USACE Survey Drivers
User Guide

March 7, 2014

SS-095

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Survey Drivers Project

User Guide

Version : 2.0.3

1.0 Overview

The Survey Drivers Project provides an extension to ArcGIS that reads standardized geospatial survey file formats of the U.S. Corps of Engineers, including, but not limited to, the national standard published in the Engineering Manual, EM1110-2-1005, and all formats used internally by the New Orleans District such as LMN830 and Traverse Computation files.

The design philosophy behind the project was to model survey data as a native format of ArcGIS. This approach offers two distinct advantages: first, it allows most of the built-in ArcGIS tools to work with survey data without the extra step of importing or exporting data. Second, users who are already comfortable with ArcGIS don't have to learn new tools to be productive with survey data; most of the magic is performed behind the scenes at the driver level.

2.0 Usage

To see Survey Drivers in action, a user can navigate to a directory containing survey files in the ArcCatalog Program or select the "Add Data" command in ArcMap to find and load a survey file into a map document. Survey Drivers uses the file's extension to recognize survey file documents. Table 1 shows the formats that Survey Drivers supports and the file extensions for these formats.

File Type	Extensions	Supported Features
EM1110-2-1005	.EM or .CL	Cross-Sections, Cross-Section Points, Profiles, Profile Points, Miscellaneous Shot Points, Areas, Area Points, Gages, Benchmarks
LMN830	.830	Cross-Sections, Cross-Section Points, Benchmarks
PRO	.PRO	Profiles, Profile Points
Traverse Computation (T-Files)	.83 or .27	Traverses, Traverse Points
EM Baseline	.BL	Traverses, Traverse Points

Table 1 : Supported survey file formats

Surveys are modeled in ArcGIS as "feature datasets", meaning that they are each composed of multiple layers, or "feature classes". These layers include cross-sections, cross-section points, profile centerlines, profile centerline points, miscellaneous shot points, benchmarks, gages, traverses (also referred to as baselines), traverse points, area features, and area points. Different survey file formats support different feature types (refer to Table 1).

Some survey files may not be properly structured or may have missing or invalid attribution. In these cases, the Survey Drivers Extension tries to be forgiving and read as much of the data file as possible. When an error occurs, a log window will appear with the error information, including the filename of the erroneous survey, approximate line number of the error, and a description of the cause of the error.

3.0 ArcCatalog Example

This section walks through a typical ArcCatalog usage case with the Survey Drivers extension. ArcCatalog is the equivalent of Windows Explorer for GIS data. It allows the user to navigate through a hierarchy of file folders and databases to browse spatial datasets.

Most surveys at the New Orleans District are nested in the \\mvd\mvn\Data_EDS\Edss\SURVEYSC\DATA directory. Copy the path \\mvd\mvn\Data_EDS\Edss\SURVEYSC\DATA into the "Location" line entry in the ArcCatalog toolbar, as shown in Figure 1. ArcCatalog will navigate to that path. You can also map a shortcut to this path in ArcCatalog with "File -> Connect Folder" command.

The left side of ArcCatalog displays a treeview of the dataset locations. You can select either the survey file, represented by the feature dataset with the same filename, or one of the survey file's individual feature classes. The right side of ArcCatalog shows a preview window with information about the currently selected dataset or feature class. In Figure 1, the survey file 13012C.EM is selected and its default feature class, 13012C.EM CrossSections, is displayed in the preview window. As of version 1.3, Survey Drivers no longer displays empty feature classes in a survey file. Since there are no profile records in 13012C.EM, the Profiles and ProfilePoints feature classes are not listed. The preview window includes tabs for Contents, Preview, Description, and Text as described in the subsections that follow.

3.1 Preview Geography Tab

The Preview tab shows a spatial view of a survey dataset's feature class. One of the feature classes listed in the feature dataset is shown by default in the Preview tab. For example, in a survey feature dataset, the CrossSections feature class is shown by default when viewing the survey at the feature dataset level. Selecting the individual feature classes allows you to preview the geometry of features in those feature classes.

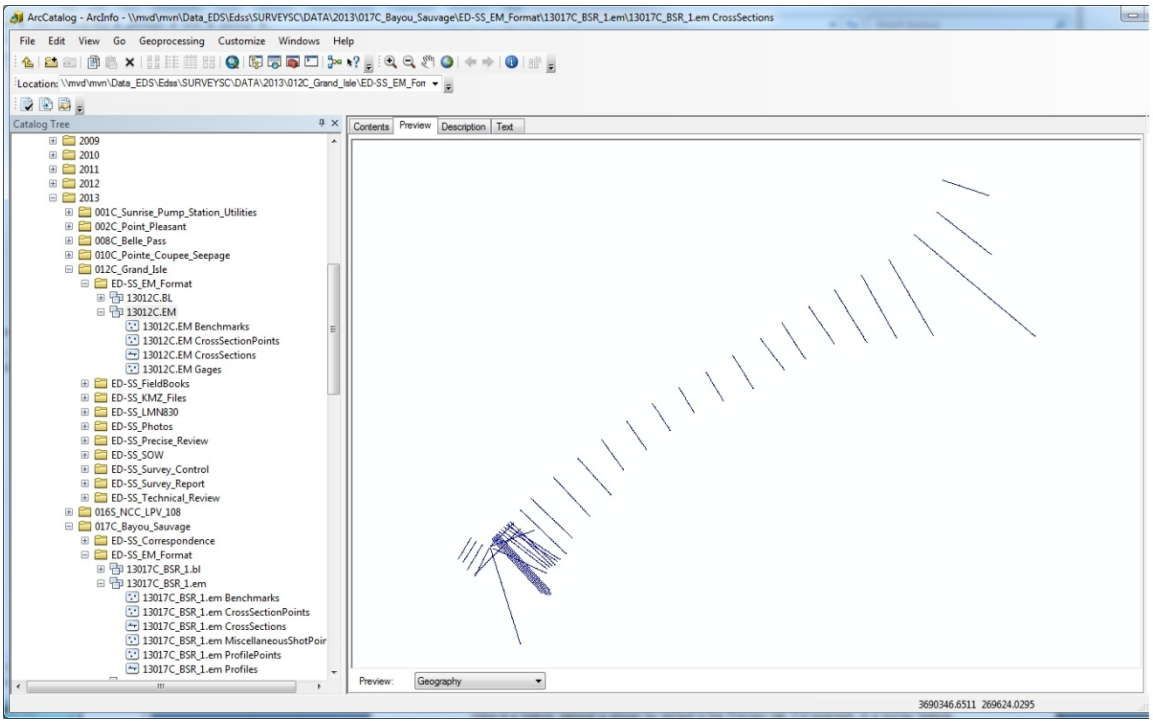

Figure 1 : 13012C.EM CrossSections opened in ArcCatalog to view its geometry.

3.2 Preview Table Tab

Each of a survey file's feature classes has its own set of associated data. To view a table of the attribute data, switch the "Preview" mode from "Geography" to "Table". A tabular view of 13012C.EM CrossSections is shown in Figure 2.

