



Implementation of a Web-GIS Application for the Turtle Mountain Monitoring Project in ArcGIS® Server 9.2

Implementation of a Web-GIS Application for the Turtle Mountain Monitoring Project in ArcGIS® Server 9.2

D.K. Chao¹, S. Chowdhury², F. Moreno¹ and C.R.
Froese¹

¹Alberta Geological Survey

²University of Lethbridge

March 2009

©Her Majesty the Queen in Right of Alberta, 2009
ISBN 978-0-7785-6970-1

Energy Resources Conservation Board/Alberta Geological Survey (ERCB/AGS) and its employees and contractors make no warranty, guarantee or representation, express or implied, or assume any legal liability regarding the correctness, accuracy, completeness or reliability of this publication. Any software supplied with this publication is subject to its licence conditions. Any references to proprietary software in the documentation, and/or any use of proprietary data formats in this release, do not constitute endorsement by ERCB/AGS of any manufacturer's product.

When using information from this publication in other publications or presentations, due acknowledgment should be given to ERCB/AGS. The following reference format is recommended:

Chao, D.K., Chowdhury, S., Moreno, F. and Froese, C.R. (2009): Implementation of a Web-GIS application for the Turtle Mountain Monitoring Project with ArcGIS® Server 9.2; Energy Resources Conservation Board, ERCB/AGS Open File Report 2009-05, 81 p.

Author address:

S. Chowdhury
University of Lethbridge
4401 University Drive
Lethbridge, AB T1K 3M4
E-mail: Subir.Chowdhury@uleth.ca

Published March 2009 by:

Energy Resources Conservation Board
Alberta Geological Survey
4th Floor, Twin Atria Building
4999 – 98th Avenue
Edmonton, Alberta
T6B 2X3
Canada
Tel: 780.422.3767
Fax: 780.422.1918
E-mail: AGS-Info@ercb.ca
Website: www.ags.gov.ab.ca

Contents

Acknowledgments.....	vi
Abstract.....	vii
1 Introduction.....	1
2 Application Design Overview.....	1
2.1 Toolset Panel.....	1
2.1.1 General GIS Functions.....	1
2.1.1.1 Navigation Tools.....	3
2.1.2 Advanced GIS Functions.....	3
2.1.2.1 Identify Tool.....	3
2.1.2.2 Description Tool.....	3
2.1.2.3 Query Tool.....	3
2.1.2.4 Select Feature(s).....	5
2.1.2.5 Charting Tool.....	5
2.1.2.6 Description Tool.....	6
2.1.2.7 3-D LiDAR Tool.....	8
2.2 Map Content.....	9
2.2.1 Historical Monitoring Points.....	9
2.2.1.1 Trilateral Points.....	9
2.2.1.2 Photogrammetric Plates.....	9
2.2.1.3 Moiré Crack Gauges.....	9
2.2.1.4 John Allan Stations.....	9
2.2.2 Sensor Networks.....	9
2.2.2.1 Weather Station.....	10
2.2.2.2 Prism Stations.....	10
2.2.2.3 Tiltmeters.....	10
2.2.2.4 Surface Microseismic Sensors.....	10
2.2.2.5 Extensometers.....	10
2.2.2.6 Differential GPS Monitoring Sites.....	10
2.2.2.7 Periodic GPS Points.....	10
2.2.2.8 Crackmeters.....	11
2.2.2.9 Borehole.....	11
2.2.3 Landslide Hazard.....	11
2.2.4 Geology.....	11
2.2.5 Other Categories.....	11
2.2.6 Images.....	11
2.3 Overview Map.....	11
2.4 Navigation.....	11
2.5 Map Display.....	12
3 Web ADF (Application Developer Framework) Architecture.....	12
3.1 ArcGIS® Server Architecture for Microsoft® .Net Framework.....	12
3.1.1 Web Controls.....	12
3.1.2 Task Framework.....	13
3.1.3 Common Data Source API.....	13
3.1.4 Web ADF Consolidation Classes and Graphics.....	13
4 Application Implementation.....	13
4.1 Hardware and Software Configurations.....	13
4.2 Installing Third-party Assemblies as Web ADF Controls.....	13
4.3 Customizing the Application Template.....	13
4.3.1 Replace Default.aspx File (default.aspx).....	15

4.3.2	Replace Default.aspx.cs File	15
4.3.3	Replace Configuration File (web.config)	15
5	Summary	15
6	References	17
	Appendices.....	18
	Appendix 1 – Default.aspx	18
	Appendix 2 – Default.aspx.cs.....	39
	Appendix 3 – WebMapApp.js.....	51
	Appendix 4 – Add Query Tool.....	61
	Appendix 5 – Add Select(s) Tool.....	63
	Appendix 6 – Floating Window for Displaying Results from Select Feature(s) and Query Tools.....	65
	Appendix 7 – Grid Results Control.....	66
	Appendix 8 – Add Dynamic Scale	71
	Appendix 9 – Add Description Tool	77
	Appendix 10 – Add Cortona VRML Viewer	80
	Appendix 11 – Add .netCharting Tool.....	81

Tables

Table 1. Functions of third-party assemblies used in the Turtle Mountain Monitoring Project Web-GIS. 14

Figures

Figure 1.	Turtle Mountain Monitoring Project Web-GIS user interface.....	2
Figure 2.	Results from the Identify tool.....	4
Figure 3.	Measure tool interface	3
Figure 4.	Query tool interface and Results table.....	5
Figure 5.	Select Feature(s) interface and Results table.....	6
Figure 6.	Charting interface for selecting a sensor network or a specific sensor.....	6
Figure 7.	Chart displaying historical data for an extensometer station.....	7
Figure 8.	Description tool: a collection of hyperlinks for detailed description of each sensor instrument... 8	8
Figure 9.	Virtual reality modelling language viewer capable of displaying and spinning a 3-D image.....	8
Figure 10.	Most of the ADF components reside solely on the web server	12
Figure 11.	Schematic design of the Turtle Mountain Monitoring Project Web-GIS application	14
Figure 12.	Open project in Visual Studio for adding the Grid Results Control.....	66
Figure 13.	Select an output location for the assembly	69
Figure 14.	Create an application name for the Charting tool.....	81

Acknowledgments

We thank our colleagues L.A. Pedersen, G. Hippolt-Squair and B. Fildes at Alberta Geological Survey, and S. Larden, A. Pond, H. Lee and D. Bobko from Energy Resources Conservation Board for their efforts to deploy this Web-GIS application.

Abstract

A Web-GIS application for the Turtle Mountain Monitoring Project has been created to enhance public awareness of the hazards and monitoring of the mountain, its effect on the surrounding communities, and efforts by the Alberta government to mitigate damage similar to that caused by the rockslide in 1903 that buried portions of the town of Frank. That event is now known as the ‘Frank Slide.’

This Web-GIS application was designed to create a user-friendly web interface for the public to display and manipulate available data on the area. These data, organized as map layers, include historical monitoring stations, sensor networks, bedrock geology, orthophoto and digital elevation model of Turtle Mountain, urban infrastructure and hydrography. They can turn on and off different map layers, navigate around the area of interest, retrieve data, and create charts with sensor readings.

Implementation of the design was a challenging exercise. It was our first attempt to create a customized Web-GIS application with ArcGIS[®] Server and Web Application Developer Framework (ADF) in Microsoft[®] .NET Framework. In addition, this application incorporates many GIS functions created by the user community, a non-GIS charting tool and a 3-D visualization utility. We gained considerable valuable experience during this development process. An overview of our application architecture and implementation is documented in the technical section, and source code of our main template and different tools are provided in the appendices.

1 Introduction

On April 29, 1903, a major rockslide occurred on the east face of Turtle Mountain in southwestern Alberta. The slide, now known as the 'Frank Slide,' killed more than 70 seventy people, destroyed the southern portion of the town of Frank and buried the entrance and surface workings of the Frank mine. At present, South Peak of the Turtle Mountain is still slowly moving toward the valley bottom, posing a geological hazard to the nearby communities. The Government of Alberta and a group of contractors have designed and installed a monitoring system, consisting of an array of sensors and instruments at strategic locations on South Peak and other portions of the mountain, to measure rock movements (Moreno and Froese, 2006). Readings are stored in a database for analysis.

A geographic information system (GIS) is a computer-based system for managing, storing, querying, analyzing, modelling and displaying map database information. When GIS data and functionality are made available over the Internet, the system is referred as Web-GIS.

Alberta Geological Survey (AGS) is using ArcGIS[®] Server and Web Application Developer Framework (ADF), developed by ESRI[®] in Microsoft[®] .NET Framework, to custom design a Web-GIS application for the Turtle Mountain Monitoring Project. This application is intended to provide public and government agencies with a bird eye's view of the area, including high-resolution images, information from previous hazard assessments, locations of settled areas, available geological information, extent of the 1903 rockslide and locations of monitoring equipment. These pieces of information are converted to a GIS dataset (ESRI shapefile format) and presented as map layers. Users can turn on or off each layer, navigate around the area using pan and zoom, query each layer spatially or by attributes stored in its database, obtain metadata, view the area in three dimensions (3-D), and create geotechnical graphs and plots with near-real-time and historical data.

With this Web-GIS application, the public can gain a better understanding of the geological hazard in the area, its effect on nearby communities and efforts to monitor future rockslide activities. Government officials and land-use planners can use the spatial analysis and modelling capabilities of the application for planning and other purposes.

2 Application Design Overview

The Web-GIS application for the Turtle Mountain Monitoring Project has four panels: toolset panels on the left; and Map Contents, Overview Map and Navigation on the right. A map display window is in the middle. There are links to other AGS web pages in the banner above the Map Contents panel (Figure 1). Most panels can be minimized by clicking the triangle at the right end of their title bars.

2.1 Toolset Panel

The toolset panel contains tools for performing General and Advanced GIS functions with map layers in the map display window. Users will select a tool based on its function.

Several functions in the toolbox were created by other users and posted on the ESRI Developer Network (ESRI, 2008c). They have been modified for this application.

2.1.1 General GIS Functions

General GIS functions include Navigation tools, a Help function on how to use this Web-GIS application and a Refresh function to redraw the map.

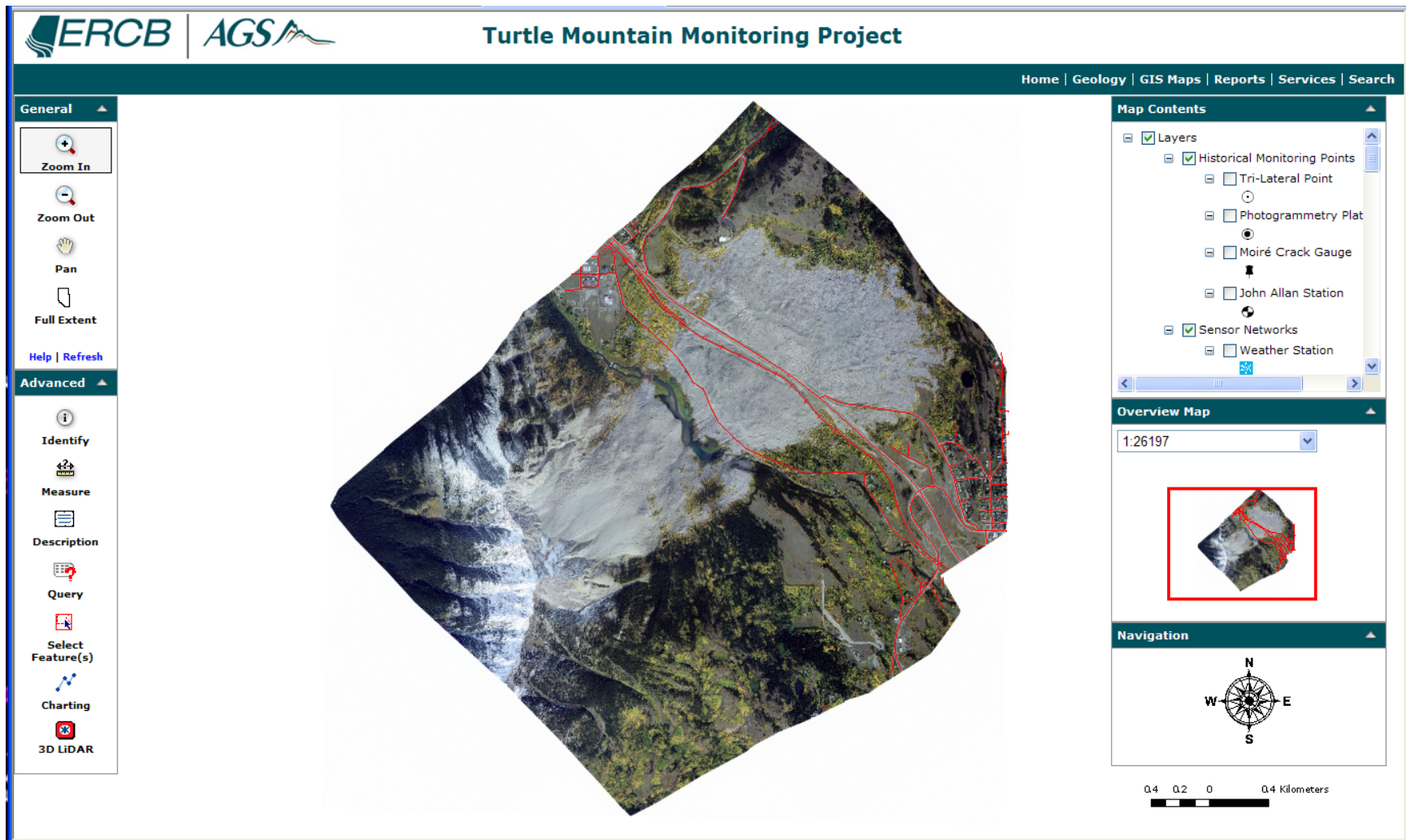


Figure 1. Turtle Mountain Monitoring Project Web-GIS user interface.

2.1.1.1 Navigation Tools

Navigation tools allow users to zoom in (Zoom In) and out (Zoom Out), move around (Pan) and reset back to original scale (Full Extent) in the map display panel. These are built-in tools.

2.1.2 Advanced GIS Functions

Advanced functions include Identify, Measure, Description, Query, Select Feature(s), Charting and 3-D LiDAR.

2.1.2.1 Identify Tool

When users select the Identify tool and click on the map, it retrieves information (attributes) belonging to all active layers at that location and displays them in the Results window (Figure 2). Users can turn on or off each layer in the Results window to highlight its features. Right-clicking a feature allows them to zoom or pan to that location, or remove that feature from the Results window. For example, in Figure 2, Blairmore Grp is a feature of the Bedrock Geology layer that is highlighted (darker green) in the map display window. Uncheck both boxes to remove highlight.

This is an ArcGIS Server built-in function. Measure Tool

The Measure tool displays the X and Y co-ordinates of a point location, calculates cumulative distance between locations and measures areas (Figure 3). To measure cumulative distance, users click at a starting point on the map and click at sequential locations. Each line segment measures the distance between current and previous locations, and the Total Length is the distance between current location and the starting point. The Measure tool supports both metric and imperial units.

This is a built-in function.

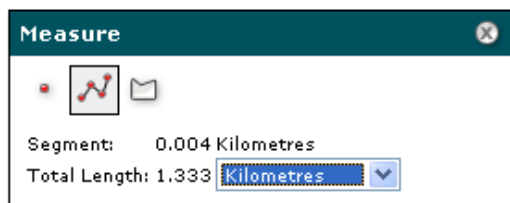


Figure 2. Measure tool interface.

2.1.2.2 Description Tool

The Description tool deploys a floating window that contains hyperlinks to detailed descriptions of sensor instruments, landside danger zones and LiDAR technology used for the monitoring application.

This tool has been modified from the built-in Magnify function.

2.1.2.3 Query Tool

The Query tool retrieves data for a map layer based on the user's defined criteria (Figure 4). Filtered data are displayed in a table (grid view). The 'Highlight feature' checkbox is used to highlight the corresponding feature on the map; the magnifying glass zooms to that location; and the 'Export all records' function saves the record as an Excel spreadsheet. The 'Select all' and 'Unselect all' functions check and uncheck the 'Highlight feature' checkbox. The 'Zoom to all' function zooms to an area that displays all selected records.

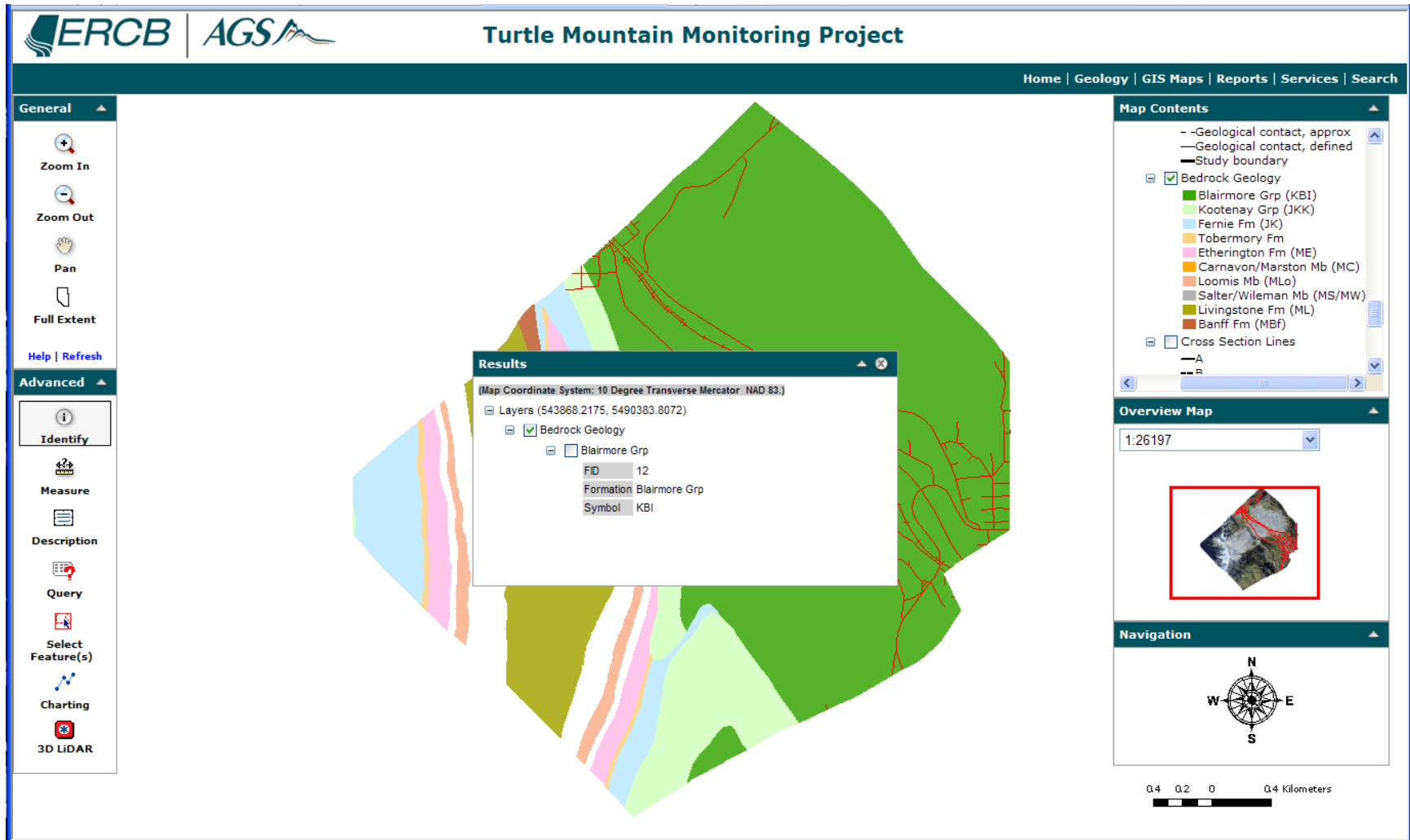


Figure 3. Results from the Identify tool: checkboxes are used for highlighting a feature in map display window.

