

## Appendix 2-1: DMS Technical Memorandum



## Certification

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## Table of Contents

1.0	Introduction and Purpose .....	1
2.0	Database Management System Framework.....	1
3.0	Web Application Interface.....	2
3.1	Navigation.....	2
3.2	Searching for Monitoring Points.....	3
3.3	Filtering.....	4
3.4	Monitoring Point Attributes and Data.....	4
3.5	Spatial Features and Coverages (GIS Data).....	6
4.0	Advanced Features.....	7
4.1	Documents Menu .....	7
4.2	Data Menu.....	8
4.3	Features Menu.....	8
4.4	Managing Spatial Features and Coverages .....	11

## List of Figures

**Figure 3-1.** DMS Map Window Overview.

**Figure 3-2.** Available Basemaps.

**Figure 3-3.** Search for Monitoring Point.

**Figure 3-4.** Filtering Monitoring Points.

**Figure 3-5.** Example Hydrograph Plot.

**Figure 3-6.** Example Water Quality plot.

**Figure 3-7.** Example Display of Spatial Data.

**Figure 4-1.** Advanced Menu Bar.

**Figure 4-2.** Example Data Dropdown Menu Page.

**Figure 4-3.** Advanced Graphing Options.

**Figure 4-4.** Example Bulk Data Upload Page.

**Figure 4-5.** Example Import Log Page.

**Figure 4-6.** Manage Additional Layers Page.

## **List of Appendices**

**Appendix A.** DMS Tables and Affiliations.

## **List of Acronyms**

API - Application Programming Interface

ASP - Active Server Pages

SSL - Secure Sockets Layer

DBS&A - Daniel B. Stephens & Associates, Inc.

DMS - Database Management System

GIS - Geographic Information System

GSA - Groundwater Sustainability Agency

GSP - Groundwater Sustainability Plan

HTTPS - Hypertext Transfer Protocol Secure

IIS - Internet Information Services

LWA - Larry Walker Associates

SGMA - Sustainable Groundwater Management Act

SQL - Structured Query Language

SVGMD - Sierra Valley Groundwater Management District

URL - Uniform Resource Locator

## 1.0 Introduction and Purpose

Daniel B. Stephens & Associates, Inc. (DBS&A) was contracted by Larry Walker Associates (LWA) under LWA Project No. 649.01 to develop an integrated hydrologic model of the Sierra Valley and database management system (DMS) to assist with Groundwater Sustainability Plan (GSP) development and implementation. This report provides a description of the DMS with examples of how to navigate the web interface for stakeholders. It also provides information on how to upload and modify data for users with administrative level access.

The DMS (<https://sierra-valley.gladata.com/>) is a user-friendly, comprehensive, web-accessible database with a geographic information system (GIS) interface that provides visual and graphic outputs in addition to traditional tables. It enables stakeholders and technical staff to readily access and interact with basin data, and provides a platform where data can be safely and easily stored, visualized, updated, and exported for more detailed analyses.

## 2.0 Database Management System Framework

The DMS is a GLA Data (<https://bit.ly/3FiGPZF>) web application that utilizes an ASP.NET solution written in C# with two SQL Server back-end databases. It can be viewed using any common web browser, although it has been optimized for Google Chrome. The web site is transmitted through the HTTPS protocol using SSL. The web application also includes client-side code written in JavaScript that utilizing numerous APIs such as jQuery, ArcGIS and HighCharts. The web application runs on a Microsoft Windows Server through IIS.

The two SQL Server databases contain discreet data, with one focused on data utilized and shared across all GLA Data web applications and the other containing basin-specific data. The shared database stores tables that limit acceptable entries for other data fields. For example, wells can only be assigned to a type contained within the *lst\_well\_types* table. This standardizes entries for these data fields which assists with overall database organization.

The second database contains basin-specific data such as monitoring point locations, water level data, water quality data, etc. Monitoring points (typically wells) are grouped together into sites which is used for mapping, graphing, filtering, and reporting purposes. Similarly, analytical (water quality) readings are grouped together into sample sets. Each set is related to a single monitoring point thus providing the overall data hierarchy: sites, wells, samples, readings. A summary of the database tables and affiliations is included in Appendix A of this document.

