CDRMapper
User Manual

Windows GUI Release: v0.8

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Contents

The MIT License (MIT)

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1 Introduction

CDRMapper is an application that plots towers from call detail record (CDR) data to a map file (kml) that can be opened in Google Earth. It can be used to assist users conducting historical cell site and sector analysis.

Currently it accepts CDR data where the cell sites / towers and CDRs are provided in separate files or where they are in the same file and row, but where the cell site identifiers are unique to a single network element.

CDRMapper is free and open source software and the source code is available on GitHub at `https://github.com/danzek/cdr-mapper`. Use of the software is governed by the MIT License and any additional disclaimers given in this user manual.

1.1 Terminology

There is a lot of terminology used when performing historical cell site and sector analysis, and different carriers use different terms. This is a list of the most commonly used terms and their general definitions.[1]

Networks

- **GSM:** Global System for Mobile Communications (originally Groupe Spécial Mobile). Devices using these networks generally require a SIM card (currently all AT&T and T-Mobile devices in the US) and use TDMA technology.
- **CDMA:** Code Division Multiple Access. Most networks in the US that do not require SIM cards (although some carriers operate both CDMA and GSM networks, such as Verizon).
- **iDEN:** Integrated Digital Enhanced Network. This is commonly identified as push-to-talk (PTT) technology (old Nextel in the US). Uses speech compression and TDMA technology.
- **TDMA:** Time Division Multiple Access. Uses multiple transmitters to provide time-division multiplexing.

Device-Specific

GSM

- **SIM:** Subscriber Identity Module (card in phone). Also mini-SIM, micro-SIM (refers to size).

[1] No copyright holder or any other party who modifies and/or conveys this program as permitted in the license is responsible for the accuracy of these terms and definitions. It is the user's responsibility to independently verify the meaning of these terms when used in specific contexts.

- **ICCID:** International Circuit Card Identifier. This is the number printed on the SIM card (may be cut off of mini- and micro-SIMs) that is essentially a serial number for the SIM card itself.
- **IMSI:** International Mobile Subscriber Identifier. This number is contained within the SIM card (you will need a reader and software to get it) and uniquely identifies the subscriber.
- **IMEI:** International Mobile Equipment Identifier. Uniquely identifies device on carrier network. You can usually find this under the battery or in device settings.
- **MSISDN:** Mobile Subscriber Integrated Services Digital Network-Number. There are actually other interpretations of this acronym; no one is quite sure which one is correct, but this is the most common. This is the device phone number.

CDMA

- **MEID:** Mobile Equipment Identifier. This was formerly the **electronic serial number (ESN)**, so you will sometimes see these acronyms used interchangeably. Uniquely identifies device on carrier network. You can usually find this under the battery or in device settings. The number is generally given in hexadecimal (hex) or decimal (dec), or both.
- **MIN:** Mobile Identification Number. Uniquely identifies the subscriber/device pair. This looks like a phone number but may not be the actual device's phone number (especially when the device has been ported).
- **MDN:** Mobile Directory Number. This is the device phone number.

Domain-Specific

Different carriers will actually use different terms. Usually they will give a key along with CDR results explaining the meaning of terms unique to them. As such, these are only general terms being used to represent these concepts. The actual terms used may vary.[2]

- **Calling Number:** The phone number that initiated the call or other transmission.
- **Called Number:** The phone number being called. This is not always the number that was dialed by the device user. This may be a number used internally by the carrier for forwarding or routing.
- **Dialed Digit Number:** This is the phone number that the caller actually entered into the keypad of the calling device.

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- **Call Direction:** The direction of the call (e.g. inbound, outbound, voicemail, mobile to mobile, forwarded, routed, etc.).
- **Network Element:** A manageable logical entity uniting one or more physical towers. This usually refers to the switching equipment that handled the call.
- **Switch:** Connects devices, typically using packet switching. The switch name often varies from the network element name, and often may even vary between those used in the CDR data vs. those used in the tower list(s). You will have to call the carrier and speak to a legal compliance analyst to determine which names correspond. Some carriers also provide a **repoll number** that corresponds to a specific switch used to handle a call. Usually named by the basic geographic area it covers.
- **Cell Site:** A cellular 'tower' on a carrier's network where antennas and other electronics communication equipment is located. On a GSM network, the correct term is **base transceiver station (BTS)**. Most networks simply use the term 'cell site' or 'cell tower' to refer to these.
- **Cell Site Sector:** Most cell sites have three antennae providing 360 degrees of cellular coverage. The coverage area (sometimes referred to as the "radius") of each antenna is thus generally 120 degrees. A specific antenna and its coverage area forms a sector. A sector is sometimes referred to as a **cell face**.
- **Azimuth:** An angular measurement in a spherical coordinate system. The standard reference plane used by cellular carriers is measured in degrees given a 360 degree horizontal radius. The azimuth corresponds to the angle in which a specific sector is facing. Thus the azimuth is the direction a specific antenna on a cell tower is pointing (e.g. 0 or 360 degrees is a sector facing north, 90 degrees is east, 180 degrees is south, and 270 degrees is west).
- **Originating Cell Site:** The cell site that the device initially connected to in order to handle the call. Sometimes simply referred to as 'first serving cell site.'
- **Terminating Cell Site:** The cell site that the device was connected to when the call ended. Sometimes simply referred to as 'last serving cell site.'
- **SMS:** Short Message Service. A traditional text message. Many carriers limit SMS messages to 160 characters (this is why longer messages get broken up into '1 of 2', '2 of 2', etc.).
- **MMS:** Multimedia Messaging Service. An extension of SMS technology that allows text messages to send data files such as pictures, videos, and songs.
- **iMessage:** An instant messaging service developed by Apple. This is like text messaging on Apple devices but is sent over data through Apple's iCloud network rather than through the carrier (and so these generally don't show up on call detail records).
- **FaceTime:** A video phone call service developed by Apple. This is a video-conference call that is sent over data using Apple iCloud's network rather than through the carrier (and so these generally don't show up on call detail records).

- **Voice:** When a content type is labelled "Voice" on a call detail record (CDR), this means that it was a traditional phone call.

1.2 Theory

Given that a cell site covers a 360 degree area and contains 3 sectors, each sector will cover an approximately 120 degree area. The azimuth corresponding to a specific sector is the center of the antenna, i.e. the direction it is facing. Thus to determine the approximate coverage area, you will subtract 60 degrees and add 60 degrees to the azimuth to determine the azimuths of each edge of the estimated coverage area. Keep in mind that radio propagation depends on numerous factors and thus these edges are only an estimate of the coverage area. It is possible for a device to connect to a sector without being in its 120 degree area, but this is rare (an example is knife-edge propagation / edge diffraction).

The range from the cell site to the device cannot be estimated without expert calculations and testing (see 'Caution' in section 1.3 below).

The goal of mapping CDR location data is to plot the location of each cell site (i.e. the cell tower, typically given as latitude and longitude) for each call placed at a fixed point in time where location data is available. The azimuth for each sector must then be correlated for each call to determine the most likely direction of the target device relative to the cell site that handled the call.

1.3 Caution

Most legal objections to the admissibility, relevance, and authenticity of location data associated with call detail records (CDRs) are associated with attempts to estimate the range from the device to the cell site. Unless you receive special training to do so (in RF physics and advanced cellular networking theory, including the inner-workings of proprietary carrier technology), range estimations and/or calculations should be avoided in your analysis. **The ultimate responsibility of verifying the accuracy of the map file produced by the CDRMapper software falls on the user of the software.**

Granularization Theory

The "granulization theory" states that the range of a device from a given tower can be estimated based on that tower's location relative to other towers, and that the coverage overlap of towers can be estimated based on the other towers' locations. The theory (faultily) makes the assumption that a device will usually connect to the closest tower. This theory has been covered in most legal journals and may come up in court, so you should be aware of it and *avoid making the same mistake(s) in your analysis.*

In UNITED STATES V. ANTONIO EVANS, 892 F. Supp2d. 949 (N.D. ILL. 2012), prosecutors tried to show that defendant Antonio EVANS placed a phone call from a location where a victim was allegedly being held for ransom. U.S. District Judge Joan H. Lefkow of Chicago wrote in an opinion and order in August 2012 that "multiple factors can affect the

signal strength of a tower" and that an FBI special agent's "chosen methodology has received no scrutiny outside the law enforcement community." As a result, the court concluded that the government had not demonstrated that the cell site and sector location data testimony was reliable.

Call detail records can tell whether a person was in the coverage area of a given tower, but where within that coverage area and the distance from the tower is difficult to scientifically demonstrate. An ABA Journal article discusses this, and you can read Judge Lefkow's opinion and order at `http://celltowertracking.com/Daubert_Order.pdf`.

Here are a few important notes (highlights) from the opinion and order:

- The admissibility and relevance of CDR location data is not entirely in jeopardy. The granularization theory used by the FBI agent in this trial failed the Daubert test and is considered scientifically unreliable.
- The court pointed out that "estimating the coverage area of radio frequency waves requires more than just training and experience; it requires scientific calculations to take into account factors that can affect coverage. [The FBI agent] presented no scientific calculations and did not consider a variety of relevant factors."
- The court determined "that using Google Maps to plot these locations does not require scientific, technical, or other specialized knowledge and that these exhibits are admissible through lay opinion testimony under Rule 701."

The decision to use CDR location data as legal evidence that a device was connected to a particular tower at a specific moment in time should be considered carefully, and you should not attempt to confidently estimate the coverage area of any specific towers solely on the basis of cell site and sector location data. It is difficult to determine the distance of a device from a given tower, and any methods used to estimate a specific range need to have widespread acceptance within the scientific community as well as hold up under scrutiny outside the law enforcement community (i.e. any proposed methodology must pass the Daubert test).

Formal Training

It is recommended that anyone performing historical cell site and sector analysis obtains formal training to do so, because you will most likely by asked to testify about your analysis. Even so, in UNITED STATES V. ANTONIO EVANS, 892 F. Supp2d. 949 (N.D. ILL. 2012), U.S. District Judge Joan H. Lefkow of Chicago wrote in an opinion and order in August 2012 "that using Google Maps to plot these locations does not require scientific, technical, or other specialized knowledge and that these exhibits are admissible through lay opinion testimony under Rule 701."

2 Getting Started

The basics of installing and uninstalling CDRMapper will be covered, as well as how to report problems encountered.

2.1 Installing CDRMapper

A self-contained installer file has been created for the Windows operating system. This Windows installer will automatically install the CDRMapper GUI application on your system.

For security purposes, the SHA256 value of the installer file should be `89bbee7f4cae34db966c3eebff3340af1f3006f56bc9bee37063ee75ee6e52b1`. A VirusTotal analysis is also available for your convenience. This manual applies to CDRMapper v0.8. The setup application should match this hash value. If it does not, the version of CDRMapper you are using may have been modified.

Launch the CDRMapper setup installer application. The installer will need administrative privileges in order to correctly install. Newer Windows systems should automatically prompt you that the application is requesting these privileges. Older Windows operating system versions may require you to manually run the installer with administrative privileges.

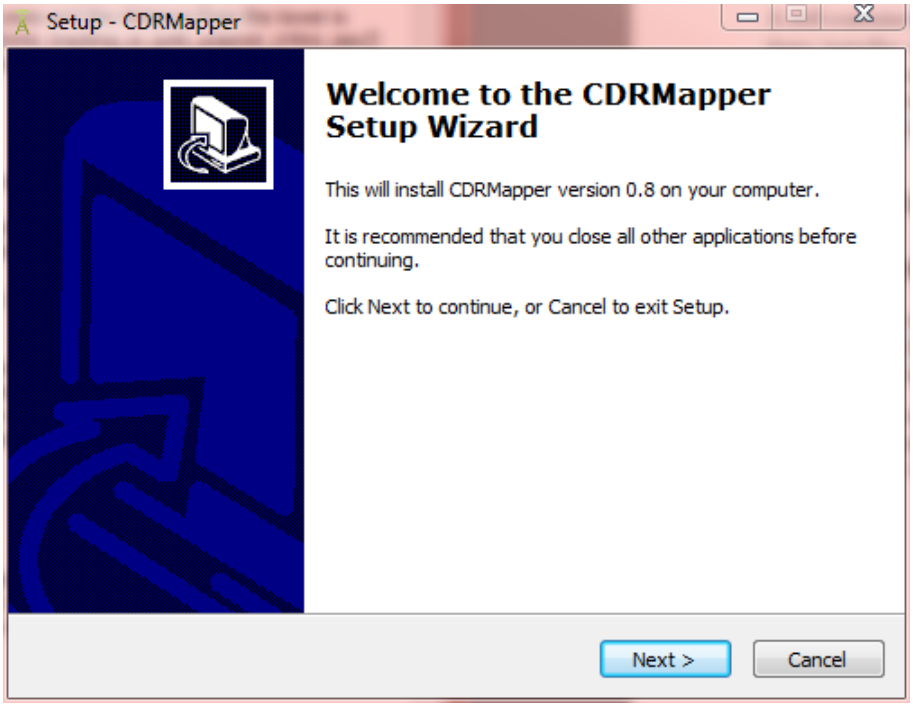

Figure 1: Initial installer screen.

