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HydroServer Capabilities

Database, Configuration Tool, and Web Services

Tools for publishing the capabilities of a HydroServer

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Distribution

The HydroServer Capabilities Database, Configuration Tool, and Capabilities Web Service and all associated source code and documentation are available at the following URL: http://his.cuahsi.org/.

The HydroServer Capabilities Database, Configuration Tool, and Capabilities Web Service software, source code, and documentation are provide free of charge under the Berkeley Software Distribution (BSD) license. Please see the following license information:

Disclaimers

Although much effort has been expended in the development and testing of the software described in this document, errors and inadequacies may still occur. Users must make the final evaluation as to the usefulness of this software for their application.

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Technical Support

There is no formal ongoing support for this freely distributed open source software. However, we are interested in feedback. If you find errors, have suggestions, or are interested in any later versions, please contact:

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1.0 Introduction and Software Description

The CUAHSI Hydrologic Information System (HIS) Project is developing information technology infrastructure to support hydrologic science. One of the major components of the HIS is a software stack called HydroServer that can be used for storing and publishing hydrologic data. HydroServer includes a point Observations Data Model (ODM), which is a relational database schema that was designed for storing time series data, a suite of data loaders and tools for working with ODM, the WaterOneFlow Web services that publish data stored in an ODM database on the Internet in WaterML format, and the capability to publish geographic information systems (GIS) datasets as spatial data services. Using the HydroServer software stack, server administrators can create any number of observational data services published using the WaterOneFlow web services as well as any number of spatial data services published as Open Geospatial Consortium (OGC) Web Map Services (WMS), Web Coverage Services (WCS), and Web Feature Services (WFS).

The HydroServer Capabilities Database, Configuration Tool, and Capabilities Web Service were created to allow administrators of HydroServers to publish the capabilities of their servers (i.e., the list of services that their HydroServer provides) in a standard way that can be automatically discovered by others. The development of these tools has several advantages. First, they make is so that a HydroServer is self describing. Through a single web service interface, all of the services published on that server and a metadata description for each can be obtained. This simplifies registration of HydroServer capabilities with regional HIS portals and the HIS Central metadata repository, and ensures that the services hosted on a HydroServer can be discovered through centralized search and discovery tools such as Hydroseek, HydroDesktop, and other HIS client applications.

1.1 General Functionality

The software described in this manual includes the blank schema for the HydroServer Capabilities database, the Capabilities Database Configuration Tool, and the Capabilities Web Services. The main objectives of these tools are as follows:

1. Provide a database within which metadata describing the services available on the HydroServer can be stored.
2. Provide a graphical user interface (GUI) tool that allows HydroServer administrators to edit the contents of the HydroServer Capabilities database.
3. Provide a Web Service interface that publishes the contents of the HydroServer capabilities database on the Internet in a machine readable, extensible markup language (XML) format.

1.2 Platform and Minimum System Requirements

The HydroServer Capabilities Database and Capabilities Web Service were designed to be used on HydroServers running Windows Server 2003 or Windows Server 2008 with Microsoft Internet Information Services (IIS) as the web server. Microsoft SQL Server 2005 or Microsoft SQL Server 2008 is also required. In addition, HydroServers must have the Microsoft .Net Framework Version 3.5 installed prior to installing the Capabilities Web Service. Instructions for obtaining the .Net Framework Version 3.5 from Microsoft are included in the Installation Instructions section below.

The Capabilities Database configuration tool can either be run on the HydroServer or on a laptop or desktop computer running Windows XP, Vista, or 7. It also requires the Microsoft .Net Framework Version 3.5. The Configuration Tool is designed to connect to a HydroServer Capabilities database that has been implemented in Microsoft SQL Server on a HydroServer. The Configuration Tool does have the capability to connect to a remote HydroServer Capabilities Database provided that the database server name and Capabilities Database name are known and the user has been given access to, and SQL Server authentication information for, that server and database.

2.0 Installation Information

2.1 Installation Prerequisites

Prior to running the installation for the Capabilities Database Configuration tool or installing the Capabilities Web Services, you must first install the Microsoft .Net Framework Version 3.5. The Capabilities Web Services also require that Windows Internet Information Services (IIS) is installed. If you have Microsoft SQL Server 2008 installed, Version 3.5 of the .Net framework will be installed already. The .Net Framework Version 3.5 is free, and is required to run software applications developed in Microsoft's Visual Studio .Net 2008. If you are running Windows Server 2008 R2, the .Net Framework Version 3.5 is included as part of your operating system, and you can add it as a Windows Feature using the Windows Server 2008 Server Manager. If you are running Windows Server 2003, instructions for downloading and installing the .Net Framework Version 3.5 can be obtained from the Microsoft website via the following URL:

http://www.microsoft.com/downloads/details.aspx?FamilyId=AB99342F-5D1A-413D-8319-81DA479AB0D7&displaylang=en

Once the .Net Framework Version 3.5 has been installed, you can continue with the installation of the Database Configuration Tool and the Capabilities Web Services.

NOTE: Implementing the HydroServer Capabilities database requires that you have an instance of Microsoft SQL Server 2005 or 2008 installed on your HydroServer. If you do not already have an instance of Microsoft SQL Server running, you can download and install Microsoft SQL Server 2008 Express from Microsoft for free. It is recommended that you download and install either the "Runtime with Management Tools" or the "Runtime with Advanced Services" version of SQL Server 2008 express. You can get these products and instructions for installing them at the following Microsoft URL:

http://www.microsoft.com/express/sql/download/

2.1.1 Setting Up a Domain for Your HydroServer

Prior to installing the HydroServer Web applications – e.g., the HydroServer Website, the HydroServer Map Application, the Time Series Analyst, the WaterOneFlow Web Services, and the HydroServer Capabilities Web Services – you will want to create a domain for your HydroServer. You will need to work with the Information Technology professionals within your organization to help you create a domain. Once a domain has been created for your HydroServer, you can proceed in the setup of the HydroServer software.

In implementing the HydroServer Web applications, it is helpful to understand the structure of the overall deployment so that each of the pieces can be implemented correctly. The HydroServer Website was designed to be a parent, or root level, application within a domain that you set up for your HydroServer. For example, if you were to create a domain name for your HydroServer called "icewater.usu.edu," the URL for your HydroServer Website would be at the root level of that domain (i.e., http://icewater.usu.edu/ would be the URL for your HydroServer Website). Each of the other HydroServer Web applications was designed to be a child application of the HydroServer domain. The following shows how the other HydroServer Web applications would be implemented under the HydroServer Website within the same domain:

http://icewater.usu.edu/tsa/ - The Time Series Analyst
http://icewater.usu.edu/map/ - The HydroServer Map application
http://icewater.usu.edu/HydroServerCapabilities/ - the HydroServer Capabilities Web service
http://icewater.usu.edu/LittleBearRiver/ - a WaterOneFlow web service for the Little Bear River experimental watershed
http://icewater.usu.edu/MudLake/ - a WaterOneFlow web service for data collected within Mud Lake at the Bear Lake National Wildlife Refuge

The above example assumes that your HydroServer is serving as the Web server running Microsoft Internet Information Services (IIS), as the database server running Microsoft SQL Server, and as the GIS server running ArcGIS Server. This doesn't have to be the case, though, and there is quite a lot of flexibility for the components of your HydroServer to be spread across multiple machines and implemented within multiple domains. In general, the HydroServer documentation assumes that you are assembling your HydroServer within a single domain.

2.2 Attaching the HydroServer Capabilities Database

The blank HydroServer Capabilities database schema is a Microsoft SQL Server database that can be attached to an instance of Microsoft SQL Server 2005 or 2008. Use the following steps to attach the blank HydroServer Capabilities database to your instance of Microsoft SQL Server. These steps were written using SQL Server Management Studio 2008, but the steps are similar regardless of which version of the Microsoft SQL Server Management Studio you are using.

1. First, ensure that you have installed Microsoft SQL Server. See the previous section if you have not done so.
2. Extract the blank Capabilities Database ("HydroServerCapabilities.mdf") and its log file ("HydroServerCapabilities_log.ldf") from the zip file to a location on your hard drive. It is suggested that you extract your database to the default SQL Server data folder, although this is not required.

> NOTE: You can extract your blank Capabilities Databases to any location on disk. However, if you do so and you have connected to SQL Server using SQL Server authentication and not Windows Authentication, you will have to give SQL Server access to read and write to the folder where you extracted your database prior to attaching it. SQL Server already has access to its default data folder using either SQL Server or Windows authentication and so this is the easiest location in which to work.

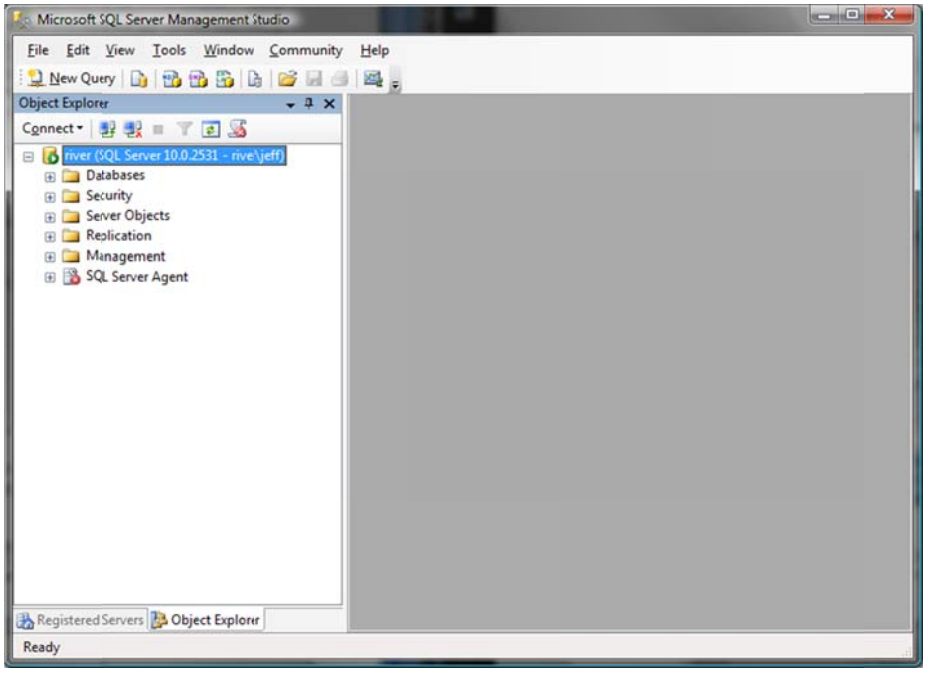
3. Open the Microsoft SQL Server Management Studio from the Start Menu by clicking Start --> All Programs --> Microsoft SQL Server --> SQL Server Management Studio. The following window will appear:

NOTE: The path to your SQL Server Management Studio shortcut in the Start menu may be different depending on which version of SQL Server you have installed and where you chose to put the shortcut in the Start Menu.

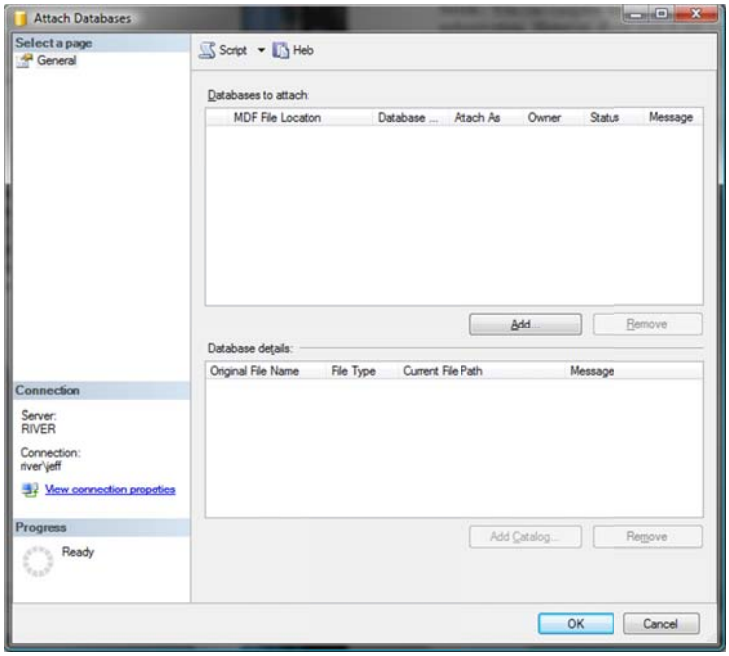
4. For this example, it is assumed that you are connecting to your local instance of SQL Server. Enter "(local)" for the Server name, and then supply either a valid SQL Server authentication login or select "Windows Authentication" from the Authentication drop down list. Your login screen should look similar to the following:

NOTE: You can complete these steps using Windows Authentication rather than SQL Server authentication. However, if you wish to use the Capabilities Database Configuration tool with this database you will be required to have a SQL Server authentication login for the database that you are attaching.