Publically available data can be viewed and downloaded the via web application (<https://sierra-valley.gladata.com/>) without the need to create an account. Nearly all data used to develop the Sierra Valley GSP is publically available. The only exceptions includes data with privacy concerns (e.g., well-specific groundwater pumping). Public users cannot modify data.

Administrative users can be provided login credentials that allow them access different capabilities such as the ability to add/update/delete data or advanced graphing and reporting

features. Access to these features is restricted by user type, which allows SVGMD to control which users can modify the database. Batch upload of new data are supported for analytical, depth to water, production, and flow data. Through the web application, templates and instructions are provided for each import type. Imported data is validated against various rules and violations are reported back to the user.

## 3.0 Web Application Interface

The web application interface of the DMS can be accessed via <https://sierra-valley.gladata.com/>.

### 3.1 Navigation

The main page of the DMS web application is an interactive map that defaults to displaying all of the monitoring points for the basin (Figure 3-1). Green circles indicate clusters on monitoring points, with the number within the circle indicating the number of monitoring points that have been clustered. Clustering is done automatically and will change depending on the current zoom level. Hovering over menu and toolbar items in the web interface will usually bring up a short description.

The map interface can be zoomed in/out using the scroll wheel on the mouse or the “Zoom In” (+) and “Zoom Out” (–) buttons on the toolbar located at the top right corner. Double clicking on a location will also zoom into that area by one level. Clicking and dragging within the map area allows the user to pan the current map extent. Users can change the basemap displayed by selecting the “Switch Basemap” (🗺️) button, which will bring up several different options

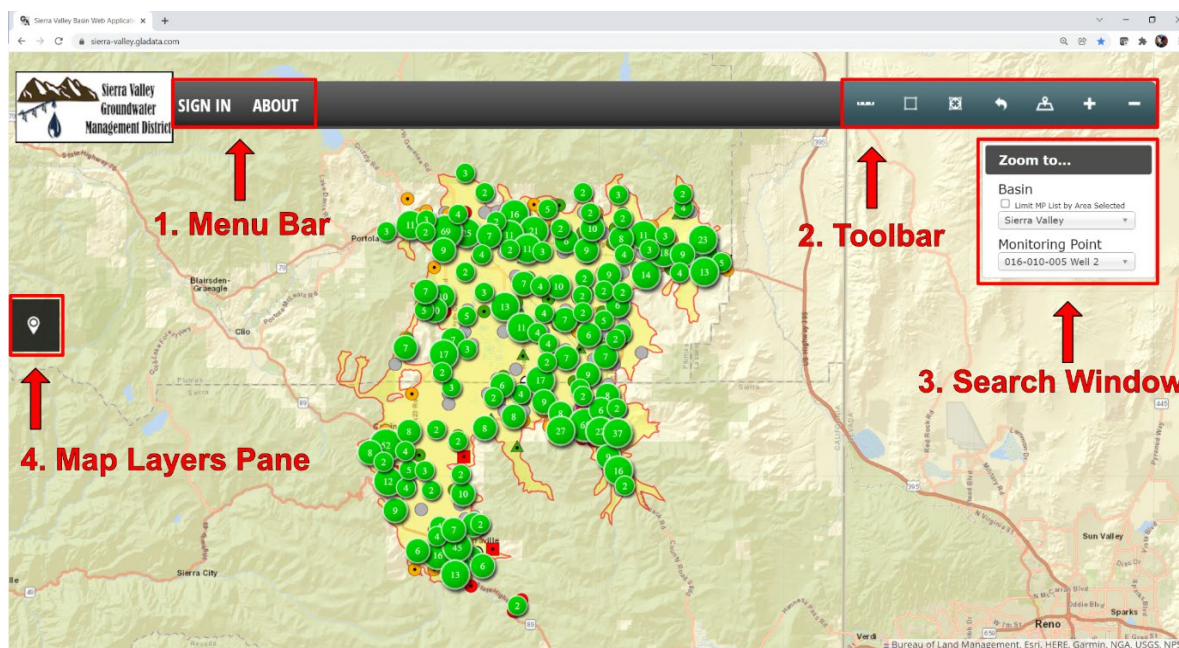
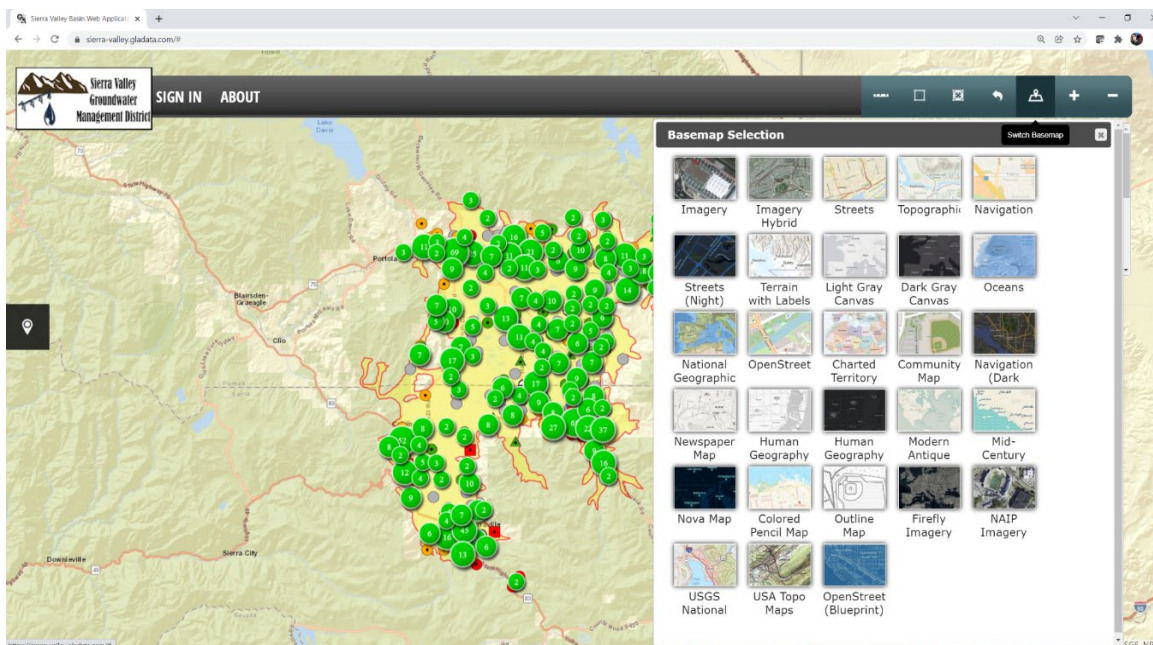