Figure 1 shows the initial installer screen. Click 'Next' to continue. The next screen displays information about the software license and requires agreement before you can install CDRMapper (cf. figure 2).

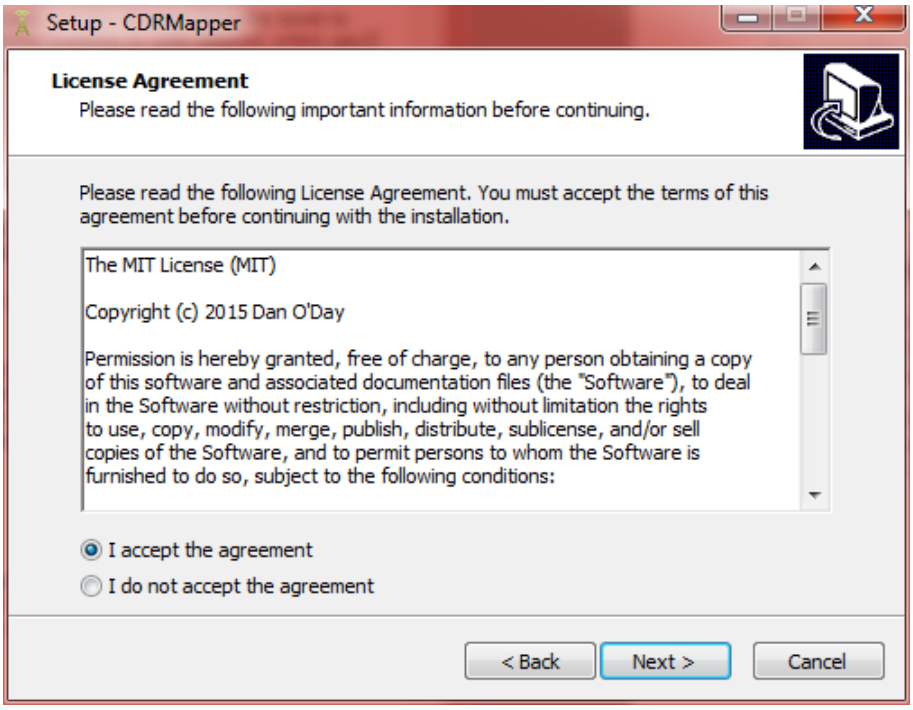

Figure 2: License agreement.

The installer will then display the location where you want to install the program. It will default to your 32-bit Windows 'Program Files' directory (cf. figure 3). The default location is the recommended setting.

The next screen will display the default name of the Start Menu folder where CDRMapper will be installed, which you have the option to change. The default is simply 'CDRMapper' (cf. figure 4).

The next screen gives you the option to create a desktop shortcut. Simply click the checkbox if you want a desktop shortcut to the CDRMapper application (cf. figure 5).

The installer will then display the settings you selected during the installation process for your confirmation before installing anything. Click 'Install' if the settings are satisfactory (cf. figure 6).

The setup application will then install the software (cf. figure 7) and notify you when finished, giving you the option to launch the software after exiting the setup application (cf. figure 8).

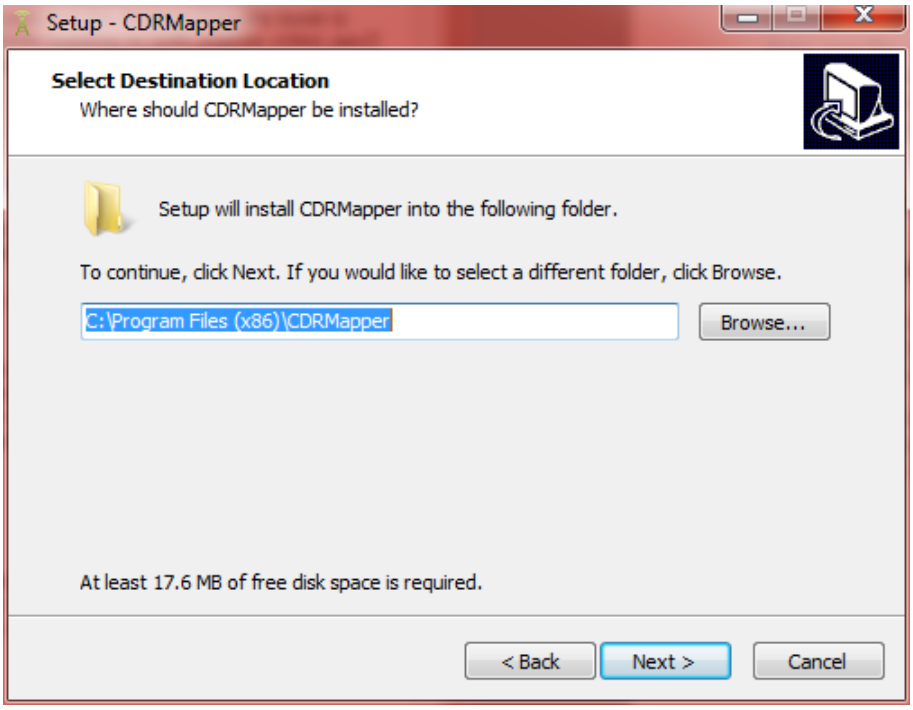

Figure 3: Default installation location.

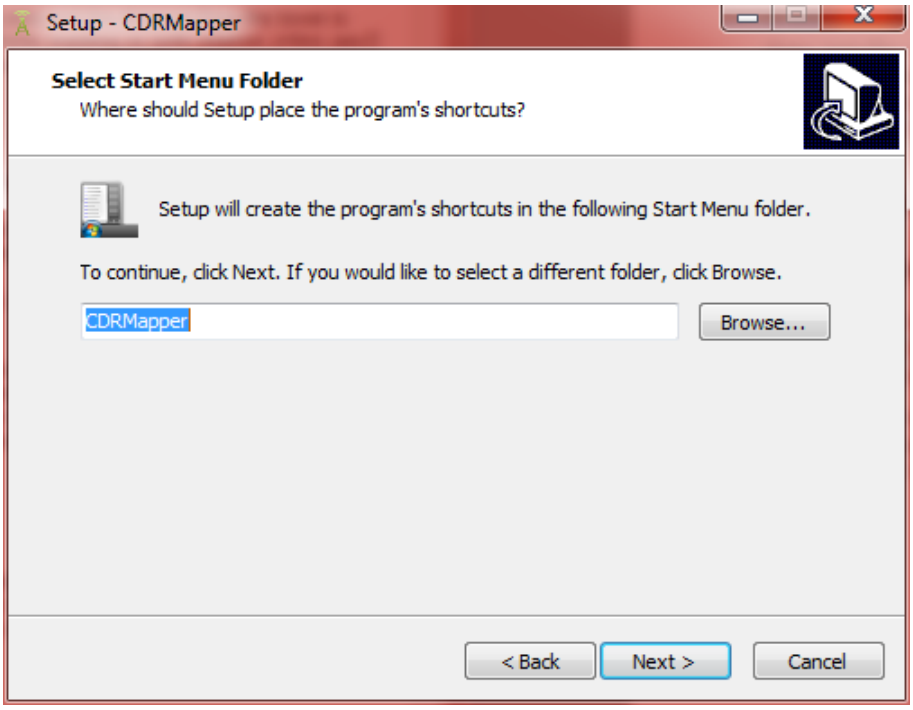

Figure 4: Startup Menu folder name.

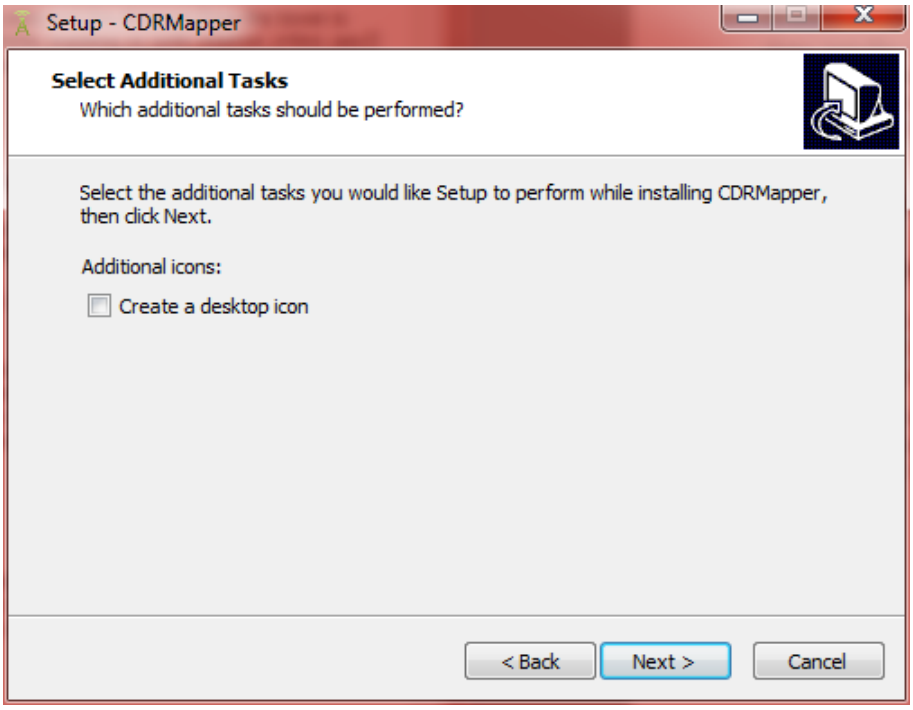

Figure 5: Option to create desktop shortcut.

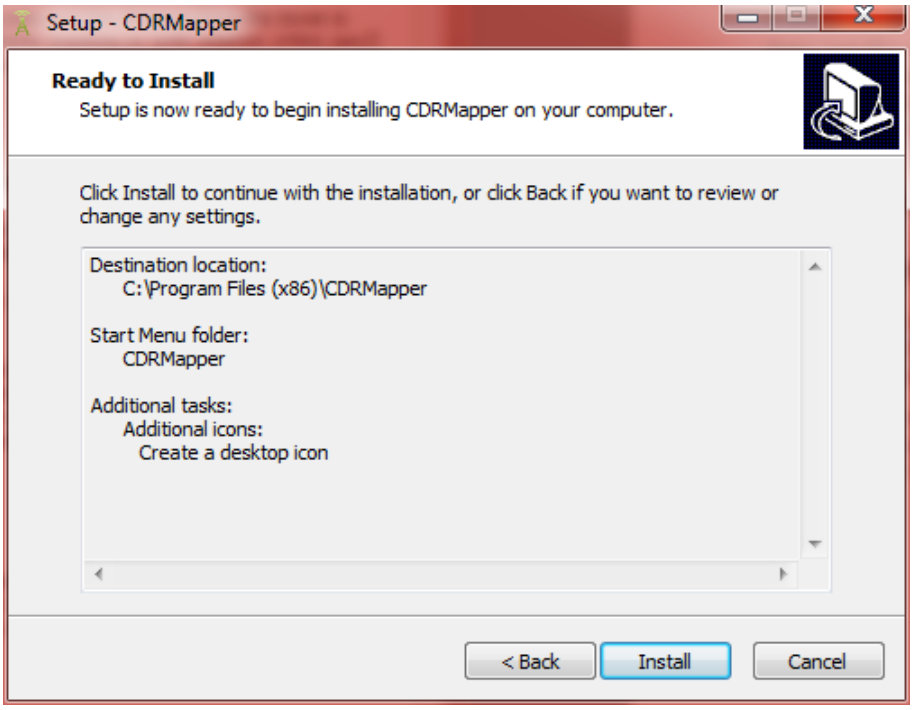

Figure 6: Installation settings confirmation screen.

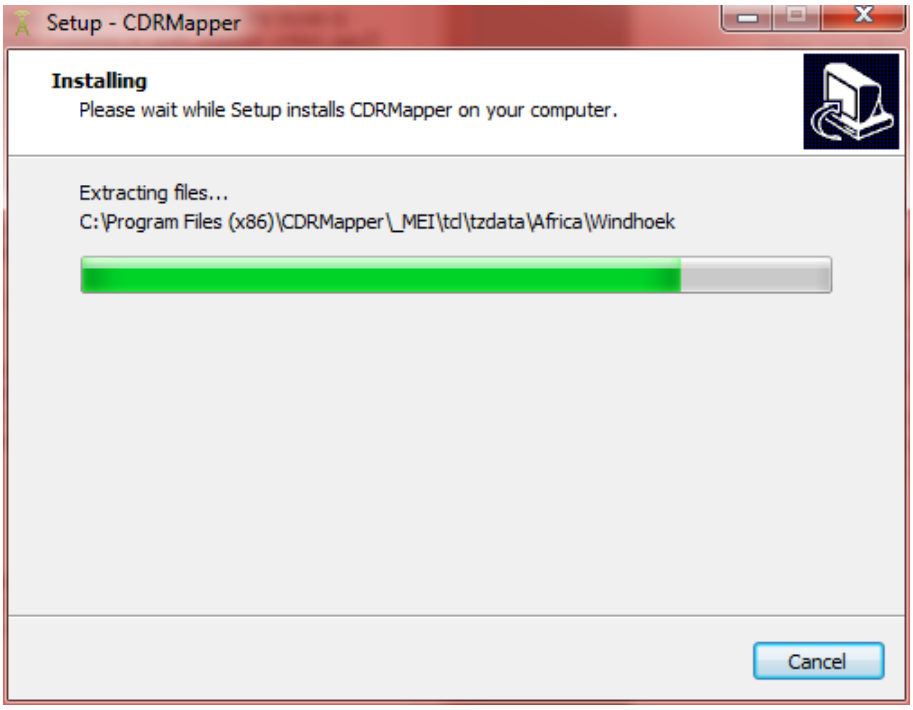

Figure 7: Installation in progress.

