the **Export** menu.

The Link Budget Tool

Overview

The Link Budget tool is accessed from the **Profile** menu. Select **Profile: Link Budget...** from the Terrain Profiler dialog.

Enter a value for **Transmitter Out** in dBm. Enter a desired



Receiver In level in dBm. Path loss is automatically obtained from the *Profile*. The Fade Margin will update as you enter information in the various boxes. Enter negative values for *loss* (connectors, coax, passive filters, etc.) and positive values for *gain* (antenna gain, amplifiers, etc.). All values are in deciBels
Antenna gain is isotropic.

Terrain Roughness Calculator

Overview

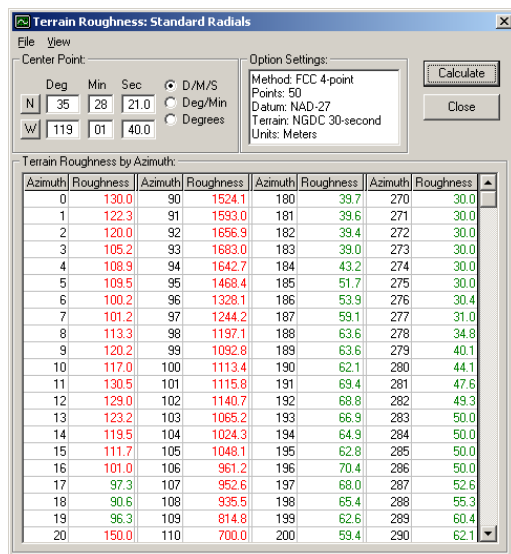
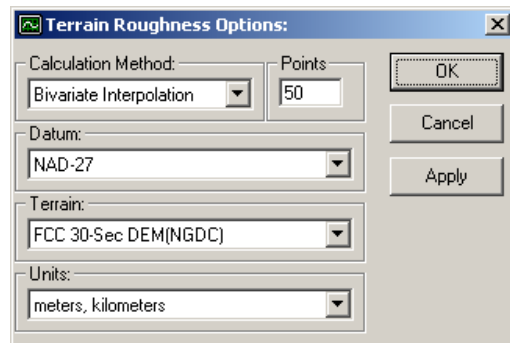
If the terrain roughness is not in the range of 20 to 100 meters then alternative methods, such as Longley-Rice may be used to determine coverage of the *city of license*. The Terrain Roughness Calculator will tell you what radials at a particular location deviate from this range.

The Terrain Roughness Calculator can be accessed from the Tools menu by selecting Tools—Calculators—Terrain Roughness... or by clicking the **drop down arrow** beside the *Calculator* Button and selecting Terrain Roughness....

Terrain Roughness: Standard Radials Dialog

The Terrain Roughness: Standard Radials dialog opens on the *Job Map center* coordinates.

Other options can be set via the Terrain Roughness Options dialog, accessible by double-clicking the mouse over the Options Settings window or by selecting Options... from the View menu.



Terrain roughness can then be calculated by clicking the **Calculate** button.

Values displayed in *green* indicate radials whose terrain roughness is within the 20 to 100 meter range where the FCC assumes contours are accurate. Values in *red* indicate areas where alternative methods of calculation may be permitted.

Terrain Roughness: Special

Radial Dialog

Terrain Roughness for a single radial can be calculated using the *Special Radial* dialog.

You can switch back and forth between *Standard* and *Special* radials using the *View* menu.

The screenshot shows the 'Terrain Roughness: Special Radial' dialog box. It has a menu bar with 'File' and 'View'. The 'Center Point' section contains latitude and longitude fields: Deg N (35), Min (28), Sec (21.0) and Deg W (119), Min (01), Sec (40.0). There are radio buttons for 'D/M/S', 'Deg/Min', and 'Degrees', with 'D/M/S' selected. The 'Option Settings' section includes 'Method: FCC 4-point', 'Points: 50', 'Datum: NAD-27', 'Terrain: NGDC 30-second', and 'Units: Meters'. There are 'Calculate' and 'Close' buttons. Below this, 'Distance to Start' is 010.0 km, 'Distance to Stop' is 050.0 km, and 'Azimuth' is 000.0 deg. The 'Terrain Roughness Summary' section shows 'Min/Max Heights' (300.0/160.0 meters), '10/90 Percentile Heights' (300.0/170.0 meters), 'Mean Height' (231.4 meters), 'Standard Deviation' (49.5 meters), and 'Terrain Roughness' (130.0 meters). A small line graph is also visible.

Max ERP Calculator

The screenshot shows the 'Max ERP/Distance to Contour' dialog box. It has a 'Required Data' section with a 'Class' dropdown set to 'C', a frequency field set to '92.1MHz', and an 'Antenna HAAT' field set to '600' meters. The 'Results' section shows 'Maximum ERP' as '100.' kW and 'Distance to Contour' as '91.82' km. A 'Reference Information for This Class' section shows 'Max ERP' (100 kW), 'Ref HAAT' (600 m), 'Min ERP' (100 kW), and 'Ref Contour' (92 km). There is a 'Close' button.

The Max ERP Calculator, accessible from the drop-down menu by selecting *Tools—Maximum ERP...* will calculate the maximum permissible ERP for a given class and antenna HAAT. Further, it will display the reference information for a given Class.

Lat/Lon Calculator

The Lat/Lon/Bearing Calculator is accessible from the drop-down menu by selecting *Tools—Lat/Lon Calculator...*, or pressing *Ctrl-F9*. This tool will calculate the *Range* and *Bearing* between two Locations or, will calculate a second

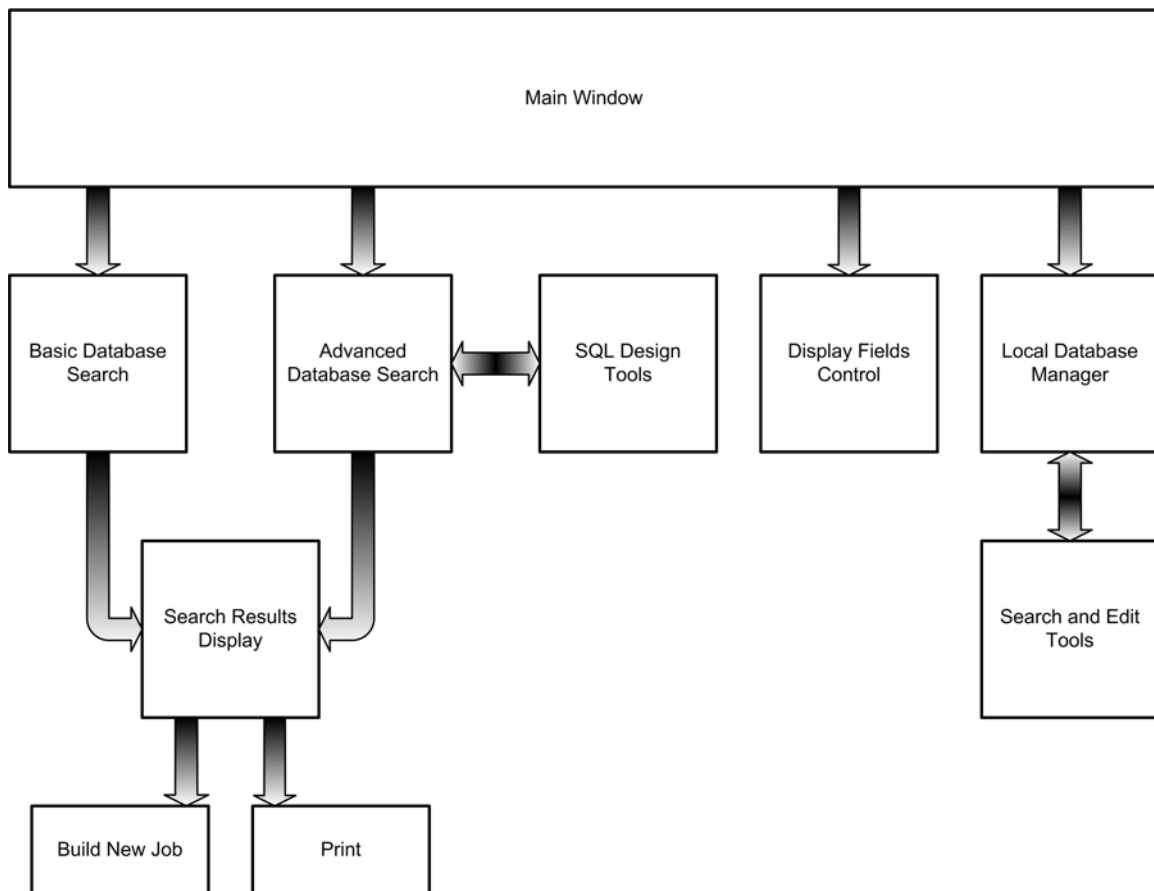
location given a first location and a range and bearing.