Figure 3-1. Overview of DMS interface.



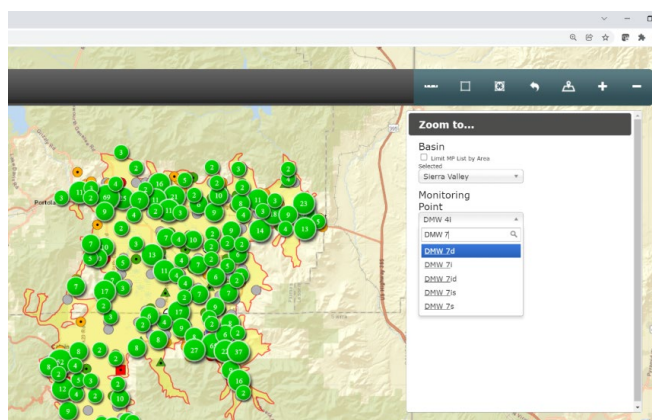


**Figure 3-2.** Available basemaps in the DMS web interface.

including satellite imagery and topographic maps (Figure 3-2). Users can return to the basin extent using the “Return to Initial Extent” (↶) button, or by selecting “Sierra Valley” from the Basin list in the search window (see Figure 3-1).

## 3.2 Searching for Monitoring Points

Monitoring points can be navigated to in the map interface either by zooming to the location or by searching for the monitoring point name in the search window. To zoom to a specific monitoring point, select the dropdown menu under “Monitoring Point” in the search window and begin typing the name of the well (Figure 3-3). The list will automatically filter all well names that contain what the user has typed in anywhere in the well name. Selecting the well in the list will automatically zoom the map to the monitoring point location. Note that the size of the search window may need to be expanded depending on user’s browser settings.