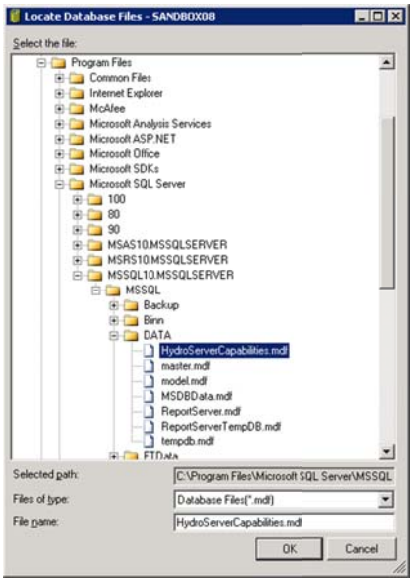
5. Click on the "Connect" button. This will connect SQL Server Management Studio to your local SQL Server instance. Your Management Studio should now look similar to the following:



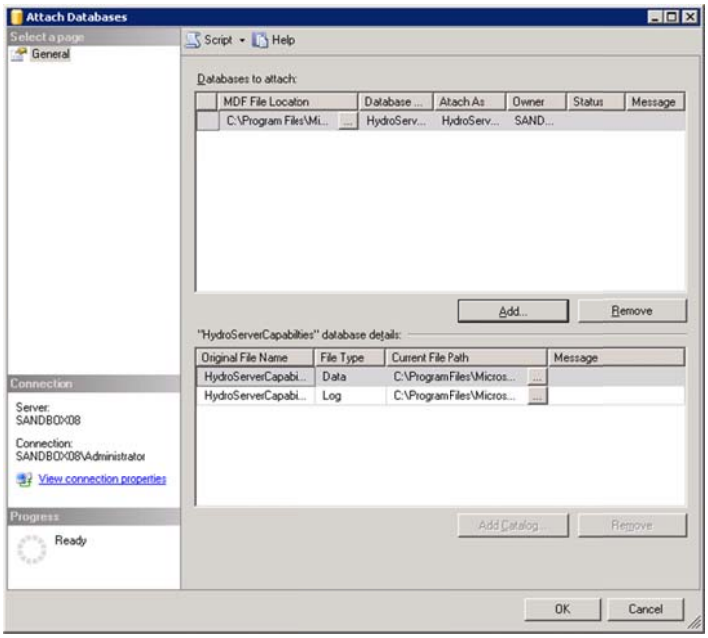
6. Right click on the “Databases” item under your server in the Object Explorer at the left of the window and choose “Attach” from the context menu. The following window will appear:



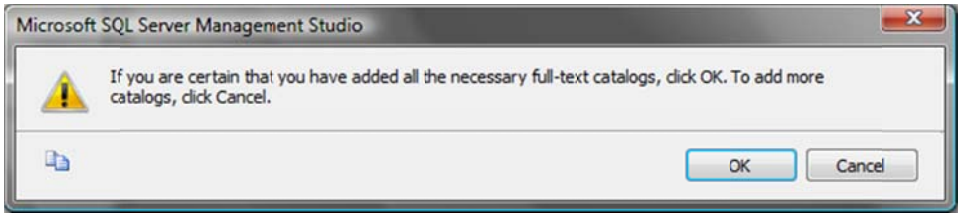
7. Click on the “Add” button near the center of the form. In the window that opens, navigate to the location on your hard drive where you extracted the blank Capabilities Database. Select the .mdf file associated with the database that you want to attach (HydroServerCapabilities.mdf). See the following figure for an example.



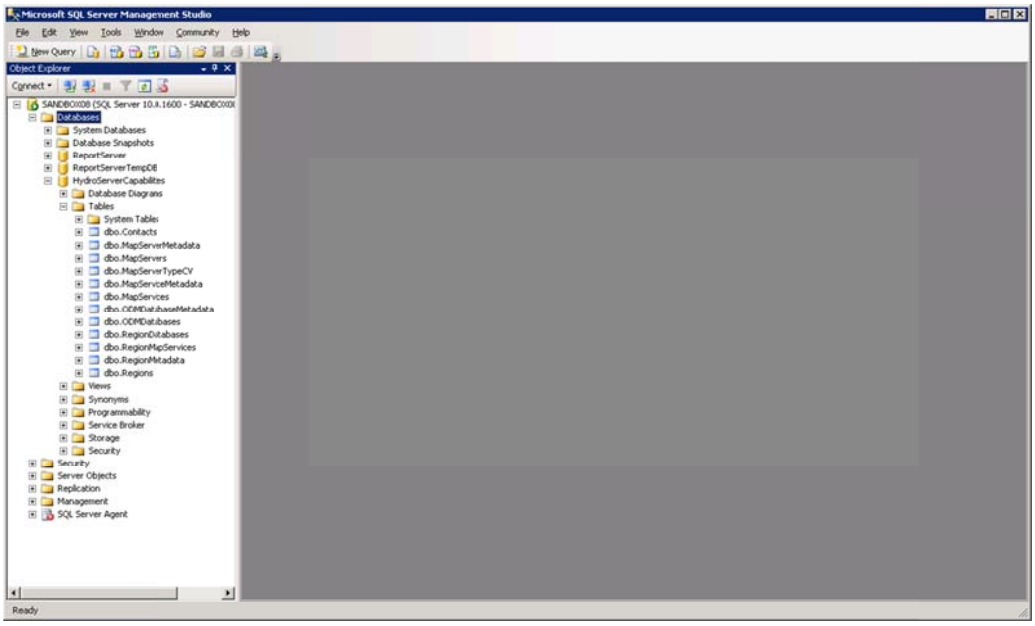
8. Click the “OK” button. This will return you to the “Attach Databases” form and will populate the form with the information needed to attach the database that you have selected. You will notice that your selected database is listed in the “Databases to attach” section and that the details of your database files are shown at the bottom of the form. See the following figure:



9. Click the “OK” button and then wait for a moment while the blank schema database is being attached. If you see the following pop-up window, click “OK” to continue attaching your database.



10. Once the database has been attached, expand the "Databases" item under your server in the Object Explorer by clicking on the plus sign next to "Databases." You should now see an item under "Databases" for the database that you just attached. If you do not see an item for your database, right click on the "Databases" item and choose "Refresh" from the context menu. You can further expand the HydroServer Capabilities database by clicking on the plus sign next to "Tables" (see the following figure).

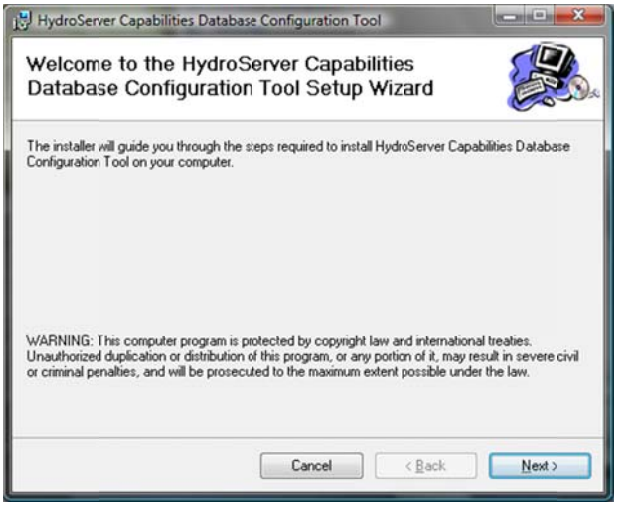


11. You are now ready to begin adding metadata to your HydroServer Capabilities database using the Configuration Tool.

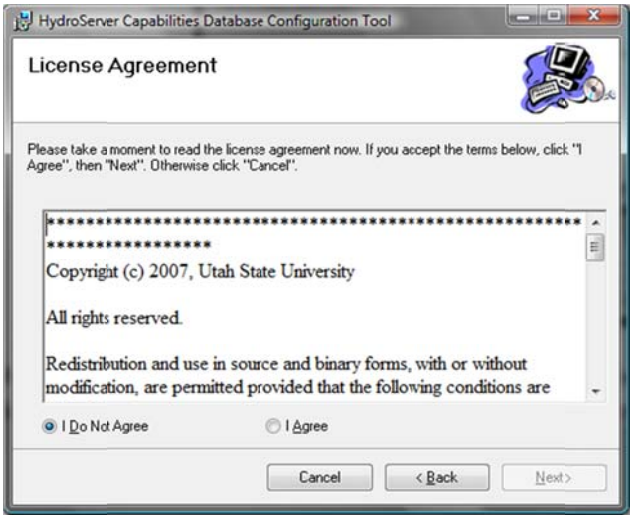
2.3 INSTALLING THE HYDROSERVER CAPABILITIES DATABASE CONFIGURATION TOOL

Use the following steps to install the HydroServer Capabilities Database Configuration Tool.

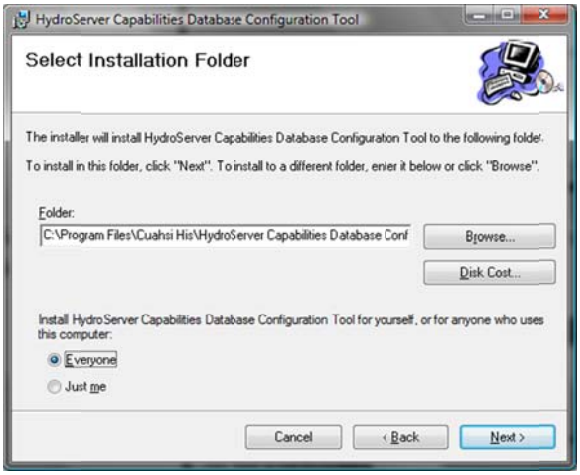
1. Double click on the installation file for the Database Configuration Tool (the ".msi" file) to begin the installation. The following window will open.



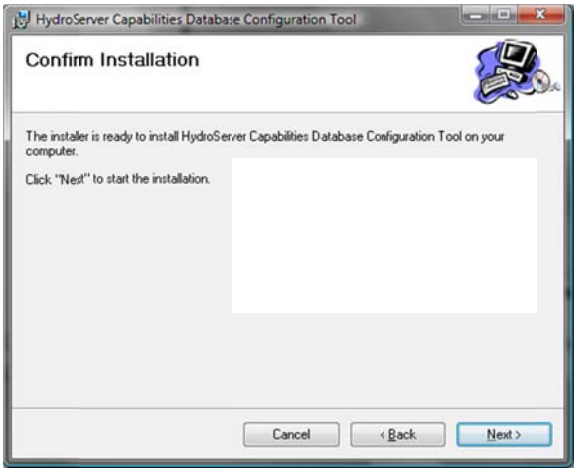
2. Click the “Next” button. The following window will open.



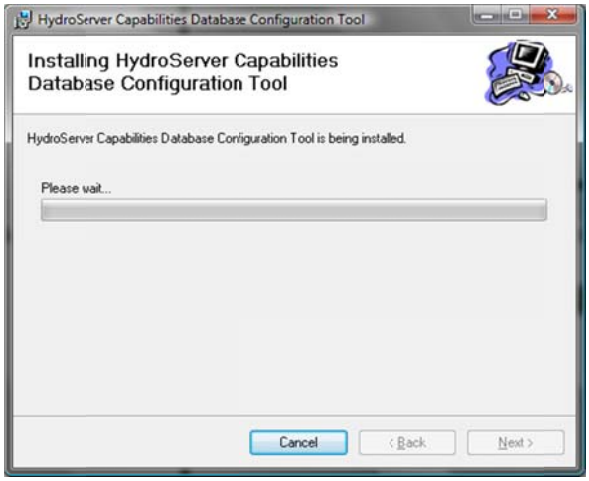
3. Read through the License Agreement and then click the radio button next to “I Agree” if you agree to the license agreement. Then, click the “Next” button. The following screen will appear.



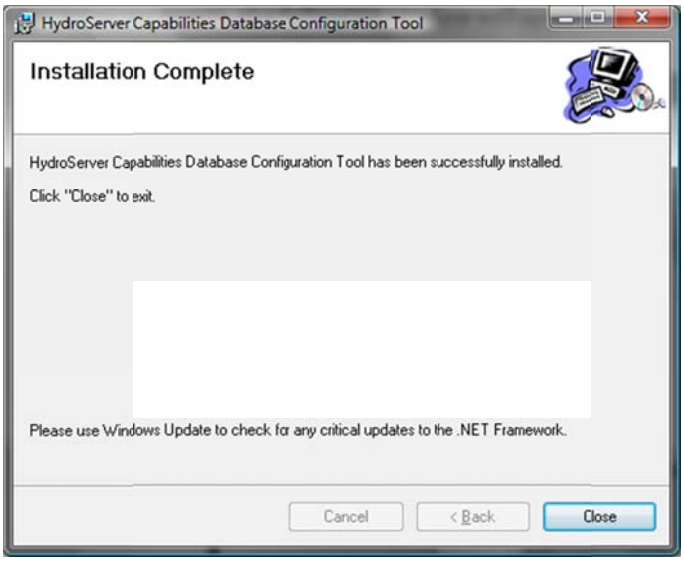
4. Select a location for the installation. It is suggested that you accept the default location. Click the "Next" button. The following window will open.



5. Click the "Next" button. The following window will appear for a few moments while the Database Configuration Tool is installed.



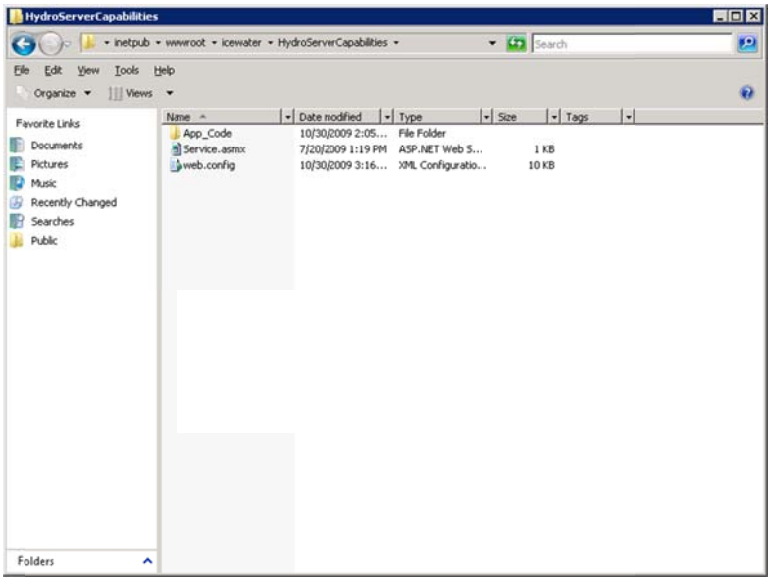
6. After a few moments, the following window will appear. Click the “Close” button to finish the installation.