Formulas specified in FCC rule 73.208 are used to calculate the results. This tool is *limited* to distances *less than* 475 kilometers.

The screenshot shows the 'Lat/Lon/Bearing Calculator FCC 73.208 Method' dialog box. It has a menu bar with 'File', 'Options', 'Tools', and 'Help'. It features two location input sections: 'Location A' and 'Location B', each with 'Deg', 'Min', and 'Sec' fields and 'N'/'W' radio buttons. A 'Bearing' section has a 'TO B' arrow pointing right and a 'TO A' arrow pointing left. A 'Range' field is set to 'km'. There are 'Profile', 'Clear', and 'Calculate' buttons. At the bottom, there are radio buttons for 'Degs', 'Mins', and 'Secs' (with 'Secs' selected), and 'Calculate' and 'Exit' buttons.

Pressing the *Profile* button will run the *Terrain Profiler* between the two locations specified by the *Lat/Lon Calculator*.

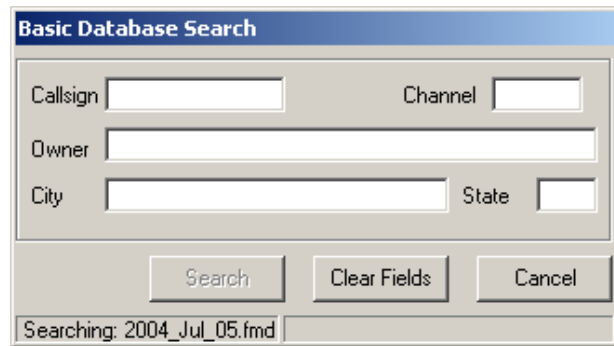
Searching for Data



Basic Searches

Overview

A database search will retrieve records from the **rflInvestigator** master database. Search results may be used to build new jobs or sent to a printer or spreadsheet.



Starting a Basic Database Search



The search screen can be accessed in several ways. The most direct is to simply press the **Basic Database Search** button. A second method is to select **Tool—Find--Basic Database Search** from the Main Form's drop-down menu or, simply press Ctrl-F7 to initiate a search.

Selecting a Database

If a master database has not been loaded, **rflInvestigator** will prompt you for the name of the database to be searched.



If the master database that is already loaded is not the one you wish to search, you must designate another current database. To do this simply press the **Select Database** button on the tool bar or select **Tools – Select Database** from the drop-down menu.

Searchable Fields

The **Basic Database** search allows you to designate up to five search fields; *Callsign*, *Channel*, *Owner*, and, *City/State of License*. Simply type some or all of the desired data in the appropriate box and press the **Search** button. The data is not case sensitive. The lower-left corner of the search screen indicates what master database is being searched.

Searching by Multiple Fields

By placing data in more than one box, the search can be narrowed. Multiple fields are automatically ANDed.

Wildcard Searches, *,?,

The Basic Search recognizes three wildcard characters. * for zero or more characters, ? for one character and # for one number.

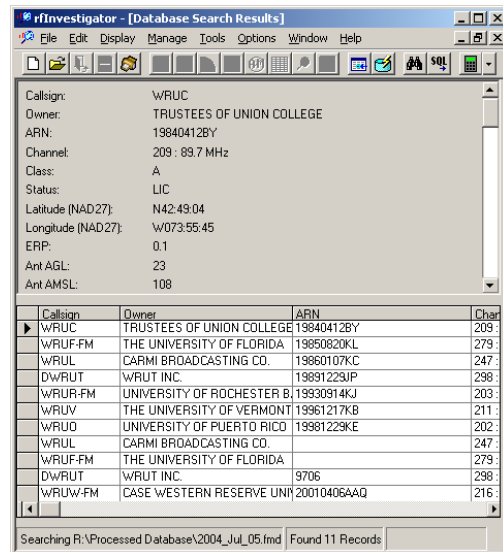
The Data Display Screen

Overview

The Data Display screen presents the results of a search.

Sorting Data

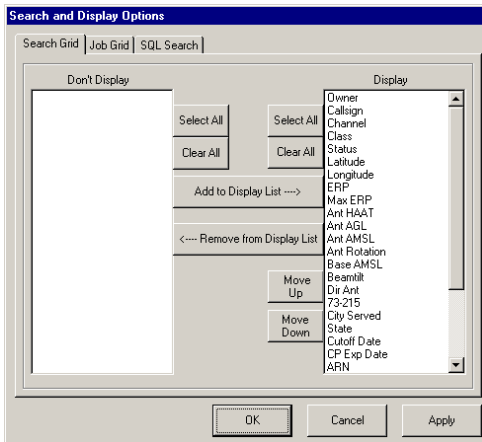
Basic search results can be sorted by selecting a column and picking the desired sort direction from the *Pop-Up* menu. Click on any column heading to select it then right click to display the *Pop-Up* menu.



Changing Displayed Fields and Field Order

The fields displayed on the Data Display Screen and the order of the columns can be controlled from the Search and Display Options Control.

The Search and Display Options Control can be accessed by pressing the *Select Fields* button, selecting Options—Display Fields... from the drop-down menu or, right clicking on the Data Display Screen and selecting Change Displayed Fields from the *pop-up* menu.



Select the Search Grid tab. Two windows are displayed, Don't Display and Display. *Fields* listed in the Display window will appear on the Data Display Screen in the order that they are listed.

Select one or more *fields* in the Display window, and change their position in the list with the *Move Up* and *Move Down* buttons.

To remove a field or fields from the Display window, select one or more fields in the Display window and click the *Remove from Display List* button.

To add a field or fields to the Display window, select one or more fields in the Don't Display window and click the *Add to Display List* button.

Exporting Data to a CSV File

The results of a search can be exported to a Comma Separated Value file by selecting Tools--Export--Search Results to CSV... from the drop-down menu.

SQL Basics

What is SQL?

Structured Query Language (SQL) is the programming language used by **rflInvestigator** to manipulate information. You use SQL to ask a question about the FCC database. This is done by creating an SQL Query.

An SQL Query is a series of statements and conditions that ask the database program a question. SQL queries always end with a semicolon.

Data Manipulation Language

SQL is subdivided into *Data Definition*, *Data Control* and *Data Manipulation Language* (DDL, DCL and DML). Internally **rflInvestigator** uses all three – but for the purposes of user searches, only DML is important.

The major DML commands include:

SELECT, FROM

WHERE

GROUP BY

ORDER BY

And various *Conditions* and *Operators*

Accessing the Query Manager

The Query Manager is accessed by pressing the **SQL Query** button, selecting Tools--Find--Advanced Database Search from the drop-down menu or, by pressing Ctrl-F8.



Building Queries

You begin most SQL queries with the statement *SELECT fields FROM tables*, where *fields* are the data fields you wish to see and *tables* are the database tables that contain the desired fields. A generic SQL query would look like this:

```
SELECT FieldNameA, FieldNameB FROM TableName1, TableName2;
```

As an example, to return fm station call signs and their respective station owners from the database, your query would begin with:

```
SELECT fac_callsign, party_name FROM fm_data, party;
```

If the same field name appears in two or more selected tables, you must discriminate between the fields by prepending the table name in the **SELECT** portion of the query:

```
SELECT fm_data.lat, am_data.lat FROM fm_data, am_data;
```

Executing either of these queries would not be a very good idea. The first one would match the more than 27,000 'fac_callsign' fields from fm_data to each of the more than 16,000 'party_name' fields in party. This query would return more than **four hundred million** records! The second query would not fare much better with 27,000 fm records matched to each of more than 15,000 am records.

```
SELECT fac_callsign FROM fm_data;
```

This would only return a list of 27,000 FM station call signs. That is a bit more manageable, but still not very useful. There needs to be a way to select specific records from the database. This is done with the **WHERE** statement.

```
SELECT fac_callsign FROM fm_data WHERE station_class = "C1";
```

Now the query returns only the call signs of FM stations that have a station_class of C1, or about 2000 records.