**Figure 3-3.** Zoom to specific well location by searching

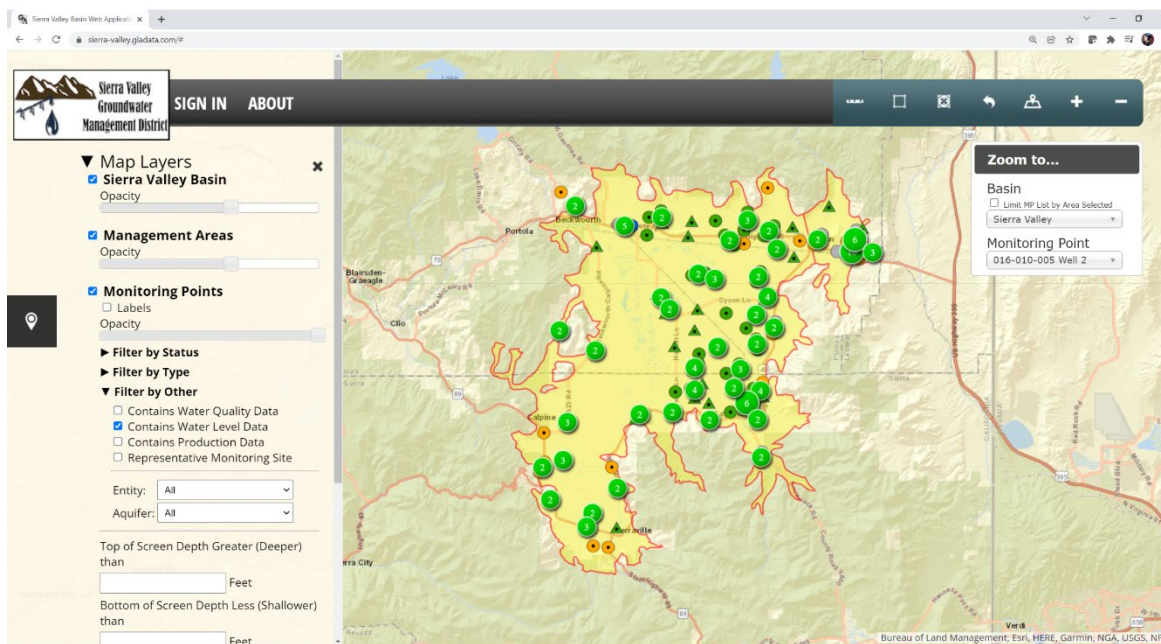
Monitoring points can also be searched for spatially using the “Query Region” (□) tool that allows the user to draw a rectangle and return all of the visible monitoring points within it, or the “Query Radius” (⊗) tool that returns all of the visible wells within a certain distance of a location on the map selected by the user. The

results of these queries will be displayed in the “Item Details” pane that appears on the left side of the web interface. Well name labels will automatically appear when zoomed in far enough, but can manually be enabled by selecting the box to the left of “Labels” under the “Monitoring Points” header in the “Map Layers” pane.

### 3.3 Filtering

The DMS web interface provides several different methods for filtering monitoring points by attributes or associated data. Clicking on the “Map Layers” icon () on the left side of the map window will open a pane with two main dropdown menus: 1) “Map Layers” and 2) “Additional Layers”. Under the “Map Layers” section, the user has the option of filtering wells by status, type, associated data, if the well is part of the representative monitoring network, associated entity, aquifer zone the well is screened within, or screen depth interval if known (Figure 3-4). This allows users to quickly find wells or data they are looking for.

Filters and data layers can be turned on and off by selecting the box to the left of the text. Note that all filters stack, meaning that only wells that meet all applied criteria will be displayed. For example, if the “Contains Water Quality Data” and “Contains Water Level Data” filters are both turned on, only wells that have both water quality and water level data associated with them will be displayed.