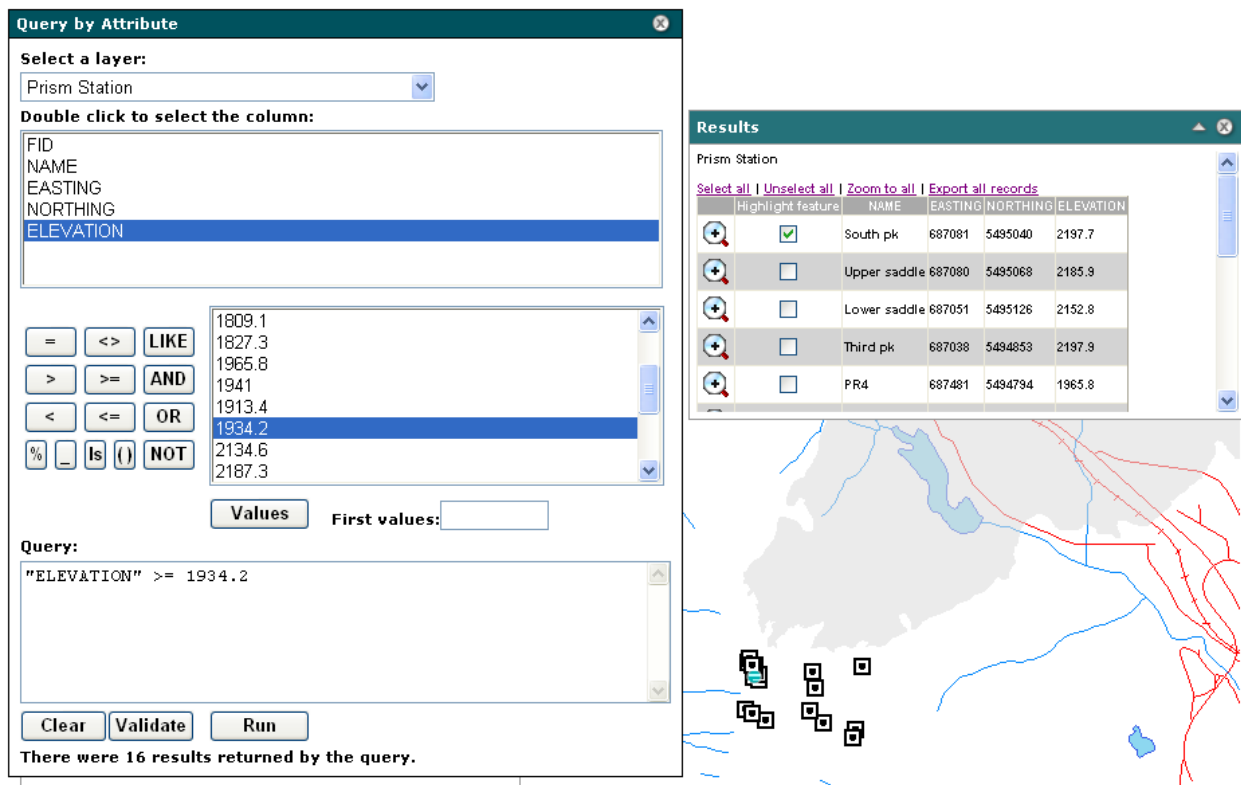


Figure 4. Query tool interface and Results table.

In Figure 4, a query was performed on the Prism Station layer where Elevation was greater than 1934.2 m. Sixteen stations matching the criteria were returned and their information displayed in the Results window. The first returned record is highlighted in blue on the map.

The Query tool was downloaded from the ESRI Support Center website (Ciavarella, 2008).

The Grid view function in the Result window was downloaded from the ArcGIS Server Development Blog website (Brenneman, 2008). It has been customized to include 'Export all records' function described above.

2.1.2.4 Select Feature(s)

Similar to the Query tool, the Select Feature(s) tool lets users select/retrieve records based on spatial criteria. After clicking on the tool, they select a map layer of interest and either click a location or draw a line, square, polygon or circle on the map display window. Information on those features included in the area of interest is retrieved and displayed in the Results window (Figure 5).

This tool was downloaded from ESRI Support Center website (Baker, 2007).

2.1.2.5 Charting Tool

The Charting tool is for viewing historical data collected by the sensor networks, or a specific sensor or station (Figure 6). When users select one of the sensor networks, a new browser window opens to display the corresponding chart generated with default values. They can reselect a station or sensor, starting date and number of recorded days to refresh the chart based on the new criteria (Figure 7).

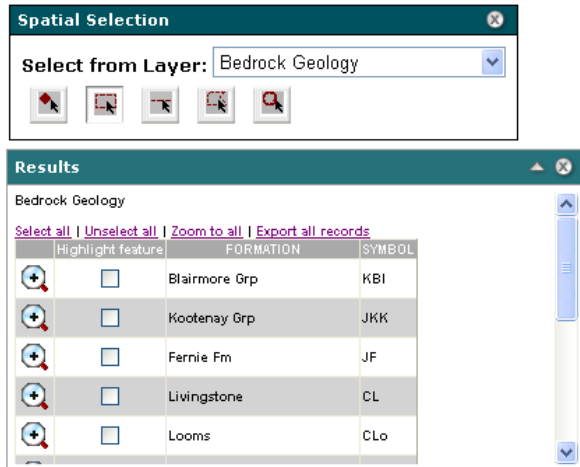


Figure 5. Select Feature(s) interface and Results table.

Alternatively, they can follow the instructions in the Dynamic Charting window (Figure 6) to view a chart for a specific sensor or station.

This tool was downloaded from the .netCharting website (webAvail Production, 2008). It has been modified for this application.

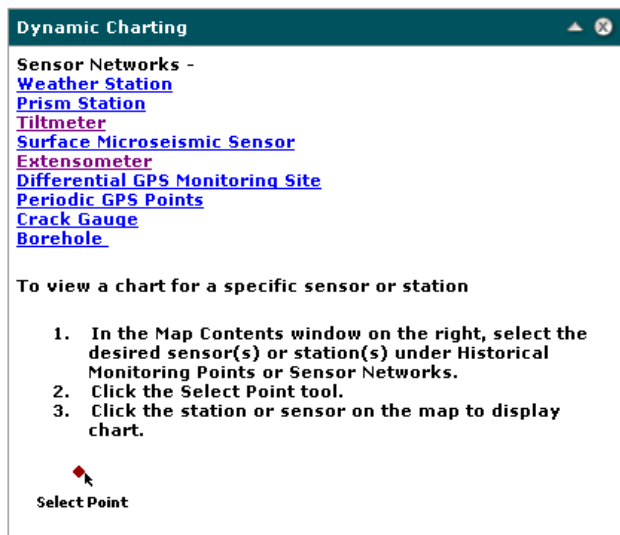


Figure 6. Charting interface for selecting a sensor network or a specific sensor.

2.1.2.6 Description Tool

The Description tool contains hyperlinks to web pages describing each sensor instrument in detail (Figure 8). These web pages are parts of the Turtle Mountain Monitoring Program home page, maintained by Alberta Geological Survey, and can be accessed directly at www.ags.gov.ab.ca/geohazards/turtle_mountain.

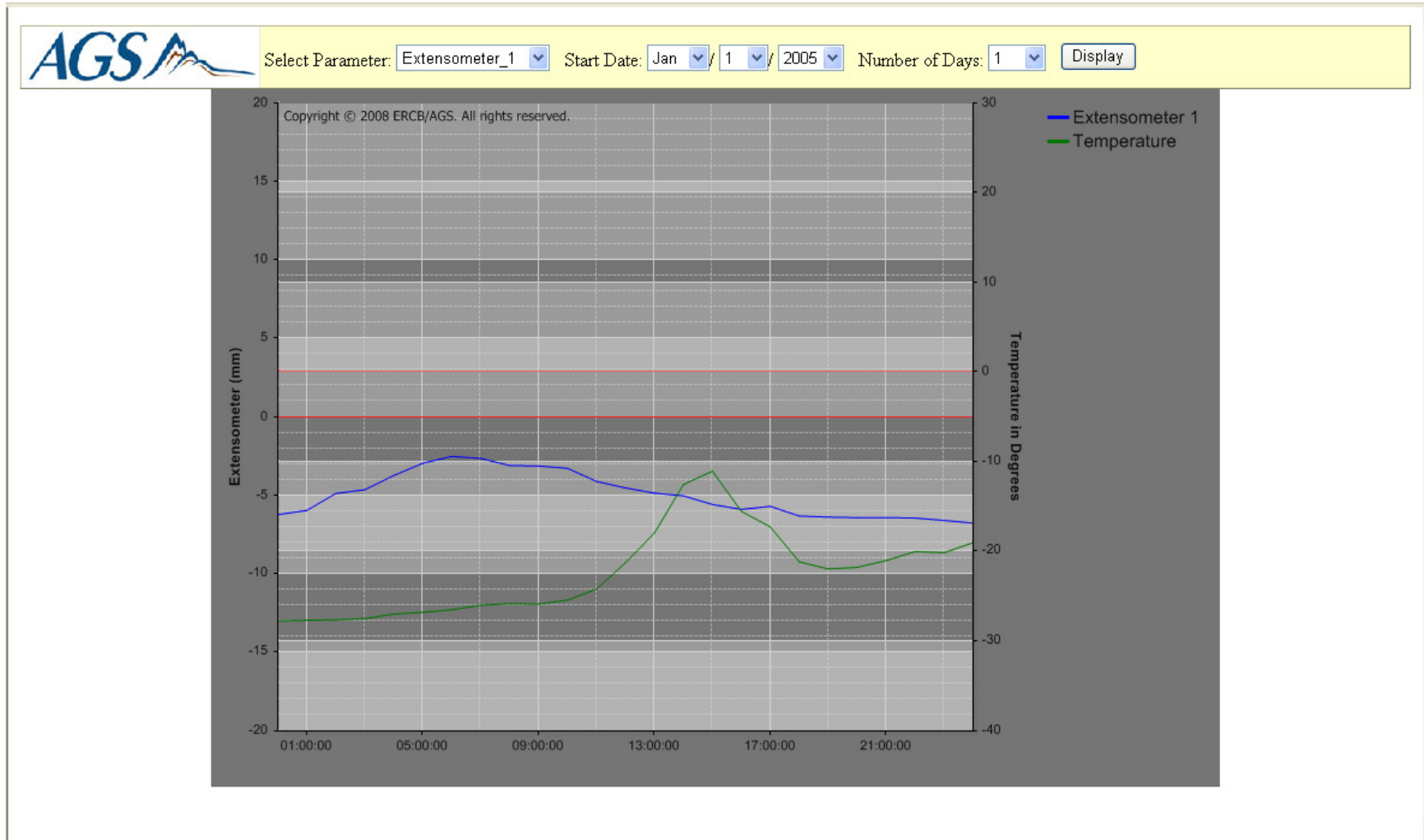


Figure 7. Chart displaying historical data for an extensometer station.

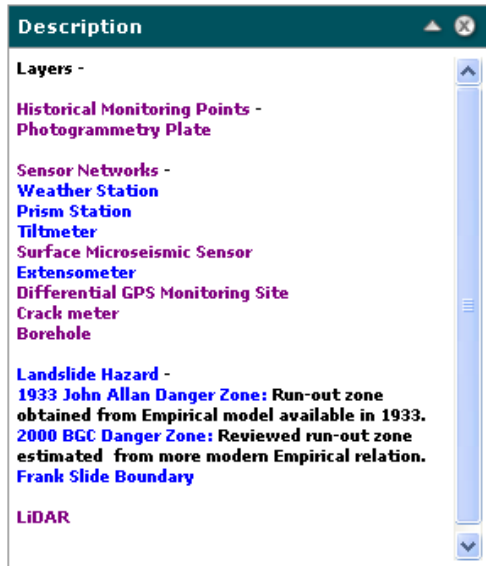


Figure 8. Description tool: a collection of hyperlinks for detailed description of each sensor instrument.

2.1.2.7 3-D LiDAR Tool

The 3-D LiDAR tool uses a virtual reality modelling language (VRML) viewer to display a detailed, 3-D model of Turtle Mountain created with LiDAR (Light Detection and Ranging) digital elevation model (DEM) data. This viewer can be used to zoom in and out or to rotate the model in any direction (Figure 9).

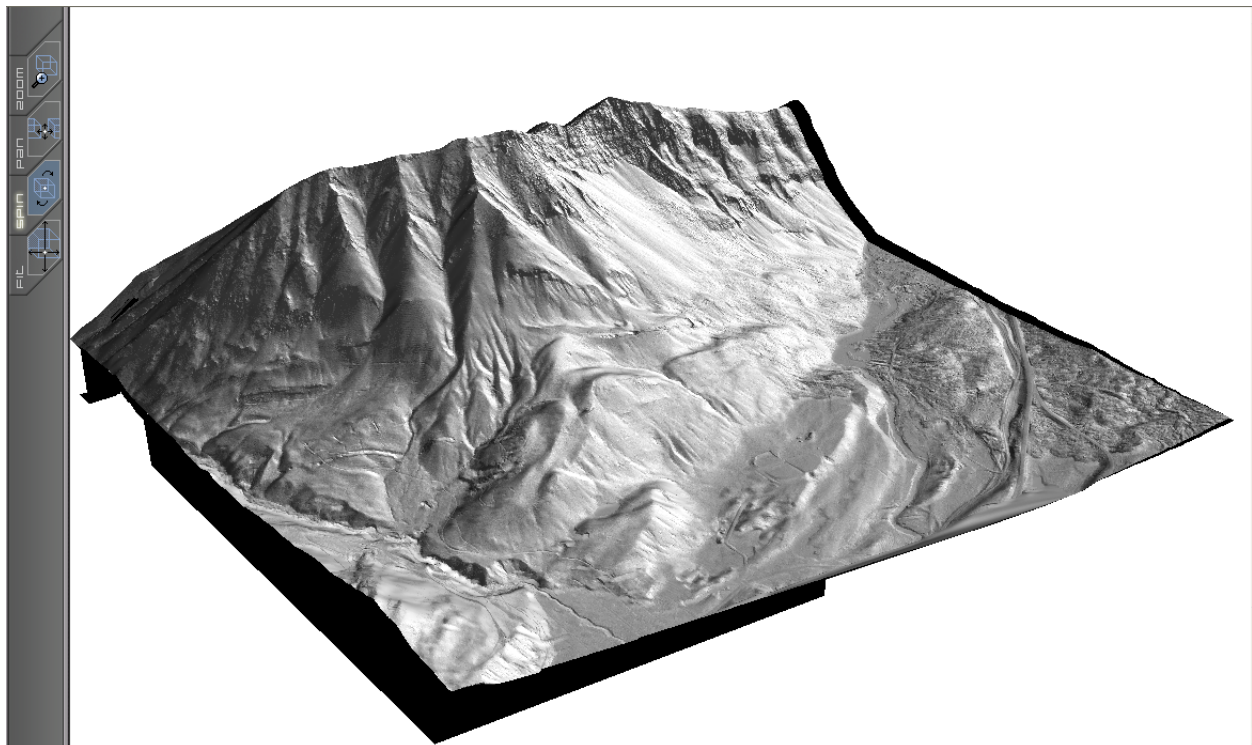


Figure 9. Virtual reality modelling language (VRML) viewer capable of displaying and spinning (rotate) a 3-D image.

A 3-D, hill-shaded LiDAR DEM, illuminated at 315° azimuth and 30° angle of elevation, was created in ArcGIS ArcScene and exported to VRML format to work with the VRML plug-in for the Internet. The viewer is a free Cortona VRML Client 5.1 plug-in by Parallel Graphics (2008).

2.2 Map Content

The Map Contents panel contains a list of GIS datasets presented as map layers. All GIS datasets are in ESRI shapefile format, with locations in Universal Transverse Mercator (UTM) Zone 11 and North American Datum (NAD) 83. Map layers are organized into seven categories: Historical Monitoring Points, Sensor Networks, Infrastructure and Urban Development, Hydrography, Landslide Hazard, Topography Contours, and Geology. Also included are two images: 3-D LiDAR Image and Frank Slide High-Resolution Image (colour orthophoto).

2.2.1 Historical Monitoring Points

The Historical Monitoring Points category contains the locations of monitoring points installed prior to the modern monitoring program. These include several installed in the 1980s (trilateral points, photogrammetric plates and Moiré crack gauges) and those marked by John Allan in 1933 (Allan, 1933). Only those locations that could be verified have been included. More information on all of the instruments and monitoring points described below has been provided by Moreno and Froese (2006, 2008a, b) and is available on the Turtle Mountain Monitoring Project website.

2.2.1.1 Trilateral Points

The trilateral points represent an array of 22 eyebolts embedded in the rock by the University of Alberta in the early 1980s (Kostak and Cruden, 1990). The information captured in the GIS dataset is their location identifier.

2.2.1.2 Photogrammetric Plates

The photogrammetric plates represent an array of 24 circular targets installed in 1981 by the Department of Survey Engineering at the University of Calgary (Fraser, 1983). They are targets that were used by low-level photogrammetric flights at the same scale and under the same constraints, so that the relative movements of the array could be determined using a point-movement-location procedure (Moreno and Froese, 2007). The information stored in the GIS dataset is their location identifier.

2.2.1.3 Moiré Crack Gauges

Two sets of Moiré crack gauges were installed in 1980 by Kostak (Kostak and Cruden, 1990). These gauges are used to show motion by changes in the Moiré fringe interference patterns produced by superimposed grids fixed to opposite sides of a crack (Kostak and Cruden, 1990). The information stored in the GIS dataset is their location identifier.

2.2.1.4 John Allan Stations

These are the monitoring points originally marked by John Allan of the Alberta Geological Survey in 1933 (Allan, 1933) on the fissures near the crest of the mountain to measure movements on either side of major cracks. By 2004, 13 of the 18 original stations had fallen (Moreno and Froese, 2006). Four locations have been included in the GIS dataset and the information stored is their location identifier.

2.2.2 Sensor Networks

Since 2003, a series of modern monitoring sensors has been installed on and around South Peak of Turtle Mountain. The sensor network provides a near-real-time data stream for 1) early warning of a failure on South Peak; 2) investigation of the mechanism for a failure of South Peak; and 3) an educational resource, for the public and researchers, regarding the conditions on the mountain (Moreno and Froese, 2006). It

includes a weather station, prism stations, tiltmeters, surface microseismic sensors, extensometers, differential GPS monitoring sites, periodic GPS sites and crack gauges. More information on these sensors and their attributes has been outlined in detail by Moreno and Froese (2006). Recordings of these sensors are captured, stored and managed in a Microsoft® Access database. The Charting tool (Section 2.1.2.6) is used to plot these data. Only the sensor locations are stored as GIS datasets.

2.2.2.1 Weather Station

A weather station was installed in 1981 on South Peak (Moreno and Froese, 2006). This station records temperatures (°C) of the rock mass, data logger and environmental enclosure; relative humidity (%); atmospheric pressure (kPa); precipitation (mm); wind speed (m/s) and direction (°E of N); and solar radiation (KJ/(m²•h).

2.2.2.2 Prism Stations

A series of 20 mirror prisms is installed on the South Peak and the eastern face of Turtle Mountain. Readings are taken of the locations of these prisms using an automated laser-ranging survey system (also known as an electronic distance measurement [EDM] system; Moreno and Froese, 2008a, b), located approximately 3 km away at the base of the valley. Information stored in the GIS dataset includes station identifier, station location in UTM northing and easting, and station elevation.

2.2.2.3 Tiltmeters

Tiltmeters are used for measuring angular deformation (or tilt) in the vertical plane (Moreno and Froese, 2006, 2007). There are ten tiltmeters on South Peak. Information stored in the GIS dataset includes each meter's identifier and serial number.

2.2.2.4 Surface Microseismic Sensors

Six surface-mounted passive seismic stations have been installed at different locations on the mountain to detect small seismic events occurring anywhere within the mass of the mountain (Moreno and Froese, 2006). These stations are no longer transmitting data.

2.2.2.5 Extensometers

Extensometers consist of a wire that extends across a series of fractures to measure how they pull apart. The wire is encased in a conduit and anchored at one end, with the other end attached to a sensitive meter that measures the distance (in mm) that the wire is stretched. There are five extensometers installed on South Peak (Moreno and Froese, 2006, 2008a, b).

2.2.2.6 Differential GPS Monitoring Sites

There are six differential global positioning system (dGPS) stations installed around South and Third Peaks. These stations use Earth-orbiting satellites to triangulate the location of these stations continuously and monitor how they move (Moreno and Froese, 2006). Information stored in the GIS dataset includes the location of each site and its elevation.

2.2.2.7 Periodic GPS Points

There are 15 monitoring points used to collect dGPS readings at least biannually, in order to detect and characterize displacements at these points (Moreno and Froese, 2006).

2.2.2.8 Crackmeters

Crackmeters consist of vibrating-wire strain gauges installed on either side of major cracks to measure changes in the width of the cracks. There are 20 crackmeters distributed in eight different groups (sets) spanning about 100 m (Moreno and Froese, 2006, 2008a, b).

2.2.2.9 Borehole

A borehole was drilled on the west side of the South Peak area to complement the monitoring data with subsurface information. It has a depth of 62.5 m and contains a thermistor string and a downhole seismic-monitoring sensor (Moreno and Froese, 2006, 2008a, b).

2.2.3 Landslide Hazard

Since the 1930s, there have been attempts to predict which downslope areas would be affected by a rock slide from the South Peak of Turtle Mountain. The landslide hazard category contains boundaries of danger zones identified by Allan (1933) and BGC Engineering (Moreno and Froese, 2008b), and the boundary of the Frank Slide (Moreno and Froese, 2008a, b).

2.2.4 Geology

The geology category provides lines and polygons associated with mapped geological features on Turtle Mountain, including a coal mine layer; a detailed bedrock geology layer; detailed structural geological features such as thrust faults, coal seams, anticlines, synclines, overturned synclines and geological contact boundaries; bedding locations recorded in 2004 and 2005; and cross-section lines constructed for the geological study published by the Alberta Geological Survey (Langenberg et al., 2007).

2.2.5 Other Categories

Other categories contain base feature layers such as hydrography, topography and urban infrastructure.

2.2.6 Images

Two raster images—a 3-D LiDAR DEM and a colour orthophoto of Turtle Mountain—provide a more realistic background of the area. They further illustrate strategic locations of the sensor networks.

The 3-D LiDAR DEM was created using ESRI's ArcGIS and 3D Analyst with 1 m bare-earth LiDAR data and illumination settings of 315° azimuth and 30° elevation. Since it is a 3-D rendering of a DEM, the values shown in the Map Content panel are scales of grey rather than true elevation values.

The 0.5 m resolution colour orthophoto is a result of merging a 20 cm colour orthophoto and a 2 m DEM acquired by the Geological Survey of Canada in 2002. It clearly shows the scar created by the landslide in 1903 and the extent of its rock debris, both in light grey.

2.3 Overview Map

The Overview Map works with navigation tools. The shaded red box in the Overview Map panel represents the zoom window in the map display panel. Users can zoom in and out by specifying a map scale in the dropdown menu, and the red box will resize accordingly. They can also move the red box around for panning.