The **WHERE** statement can be expanded to further limit the query results:

```
SELECT fac_callsign FROM fm_data WHERE station_class = "C1"  
AND comm_state = "CA";
```

This query returns the call signs of approximately 25 C1 stations in California.

By using the **WHERE** statement to limit the number of records a query returns you can now select fields from multiple tables without crashing your computer. For example:

```
SELECT fac_callsign, party_name FROM fm_data, party WHERE  
station_class = "C1" AND comm_state = "CA";
```

This query returns 25 x 16,000 or four hundred thousand records!

There is one more filter that needs to be added.

```
SELECT fac_callsign, party_name FROM fm_data, party WHERE
station_class = "C1" AND comm_state = "CA" AND fm_data.party_id =
party.party_id ;
```

Relating the party table *Primary Key* to the fm table *Foreign Key* limits the records this query returns to the 25 California C1 stations and their station owner names.

Another useful SQL statement is **ORDER BY**. **ORDER BY** will sort the output of a query. For example:

```
SELECT fac_callsign, station_class, lat, lon/14400 AS Longitude FROM
fm_data WHERE comm_state = "CA" ORDER BY fac_callsign ;
```

A few of the 1983 results of this query are shown below.

Notice the values in the 'lat' column. They are all very large integers. **rflInvestigator** stores latitude and longitude in quarter-seconds. There are 60-minutes times 60-seconds times 4-quarters of a second in every degree. That means there are 14,400 quarter-seconds per degree.

fac_callsign	station_class	lat	Longitude
KPSI-FM	B1	488816	-116.409444444444
KPSI-FM	B1	488812	-116.409444444444
KPSL-FM	B1	508624	-119.707222222222
KPWR	B	492872	-118.066666666667
KPWR	B	491960	-118.195833333333
KQED-FM	B	542732	-122.436944444444
KQEX	C1	582092	-124.105833333333
KQEX	C1	582092	-124.105833333333
KQJZ	B	509188	-120.655
KQLB	A	531740	-120.845
KQOD	A	547092	-121.213888888889
KQPM	B	563480	-123.075555555556

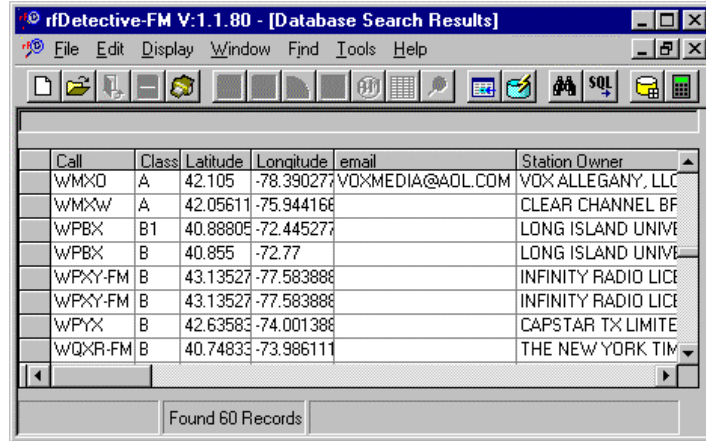
Now look at the Longitude column. These values seem to be appropriate decimal degrees of longitude for the State of California. Look again at the **SELECT** statement; you will see that the value of lon was divided by 14400. This converted the query output into degrees. Further, the field statement is followed by an **AS** statement. **AS** renames the field heading for display purposes.

Here a more complex query:

```
SELECT fac_callsign AS Call, station_class AS Class, lat/14400 AS
Latitude, lon/14400 AS Longitude, party.party_email AS email,
party.party_name AS [Station Owner] FROM fm_data, party WHERE
fm_data.party_id = party.party_id AND comm_state = "NY" AND
fac_callsign LIKE "%X%" ORDER BY fac_callsign;
```

And the results:

There are two new things in this query. First, the column heading for party_owner is "Station Owner". Notice that there is a space in the column name. This was done by putting the name in square brackets []. Using [] will also allow you to name a column with a reserved keyword, such as **SELECT**, **FROM** or **GROUP BY**.



The screenshot shows a window titled "rfDetective-FM V:1.1.80 - [Database Search Results]". The window contains a table with the following data:

Call	Class	Latitude	Longitude	email	Station Owner
WMXD	A	42.105	-78.390277	VOXMEDIA@AOL.COM	VOX ALLEGANY, LLC
WMXW	A	42.05611	-75.944166		CLEAR CHANNEL BF
WPBX	B1	40.88805	-72.445277		LONG ISLAND UNIVE
WPBX	B	40.855	-72.77		LONG ISLAND UNIVE
WPXY-FM	B	43.13527	-77.583888		INFINITY RADIO LIC
WPXY-FM	B	43.13527	-77.583888		INFINITY RADIO LIC
WPYX	B	42.63583	-74.001388		CAPSTAR TX LIMITE
WQXR-FM	B	40.74833	-73.986111		THE NEW YORK TIM

At the bottom of the window, it says "Found 60 Records".

```
SELECT fac_callsign AS [SELECT], station_class AS [GROUP BY],  
lat/14400 AS [FROM], lon/14400 AS Longitude FROM fm_data  
WHERE comm_state = "NY" AND fac_callsign LIKE "%WA%";
```

Two other new items in this query are the **LIKE** statement and the % symbol. **LIKE** is used to compare two text strings and % is a *wildcard* for zero or more characters.

Numeric field values can be manipulated and compared with all the standard functions, addition +, subtraction -, multiplication *, and division /, as well as greater than >, less than <, etc. One useful comparison function is **BETWEEN**. The following statement returns all FM station call signs that are north of 40.5 degrees and south of 50 degrees.

```
SELECT fac_callsign FROM fm_data WHERE lat/14400 BETWEEN  
40.5 AND 50;
```

Saving Queries

Queries can be *saved/retrieved to/from* text files by pressing the Load or *Save* button on the Query Manager.

By default the text files are stored in the *Program Jobs* folder.

The Master Database

Overview

The **rfInvestigator Master Database** is a custom designed, high-performance, compilation of information from the FCC's Consolidated Database System (CDBS). Extensive pre-processing allows a large amount of data to be squeezed into a small space without a performance trade-off.

Data Tables and Fields

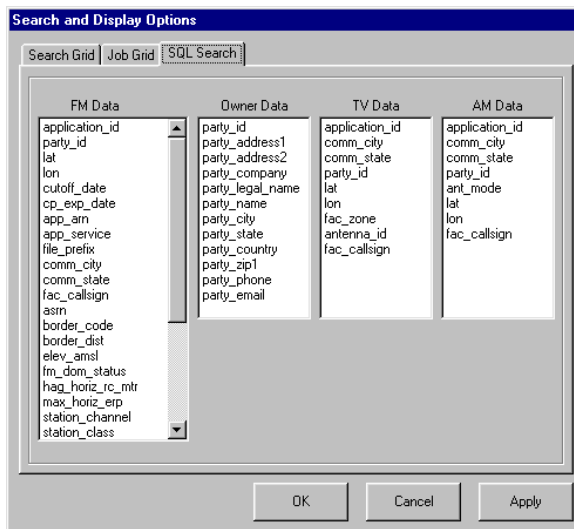
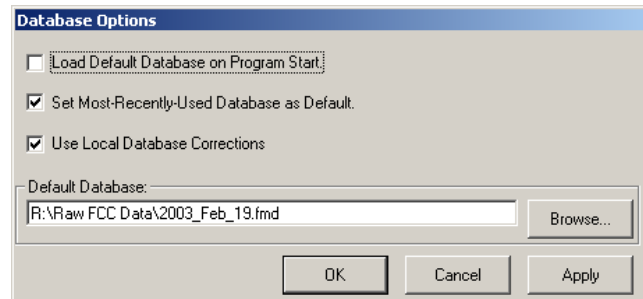


Table and field names can be seen with the Fields Selector. The FM, TV and AM tables are each related to the Owner table by the party_id field.