**Figure 3-4.** DMS browser window with “Map Layers” pane visible and only wells with water level data being displayed.

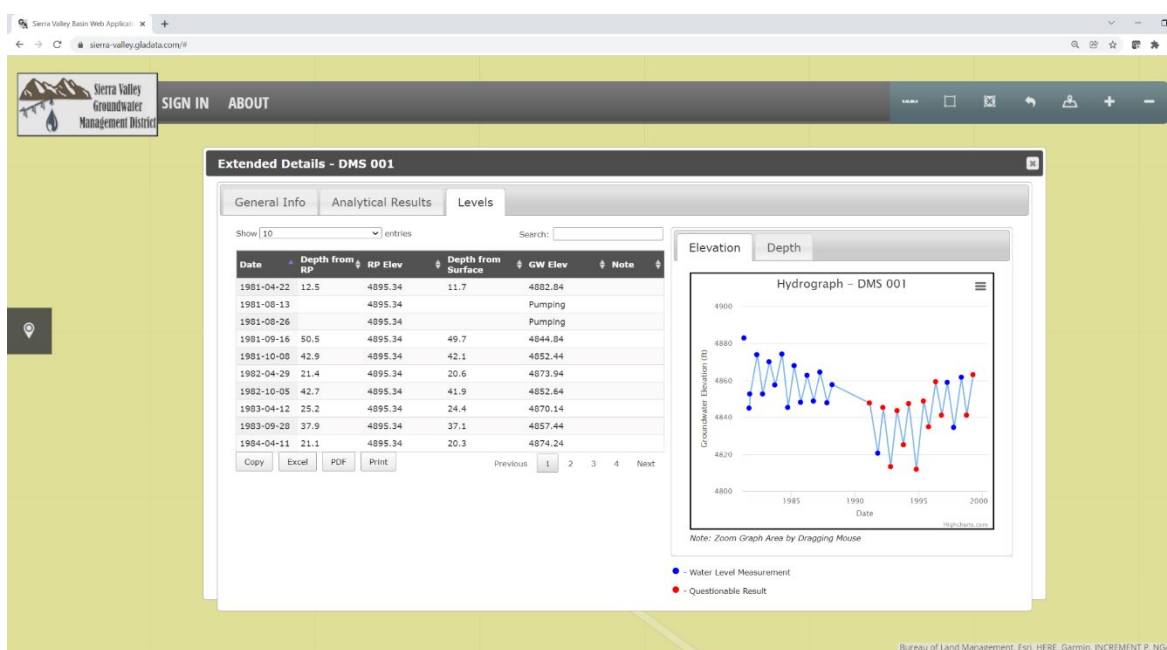
### 3.4 Monitoring Point Attributes and Data

Users can view pertinent information about a well contained in the DMS by clicking on the symbol in the map window, which brings up the up the “Item Details” pane. Selecting a cluster of



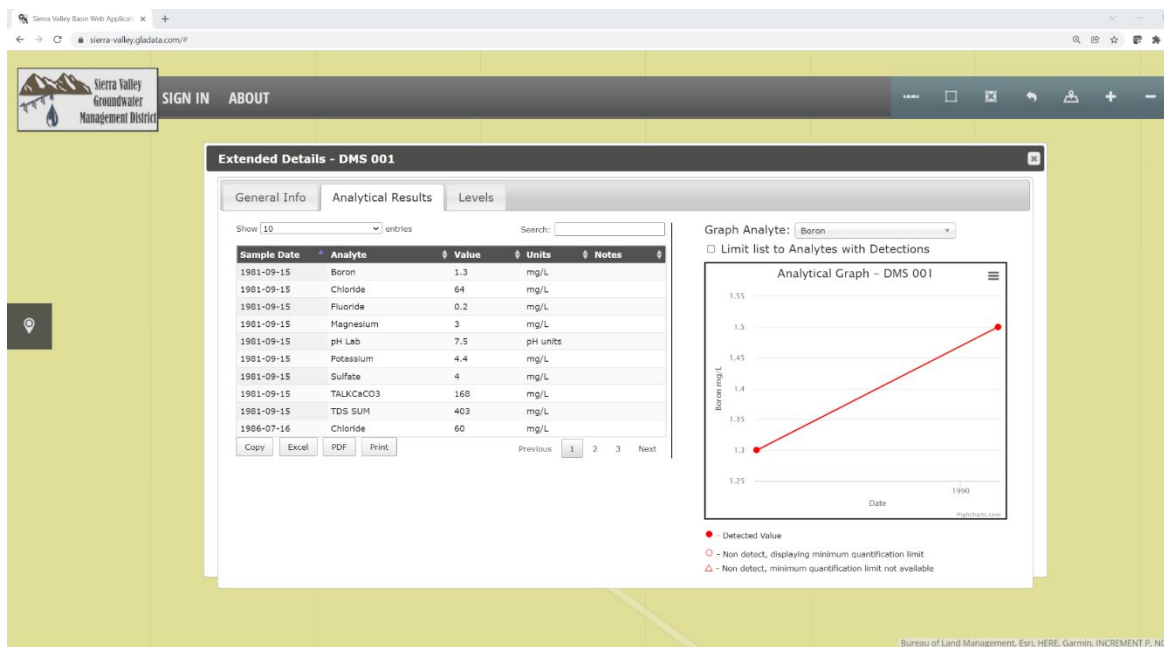
wells brings up a window that allows the user to cycle through each well to make a selection. This typically occurs when the map is not zoomed in very far or multiple wells have identical coordinates, such as nested monitoring wells. Selecting the “View Extended Details” link in the “Item Details” pane will open a new window with different tabs depending on the data associated with the monitoring point. The “General Info” tab contains the same information that was displayed on the “Item Details” pane that appears when the well is selected on the map viewer.