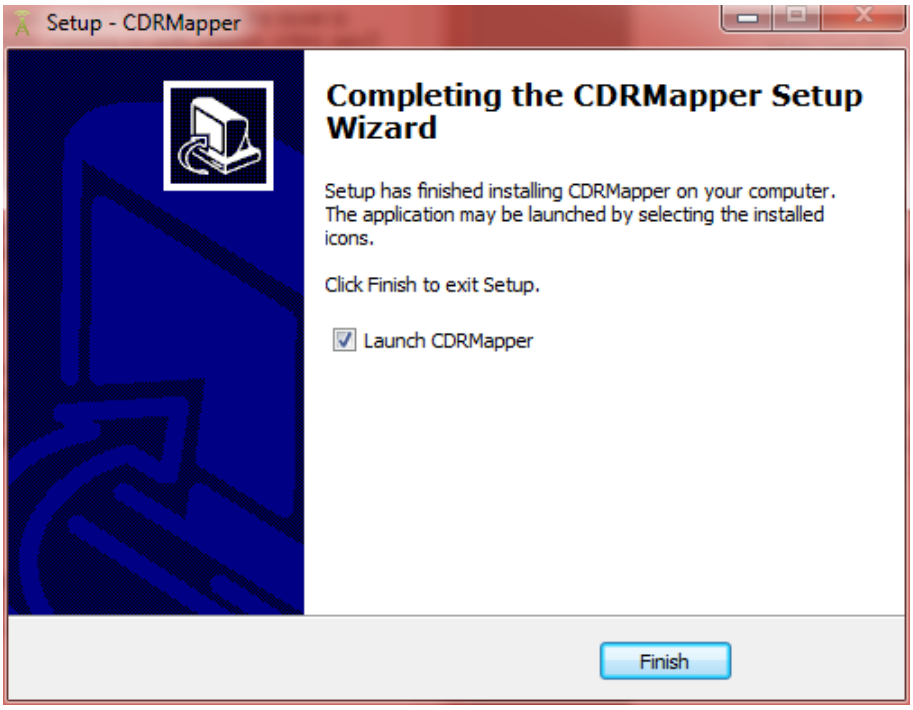

Figure 8: Installation finished.

2.2 Uninstalling CDRMapper

CDRMapper can be uninstalled through the Windows control panel just like most other Windows programs. Generally, this can be found by going to your **Start Menu** and then clicking on **Control Panel**. You should then see either **Add or Remove Programs** (older Windows operating systems) or **Programs and Features** (Windows Vista or 7).

On the latest Windows 8 and 8.1 operating systems that do not have a Start Menu, you can find the **Control Panel** by swiping in from the right edge of the screen, tapping **Search**, then entering 'control panel' in the search box. Once you have launched the **Control Panel**, under **View By**, select **Large Icons**, and then tap or click on **Programs and Features**.

Once you have launched **Programs and Features** (or **Add or Remove Programs**), click (or tap) on the CDRMapper application and then select **Uninstall**. You will then be asked to confirm that you wish to completely uninstall CDRMapper (cf. figure 9). Select 'Yes'. Once the program is finished uninstalling, a message will be displayed notifying you of a successful uninstallation (cf. figure 10).

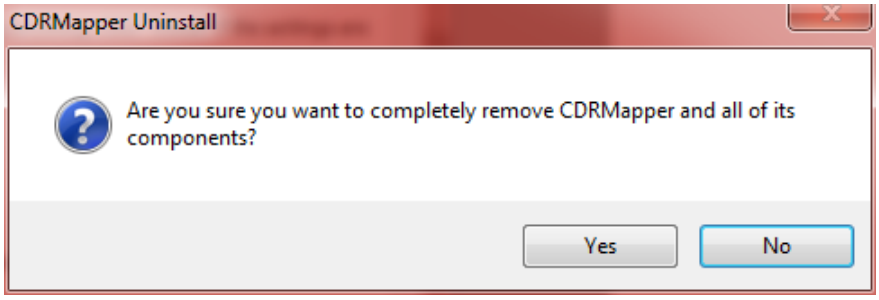

Figure 9: Uninstall confirmation.

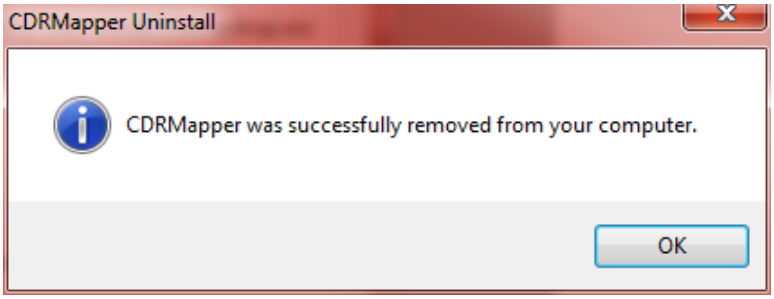

Figure 10: Uninstallation successful.

2.3 Reporting Problems

CDRMapper is free and open source software and the source code is available on GitHub at `https://github.com/danzek/cdr-mapper`. Use of the software is governed by the MIT License and any additional disclaimers given in this user manual.

Issues can be reported through GitHub at `https://github.com/danzek/cdr-mapper/issues`. There is no implied or actual support provided with this software. Users are free to report problems, but they may or may not be addressed. It is the user's responsibility to check this website for any known issues that may affect your use of CDRMapper. No copyright holder or any other party who modifies and/or conveys this program as permitted in the license is responsible for errors that may be caused by actual or perceived software issues. It is ultimately the user's responsibility to verify the accuracy of any content produced by this software.

2.4 Launching CDRMapper

Once installed, you can open CDRMapper by navigating to your programs and then finding the folder and application named 'CDRMapper' (default setting; this will differ if you changed it during installation). If you opted to create a desktop icon, there will also be a shortcut on your desktop similar to that shown in figure 11.

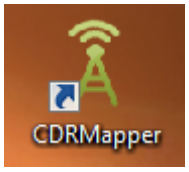

Figure 11: Desktop shortcut icon.

3 Tutorial

CDRMapper is an application that plots towers from call detail record (CDR) data to a map file (kml) that can be opened in Google Earth. It can be used to assist users conducting historical cell site and sector analysis.

Currently CDRMapper accepts CDR data where the cell sites / towers and CDRs are provided in separate files or where they are in the same file and row, but where the cell site identifiers are unique to a single network element.

3.1 Originating and Terminating Cell Sites

The application only accepts *one* latitude and *one* longitude for each CDR. Most CDR data contain both originating (first serving) and terminating (last serving) cell sites / towers.

To properly plot this data, it should be run *twice* through CDRMapper software (once to plot the originating cell sites and once to plot the terminating cell sites). The final result will be *two* map files, once containing originating cell sites and the other terminating. Users should be sure to save these files in locations where the distinction is elucidated, or rename the files for clarification. Google Earth allows multiple map files to be viewed simultaneously so that this data can be seen together on the same map.

3.2 Disclaimer

Every time CDRMapper is opened, it will display a disclaimer containing a summary of the license details (cf. figure 12). You must click 'I understand and accept these terms' to continue. Note that use of this software constitutes acceptance of these terms.

3.3 Case Information

After accepting the terms of the disclaimer, you will be prompted to enter the case information relevant to the data you intend to plot with CDRMapper (cf. figure 13). The application will include this information in the final map file produced.

There are fields for **Case Number**, **Agency**, **Agent**, **Analyst**, and **Target Number**. All of the fields are mandatory, however you may simply enter 'N/A' or a hyphen into a field you wish to leave 'blank'.

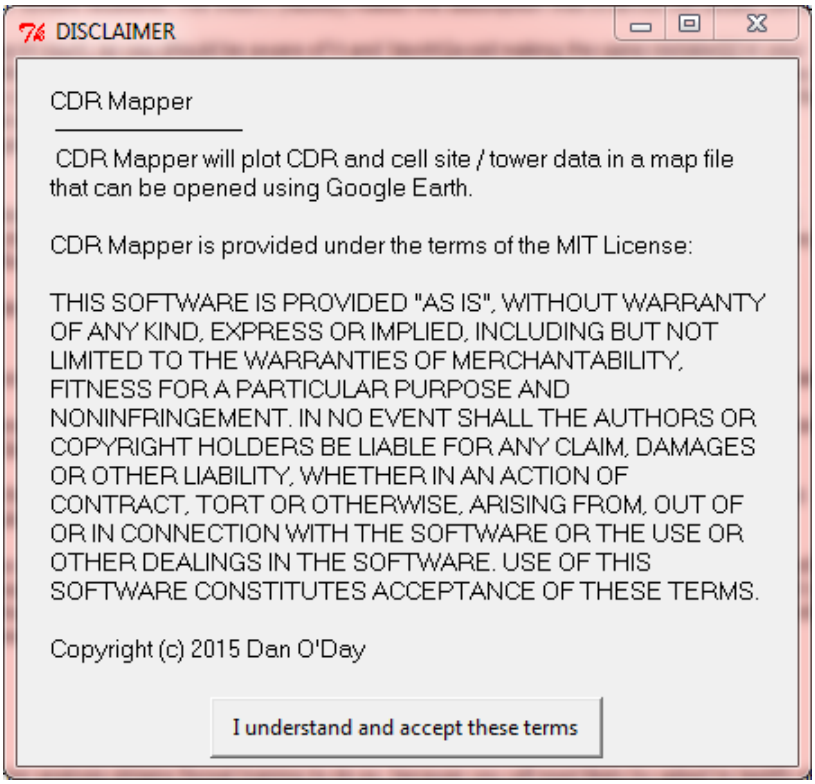

Figure 12: CDRMapper disclaimer.

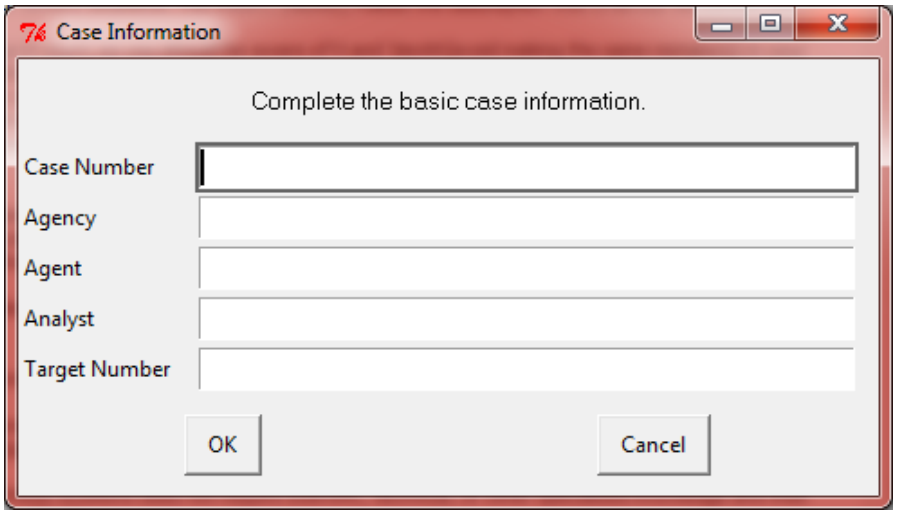

Figure 13: Case information.

3.4 Acceptable Data Formats

After entering you case information, CDRMapper will ask you whether your CDR and cell site / tower data are in the same CSV file (cf. figure 14). Click 'Yes' if you have one CSV file and it has the CDR data and latitude and longitude of each cell site / tower on the same row. Click 'No' if you have one file with cell sites / towers containing latitudes, longitudes, and sector azimuths and a separate file containing CDR data with cell site / tower and sector identifiers.

Latitudes and longitudes must be in **signed degrees format** (e.g. 41.878876, –87.635915).

Additional information about what fields are required for different types of data are available in the sections devoted to each type of data import:

- Single data file: section 3.5
- Separate data files: section 3.6

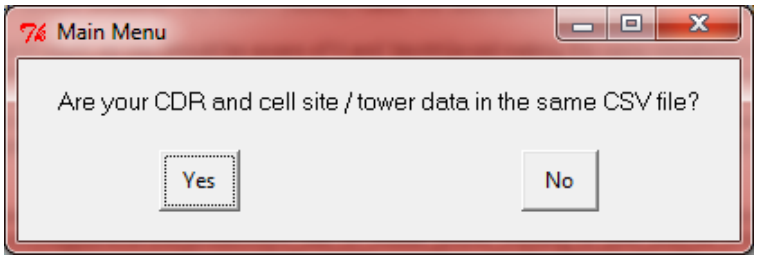

Figure 14: Prompt asking whether data is in one or two CSV files.