Database Options

The Database Options dialog can be accessed by selecting Options--Database from the Main Menu.

The first two options are self-explanatory. The third option, Use Local Database Corrections allows you to enable or disable the use of modified fields from the local database.



Naming Convention

Databases obtained from **rfSoftware** are named with the Year-Month-Day of their source data. For example, if a database was build from the August 3, 2001 CDBS the filename would be:

2001_AUG_03.fmd

The associated *Antenna Pattern* file would be: 2001_AUG_03.pat

The associated *Antenna Information* file would be: 2001_AUG_03.fam

The Database Folder

If the default values are used during install, the database folder will be *C:\Program Files\rfSoftware\database*.

Building a Master Database

The database building process is performed by the **DbBuilder** Program. Refer to the Operation Manual for **Database Builder** for details.

The Local Database

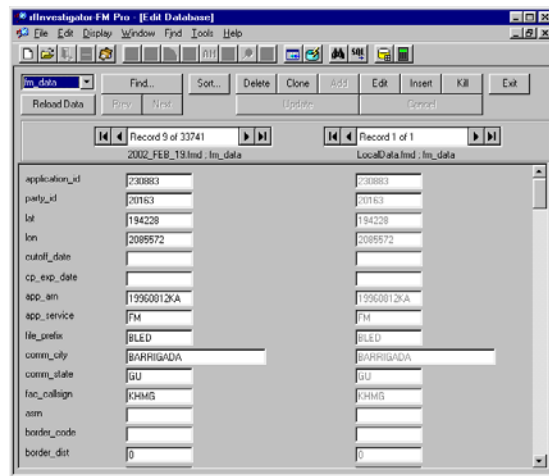
Overview

The *Local Database* allows changes to be maintained even when the *Master Database* has been updated. It does this by making a local copy of the edited record. Whenever data is retrieved from the *Master Database*, the *Local Database* is checked to see if an edited copy of that record exists.

Data Tables, Records and Fields

Information in a Database is organized into *Tables*, *Records* and *Fields*. A *Field* is a container that holds one piece of information. A *Record* is a collection of *Fields*. A collection of identically structured *Records* is a *Table*. A collection of *Tables* is a *Database*.

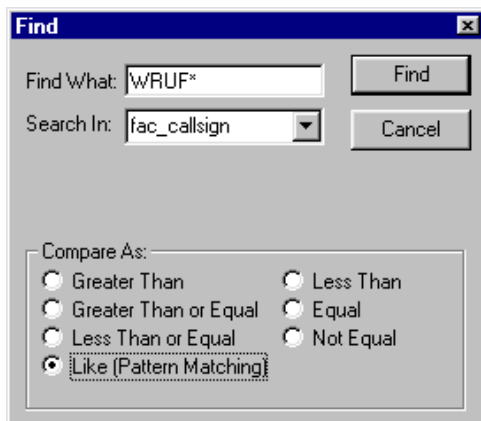
The *Local Database* has three *Tables*; am_data, fm_data and, tv6_data.



Finding Records in the Local/Master Database

Searching For Records

Select a table from the drop-down box and press **Reload Data**. Next Click **Find...**

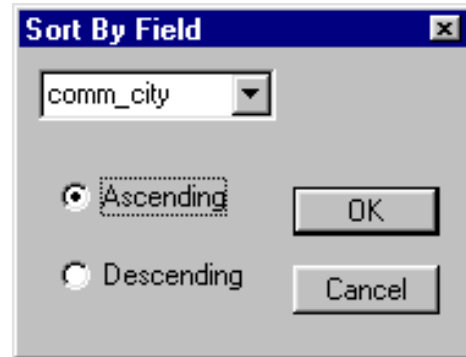
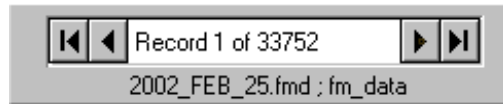


Enter your search string, using wildcards if necessary. Select a *field* to search. Select a *Compare As* mode, pattern matching is best for text searches.

Click the **Find** button to execute the search.

Sorting Records

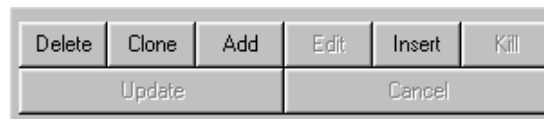
Click the **Sort...** button. Select the field to sort by. Select the direction of the sort. Click **OK**.



Use the Record Control to move through the data records.

Manipulating Records

Master Database records are manipulated by making a copy of the record-of-interest in the *Local Database* then operating on that local record.



Deleting Records

Pressing the **Delete** button marks a copy of the record in the *Local Database* as deleted. If this record exists in the *Master Database*, it will be ignored.

Cloning Records

Pressing the **Clone** button makes a copy of the current *Master Database* record and places it in the *Local Database* with a new application ID. This appears to the system as an entirely new record.

Adding Records

Pressing the **Add** button makes a copy of the current *Master Database* record and places it in the *Local Database*. The system will use this copy instead of the original record.

Editing Records

Pressing the **Edit** button will allow you to make changes to the current *Local Database* record.

Inserting Records

Pressing the **Insert** button will create an entirely new record in the *Local Database*.

Killing Records

Pressing the **Kill** button will remove the current record from the *Local Database*.

The Job Database

Overview

A *Job File* is a database. It contains:

- Job Information

- Extracts from the *Master Database*

- State, County and City borders

- Roads, Railroads and Water features (Hydrology)

- Contour Information

The Job Information Table

The Job Information Table contains the name of the *Master Database* that was used to build the *Job*, the *Job creation date*, *Job Center*, *Channel*, *Class* and *Comments*.

Job Channel, *Class*, *Int'l Class* and *Comments* can be changed and saved into a new Job.

You can access the Job Information dialog from the drop-down menu. Select Edit--Job Information....

The screenshot shows a dialog box titled "kftb cell # 3b Information". It has a standard Windows-style title bar with a close button. The dialog is organized into several sections. At the top left is a text box for "Source Database" containing "2002_FEB_19.fmd". To its right is a "Creation Date" field with "3/4/02". Further right is a "Latitude - Longitude" section with a grid of input boxes: "N" (34), "49", "31" for degrees, minutes, and seconds, and "W" (112), "34", "7" for longitude. Below this is a "94.3 MHz" section with a frequency input of "232" and navigation arrows. Next to it are "Class" (C3) and "Int'l Class" (B1) dropdown menus. To the right is an "Offset (km)" field with "000.0". At the bottom is a "Comments" text area with "No Comments". The dialog concludes with "Save As..." and "Cancel" buttons.

Adding Markers to a Job

A *Marker* is a dot with a label and an optional ring that can be placed on the *Job Map*.

Place the mouse on or near the location you wish to mark. Right click and select Add Marker... from the *pop-up* menu. You may add a ring around your marker by inserting a distance in km. in the Ring Radius box. Give the marker a name and adjust the lon/lat if necessary.

The screenshot shows a dialog box titled "Add Markers". It has a title bar with the text "Add Markers" and a close button. The dialog contains a "Marker Name" text box at the top. Below it are "OK" and "Cancel" buttons. The main section is "Location NAD-83", which includes a grid of input boxes for coordinates: "N" (35), "34", "34.4" for degrees, minutes, and seconds, and "W" (119), "10", "35.5" for longitude. Below the grid are radio buttons for "D", "DM", and "DMS". To the right of the grid is a "Show:" section with "Ring" and "Dot" checkboxes, both of which are checked. Below that is a "Ring Radius" input box followed by "km".

Editing Markers in the Job

Existing markers can be edited or removed with the **Edit Markers** dialog. Select **Edit--Markers...** from the drop-down menu. Click the right/left record control arrows at the bottom of the dialog to find the record of interest. Click the **Edit** button to change the marker or Click **Delete** to remove it.

Sending Markers to the Master (Local) Database

Markers can be saved in the *Master Database* from the **Edit Markers** dialog. These markers will appear in *New Jobs* built in the current area. To save a *marker* in the *Master Database* select the desired marker with the record control and click the **Copy to Master** button.