2.4 Navigation

The compass rose represents true geographic north and also functions as a pan tool. Clicking on the side of the rose toward which a user wishes to pan causes the map display to move in that direction.

2.5 Map Display

The map display is the focal point of the application. Supported by the Toolsets, Map Contents, Overview Map and Navigation functions, it provides users with a bird's eye view of Turtle Mountain. By adding and removing map layers, they can visualize and appreciate the potentially dangerous relationship between the geological hazards of Turtle Mountain and its nearby communities.

3 Web ADF (Application Developer Framework) Architecture

3.1 ArcGIS® Server Architecture for Microsoft® .Net Framework

The Turtle Mountain Monitoring Project Web-GIS application was developed using ArcGIS® Web ADF for Microsoft® .Net Framework. It is a set of developer tools that includes web controls, classes, frameworks and application programming interfaces (APIs) for building web applications in Visual Studio. The Web ADF is built on top of the Microsoft .Net Framework and leverages many capabilities provided with ASP.Net 2.0, such as the callback framework and embedded resources.

The Web ADF has four distinct components working in conjunction with one another:

- Web Controls or Web ADF controls
- Task Framework
- Common Data Source API
- Web ADF consolidation classes and graphics (Figure 10)

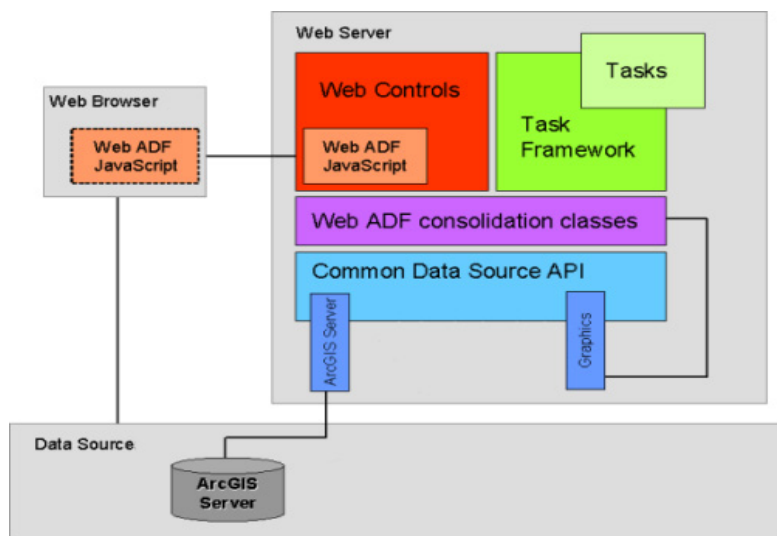


Figure 10. Most of the ADF components reside solely on the web server (modified from ESRI, 2008a).

3.1.1 Web Controls

Web ADF Controls leverage the Common Data Source API to interact with multiple sources of data as resources. These resources are managed by a set of 'resource managers' controls. Other controls consume the managed resource directly or via another control. For example, in Figure 11, the Map Resource Manager interacts with Main Map (Core Web Control), Query by Attribute Task (Task Web Control), Query (Core Web Control) and Grid Results (Task Framework Web Control) to create a listing of data for export.

3.1.2 Task Framework

Web ADF Task Framework enables the developer to integrate and deploy custom functionality as a ‘Web Task’ in a Web ADF application. ‘Web Task’ is a web control that encapsulates a set of related actions to generate results. In the Turtle Mountain application, Query and Select Feature(s) functions are custom ‘Web Tasks’.

3.1.3 Common Data Source API

Common Data Source API allows the developer to integrate and interact data from different data sources at the same time, in the same application. Web ADF Controls use this capability to interact with other controls.

3.1.4 Web ADF Consolidation Classes and Graphics

Web ADF Consolidation Classes and Graphics determine how map layers and their symbols should display by enforcing their geometry types (point, line and polygon), renderings and symbols. It also interacts with other controls, such as Select Feature(s), to enable spatial selections.

Refer to the ESRI Developer Network web page (ESRI, 2008a, b) for full documentation on Web Application Developer Framework.

4 Application Implementation

4.1 Hardware and Software Configurations

At Alberta Geological Survey, ArcGIS Server components such as SOM, SOC and .Net Framework ADF Runtime are installed on a dedicated server for deploying all Web-GIS applications, including this Turtle Mountain Monitoring Project. The remaining components, such as .Net Framework ADF Developer Kit and Visual Studio 2005, are installed on several ArcGIS Desktop workstations used for developing Web-GIS applications. These workstations are referred as the Data Server in ArcGIS Server documentation.

4.2 Installing Third-party Assemblies as Web ADF Controls

Several GIS functions in the Turtle Mountain Web-GIS application toolset, specifically Select Feature(s), Query and grid results, have been downloaded from the ESRI Download Center and the ESRI Blog website as Microsoft Windows assemblies (.dll), ArcScript and/or C# files. To develop and deploy these functions, **their assemblies must be installed in the C:\windows\assembly folder on both the ArcGIS Server and the desktop workstations, and IIS (Internet Information Services) must be restarted from the Administrative Tools.** These assemblies become .NET Framework Components in Visual Studio 2005 for developing applications. As such, they are also needed when deploying this application on the ArcGIS Server. Each function and its assembly is listed in Table 1.

4.3 Customizing the Application Template

When redesigning the template for this Turtle Mountain Monitoring Project application, we wanted it to be as user friendly as possible without sacrificing its GIS functionalities. We also wanted to include several GIS functions that were lacking in the default template. Because of several template designs and interval reviews, this final template will be used not only for this application but for the general AGS web-application interface.

It is beyond the scope of this report to describe in detail how this template was designed and implemented in Visual Studio, beyond the fact that it was a programming exercise in C#. We have, however, included all scripts as appendices to the report and will detail how they are incorporated into the template. A default web application must be created first and then all default files replaced with modified ones.

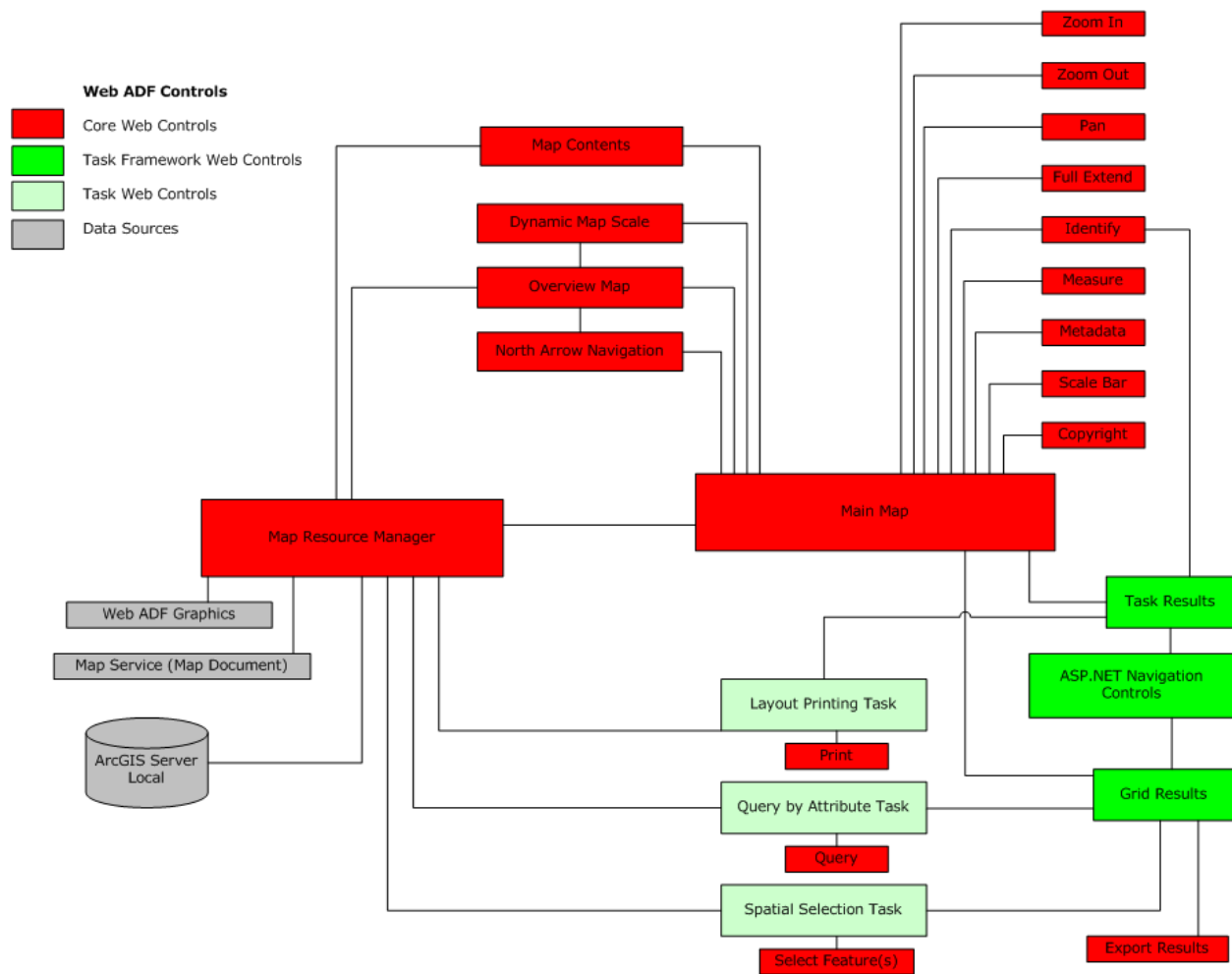


Figure 11. Schematic design of the Turtle Mountain Monitoring Project Web-GIS application, showing the relationship between 'resource manager' controls and their related GIS tools and functions.

Template customization includes the following steps:

- 1) Replace the default versions of the Default.aspx and Default.aspx.cs files with the new code in Appendices 1 and 2, respectively. These three files define the new template layout, and manage and maintain relationships between all GIS and .Net components.
- 2) Replace the parameters for <Identity> in the web.config file to avoid a configuration error in the web browser.

Table 1. Functions of third-party assemblies used in the Turtle Mountain Monitoring Project Web-GIS.

Function	ADF Control	Assembly
Query	Task Web Control	Sudioat.ARCGIS.ADF.Tasks.QueryBuilderTask.dll
Select Feature(s)	Task Web Control	SelectToolTask.dll
Grid Results	Task Framework Web Control	gridResults.dll

- 3) Replace the default version of the WebMapApp.js file with the new code in Appendix 3 to rearrange the Map Content, Navigation toolset and Results panels from left justified to both sides of the map display.
- 4) Modify the default version of the Magnifier function to create a floating window for displaying results from the Query, Select Features and Identify tools (Appendices 4, 5 and 6, respectively).
- 5) Create a new Grid Results Control to display and export results from queries (Appendix 7).
- 6) Add a Dynamic Scale inside the overview map (Appendix 8).
- 7) Add the Description (Appendix 9), view 3D LiDAR (Appendix 10) and Charting (Appendix 11) tools.

4.3.1 Replace Default.aspx File (default.aspx)

Default.aspx is the main file. Along with web.config, it contains code defining the template layout, and manages and maintains relationships between all GIS and native .Net Framework components. Replace the default file with the code in Appendix 1.

4.3.2 Replace Default.aspx.cs File

Replace the default source code with the code in Appendix 2 to exclude the default toolset panel and add Result panels for task results and grid results.

4.3.3 Replace Configuration File (web.config)

The standard ASP.NET configuration file stores references of all assemblies and the identity of the ArcGIS Server local data source used in web applications. Replace the default <identity> with the following code to avoid a configuration error in the web browser.

```
<identity impersonate="true" userName="your username" password="your password" />
```

5 Summary

It has been a good learning experience to design and implement the Web-GIS application for the Turtle Mountain Monitoring Project with ArcGIS[®] Server and Web ADF in Microsoft[®] .NET Framework. We have gained valuable insight on this technology and identified its strengths and weaknesses for our application.

The strengths are the flexibility of these tools for developing an application in the .NET environment and the extensive support available from the user community. The Web ADF tool allows us to integrate other .NET applications, such as .NetCharting for plotting sensor data in the Web-GIS application. We are able to select a particular sensor from a sensor layer and pass its identifier to .NetCharting to plot its readings. Alternatively, we can select a sensor network and plot the readings of an individual sensor within the network.

There is a wealth of information available, ranging from documentation and discussion forums to code exchange in the ESRI Developer Network. This was the primary site for our research during our application development. We have included and modified code such as Grid Result Control, shared by the user community in our application.

The weakness lies in its .NET programming. Unlike the ArcIMS that this technology is replacing, there is a very steep learning curve to develop a customized Web-GIS application for the Internet. There is a great

deal to learn about .NET programming and ArcGIS Server's object library, and it could be extremely frustrating when debugging errors. In comparison, ArcIMS was much easier to customize for rapid deployment.

6 References

- Allan, J.A. (1933): Report on stability of Turtle Mountain, Alberta and survey of fissures between North Peak and South Peak; Alberta Department of Public Works, Alberta Provincial Archives, 28 p.
- Baker, B. (2007): Select tool task from Web ADF; ESRI Support Center, URL
<<http://arcscrips.esri.com/details.asp?dbid=15133>> [January 27, 2009].
- Brenneman, T. (2008): Displaying task results in a table; ArcGIS Server Blog, URL
<<http://blogs.esri.com/Dev/blogs/arcgisserver/archive/2007/10/24/Displaying-task-results-in-a-table.aspx>> [January 27, 2009].
- Ciavarella, D. (2008): Query Builder Task sp4; ESRI Support Center, URL
<<http://arcscrips.esri.com/details.asp?dbid=15292>> [January 27, 2009].
- ESRI (2008a): What is the Web Application Developer Framework?; ESRI Developer Network, Developing Web Applications with the Web ADF, URL
<http://edndoc.esri.com/arcobjects/9.2/NET_Server_Doc/developer/ADF/adf_overview.htm> [January 27, 2009].
- ESRI (2008b): Web controls; ESRI Developer Network, Developing Web Applications with the Web ADF, URL
<http://edndoc.esri.com/arcobjects/9.2/NET_Server_Doc/developer/ADF/control_overview.htm> [January 27, 2009].
- ESRI (2008c): ESRI Developer Network; ESRI, URL
<<http://edn.esri.com/index.cfm?fa=home.welcome>> [January 27, 2009].
- Fraser, C.S. (1983): Deformation of Turtle Mountain by high precision photogrammetry; Alberta Environment Research Management Division, Report L0-83, 43 p.
- Kostak, B and Cruden, D.M. (1990): The moiré crack gauges on the crown of Frank Slide; Canadian Geotechnical Journal, v. 27, p. 835–840.
- Langenberg, C.W., Paná, D., Richards, B.C., Spratt, D.A. and Lamb, M.A. (2007): Structural geology of the Turtle Mountain area near Frank, Alberta; Alberta Energy and Utilities Board, EUB/AGS Earth Sciences Report 2007-03, 46 p.
- Moreno, F. and Froese, C.R. (2006): Turtle Mountain field laboratory monitoring and research summary report, 2005; Alberta Energy and Utilities, EUB/AGS Earth Sciences Report 2006-07, 84 p.
- Moreno, F. and Froese, C.R. (2008a): Turtle Mountain Field Laboratory: 2006 data and activity summary; Energy Resources Conservation Board, ERCB/AGS Open File Report 2008-01, 85 p.
- Moreno, F. and Froese, C.R. (2008b): Turtle Mountain Field Laboratory: 2007 data and activity summary; Energy Resources Conservation Board, ERCB/AGS Open File Report 2008-07, 40 p.
- ParallelGraphics (2008): Cortona VRML Client; ParallelGraphics, URL
<<http://www.parallelgraphics.com/products/cortona>> [January 27, 2009].
- webAvail Productions Inc. (2008): .netCharting; webAvail Productions Inc.,
<<http://www.dotnetcharting.com/>> [January 27, 2009].
- Wikimedia Foundation Inc. (2008): Web.config; *in* Wikipedia, Wikimedia Foundation Inc., URL
<<http://en.wikipedia.org/wiki/web.config>> [January 27, 2009].

Appendices

Appendix 1 – Default.aspx

Default.aspx generates a customized Web-GIS interface based on AGS design specifications. Together with Default.aspx.cs, WebMapApp.js and Web.config files, it manages all navigation and GIS functions by calling or referencing their components.

```
<%-- ERCB/AGS Web Mapping Application Template --%>
<%-- Developed by the Alberta Geological Survey --%>
<%-- Copyright © 2008 ERCB/AGS. All rights reserved. --%>

<%@ Page Language="C#" AutoEventWireup="true" CodeFile="Default.aspx.cs" Inherits="WebMapApplication"
Culture="Auto" %>

<%@ Register Assembly="gridResults, Version=1.3.1.0, Culture=neutral, PublicKeyToken=4117b0729e6ae73a"
Namespace="esri_samples" TagPrefix="esri_samples" %>
<%@ Register Src="SetScale.ascx" TagName="SetScale" TagPrefix="ss" %>
<%@ Register Assembly="ESRI.ArcGIS.ADF.Web.UI.WebControls, Version=9.2.4.1420, Culture=neutral,
PublicKeyToken=8fc3cc631e44ad86" Namespace="ESRI.ArcGIS.ADF.Web.UI.WebControls" TagPrefix="esri" %>
<%@ Register Assembly="ESRI.ArcGIS.ADF.Tasks, Version=9.2.4.1420, Culture=neutral,
PublicKeyToken=8fc3cc631e44ad86" Namespace="ESRI.ArcGIS.ADF.Tasks" TagPrefix="esriTasks" %>
<%@ Register Src="Measure.ascx" TagName="Measure" TagPrefix="uc1" %>
<%@ Register Assembly="Studioat.ARCGIS.ADF.Tasks.QueryBuilderTask, Version=9.2.4.1420, Culture=neutral,
PublicKeyToken=f96bdf56e497392b" Namespace="Studioat.ARCGIS.ADF.Tasks.QueryBuilderTask"
TagPrefix="ccQueryBuilderTask" %>
<%@ Register Assembly="SelectToolTask, Version=1.0.0.0, Culture=neutral, PublicKeyToken=9eb0bc47879e56ec"
Namespace="SelectToolTask" TagPrefix="cc1" %>

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-
transitional.dtd">

<html xmlns="http://www.w3.org/1999/xhtml" >
<head id="Head1" runat="server">
    <meta content="text/VBScript" http-equiv="content-script-type" />
    <title>Turtle Mountain Web Mapping Application</title>
</head>

<body style="margin: 0px 0px 0px 0px; background-color: white; width: 100%; font-family: Verdana; font-
size: 8pt; color: #A9A9A9; position: static; overflow: auto;" bgproperties="fixed" >
```



```
<esri:Map ID="Map1" runat="server" MapResourceManager="MapResourceManager1" style="POSITION: absolute;
overflow: hidden; " Height="100%" Width="100%" PrimaryMapResource="Layers" BackColor="White"
BorderColor="White" InitialExtent="Full" ImageBlendingMode="WebTier" >
</esri:Map>
```

```
<%-- Description Panel --%>
<esri:FloatingPanel ID="Metal" runat="server" BackColor="White" BorderColor="Black" BorderStyle="Outset"
BorderWidth="1px" Docked="False" Font-Bold="False" Font-Names="Verdana" Font-Size="7pt" ForeColor="Black"
Height="296px" Style="left: 26%; overflow: auto; position: absolute; top: 21%" Title="Description"
TitleBarColor="#00525E" TitleBarForeColor="White" TitleBarHeight="20px" Transparency="0" Visible="False"
Width="287px">
<span style="font-size: 7pt"><span style="background-color: white"><span><span>Layers -
<br />
<br />
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/turtle_mountain.html"
target="_blank">Historical Monitoring Points</a>-<br />
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/photogrammetry.html"
target="_blank">Photogrammetry Plate </a>
<br />
</span>
<br />
</span></span><span style="background-color: white"><span><span>
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/sensor_network.html" target="_blank">Sensor
Networks</a>
-<br />
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/weather_station.html" target="_blank">Weather
Station</a>
<br />
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/laser_ranging.html"
target="_blank">PrismStation</a>
<br />
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/tiltmeters.html" target="_blank">Tiltmeter</a>
<br />
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/seismic_monitoring.html"
target="_blank">Surface Microseismic Sensor</a>
<br />
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/surface_extensometers.html"
target="_blank">Extensometer</a>
<br />
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/dgps.html" target="_blank">Differential GPS
Monitoring Site</a>
```

```

<br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/crackmeter.html" target="_blank">Crack
meter</a>
<br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/thermistors.html" target="_blank">Borehole</a>
<br />
<br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/runout_modelling.html"
target="_blank">Landslide Hazard</a> -<br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/runout_modelling.html" target="_blank">1933
John Allan Danger Zone:</a> Run-out zone obtained from Empirical model availablein 1933.&nbsp;<br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/runout_modelling.html" target="_blank">2000
BGC Danger Zone:</a> Reviewed run-out zone estimated&nbsp;    from more modern Empirical relation.<br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/frank_slide.html" target="_blank">Frank Slide
Boundary</a>
<br />
</span>
</span><span><span><br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/lidar.html" target="_blank">LiDAR</a><br />
<br />
</span>
<br />
</span></span></span>
</esri:FloatingPanel>

<!-- 3D Model Panel -->
<esri:FloatingPanel ID="t3d" runat="server" BackColor="White" BorderColor="Black" BorderStyle="Outset"
BorderWidth="1px" Docked="False" Font-Bold="False" Font-Names="Verdana"
Font-Size="7pt" ForeColor="Black" Height="142px" HeightResizable="False" Style="left: 26%; position:
absolute; top: 28%; font-size: 7pt; color: black; font-style: normal; font-family: verdana; font-variant:
normal;" Title="3D Model" TitleBarColor="#00525E" TitleBarForeColor="White" TitleBarHeight="20px"
Transparency="0" Visible="False" Width="340px" WidthResizable="False">
<span style="font-family: Verdana">
<span><strong>A VRML plug-in will install automatically for Internet Explorer. You must manually install it
for Firefox and Netscape.</strong></span>
<p><span><strong><a href="VRML.htm" target="_blank"><strong>View with Internet Explorer</strong>
</a></strong></span>
<span><strong></strong></span></p>
<p><span><strong><a href="http://turtle.ag.s.gov.ab.ca/Turtle_Mountain/VRML/TM_3d.wrl" target="_blank">View
with &nbsp;   Firefox or Netscape</a></strong></span></p>