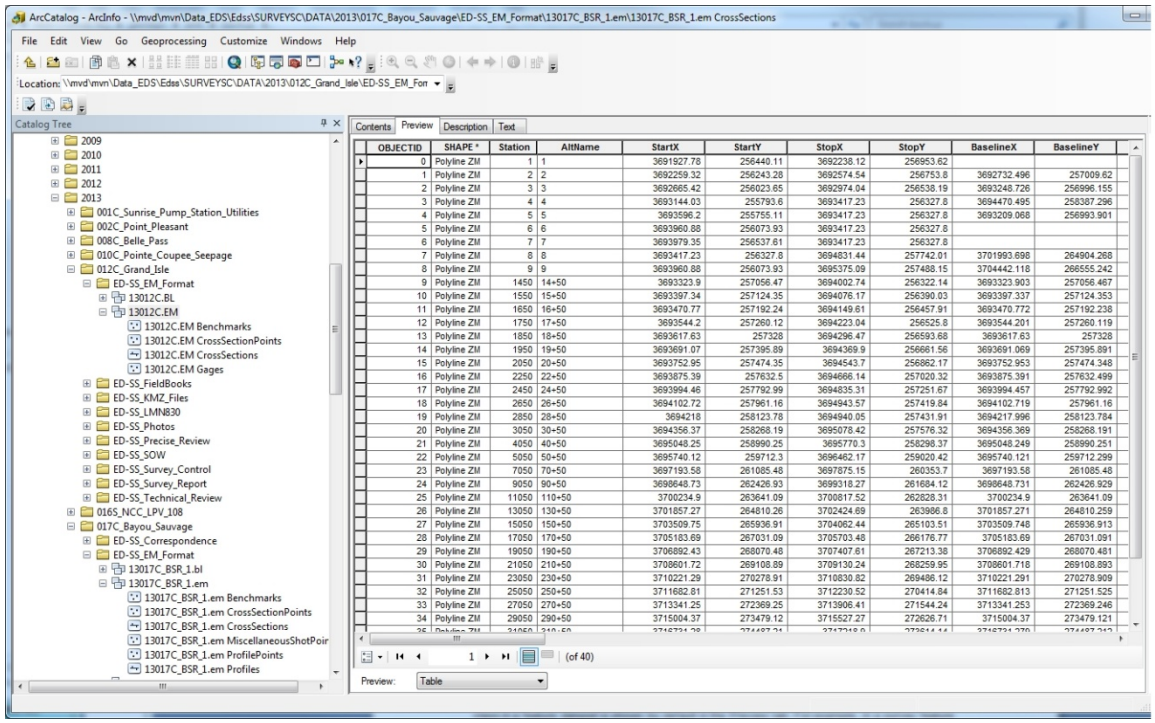

Figure 2 : 13012C.EM CrossSections opened in ArcCatalog to view its attribute data.

3.3 Text Tab

Survey Drivers includes a viewer window that allows the user to view the source of a survey file without having to switch to an editing program. This source view can be accessed by selecting the "Text" tab above the preview window. The Text view of 13012C.EM is shown in Figure 3. While in the Text view, ArcCatalog will display the line number where the cursor is currently located in the status bar.

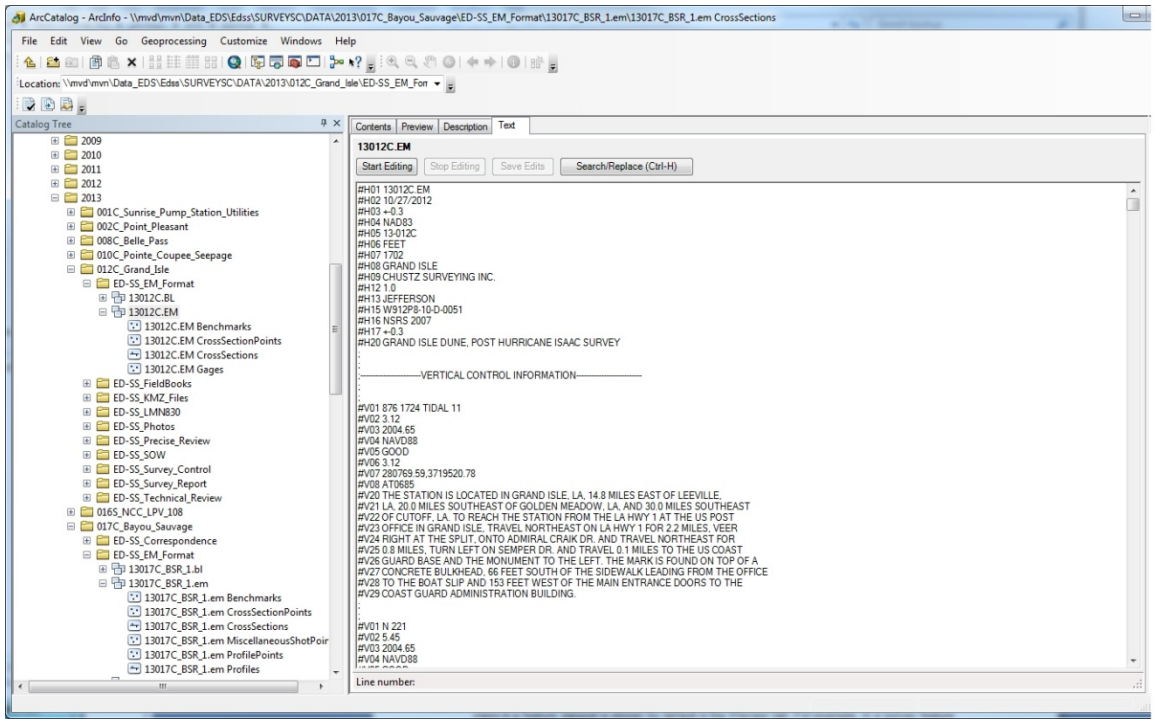

Figure 3 : A view of 13012C.EM's source text in ArcCatalog.

If the survey has any errors such as bad dates, duplicate records, or misordered records, a dialog box will appear, as shown in Figure 4, displaying the description of the error and the beginning line number of the offending section of the survey file. When a line in the error dialog is double-clicked, ArcCatalog will switch to the Text view of the survey and scroll directly to the line number listed in the error message. If the line is double-clicked in an error dialog for an ArcMap session, the ArcCatalog program will open (unless it is already open), navigate to the survey, switch to Text View, and scroll to the line number from the error message.

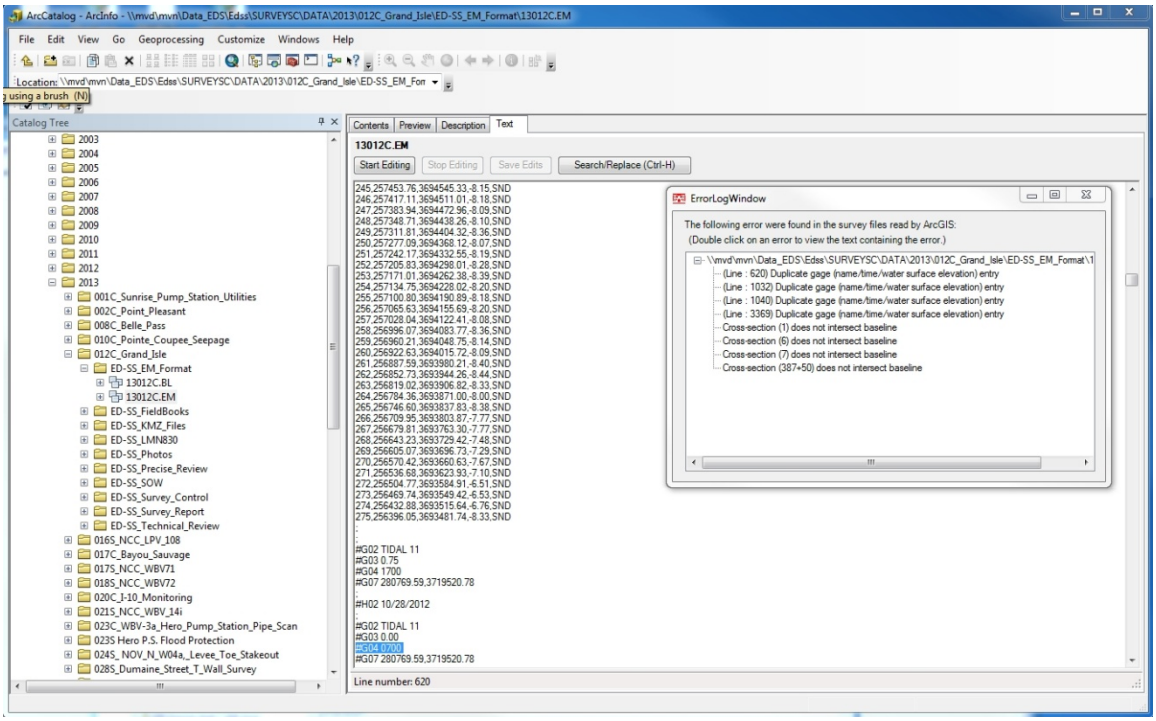

Figure 4 : A view of 13012.EM's source text in ArcCatalog. Line 620 has been highlighted by clicking on the first error message.