If there is no current *Master Database* selected the **Copy to Master** button will not be enabled.

Changing the **Marker Source** to *Master Database* will allow you to **Add**, **Edit** or **Delete** markers in the *Master Database*.

Exporting Data

CSV File Format

A *Comma Separated Value* (CSV) file is a standardized format that many spreadsheet programs, such as Microsoft Excel, can access directly.

The data is stored as plain text. Each line of text represents one row (one record) of information on the spreadsheet. Individual cell (field) values are separated by commas. A comma can be included in a cell by enclosing the information in single or double quotes.

Data Available for Export

Most data that can be displayed in a tabular format can be exported from **rflInvestigator**. This includes:

Search Results:

The first line consists of column headings. The following lines contain the field data. The number of fields and their order depends on the settings of the *Fields Selector*. The number of lines output equals the number of records returned by the search plus one for the heading.

Job Grid Data:

Job Grid output is identical in structure to Search Results.

Profiles:

The first line is column headings, followed by one line of data.

The third line is column headings, followed by two lines of data.

The sixth line is column headings, followed by as-many-as 5000 lines of data, depending on the length of the profile and the profile options settings.

ITM (Longley-Rice) Arrays:

The first line is column headings, followed by one line of data.

Next is an array of data arranged in 99 columns of Confidence by 99 rows of Reliability values.

HAT Radials:

The first line is column headings, followed by one line of data. fields.

Line three is column headings, followed by 2400 lines of data fields.

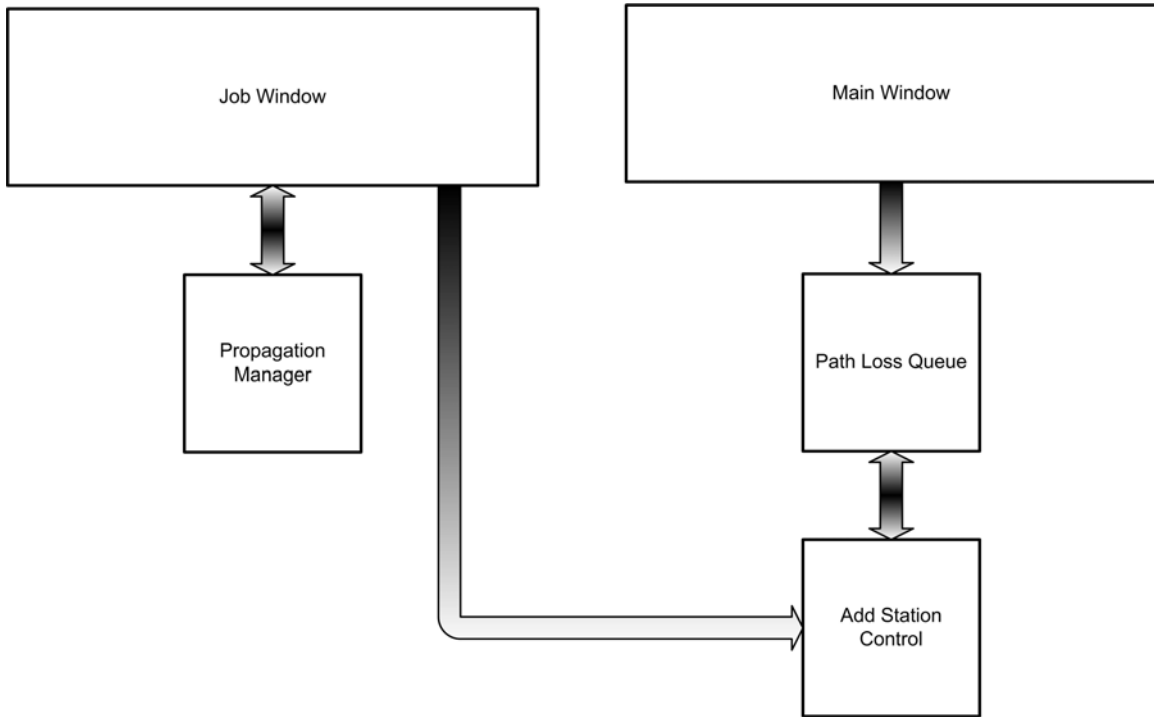
Antenna Patterns:

The first line is column headings, followed by 360 lines of data.

Path-Loss Profiles:

Available from the profiler drop-down menu. Exports terrain heights, lat/lon, pathloss and predicted signal level along a radial path.

Advanced Topics: Propagation



Overview

Path-loss files can take a considerable amount of time to generate. With this in mind, **rfSoftware** has designed **PLServer** to run independently from **rflInvestigator**. While *path-loss* files are being generated, you may continue to open and close Jobs or even shutdown and restart **rflInvestigator**.

There are several steps required to get from the *Path-loss* files to *Propagation files*. **rflInvestigator** uses *Propagation files* to Display/Analyze Coverage, Best Server and Interference analyses.

First, it is necessary to set up the information needed to create *Path-loss* files. This information is input through a series of dialogs. After these dialogs are completed for each station, the *Path-loss* files can then be created.

Next, the *Path-loss* files of interest are selected from the **Propagation Manager**, and additional information about power and antenna information are input. At this point, the *Propagation files* are created. These files may now be loaded and displayed in **rflInvestigator** via the **Coverage Manager**.

Creating Path-loss Files

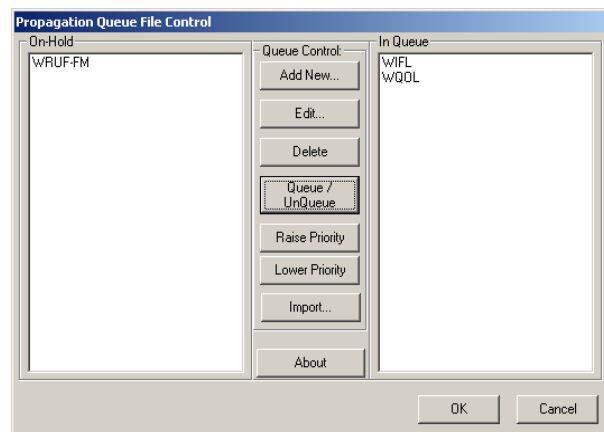
Overview

PLServer builds *path-loss* files from a queue. *PL Jobs* can be added, edited or deleted from the *queue*. The order of jobs in the *queue* is adjustable. In order to manipulate the *queue*, *PLServer* calculation must first be paused.

Jobs can be placed in the *queue* en-masse from a spreadsheet, manually using the Add Stations Dialog, or from the Station Grid of an open **rflInvestigator** Job.

Propagation Queue File Control

The Propagation Queue File Control can be accessed directly from the Main Menu by selecting Propagation--Queue...

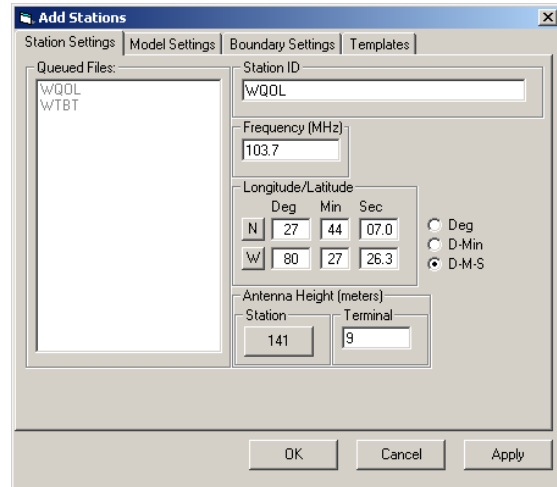


Adding a New Station

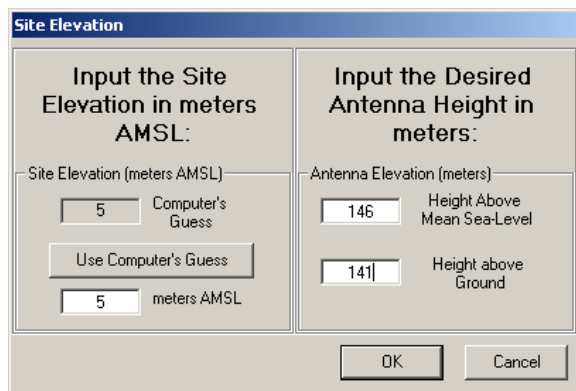
Use the *Add New* button to manually add a station to the queue.