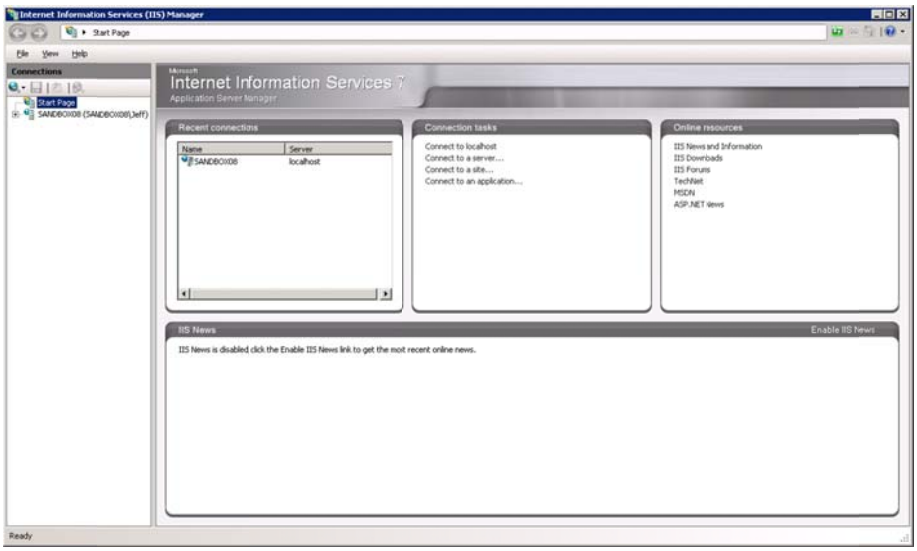
2.4 INSTALLING AND CONFIGURING THE HYDROSERVER CAPABILITIES WEB SERVICES

Use the following steps to install and configure the HydroServer Capabilities Web Services. The following steps were written for a web server running Windows Server 2008 and IIS Version 7.0.

1. The HydroServer Capabilities web service application is distributed as a zip file that contains the application directory, which is a folder called “HydroServerCapabilities.” From the zip file, copy the folder containing the “HydroServerCapabilities” folder to a web application directory on your HydroServer. For this example, I have set up a folder called “icewater” under my “c:\inetpub\wwwroot\” path for this application. I copied the “HydroServerCapabilities” folder from the zip file into the “icewater” folder that I created (see the following figure).



2. Open the Internet Information Services (IIS) Manager by clicking Start → Administrative Tools → Internet Information Services (IIS) Manager. The following window will appear.

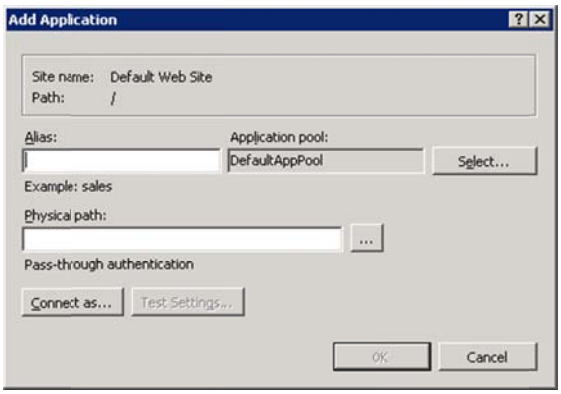


3. Expand your server in the tree view at the left of the form by clicking on the plus sign next to its name. Then, expand the "Sites" element by clicking on the plus sign.
4. We will first create an Application Pool for running these services. In the tree view on the left of the IIS Manager, right click on "Application Pools" and select "Add Application Pool". The following window will appear.

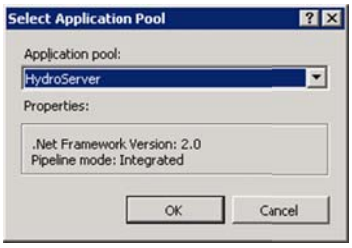
5. Create a name for the Application Pool in the "Name:" text box. For this example, we will call our Application Pool "HydroServer." Make sure that ".NET Framework v2.0.50727" is selected in the ".Net Framework version:" text box. From the "Managed pipeline mode:" drop down box, select "Integrated." Ensure that the check box next to "Start application pool immediately" is checked. Your form should look like the following:

NOTE: In this example we are creating an Application Pool called "HydroServer." We have chosen the "Integrated" Managed pipeline mode because the Capabilities Web Services were created using Visual Studio 2008. If we implement other HydroServer Web applications (e.g., the HydroServer Website) that were developed in Visual Studio 2008, we can reuse this Application Pool for those applications. This Application Pool cannot be used for Web applications developed in Microsoft Visual Studio 2005.

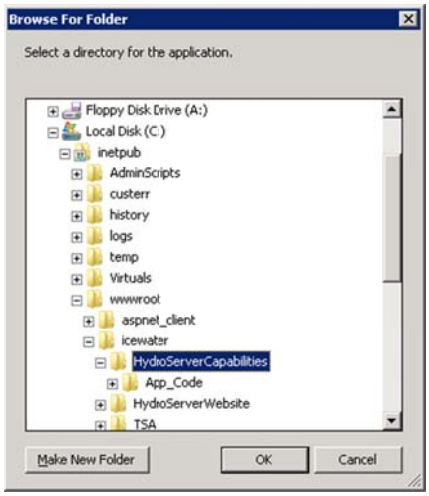
6. For this example, we will implement the Web services under the Default Website in IIS. Right click on the "Default Website" item in the tree view of the IIS Manager and select "Add Application" from the context menu. The following window will open:



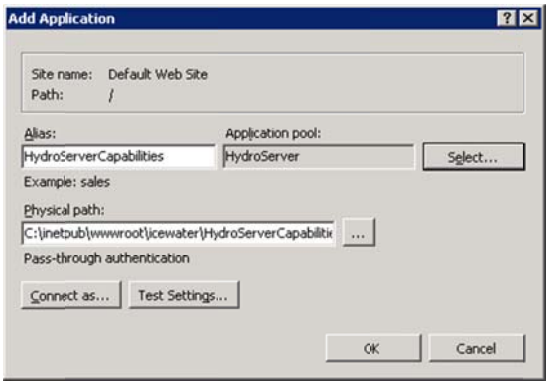
7. In the "Alias" text box, enter "HydroServerCapabilities." Click the "Select" button next to the "Application pool:" box. In the "Select Application Pool" form that pops up, select the "HydroServer" application pool from the "Application pool" drop down list and then click "OK".



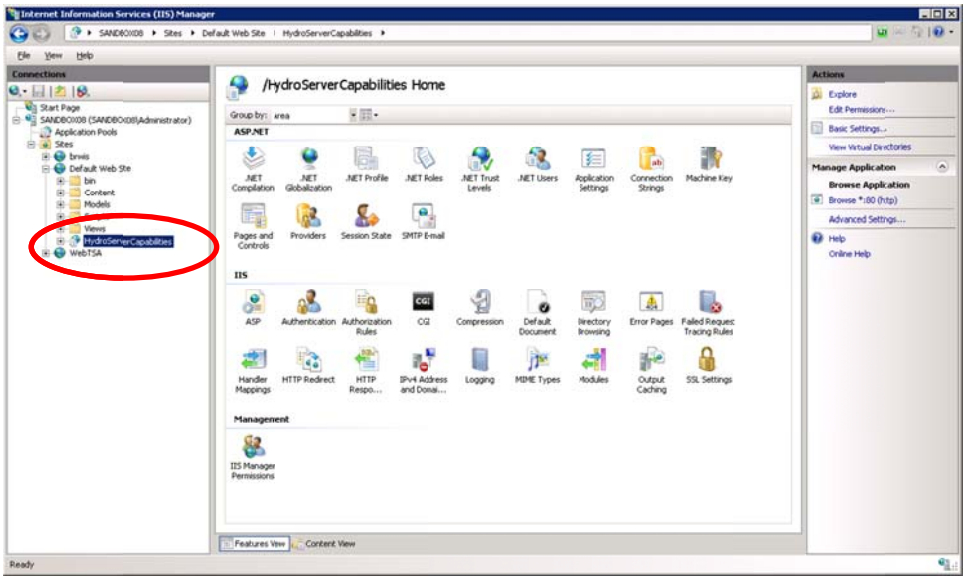
8. Click the navigate button next to the "Physical path:" box. The following window will open. Navigate to and select the folder where you extracted the Web Service application files (e.g., c:\inetpub\wwwroot\icewater\HydroServerCapabilities"). Then click the "OK" button.



9. Your “Add Application” form should now look something like the following. Click the “OK” button to complete this step.

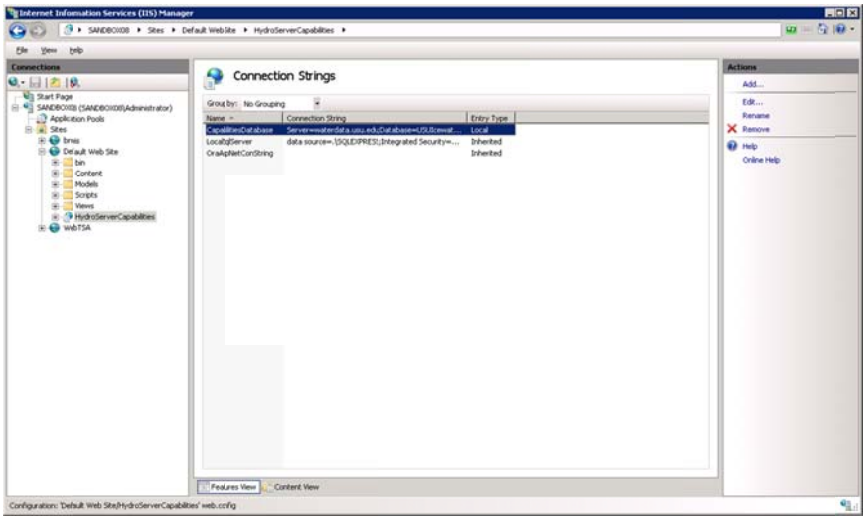


10. You will now notice that an application called “HydroServerCapabilities” has been created under the Default Website in the IIS Manager.

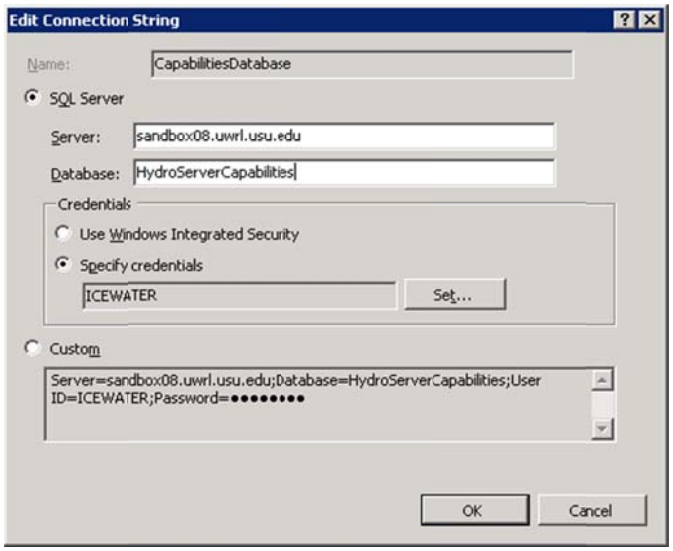


NOTE: The process for setting up the Capabilities Web Services under a different website is the same as setting them up under the Default Website. However, you must first have created the website in IIS before you can do this. In the example above, since I implemented the Web services under the default website on a machine called "sandbox08.uwrl.usu.edu", my Capabilities Web Service will have a URL path of http://sandbox08.uwrl.usu.edu/HydroServerCapabilities/. If I wanted my Web Services to have a different URL, I would first have to set up an appropriate domain name and then set up a website in IIS to handle that domain name. For example, I could register a domain name called "icewater.usu.edu" and have it pointed at this same machine. I would then create a website in IIS called "icewater" that would handle the "icewater.usu.edu" domain. Then, I would follow the steps above to register the Capabilities Web Services under the "icewater" website in IIS. The path for my web services would then be http://icewater.usu.edu/HydroServerCapabilities/. If you wish to register alternate domain names for your HydroServer, you will need to work with the individuals in charge of your IT infrastructure.

11. Next, we need to tell the Capabilities Web Service how to connect to the HydroServer Capabilities SQL Server database. Under the "ASP.NET" icon group in the middle section of the IIS Manager form, double click on the "Connection Strings" icon. This will open the connection strings editor within the IIS Manager.



12. Double click on the "CapabilitiesDatabase" line. The following form will open:

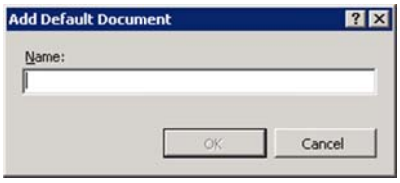


13. On this form, you need to edit the items to match the location and user credentials for your HydroServer Capabilities database. Using the figure above, fill in the appropriate values for your database and server. In this example, I am connecting to a Capabilities Database called "HydroServerCapabilities" on a SQL Server machine called "sandbox08.uwrl.usu.edu." I have created a SQL Server user with read only access to that database called "ICEWATER." To specify your SQL Server username and password, click the "Set" button next to the "Specify credentials" radio button and text box. You will notice that the connection string for your database is automatically created for you in the text box at the bottom of the form. Click the "OK" button when you are finished.