As of version 1.3 of Survey Drivers, the Text View has editing functionality. Four buttons appear above the text window labeled “Start Editing”, “Stop Editing”, and “Save Edits” and “Search/Replace”. The “Start Editing” button initiates an edit session, in which the text background changes color to green as shown in Figure 5. The user can modify text and either save the changes by clicking “Save Edits” or discontinue editing by clicking “Stop Editing”. If the session has unsaved changes when “Stop Editing” is clicked, a dialog will appear prompting the user to save or discard the edits.

The editor includes basic find and replace functionality. This functionality can be accessed by typing Ctrl-H combination. The dialog is similar to the find/replace dialog found in the Word or Notepad applications. Some edits like corrections to X and Y coordinates, and elevations may not appear immediately in the Preview Geography tab. If this happens, ArcCatalog will need to be closed and reopened to view the impact of these edits.

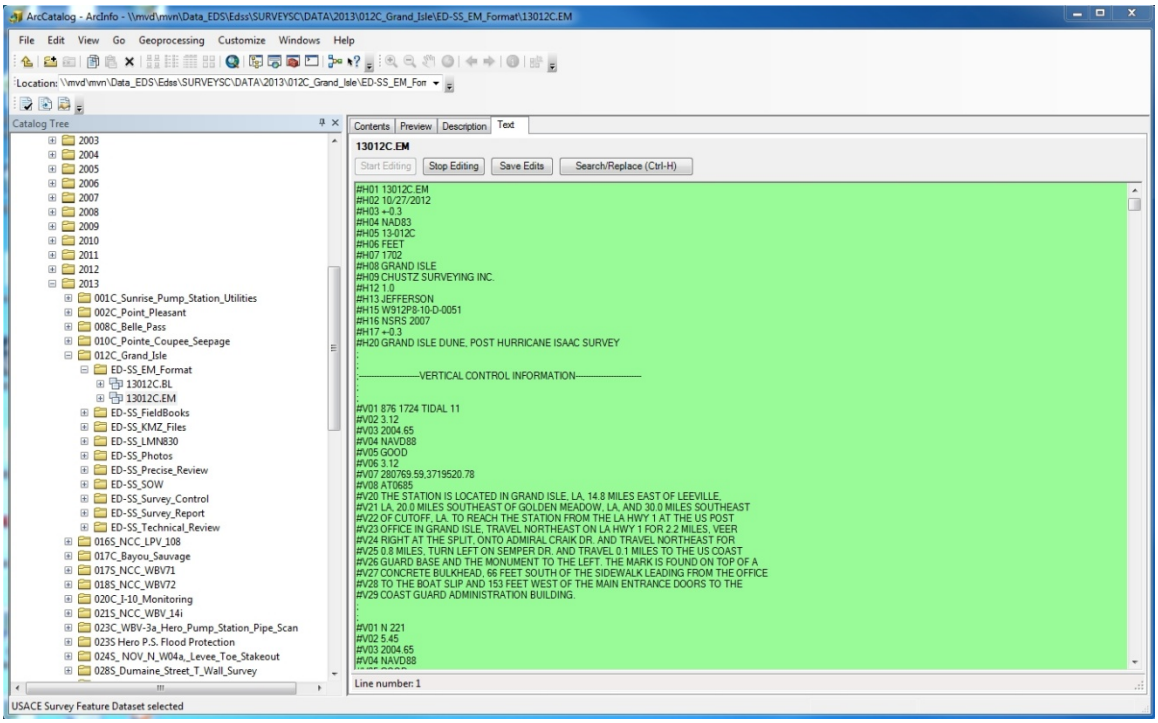

Figure 5 : Example of an active edit session. Background color has been changed to green and the "Stop Editing" and "Save Editing" buttons are activated.

3.4 Description Tab (Metadata)

One of the most important aspects of an engineering survey is its metadata: information associated with the dataset as a whole. This information can be viewed in the "Description" tab above the preview window. Survey metadata includes information such as the job-number, which can be used to track down other information about the survey job from Survey Section, and permanent benchmarks, which compose the survey's vertical control network.

Starting in ArcGIS 10, the ArcCatalog "Metadata" tab has been renamed as the "Description" tab. The default metadata style is the "Item Description" style, which is a simple style with a handful of basic descriptive comments (Figure 6). None of the SurveyDrivers metadata elements will display when "Item Description" is the active metadata style. In order to see the SurveyDrivers metadata elements, choose "Customize/ArcCatalog Options" from the ArcCatalog pull-down menus. Select the "Metadata" tab, and under Metadata Style, switch from "Item Description" to "FGDC CSDGM Metadata" and hit the "OK" button.

Once the metadata style has been changed to "FGDC CSDGM Metadata", metadata elements from the survey file will be listed under both the "ArcGIS Metadata" section and the "FGDC Metadata (read only)" section (Figure 7). Click on the triangle next to a metadata section to expand it. The metadata for the survey file will include a listing of the benchmarks and gages referenced in the file. The metadata will also include the survey crew members and the surveying equipment.

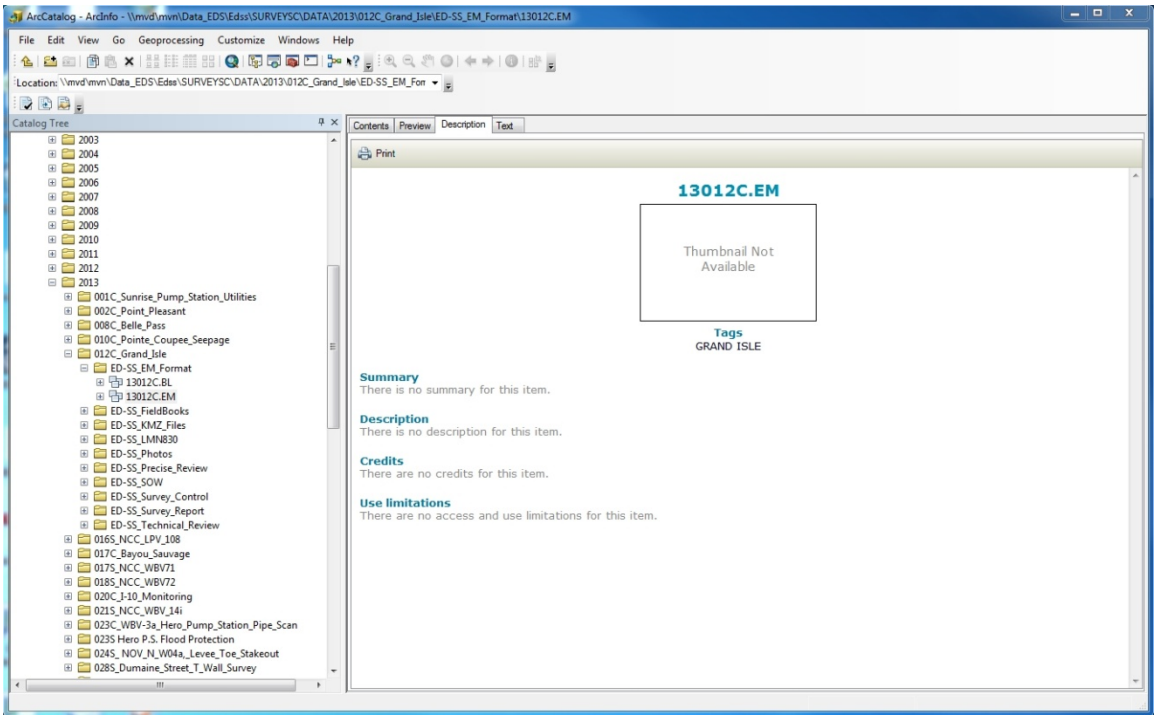

Figure 6: A view of the default "Item Description" metadata for 13012.EM before the ArcCatalog metadata configuration is changed to FGDC metadata style.