```

<p>Install plug-in for Firefox and Netscape</p></esri:FloatingPanel>

```
<%-- Grid Results Panel --%>
<esri:FloatingPanel ID="Results1" runat="server" BackColor="White" BorderColor="Black" BorderStyle="Outset"
BorderWidth="1px" Docked="False" Font-Bold="False" Font-Names="Verdana" Font-Size="7pt" ForeColor="Black"
Height="194px" HeightResizable="True" Style="left: 26%;margin-bottom: 0px; position: absolute; top: 35%"
Title="Results" TitleBarColor="#00525E" TitleBarForeColor="White" TitleBarHeight="20px"
TitleBarSeparatorLine="True"Transparency="0" Visible="False" Width="416px">
<span style="font-size: 6.5pt; color: red"><span style="color: #000000"></span><span style="background-
color: #cccccc"><span style="font-size: 7pt; color: #000000"></span></span></span></span>
<esri:samples:gridResults ID="GridResults1" runat="server" BackColor="White" BorderColor="Black"
BorderStyle="None" Font-Names="Arial" Font-Size="7pt" ForeColor="Black" Height="100%" Map="Map1"
Style="clear: right; left: 0px; overflow: auto; position: absolute; top: 0px" Visible="True" Width="100%"
/>
</esri:FloatingPanel>
```

```
<%-- Task Results Panel --%>
<esri:FloatingPanel ID="Results" runat="server" BackColor="White" BorderColor="Black" BorderStyle="Outset"
BorderWidth="1px" Docked="False" Font-Bold="False" Font-Names="Verdana"
Font-Size="7pt" ForeColor="Black" Height="194px" HeightResizable="True" Style="left: 33%; margin-bottom:
0px; position: absolute; top: 41%" Title="Results" TitleBarColor="#00525E" TitleBarForeColor="White"
TitleBarHeight="20px" TitleBarSeparatorLine="True"
Transparency="0" Visible="False" Width="416px">
<span style="font-size: 6.5pt; color: red"><span style="color: #000000"></span>
<span style="background-color: #cccccc"><span style="font-size: 7pt; color: #000000"></span>
</span></span>
<esri:TaskResults ID="TaskResults1" runat="server" BackColor="#ffffff" BorderColor="WhiteSmoke"
ExpandDepth="3" Font-Bold="False" Font-Names="Arial" Font-Size="8pt" ForeColor="#000000"
Height="92%" Map="Map1" ShowClearAllButton="True" Style="left: 0px; overflow: auto; position: absolute;
top: 17px" Width="100%" />
<span style="font-family: Arial"><span style="background-color: #cccccc"><span style="font-size: 7pt">
(Map CoordinateSystem: 10 Degree Transverse Mercator &nbsp;&nbsp;&nbsp;NAD 83.)</span></span></span>
</esri:FloatingPanel>
&nbsp;&nbsp;&nbsp;
```

```
<esri:FloatingPanel ID="charting" runat="server" BackColor="White" BorderColor="Black"
BorderStyle="Outset" BorderWidth="1px" Docked="False" Font-Bold="False" Font-Names="Verdana"
Font-Size="7pt" ForeColor="Black" Height="277px" HeightResizable="False" Style="left: 39%;
margin-bottom: 0px; position: absolute; top: 48%" Title="Dynamic Charting" TitleBarColor="#00525E"
TitleBarForeColor="White" TitleBarHeight="20px" TitleBarSeparatorLine="True"
```



```

mso-bidi-font-family: Verdana"><span style="mso-list: Ignore">2.<span style="font: 7pt 'Times New Roman'">
&nbsp; &nbsp; &nbsp; &nbsp;
</span></span></span><span style="font-size: 7pt; font-family: Verdana">Click the <span style="font-family:
Verdana">SelectPoint</span> tool.<o:p></o:p>
</span>
</p>
<p class="MsoNormal" style="margin: 0in 0in 12pt 0.75in; text-indent: -0.25in; mso-margin-top-alt: auto;
mso-list: l0 level1 lfol; tab-stops: list .75in">
<span style="font-size: 7pt; font-family: Verdana; mso-fareast-font-family: Verdana; mso-bidi-font-family:
Verdana"><span style="mso-list: Ignore">3.<span style="font: 7pt 'Times New Roman'">
&nbsp; &nbsp; &nbsp; &nbsp;
</span></span></span><span style="font-size: 7pt; font-family: Verdana">Click the station or sensor on the
map to display chart.<o:p></o:p></span></p>
</span></span></strong></span>

<%-- Dynamic Charting Panel --%>
<esri:Toolbar ID="Toolbar13" runat="server" BorderColor="Black" BuddyControlType="Map" CurrentTool="Full
Extent" Group="Toolbar8_Group" Height="50px" Orientation="Vertical" Style="left: 7px; position: static;
top: 12px" ToolbarItemDefaultStyle-BackColor="Transparent" ToolbarItemDefaultStyle-BorderColor="White"
ToolbarItemDefaultStyle BorderWidth="1px" ToolbarItemDefaultStyle-Font-Names="Verdana"
ToolbarItemDefaultStyle-Font-Size="XX-Small" ToolbarItemDisabledStyle-BackColor="Transparent"
ToolbarItemDisabledStyle-Font-Names="Verdana" ToolbarItemDisabledStyle-Font-Size="Smaller"
ToolbarItemDisabledStyle-ForeColor="Gray" ToolbarItemHoverStyle-BackColor="LightSteelBlue"
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid" ToolbarItemHoverStyle-
BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True" ToolbarItemHoverStyle-Font-Italic="False"
ToolbarItemHoverStyle-Font-Names="Verdana" ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-
ForeColor="Black" ToolbarItemSelectedStyle-BackColor="WhiteSmoke" ToolbarItemSelectedStyle-
BorderColor="Black" ToolbarItemSelectedStyle-BorderStyle="Solid"
ToolbarItemSelectedStyle-BorderWidth="1px" ToolbarItemSelectedStyle-Font-Bold="True"
ToolbarItemSelectedStyle-Font-Names="Verdana" ToolbarItemSelectedStyle-Font-Size="Smaller"
WebResourceLocation="/aspnet_client/ESRI/WebADF/" Width="90px">
<ToolbarItems>
<esri:Tool ClientAction="Point" DefaultImage="~/images/select_point_1.gif" JavaScriptFile=""
Name="Spatialdynamiccharting" ServerActionAssembly="HyperlinkTool"
ServerActionClass="stl_samples.Hyperlink" Text="Select Point" ToolTip="Spatial dynamic charting" />
<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>

```

```

<strong><span style="font-family: Arial"><span></span></span></strong>
</div>
</esri:FloatingPanel>
<%-- Description Panel --%>

</div>

<%-- Kept as a LeftPanel holder to reduce major changes in JavaScript/WebMapApp.js --%>
<table id="LeftPanelCell" cellpadding="0" cellspacing="0" style="position: absolute; left: 0px; top: 81px;
background-color: White; width: 100px;" width="100">
<tr><td id="LeftPanelTableCell" style="position: relative; height: 100%; width: 57px;">
<div id="LeftPanelScrollDiv" style="position: relative; width: auto;">
&nbsp;</div>
</td>
<td style="width: 0px">

<div id="ToggleCell" style="overflow: hidden; width: 10px; border: solid 1px #999999; background-color:
White; position: relative ; display: none;">
<table id="ToggleCellTable" cellpadding="0" cellspacing="0" style="position: relative; height: 100%; width:
100%;">
<tr>
<td id="PanelSlider" onmousedown="startWebMapAppDockDrag(event); return false;" style="cursor: e-resize;
background-color: White; height: 45%" ></td>
</tr>
<tr>
<td style="height: 24px;" ></td>
</tr>
<tr>
<td id="PanelSliderBottom" onmousedown="startWebMapAppDockDrag(event); return false;" style="cursor: e-
resize; background-color: White; height: 50%" ></td>
</tr>
</table>
</div>
</td>
</tr>
</table>

<%-- Left panel with General and Advanced --%>

```



```
<div id="Div2" style="left: 0px; width: 102px; position: absolute; top: 82px; border-top-width: 0px; border-left-width: 0px; border-left-color: white; visibility: visible; border-bottom-width: 0px; border-bottom-color: white; border-top-color: white; border-right-width: 0px; border-right-color: white;">
```

```
<!-- General panel -->
```

```
<esri:FloatingPanel ID="FloatingPanel2" runat="server" BackColor="White" BorderColor="Black" BorderStyle="Outset" BorderWidth="1px" CloseButton="False" Draggable="False" Font-Bold="True" FontNames="Verdana" Font-Size="8pt" ForeColor="Black" Height="100%" HeightResizable="False" Style="left: 0px; margin-bottom: 0px; position: static; top: 0px" Title="General" TitleBarColor="#00525E" TitleBarForeColor="White" TitleBarHeight="20px" TitleBarSeparatorLine="True" Transparency="0" Width="100%" WidthResizable="False">
```

```
<!-- Zoom In -->
```

```
<esri:ToolBar ID="ToolBar3" runat="server" BuddyControlType="Map" EnableTheming="True" Group="ToolBar1_Group" Height="50px" Orientation="Vertical" Style="left: 10px; position: static; top: -1px" ToolBarItemDefaultStyle-BackColor="Transparent" ToolBarItemDefaultStyle-BorderColor="White" ToolBarItemDefaultStyle-BorderWidth="1px" ToolBarItemDefaultStyle-Font-Names="Verdana" ToolBarItemDefaultStyle-Font-Size="Smaller" ToolBarItemDefaultStyle-ForeColor="Black" ToolBarItemDisabledStyle-BackColor="Transparent" ToolBarItemDisabledStyle-BorderColor="Transparent" ToolBarItemDisabledStyle-Font-Names="Verdana" ToolBarItemDisabledStyle-Font-Size="Smaller" ToolBarItemDisabledStyle-ForeColor="Black" ToolBarItemHoverStyle-BackColor="LightSteelBlue" ToolBarItemHoverStyle-BorderColor="Black" ToolBarItemHoverStyle-BorderStyle="Solid" ToolBarItemHoverStyle-BorderWidth="1px" ToolBarItemHoverStyle-Font-Bold="True" ToolBarItemHoverStyle-Font-Italic="False" ToolBarItemHoverStyle-Font-Names="Verdana" ToolBarItemHoverStyle-Font-Size="Smaller" ToolBarItemHoverStyle-ForeColor="Black" ToolBarItemSelectedStyle-BackColor="WhiteSmoke" ToolBarItemSelectedStyle-BorderColor="Black" ToolBarItemSelectedStyle-BorderStyle="Solid" ToolBarItemSelectedStyle-BorderWidth="1px" ToolBarItemSelectedStyle-Font-Bold="True" ToolBarItemSelectedStyle-Font-Names="Verdana" ToolBarItemSelectedStyle-Font-Size="Smaller" ToolBarItemSelectedStyle-ForeColor="Black" WebResourceLocation="/aspnet_client/ESRI/WebADF/" Width="90px">
```

```
<ToolBarItems>
```

```
<esri:Tool ClientAction="DragRectangle" DefaultImage="esriZoomIn.png" HoverImage="esriZoomIn.png" JavaScriptFile="" Name="MapZoomIn" SelectedImage="esriZoomIn.png" ServerActionAssembly="ESRI.ArcGIS.ADF.Web.UI.WebControls" ServerActionClass="ESRI.ArcGIS.ADF.Web.UI.WebControls.Tools.MapZoomIn" Text="Zoom In" ToolTip="Zoom In" />  
<esri:Space Size="1" />
```

```
</ToolBarItems>
```

```
<BuddyControls>
```

```
<esri:BuddyControl Name="Map1" />
```

```
</BuddyControls>
```

```
</esri:Toolbar>
```

```
<%-- Zoom Out --%>
```

```
<esri:Toolbar ID="Toolbar5" runat="server" BuddyControlType="Map" EnableTheming="True"  
Group="Toolbar1_Group" Height="50px" Orientation="Vertical" Style="left: 10px; position: static; top: -1px"  
ToolbarItemDefaultStyle-BackColor="Transparent" ToolbarItemDefaultStyle-BorderColor="White"  
ToolbarItemDefaultStyle-BorderWidth="1px" ToolbarItemDefaultStyle-Font-Names="Verdana"  
ToolbarItemDefaultStyle-Font-Size="Smaller" ToolbarItemDefaultStyle-ForeColor="Black"  
ToolbarItemDisabledStyle-BackColor="Transparent" ToolbarItemDisabledStyle-BorderColor="Transparent"  
ToolbarItemDisabledStyle-Font-Names="Verdana" ToolbarItemDisabledStyle-Font-Size="Smaller"  
ToolbarItemDisabledStyle-ForeColor="Black" ToolbarItemHoverStyle-BackColor="LightSteelBlue"  
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid" ToolbarItemHoverStyle-  
BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True" ToolbarItemHoverStyle-Font-Italic="False"  
ToolbarItemHoverStyle-Font-Names="Verdana" ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-  
ForeColor="Black" ToolbarItemSelectedStyle-BackColor="WhiteSmoke"  
ToolbarItemSelectedStyle-BorderColor="Black" ToolbarItemSelectedStyle-BorderStyle="Solid"  
ToolbarItemSelectedStyle-BorderWidth="1px" ToolbarItemSelectedStyle-Font-Bold="True"  
ToolbarItemSelectedStyle-Font-Names="Verdana" ToolbarItemSelectedStyle-Font-Size="Smaller"  
ToolbarItemSelectedStyle-ForeColor="Black" WebResourceLocation="/aspnet_client/ESRI/WebADF/"  
Width="90px">  
<ToolbarItems>  
<esri:Tool ClientAction="DragRectangle" DefaultImage="esriZoomOut.png" HoverImage="esriZoomOut.png"  
JavaScriptFile="" Name="MapZoomOut" SelectedImage="esriZoomOut.png"  
ServerActionAssembly="ESRI.ArcGIS.ADF.Web.UI.WebControls"  
ServerActionClass="ESRI.ArcGIS.ADF.Web.UI.WebControls.Tools.MapZoomOut" Text="Zoom Out" ToolTip="Zoom Out"  
</>  
<esri:Space Size="1" />  
</ToolbarItems>  
<BuddyControls>  
<esri:BuddyControl Name="Map1" />  
</BuddyControls>  
</esri:Toolbar>
```

```
<%-- Pan --%>
```

```
<esri:Toolbar ID="Toolbar6" runat="server" BuddyControlType="Map" EnableTheming="True"  
Group="Toolbar1_Group" Height="50px" Orientation="Vertical" Style="left: 19px; position: static; top: -1px"  
ToolbarItemDefaultStyle-BackColor="Transparent"  
ToolbarItemDefaultStyle-BorderColor="White" ToolbarItemDefaultStyle-BorderWidth="1px"  
ToolbarItemDefaultStyle-Font-Names="Verdana" ToolbarItemDefaultStyle-Font-Size="Smaller"  
ToolbarItemDefaultStyle-ForeColor="Black" ToolbarItemDisabledStyle-BackColor="Transparent"
```

```

ToolbarItemDisabledStyle-BorderColor="Transparent" ToolbarItemDisabledStyle-Font-Names="Verdana"
ToolbarItemDisabledStyle-Font-Size="Smaller" ToolbarItemDisabledStyle-ForeColor="Black"
ToolbarItemHoverStyle-BackColor="LightSteelBlue" ToolbarItemHoverStyle BorderColor="Black"
ToolbarItemHoverStyle-BorderStyle="Solid"
ToolbarItemHoverStyle-BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True" ToolbarItemHoverStyle-Font-
Italic="False"
ToolbarItemHoverStyle-Font-Names="Verdana" ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-
ForeColor="Black"
ToolbarItemSelectedStyle-BackColor="WhiteSmoke" ToolbarItemSelectedStyle-BorderColor="Black"
ToolbarItemSelectedStyle-BorderStyle="Solid" ToolbarItemSelectedStyle-BorderWidth="1px"
ToolbarItemSelectedStyle-Font-Bold="True" ToolbarItemSelectedStyle-Font-Names="Verdana"
ToolbarItemSelectedStyle-Font-Size="Smaller" ToolbarItemSelectedStyle-ForeColor="Black"
WebResourceLocation="/aspnet_client/ESRI/WebADF/" Width="90px">
<ToolbarItems>
<esri:Tool ClientAction="DragImage" Cursor="hand" DefaultImage="esriPan.png" HoverImage="esriPan.png"
JavaScriptFile="" Name="MapPan" SelectedImage="esriPan.png"
ServerActionAssembly="ESRI.ArcGIS.ADF.Web.UI.WebControls"
ServerActionClass="ESRI.ArcGIS.ADF.Web.UI.WebControls.Tools.MapPan" Text="Pan" ToolTip="Pan" />
<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>

<!-- Full Extent -->
<esri:Toolbar ID="Toolbar7" runat="server" BuddyControlType="Map" EnableTheming="True"
Group="Toolbar1_Group" Height="55px" Orientation="Vertical" Style="left: 4px; position: static; top: 1px"
ToolbarItemDefaultStyle-BackColor="Transparent" ToolbarItemDefaultStyle-BorderColor="White"
ToolbarItemDefaultStyle-BorderWidth="1px" ToolbarItemDefaultStyle-Font-Names="Verdana"
ToolbarItemDefaultStyle-Font-Size="Smaller" ToolbarItemDefaultStyle-ForeColor="Black"
ToolbarItemDisabledStyle-BackColor="Transparent" ToolbarItemDisabledStyle-BorderColor="Transparent"
ToolbarItemDisabledStyle-Font-Names="Verdana" ToolbarItemDisabledStyle-Font-Size="Smaller"
ToolbarItemDisabledStyle-ForeColor="Black" ToolbarItemHoverStyle-BackColor="LightSteelBlue"
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid"
ToolbarItemHoverStyle-BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True"
ToolbarItemHoverStyle-Font-Italic="False" ToolbarItemHoverStyle-Font-Names="Verdana"
ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-ForeColor="Black"
ToolbarItemSelectedStyle-BackColor="WhiteSmoke" ToolbarItemSelectedStyle-BorderColor="Black"
ToolbarItemSelectedStyle-BorderStyle="Solid" ToolbarItemSelectedStyle-BorderWidth="1px"
ToolbarItemSelectedStyle-Font-Bold="True" ToolbarItemSelectedStyle-Font-Names="Verdana"

```



```

ToolbarItemDisabledStyle-ForeColor="Gray" ToolbarItemHoverStyle-BackColor="LightSteelBlue"
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid"
ToolbarItemHoverStyle-BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True"
ToolbarItemHoverStyle-Font-Italic="False" ToolbarItemHoverStyle-Font-Names="Verdana"
ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-ForeColor="Black"
ToolbarItemSelectedStyle-BackColor="WhiteSmoke" ToolbarItemSelectedStyle-BorderColor="Black"
ToolbarItemSelectedStyle-BorderStyle="Solid" ToolbarItemSelectedStyle-BorderWidth="1px"
ToolbarItemSelectedStyle-Font-Bold="True" ToolbarItemSelectedStyle-Font-Names="Verdana"
ToolbarItemSelectedStyle-Font-Size="Smaller" WebResourceLocation="/aspnet_client/ESRI/WebADF/"
Width="90px">
<ToolbarItems>
<esri:Tool ClientAction="MapIdentify('Map1');" Cursor="default" DefaultImage="esriIdentify.png"
HoverImage="esriIdentify.png" JavaScriptFile="" Name="MapIdentify" SelectedImage="esriIdentify.png"
Text="Identify" ToolTip="Identify (Ctrl-MouseClick)" />
<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>

<%-- Measure --%>
<esri:Toolbar ID="Toolbar2" runat="server" BuddyControlType="Map" Group="Toolbar1_Group" Height="50px"
Orientation="Vertical" Style="left: 11px; position: static; top: 0px"
ToolbarItemDefaultStyle-BackColor="Transparent" ToolbarItemDefaultStyle-BorderColor="White"
ToolbarItemDefaultStyle-BorderWidth="1px" ToolbarItemDefaultStyle-Font-Names="Verdana"
ToolbarItemDefaultStyle-Font-Size="Smaller" ToolbarItemDisabledStyle-BackColor="Transparent"
ToolbarItemDisabledStyle-Font-Names="Verdana" ToolbarItemDisabledStyle-Font-Size="Smaller"
ToolbarItemDisabledStyle-ForeColor="Gray" ToolbarItemHoverStyle-BackColor="LightSteelBlue"
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid"
ToolbarItemHoverStyle-BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True"
ToolbarItemHoverStyle-Font-Italic="False" ToolbarItemHoverStyle-Font-Names="Verdana"
ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-ForeColor="Black"
ToolbarItemSelectedStyle-BackColor="WhiteSmoke" ToolbarItemSelectedStyle-BorderColor="Black"
ToolbarItemSelectedStyle-BorderStyle="Solid" ToolbarItemSelectedStyle-BorderWidth="1px"
ToolbarItemSelectedStyle-Font-Bold="True" ToolbarItemSelectedStyle-Font-Names="Verdana"
ToolbarItemSelectedStyle-Font-Size="Smaller" WebResourceLocation="/aspnet_client/ESRI/WebADF/"Width="90px">
<ToolbarItems>
<esri:Tool ClientAction="startMeasure()" DefaultImage="esriMeasure.png" HoverImage="esriMeasure.png"
JavaScriptFile="" Name="Measure" SelectedImage="esriMeasure.png" Text="Measure"
ToolTip="Measure" />