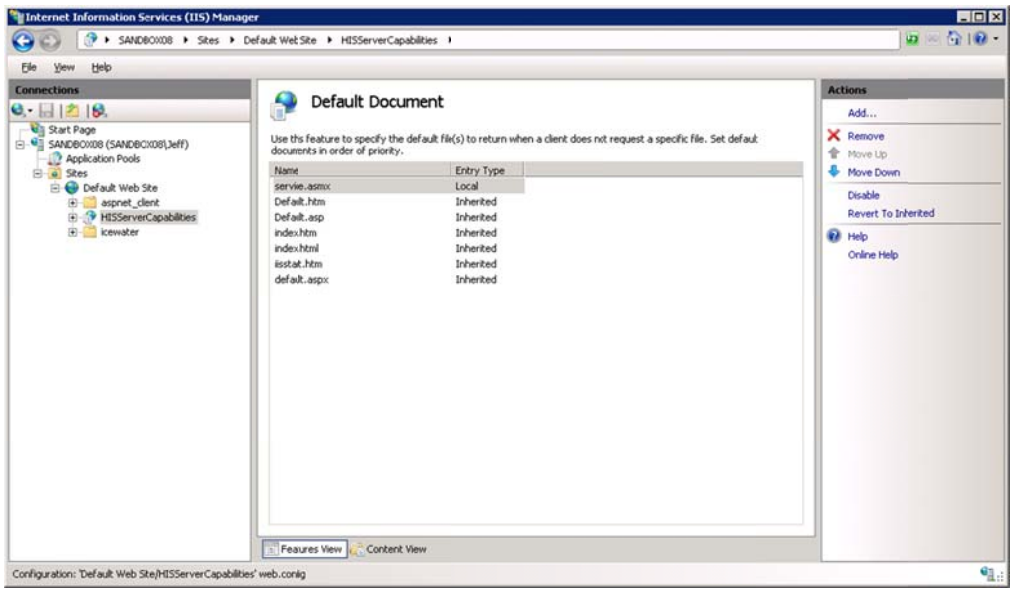
NOTE: Since the Capabilities Web Service is a public web application, you want to make sure that you create a SQL Server user within your HydroServer Capabilities database that has read only access for use in specifying the connection from the Capabilities Web Service. You can do this within SQL Server Management Studio.

14. As a final step in the setup, we will add the default page, "service.asmx," to the list of default pages in IIS so that users do not have to type this in to access your service. Click on your new web application in the

tree view to return to the main icon view in the IIS Manager. Under the "IIS" icon group, double click on the "Default Document" icon. This will open the default document editor in the IIS Manager form. Click the "Add…" link under the "Actions" panel on the right part of the IIS Manager form. The following form will open:



15. Type "service.asmx" in the "Add Default Document" form and then click the "OK" button. Your IIS Manager should now look like the following:



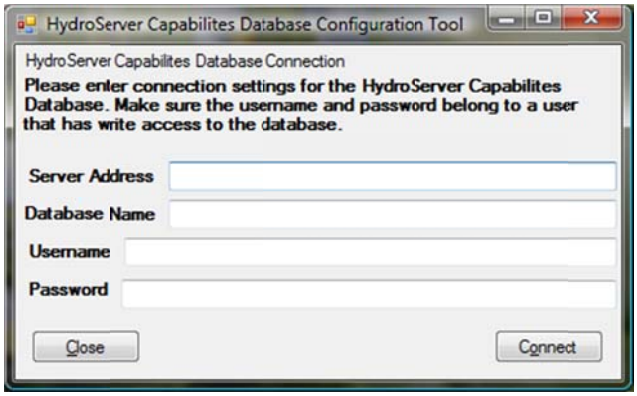
16. Your HydroServer Capabilities Web Service setup is now complete. You should be able to navigate to your service in a web browser. For this example, the URL for the web service we set up would be http://sandbox08.uwrl.usu.edu/HydroServerCapabilities/.

NOTE: You can test the methods of your Capabilities Web Service by opening a web browser on your server, navigating to the URL of your services, and then clicking on the links for each method. Some methods require an ID as in input, which you can type in the appropriate text box. When you click the "Invoke" button, you will see the XML string that is returned by the web services. Note, however, that you must input some metadata into your HydroServer Capabilities database before anything will be returned by your web services.

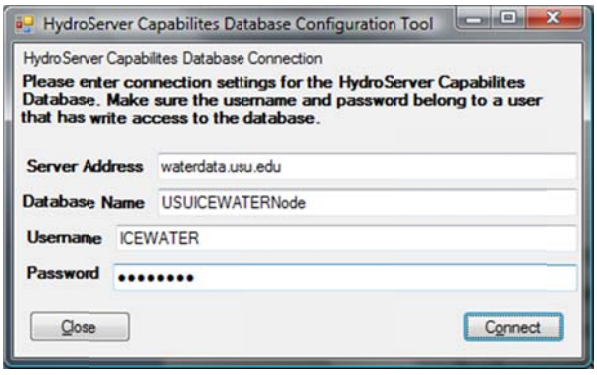
3.0 Editing the HydroServer Capabilities Database Using the Configuration Tool

The HydroServer Capabilities Database Configuration Tool enables you to create metadata descriptions for all of the services that you are publishing on your HydroServer. These metadata descriptions are used by the other HydroServer software applications, and are also broadcast via the HydroServer Capabilities Web Services so that others can discover the capabilities of your HydroServer. Use the following steps to edit the HydroServer Configuration database using the Database Configuration Tool.

1. Open the Capabilities Database Configuration Tool by clicking on Start → All Programs → CUAHSI HIS → HydroServer Capabilities Database. The following window will appear.

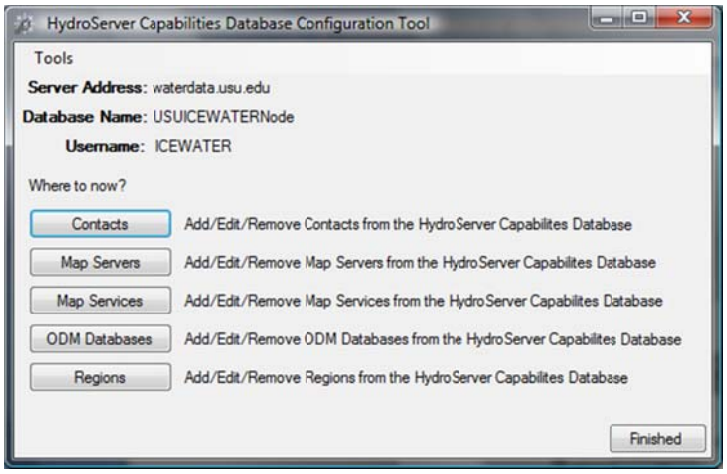


2. The first step is to create a connection to your HydroServer Capabilities Database. At the top of the form, enter the Server Address, the name of your HydroServer Capabilities database, your SQL Server Username, and SQL Server Password for connecting to your HydroServer Capabilities database. Your form should look something like the following.



NOTE: You need to connect to your HydroServer Capabilities database using a SQL Server user account that has both read and write access to the database. For this example, we will connect to a Capabilities Database on a machine called "waterdata.usu.edu" using a SQL Server user account called "ICEWATER." The Configuration Tool can connect to HydroServer Capabilities databases on remote machines provided that you have enabled remote connections in SQL Server and you have an appropriate SQL Server login for that machine.

3. Click the "Connect" button. The following window will appear.



NOTE: In this example, my HydroServer Capabilities database is called "USUICEWATERNode." Your database would likely be called "HydroServerCapabilities" if you followed the instructions above and did not change the name of the blank schema database when you attached it.

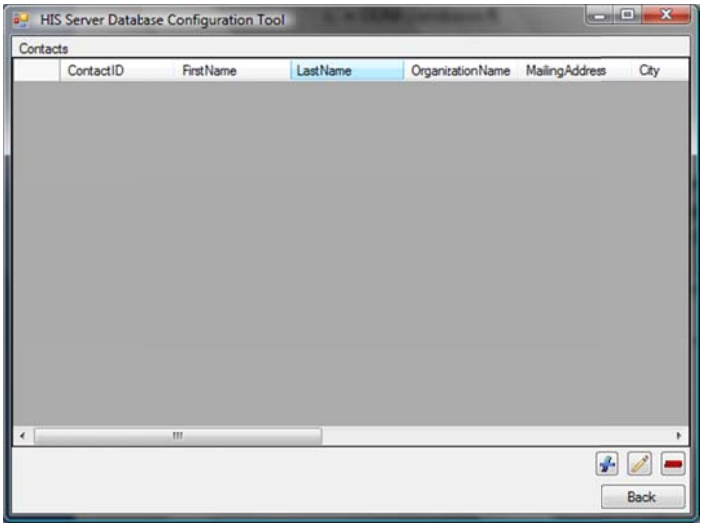
Your database connection information is stored in a configuration file so that next time you open the configuration tool you will be automatically connected to your HydroServer Capabilities database. If you want to change the database connection, use the "Tools" menu at the top of the main configuration tool form.

4. Now that you are connected to your HydroServer Capabilities Database, you can add metadata by clicking on the buttons on the form. In general, you want to use the following order to add metadata to your database. However, you don't have to follow this order if you don't want to. In the following sections, adding metadata for each of the following items is described in more detail.
    a. Contacts
    b. Map Servers
    c. ODM Databases
    d. Map Services
    e. Regions

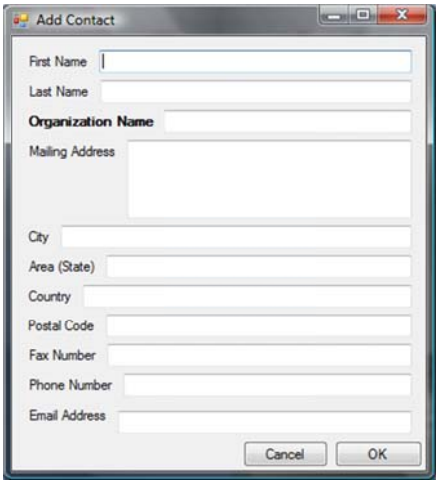
3.1 Adding Contact Metadata

The HydroServer Capabilities database stores contact information for data publishers and metadata managers. This contact information can be linked to each map service or spatial data service that is published on your HydroServer and is the information that data consumers would use to contact you if they have questions about your data or metadata. Use the following steps to create a contact within your HydroServer Capabilities database.

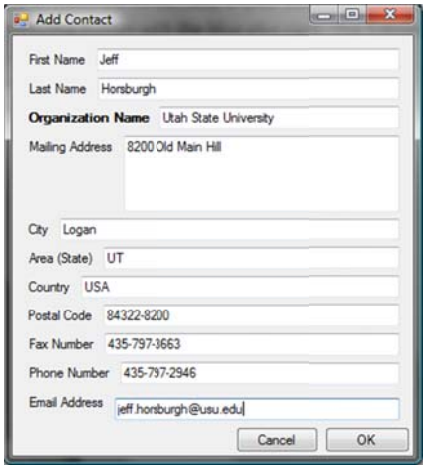
1. Click on the "Contacts" button. The following form will appear.



2. You will notice that initially this form is blank as there are no contacts in your database. To add a contact, click the add button at the bottom of the form (the button with the blue plus sign). The following form will open.



3. Fill in the information on this form to fully describe the contact that you are adding to the database. The required field names are listed in bold type; however, it is recommended that you fill in as much metadata as you can. When you are done filling in the form, it should look something like the following



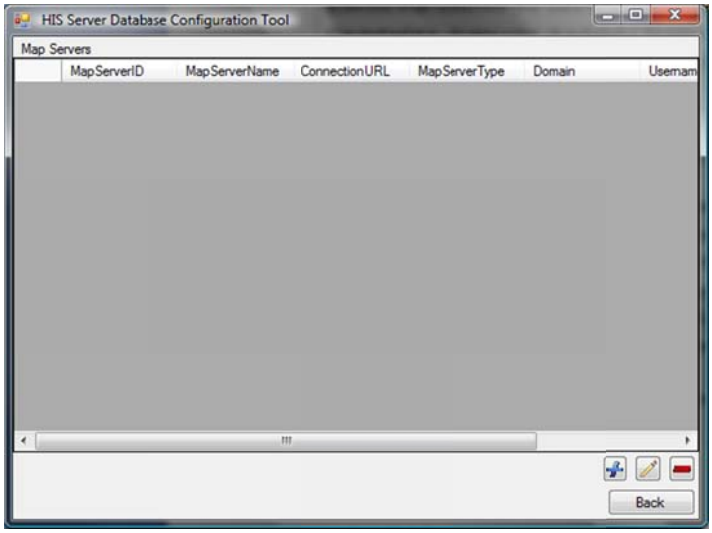
4. Click the "OK" button. You will notice that a new row for your contact has now been added to the main Contacts form. At a later time if you want to edit the information for your contact, click on the edit contact button at the bottom of the form (the button with the pencil in it). If you want to delete the contact from your database, click the delete contact button at the bottom of the form. If you want to add additional contacts, just click the add contact button and follow the steps above. Click the "Back" button to return to the main Configuration Tool form.

NOTE: In general, two contacts are required for each dataset that you publish on your HydroServer. One contact is for the data, and the other is for the metadata. You can use the same contact for both, but you may want the scientist that collected the data to be the contact for the data and you as the data manager to be the contact for the metadata. In any case, it is helpful to add the required contacts to the database before you start adding metadata for map services or ODM databases because you will link these contacts to those records in your database.