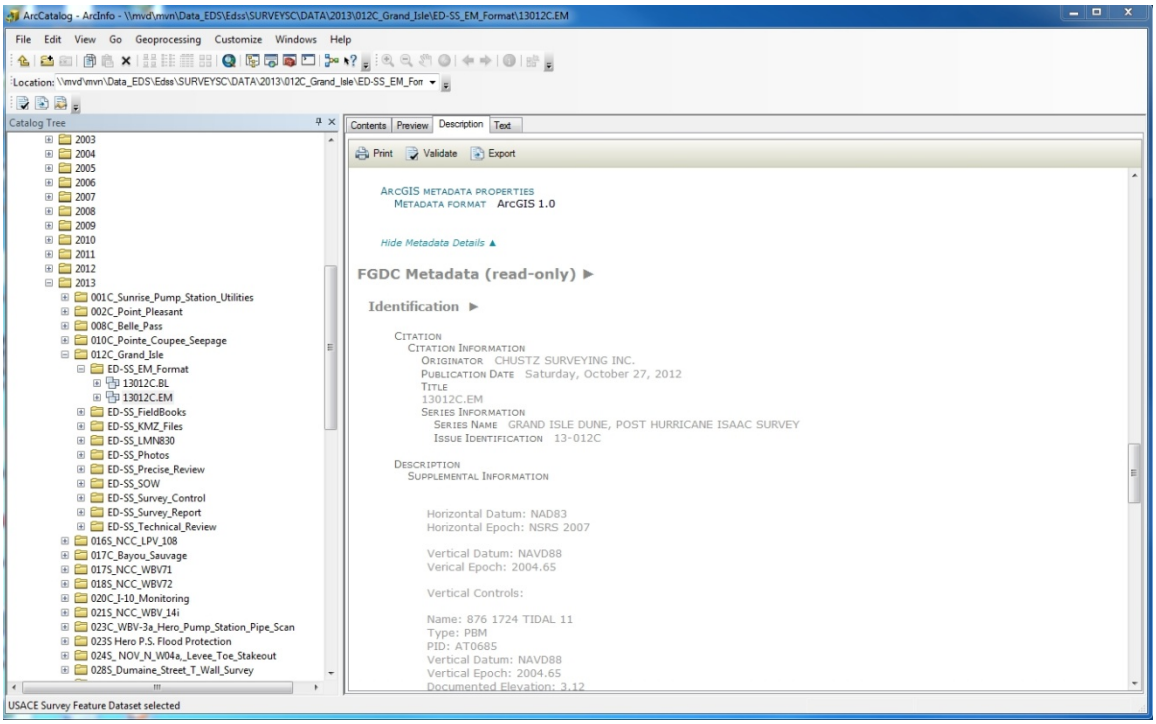

Figure 7: A view of the survey file metadata for 13012.EM once ArcCatalog metadata options have been switched to "FGDC CSDGM Metadata".

4.0 ArcMap Example

The following example demonstrates how to open a survey file in ArcMap. We will examine a survey for the Western Tie-in East-West levees (WBV-72). This example uses datasets available in-house at the New Orleans District.

First, open the ArcMap program. “ArcMap” should appear as an icon on your desktop or as an entry in the Windows Start Menu. You can start with an empty map. Next, find the "Add Data" button. This button can be used to add data such as surveys to your map. It should appear as an entry in the file menu as shown in Figure 8 or as a tool button in the "Standard" toolbar that appears below the menus.

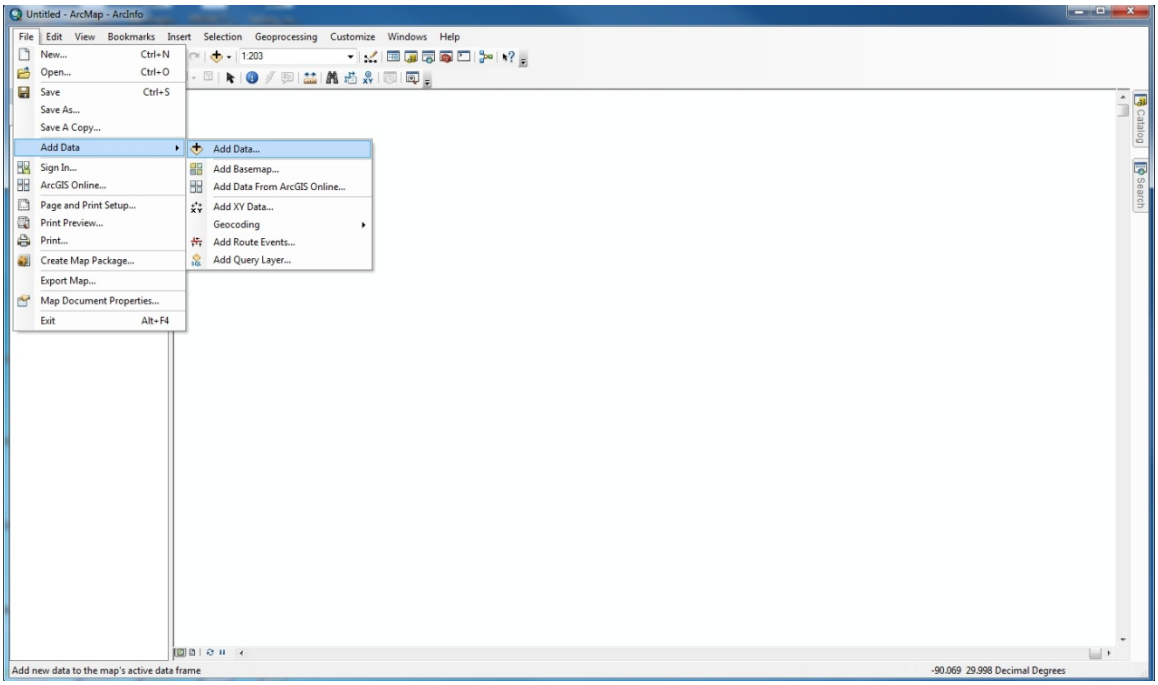

Figure 8 : The ArcMap application and location of "Add Data" command in the File menu.

Click on the "Add Data" button to launch the dialog shown in Figure 9. First, we will add recent New Orleans HSDRRS high-resolution imagery as a background reference layer. Navigate to "Database Connections/eGISDatabaseRaster.sde" and find the "RASTER.NO_RPC_IMAGERY_2012" dataset. Highlight the " RASTER.NO_RPC_IMAGERY_2012" dataset and click the "Add" button to bring the imagery into the map.

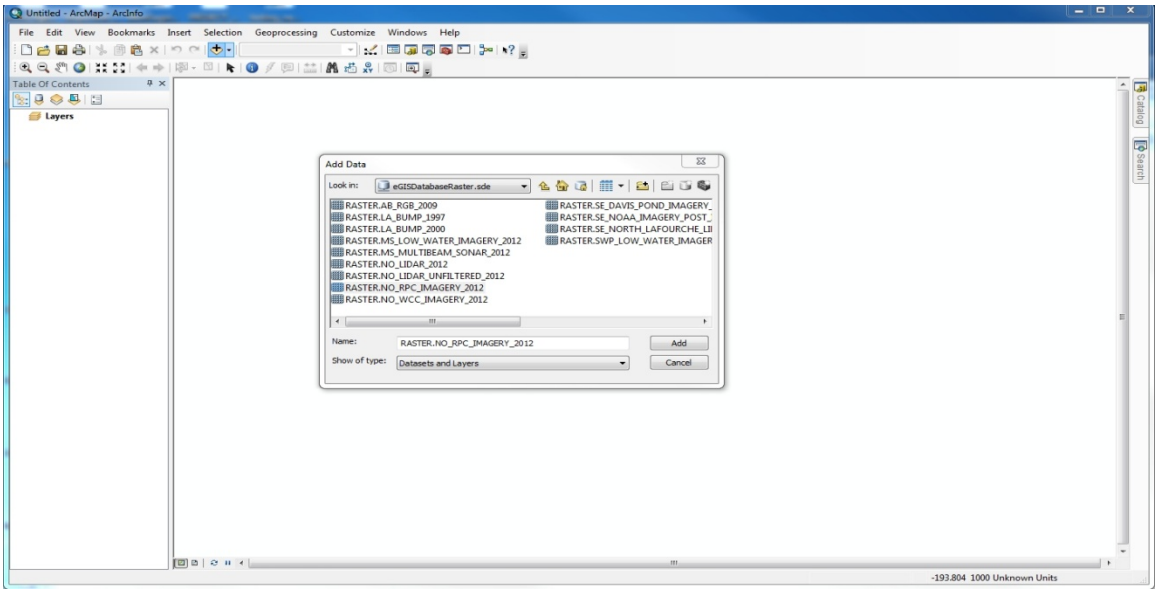

Figure 9 : The Add Data Dialog in ArcMap. "RASTER.NO_RPC_IMAGERY_2012" dataset has been selected to be added into the map.