When accessed without an **rflInvestigator** Job the Add Stations Dialog opens filled with the previous *PL Job* data. Enter the required data manually. If a Job is open, the Add Stations Dialog will open filled out with the current *map center* information.

Another option is to select a station from the *Job Grid*, right click and select Add to Propagation Queue from the *Pop-Up* Menu.



Station Settings

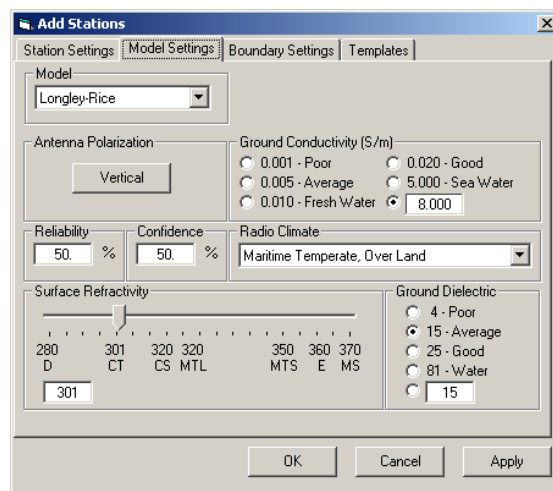


Antenna Heights are *Above-Ground-Level* in meters. See *Appendix B*. The *terminal height* is the height at the receiver. Set the *Station height* by clicking the *Station* button. Use the *Site Elevation* dialog to specify transmitter antenna height.

Model Settings

Next, click the **Model Settings** Tab on the Add Stations dialog. These are the Longley-Rice model settings.

Configure the Model Settings for your particular station location.



Boundary Settings

The next tab on the Add Stations Dialog is Boundary Settings.

This is where you designate what area you wish to analyze.

Boundaries are defined by Northeast and Southwest corner lat/lon values. It is not necessary to include the *Station Center* within the boundaries when specifying the corner values. This is useful if you wish to analyze a small area in greater detail.

The screenshot shows the 'Add Stations' dialog box with the 'Boundary Settings' tab selected. The 'Define Boundary By' section has 'Station Center and Radius' selected. The 'Radius (km)' is set to 100. The 'Northeast Corner' and 'Southwest Corner' are defined by latitude and longitude values in degrees, minutes, and seconds. The 'Terrain Resolution' is set to 'GLOBE 30-Sec DEM(NGDC)' and the 'Bin Size' is 15 Second. The 'Number of Bins' is 210,871, the 'Cost' is \$42.17, and the 'Est. Processing Time' is 00:04.0 Hours:M. Buttons for 'OK', 'Cancel', and 'Apply' are at the bottom.

The boundary may also be designated by the *Station Center* and a radius.

The *Terrain database* used in the *path loss* calculations is specified from the Boundary Settings tab. The default *Terrain database* is the GLOBE 30-second database from NGDC. Other *Terrain databases* are available which may give more accuracy to the calculations.

Bins

In order to create a *Path-Loss File*, the area defined by your *Boundary Settings* is divided in to a grid of discrete cells called *bins*. A path loss calculation is then performed from the *transmitter location* to each *bin*. Therefore, the smaller (and more numerous) the *bins* the larger the computing task becomes.

Bin size is specified in seconds of arc. Thirty seconds of arc is approximately 900 meters. Therefore, 30-second bins will be slightly smaller than one square kilometer. **PLServer** can be set to use 30, 15, 9, 6 or 3-second bins. Three seconds of arc is about 90 meters.

The number of bins in a *path-loss* file, the cost of producing the file (if ordered from **rfSoftware**) and a very rough estimate of the processing time is displayed at the bottom of the Boundary Settings Page.

Templates

The last tab of the Add Stations Dialog allows you to save or retrieve path-loss settings as a *template*.

Station information can also be imported into the queue from a comma-delimited or *.csv file.

The screenshot shows the 'Add Stations' dialog box with the 'Templates' tab selected. The 'Template Files' list contains 'wDJY'. The 'Template ID' field contains 'wQOL'. There are buttons for 'Load Selected Template', 'Delete Selected Template', and 'Add Current Settings As New Template'. Buttons for 'OK', 'Cancel', and 'Apply' are at the bottom.

The source file should be in text format and configured as specified in Appendix C.

Building the Path Loss File

Once the Propagation Queue is populated, you can begin building path-loss files. Select Start Processing from the Propagation Menu to begin the building process.

The process can be paused by selecting Propagation--Halt Processing.

Creating Propagation Files

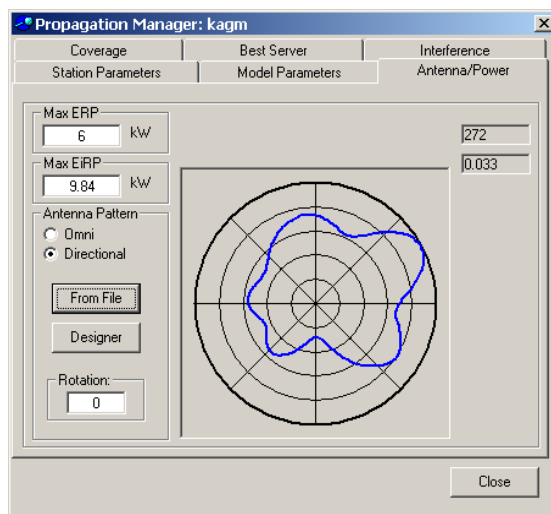
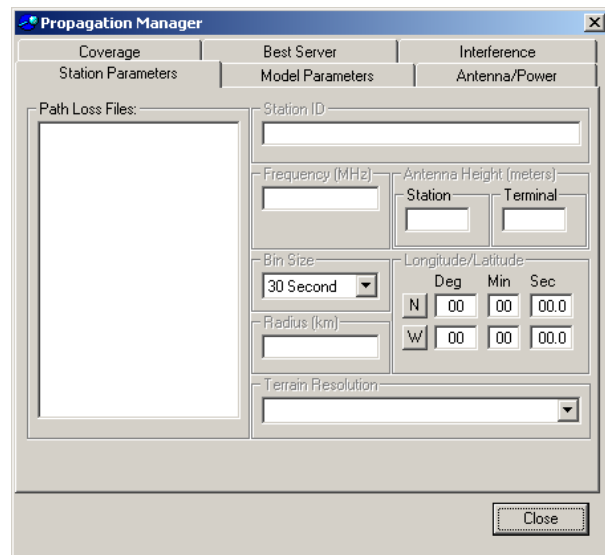
Overview

This process begins with the Propagation Manager. You access it through the Propagation Menu with Propagation.

The Station Parameters and Model Parameters are for reference only. They tell what the settings were in the *PL File*. They cannot be changed here. If changes to these settings are required, a new Path-loss file must be created.

The Propagation Manager

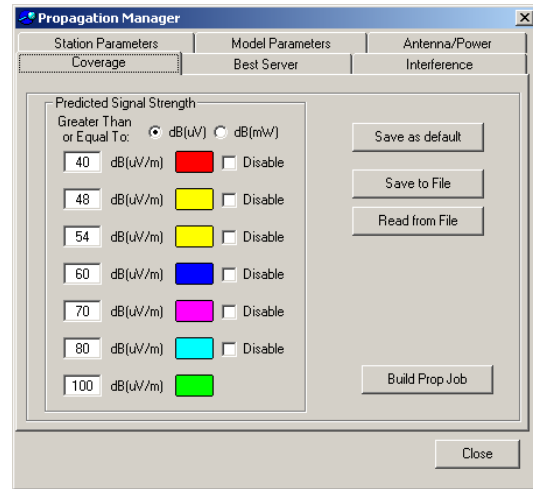
The Propagation Manager will display a list of the current *Path Loss Files*. Select the one you wish to work with, and then click the Antenna/Power tab. Set the maximum ERP.