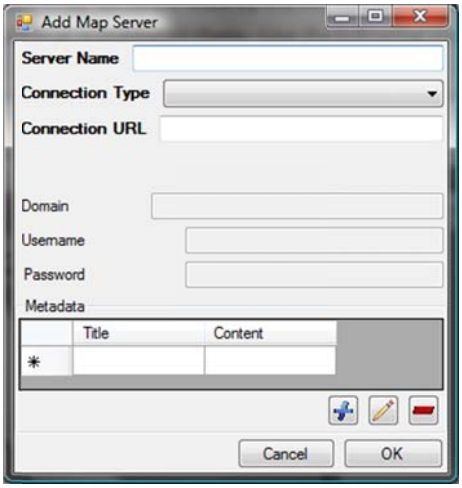
3.2 Adding Map Server Metadata

The HydroServer Capabilities Database stores some information about GIS data servers on which the spatial data that you are publishing or using are stored. If you are the administrator of a HydroServer, it is likely that you would only describe your own map server in this table, but if you want to reference GIS datasets published on another server (e.g., to reference public GIS services such as those hosted at ESRI), you can do that as well. The information that you supply about map servers is used by the HydroServer map application to connect to the server so that it can display the data that is published there. Use the following steps to create a metadata entry for a map server.

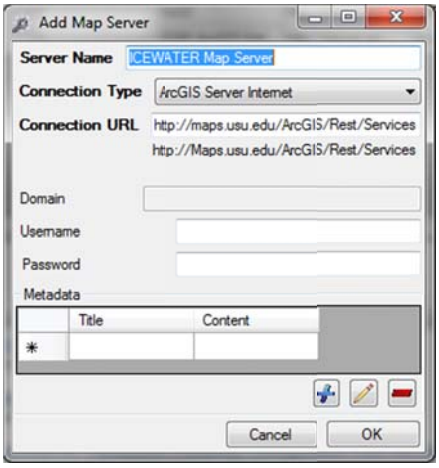
1. Click on the "Map Servers" button. The following form will open.



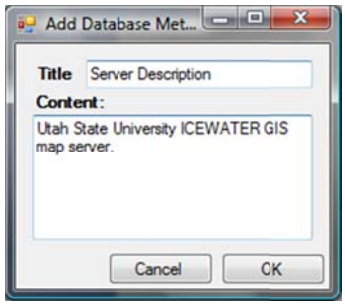
2. Initially there will be no records on this form until you add metadata for one or more map servers. Click the add map server button at the bottom of the form (the button with the blue plus sign in it). The following form will open.



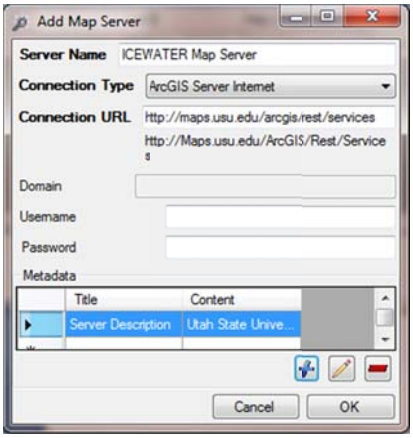
3. On this form you will specify a "Server Name", a "Connection Type", and a "Connection URL" for your map server. For a standard HydroServer that uses ArcGIS Server, the "Server Name" can be a name that you choose for the machine on which ArcGIS Server is installed. The "Connection Type" will be "ArcGIS Server Internet." The connection URL will be the URL to the REST service endpoint of the map services on your ArcGIS Server (e.g., http://maps.usu.edu/ArcGIS/rest/services/, where "maps.usu.edu" is the name of the machine on which your ArcGIS server is running – you would replace this with your server name). For this type of map server connection there is no Domain or Username and Password. When you have filled out the form, it should look something like the following.



4. If you want to add additional metadata about your map server, you can do so by clicking on the add metadata button at the bottom of the form (the button with the blue plus sign). This is not required, but it enables you to add additional metadata attributes to your database if you want to. If you click the add metadata button, the following form will appear.



5. You must add a title for the metadata element that you wish to add and content for the metadata description (see above). When you have completed this form, click the "OK" button. You will notice that you now have an optional metadata item in the list at the bottom of the "Add Map Server" form (see below). Metadata items can be edited or deleted using the appropriate buttons at the bottom of the form.



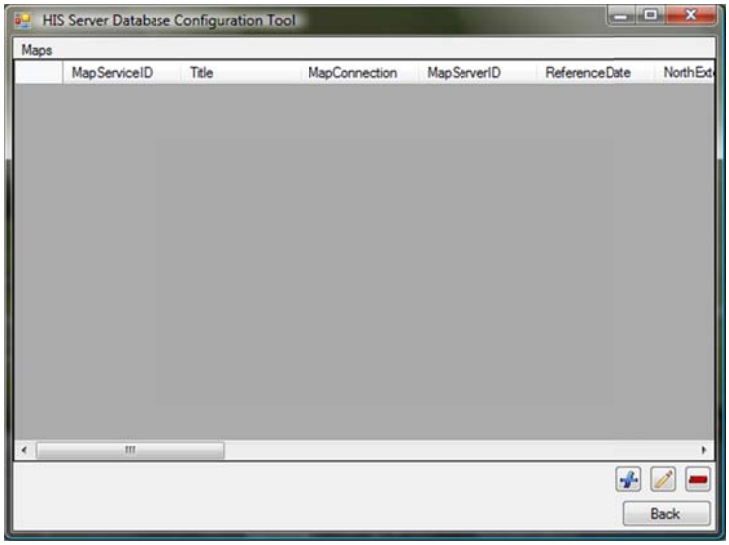
NOTE: Adding additional metadata items is optional. Throughout the Database Configuration Tool forms, all required metadata items will appear on the main form. The "Metadata" section enables you to add "free form" metadata about the services in your database. The free form metadata that you define about the objects in your database will be available to users when they discover the capabilities of your HydroServer.

6. Click "OK" to finish adding your map server description to your database. You will notice that there is now a new row in the table on the Map Servers form. At a later time if you want to edit the information for your map server, click on the edit map server button at the bottom of the form (the button with the pencil in it). If you want to delete the map server from your database, click the delete map server button at the bottom of the form. If you want to add additional map servers, just click the add map server button and follow the steps above. Click the "Back" button to return to the main Configuration Tool form.

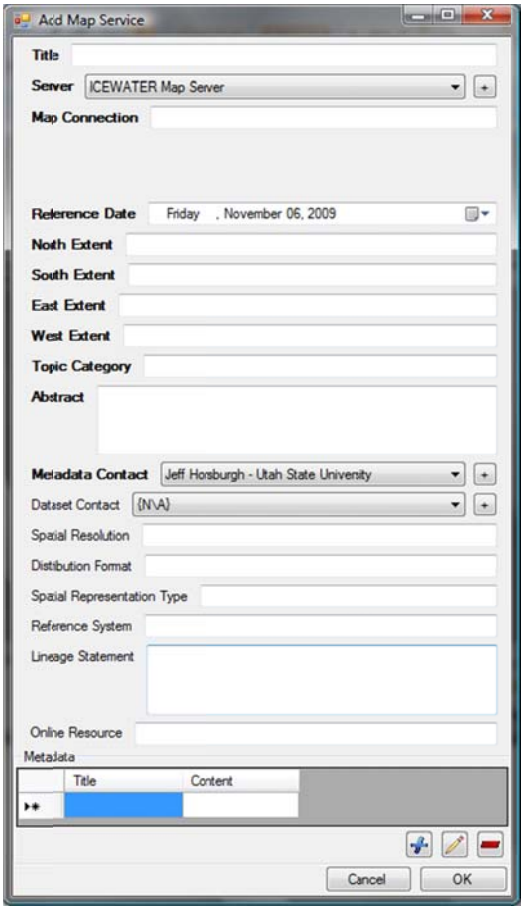
3.3 Adding Map Service Metadata

The HydroServer Capabilities Database stores information about spatial datasets that either you are publishing or that are published on servers other than your own. For example, you can list spatial datasets that you have published using ArcGIS Server on your own HydroServer, but you can also list public services such as those available on servers at ESRI (http://www.esri.com/software/arcgis/arcgisonline/map-services.html). The information that you supply about map services is used by the HydroServer map application to connect to the service so that it can display the data that is published there. Use the following steps to create a metadata entry for a map service.

1. Click on the "Map Services" button. The following form will appear.



2. Initially there will be no records on this form until you add metadata for one or more map services. Click the add map service button at the bottom of the form (the button with the blue plus sign in it). The following form will open.

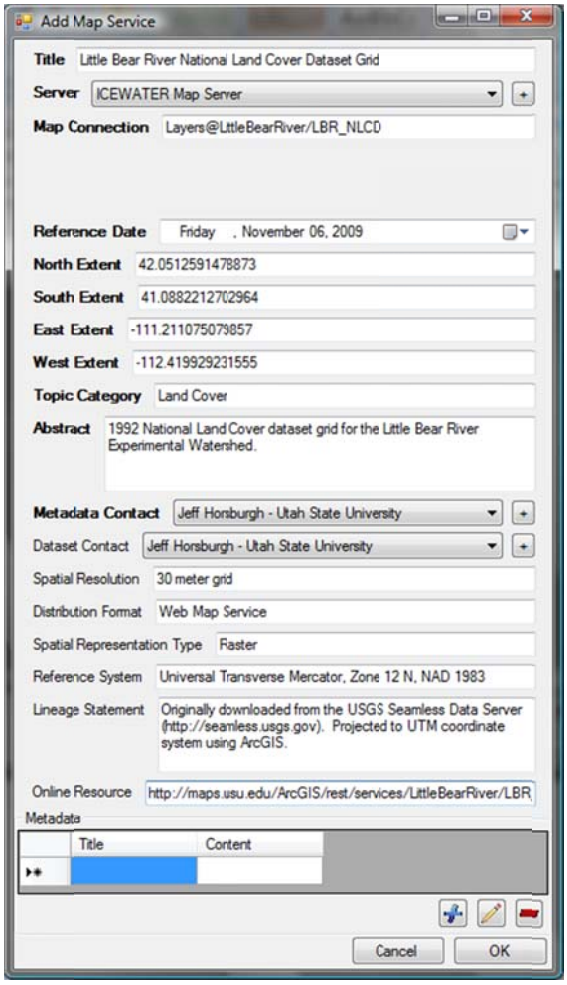


3. On this form, you need to supply metadata for the map service that you are adding to your database. The following are descriptions of each of the items on this form with examples of what you should supply.

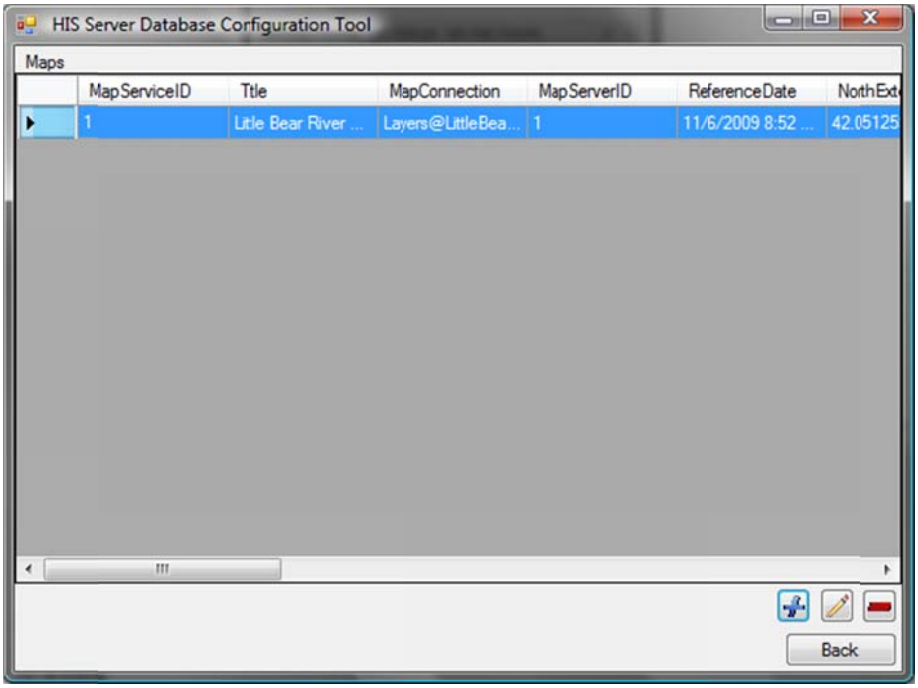
- ***Title***: This is a title that you assign to your map service (e.g., "Little Bear River Watershed National Land Cover Dataset Grid").
- ***Server***: This is the map server on which the dataset is published. Select from the list, or click the add button next to the drop down to create a new map server entry.
- ***Map Connection***: This is a specific string that is used to connect to the layers that are part of the map service. For an ArcGIS Server, it will have the following form "layers@FolderName/ServiceName" where the "FolderName" is the folder where the service is located on the ArcGIS Server and the "ServiceName" is the name of the service on the server (e.g., "layers@littlebearriver/LBR_NLCD" is the map connection for the service located at http://maps.usu.edu/ArcGIS/rest/services/LittleBearRiver/LBR_NLCD/MapServer)
- ***Reference Date***: This is the reference date for the spatial dataset. It can be the date that you publish the dataset, or the date that the dataset represents (for example, an aerial photograph that was created on a particular date).
- ***North Extent***: Latitude of north extent of the spatial dataset in decimal degrees (42.0512591478873)
- ***South Extent***: Latitude of south extent of the spatial dataset in decimal degrees (41.0882212702964)
- ***East Extent***: Longitude of east extent of the spatial dataset in decimal degrees (-111.211075079857)
- ***West Extent***: Longitude of west extent of the spatial dataset in decimal degrees (-112.419929231555)

- ***Topic Category***: This is a keyword or topic that you want to assign to your dataset (e.g., "Land Cover").
- ***Abstract***: This is a text field within which you can type an abstract description of your map service (e.g., "1992 National Land Cover dataset grid for the Little Bear River Experimental Watershed.").
- ***Metadata Contact***: This is the person that data users should contact with questions about the metadata in your HydroServer Capabilities Database. Pick a contact from the list, or click on the add button next to the drop down to add a new contact.
- ***Dataset Contact***: This is the person that data users should contact with questions about the data contained within the map service. Pick a contact from the list, or click on the add button next to the drop down to add a new contact.
- ***Spatial Resolution***: This is a text field within which you can supply information about the spatial resolution of the data contained within the map service (e.g., "1:24,000" or "30-meter grid").
- ***Distribution Format***: This is the format in which people can access the data. In most cases, this will be "Web Map Service."
- ***Spatial Representation Type***: This is the type of features that are represented by your map service (e.g., "Point," "Line," "Polygon," "Raster").
- ***Reference System***: This is a text field within which you can describe the spatial reference system of the spatial dataset (e.g., "Universal Transverse Mercator, Zone 12 N, NAD 1983."
- ***Lineage Statement***: This is a text field within which you can describe the history of your dataset (e.g., "Originally downloaded from the USGS Seamless Data Server (http://seamless.usgs.gov). Projected to UTM coordinate system using ArcGIS.")
- ***Online Resource***: This is a text field within which you can past a link to an online resource for your dataset. In this field, you should paste a link to the web map service (e.g., "http://maps.usu.edu/ArcGIS/rest/services/LittleBearRiver/LBR_NLCD/MapServer").