```

```

<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>

<%-- Description --%>
<esri:Toolbar ID="Toolbar10" runat="server" BuddyControlType="Map" Group="Toolbar1_Group"
Height="50px" Orientation="Vertical" Style="left: 7px; position: static; top: 12px"
ToolbarItemDefaultStyle-BackColor="Transparent" ToolbarItemDefaultStyle-BorderColor="White"
ToolbarItemDefaultStyle-BorderWidth="1px" ToolbarItemDefaultStyle-Font-Names="Verdana"
ToolbarItemDefaultStyle-Font-Size="Smaller" ToolbarItemDisabledStyle-BackColor="Transparent"
ToolbarItemDisabledStyle-Font-Names="Verdana" ToolbarItemDisabledStyle-Font-Size="Smaller"
ToolbarItemDisabledStyle-ForeColor="Gray" ToolbarItemHoverStyle-BackColor="LightSteelBlue"
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid"
ToolbarItemHoverStyle-BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True"
ToolbarItemHoverStyle-Font-Italic="False" ToolbarItemHoverStyle-Font-Names="Verdana"
ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-ForeColor="Black"
ToolbarItemSelectedStyle-BackColor="WhiteSmoke" ToolbarItemSelectedStyle-BorderColor="Black"
ToolbarItemSelectedStyle-BorderStyle="Solid" ToolbarItemSelectedStyle-BorderWidth="1px"
ToolbarItemSelectedStyle-Font-Bold="True" ToolbarItemSelectedStyle-Font-Names="Verdana"
ToolbarItemSelectedStyle-Font-Size="Smaller" WebResourceLocation="/aspnet_client/ESRI/WebADF/"
Width="90px">
<ToolbarItems>
<esri:Command ClientAction="toggleMetal()" DefaultImage="~/images/defaultMapTip.gif"
JavaScriptFile="" Name="Metal" Text="Description" ToolTip="Background Information of Layers" />
<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>

<%-- Query --%>
<esri:Toolbar ID="Toolbar4" runat="server" BuddyControlType="Map" Group="Toolbar1_Group"
Height="50px" Orientation="Vertical" Style="left: 9px; position: static; top: 0px"
ToolbarItemDefaultStyle-BackColor="Transparent" ToolbarItemDefaultStyle-BorderColor="White"
ToolbarItemDefaultStyle-BorderWidth="1px" ToolbarItemDefaultStyle-Font-Names="Verdana"
ToolbarItemDefaultStyle-Font-Size="Smaller" ToolbarItemDisabledStyle-BackColor="Transparent"
ToolbarItemDisabledStyle-Font-Names="Verdana" ToolbarItemDisabledStyle-Font-Size="Smaller"

```

```

ToolbarItemDisabledStyle-ForeColor="Gray" ToolbarItemHoverStyle-BackColor="LightSteelBlue"
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid"
ToolbarItemHoverStyle-BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True"
ToolbarItemHoverStyle-Font-Italic="False" ToolbarItemHoverStyle-Font-Names="Verdana"
ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-ForeColor="Black"
ToolbarItemSelectedStyle-BackColor="WhiteSmoke" ToolbarItemSelectedStyle-BorderColor="Black"
ToolbarItemSelectedStyle-BorderStyle="Solid" ToolbarItemSelectedStyle-BorderWidth="1px"
ToolbarItemSelectedStyle-Font-Bold="True" ToolbarItemSelectedStyle-Font-Names="Verdana"
ToolbarItemSelectedStyle-Font-Size="Smaller" WebResourceLocation="/aspnet_client/ESRI/WebADF/" Width="90px"
CurrentTool="Full Extent">
<ToolbarItems>
<esri:Command ClientAction="togglequery()" DefaultImage="~/images/query1.gif"
JavaScriptFile="" Name="QueryBuilderTask1" Text="Query" ToolTip="Query by Attribute" />
<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>

<%-- Select Feature(s) --%>
<esri:Toolbar ID="Toolbar9" runat="server" BuddyControlType="Map" Group="Toolbar1_Group"
Height="59px" Orientation="Vertical" Style="left: 4px; position: static; top: 0px"
ToolbarItemDefaultStyle- ToolbarItemDefaultStyle-BorderWidth="1px" ToolbarItemDefaultStyle-Font-
Names="Verdana"
ToolbarItemDefaultStyle-Font-Size="Smaller" ToolbarItemDisabledStyle-BackColor="Transparent"
ToolbarItemDisabledStyle-Font-Names="Verdana" ToolbarItemDisabledStyle-Font-Size="Smaller"
ToolbarItemDisabledStyle-ForeColor="Gray" ToolbarItemHoverStyle-BackColor="LightSteelBlue"
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid"
ToolbarItemHoverStyle-BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True"
ToolbarItemHoverStyle-Font-Italic="False" ToolbarItemHoverStyle-Font-Names="Verdana"
ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-ForeColor="Black"
ToolbarItemSelectedStyle-BackColor="WhiteSmoke" ToolbarItemSelectedStyle-BorderColor="Black"
ToolbarItemSelectedStyle-BorderStyle="Solid" ToolbarItemSelectedStyle-BorderWidth="1px"
ToolbarItemSelectedStyle-Font-Bold="True" ToolbarItemSelectedStyle-Font-Names="Verdana"
ToolbarItemSelectedStyle-Font-Size="Smaller" WebResourceLocation="/aspnet_client/ESRI/WebADF/"
Width="87px">
<ToolbarItems>
<esri:Command ClientAction="toggleselect()" DefaultImage="~/images/select_poly_1.gif"
JavaScriptFile="" Name="SelectToolTask1" Text="Select Feature(s)" ToolTip="Spatial selection of map
feature(s)" />

```

```

<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>

<%-- Charting --%>
<esri:Toolbar ID="Toolbar11" runat="server" BuddyControlType="Map" Group="Toolbar1_Group"
Height="50px" Orientation="Vertical" Style="left: 7px; position: static; top: 12px"
ToolbarItemDefaultStyle-BackColor="Transparent" ToolbarItemDefaultStyle-BorderColor="White"
ToolbarItemDefaultStyle-BorderWidth="1px" ToolbarItemDefaultStyle-Font-Names="Verdana"
ToolbarItemDefaultStyle-Font-Size="Smaller" ToolbarItemDisabledStyle-BackColor="Transparent"
ToolbarItemDisabledStyle-Font-Names="Verdana" ToolbarItemDisabledStyle-Font-Size="Smaller"
ToolbarItemDisabledStyle-ForeColor="Gray" ToolbarItemHoverStyle-BackColor="LightSteelBlue"
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid"
ToolbarItemHoverStyle-BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True"
ToolbarItemHoverStyle-Font-Italic="False" ToolbarItemHoverStyle-Font-Names="Verdana"
ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-ForeColor="Black"
ToolbarItemSelectedStyle- ToolbarItemSelectedStyle-BorderStyle="Solid" ToolbarItemSelectedStyle-
BorderWidth="1px"
ToolbarItemSelectedStyle-Font-Bold="True" ToolbarItemSelectedStyle-Font-Names="Verdana"
ToolbarItemSelectedStyle-Font-Size="Smaller" WebResourceLocation="/aspnet_client/ESRI/WebADF/"
Width="90px">
<ToolbarItems>
<esri:Command ClientAction="togglecharting()" DefaultImage="~/images/MIO_rl_polyline.gif"
JavaScriptFile="" Name="Charting" Text="Charting" ToolTip="Charting" />
<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>

<%-- 3D LiDAR --%>
<esri:Toolbar ID="Toolbar12" runat="server" BuddyControlType="Map" Group="Toolbar1_Group"
Height="50px" Orientation="Vertical" Style="left: 7px; position: static; top: 12px"
ToolbarItemDefaultStyle-BackColor="Transparent" ToolbarItemDefaultStyle-BorderColor="White"
ToolbarItemDefaultStyle-BorderWidth="1px" ToolbarItemDefaultStyle-Font-Names="Verdana"
ToolbarItemDefaultStyle-Font-Size="Smaller" ToolbarItemDisabledStyle-BackColor="Transparent"
ToolbarItemDisabledStyle-Font-Names="Verdana" ToolbarItemDisabledStyle-Font-Size="Smaller"

```



```

ToolbarItemDisabledStyle-ForeColor="Gray" ToolbarItemHoverStyle-BackColor="LightSteelBlue"
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid"
ToolbarItemHoverStyle-BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True"
ToolbarItemHoverStyle-Font-Italic="False" ToolbarItemHoverStyle-Font-Names="Verdana"
ToolbarItemHoverStyle-Font- ToolbarItemSelectedStyle-BackColor="WhiteSmoke" ToolbarItemSelectedStyle-
BorderColor="Black"
ToolbarItemSelectedStyle-BorderStyle="Solid" ToolbarItemSelectedStyle-BorderWidth="1px"
ToolbarItemSelectedStyle-Font-Bold="True" ToolbarItemSelectedStyle-Font-Names="Verdana"
ToolbarItemSelectedStyle-Font-Size="Smaller" WebResourceLocation="/aspnet_client/ESRI/WebADF/"Width="90px">
<ToolbarItems>
<esri:Command ClientAction="togglet3d()" DefaultImage="~/images/clickMapTip.GIF"
JavaScriptFile="" Name="3D" Text="3D LiDAR" ToolTip="3D LiDAR" />
<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>
</esri:FloatingPanel>
</div>

```

```

<!-- Right panel with Map Contents, Overview Map, Dynamic Map Scale, Navigation, and Scalebar. Right panel
ID has been changed to "LeftPanelCellDiv" for JavaScript/WebMapApp.js -->
<div id="LeftPanelCellDiv" style="right: 0px; width: 270px;position: absolute; top: 82px; border-top-width:
0px; border-left-width: 0px; border-left-color: white; visibility: visible; border-bottom-width: 0px;
border-bottom-color: white; border-top-color: white; border-right-width: 0px; border-right-color: white;
background-color: white;" >

```

```

<!-- Map Contents (TOC)-->
<esri:FloatingPanel ID="FloatingPanel1" runat="server" BackColor="White" BorderColor="Black"
BorderStyle="Outset" BorderWidth="1px" CloseButton="False" Draggable="False" Font-Bold="True" Font-
Names="Verdana" Font-Size="8pt" ForeColor="Black" Height="259px" HeightResizable="True"
ShowDockedContextMenu="True" Style="position: relative" Title="Map Contents" TitleBarColor="#00525E"
TitleBarForeColor="White" TitleBarHeight="20px"TitleBarSeparatorLine="True" Transparency="0" Width="100%"
WidthResizable="False">
<esri:Toc ID="Toc2" runat="server" BuddyControl="Map1" ExpandDepth="4" Font-Bold="False"Font-
Names="Verdana" Font-Size="8pt" ForeColor="Black" Height="100%" RenderOnDemand="True"Style="left: 0px;
overflow: auto; width: 100%; position: absolute; top: 0px; height: 100%" Width="100%" />
</esri:FloatingPanel>

```

```

<!-- Overview Map -->

```



```

</esri:NavigationBar>
<esri:ZoomLevel ID="ZoomLevel1" runat="server" />
</td>
</tr>
</table>
</esri:FloatingPanel>
<br />

<!-- Scalebar -->
<esri:ScaleBar ID="ScaleBar1" runat="server" BackColor="Transparent" BarColor="Black" BarFont="Verdana,
7pt"BarHeight="6" BarUnits="Kilometers" BorderColor="Transparent" BorderStyle="None"
ForeColor="Black"Height="30px" Map="Map1" Style="left: 0px; position: static; top: 0px" Width="250px" />
<br />
</div>
</div>

<!-- Map Resource Manager -->
<esri:MapResourceManager ID="MapResourceManager1" runat="server" Style="left: 442px; position: absolute;
top: 180px; z-index: 102;" UseDefaultWebResources="False" ValidationTimeOut="6000">
<ResourceItems><esri:MapResourceItem Definition="&lt;Definition
DataSourceDefinition=&quot;server_name&quot;; DataSourceType=&quot;ArcGIS Server Local&quot;;
Identity=&quot;To set, right-click project and 'Add ArcGIS Identity'&quot;;
ResourceDefinition=&quot;Layers@turtle_mountain&quot;; DataSourceShared=&quot;True&quot;; /&gt;"
DisplaySettings="visible=True:transparency=0:mime=True:imgFormat=PNG32:height=100:width=100:dpi=96:color=:t
ransbg=False:displayInToc=True" Name="Layers" />
<esri:MapResourceItem Definition="&lt;Definition DataSourceDefinition=&quot;server_name&quot;;
DataSourceType=&quot;ArcGIS Server Local&quot;; Identity=&quot;To set, right-click project and 'Add ArcGIS
Identity'&quot;; ResourceDefinition=&quot;Layers@hidden_layer&quot;; DataSourceShared=&quot;True&quot;; /&gt;"
DisplaySettings="visible=False:transparency=0:mime=False:imgFormat=PNG8:height=100:width=100:dpi=96:color=:
transbg=False:displayInToc=False"="SensorNetwork" />
</ResourceItems>
</esri:MapResourceManager>
<!-- Not used. Kept here for other supporting scripts. -->
<asp:Panel ID="CopyrightTextHolder" runat="server" Style="position: absolute; left: 408px; top: 604px;
padding: 3px; cursor: pointer; -moz-opacity: 0.75; filter: alpha(opacity=75);" BorderColor="DarkGray"
BorderStyle="Solid" BorderWidth="1px" ToolTip="Display Copyright Information" Font-Underline="True"
BackColor="White" Font-Size="XX-Small">Copyright
</asp:Panel>

<script language="javascript" type="text/javascript">setPageElementSizes();

```

```
</script>
```

```
<esri:MapTips ID="MapTips1" runat="server" Style="position: absolute; left: 139px; top: 640px;"  
ClickImage="images/clickMapTip.gif" DefaultImage="images/defaultMapTip.gif"  
HoverImage="images/hoverMapTip.gif" UseDefaultWebResources="True" />
```

```
<!-- Measure Box -->
```

```
<ucl:Measure ID="Measure1" runat="server" AreaUnits="Sq_Kilometres" MapBuddyId="Map1"  
MapUnits="Resource_Default" MeasureUnits="Kilometres" NumberDecimals="3" />
```

```
<!-- Not used. Kept here for other supporting scripts. -->
```

```
<esri:GeocodeResourceManager ID="GeocodeResourceManager1" runat="server" style="left: 64px; position:  
absolute; top: 560px">
```

```
<ResourceItems></ResourceItems></esri:GeocodeResourceManager>
```

```
<esri:GeoprocessingResourceManager ID="GeoprocessingResourceManager1" runat="server" style="left: 189px;  
position: absolute; top: 732px">
```

```
<ResourceItems></ResourceItems></esri:GeoprocessingResourceManager>
```

```
<!-- Query builder task panel -->
```

```
<ccQueryBuilderTask:QueryBuilderTask ID="QueryBuilderTask1" runat="server"  
BackColor="White" BorderColor="Black" BorderWidth="1px" Font-Bold="True" Font-Names="Verdana"Font-  
Size="8pt" ForeColor="Black" Map="Map1" MapResourceName="Layers" Title="Query by Attribute"Width="100px"  
Visible="False" FeatureSelectionColor="Transparent" SelectedSetColor="Transparent" SetColor="Transparent"  
FillBoundaryColor="Transparent" FillBoundaryColorSelected="Transparent" MarkerOutlineColor="Transparent"  
MarkerOutlineColorSelected="Transparent" Transparency="0" FillBoundaryTransparency="100"  
FillBoundaryTransparencySelected="100" LineTransparency="100" LineTransparencySelected="100"  
MarkerTransparency="100" MarkerTransparencySelected="100" FillTransparency="100"  
FillTransparencySelected="100" BorderStyle="Outset" Docked="False" ExpandCollapseButton="False"  
TitleBarColor="#00525E" TitleBarForeColor="White">
```

```
<TaskResultsContainers>
```

```
<esri:BuddyControl Name="GridResults1">
```

```
</esri:BuddyControl>
```

```
</TaskResultsContainers>
```

```
</ccQueryBuilderTask:QueryBuilderTask>
```

```
<!-- Spatial Selection task panel -->
```

```
<ccl:selecttooltask id="SelectToolTask1" runat="server" backcolor="White" bordercolor="Black"  
borderstyle="Outset" borderwidth="1px" docked="False" font-names="Verdana" font-size="8pt"  
forecolor="Black" showlegend="True" title="Spatial Selection" titlebarcolor="#00525E" titlebarheight="20px"  
transparency="0" visible="False" width="200px" ResultsTitle="Spatial Selection" TitleBarForeColor="White"  
Font-Bold="True" PointSelectionTolerance="10" SelectedSetColor="Transparent"
```

```

FeatureSelectionColor="Transparent" HidePreviousSelections="False" RenderSelectedSet="False"
ExpandCollapseButton="False">
<TaskResultsContainers>
<esri:BuddyControl Name="GridResults1">
</esri:BuddyControl>
</TaskResultsContainers>
</cc1:selecttooltask>
<!--
<asp:TextBox ID="MapDebugBox" runat="server" Height="200px" Width="935px" TextMode="MultiLine" style="left:
5px; position: absolute; top: 549px" Visible="true">Debug box... This is useful for debugging modifications
or additions to the Map Viewer application. Set Visible property to true to display Map Viewer requests and
responses on web page.
By default, the property is set to false, and the box will not be rendered on the web page.
</asp:TextBox>
<input id="Button1" style="left: 749px; position: absolute; top: 516px" type="button" value="Clear Debug
Box" onmousedown="document.forms[0].MapDebugBox.value='' />

--%>
</form>
<script language="javascript" type="text/javascript">
newLoad = <%=m_newLoad %>;
webMapAppCloseCallback = "<%=m_closeOutCallback %>";
webMapAppCopyrightCallback = "<%=m_copyrightCallback %>";

if (window.addEventListener) window.addEventListener("load", startUp, false);
else if (window.attachEvent) window.attachEvent("onload", startUp);
</script>
</body>
</html>

```

Appendix 2 – Default.aspx.cs

These are C# code behind the customized Default.aspx file. The code exclude the default toolset panel and add Results windows for task results and grid results.