Next, add one of the Western Tie-in NCC surveys into the map. To do this, you may need to connect to Survey Section's directory on the file server. This can be done in the "Add Data" dialog by clicking on the “Connect to Folder” button.  . When you click on this button, a directory selection dialog appears like the dialog shown in Figure 10. Type in the path to Survey Section's network directory, which is currently \\mvd\mvn\Data_EDS\Edss\SURVEYSC\DATA, and click OK.

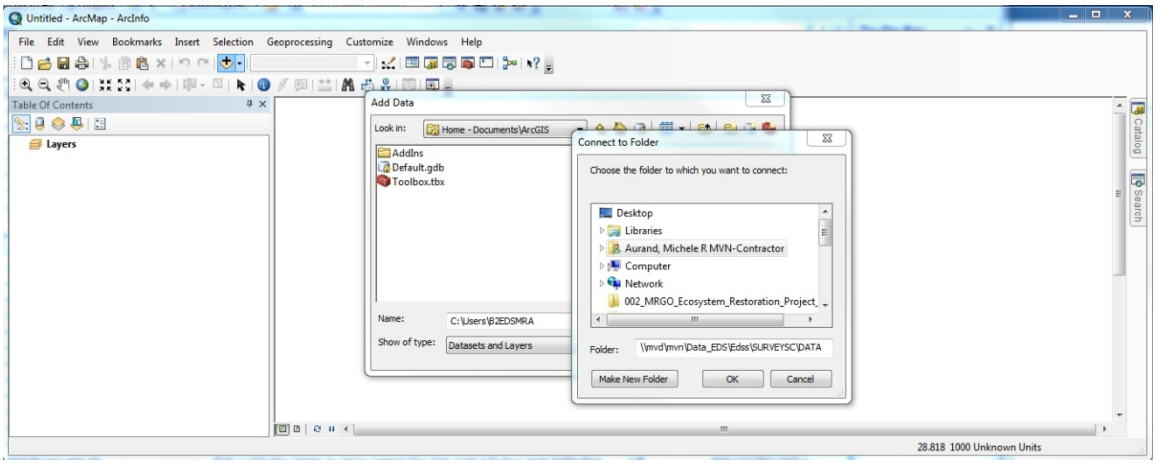

Figure 10 : Connecting to a directory in the Add Data Dialog.

Once connected to Survey Section's file server, you can load any of their survey files. For this example, we'll load the EM survey from the following directory:

\\mvd\mvn\Data_EDS\Edss\SURVEYSC\DATA\2013\018S_NCC_WBV72\ED-SS_P_EM_Format

You can navigate to the EM file using the "Add Data" dialog or you can paste the path directly into the "Name" data entry field. Figure 11 shows the surveys available in this directory.

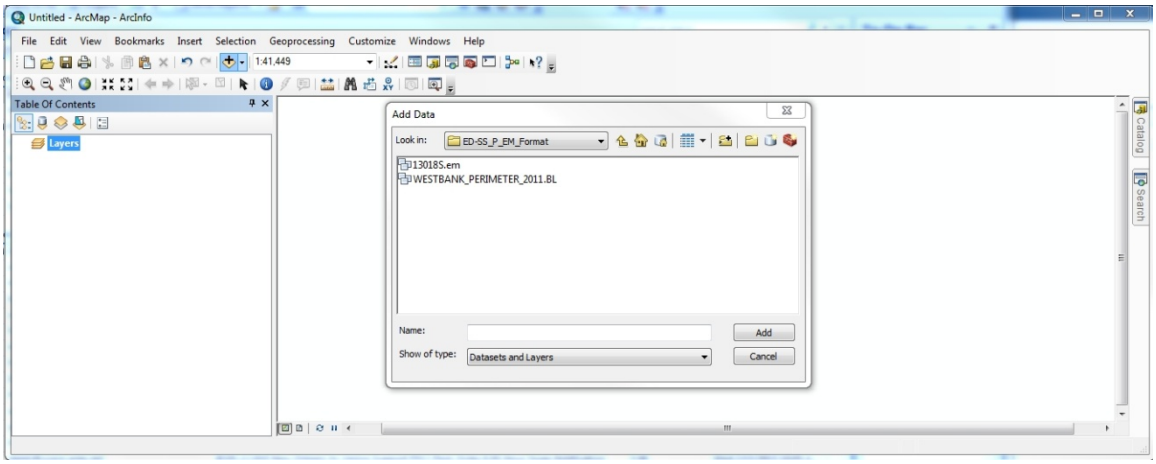

Figure 11 : Survey files for Western Tie-in East-West levees NCC survey 13018S.EM listed in the Add Data Dialog.

Highlight the EM file to load all of the survey's feature classes into ArcMap as shown in Figure 12. Feature classes appear in the Table of Contents (left side of Figure 12) with the name of both the file and feature class type. In the map view, the surveyed features from the data file will appear in their correct spatial locations. If the survey file is properly attributed, it will be automatically projected to the map's coordinate system. In Figure 12, the map is in UTM15 coordinate system (notice the units in the bottom left corner), but the survey, which is in State Plane 1702 NAD83 FT, aligns correctly to the imagery because its spatial reference in the map is understood and its features can be projected into UTM15.

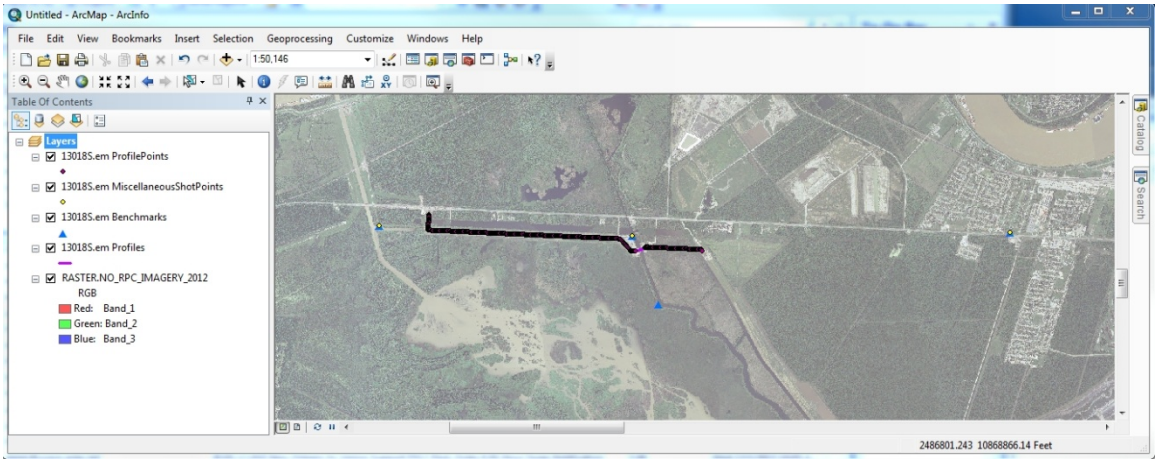

Figure 12 : Survey Files loaded into ArcMap.

Once a survey is loaded, you can export, select, query, and identify the data just as you would any other layer in the map.

5.0 Troubleshooting

This section lists some common problems that may be encountered while using Survey Drivers and how to resolve them.

5.1 Coordinate Systems

In some cases you may get an error message from ArcMap indicating that the coordinate system is undefined. The data will still load in these cases, but you must make sure that your map document is in the same coordinate system as the survey file. In most cases in Louisiana this will be "Louisiana South State Plane 1702 Feet NAD83". To fix this error, make sure the map projection (#H07 record in EM format) is one of the following: LAMBERT, 1702, or LAMBERT 1702 and the horizontal datum (#H04 record in EM format) is either NAD83 or NAD27, and the units (#H06 record in EM format) are either FEET, FT, or METERS.