If groundwater levels have been measured in the well, the “Levels” tab will be visible (Figure 3-5). This will display a data table and interactive plot within the window. The data table can be expanded using the dropdown menu located above, or exported to one of several available file formats. Text typed into the search bar is applied to all fields, so specific dates, water levels, or conditions can easily be identified. Columns can be sorted by clicking on the header. Water level data can be viewed visually either as elevation or as depth from surface by selecting the appropriate tab above the plot. All plots are interactive, with labels that appear when the user hovers over a data point on the graph. Axis limits can also be dynamically changed by clicking and dragging within the plot window.



**Figure 3-5.** “Extended Details” window with “Levels” tab selected for well DMS 001. Data can be exported to various formats. Plot is interactive or can be exported to several different image formats.



If a well has water quality data associated with it then the “Analytical Results” tab will be visible. This tab operates nearly identically to the “Levels” tab, with water quality data tabulated on the left and plotted on the right (Figure 3-6). The user can select the chemical constituent to be plotted using the dropdown menu above the plot, with those having no detections removed from the list by enabling the filter above the plot. Just like the water level data, water quality data can be exported to several different tabular or image formats.

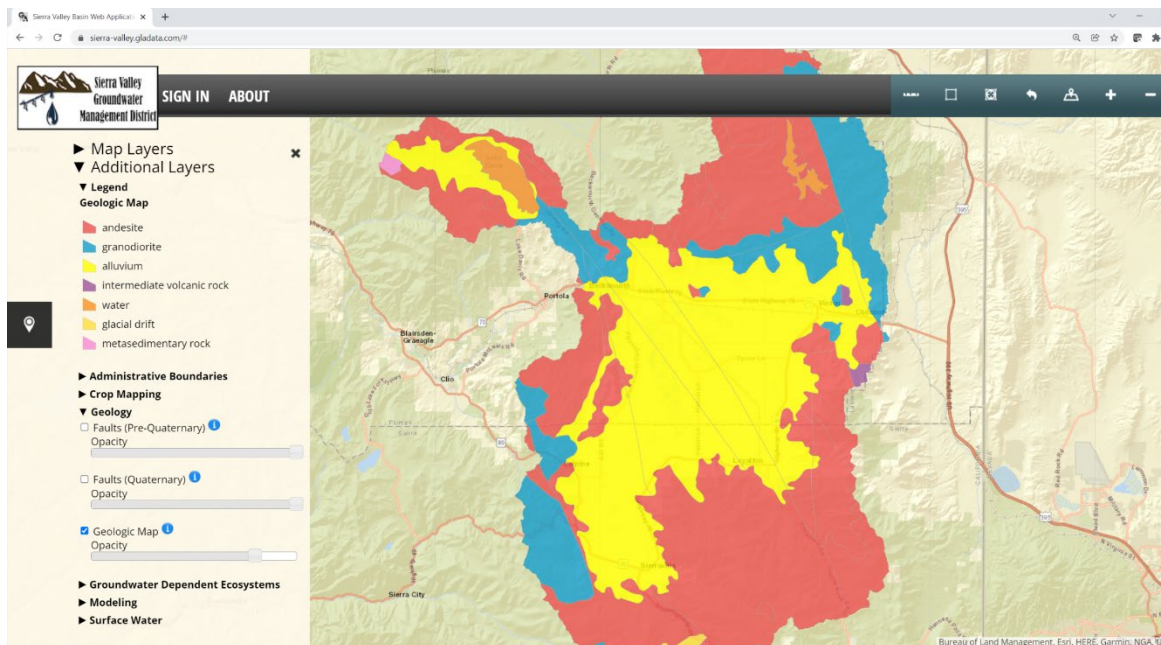