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Collections.Generic;
using System.Collections.Specialized;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
using ESRI.ArcGIS.ADF.Web;
using ESRI.ArcGIS.ADF.Web.UI.WebControls;
using ESRI.ArcGIS.ADF.Web.DataSources;
using ESRI.ArcGIS.ADF.Web.DataSources.ArcGISServer;
using ESRI.ArcGIS.ADF.Connection.AGS;
using ESRI.ArcGIS.Server;

public partial class WebMapApplication : System.Web.UI.Page, ICallbackEventHandler
{
    MapIdentify identify;

    public string m_newLoad = "false";
    public string m_closeOutCallback = "";
    public string m_copyrightCallback = "";

    protected void Page_Load(object sender, EventArgs e)
    {
        if (!Page.IsCallback && !Page.IsPostBack)
        {
            {
                //The following session variables configure the hyperlink tool.
                //Set HyperResourceItem to the name of the resource in the
                //resource manager. This resource must have a
```

```

//Layer with a field that will be used for the hyperlink.
Session["HyperResourceItem"] = "Sensor Network";
//The HyperLayer is the name of the layer that contains the
//hyperlink features.
Session["HyperLayer"] = "hidden_layer";
//HyperFields are the fields containing the hyperlink
//information. It is an array of string values
//containing each field to query in the layer.
//The number of items in the array should match the number of
//format items in the format string below.
string[] strHyperFields = new string[1];
strHyperFields[0] = "INSTRUMENT";
Session["HyperFields"] = strHyperFields;
//HyperBaseUrl contains a reference to the base information for
//the URL. The text {0} will be replaced by the value from
//strHyperFields. If strHyperFields contains the full url
//just use the string "{0}" for HyperBaseUrl
//Hyperbase URL can also contain multiple format items; one for
//each item in the HyperFields array. For example:
//"http://www.someurl.com/{0}/picture_{1}.html"
Session["HyperBaseUrl"] = "/Turtle_Mountain/Charting/Charts/{0}.aspx";
//HyperChangeFieldCase will change the case of the value from
//the field to work with case sensitive URL's.
//Set this variable to upper, lower, or none.
Session["HyperChangeFieldCase"] = "none";
//Set the distance to buffer the point if the layer being
//queried is a line or point the default is 100 map units.
//This would be very inappropriate for data using a
//geographic coordinate system (lat/long).
Session["HyperPointBuffer"] = "1.2";
}

if (Map1.MapResourceManager == null || Map1.MapResourceManager.Length == 0)
callErrorPage("No MapResourceManager defined for the map.", null);
if (MapResourceManager1.ResourceItems.Count == 0 || MapResourceManager1.ResourceItems[0] ==
null)
    callErrorPage("The MapResourceManager does not have a valid ResouceItem Definition.", null);

m_newLoad = "true";
}

```

```

        m_closeOutCallback = Page.ClientScript.GetCallbackEventReference(Page, "argument",
"CloseOutResponse", "context", true);
        m_copyrightCallback = Page.ClientScript.GetCallbackEventReference(Page, "argument",
"processCallbackResult", "context", true);

        // initiate identify class and set link to TaskResults1 for response
        identify = new MapIdentify(Map1);
        identify.ResultsDisplay = TaskResults1;

        identify.NumberDecimals = 4;

        FloatingPanel ovPanel = Page.FindControl("OverviewMap_Panel") as FloatingPanel;
        if (ovPanel != null)
        {
            ovPanel.PanelCollapsed += new
ESRI.ArcGIS.ADF.Web.UI.WebControls.FloatingPanelCollapseEventHandler(OverviewMap_Panel_PanelCollapsed);
            ovPanel.PanelExpanded += new
ESRI.ArcGIS.ADF.Web.UI.WebControls.FloatingPanelExpandEventHandler(OverviewMap_Panel_PanelExpanded);
        }
    }
    // Handles unhandled exceptions in the page.
    protected void Page_Error(object sender, System.EventArgs e)
    {
        Exception exception = Server.GetLastError();
        Server.ClearError();
        callErrorPage("Page_Error", exception);
    }

    protected void Page_PreRenderComplete(object sender, EventArgs e)
    {
        // check to see if any of the resource items are non-pooled
        if (!Page.IsCallback || !Page.IsPostBack)
        {
            CloseHyperLink.Visible = HasNonPooledResources();
            OverviewMap ov = Page.FindControl("OverviewMap1") as OverviewMap;
            if (ov!=null && !OverviewMapResourceIsValid(ov))
                ov.OverviewMapResource = Map1.PrimaryMapResource;
        }
        CopyrightTextHolder.Visible = HasCopyrightText();
    }

```



```

}

protected void Page_PreInit(object sender, EventArgs e)
{
    // Make the overview enabled property match floatingpanel expanded property
    FloatingPanel ovPanel = Page.FindControl("OverviewMap_Panel") as FloatingPanel;
    if (ovPanel != null)
    {
        OverviewMap ov = ovPanel.FindControl("OverviewMap1") as OverviewMap;
        if (ov != null)
            ov.Enabled = ovPanel.Expanded;
    }
}

protected void TitleMenu_DataBound(object sender, EventArgs e)
{
    Menu menu = sender as Menu;
    if (menu != null)
    {
        for (int i = 0; i < menu.Items.Count - 1; i++)
        {
            menu.Items[i].SeparatorImageUrl = "~/images/separator.gif";
        }
    }
}

//Displays the error page.
private void callErrorPage(string errorMessage, Exception exception)
{
    Session["ErrorMessage"] = errorMessage;
    Session["Error"] = exception;
    Page.Response.Redirect("ErrorPage.aspx", true);
}

// Checks to see if any resources used by the app are local non-pooled
private bool HasNonPooledResources()
{
    // define a boolean and set it to false by default... no non-pooled resourceitems
    bool hasNonPooledResource = false;
}

```

```

// Now go through all resources and find any non-pooled local resources
MapResourceLocal mapResource = null;
GISDataSourceLocal localDataSource = null;
// First, check the map resourceitems
foreach (MapResourceItem mri in MapResourceManager1.ResourceItems)
{
    if (mri != null)
    {
        mapResource = mri.Resource as MapResourceLocal;
        if (mapResource != null)
        {
            MapResourceLocal localRes = mapResource as MapResourceLocal;
            localDataSource = mapResource.DataSource as GISDataSourceLocal;
            if
(!localDataSource.Connection.IsServerObjectPooled(mapResource.ServerContextInfo.ServerObjectName,
"MapServer")) hasNonPooledResource = true;

        }
    }
}
// If there any geocoding resourceitems, check these
if (GeocodeResourceManager1.ResourceItems.Count >0)
{
    if (!GeocodeResourceManager1.Initialized) GeocodeResourceManager1.Initialize();
    GeocodeResourceLocal geocodeResource = null;
    foreach (GeocodeResourceItem gri in GeocodeResourceManager1.ResourceItems)
    {
        if (gri != null)
        {
            geocodeResource = gri.Resource as GeocodeResourceLocal;
            if (geocodeResource != null)
            {
                localDataSource = geocodeResource.DataSource as GISDataSourceLocal;
                if
(!localDataSource.Connection.IsServerObjectPooled(geocodeResource.ServerContextInfo.ServerObjectName,
"GeocodeServer")) hasNonPooledResource = true;

            }
        }
    }
}
// If there any geoprocessing resourceitems, check these

```

```

if (GeoprocessingResourceManager1.ResourceItems.Count > 0)
{
    if (!GeoprocessingResourceManager1.Initialized) GeoprocessingResourceManager1.Initialize();
    GeoprocessingResourceLocal geoprocessResource = null;
    foreach (GeoprocessingResourceItem gpri in GeoprocessingResourceManager1.ResourceItems)
    {
        if (gpri != null)
        {
            geoprocessResource = gpri.Resource as GeoprocessingResourceLocal;
            if (geoprocessResource != null)
            {
                localDataSource = geoprocessResource.DataSource as GISDataSourceLocal;
                if
(!localDataSource.Connection.IsServerObjectPooled(geoprocessResource.ServerContextInfo.ServerObjectName,
"GPServer")) hasNonPooledResource = true;
            }
        }
    }
    return hasNonPooledResource;
}

protected void ResourceManager_ResourcesInit(object sender, EventArgs e)
{
    if (DesignMode)
        return;
    ResourceManager manager = sender as ResourceManager;
    if (!manager.FailureOnInitialize)
        return;
    if (manager is MapResourceManager)
    {
        MapResourceManager mapManager = manager as MapResourceManager;
        for (int i = 0; i < mapManager.ResourceItems.Count; i++)
        {
            MapResourceItem item = mapManager.ResourceItems[i];
            if (item != null && item.FailedToInitialize)
            {
                mapManager.ResourceItems[i] = null;
            }
        }
    }
}

```

```

else if (manager is GeocodeResourceManager)
{
    GeocodeResourceManager gcManager = manager as GeocodeResourceManager;
    for (int i = 0; i < gcManager.ResourceItems.Count; i++)
    {
        GeocodeResourceItem item = gcManager.ResourceItems[i];
        if (item != null && item.FailedToInitialize)
        {
            gcManager.ResourceItems[i] = null;
        }
    }
}
else if (manager is GeoprocessingResourceManager)
{
    GeoprocessingResourceManager gpManager = manager as GeoprocessingResourceManager;
    for (int i = 0; i < gpManager.ResourceItems.Count; i++)
    {
        GeoprocessingResourceItem item = gpManager.ResourceItems[i];
        if (item != null && item.FailedToInitialize)
        {
            gpManager.ResourceItems[i] = null;
        }
    }
}
}

private bool OverviewMapResourceIsValid(OverviewMap ov)
{
    bool isValidResource = false;
    foreach (MapResourceItem resource in MapResourceManager1.ResourceItems)
    {
        if (resource != null)
        {
            if (resource.Name == ov.OverviewMapResource)
                isValidResource = true;
        }
    }
    return isValidResource;
}

private bool HasCopyrightText()

```

```

{
    return (GetCopyrightText().Length > 0);
}

private string GetCopyrightText()
{
    System.Text.StringBuilder sb = new System.Text.StringBuilder();
    string key = "";
    string value = "";
    string dataframeValue = "";
    int layerId;
    foreach (IMapFunctionality mapFunc in Map1.GetFunctionalities())
    {
        if (mapFunc.Supports("GetCopyrightText"))
        {
            Dictionary<string, string> crDictionary = mapFunc.GetCopyrightText();
            System.Text.StringBuilder sb2 = new System.Text.StringBuilder();
            string[] layerIds = null;
            string[] layerNames = null;
            mapFunc.GetLayers(out layerIds, out layerNames);
            foreach (KeyValuePair<string, string> kvPair in crDictionary)
            {
                key = kvPair.Key;
                value = kvPair.Value;
                if (value != null && value.Length > 0)
                {
                    if (key != null && key.Length > 0)
                    {
                        layerId = Convert.ToInt32(key);
                        sb2.Append(layerNames[layerId] + ": ");
                        sb2.Append(value + "<br/>");
                    }
                    else
                        dataframeValue = value;
                }
            }
            string layerCopyrights = string.Empty;
            if (sb2.Length > 0)
                layerCopyrights = sb2.ToString();
            if (!string.IsNullOrEmpty(dataframeValue) || !string.IsNullOrEmpty(layerCopyrights))

```

```

        sb.AppendFormat("<div style='font-weight: bold'>{0}</div><div style='padding: 0px 5px 5px 5px;font-weight: normal;'>{2}<br/>{1}</div>", mapFunc.Resource.Name, layerCopyrights, dataframeValue);
        sb2.Length = 0;
        dataframeValue = "";

        sb2.Length = 0;
        dataframeValue = "";
    }
}
return sb.ToString();
}

void OverviewMap_Panel_PanelExpanded(object sender, EventArgs args)
{
    FloatingPanel ovPanel = Page.FindControl("OverviewMap_Panel") as FloatingPanel;
    if (ovPanel != null)
    {
        OverviewMap ov = ovPanel.FindControl("OverviewMap1") as OverviewMap;
        if (ov != null)
        {
            ov.Enabled = true;
            ov.Refresh();
            ovPanel.CallbackResults.CopyFrom(ov.CallbackResults);
        }
    }
}

void OverviewMap_Panel_PanelCollapsed(object sender, EventArgs args)
{
    FloatingPanel ovPanel = Page.FindControl("OverviewMap_Panel") as FloatingPanel;
    if (ovPanel != null)
    {
        OverviewMap ov = ovPanel.FindControl("OverviewMap1") as OverviewMap;
        if (ov != null)
            ov.Enabled = false;
    }
}

#region ICallbackEventHandler Members

private string _callbackArg;

```

```

void ICallbackEventHandler.RaiseCallbackEvent(string eventArgument)
{
    _callbackArg = eventArgument;
}
string ICallbackEventHandler.GetCallbackResult()
{
    return RaiseCallbackEvent(_callbackArg);
}
#endregion
#region ICallbackHandler

public virtual string RaiseCallbackEvent(string responseString)
{
    // break out the responseString into a querystring
    Array keyValuePairs = responseString.Split("&".ToCharArray());
    NameValueCollection m_queryString = new NameValueCollection();
    string[] keyValue;
    string response = "";
    if (keyValuePairs.Length > 0)
    {
        for (int i = 0; i < keyValuePairs.Length; i++)
        {
            keyValue = keyValuePairs.GetValue(i).ToString().Split("=".ToCharArray());
            m_queryString.Add(keyValue[0], keyValue[1]);
        }
    }
    else
    {
        keyValue = responseString.Split("=".ToCharArray());
        if (keyValue.Length > 0)
            m_queryString.Add(keyValue[0], keyValue[1]);
    }
    // isolate control type and mode
    string controlType = m_queryString["ControlType"];
    string eventArg = m_queryString["EventArg"];
    if (controlType == null) controlType = "Map";
    switch (controlType)
    {
        case "Map":
            // request is for the map control

```

```

if (eventArg == "MapIdentify")
{
    // Identify
    if (identify != null)
    {
        identify.Map = Map1; // make sure it is current
        response = identify.Identify(m_queryString);
    }
}
else if (eventArg == "CloseOutApplication")
{
    // Close out session and quit application
    IServerContext context;
    for (int i = 0; i < Session.Count; i++)
    {
        context = Session[i] as IServerContext;
        if (context != null)
        {
            context.RemoveAll();
            context.ReleaseContext();
        }
    }
    response = "SessionClosed";
    Session.RemoveAll();
    response = ConfigurationManager.AppSettings["CloseOutUrl"];
    if (response == null || response.Length == 0) response = "ApplicationClosed.aspx";
}
else if (eventArg == "GetCopyrightText")
{
    System.Text.StringBuilder sb = new System.Text.StringBuilder();
    sb.AppendFormat("///:::{0}:::innercontent:::", "CopyrightTextContents");
    int sbLength = sb.Length;
    sb.Append(GetCopyrightText());
    if (sb.Length==sbLength) sb.Append("No Copyright information available.");
    response = sb.ToString();
}

break;
default:
    //
    break;

```



```
    }  
    return response;  
  }  
  
#endregion  
}
```

Appendix 3 – WebMapApp.js

WebMapApp.js is a Javascript file that preforms functions called by Default.aspx.cs and Default.aspx. These functions may include resizing the map window or opening a new window, and passing parameters to other application modules.

```
// Javascript file for Web Mapping Application

var reloadTimer;
var webMapAppLeftPanelWidth = 102;
var webMapAppToggleWidth = 10;
var webMapAppTopBannerHeight = 80;
var newLoad = false;
var webMapAppCloseCallback = "";
var webMapAppCopyrightCallback = "";
var webMapAppMoveFunction = null;
var webMapAppMapDisplay = null;
var webMapAppPanelDisplay = null;
var webMapAppPanelDisplayCell = null;
var webMapAppPanelDisplayTableCell = null;
var webMapAppPanelScrollDiv = null;
var webMapAppToggleDisplay = null;
var webMapAppSpacerDiv = null;
var webMapAppPanelBottomSlider = null;
var webMapAppScaleBar = null;
var webMapAppCopyrightText = null;
var webMapAppWindowWidth = 500;
var webMapAppLeftOffsetX = 0;
var webMapAppRightOffsetX = 0
var webMapAppDefaultMinDockWidth = 125;
var webMapAppMinDockWidth = webMapAppDefaultMinDockWidth;
var webMapAppMapLeft = 102;
var webMapAppHasScroll = false;
var webMapAppLastHasScroll = false;
var webMapAppFirstScalebarPosition = true;
var webMapAppDockMoving = false;
var m_measureToolBarId = "";

// function to set initial sizes of page elements
function setPageElementSizes() {
    // set body style
```

```

if (document.documentElement) {
    document.documentElement.style.overflow = "hidden";
    document.documentElement.style.height = "100%";
} else {
    document.body.style.overflow = "hidden";
    document.body.style.height = "100%";
}
// get necessary elements
webMapAppMapDisplay = document.getElementById("Map_Panel");
webMapAppPanelDisplay = document.getElementById("LeftPanelCellDiv");
webMapAppPanelDisplayCell = document.getElementById("LeftPanelCell");
webMapAppPanelScrollDiv = document.getElementById("LeftPanelScrollDiv");
webMapAppToggleDisplay = document.getElementById("ToggleCell");
webMapAppPanelSlider = document.getElementById("PanelSlider");
webMapAppPanelDisplayTableCell = document.getElementById("LeftPanelTableCell");
webMapAppPanelBottomSlider = document.getElementById("PanelSliderBottom");
webMapAppScaleBar = document.getElementById("ScaleBar1");
webMapAppCopyrightText = document.getElementById("CopyrightTextHolder");
var headerDisplay = document.getElementById("PageHeader");
var linkDisplay = document.getElementById("LinkBar");
// set scroll on Dock
webMapAppPanelScrollDiv.style.overflowY = "auto";
if (isIE) {
    webMapAppPanelDisplay.style.overflow = "hidden";
}
// get the set widths and heights
webMapAppLeftPanelWidth = webMapAppPanelDisplay.clientWidth;
webMapAppToggleWidth = parseInt(webMapAppToggleDisplay.style.width);
webMapAppTopBannerHeight = headerDisplay.clientHeight + linkDisplay.clientHeight;
// get browser window dimensions
var sWidth = getWinWidth();
var sHeight = getWinHeight();
// set map display dimensions
var mWidth = sWidth - webMapAppLeftPanelWidth - webMapAppToggleWidth;
var mHeight = sHeight - webMapAppTopBannerHeight;
webMapAppMapLeft = webMapAppLeftPanelWidth + webMapAppToggleWidth;
webMapAppMapDisplay.style.width = mWidth + "px";
webMapAppMapDisplay.style.height = mHeight + "px";
if (webMapAppScaleBar!=null) {

    positionScalebar();
}

```

```

    }
    if (webMapAppCopyrightText!=null) {
        webMapAppCopyrightText.onmousedown = webMapAppGetCopyrightText;
        var crtHeight = webMapAppCopyrightText.clientHeight;
        webMapAppCopyrightText.style.left = (webMapAppMapLeft + 10) + "px";
        webMapAppCopyrightText.style.top = (sHeight - crtHeight - 10) + "px";
    }
    // set heights of left panel and toggle bar
    webMapAppToggleDisplay.style.height = mHeight + "px";
    webMapAppPanelScrollDiv.style.height = mHeight + "px";
    esriMaxFloatingPanelDragRight = sWidth - 15;
    esriMaxFloatingPanelDragBottom = sHeight - 15;

}

// function to toggle Dock visibility
function togglePanelDock() {
    if (webMapAppPanelDisplay.style.display=="none") {
        expandPanelDock();
    } else {
        collapsePanelDock();
    }
}

function expandPanelDock() {
    var image = document.images["CollapseImage"];
    webMapAppPanelDisplay.style.display = "block";
    image.src = "images/collapse_left.gif";
    image.alt = "Collapse";
    webMapAppPanelSlider.style.cursor = "e-resize";
    webMapAppPanelBottomSlider.style.cursor = "e-resize";
    webMapAppMapLeft = webMapAppLeftPanelWidth + webMapAppToggleWidth;
    webMapAppMapDisplay.style.left = webMapAppMapLeft + "px";
    AdjustMapSize();
}

function collapsePanelDock() {
    var image = document.images["CollapseImage"];
    dockWidthString = webMapAppPanelDisplayCell.clientWidth + "px";
    webMapAppPanelDisplay.style.display = "none";
}

```

```

image.src = "images/expand_right.gif";
image.alt = "Expand";
webMapAppPanelSlider.style.cursor = "default";
webMapAppPanelBottomSlider.style.cursor = "default";
webMapAppMapLeft = webMapAppToggleWidth;
webMapAppMapDisplay.style.left = webMapAppMapLeft + "px";
AdjustMapSize();

}

// function for adjusting element sizes when browser is resized
function AdjustMapSize() {
// set element widths
webMapAppPanelDisplay.style.width = webMapAppLeftPanelWidth + "px";
webMapAppToggleDisplay.style.width = webMapAppToggleWidth + "px";
// get browser window dimensions
var sWidth = getWinWidth();
var sHeight = getWinHeight();
// calc dimensions needed for map
var mWidth = sWidth - 270 - 108;
var mHeight = sHeight - webMapAppTopBannerHeight;
if (mWidth<5) mWidth = 5;
if (mHeight<5) mHeight = 5;
webMapAppMapDisplay.style.width = mWidth + "px";
webMapAppMapDisplay.style.left = 102 + "px" ;
// set heights on elements
webMapAppMapDisplay.style.height = mHeight + "px";
webMapAppToggleDisplay.style.height = mHeight + "px";
webMapAppPanelScrollDiv.style.height = mHeight + "px";
if (webMapAppScaleBar!=null) {
var sbWidth = webMapAppScaleBar.clientWidth;
var sbHeight = webMapAppScaleBar.clientHeight;
if (webMapAppFirstScalebarPosition) {
window.setTimeout("positionScalebar();", 1000);
webMapAppFirstScalebarPosition = false;
} else
positionScalebar();
}
// resize the map
window.setTimeout("resizeTheMap(" + mWidth + ", " + mHeight + ", false);", 500);
// update map properties

```

```

var box = calcElementPosition("Map_Panel");
map.containerLeft = box.left;
map.containerTop = box.top;
if (webMapAppCopyrightText!=null) {
    var crtHeight = webMapAppCopyrightText.clientHeight;
    webMapAppCopyrightText.style.left = (box.left + 10) + "px";
    webMapAppCopyrightText.style.top = (sHeight - crtHeight - 10) + "px";
}
return false;
}

// function for resizing map in Web Map App
function resizeTheMap(width, height, resizeExtent) {
    if (resizeExtent==null) resizeExtent = true;
    map.resize(width, height, resizeExtent);
    var div = document.getElementById("LeftPanelCellDiv");
    // update overview, if doc panel is expanded
    if (ov!=null && div.style.display!="none") {
        var argument = "ControlType=OverviewMap&EventArg=OverviewZoom";
        var context = ov.controlName;
        eval(ov.callBackFunctionString);
    }
    return false;
}

// handler for window resize
function AdjustMapSizeHandler(e) {
    window.clearTimeout(reloadTimer);
    reloadTimer = window.setTimeout("AdjustMapSize();",1000);
}

// function run at startup
function startUp() {
    // set up identify mode for javascript
    map.ctrlMode = "MapIdentify";
    map.ctrlAction = "Point";
    map.ctrlCursor = "pointer";
    map.ctrlFunction = "MapIdClick(e)";
    if (newLoad) {
        // execute only on intial load.... not callbacks

```