Additional coordinate systems can be added to the Survey Drivers extension by modifying the configuration files in the “config” directory under the installation directory. By default, this installation directory is C:\Program Files\CEMVN\SurveyDrivers and contains the configuration files COORDSYS.csv and DOMAINS.csv. The DOMAINS table maps accepted attribute values to a single value that is recognized by Survey Drivers metadata and spatial reference components. The COORDSYS table maps horizontal datum, coordinate reference system zone, units, and horizontal epoch into a numeric coordinate system identifier. A prj file with the definition of the coordinate system must be placed in the “coordsys” directory and given the name of the coordinate system identifier with the .prj extension. For more information, refer to the developer documentation found in the installation Start Menu.

5.2 Missing Record Code Definition

CEMVN maintains a list of standard survey point codes (See the USACE New Orleans District Minimum Survey Standards, Appendix 2: http://www.mvn.usace.army.mil/Missions/Engineering/SurveySection/SurveyingGuidelines.aspx or refer to the EM file format specification) In addition to the standard codes, custom codes can be added to a CODES.DAT file that resides in the same directory as the EM file. If survey point code definitions are missing from the CodeDef column in ArcGIS, it may be because they are in neither of these two locations.

In such cases (particularly when new standard codes are needed), Survey Drivers allows the user to add additional point codes by modifying the DOMAINS.csv configuration file in the “config” directory under the installation path. (By default this path is C:\Program Files\CEMVN\SurveyDrivers.) Add an additional line with the word “CODE”, followed by the survey code and the code definition, separating the three entries with commas. For example, adding the following line to DOMAINS.csv:

CODE,GLF,GOLF COURSE

adds the survey code definition, “GOLF COURSE” to survey points with point code, “GLF”.

5.3 Performance Problems

Surveys that have errors will generally take a long time to render due to the fact that Survey Drivers builds and displays an error list dialog. It would be advisable to correct all formatting errors in the Survey Driver Text View editor (or an external text editor) before using the survey in order to skip the computationally intensive error collection process.

In cases where the survey is too large to be used effectively by Survey Drivers, it is recommended that the survey file either be split into multiple files or exported to a shapefile data source using the survey_ogr utility described in Section 6.

6.0 Utilities

Survey Drivers includes command-line utility programs for working with survey data. These utilities are installed in the 'bin' directory of the Survey Drivers application path. You can run the 'Survey Utilities Shell' from the Survey Drivers location in the Windows Start Menu. This program will open a command prompt and add the bin directory to your executable path in that command prompt so that you can simply type in command names without having to find them in the file system.

6.1 survey_ogr

The survey_ogr program compiles multiple survey files into a single data source consisting of shapefiles and dbase files. ArcGIS can work with shapefiles and dbase files more efficiently than survey files. This is especially true when creating a map with a large survey file or a large number of survey files.

To use the survey_ogr utility, you must first initialize a survey data source to store the output data. This can be accomplished with the survey_ogr create command. For example, running the following command creates a new directory called c:\scratch\survey_data and populates it with empty tables and shapefiles, using a Louisiana South State Plane coordinate system.

```
survey_ogr.exe -o create c:\scratch\survey_data 1702,NAD83,USFEET
```

The path c:\scratch\survey_data can be substituted with a path of your choice. Do not use a path that already exists. Once a survey data source is created, you can use the survey_ogr add command to add survey files to the data source. Just specify the path to the directory data source created with the survey_ogr create command, followed by a list of survey file paths or glob expressions. For example, any of the following expressions would add surveys to a directory data source in c:\scratch\survey_data (as created in the previous example).

```
survey_ogr.exe -o add c:\scratch\survey_data P:\DATA\07004C.EM
survey_ogr.exe -o add c:\scratch\survey_data P:\DATA\*.EM
survey_ogr.exe -o add c:\scratch\survey_data P:\DATA\*.EM P:\DATA2\*.EM c:\X.EM
```

Name	Description	Joins
area_points.shp	Vertex and point data for area features	AreaId → areas.AreaId SurveyId → survey_metadata.SurveyId
areas.shp	Polygonal boundary surveys	SurveyId → survey_metadata.SurveyId
baseline_points.shp	Vertex and point data for survey traverses or baselines	BaselineId → baselines.BaselineId SurveyId → survey_metadata.SurveyId
baselines.shp	Linear surveyed traverses or baselines	SurveyId → survey_metadata.SurveyId
benchmarks.shp	Vertical control information	SurveyId → survey_metadata.SurveyId
crew.dbf	Persons collecting data for surveys	SurveyId → survey_metadata.SurveyId
cross_section_points.shp	Vertex and point data of survey cross-sections	CsId → cross_sections.CsId SurveyId → survey_metadata.SurveyId
cross_sections.shp	Linear surveyed features that run across the survey area	SurveyId → survey_metadata.SurveyId

equipment.dbf	Instruments used to collect survey data	SurveyId → survey_metadata.SurveyId
errors.dbf	Errors in survey text	SurveyId → survey_metadata.SurveyId
gages.shp	Water gage information	SurveyId → survey_metadata.SurveyId
miscellaneous_shot_points.shp	Vertex and point data for miscellaneous surveyed points	SurveyId → survey_metadata.SurveyId
profile_points.shp	Vertex and point data for profiles	ProId → profiles.ProId SurveyId → survey_metadata.SurveyId
profiles.shp	Linear surveyed features that follow the path of the survey area	SurveyId → survey_metadata.SurveyId
survey_metadata.shp	Metadata information applicable to the whole survey file	BaselineId → baselines.BaselineId
version_info.dbf	Information about data source version	
weather.dbf	Weather conditions observed during surveys for specific dates	SurveyId → survey_metadata.SurveyId

Table 2 : DBase tables and shapefile names/descriptions for a survey data source. Survey data sources can be created with the survey_ogr create command. The Joins column shows the columns that can be used to join datasets together in GIS applications.

The first example adds a single survey, 07004C.EM to the data source, c:\scratch\survey_data. The second example adds all files in the P:\DATA directory with the EM extension to the survey data source, c:\scratch\survey_data. The third example adds all files with an EM extension from directories P:\DATA and P:\DATA2 to c:\scratch\survey_data, as well as local survey, X.EM.

Table 2 shows a listing of files that comprise a survey data source. Some tables and shapefiles can be joined based on their id attributes in programs like ArcGIS. For example, you can use the Survey Id field to see the contracting company that surveyed a specific survey cross-section point by joining cross_section_points.shp with survey_metadata.dbf using the SurveyId columns in both datasets. As of version 1.4, the survey_ogr script also generates a “survey_map.mxd” file that includes all of the generated survey files and dbase files in a map document, complete with all appropriate joins, relates, and symbology.

6.2 survey_to_kml

The survey_to_kml program converts individual survey and traverse files to KML format, which can be viewed in Google Earth. To convert surveys to KML simply call the survey_to_kml program and specify the input survey file and output KML path. Using the “.kmz” extension will created a compressed KML file, which will still be readable in Google Earth. For example the following two commands convert two hypothetical survey files into KML format.

```
survey_to_kml.exe C:\data\07001.EM C:\output\07001.KML
survey_to_kml.exe C:\data\07001.830 C:\output\07001.KMZ
```

The generated KML file will include geometries for cross-sections, profile/centerlines, miscellaneous shot points, areas and area points, gage readings, benchmarks, and baseline points, including both line and point features. You can double-click on the output KML file to open the Google Earth program if you have it installed or you can open Google Earth and add an exported KML file using the 'File' menu. Once a survey is loaded into Google Earth, click on an

individual point or line to open a window that displays information about that feature. By rotating the view, you can see the elevation of the surveyed features. Figure 13 shows a sample output KML file with a survey point selected. The window in the center displays information including the survey point's elevation, survey code, and vertical control.