CSV Format

CDRMapper will only accept plain text files containing comma-separated values (CSV). Only comma-delimited formats are acceptable (i.e. not tab-delimited or other types). The file must be saved with a `*.csv` or `*.txt` file extension. The first line in the CSV file must contain header names for each column of data you wish to include.

Different carriers send their data in varying formats, so they will need to be formatted as conventional CSV file(s) before the data can be imported by CDRMapper. Sometimes users may need to do additional data processing and formatting prior to using CDRMapper in order to ensure that required fields are available in separate columns. **Always be sure to modify a copy of the data so that the original file remains unchanged.**

Common Formatting Tasks

Sometimes users may need to do additional data processing and formatting prior to using CDRMapper in order to ensure that these required fields are available in separate columns. **Always be sure to modify a copy of the data so that the original file remains unchanged.**

Ensure First Line of Data Contains Header Labels

Some data formats, such as the example shown in figure 15, have additional information above the header labels. This information must be removed so that the first line of the file contains the header labels. Similarly, if the entire file is not formatted as a CSV file and contains additional information, this data must be combined into one CSV file or broken into separate files.

	A	B	C	D	E	F	G	H	I	J	K
1	Combined Detail LE										
2											
3	MSISDN	IMSI	IMEI	Event Type	TimeWhen	Direction	Connected To	Home/Roam	First LAC	First Cell ID	First Tower Latitude
4	12195551212	123450132912345	NA	SMS	8/3/2013 21:08	Incoming	129	Carrier USA	NA	NA	NA
5	12195551212	123450132912345	NA	SMS	8/3/2013 21:08	Incoming	129	Carrier USA	NA	NA	NA
6	12195551212	123450132912345	NA	Voice	8/3/2013 21:14	Incoming	17735551212	Carrier USA	7194	22868	41.6546

Figure 15: Ensure first row of data contains header labels.

Separating Two Fields Stored in One Column in the Original Data

Some carriers combine the cell site sector and identifier into one field. A value of `10345` may thus represent sector `1` of cell site `345` In this example, the user will first need to use a spreadsheet program such as Microsoft Excel to separate this data into two columns (the examples in this section use Microsoft Office 2013). Figure 16 shows a sample data set where the cell site sector and identifier are combined in one column.

	A	B	C	D	E
1	CALLED NUMBER	CALLING NUMBER	DATETIME	1ST CELL	LAST CELL
2	2195551212	7735551212	1/15/15 11:52 AM	10345	10345
3	7735551212	2195551212	1/16/15 1:23 PM	20416	30519

Figure 16: Data with sector and cell site identifier combined in one column.

To separate this field into two columns, first insert a new column after the column containing the combined fields (cf. figure 17). If you do not insert a blank column in the correct location, you may overwrite existing data columns and thus change or lose data.

	A	B	C	D	E	F
1	CALLED NUMBER	CALLING NUMBER	DATETIME	1ST CELL		LAST CELL
2	2195551212	7735551212	1/15/15 11:52 AM	10345		10345
3	7735551212	2195551212	1/16/15 1:23 PM	20416		30519

Figure 17: Insert a new column after the column containing both fields.

After you have created a new column for the separated field to move into, select the entire column containing the combined fields (in this example, that would mean selecting column

'D', cf. figure 17). Then use your spreadsheet or other program to separate this field into two. In Microsoft Excel 2013, select the **Data** tab and then click on **Text to Columns** as shown in figure 18.

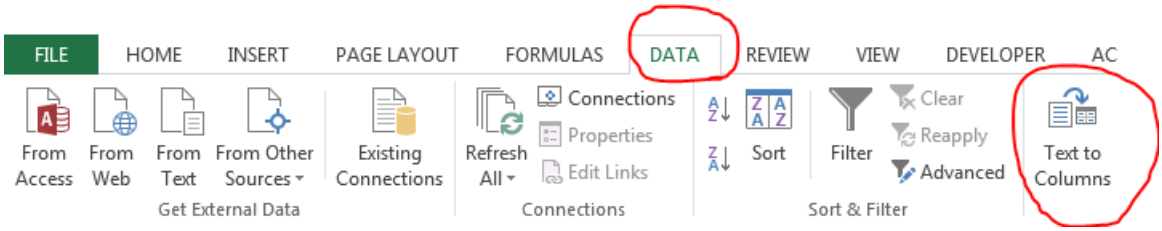

Figure 18: Text to columns feature in Microsoft Excel 2013.

The 'Convert Text to Columns Wizard' will appear. Under **Original data type**, select **Fixed width** (cf. figure 19). You should see your combined data in the preview. If you do not, you did not select the correct column. The fixed width option best fits this example data set since sectors are always a single digit in this particular data set and there is no other delimiter between the sector and cell site identifier (your data set may be different, in which case you will need to choose the appropriate means of dividing the text into two columns, and the options you receive will differ from this example). After you have selected the proper original data type, click 'Next'.

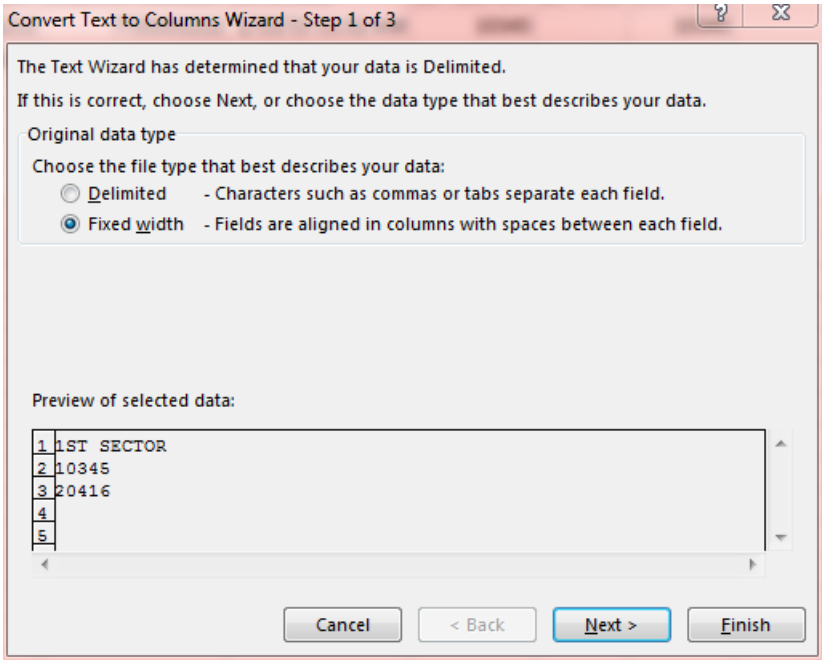

Figure 19: Text to columns wizard: select original data type.

Step 2 of the the 'Convert Text to Columns Wizard' will then prompt you to **set field widths (column breaks)** where desired. Since the sector is always the first character in

the example data set, a column break should be set in this location as shown in figure 20. Once you've set the column break after the first character, select 'Next' to continue.

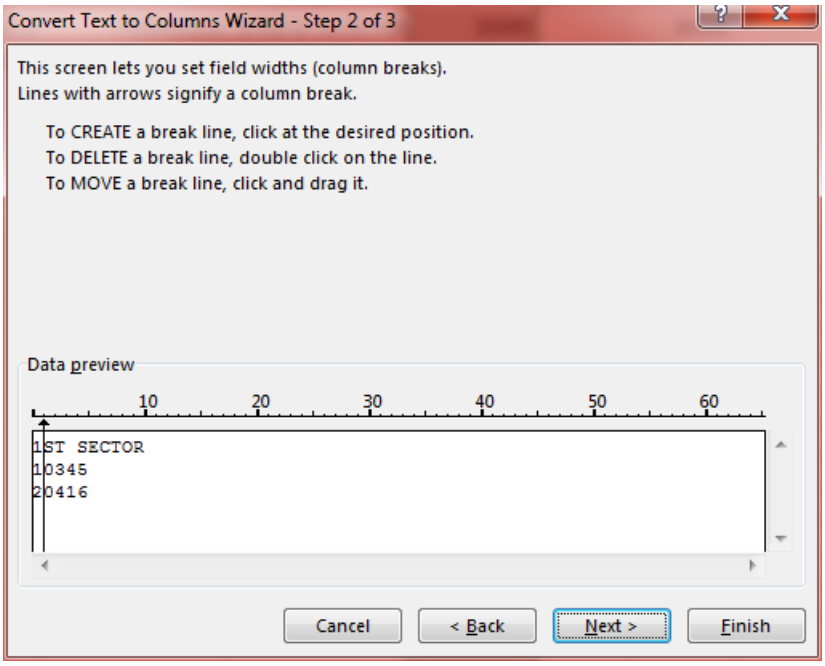

Figure 20: Text to columns wizard: set column breaks.

Step 3 of the the 'Convert Text to Columns Wizard' lets you select each column and set the **Data Format**. Leaving both columns as 'General' will suffice for the data in this example, as shown in figure 21. Click 'Finish' to complete the 'Text to Columns' process.

The originally selected field will now have been broken up into two columns, as shown in figure 22. The sector is now in the original column where both fields were combined (column 'D') and the cell site identifier is now in the blank column that was created for it. You'll also notice that the header column label was separated as well (i.e. the `1` from `1ST CELL` was separated). Now all that remains is simply to rename the column headings, as shown in figure 23. Save the document as a CSV file and it is now ready for import into CDRMapper.

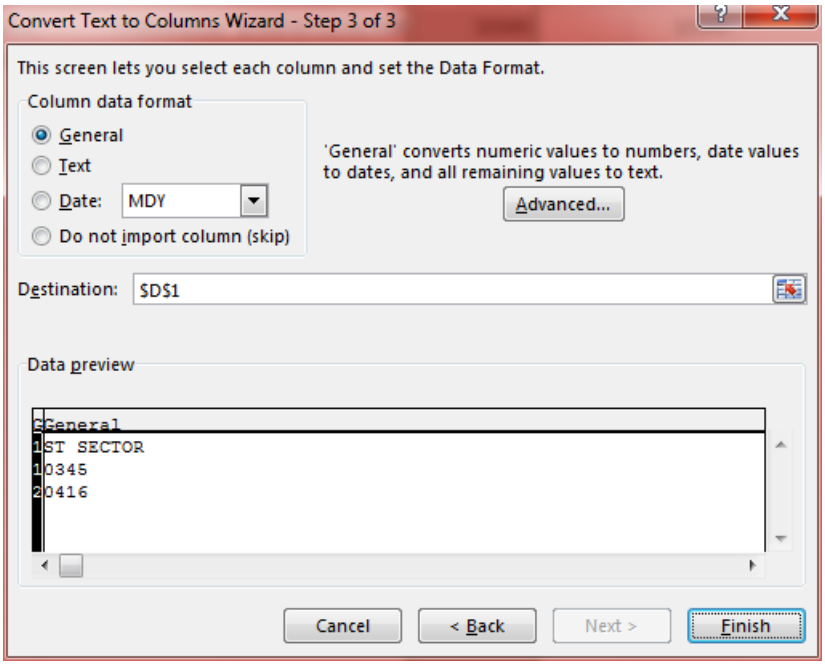

Figure 21: Text to columns wizard: set the data format for each column.

	A	B	C	D	E	F
1	CALLED NUMBER	CALLING NUMBER	DATETIME	1	ST CELL	LAST CELL
2	2195551212	7735551212	1/15/15 11:52 AM	1	345	10345
3	7735551212	2195551212	1/16/15 1:23 PM	2	416	30519

Figure 22: The originally selected column has been split into two columns.

	A	B	C	D	E	F
1	CALLED NUMBER	CALLING NUMBER	DATETIME	1ST SECTOR	1ST CELL	LAST CELL
2	2195551212	7735551212	1/15/15 11:52 AM	1	345	10345
3	7735551212	2195551212	1/16/15 1:23 PM	2	416	30519

Figure 23: Rename column headings.

3.5 Instructions for a Single Data File

If your data are in a single CSV file, the only required fields are **latitude** and **longitude**.[3] After clicking 'Yes' to indicate that your CDR and cell site / tower data are in the same CSV file (cf. figure 14), you will be prompted for the location of the file, as shown in figure 24.