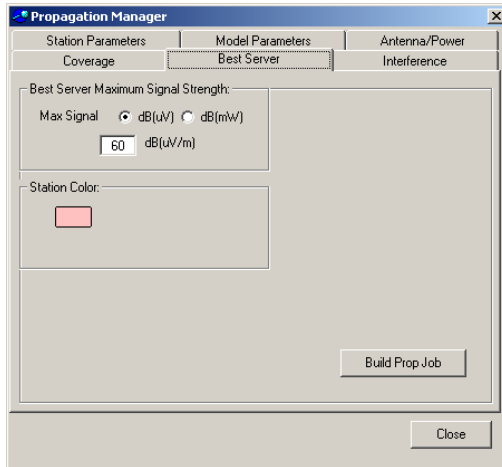
If a directional antenna is desired you can obtain it from the local or FCC database or import it from an *.apf file. You may also use the Antenna Pattern Designer to create a user defined antenna pattern. If necessary, set the antenna rotation.

Coverage

Click the Coverage tab and set the Predicted Signal Strength ranges. Change the color for a given *signal strength range* by clicking on the colored block.



Best Server

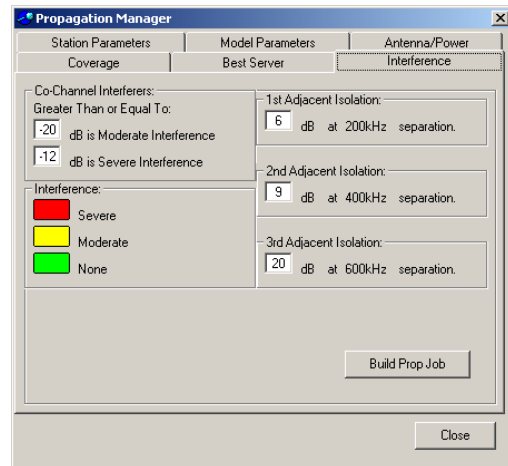


If you are interested in displaying Best Server Coverage, click the Best Server tab, set a maximum signal strength level and a unique color.

Interference

If you are interested in displaying Interference, click the interference tab. Set threshold values for moderate and severe co-channel interference. Set interference colors as desired.

All interference is assumed to be co-channel. Assign appropriate isolation values for 1st, 2nd and 3rd adjacent channels.



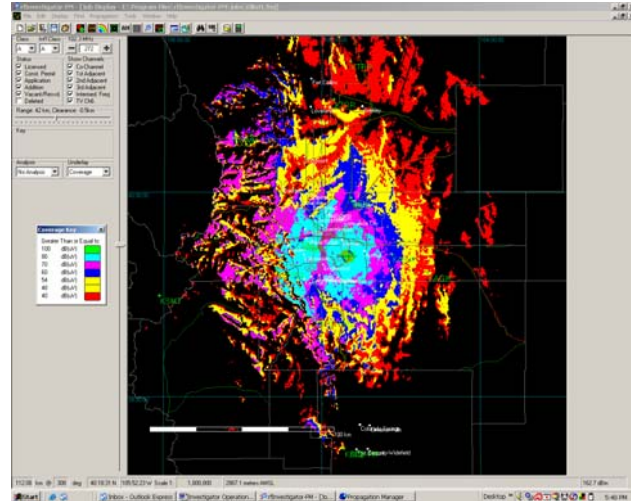
Building the File

After specifying power, antenna, and coverage parameters click the Build Prop Job button to create the propagation file.

Propagation Display and Analysis

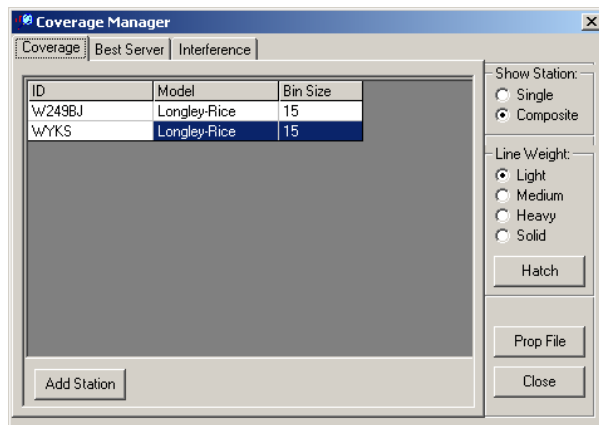
Overview

After the propagation files are built, they can be used for coverage and interference analysis. Propagation coverage can be displayed either as an underlay (bitmap) or as a vector map. To display an underlay simply select coverage from the Analysis/Underlay Control and specify the propagation file you wish to display.



Propagation display of vector maps is controlled through the *Coverage Manager*. The *Coverage Manager* can be accessed by selecting coverage from the Propagation menu.

Coverage/Best Server Tab



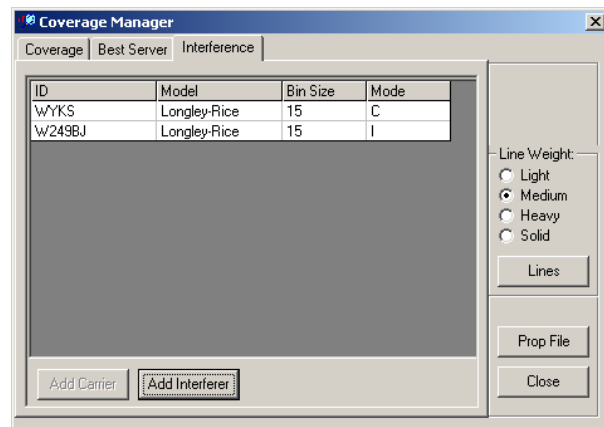
Add one or more propagation files to the *coverage/Best Server* list by pressing the **Add Station** button and selecting the desired propagation file. Display single station coverage by selecting stations from the list.

Display *composite coverage* for all stations on the list by selecting **Composite** from the **Show Station** control.

Press the **Lines** button to toggle between lines and crosshatch.

Interference Tab

Press the **Add Carrier** button to add the single carrier (desired) propagation file. Press the **Add Interferer** button to one or more interferer (undesired) propagation files.



Appendix A

Projecting a Curved Surface onto a Flat Screen

Overview

A *Projection* is the process of displaying a curved surface onto a flat surface. Generally, a flat surface is ‘wrapped’ around the curved object in some manner, the information is transferred from the curved surface and the flat surface is then ‘unwrapped’.

Map Projections are classified by how the flat surface is positioned relative to the curved surface (cylindrical, conical, etc.)

Projections can be conformal; preserving angular relationships between the curved and flat surfaces or,

equal-area; where the two surfaces have common scales. It is not possible for a projection to be both conformal and equal-area.

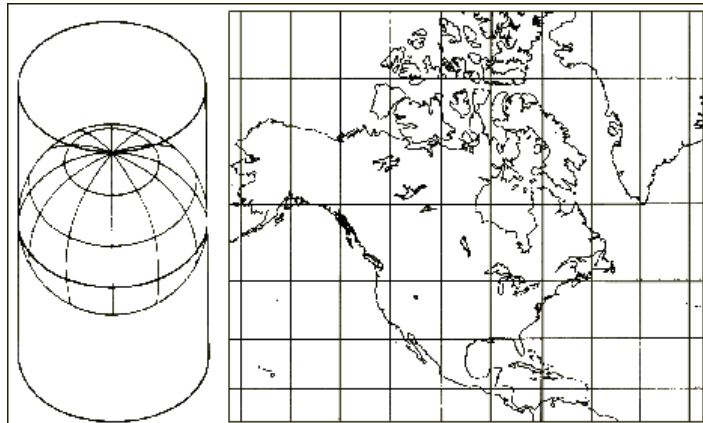


Figure 1. Regular cylindrical projection: the Mercator.

Transverse Mercator

The *Transverse Mercator* is the type of projection used on maps common to radio broadcast licensing purposes.