4. Once you have finished inputting items on the form, it should look something like the following:



5. At this point, you can choose to add additional metadata items for your spatial data service by clicking on the add metadata button at the bottom of the form (the one with the blue plus sign). Again, you can define whatever additional metadata elements you want. When you have completed adding any additional metadata elements, click the "OK" button at the bottom of the form. Your main "Maps" form will look like the following, with a new record in the table for the map service that you just created.

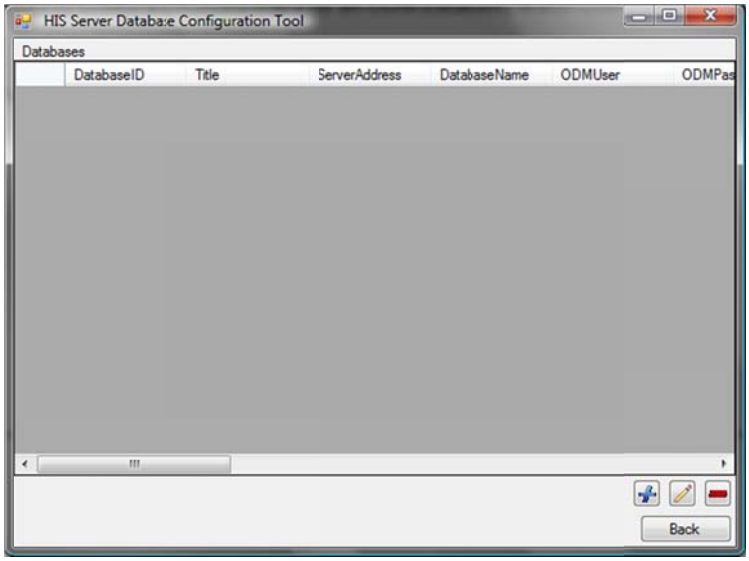


6. At a later time if you want to edit the information for your map service, click on the edit map service button at the bottom of the form (the button with the pencil in it). If you want to delete the map service from your database, click the delete map service button at the bottom of the form. If you want to add additional map services, just click the add map services button and follow the steps above. Click the "Back" button to return to the main Configuration Tool form.

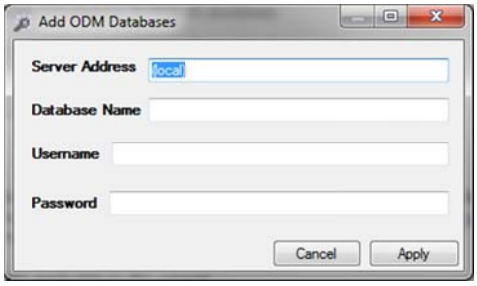
3.4 Adding ODM Database Metadata

The HydroServer Capabilities Database stores information about observational datasets that you are loading into ODM datasets and publishing using the WaterOneFlow web services. The information that you supply in the "ODM Databases" table is metadata for ODM Databases and WaterOneFlow web services on your HydroServer. The metadata in the "ODM Databases" table is used by the HydroServer Map Application and the HydroServer Time Series Analyst Application to connect to the databases so that they can display the data that is stored in the database. Use the following steps to create a metadata entry for an ODM Database/WaterOneFlow Web Service combination.

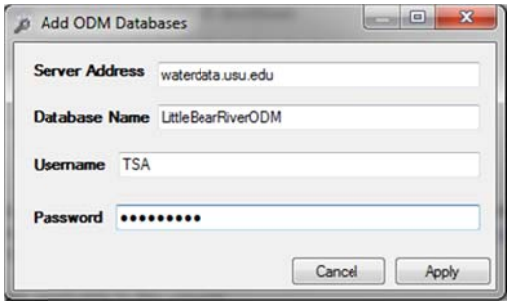
1. Click on the "ODM Databases" button. The following form will appear.



2. Initially there will be no records on this form until you add metadata for one or more ODM databases. Click the add ODM database button at the bottom of the form (the button with the blue plus sign in it). The following form will open.



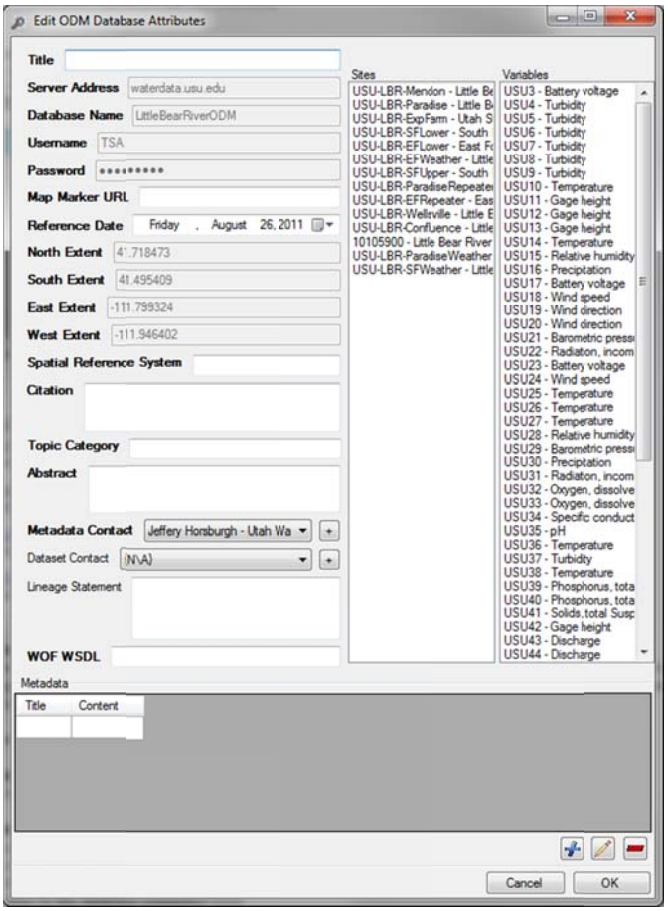
3. On this form, you need to supply the address of the SQL Server on which your ODM Databases are stored, the name of the ODM database that you are adding, and a valid SQL Server User and Password that can be used to connect to the ODM Databases. When you fill in these items on the form, it should look like the following.



NOTE: In this example, I am connecting to a SQL Server database called “LittleBearRiverODM” on a server named “waterdata.usu.edu” using a SQL Server user called “TSA.” I have set up this user with read only access to the LittleBearRiverODM database. Because the username and password that you specify on this form will be used by the HydroServer web applications to connect to your ODM Databases, you will want to set up a similar SQL

Server user within your ODM databases. For security reason, it is not recommended that you use a SQL Server user on this form that has anything but read access to your ODM database.

4. After you have supplied your database connection information, click the "Apply" button. The following form will appear.

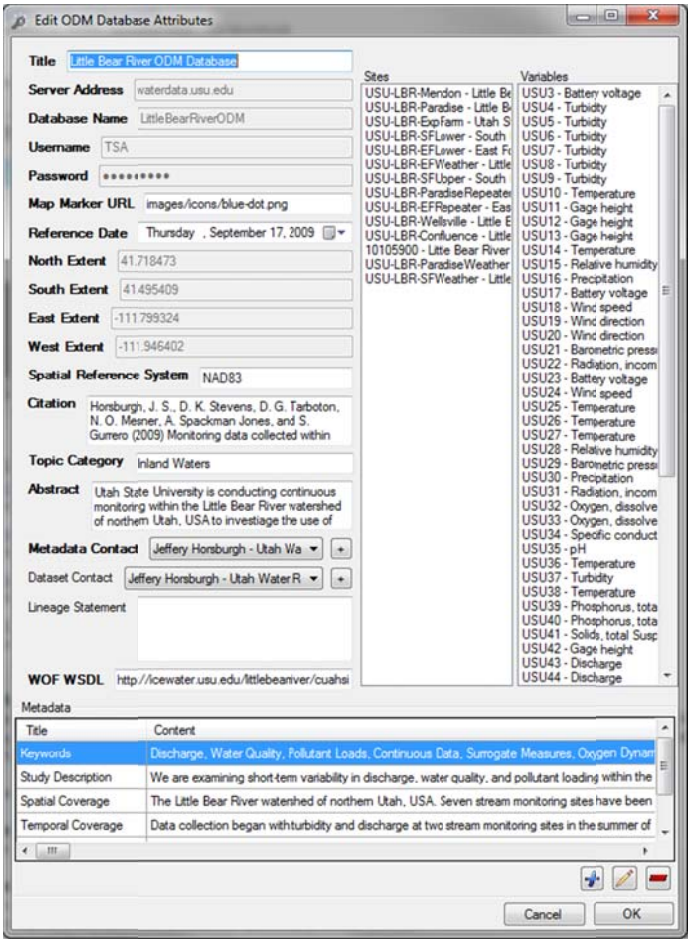


5. You will notice that the Configuration Tool has connected to your ODM database and has created a list of your monitoring sites and variables. You will also notice that several of the fields on the form have been automatically populated using information from your ODM database and the connection information that you have supplied. You need to fill in all of the other fields on this form. The following is a description of what should go in each of these fields.

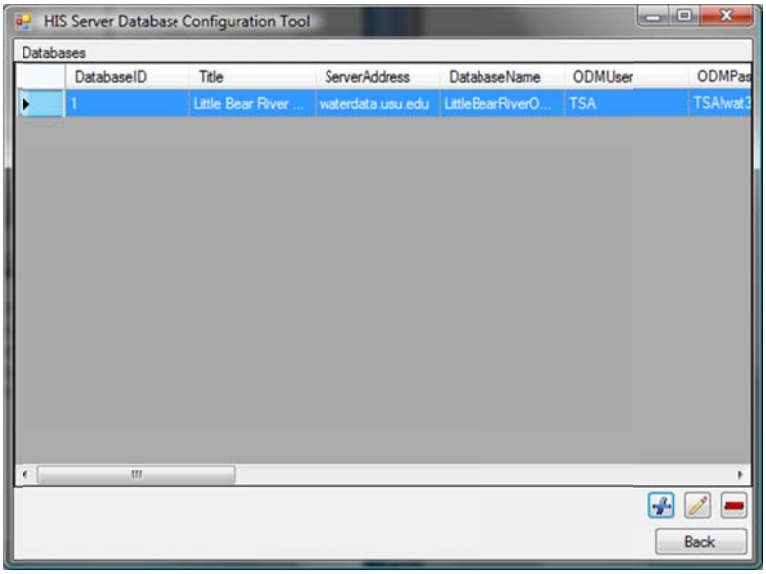
- ***Title***: This is a text field within which you can create a title for your ODM database (e.g., "Little Bear River Experimental Watershed Observations Database").
- ***Map Marker URL***: This is a text field within which you can paste the link to an image file that will be used by the HydroServer Map Application to place the Sites from your ODM database on the map. This field is not required, as the Map Application has a default map marker that it can use. However, if you want to use a specific map marker, you need to specify a path here. For this example, I am leaving this field blank, but it should be noted that this can be revisited in the setup for the HydroServer Map Application.

- ***Reference Date***: This is the reference date for your ODM database. Since your ODM database contains time series data, we suggest that you use the publication date or the date on which you add the metadata to your HydroServer Capabilities Database for the Reference Date.
- ***Citation***: In this field you can supply a citation that tells data users how they should cite your ODM database (e.g., "Horsburgh, J. S., D. K. Stevens, D. G. Tarboton, N. O. Mesner, A. Spackman Jones, 2009, Continuous monitoring data collected in the Little Bear River watershed, Utah Water Research Laboratory, Utah State University, Logan, UT"). It should be noted that this is a citation for your database as a whole – there are also citation fields within your ODM database for individual datasets that are delivered when people request data from your database using the WaterOneFlow web services.
- ***Topic Category***: In this field, you can supply a topic keyword for your ODM database (e.g., "Inland Waters")
- ***Abstract***: This is a text field in which you can supply a descriptive abstract for the data stored in your ODM database (e.g., "Observations data for the Little Bear River experimental watershed near Logan, Utah").
- ***Metadata Contact***: This is the person that is the contact for the metadata for this database. Select a contact from the list or click on the add contact button next to the drop down list.
- ***Dataset Contact***: This is the person that is the contact for the data contained within your ODM database. Select a contact form the list or click on the add contact button next to the drop down list.
- ***Lineage Statement***: In this field you can input a description of the lineage for your data. It is not required, but it is recommended that you supply this information if it is important in the interpretation of the data.
- ***WOF WSDL***: In this field you will supply the URL to the WSDL location of the WaterOneFlow that you have implemented for this ODM database (e.g., "http://icewater.usu.edu/littlebearriver/cuahsi_1_0.asmx?WSDL").