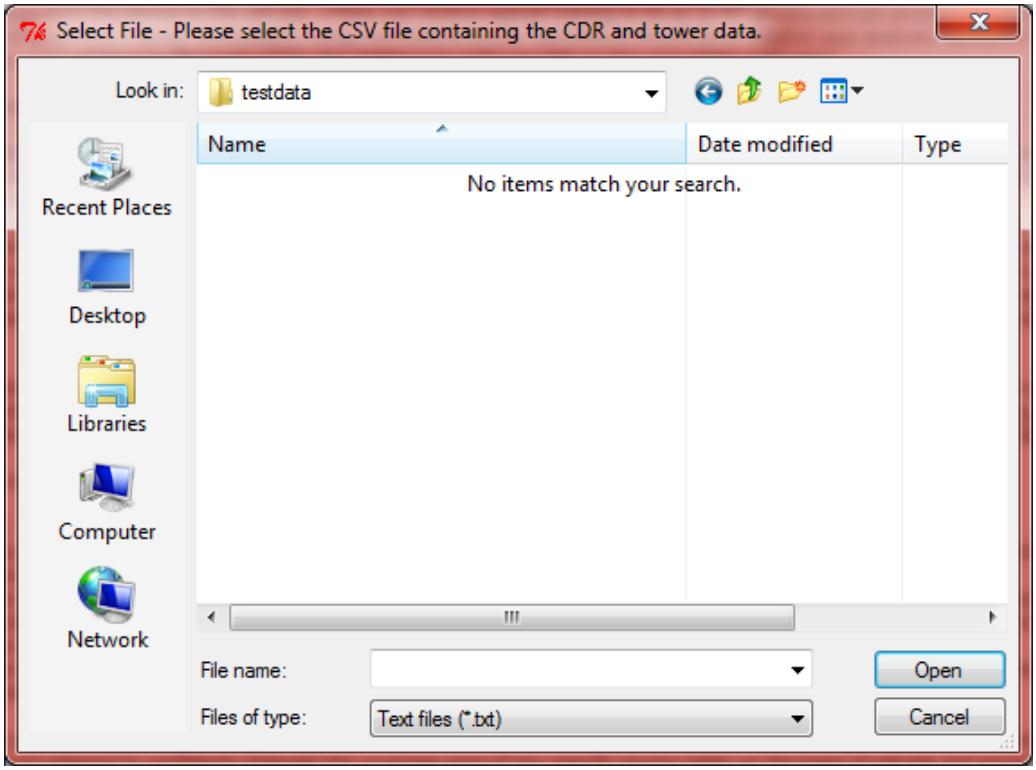

Figure 24: Specify location of single CSV file containing all required data.

If you have navigated to the correct folder but don't see your file, note that by default the file type is set to text files (`*.txt`). If your file has a `*.csv` or other extension, you will need to select the appropriate file type from the dropdown menu (cf. figure 25). Once you have selected the proper file type, you should see your file. Select it and then click 'Open' (cf. figure 26).

Next you will see an alphabetical listing of all of the column header labels in the CSV file (cf. figure 27). Select the column header corresponding to the **latitude** you wish to plot on the map. Note that in figure 27 the originating cell site ('first tower') latitude is chosen. To plot the terminating cell site ('last tower'), you would simply select the corresponding column header.

After selecting the latitude you will again see an alphabetical listing of all of the column header labels in the CSV file (cf. figure 28). Select the column header corresponding to the **longitude** you wish to plot on the map. Note that in figure 28 the originating cell site ('first

[3]CDRMapper can actually plot any data containing latitudes and longitudes where all of the data are in the same table and row.

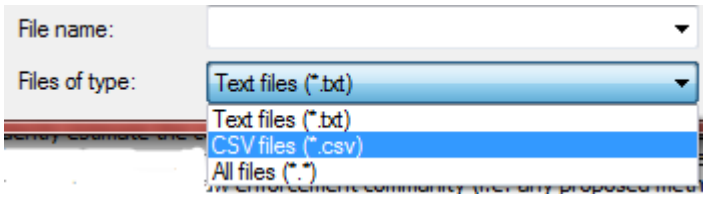

Figure 25: Select file type.

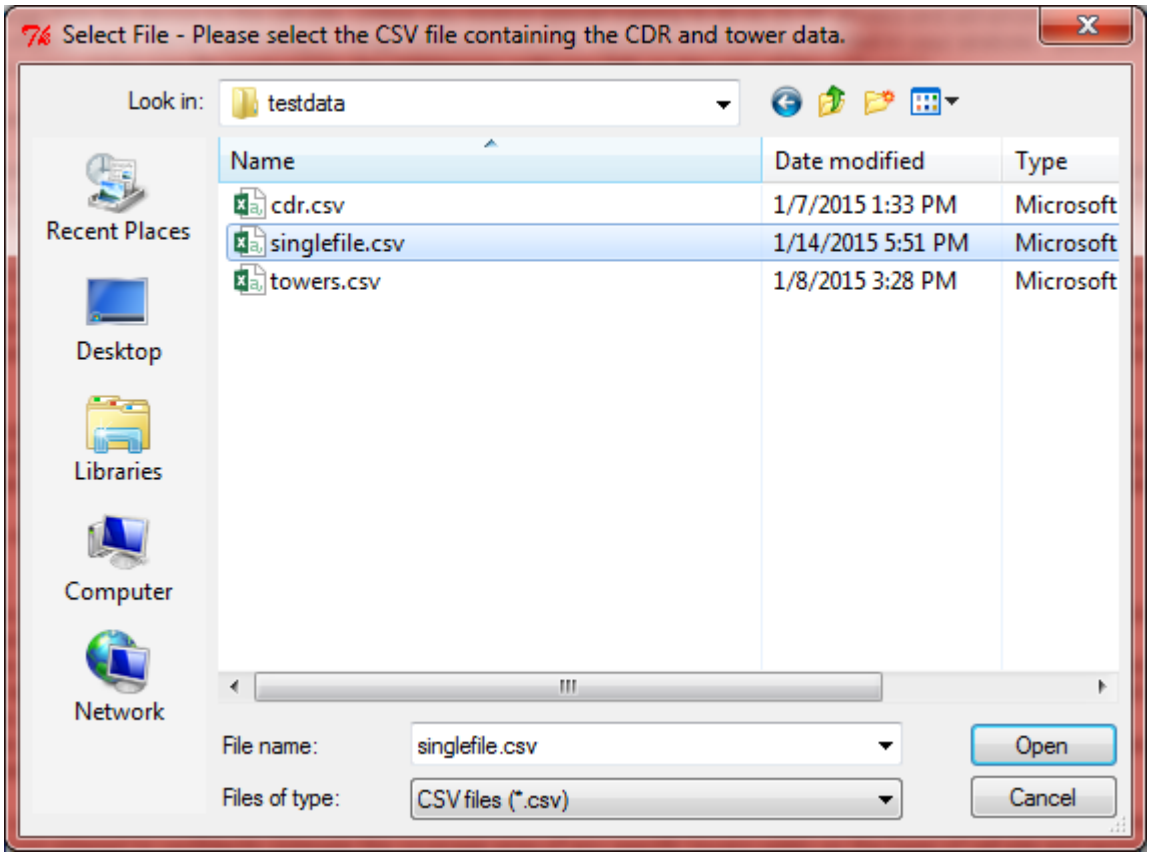

Figure 26: Select the CSV file containing all required data.

tower') longitude is chosen. To plot the terminating cell site ('last tower'), you would simply select the corresponding column header.

Once CDRMapper knows which columns contain the latitudes and longitudes you want to plot in the map file, it will ask what additional columns you wish to include in the description of each point in the map file (cf. figure 29). By default, CDRMapper will already include any required fields (latitude and longitude in this case). You may select any additional columns you wish to appear in the map file by clicking on them (selected columns will be highlighted in blue).

Next you will be asked to specify the directory where you wish to save the final report (map file, cf. figure 30). Navigate to the desired directory, select it, then click 'OK'.

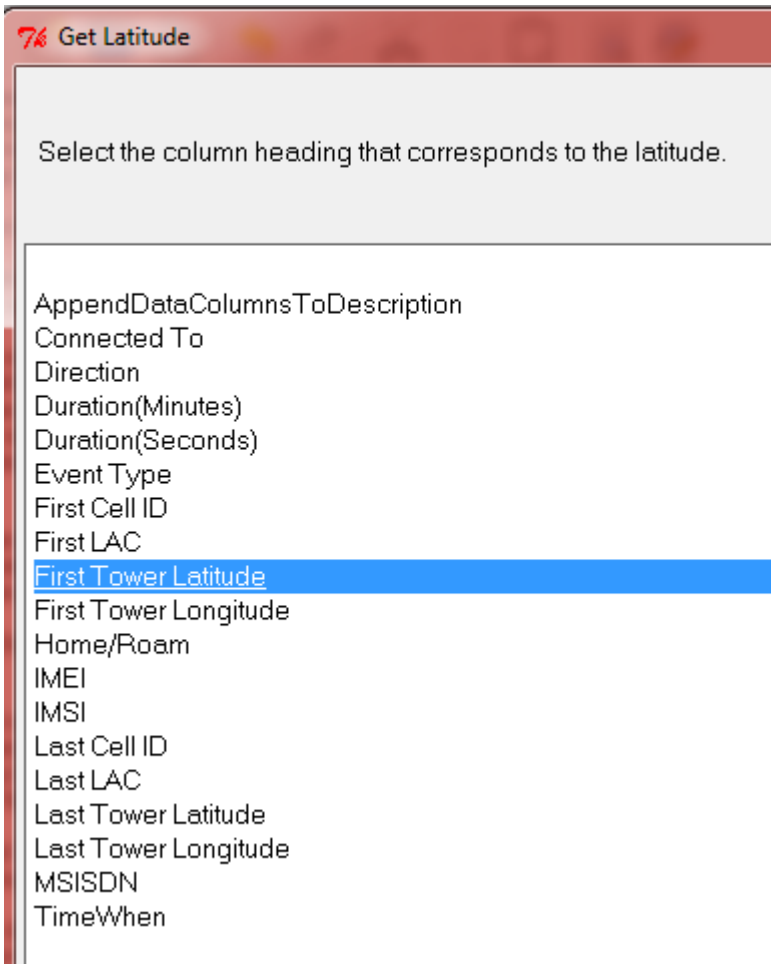

Figure 27: Select column header containing latitude.

Once the report (map file) has been successfully created, you will see a message indicating this and showing the location you selected it be saved (cf. figure 31). By default it will be saved with the case number specified when you entered your case information. The program will automatically close after you click 'OK'. To plot additional data, reopen the application.

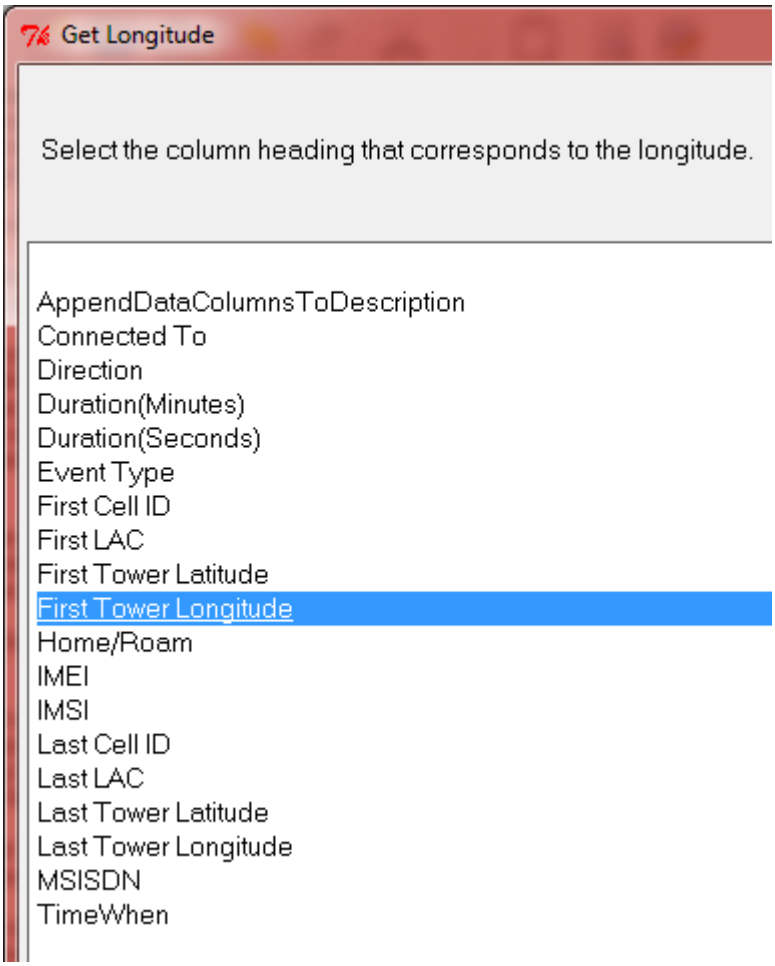

Figure 28: Select column header containing longitude.