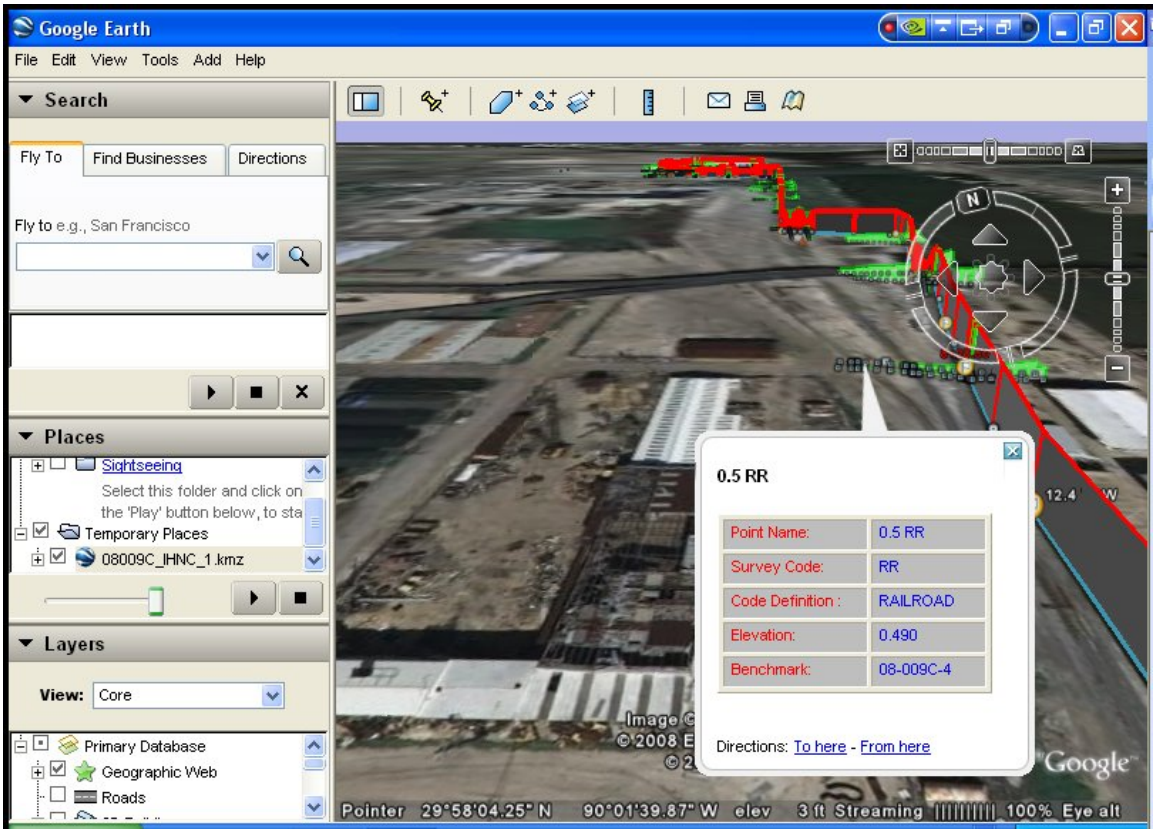

Figure 13 : Sample KML output file created by survey_to_kml. A cross-section point is highlighted, showing the point elevation, code, and other attributes.

In addition to survey data attributes, the KML file also contains the survey metadata. To see this metadata, click on the survey file in the "Places Panel". This will launch a window like the one shown in Figure 14.

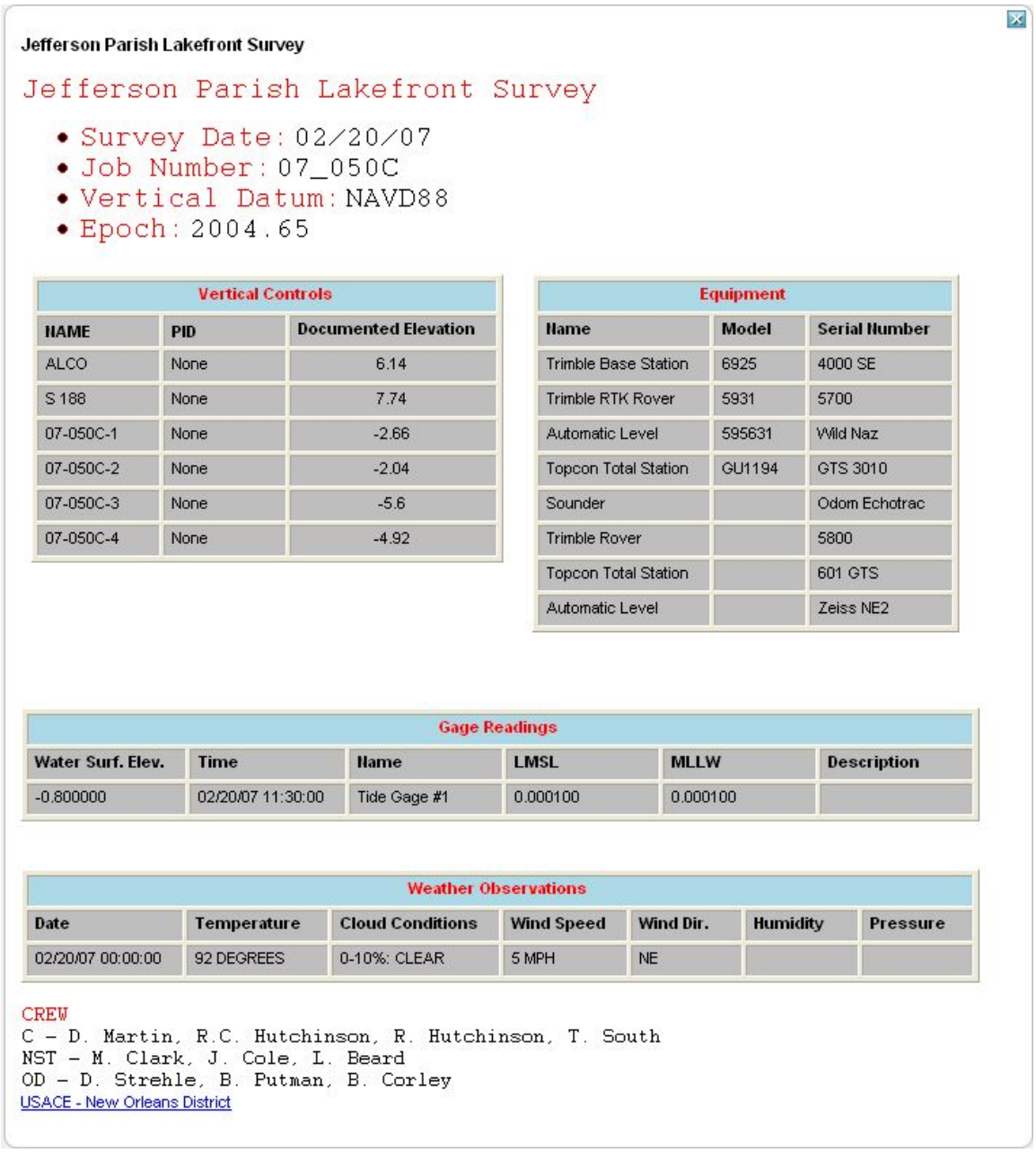

Figure 14 : KML Metadata Window. Clicking on the survey file layer in Google Earth opens this window.

6.3 survey_checker

The survey_checker program was created to provide a simple and quick method to check survey files of any type for file syntax or semantic errors. The survey_checker program also offers the option of generating shapefile and KML outputs (using survey_ogr and survey_to_kml) to visualize the survey data. Input to survey checker consists of a single survey file (EM, LMN830, or PRO). The program is interactive and will ask the user a series of yes or no questions about the outputs to generate. For example, running

```
survey_checker.exe C:\data\06-137C_Mississippi_River_Levee\5TH_LIDAR.EM
```

produces the following output:

```
US Army Corps of Engineers Survey Checker
$Revision: 6799 $Date: 2010-02-20 19:01:29 -0600 (Sat, 20 Feb 2010) $

checking 5TH_LIDAR.EM...
generate statistics text file [Y/N]?Y
open statistics text file [Y/N]?N
generate error log [Y/N]?Y
checking coordinate system id...[ok 102682]
checking coordinate bounds (survey points)...[ok]
checking coordinate bounds (benchmarks)...[##error : 2 invalid coordinate(s)]
checking coordinate bounds (gages)...[skip]
checking coordinate bounds (baselines)...[ok]
checking date...[ok]
checking horizonal datum...[ok]
checking coordinate system zone...[ok]
checking units of measure...[ok]
checking vertical datum...[ok]
checking horizontal epoch...[ok]
checking vertical epoch...[ok]
checking benchmark (N 367) condition...[ok]
checking benchmark (876 0849 A TIDAL) condition...[ok]
checking benchmark (C 195) condition...[##error : Invalid value '']
checking benchmark (D 370) condition...[ok]
view error log [Y/N]?N
generate map [Y/N]?Y
open map document (ArcGIS 9.0  or later required) [Y/N]?N
generate KML [Y/N]?Y
compressing output
view KML (Google Earth Required) [Y/N]?N
```

Depending on the user choices, the program will generate a series of files in the same directory as the input survey file. Output files include the following: a statistics file (<input_filename>.ref), an error file (<input_filename>.err), a survey_ogr data source (<input_filename>_svy directory), and a KML file <input_filename>.kmz. User must have permissions to write to the directory where the input file is located.