6. When you are finished filling out the form, it should look something like the following.



7. At this point, you can choose to add additional metadata items for your ODM database by clicking on the add metadata button at the bottom of the form (the one with the blue plus sign). Again, you can define whatever additional metadata elements you want. When you have completed adding any additional metadata elements, click the "OK" button at the bottom of the form. Your main "Databases" form will look like the following, with a new record in the table for the ODM database that you just added.

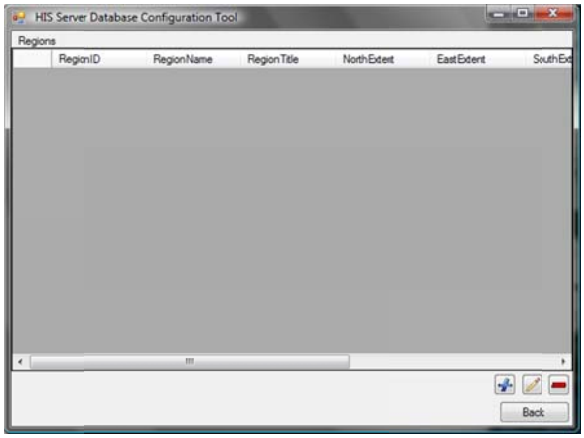


8. At a later time if you want to edit the information for your ODM Database, click on the edit ODM database button at the bottom of the form (the button with the pencil in it). If you want to delete the ODM database from your database, click the delete ODM database button at the bottom of the form. If you want to add additional ODM databases, just click the add ODM database button and follow the steps above. Click the "Back" button to return to the main Configuration Tool form.

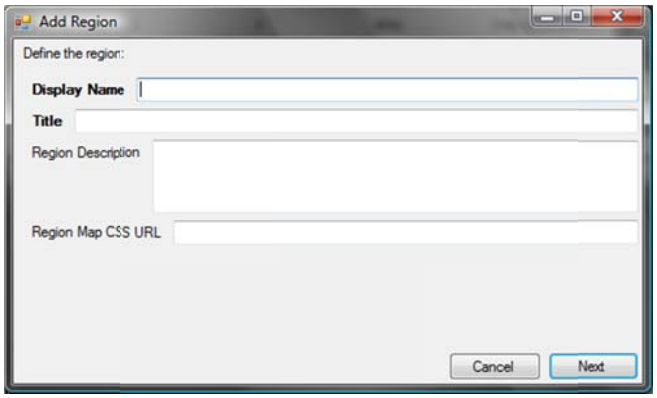
3.5 Adding Region Metadata

On your HydroServer, a "Region" is an experimental watershed, a study site, or some other geographic area for which you are publishing data (e.g., the "Little Bear River Experimental Watershed" or the "Dry Creek Experimental Watershed"). Within the HydroServer Capabilities database, you can specify metadata for the regions for which you are publishing data. You can also store the relationship between a region and the spatial data services and ODM database(s)/WaterOneFlow Web service(s) that represent that region. Use the following steps to create metadata for your regions and link the services that you have published with the region.

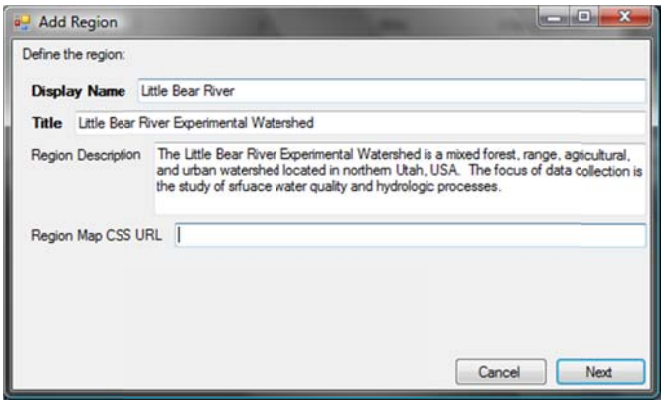
1. Click on the "Regions" button on the main Configuration Tool form. The following form will open.



2. Click on the add region button at the bottom of the form (the one with the blue plus sign). The following form will open.

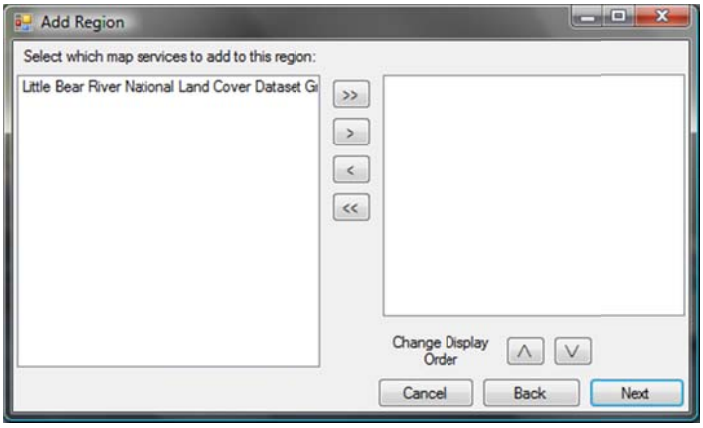


3. On this form, you will create a “Diplay Name,” a “Title,” a “Region Description,” and a “Region Map CSS URL. Your form should look something like the following.

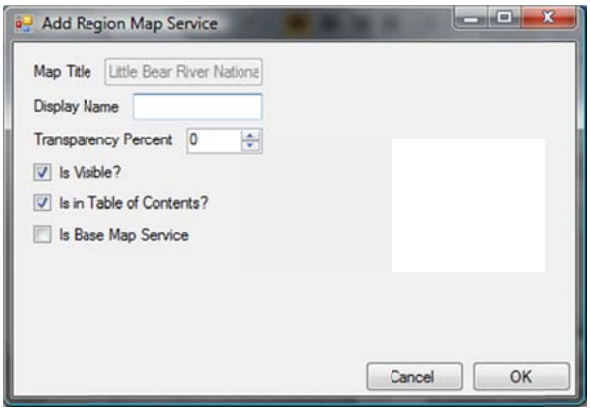


NOTE: You will notice that I have left the “Region Map CSS URL” field blank. This field is not required, and is an advanced configuration option for the HydroServer Map Application. Consult the manual for the Map Application for customization of this field. It is fine to leave it blank – the Map Application has a default CSS file that it will use.

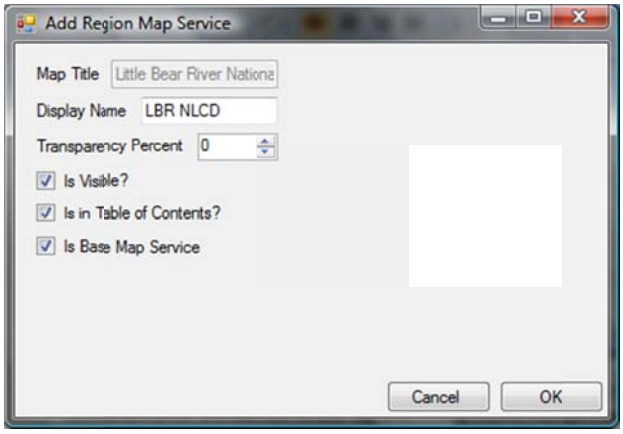
4. Click the “Next” button. The following form will appear.



5. This form allows you to associate map services stored in your database with your region. Select map services on the left, and add them to your region by moving them to the right side of the form using the arrows. In this example, we only have one map service in the list, but you can add multiple map services to your region, depending on how many services you have published for the region. When you select a service and click on the arrow to move it to the right, the following form will open.

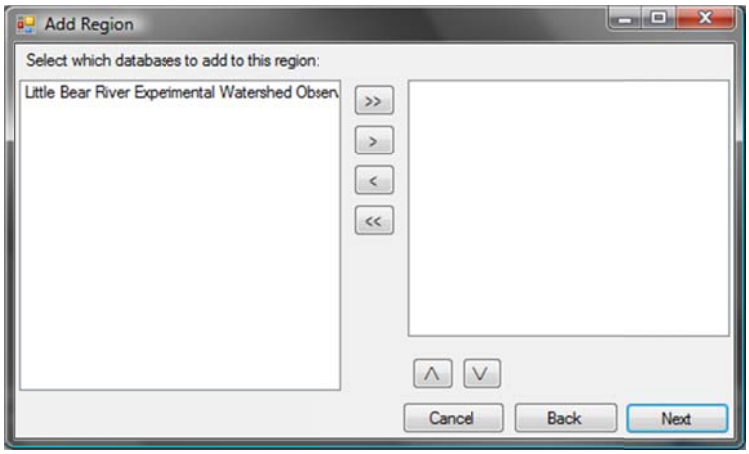


6. On this form, fill in a "Display Name" (the name that will be shown in the legend of the HydroServer Map Application). You can also control the "Transparency Percent," which is a value from 0 – 100 that controls how transparent the data will be when it is added to the map (0 = no transparency). On this form, you can also control whether the service will be visible within the Map Application, whether it will be shown in the Table of Contents/Legend, and whether it will serve as the "Base Map Service" for the Map Application. When you are finished, your form will look something like the following.

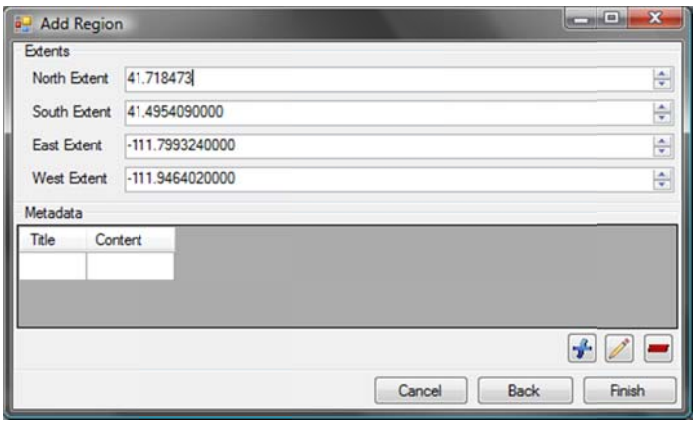


NOTE: The "Is Base Map Service" option determines whether the service will be the base map service for the Map Application. The Base Map Service sets the coordinate system and extents for the Map Application. Only one service should be specified as the Base map Service for each region. You will learn more about this in the manual for the HydroServer Map Application.

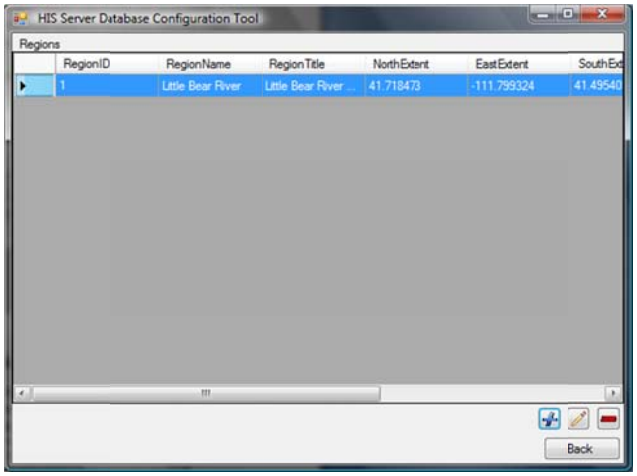
7. Click the "OK" button. The map service that you selected should now be on the right side of the form. Once you have added more than one map service to the right side of the form, you can control the order in which they will be drawn in your HydroServer Map Application by using the up and down arrows below the list on the right side of the form. Keep in mind that items high in the list will be drawn on top of items low in the list within the HydroServer Map. Don't worry about this too much – you can always come back later and adjust this order.
8. Once you have moved all of the map services associated with your region to the right side of the form, click the "Next" button. The following form will appear.



9. On this form, you will specify with ODM databases from your Capabilities Database that should be associated with your region. Select ODM Databases on the left and move them to the right if they are associated with the region that you are creating. Again, you can control the order in which the points from the ODM databases are drawn in the HydroServer Map application by moving them up and down in the list on the right using the up and down arrows.
10. Once you have moved all of the ODM databases associated with your region to the right side of the form, click the "Next" button. The following form will appear.



11. On this form, you must specify the latitude and longitude coordinates for the extents of your region in decimal degrees. On this form, you can also add additional metadata elements for your region. Use the buttons at the bottom of the form to add, remove, or edit additional metadata items. When you have specified the extents and any metadata that you want to add, click the "Finish" button. Your main "Regions" form will look like the following with a new record for the region that you just created.



12. At a later time if you want to edit the information for your region, click on the edit region button at the bottom of the form (the button with the pencil in it). If you want to delete the region from your database, click the delete region button at the bottom of the form. If you want to add additional regions, just click the add regions button and follow the steps above. Click the "Back" button to return to the main Configuration Tool form.

APPENDIX A: DATA DICTIONARY FOR THE HYDROSERVER CAPABILITIES DATABASE

Table Name: Contacts

Stores information about metadata and datset contacts.