```

map.divObject.style.cursor = "wait";
// move magnifier and measure toolbar to top left corner of map display
var box = calcElementPosition("Map_Panel");
var mag = document.getElementById("Magnifier1");
if (mag!=null && typeof(esriMagnifiers)!="undefined" && esriMagnifiers!=null) {
    floatingPanel = esriMagnifiers["Magnifier1"].floatingPanel;
    if (floatingPanel!=null) moveTo(box.left, box.top);
}
var tb = document.getElementById(m_measureToolbarId);
if (tb!=null) {
    tb.style.left = box.left + "px";
    tb.style.top = box.top + "px";
}
var fp = document.getElementById("CopyrightText_Panel");
if (fp!=null) {
    floatingPanel = fp;
    moveTo(box.left, box.top);
}
if (webMapAppScaleBar!=null) window.setTimeout("positionScalebar();", 1000);
}
// set window resize event handler
window.onresize = AdjustMapSizeHandler;
for (var fp in FloatingPanels) {
    FloatingPanels[fp].onDockFunction = scrollDockToPanel;
}
}

// function to request closing of session items.... only called if at least one resource is local non-
pooled
function CloseOut() {
    var argument = "ControlID=Map1&ControlType=Map&EventArg=CloseOutApplication";
    var context = map.controlName;
    eval(webMapAppCloseCallback);
}

// response function to close out browser ... request sent to server by CloseOut()
function CloseOutResponse(response, context) {
    window.close();
    // if user selects Cancel in close dialog, send to close page
    document.location = response;
}

```

```

function startWebMapAppDockDrag(e) {
    if (!webMapAppDockMoving) {
        webMapAppMoveFunction = document.onmousemove;
        webMapAppDockMoving = true;
    }
    document.onmouseup = stopWebMapAppDocDrag;
    if (webMapAppPanelDisplay.style.display!="none") {
        webMapAppWindowWidth = getWinWidth();
        getXy(e);
        webMapAppLeftOffsetX = mouseX - webMapAppPanelDisplay.clientWidth;
        var box = calcElementPosition("Map_Panel");
        webMapAppRightOffsetX = box.left - mouseX;
        document.onmousemove = moveWebMapAppDockDrag;
        var ovPanel = document.getElementById("OverviewMap_Panel_BodyRow");
        var ovDisplay = document.getElementById("OVDiv_OverviewMap_Panel_OverviewMap1");
        // because the panel cell will be as wide as the overview map image, keep the element width larger
        than the image.
        if (FloatingPanels["OverviewMap_Panel"]!=null &&FloatingPanels["OverviewMap_Panel"].docked)
            webMapAppMinDockWidth = parseInt(ovDisplay.style.width) + 20;
        else
            webMapAppMinDockWidth = webMapAppDefaultMinDockWidth;
    }
    return false;
}

function moveWebMapAppDockDrag(e) {
    getXy(e);
    var theButton = (isIE) ? event.button : e.which;
    if (theButton==0) stopWebMapAppDocDrag(e)
    webMapAppLeftPanelWidth = mouseX - webMapAppLeftOffsetX;
    var sWidth = getWinWidth();
    if (webMapAppLeftPanelWidth>sWidth-webMapAppToggleDisplay.clientWidth-2)
webMapAppLeftPanelWidth=sWidth-webMapAppToggleDisplay.clientWidth-2;
    if (webMapAppLeftPanelWidth < webMapAppMinDockWidth) webMapAppLeftPanelWidth = webMapAppMinDockWidth;
    var mapLeftString = (webMapAppLeftPanelWidth + webMapAppToggleDisplay.clientWidth) + "px";
    var widthString = webMapAppLeftPanelWidth + "px";
    webMapAppPanelDisplay.style.width = widthString;
    var width = webMapAppWindowWidth - webMapAppPanelDisplayCell.clientWidth;
    if (width<1) width = 1;
}

```



```

    webMapAppMapDisplay.style.width = width + "px";
    webMapAppMapDisplay.style.left = mapLeftString;
    return false;
}

function stopWebMapAppDocDrag(e) {
    document.onmousemove = webMapAppMoveFunction;
    document.onmouseup = null;
    webMapAppDockMoving = false;
    webMapAppCheckPanelWidths();
    AdjustMapSize();
    return false;
}

function OpenWindow(url) {
    window.open(url);
}

function webMapAppCheckPanelScroll() {
    if (webMapAppHasScroll!=webMapAppLastHasScroll)
        AdjustMapSize();
    webMapAppLastHasScroll = webMapAppHasScroll;
    return false;
}

function webMapAppCheckPanelWidths() {
    var maxWidth = 0;
    var node;
    for (var i=0; i< webMapAppPanelDisplay.childNodes.length; i++) {
        if (webMapAppPanelDisplay.childNodes[i].tagName=="TABLE") {
            node = webMapAppPanelDisplay.childNodes[i];
            if (node.clientWidth>maxWidth) maxWidth = node.clientWidth;
        }
    }
    webMapAppPanelDisplay.style.width = maxWidth + "px";
    return false;
}

function webMapAppGetCopyrightText() {
    var argument = "ControlID=Map1&ControlType=Map&EventArg=GetCopyrightText";
    var context = map.controlName;

```

```

        eval(webMapAppCopyrightCallback);
        showFloatingPanel('CopyrightText_Panel');
    }

function scrollDockToPanel(panelElement) {
    if (panelElement==null) return;
    var yPos = panelElement.offsetTop;
    webMapAppPanelScrollDiv.scrollTop = yPos;
}

function toggleMetal() {
    var mag1 = document.getElementById("Metal");
    if (mag1!=null) {
        toggleFloatingPanelVisibility('Metal');
    } else
        alert("Metadata is not available");
}

function togglet3d() {
    var mag5 = document.getElementById("t3d");
    if (mag5!=null) {
        toggleFloatingPanelVisibility('t3d');
    } else
        alert("Print is not available");
}

function togglecharting() {
    var mag6 = document.getElementById("charting");
    if (mag6!=null) {
        toggleFloatingPanelVisibility('charting');
    } else
        alert("Print is not available");
}

function toggleprint() {
    var mag2 = document.getElementById("LayoutSOETask1");
    if (mag2!=null) {
        toggleFloatingPanelVisibility('LayoutSOETask1');
    } else
        alert("Print is not available");
}

```

```
}
function togglequery() {
    var mag3 = document.getElementById("QueryBuilderTask1");
    if (mag3!=null) {
        toggleFloatingPanelVisibility('QueryBuilderTask1');
    } else
        alert("Query is not available");
}
function toggleselect() {
    var mag4 = document.getElementById("SelectToolTask1");
    if (mag4!=null) {
        toggleFloatingPanelVisibility('SelectToolTask1');
    } else
        alert("Selection is not available");
}
function positionScalebar() {
    var sWidth = getWinWidth();
    var sHeight = getWinHeight();
    var sbWidth = webMapAppScaleBar.clientWidth;
    var sbHeight = webMapAppScaleBar.clientHeight;
    webMapAppScaleBar.style.left = (sWidth - sbWidth - 10) + "px";
    webMapAppScaleBar.style.top = (sHeight - sbHeight - 10) + "px";
}
```

Appendix 4 – Add Query Tool

The Add Query tool allows the user to select records from a map layer based on attributes and values. The source code for the Query task was downloaded from <http://arcscripts.esri.com/details.asp?dbid=15292>. The following steps ensure that the tool is properly installed in the application.

- 1) Insert assembly registration code into line 13 of the Default.aspx file.

```
<%@ Register Assembly="Studioat.ARCGIS.ADF.Tasks.QueryBuilderTask, Version=9.2.4.1420, Culture=neutral,
PublicKeyToken=f96bdf56e497392b" Namespace="Studioat.ARCGIS.ADF.Tasks.QueryBuilderTask"
TagPrefix="ccQueryBuilderTask" %>
```

- 2) Add JavaScript togglequery function to line 368 of the WebMapApp.js file.

```
function togglequery() {
    var mag3 = document.getElementById("QueryBuilderTask1");
    if (mag3!=null) {
        toggleFloatingPanelVisibility('QueryBuilderTask1');
    } else
        alert("Query is not available");
}
```

- 3) The following code interact with the togglequery function in WebMapApp.js to trigger the Query task. Insert this code into line 528 of the Default.aspx file.

```
<%-- Query --%>
```

```
<esri:ToolBar ID="ToolBar4" runat="server" BuddyControlType="Map" Group="ToolBar1_Group" Height="50px"
Orientation="Vertical" Style="left: 9px; position: static; top: 0px" ToolBarItemDefaultStyle-
BackColor="Transparent" ToolBarItemDefaultStyle-BorderColor="White" ToolBarItemDefaultStyle-
BorderWidth="1px" ToolBarItemDefaultStyle-Font-Names="Verdana" ToolBarItemDefaultStyle-Font-Size="Smaller"
ToolBarItemDisabledStyle-BackColor="Transparent" ToolBarItemDisabledStyle-Font-Names="Verdana"
ToolBarItemDisabledStyle-Font-Size="Smaller" ToolBarItemDisabledStyle-ForeColor="Gray"
ToolBarItemHoverStyle-BackColor="LightSteelBlue" ToolBarItemHoverStyle-BorderColor="Black"
ToolBarItemHoverStyle-BorderStyle="Solid" ToolBarItemHoverStyle-BorderWidth="1px" ToolBarItemHoverStyle-
Font-Bold="True" ToolBarItemHoverStyle-Font-Italic="False" ToolBarItemHoverStyle-Font-Names="Verdana"
ToolBarItemHoverStyle-Font-Size="Smaller" ToolBarItemHoverStyle-ForeColor="Black" ToolBarItemSelectedStyle-
BackColor="WhiteSmoke" ToolBarItemSelectedStyle-BorderColor="Black" ToolBarItemSelectedStyle-
BorderStyle="Solid" ToolBarItemSelectedStyle-BorderWidth="1px" ToolBarItemSelectedStyle-Font-Bold="True"
```

```

ToolbarItemSelectedStyle-Font-Names="Verdana"  ToolbarItemSelectedStyle-Font-Size="Smaller"
WebResourceLocation="/aspnet_client/ESRI/WebADF/" Width="90px" CurrentTool="Full Extent">
<ToolbarItems>
<esri:Command ClientAction="togglequery()" DefaultImage="~/images/query1.gif" JavaScriptFile=""
Name="QueryBuilderTask1" Text="Query" ToolTip="Query by Attribute" />
<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>

```

- 4) The following code uses the Grid Results Control as a Results window for the Query task. Insert this code into line 745 of the Default.aspx file.

```

<ccQueryBuilderTask:QueryBuilderTask ID="QueryBuilderTask1" runat="server"
BackColor="White" BorderColor="Black" BorderWidth="1px" Font-Bold="True" Font-Names="Verdana" Font-
Size="8pt" ForeColor="Black" Map="Map1" MapResourceName="Layers" Title="Query by Attribute" Width="100px"
Visible="False" FeatureSelectionColor="Transparent" SelectedSetColor="Transparent" SetColor="Transparent"
FillBoundaryColor="Transparent" FillBoundaryColorSelected="Transparent" MarkerOutlineColor="Transparent"
MarkerOutlineColorSelected="Transparent" Transparency="0" FillBoundaryTransparency="100"
FillBoundaryTransparencySelected="100" LineTransparency="100" LineTransparencySelected="100"
MarkerTransparency="100" MarkerTransparencySelected="100" FillTransparency="100"
FillTransparencySelected="100" BorderStyle="Outset" Docked="False" ExpandCollapseButton="False"
TitleBarColor="#00525E" TitleBarForeColor="White">
<TaskResultsContainers>
<esri:BuddyControl Name="GridResults1">
</esri:BuddyControl>
</TaskResultsContainers>
</ccQueryBuilderTask:QueryBuilderTask>

```

- 5) Restart IIS to complete installation.

Appendix 5 – Add Select(s) Tool

The Add Select(s) tool enable user to select features from a list of map layers by drawing a point, a line, a rectangle, a polygon or a circle on the map. The source code of the Select task is collected from <http://arcsripts.esri.com/details.asp?dbid=15133>. The following steps ensure the tool is properly installed into the application.

1. Insert assembly registration code into line 14 of the Default.aspx file

```
<%@ Register Assembly="SelectToolTask, Version=1.0.0.0, Culture=neutral, PublicKeyToken=9eb0bc47879e56ec"
    Namespace="SelectToolTask" TagPrefix="ccl" %>
```

2. Insert toggleselect function into line 376 of the WebMapApp.js file

```
function toggleselect() {
    var mag4 = document.getElementById("SelectToolTask1");
    if (mag4!=null) {
        toggleFloatingPanelVisibility('SelectToolTask1');
    } else
        alert("Selection is not available");
}
```

3. Insert the following code into line 554 of the Default.aspx file. They call the toggleselect function to trigger the Selection task.

```
<%-- Select Feature(s) --%>
<esri:ToolBar ID="ToolBar9" runat="server" BuddyControlType="Map" Group="ToolBar1_Group" Height="59px"
Orientation="Vertical" Style="left: 4px; position: static; top: 0px" ToolBarItemDefaultStyle-
BackColor="Transparent" ToolBarItemDefaultStyle-BorderColor="White" ToolBarItemDefaultStyle-
BorderWidth="1px" ToolBarItemDefaultStyle-Font-Names="Verdana" ToolBarItemDefaultStyle-Font-Size="Smaller"
ToolBarItemDisabledStyle-BackColor="Transparent" ToolBarItemDisabledStyle-Font-Names="Verdana"
ToolBarItemDisabledStyle-Font-Size="Smaller" ToolBarItemDisabledStyle-ForeColor="Gray"
ToolBarItemHoverStyle-BackColor="LightSteelBlue" ToolBarItemHoverStyle-BorderColor="Black"
ToolBarItemHoverStyle-BorderStyle="Solid" ToolBarItemHoverStyle-BorderWidth="1px" ToolBarItemHoverStyle-
Font-Bold="True" ToolBarItemHoverStyle-Font-Italic="False" ToolBarItemHoverStyle-Font-Names="Verdana"
ToolBarItemHoverStyle-Font-Size="Smaller" ToolBarItemHoverStyle-ForeColor="Black" ToolBarItemSelectedStyle-
BackColor="WhiteSmoke" ToolBarItemSelectedStyle-BorderColor="Black" ToolBarItemSelectedStyle-
BorderStyle="Solid" ToolBarItemSelectedStyle-BorderWidth="1px" ToolBarItemSelectedStyle-Font-Bold="True"
ToolBarItemSelectedStyle-Font-Names="Verdana" ToolBarItemSelectedStyle-Font-Size="Smaller"
WebResourceLocation="/aspnet_client/ESRI/WebADF/" Width="87px">
<ToolBarItems>
<esri:Command ClientAction="toggleselect()" DefaultImage="~/images/select_poly_1.gif" JavaScriptFile=""
Name="SelectToolTask1" Text="Select Feature(s)" ToolTip="Spatial selection of map feature(s)" />
```

```
<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>
```

4. Insert the following code into line 754 of the Default.aspx file for using the Grid Results Control as a result container.

```
<!-- Spatial Selection task panel -->
<cc1:selecttooltask id="SelectToolTask1" runat="server" bgcolor="White" bordercolor="Black"
borderstyle="Outset" borderwidth="1px" docked="False" font-names="Verdana" font-size="8pt"
forecolor="Black" showlegend="True" title="Spatial Selection" titlebarcolor="#00525E" titlebarheight="20px"
transparency="0" visible="False" width="200px" ResultsTitle="Spatial Selection" TitleBarForeColor="White"
Font-Bold="True" PointSelectionTolerance="10" SelectedSetColor="Transparent"
FeatureSelectionColor="Transparent" HidePreviousSelections="False" RenderSelectedSet="False"
ExpandCollapseButton="False">
<TaskResultsContainers>
<esri:BuddyControl Name="GridResults1">
</TaskResultsContainers>
</cc1:selecttooltask>
```

5. Restart IIS to complete installation.

Appendix 6 – Floating Window for Displaying Results from Select Feature(s) and Query Tools

The following code will create a common floating window to display results from the Select Feature(s) and Query tools. Insert this code into line 141 of the Default.aspx file.

```
<!-- Grid Results Panel -->
<esri:FloatingPanel ID="Results1" runat="server" BackColor="White" BorderColor="Black" BorderStyle="Outset"
BorderWidth="1px" Docked="False" Font-Bold="False" Font-Names="Verdana" Font-Size="7pt" ForeColor="Black"
Height="194px" HeightResizable="True" Style="left: 26%;margin-bottom: 0px; position: absolute; top: 35%"
Title="Results" TitleBarColor="#00525E" TitleBarForeColor="White" TitleBarHeight="20px"
TitleBarSeparatorLine="True"
Transparency="0" Visible="False" Width="416px">
<span style="font-size: 6.5pt; color: red"><span style="color: #000000"></span><span style="background-
color: #cccccc"><span style="font-size: 7pt; color: #000000"></span>
</span></span>
<esri_samples:gridResults ID="GridResults1" runat="server" BackColor="White" BorderColor="Black"
BorderStyle="None" Font-Names="Arial" Font-Size="7pt" ForeColor="Black" Height="100%" Map="Map1"
Style="clear: right; left: 0px; overflow: auto; position: absolute; top: 0px" Visible="True" Width="100%"
/>
</esri:FloatingPanel>
```


Appendix 7 – Grid Results Control

The Grid Results Container displays results returned by the Query and Select Feature(s) tools. An export option has been added to export these results in XLS (Excel) or CSV (comma separated) format. Source code for this control was downloaded from ESRI Support Center (<http://arcscripts.esri.com/details.asp?dbid=15452>) [January 27, 2009].

The following steps describe how to add this control to Visual Studio and to modify code for this application:

- 1) In Visual Studio, navigate to the directory where the GridResults project file is stored and open the project.

The assembly is created after modifying the source code of GridResults. To add source code to your application:

File → Open → Project/Solution and browse the directory of the GridResults project file (Figure 12).

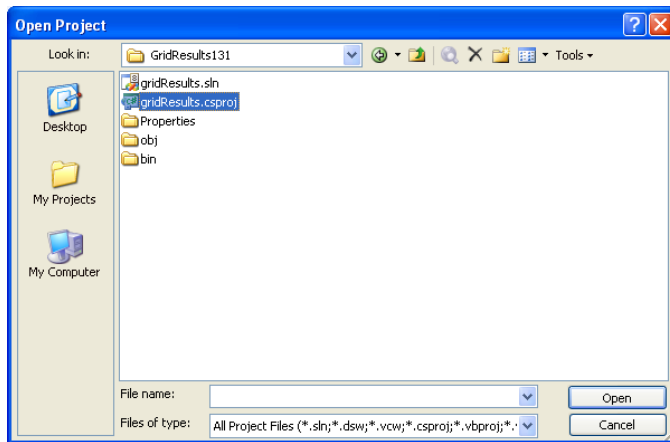


Figure 12. Open project in Visual Studio for adding the Grid Results Control.

- 2) Ignore any error messages that you might experience while opening the GridResults project.
- 3) Add the following code to line 257 inside the switch (kVC["EventArg"]) function of the public override string GetCallbackResult() function in the gridResults.cs file:

```
case "gridViewExport":  
    //This is the Export Link above the Grid Results and  
    //below code exports the gridview results to Excel file
```

```

GridView gv = (GridView)Page.Session["gview"];
// this for loop is to hide the Zoom,Pan, Report, Check box fields
// while exporting the excel sheet
foreach (TemplateField dColumn in gv.Columns)
{
    if (dColumn.HeaderText == "Selected")
    {
        dColumn.Visible = false;
        break;
    } dColumn.Visible = false;
}
string strFileName = String.Empty, strFilePath = String.Empty;
strFileName = (HttpContext.Current.Session["HttpSessionID"] + "Export.xls");
strFilePath = HttpContext.Current.Server.MapPath("./ExportData/") +
strFileName;

if (File.Exists(strFilePath))
{
    File.Delete(strFilePath);
}
System.IO.StringWriter oStringWriter = new StringWriter();
System.Web.UI.HtmlTextWriter oHtmlTextWriter = new
HtmlTextWriter(oStringWriter);
StreamWriter objStreamWriter;
objStreamWriter = File.AppendText(strFilePath);
gv.RenderControl(oHtmlTextWriter);
objStreamWriter.WriteLine(oStringWriter.ToString());
objStreamWriter.Close();
string strScript = "window.open('./ExportData/' + strFileName + "','Export');";
CallbackResults.Add(new CallbackResult(Parent, "javascript", strScript));
break;

```

4) Insert the following code into line 756 inside the `private void addResultsGridToPanel(DataTable dt, Panel pGridPanel)` function:

```

//Add a comma between the links
pGridPanel.Controls.Add(new LiteralControl(", "));
//Add Export link
string sExportCallback =
    string.Format("var argument = 'EventArg={0}&TableID={1}';var context =
'gridResults';{2};return false;",
    "gridViewExport", iTableID, CallbackFunctionString);

```

```
HyperLink hyperExport = new HyperLink();
hyperExport.NavigateUrl = ".";
hyperExport.Text = "Export table";
hyperExport.Attributes.Add("onclick", sExportCallback);
hyperExport.ToolTip = "Export all results";
pGridPanel.Controls.Add(hyperExport);
Page.Session.Add("gview", pGview);
```

- 5) Insert the following code into line 683 inside the foreach (DataColumn dc in dt.Columns) of private void addResultsGridToPanel(DataTable dt, Panel pGridPanel) function for hiding the Shape_Length and Shape_Area field from grid result columns:

```
if (dc.ColumnName != pGl.GraphicsIDColumn.ColumnName
    && dc.ColumnName.ToUpper() != pGl.IsSelectedColumn.ColumnName.ToUpper()
    && dc.ColumnName.ToUpper() != pGl.GeometryColumnName.ToUpper()
    && dc.ColumnName != "Shape_Length"
    && dc.ColumnName != "Shape_Area"
    && dc.ColumnName != c_sTableIdColumnName)
```

- 6) Build the modified GridResult assembly in Visual Studio to create the Grid Results Control (Figure 13).

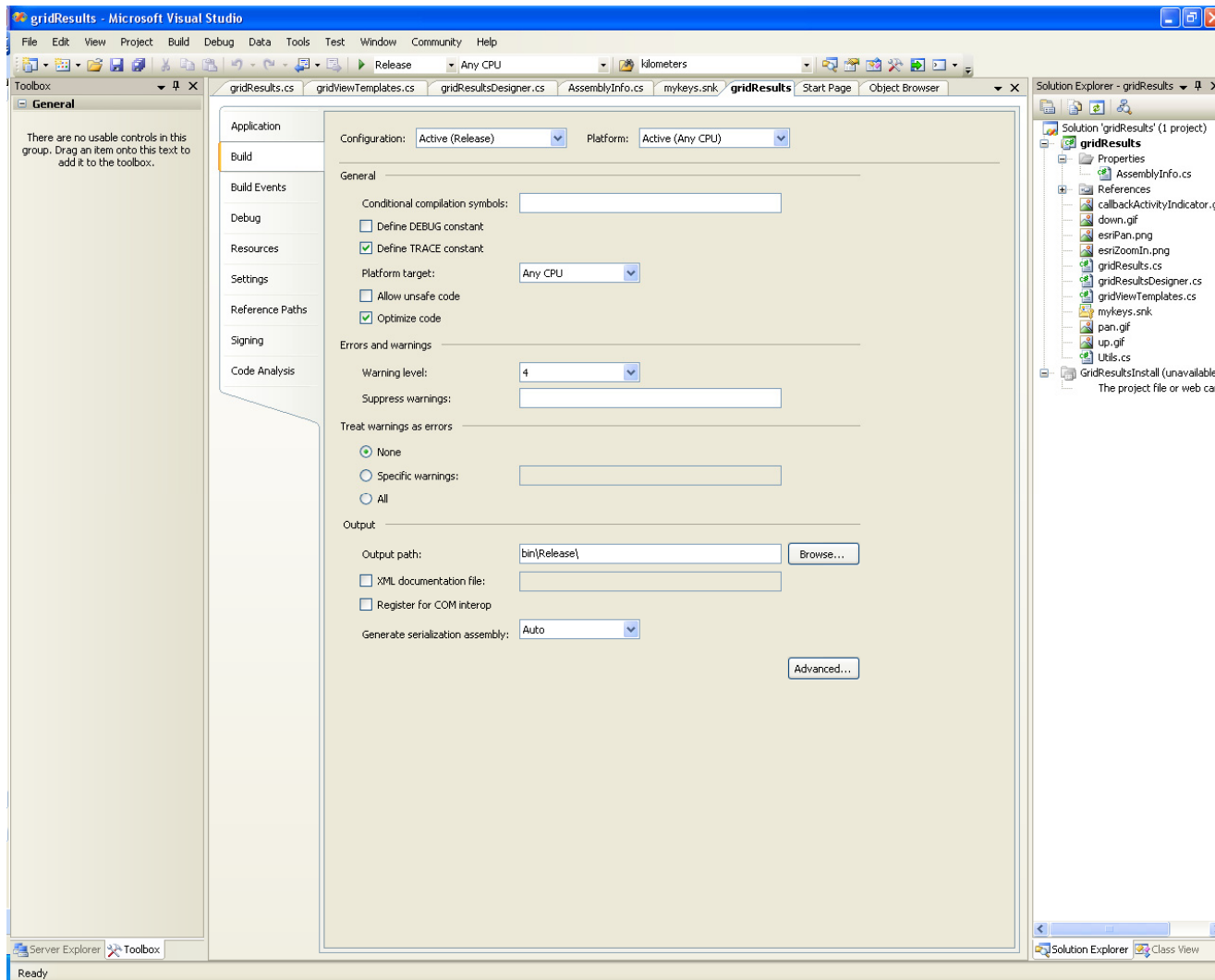


Figure 13. Select an output location for the assembly.

7) Insert the following code into line 7 of the Default.aspx file to register the Grid Results Control:

```
<%@ Register Assembly="gridResults, Version=1.3.1.0, Culture=neutral, PublicKeyToken=4117b0729e6ae73a"  
    Namespace="esri_samples" TagPrefix="esri_samples" %>
```

Appendix 8 – Add Dynamic Scale

Dynamic Scale reflects map-scale changes while zooming in or out in the map display window.

1) Insert the following code into line 9 of the Default.aspx file to register the scale:

```
<%@ Register Src="SetScale.ascx" TagName="SetScale" TagPrefix="ss" %>
```

2) Insert the following code into line 663 in the Default.aspx file for adding map scale to the overview map:

```
<!-- Dynamic Map Scale --> <ss:SetScale ID="SetScaleControl" runat="server" />
```

3) Replace all code in the SetScale.ascx file with the following code:

```
<%@ Control Language="C#" AutoEventWireup="true" CodeFile="SetScale.ascx.cs" Inherits="SetScale" %>
```

```
<select id="ScaleDdl" style="position: absolute; top:0px; left:0px; width: 196px;" onchange="return SetScale();" >
```

```
    <option value="Other">Enter a Map Scale (e.g. 100)</option>
```

```
    <option value="2000">1:2000</option>
```

```
    <option value="5000">1:5000</option>
```

```
    <option value="5000">1:5000</option>
```

```
    <option value="10000">1:10000</option>
```

```
    <option value="25000">1:25000</option>
```

```
</select>
```

```
<input id="ScaleTxt" type="text" style="position: absolute; top:0px; left:0px; visibility:hidden; width: 195px;" onkeypress="return HandleEnter(this, event);" />
```

```
<script type="text/javascript" language="javascript">
```

```
    function SetScale() {
        var ScaleDdl = document.getElementById('ScaleDdl');
        var ScaleTxt = document.getElementById('ScaleTxt');
        var ScaleValue = ScaleDdl.options[ScaleDdl.selectedIndex].value;
        if (ScaleValue == 'Other') {
            // show the input box instead of the select dropdown
            ScaleDdl.style['visibility'] = 'hidden';
            ScaleTxt.style['visibility'] = 'visible';
        } else {
            SetMapScale(ScaleValue);
        }
    }
}
```

```

function SetMapScale(Scale) {
    var Message = 'ControlType=Map&Event=SetScale&Scale=' + Scale;
    var Context = 'Map1';
    <%=mCallbackInvocation %>
}

function UpdateScaleDdl(Scale) {
// check to see if Scale is already in the DDL, if not add it, otherwise select it
    var ScaleDdl = document.getElementById('ScaleDdl');
    var Options = ScaleDdl.options;
    var Found = false;
    for (var i=0; i<Options.length; i++) {
        if (Options[i].value == Scale) {
            Found = true;
            ScaleDdl.selectedIndex = i;
        }
    }
    if (!Found) {
        if (Options.length == 10) {
            Options[Options.length-1] = new Option('1:' + Scale, Scale);
            Options[Options.length] = new Option('(Other)', 'Other');
        } else {
            Options[Options.length-2] = new Option('1:' + Scale, Scale);
            ScaleDdl.selectedIndex = Options.length-2;
        }
    }
}

function HandleEnter (field, event) {
    var keyCode = event.keyCode ? event.keyCode : event.which ? event.which : event.charCode;
    if (keyCode == 13) {
        var ScaleDdl = document.getElementById('ScaleDdl');
        var ScaleTxt = document.getElementById('ScaleTxt');
        var Options = ScaleDdl.options;

        // check if they entered an integer > 0 (a valid scale)
        var Scale = parseFloat(field.value);
        if (isNaN(Scale) || Scale == 0) {
            alert('Please enter a valid number greater than 0 for the scale');
            return false;
        }
    }
}

```

```

        if (Options.length == 10) {
            Options[Options.length-1] = new Option('1:' + Scale, Scale);
            Options[Options.length] = new Option('(Other)', 'Other');
        } else {
            Options[Options.length-2] = new Option('1:' + Scale, Scale);
        }
        ScaleDdl.selectedIndex = Options.length-2;

        ScaleDdl.style['visibility'] = 'visible';
        ScaleTxt.style['visibility'] = 'hidden';
        ScaleTxt.value = '';
        SetMapScale(Scale);
        return false;
    } else
        return true;
}
</script>

```

4) Replace all code in the SetScale.ascx.cs file with the following code:

```

using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Collections.Specialized;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
using ESRI.ArcGIS.ADF.Web;
using ESRI.ArcGIS.ADF.Web.UI.WebControls;
using ESRI.ArcGIS.ADF.Web.DataSources;
using ESRI.ArcGIS.ADF.Web.DataSources.ArcGISServer;
using ESRI.ArcGIS.ADF.Connection.AGS;
using ESRI.ArcGIS.Server;
using ESRI.ArcGIS.ADF.Web.DataSources.Graphics;
using ESRI.ArcGIS.ADF.Web.Display.Graphics;
using ESRI.ArcGIS.ADF.Web.Display.Symbol;
using ESRI.ArcGIS.ADF.Web.Geometry;

```



```

public partial class SetScale : System.Web.UI.UserControl, ICallbackEventHandler
{
    private string mMapBuddyId = "Map1";
    public string mCallbackInvocation = "";
    Map mMap;

    protected void Page_Load(object sender, EventArgs e)
    {
        if (mMapBuddyId == null || mMapBuddyId.Length == 0) mMapBuddyId = "Map1";
        mMap = this.Page.FindControl(mMapBuddyId) as Map;
        mCallbackInvocation = this.Page.ClientScript.GetCallbackEventReference(this, "Message",
"processCallbackResult", "Context", true);
        mMap.ScaleChanged += new MapScaleChangeEventHandler(mMap_ScaleChanged);
    }
    // update the scale properly
    void mMap_ScaleChanged(object sender, ScaleEventArgs args)
    {
        int Scale = Convert.ToInt32(mMap.Scale);
        string UpdateDdl = "UpdateScaleDdl('" + Scale + "')";
        mMap.CallbackResults.Add(new CallbackResult(mMap, "JavaScript", UpdateDdl));
    }

    protected void Page_PreRenderComplete(object sender, EventArgs e)
    {
        double Scale = mMap.Scale;
    }

    #region ICallbackEventHandler Members
    private string _callbackArg;
    #endregion

    #region ICallbackEventHandler Members

    string ICallbackEventHandler.GetCallbackResult()
    {
        return RaiseCallbackEvent(_callbackArg);
    }
    void ICallbackEventHandler.RaiseCallbackEvent(string eventArgument)
    {
        _callbackArg = eventArgument;
    }

```

```

    }

public virtual string RaiseCallbackEvent(string RequestString)
{
    // break out the responseString into a querystring
    Array KVPairs = RequestString.Split("&".ToCharArray());
    NameValueCollection QueryString = new NameValueCollection();
    string[] KV;
    string Resp = "";
    if (KVPairs.Length > 0)
    {
        for (int i = 0; i < KVPairs.Length; i++)
        {
            KV = KVPairs.GetValue(i).ToString().Split("=".ToCharArray());
            QueryString.Add(KV[0], KV[1]);
        }
    }
    else
    {
        KV = RequestString.Split("=".ToCharArray());
        if (KV.Length > 0)
            QueryString.Add(KV[0], KV[1]);
    }
    // isolate control type and mode
    string ControlType = QueryString["ControlType"];
    if (ControlType == null) ControlType = "Map";
    if (ControlType == "Map" && QueryString["Event"] == "SetScale")
    {
        double CurrentScale = mMap.Scale;
        double NewScale = double.Parse(QueryString["Scale"]);
        double ZoomFactor = CurrentScale / NewScale;
        mMap.Zoom(ZoomFactor);
        mMap.Refresh();
        Resp = mMap.CallbackResults.ToString();
    }
    return Resp;
}
#endregion
#region Properties
public string MapBuddyId
{

```

```
        get { return mMapBuddyId; }
        set { mMapBuddyId = value; }
    }
#endregion
}
```

Appendix 9 – Add Description Tool

The Description tool opens a floating window with hyperlinks to pages containing a detailed description of each sensor in the network.

1) Insert the following toggleMetal function into line 336 of the WebMapApp.js file:

```
function toggleMetal() {  
    var mag1 = document.getElementById("Metal");  
    if (mag1!=null) {  
        toggleFloatingPanelVisibility('Metal');  
    } else  
        alert("Metadata is not available");  
}
```

2) Insert the following code into line 62 of the Default.aspx file to create a Description floating panel called by the toggleMetal function:

```
<%-- Description Panel --%>  
<esri:FloatingPanel ID="Metal" runat="server" BackColor="White" BorderColor="Black" BorderStyle="Outset"  
BorderWidth="1px" Docked="False" Font-Bold="False" Font-Names="Verdana" Font-Size="7pt" ForeColor="Black"  
Height="296px" Style="left: 26%; overflow: auto; position: absolute; top:  
21%" Title="Description" TitleBarColor="#00525E" TitleBarForeColor="White" TitleBarHeight="20px"  
Transparency="0" Visible="False" Width="287px">  
<span style="font-size: 7pt"><span style="background-color: white"><span><span>Layers -  
<br />  
<br />  
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/turtle_mountain.html" target="_blank">  
Historical Monitoring Points</a><br/>  
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/photogrammetry.html"  
target="_blank">Photogrammetry Plate </a><br/>  
</span>  
<br />  
</span></span><span style="background-color: white"><span><span><a  
href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/sensor_network.html" target="_blank">Sensor  
Networks</a><br />  
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/weather_station.html" target="_blank">Weather  
Station</a><br/>  
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/laser_ranging.html" target="_blank">Prism  
Station</a><br />  
<a href="http://www.ags.gov.ab.ca/geohazards/turtle_mountain/tiltmeters.html"  
target="_blank">Tiltmeter</a><br />
```

```

<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/seismic_monitoring.html"
target="_blank">Surface Microseismic Sensor</a><br/>
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/surface_extensometers.html"
target="_blank">Extensometer</a><br/>
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/dgps.html" target="_blank">DifferentialGPS
Monitoring Site</a><br/>
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/crackmeter.html" target="_blank">Crack
meter</a><br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/thermistors.html"
target="_blank">Borehole</a><br />
<br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/runout_modelling.html"
target="_blank">Landslide Hazard</a><br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/runout_modelling.html" target="_blank">1933
John Allan Danger Zone:</a> Run-out zone obtained from Empirical model available in 1933.&nbsp;<br/>
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/runout_modelling.html" target="_blank">2000
BGC Danger Zone:</a> Reviewed run-out zone estimated&nbsp;<br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/frank_slide.html" target="_blank">Frank Slide
Boundary</a><br/>
</span>
</span><span><span><br />
<a href="http://www.ag.s.gov.ab.ca/geohazards/turtle_mountain/lidar.html" target="_blank">LiDAR</a><br />
<br />
</span>
<br />
</span></span></span>
</esri:FloatingPanel>

```

3) Insert the following code into line 502 of the Default.aspx file to create the Description tool button:

```

<%-- Description --%>
<esri:Toolbar ID="Toolbar10" runat="server" BuddyControlType="Map" Group="Toolbar1_Group" Height="50px"
Orientation="Vertical" Style="left: 7px; position: static; top: 12px" ToolbarItemDefaultStyle-
BackColor="Transparent" ToolbarItemDefaultStyle-BorderColor="White" ToolbarItemDefaultStyle-
BorderWidth="1px" ToolbarItemDefaultStyle-Font-Names="Verdana" ToolbarItemDefaultStyle-Font-Size="Smaller"
ToolbarItemDisabledStyle-BackColor="Transparent" ToolbarItemDisabledStyle-Font-Names="Verdana"
ToolbarItemDisabledStyle-Font-Size="Smaller" ToolbarItemDisabledStyle-ForeColor="Gray"
ToolbarItemHoverStyle-BackColor="LightSteelBlue"
ToolbarItemHoverStyle-BorderColor="Black" ToolbarItemHoverStyle-BorderStyle="Solid" ToolbarItemHoverStyle-
BorderWidth="1px" ToolbarItemHoverStyle-Font-Bold="True" ToolbarItemHoverStyle-Font-Italic="False"
ToolbarItemHoverStyle-Font-Names="Verdana" ToolbarItemHoverStyle-Font-Size="Smaller" ToolbarItemHoverStyle-

```

```
ForeColor="Black" ToolbarItemSelectedStyle-BackColor="WhiteSmoke" ToolbarItemSelectedStyle-
BorderColor="Black" ToolbarItemSelectedStyle-BorderStyle="Solid" ToolbarItemSelectedStyle-BorderWidth="1px"
ToolbarItemSelectedStyle-Font-Bold="True" ToolbarItemSelectedStyle-Font-Names="Verdana"
ToolbarItemSelectedStyle-Font-Size="Smaller" WebResourceLocation="/aspnet_client/ESRI/WebADF/"
Width="90px">
<ToolbarItems>
<esri:Command ClientAction="toggleMeta1()" DefaultImage="~/images/defaultMapTip.gif" JavaScriptFile=""
Name="Meta1" Text="Description" ToolTip="Background Information of Layers" />
<esri:Space Size="1" />
</ToolbarItems>
<BuddyControls>
<esri:BuddyControl Name="Map1" />
</BuddyControls>
</esri:Toolbar>
```

Appendix 10 – Add Cortona VRML Viewer

Cortona VRML is a free browser plug-in that can be downloaded from <http://www.parallelgraphics.com/bin/cortvrml.exe>. For an easy control system, after completing the installation process, just open the VRML model in your browser, right-click anywhere in the 3-D model and click on Preferences → Skin tab → and choose CAD-like skin. Once you have installed the plug-in and changed the settings, you do not have to install or change any settings the next time you view any VRML model from the web.

The best way to view the VRML model in a browser without installing any plug-in is to save the following code in .htm format. Just copy the code to the Notepad and rename it to xxxxx.htm. Make sure to replace the path of the .wrl file inside <PARAM NAME="SRC" VALUE="type the path of the .wrl file here">.

```
<OBJECT CLASSID="CLSID:86A88967-7A20-11d2-8EDA-00600818EDB1"
CODEBASE="http://www.parallelgraphics.com/bin/cortvrml.cab#Version=5,1,0,167"
WIDTH="1152" HEIGHT="846">
<PARAM NAME="SRC" VALUE="http:xxx/**.wrl">
<param name="Skin" value="{46BB95BF-8EB4-481A-A1EF-50D43FC32B9D};
http://www.parallelgraphics.com/bin/cad.zip">
<PARAM NAME="VRML_BACKGROUND_COLOR" VALUE="#CDCDCD">
<PARAM NAME="CONTEXTMENU" VALUE="true">
</OBJECT>
```

Open the .wrl file in Notepad and reduce the speed to 0.2 (depending on how precise you want the zooming and panning control). The following portion of the code shows adjusted speed inside the NavigationInfo function in the .wrl file.

```
NavigationInfo
{headlight FALSE speed 0.200}
```

VRML tutorials are available at following websites:

<http://www.vislab.uq.edu.au/users/manuals/vrml97/slides/mt0017.htm>

<http://gis.washington.edu/esrm250/lessons/3d/exercise/index.html#vrml>

<http://docs.rinet.ru/MultiG/appb.htm#GroupingNodes>

Appendix 11 – Add .netCharting Tool

.netCharting is the only non-GIS tool in the application. It is a powerful charting tool created by WebAvail Productions Inc. This tool has been modified and incorporated in the application to chart readings from the various sensor networks.

- 1) Download and install application to a folder.
- 2) Modify default config.sys to connect to your database.
- 3) Open properties of the IIS Manager of that folder.
- 4) In the Directory tab, create an Application name and click OK (Figure 14).
- 5) Give the ASPNET\Network Service account 'write' permission to the Temp folder inside the CSharp folder.
- 6) Open TMRTMS.aspx in the CSharpe folder in Internet Explorer for deployment.

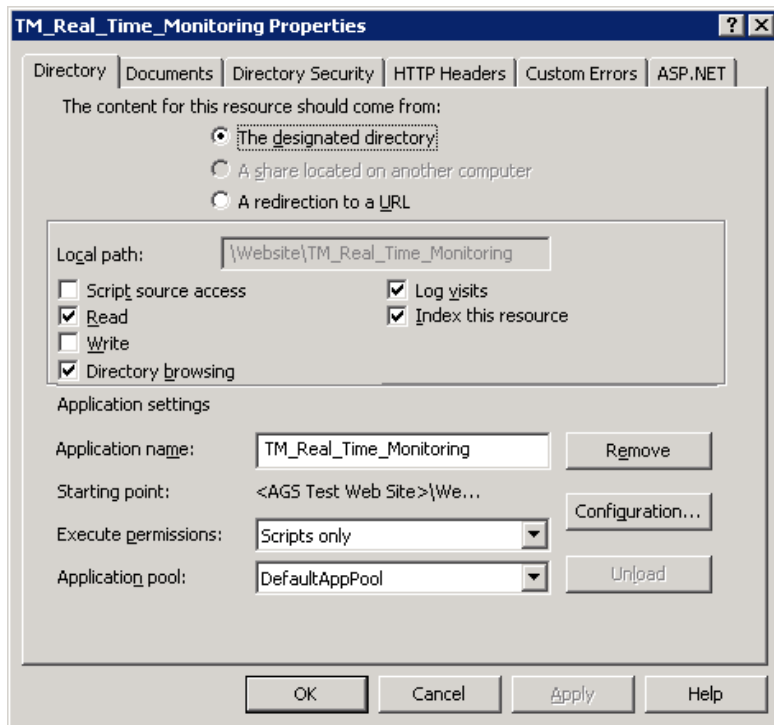


Figure 14. Create an application name for the Charting tool.