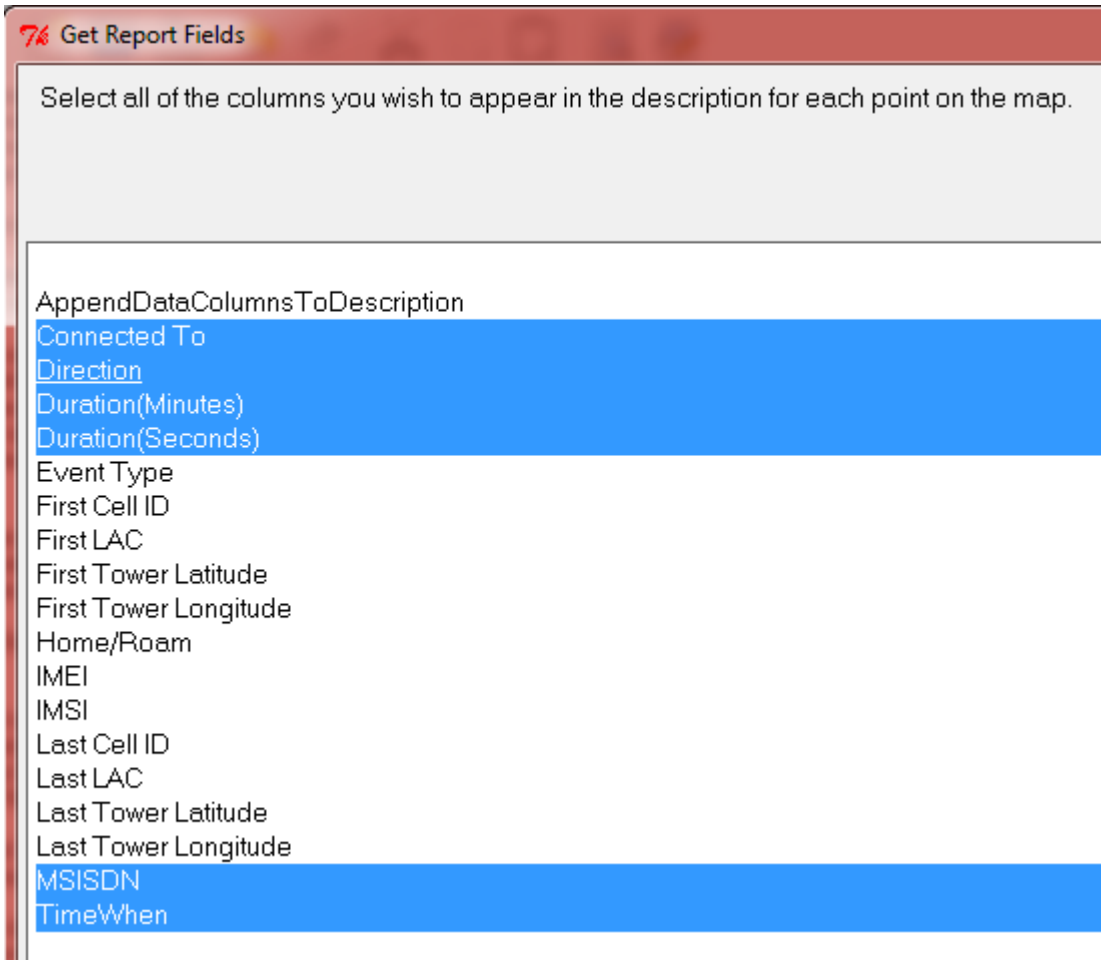

Figure 29: Select additional column headers you wish to appear in the description for each record.

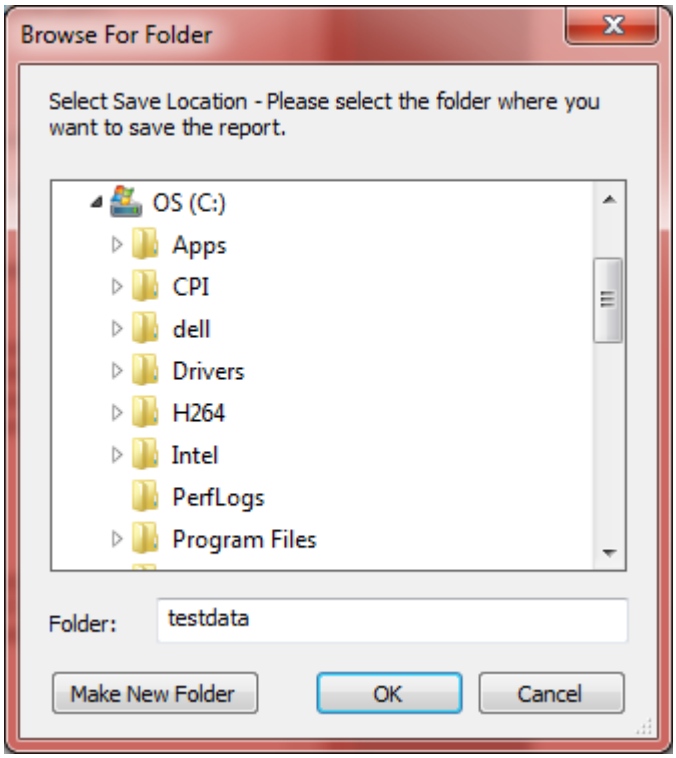

Figure 30: Select directory where report will be saved.

Figure 31: Report successfully saved to specified location.

3.6 Instructions for Separate Data Files

If your cell sites / towers and CDR data are in separate files, they must contain the required fields (columns) listed in each section of this tutorial.

Cell Site / Tower Data CSV File

- **Cell Site ID:** A unique identifier for each cell site / tower that is used consistently both in this file and in the CDR data file.
- **Latitude:** The angular distance of the cell site north or south of the earth's equator, expressed in **signed degrees format**.
- **Longitude:** The angular distance of the cell site east or west of the meridian at Greenwich, England, expressed in **signed degrees format**.
- **Sector:** A unique identifier for each specific cell site sector / face.
- **Azimuth:** The angle corresponding to the direction in which the sector is facing.

CDRMapper will remind you of these requirements prior to uploading the cell site / tower CSV data file, as shown in figure 32.

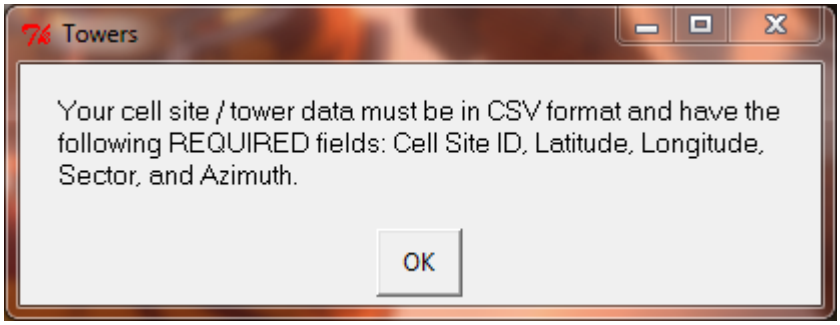

Figure 32: Reminder concerning required cell site / tower CSV data fields.

You will then be prompted for the location of the CSV file containing the cell site / tower data (cf. figure 33). Navigate to the file, select it, then click 'Open'. Next you will be asked to select the column heading corresponding to each required field: **latitude, longitude, cell site ID, sector,** and **azimuth** (cf. figures 34, 35, 36, 37, and 38).

Once you have selected the column heading labels corresponding to each required field, you will receive a warning that importing the towers may take several minutes (cf. figure 39). Carriers often send the entire list of all of their towers for a given network element, so there may be a large quantity of towers that will be imported. **The application will run in the background while the tower import process is running.** This means that you will not see the application on your screen. This is the intended program behavior. A message will

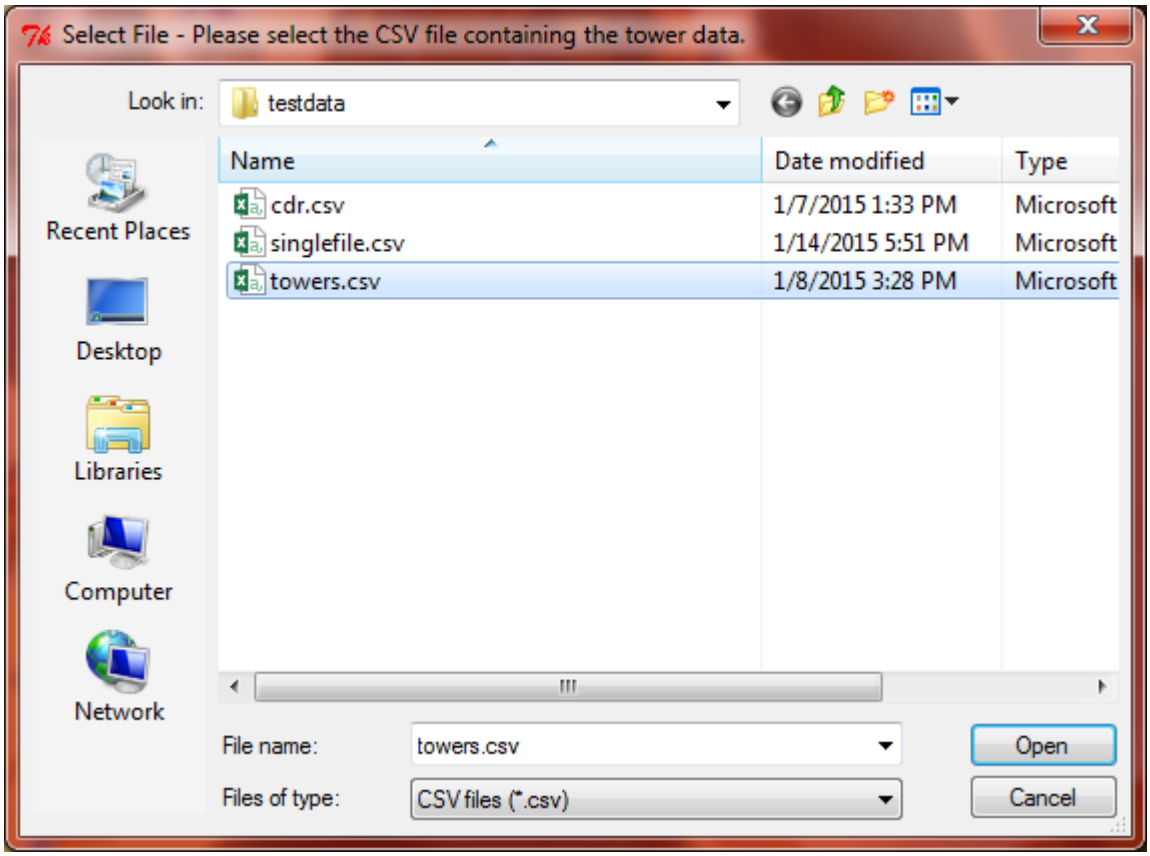

Figure 33: Prompt asking for the location of the cell site / tower CSV file.

be displayed to you once the import is finished (cf. figure 40). You must click 'OK' on the loading time warning screen shown in figure 39 before the tower import process will begin.

Once the towers are imported, the CDR CSV data import process will begin.

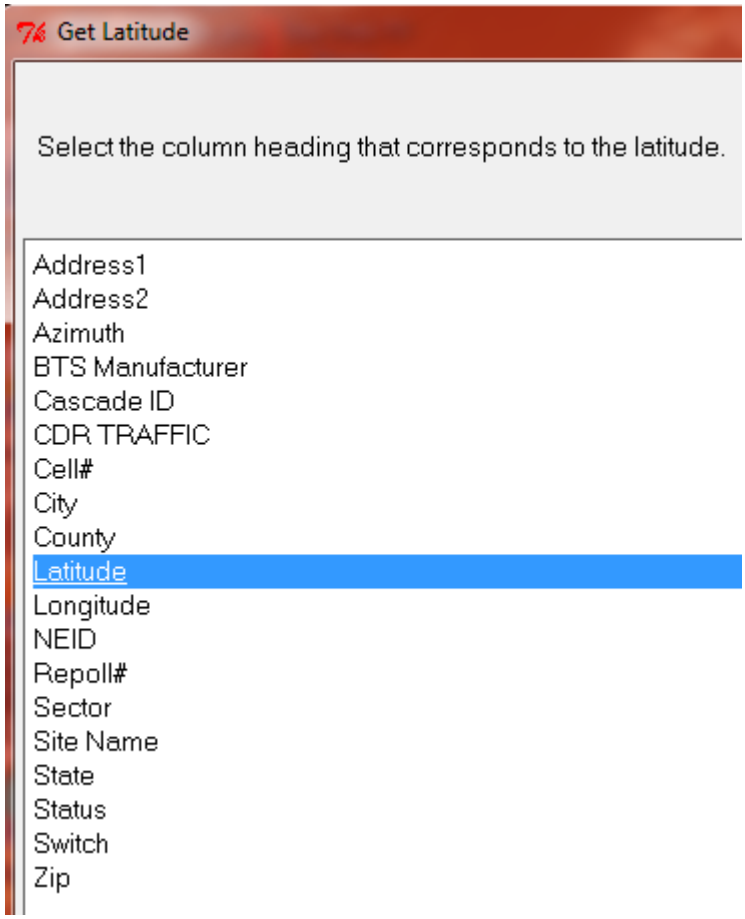

Figure 34: Select column heading label that corresponds to latitude.