**Figure 3-6.** “Extended Details” window with “Analytical Results” tab selected for well DMS 001. Chemical constituent can be selected using dropdown menu above plot. Non-detects can be removed by selecting the filter above the plot. Data can be exported to various formats. Plot is interactive or can be exported to several different image formats.

### 3.5 Spatial Features and Coverages (GIS Data)

The DMS web interface has the capability of displaying GIS features and coverages such as shapefile layers and raster images. This allows users to view spatial data for the basin without the need for a high level understanding of GIS, as layer symbology has already been defined. Users simply toggle the layers on or off, and can adjust layer transparency if multiple overlapping shapefiles or coverages are being displayed simultaneously. The ability to display multiple types, or rapidly toggle back and forth between different layers, allows users to explore the spatial data available for the basin and gain a greater understanding of spatial relationships within the basin.

Spatial features and coverages can be accessed by selecting the “Map Layers” icon () on the left side of the map window. All shapefiles and coverages (excluding the basin boundary, management areas, and monitoring points) are found under the “Additional Layers” dropdown menu on the “Map Layers” pane (Figure 3-7). Layers can be toggled on and off by selecting the box to the left of the layer name. The user can access a description of the shapefile by selecting the “Information” icon (). The slider bar beneath each layer controls the layer transparency, and legends for all active layers can be found by expanding the “Legend” dropdown menu under “Additional Layers.” Selecting an item within a spatial layer (e.g., selecting one of the



**Figure 3-7.** Spatial data can be displayed by toggling layers on and off under the “Additional Layers” dropdown menu.

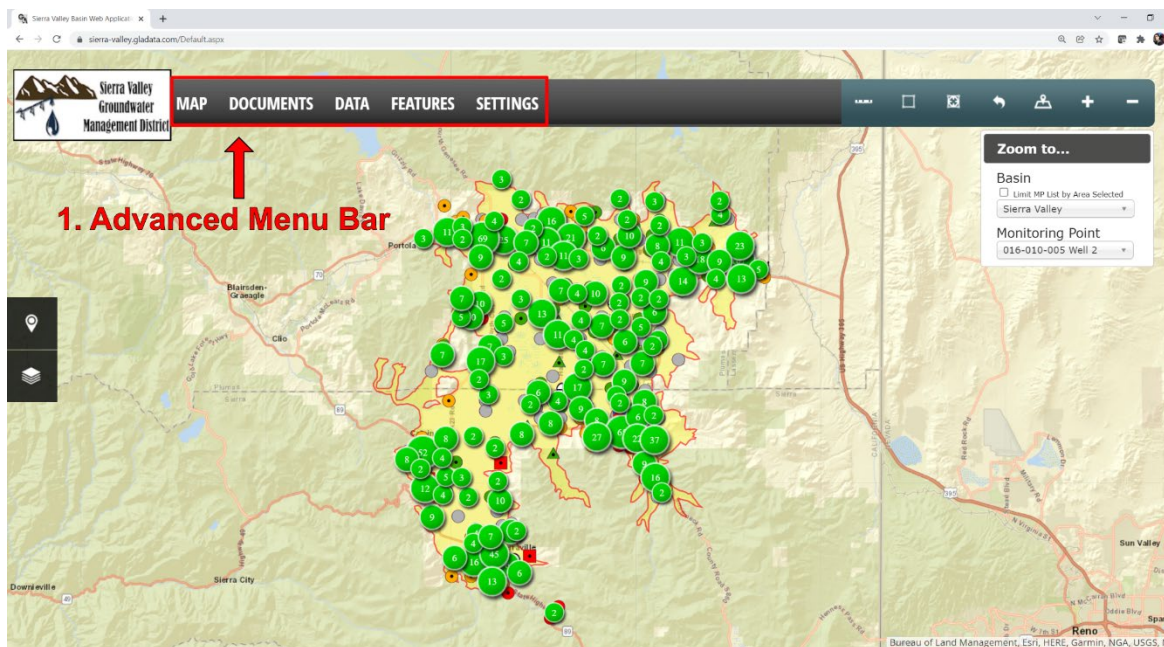
colored polygons in Figure 3-7) will bring up the “Item Details” pane that displays of the data for that item contained with the attribute table.