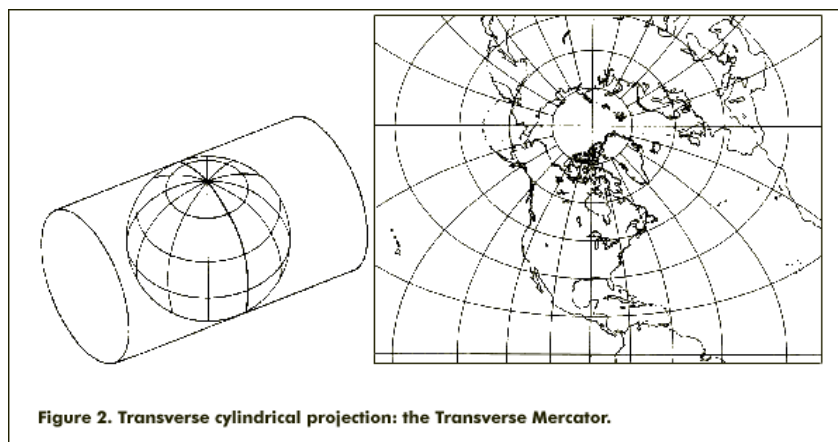


Figure 2. Transverse cylindrical projection: the Transverse Mercator.

FCC Rules: 73.208

Part 73.208 of the FCC rules specifies a method to be used in determining distances between stations for the purposes of licensing FM broadcast facilities. Using these formulas rfSoftware developed a transverse pseudocylindrical projection that, we feel, is especially appropriate to the broadcast industry.

Limits of the Job Map

As with all map projections, the method used by rfInvestigator has several limitations.

FCC rule 73.208(c) says “...The method set forth in this paragraph is valid only for distances not exceeding 475 km.” This means that displays that are more than about 700 km across will be significantly distorted at the extremities of the map.

An additional limitation imposed by using this map projection is significant distortion north of about 75 degrees latitude. **rfInvestigator** will not permit a site to be modeled or a Job Map to be recentered north of 75 degrees North Latitude.

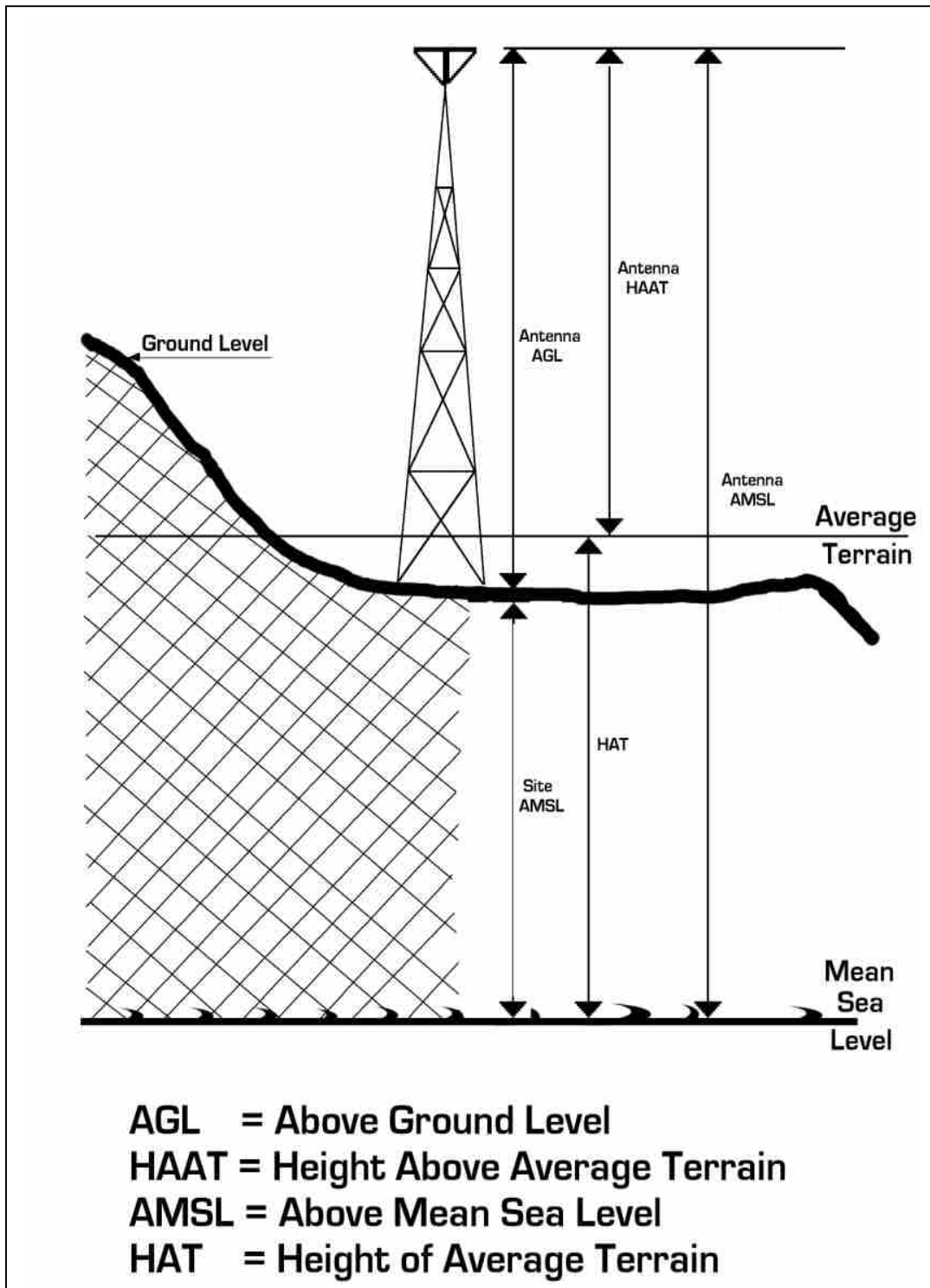
Underlay Maps

Underlay maps are bitmaps (pictures) that are stretched or shrunk to the current map scale and placed on the screen for reference purposes. Due to the distortion of the map projection, underlay maps are only accurate at the map center.

Since underlay maps are a picture, only ONE underlay may be displayed at a time.

Appendix B

Definition of Antenna Height



Appendix C

External Queue File Format

Fld #	Field Name	Remarks
1	Station ID	Up to of 26 characters.
2	Frequency	Frequency in MHz, Min = 20, Max = 20,000
3	Center Latitude	Station location in decimal degrees
4	Center Longitude	Station location in decimal degrees
5	Tx AGL	Meters above ground level to radiation center.
6	Rx AGL	Meters above ground level to radiation center.
7	Terrain	1 = GLOBE 30-sec, 2 = USGS 3-sec, 3 = FCC 30-sec.
8	Bin Size	3, 6, 9, 15, or 30 seconds.
9	Radius	Radius in km, set to zero if specifying corner boundaries.
10	North Latitude	Corner boundaries, set to zero if using radius.
11	East Longitude	Corner boundaries, set to zero if using radius.
12	South Latitude	Corner boundaries, set to zero if using radius.
13	West Longitude	Corner boundaries, set to zero if using radius.
14	Prop Model	0 = Longley-Rice
15	Ant Polarization	0 = Horizontal, 1 = Vertical
16	Reliability	1 to 99 per cent.
17	Confidence	1 to 99 per cent.
18	Radio Climate	Integer 1 through 7. See details below.
19	Refractivity	Integer 280 through 370. See details below.
20	Dielectric Const	Integer 1 – 81. 4 = Poor, 15 = Average, 81 = Sea Water
21	Conductivity	0.001 through 5.0 in Mho's per meter. Set to 0 to use M3.

Longley-Rice settings:

Antenna Polarization, Field # 15

0 - horizontal

1 – vertical

Radio Climate, Field # 18

1 - Equatorial

2 - Continental Subtropical

3 - Maritime Tropical

4 - Desert

5 - Continental Temperate

6 - Maritime Temperate, Over Land

7 - Maritime Temperate, Over Sea

Dielectric constant of ground, Field # 20

15 – Average

4 - Poor

25 - Good

81 - Fresh Water

81 - Sea Water

Ground conductivity, Field # 21

0.005 - Average

0.001 - Poor

0.020 - Good

0.010 - Fresh Water

5.0 - Sea Water

0.0 – Use M3 conductivity value

Surface refractivity, Field # 19

280 - Desert

301 - Continental Temperate

320 - Maritime Temperate over Land

320 - Continental Subtropical

350 - Maritime Temperate over Sea

360 - Equatorial

370 - Maritime Subtropical

Confidence, Field # 17

1% to 99%

Reliability, Field # 16

1% to 9