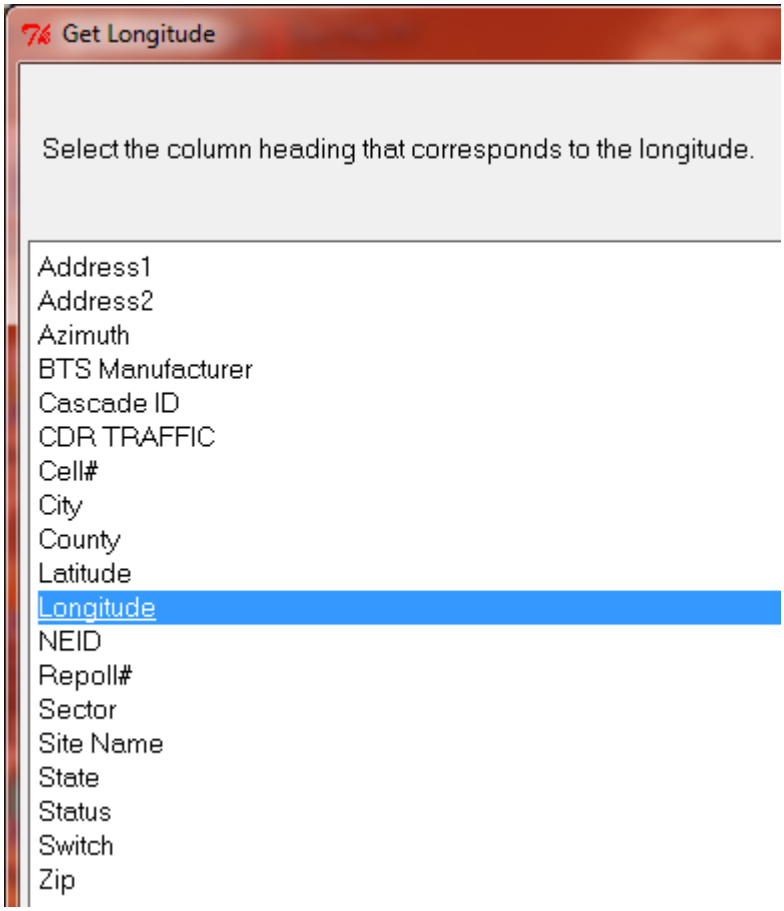

Figure 35: Select column heading label that corresponds to longitude.

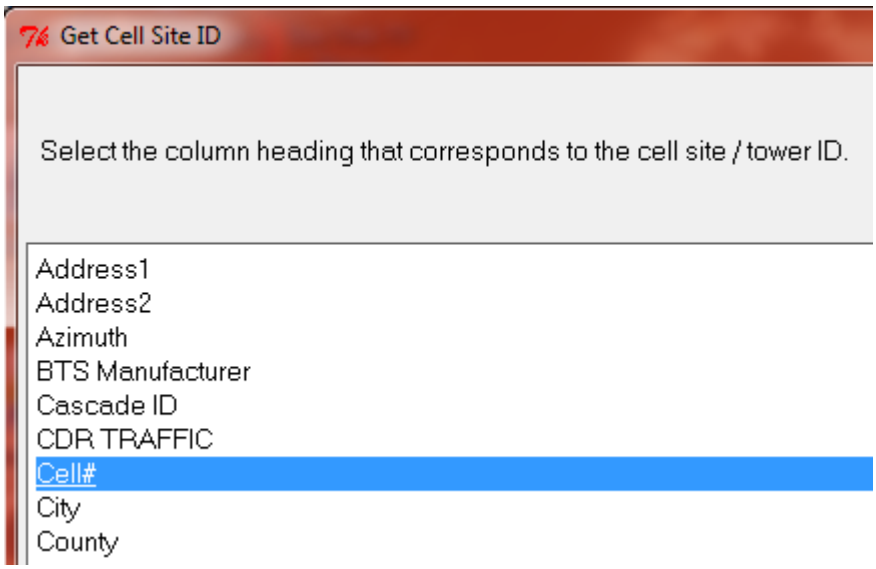

Figure 36: Select column heading label that corresponds to the cell site ID.

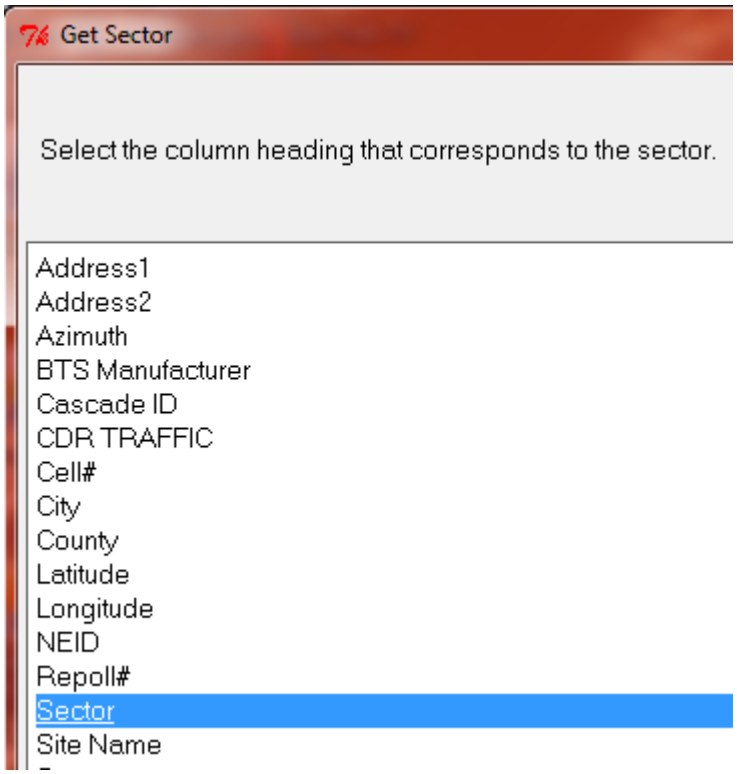

Figure 37: Select column heading label that corresponds to sector.

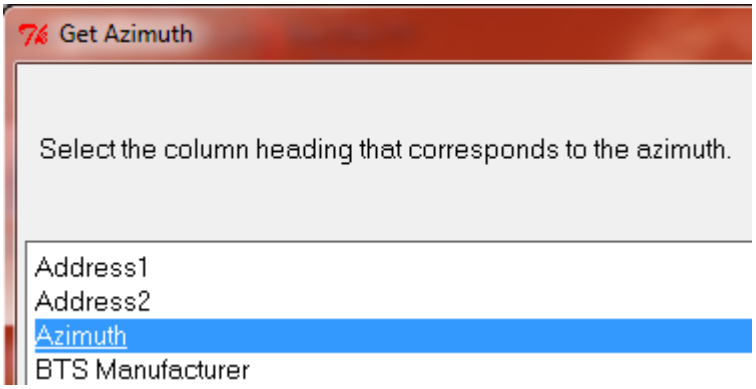

Figure 38: Select column heading label that corresponds to azimuth.

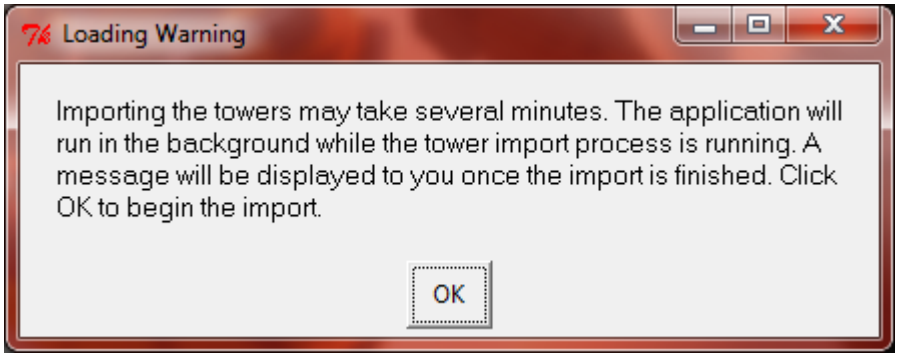

Figure 39: Warning about loading time.

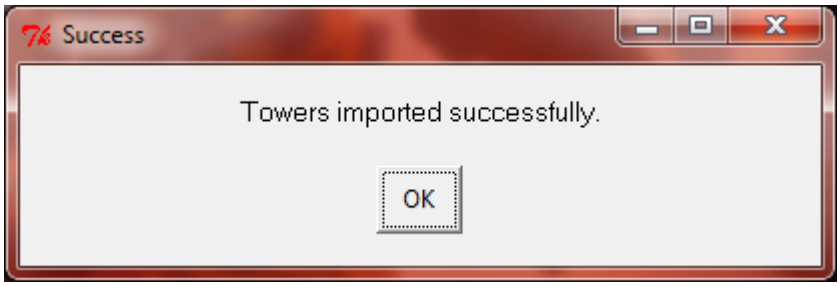

Figure 40: Tower import success message.

CDR Data CSV File

- **Called (or Non-Target) Number:** Either the number called (in data where both called and calling numbers are specified) or the column corresponding to the non-target numbers (for data where non-target numbers are displayed in a single column and another column indicates the direction of the call).
- **Cell Site ID:** A unique identifier for each cell site / tower that is used consistently both in this file and in the cell site / tower data file. You may select either the originating or terminating cell site identifier depending on which map file you are producing.
- **Sector:** A unique identifier for each specific cell site sector / face to which the device connected that corresponds to that used in the cell site / tower data file.

CDRMapper will also remind you of these requirements prior to uploading the CDR CSV data file, as shown in figure 41.

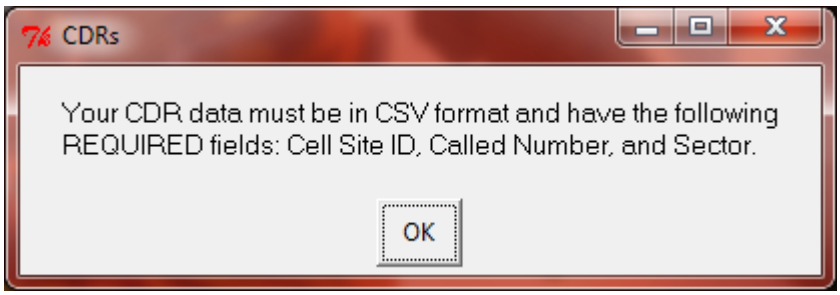

Figure 41: Reminder concerning required CDR CSV data fields.

You will then be prompted for the location of the CSV file containing the CDR data (cf. figure 42). Navigate to the file, select it, then click 'Open'. Next you will be asked to select the column heading corresponding to each required field: **called (or non-target) number, cell site ID,** and **sector** (cf. figures 43, 44, and 45).

Next you will be asked to select all of the columns that you wish to appear in the description for each point on the map (cf. figure 46). Select any additional columns you wish to appear in the final map report. By default, all required fields will already be included regardless of whether or not you select them.

You will then receive a warning that importing the CDR data may take several minutes (cf. figure 47). **The application will run in the background while the CDR import process is running.** This means that you will not see the application on your screen. This is the intended program behavior. A message will be displayed to you once the import is finished (cf. figure 48). You must click 'OK' on the loading time warning screen shown in figure 47 before the tower import process will begin.

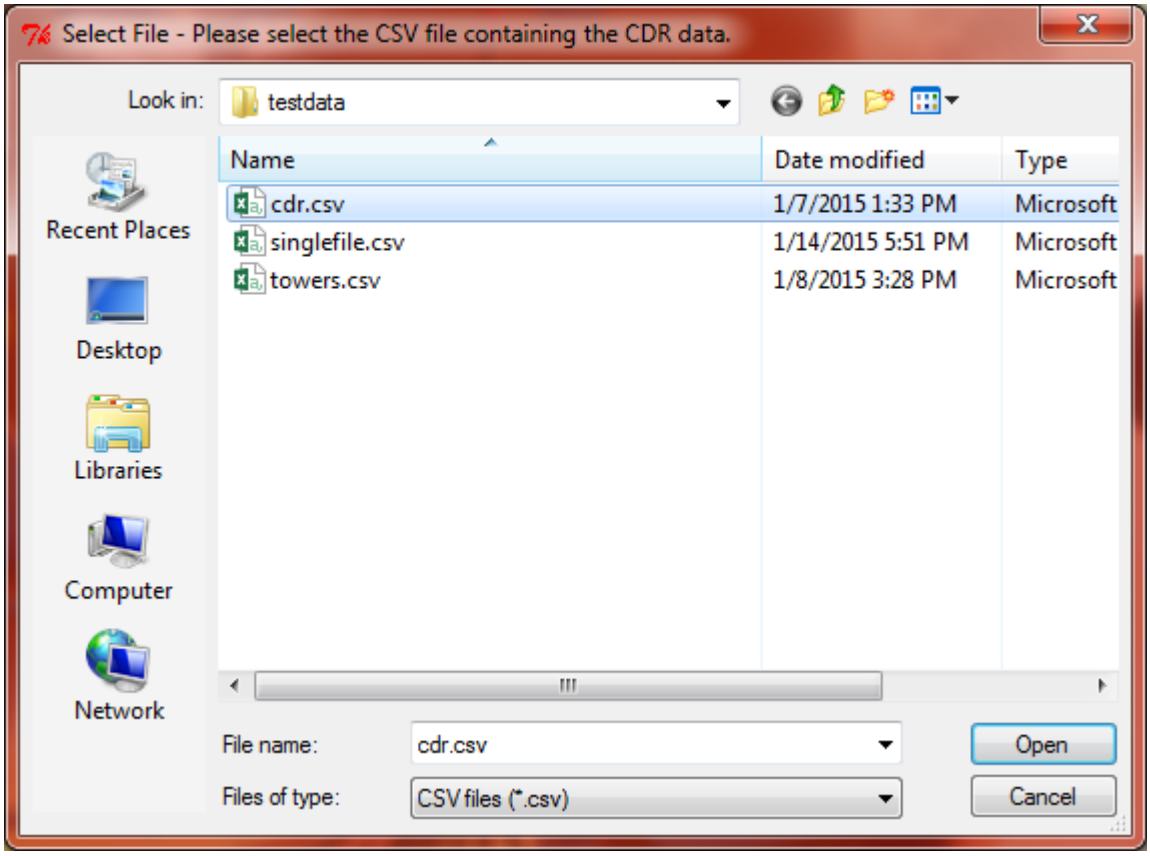

Figure 42: Prompt asking for the location of the CDR CSV file.