Field Name	Data Type	Description	Validation
ContactID	Integer	Automatically generated ID.	Mandatory Unique Primary Key
FirstName	String(255)	First name of contact.	
LastName	String(255)	Last name of contact.	
OrganizationName	String(255)	Name of contact organization.	Mandatory
MailingAddress	String(255)	Mailing address of contact organization.	
City	String(255)	City in which contact is located.	
Area	String(255)	State for USA.	
Country	String(255)	Country in which contact is located.	
PostalCode	String(255)	Postal code for contact.	
FaxNumber	String(255)	Fax number for contact.	
PhoneNumber	String(255)	Phone number for contact.	
EmailAddress	String(255)	Email address for contact.	

Table Name: MapServerMetadata

Stores user defined metadata for map servers.

Field Name	Data Type	Description	Validation
MapServerID	Integer	Links to MapServers.MapServerID.	Mandatory Foreign Key
MetadataTitle	String(255)	Title of the metadata element.	Mandatory
MetadataContent	String(unlimited)	Text content of the metadata element.	Mandatory
DisplayOrder	Integer	Order in which the metadata items will be displayed or written to a metadata description of a map server. Lower values displayed before higher.	

Table Name: MapServers

Stores information about map servers.

Field Name	Data Type	Description	Validation
MapServerID	Integer	Automatically generated ID.	Mandatory Primary Key
MapServerName	String(255)	Display name of the map server.	Mandatory
ConnectionURL	String(500)	URL of the map server.	Mandatory
MapServerType	String(255)	Map server type. Links to MapServerTypeCV.MapServerType..	Mandatory Foreign Key

Field Name	Data Type	Description	Validation
Domain	String(255)	Domain to login to if necessary.	
Username	String(255)	Username to login if necessary.	
Password	String(255)	Password to login if necessary.	

Table Name: MapServerTypeCV

Controlled vocabulary for the Map Server Types.

Field Name	Data Type	Description	Validation
MapServerType	String(255)	Map server type.	Mandatory Primary Key
Description	String(unlimited)	Description of the map server type.	Mandatory
SampleServerConnection	String(500)	Sample for MapServers.ConnectionURL.	Mandatory
SampleMapConnection	String(500)	Sample for MapsServices.MapConnection.	Mandatory
HasDomain	Boolean	Whether mapserver type requires MapServers.Domain.	Mandatory
HasUsername	Boolean	Whether mapserver type requires MapServers.UserName and MapServers.Password.	Mandatory

Table Name: MapServiceMetadata

Stores user defined metadata for map services.

Field Name	Data Type	Description	Validation
MapServiceID	Integer	Links to MapServices.MapServiceID.	Mandatory Foreign Key
MetadataTitle	String(255)	Title of the metadata element.	Mandatory
MetadataContent	String (unlimited)	Text content of the metadata element.	Mandatory
DisplayOrder	Integer	Order in which the metadata items will be displayed or written to a metadata description of a map service. Lower values displayed before higher.	

Table Name: MapServices

Stores information about published map services.

Field Name	Data Type	Description	Validation
MapServiceID	Integer	Automatically generated ID.	Mandatory Primary Key
Title	String (255)	Title for the map service.	Mandatory
MapConnection	String(500)	ArcGIS Server connection info to get to the map service.	Mandatory
MapServerID	Integer	Links to MapServers.MapServerID.	Mandatory Foreign Key
ReferenceDate	Datetime	Date for when the map service was created or published.	Mandatory
NorthExtent	Float	Latitude coordinate for north extent of map service.	Mandatory
EastExtent	Float	Longitude coordinate for east extent of map	Mandatory

Field Name	Data Type	Description	Validation
		service.	
SouthExtent	Float	Latitude coordinate for south extent of map service.	Mandatory
WestExtent	Float	Longitude coordinate for west extent of map service.	Mandatory
TopicCategory	String(255)	Topic Category for the map service.	Mandatory
Abstract	String(unlimited)	Abstract for the map service.	Mandatory
MetadataContactID	Integer	Contact for the map service metadata. Links to Contacts.ContactID	Mandatory Foreign Key
DatasetContactID	Integer	Contact for the data contained within the map service. Links to Contacts.ContactID	Foreign Key
SpatialResolution	String(255)	Spatial resolution for the map service.	
DistributionFormat	String(255)	Format of the map service (WMS, WFS, etc.).	
SpatialRepresentationType	String(255)	Spatial representation type (vector or raster).	
SpatialReferenceSystem	String(255)	Spatial reference system used by the map service.	
LineageStatement	String(unlimited)	Statement that describes the lineage of the map service.	
OnlineResource	String(500)	URL link to the map service.	

Table Name: ODMDatabaseMetadata

Stores user defined metadata for ODM databases.

Field Name	Data Type	Description	Validation
DatabaseID	Integer	Links to ODMDatabases.DatabaseID.	Mandatory Foreign Key
MetadataTitle	String(255)	Title of the metadata element.	Mandatory
MetadataContent	String(unlimited)	Text content of the metadata element.	Mandatory
DisplayOrder	Integer	Order in which the metadata items will be displayed or written to a metadata description of the ODM database. Lower values displayed before higher.	

Table Name: ODMDatabases

Stores information about ODM databases.

Field Name	Data Type	Description	Validation
DatabaseID	Integer	Automatically generated ID.	Mandatory Primary Key
Title	String(255)	Title of the ODM Database.	Mandatory
ServerAddress	String(500)	Fully qualified address of the server hosting the ODM database (e.g., waterdata.usu.edu)	Mandatory
DatabaseName	String(255)	Name of the ODM database on the database server.	Mandatory
ODMUser	String(255)	SQL Server username to connect to the ODM database.	Mandatory
ODMPassword	String(255)	SQL Server password to connect to the ODM database.	Mandatory
MapMarkerURL	String(500)	URL/path to the symbol used for each site on the map when plotting sites from an ODM database.	

Field Name	Data Type	Description	Validation
ReferenceDate	Datetime	Date the ODM database was created or published.	Mandatory
NorthExtent	Float	Latitude of north extent of the sites in the ODM database. Automatically generated from the ODM database.	Mandatory
EastExtent	Float	Longitude of east extent of the sites in the ODM database. Automatically generated from the ODM database.	Mandatory
SouthExtent	Float	Latitude of south extent of the sites in the ODM database. Automatically generated from the ODM database.	Mandatory
WestExtent	Float	Longitude of west extent of the sites in the ODM database. Automatically generated from the ODM database.	Mandatory
SpatialReferenceSystem	String(255)	Spatial reference system associated with the extents of the ODM database.	Mandatory
TopicCategory	String(255)	Topic Category for the ODM database.	Mandatory
Abstract	String(unlimited)	Abstract for the ODM database.	Mandatory
Citation	String(unlimited)	Citation for citing data in the ODM database/WaterOneFlow service.	Mandatory
MetadataContactID	Integer	Contact for the ODM database metadata. Links to Contacts.ContactID.	Mandatory Foreign Key
DatasetContactID	Integer	Contact for the data contained within the ODM database. Links to Contacts.ContactID.	Foreign Key
LineageStatement	String(unlimited)	Statement of lineage for the data within the ODM database.	
WaterOneFlowWSDL	String(500)	URL for the WSDL to connect to the Water One Flow web services for the database.	Mandatory

Table Name: RegionDatabases

Stores the relationship between regions and the ODM databases for that region.

Field Name	Data Type	Description	Validation
RegionID	Integer	Links to Regions.RegionID	Mandatory Foreign Key
DatabaseID	Integer	Links to ODMDatabases.DatabaseID	Mandatory Foreign Key
DisplayOrder	Integer	Order in which the points for the ODM databases will be added to the map and displayed in the legend of the map server application. Lower placed below higher in map.	Mandatory
DisplayName	String(255)	Display name of the database for the legend of the map server application.	Manadatory

Table Name: RegionMapServices

Stores the relationship between regions and the map services for that region.

Field Name	Data Type	Description	Validation
RegionID	Integer	Links to Regions.RegionID.	Mandatory Foreign Key
MapServiceID	Integer	Links to MapServices.MapServiceID.	Mandatory Foreign Key
DisplayOrder	Integer	Order in which the map services are displayed in the map server application. Lower placed below higher in map.	Mandatory

Field Name	Data Type	Description	Validation
DisplayName	String(255)	Display name of the map service for the legend of the map server application.	Mandatory
TransparencyPercent	Integer	Percent of transparency (100% = transparent) with which the service will be displayed.	
IsVisible	Boolean	Whether the map service is visible at startup of the map server application.	
IsTOC	Boolean	Whether the map service is displayed in the legend for the map server application.	
IsBaseMapService	Boolean	Whether the map service should be used as the base map for the map server application, determining spatial reference system, extents, etc.	Mandatory

Table Name: RegionMetadata

Stores user defined metadata for regions.

Field Name	Data Type	Description	Validation
RegionID	Integer	Links to Regions.RegionID.	Mandatory Foreign Key
MetadataTitle	String(255)	Title of the metadata element.	Mandatory
MetadataContent	String(unlimited)	Text content of the metadata element.	Mandatory
DisplayOrder	Integer	Order in which the metadata items will be displayed or written to a metadata description of a region. Lower values displayed before higher.	

Table Name: Regions

Stores information about study areas or regions (i.e., watersheds, experimental sites, etc.).

Field Name	Data Type	Description	Validation
RegionID	Integer	Automatically generated ID	Mandatory Primary Key
RegionName	String(255)	Name of the Region.	Mandatory
RegionTitle	String(255)	Title of the Region. Used for display purposes.	Mandatory
NorthExtent	Float	Latitude north extent of region.	Mandatory
EastExtent	Float	Longitude east extent of the region.	Mandatory
SouthExtent	Float	Latitude south extent of the region.	Mandatory
WestExtent	Float	Longitude west extent of the region.	Mandatory
RegionDescription	String(unlimited)	Description of the region. Used for display purposes.	
RegionMapCSSURL	String(500)	URL to a CSS file for use with the map server application.	

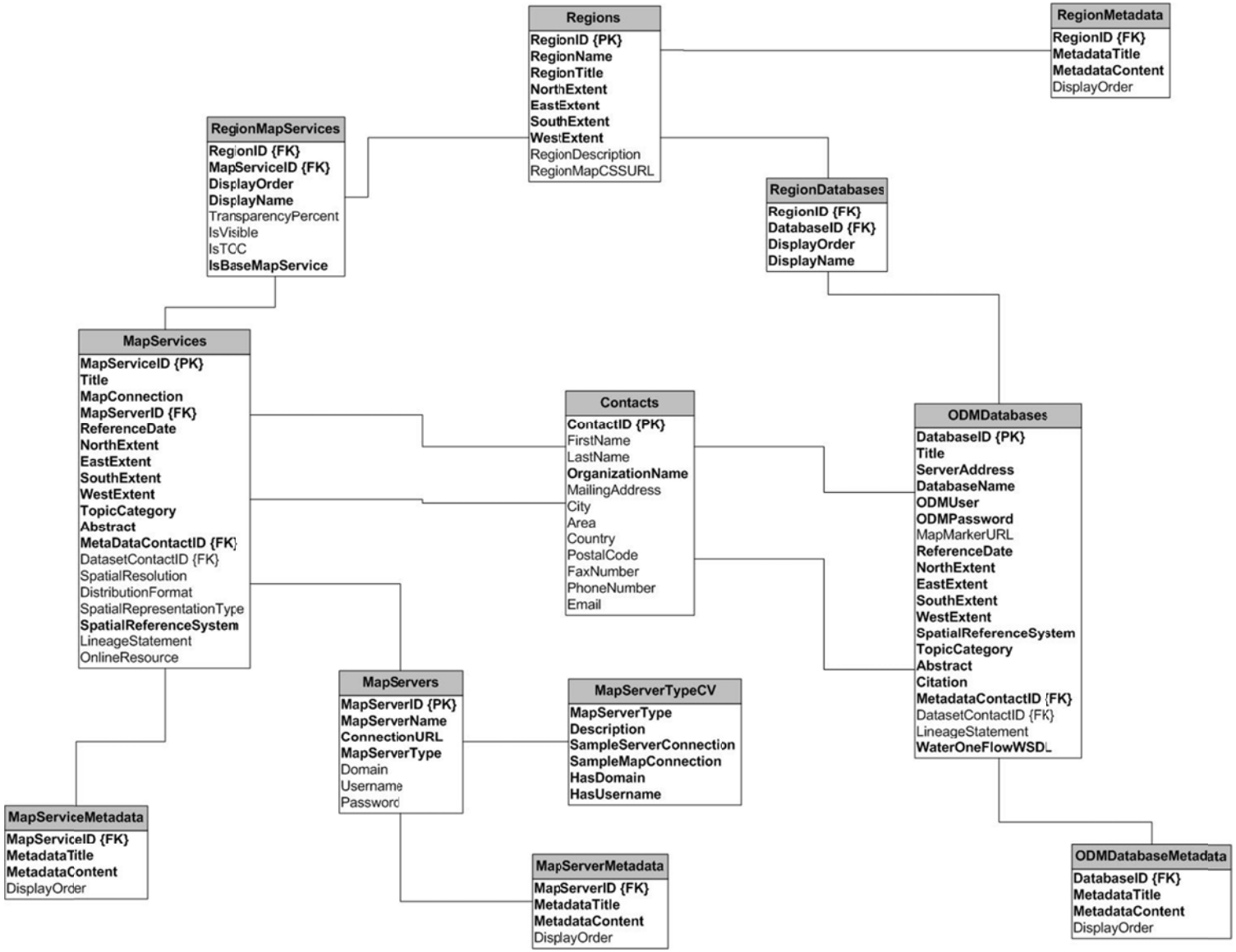


Figure A-1. HydroServer Capabilities Database schema.