7.0 Change Log

1) 2.0.3
   a) Modified for use with ArcGIS 10.1.

2) 2.0.0
   a) Re-wrote the front-end of the application in C# to make it compatible with ArcGIS 10.
   b) Modified the metadata functionality to generate metadata in both FGDC metadata format and ArcGIS metadata format.

3) 1.6.5
   a) Fixed Convex Hull Calculation in survey_ogr.

4) 1.6.4
   a) Added VERTICAL UPDATE to Benchmark Conditions domain.
   b) Added NA2011 to Horizontal Epochs domain.
   c) Fixed profile stationing algorithm to work in the special case where no points from the baseline can be projected onto the centerline.

5) 1.6.3
   a) Added additional survey codes documented in Revision 4 of the EM09 format specification.

b) Reduced precision of Grid Azimuth, Geodetic Azimuth, and Lateral Offsets from four decimal places to three to prevent conflict with internal null representation, which uses four decimal places.

6) 1.6.2

a) Changed error for a cross-section that does not intersect a baseline to a warning.

7) 1.6.1

a) Added error message for gages that are missing time or water surface elevation.
b) Updated EM File Format specification.
c) Recompiled utilities (survey_ogr.exe, survey_checker.exe, and survey_to_kml.exe) with Python 2.5 (previous version was built with Python 2.4).

8) 1.6.0

a) Added “GridAzimuth” and “GeodeticAzimuth” attributes to cross-sections table. Grid Azimuth is the azimuth of the cross-section based on the native projection of the survey. Geodetic Azimuth is the calculation of the azimuth based on the survey’s spherical coordinates (latitude/longitude). Currently, the Geodetic Azimuth is only implemented for LMN830 files.
b) Added “BaselineIntersectX” and “BaselineIntersectY” properties to the cross-sections table. These values represent the coordinate where a cross-section intersects the survey’s associated baseline.
c) Added “BaselineOffset” attribute to cross-section points table. This value represents the distance from the intersection of the baseline and the cross-section to the point along the cross-section range line.
d) Added “RangeStartOffset” attribute to cross-section points table. This value represents the distance from the range line start point to the cross-section point along the range line.
e) Added “LateralOffset” attribute to cross-section points table. This value represents the distance from the cross-section point to the range line.
f) Fixed equipment descriptions in EM files.
g) Removed references to VTK in survey_ogr utility program.
h) Implemented hatching features for profiles and cross-section M-values.
i) Added support for area features in the survey_to_kml utility program.
j) Added support for Louisiana HARN for State Plane Zone 1702.

9) 1.5.0

a) Fixed to support metadata in ArcGIS 9.3.1
b) Fixed installer registration issues for Windows 7 and other windows systems that install programs in C:\Program Files (x86).
c) Added stationing calculation for EM profiles.
d) Fixed profiles. If a profile is missing a name, an error will no longer be generated and the profile starting northing and easting will be parsed.
e) Added benchmark references to gages.
f) Added missing profile descriptions in ArcGIS for EM files.
g) Added missing benchmark dates in ArcGIS for EM files.

10) 1.4.0

a) Added survey checker program.
b) Implemented support for EM09 specification.
c) Added support for most U.S. State Plane AND UTM Coordinate Reference Systems.
d) Added support for CODES.DAT file.
e) Added map document generation to survey_ogr.
f) Added progress monitoring and error logging to survey_ogr.

11) 1.3.1

a) Updated installer to support Windows XP 64bit operating system.

b) Fixed file handle leak for MVN Traverse files.
c) Fixed datum shift between NAD27 and NAD83 referenced data in survey_ogr and survey_to_kml utilities.

12) 1.3.0
a) Added benchmarks and gages to available feature classes.
b) Added edit mode to ArcCatalog Text View.
c) Removed display of empty feature classes in ArcCatalog and "Add Data" Dialog.
d) Added find and replace to ArcCatalog Text View.
e) Add 3D extrusion and labeling to survey_to_kml.
f) Added support for traverse input files to survey_to_kml.
g) Added "Station" attribute to profile points. Stationing is currently implemented for .PRO files.
h) Added more warnings if benchmark or gage records are duplicated in EM files.
i) Fixed rounding error of baseline point station field in survey_ogr.
j) Added tool to check for survey file syntax errors.
k) Added "Point Tag" column to survey point attribute table to capture string point ids.
l) Fixed miscellaneous shot points for non-#M01 records in EM file.
m) Implemented multiline miscellaneous shot point records in EM file.

13) 1.2.5
a) Stopped flagging empty #P01 and #M01 records as errors.

14) 1.2.4
a) Fixed EM gage records. (Gages will use the previously declared #G02 name.)

15) 1.2.0
a) Added auto-sorting of cross-sections based on the dot-product calculation of the #X01 record for EM surveys.
b) Fixed Text Tab to handle surveys larger than 64Kb.
c) Added survey code lookup functionality to domain table and survey point feature classes.
d) Added support for EM Baseline Surveys (.BL)
e) Added Local Mean Sea Level and Mean Lower Low Water Reference to vertical datum domain.
f) Corrected exported of survey files to maintain their Z values on vertices (previously exported as 0).
g) Added internal support for gages, equipment, field books, weather, and survey crews (through the programming interface) .
h) Added dates, vertical datum references, and vertical adjustments to survey point feature classes.
i) Fixed Copy and Rename of Survey Files in ArcCatalog.
j) Fixed handling of empty PRO files to prevent crashing.
k) Added beta versions of utility scripts survey_ogr and survey_to_kml.

16) 1.1.0
a) Added Metadata for Traverses
b) Reimplemented error log viewer as a treelist.
c) Removed spurious pop-ups of the error log during pan/zoom interaction in ArcMap.

17) 1.0.1
a) Made performance improvements
b) Added ArcMap example to documentation
c) Removed duplicate benchmarks from LMN830 metadata.

18) 1.0.0
a) Implemented EM support

b) Implemented LMN830 support
c) Implemented PRO support
d) Implemented MVN Traverse support
e) Added Metadata and survey stylesheet

8.0 Known Issues

- Exporting surveys from ArcCatalog does not work. (However, exporting from ArcMap works correctly.) This problem was found in ArcGIS versions 9.2, 9.3.1, 10.0, and 10.1.
- Multiple readings of the same gage have to include a preceding #G02 record. This behavior may change in the future.
- Traverse files will list traverse and traverse point feature classes in ArcCatalog, even if the traverse data file is empty. This behavior is different from the survey files, which will display no feature classes for an empty file.
- When a survey or traverse file is renamed, the feature class names will retain the old filename until the ArcMap/ArcCatalog session is closed. For example, one can rename AREA_B1.EM to AREA.BM, but the cross-sections will still be listed as AREA_B1 CrossSections.
- Renaming a survey file in ArcCatalog during an open edit session will copy the target survey file to the new filename, leaving an old copy of the survey with the previous filename.
- When Survey Drivers is used with the Survey Plot application, Survey Plot displays Vertical Units as “unknown”. The EM File specification indicates that the #H06 = Units of Measure is units for both horizontal and vertical component. Modify the metadata to display Vertical Units correctly.
- ArcCatalog may not immediately render changes when editing in ArcCatalog.
- When a single Benchmark contains more than one measured elevation, the first measured elevation is used and subsequent measured elevations are ignored.
- If a profile runs in the opposite direction from its associated traverse, it will not be stationed correctly.