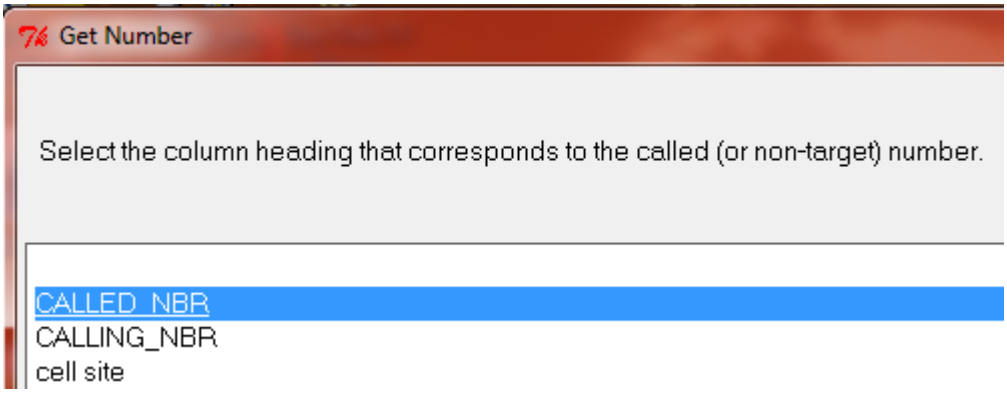

Figure 43: Select column heading label that corresponds to the called (or non-target) number.

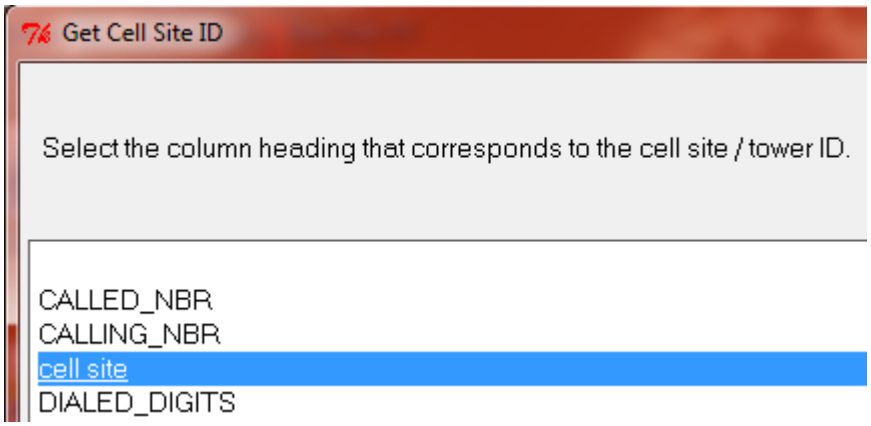

Figure 44: Select column heading label that corresponds to the cell site ID.

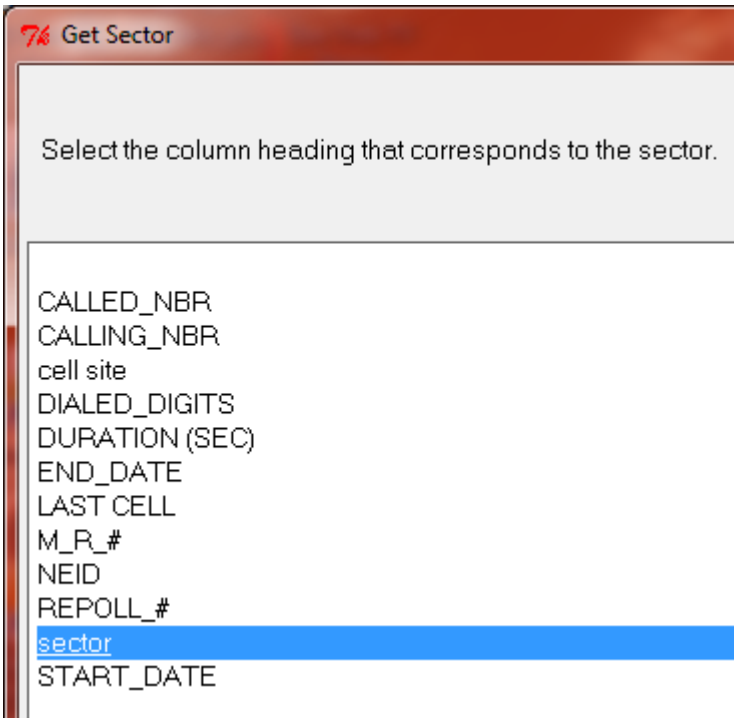

Figure 45: Select column heading label that corresponds to the sector.

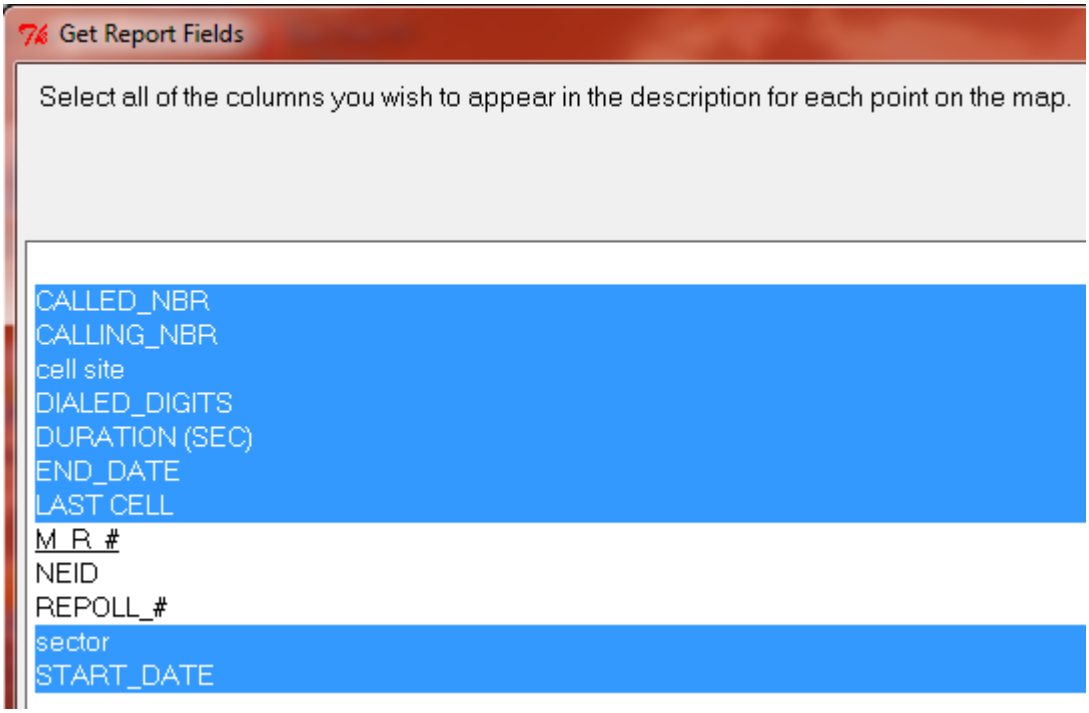

Figure 46: Select additional column headers you wish to appear in the description for each record.

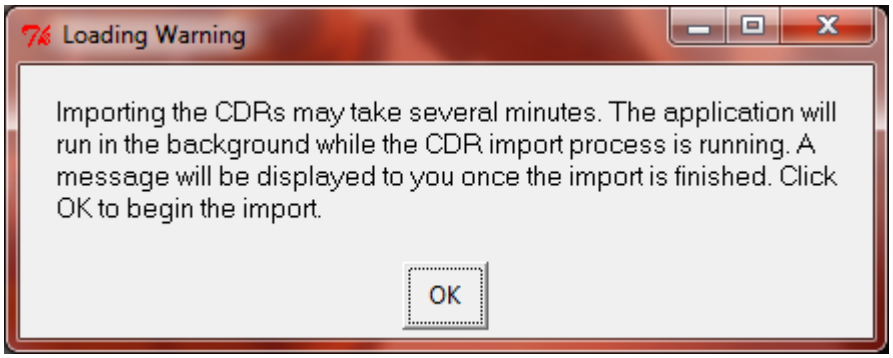

Figure 47: Warning about loading time.

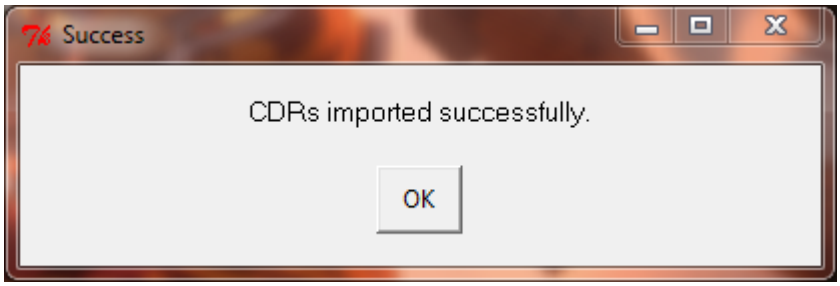

Figure 48: CDR import success message.

Final Report

Next you will be asked to specify the directory where you wish to save the final report (map file, cf. figure 49). Navigate to the desired directory, select it, then click 'OK'.

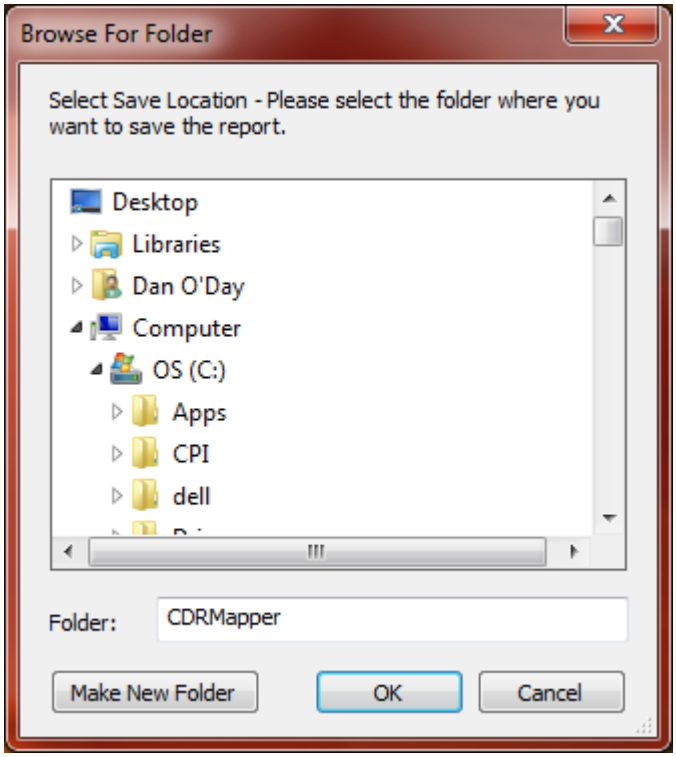

Figure 49: Select directory where report will be saved.

Once the report (map file) has been successfully created, you will see a message indicating this and showing the location you selected it be saved (cf. figure 50). By default it will be saved with the case number specified when you entered your case information. The program will automatically close after you click 'OK'. To plot additional data, reopen the application.

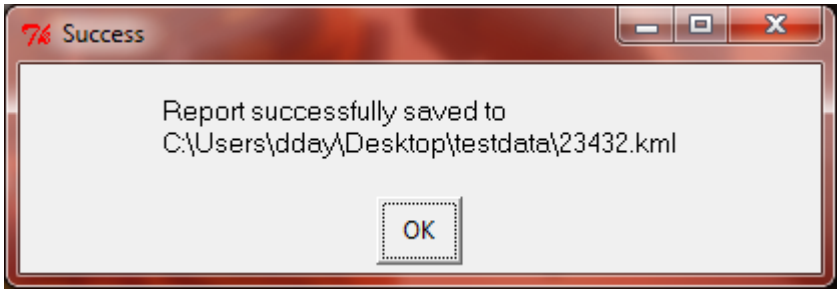

Figure 50: Report successfully saved to specified location.

List of Figures