## 4.0 Advanced Features

Users with login credentials can access additional functionality not available to the public. The majority of this functionality is related to database maintenance, and includes the ability to upload, modify, or delete data or spatial coverages directly through the web interface; knowledge of SQL or relational databases is not required. Access to these features is restricted by user type, which allows SVGMD to control which users can modify the database. Users can provide their credentials by selecting the “Sign In” button on the menu bar at top of the map window. After logging in, the option in the menu bar will change to those shown in Figure 4-1. The “Map” menu item returns the user to the map window. The other dropdown menu items are described below.

### 4.1 Documents Menu

The DMS includes a document and photo library for reference and organization. Both can be associated with a monitoring point, such as well logs or site photos, or pertain to the basin in general, such as previous reports. To add new items, select the “Add Document” or “Add Photo Library Item” at the top of the respective page after selection from the dropdown menu. Several different attributes can be assigned to each document, such as name, date, type/category, and



**Figure 4-1.** Advanced menu bar for users with appropriate login credentials.

any specific notes. Documents and photos can be viewed in the web browser or downloaded by the user.

## 4.2 Data Menu

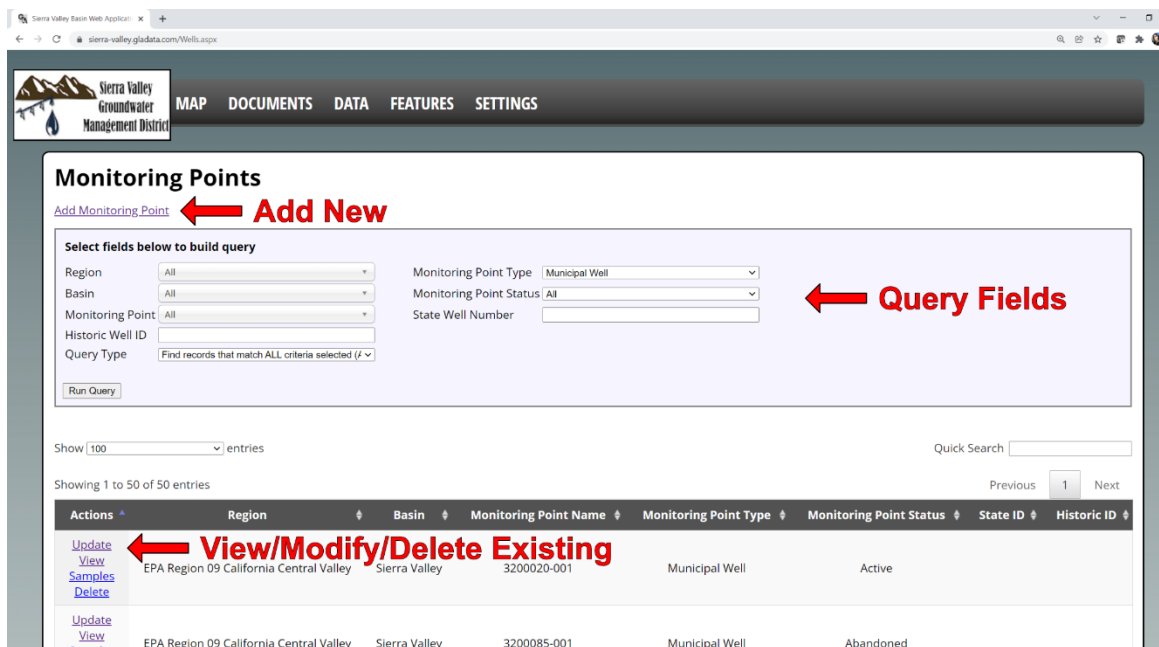
The “Data” dropdown menu allows users with appropriate level access to view, query, modify, and delete data contained within the database. The dropdown menu items are basin, monitoring points, samples, and results, which corresponds with the overall data hierarchy in the DMS. New entries can be added to the database by selecting the link located at the top of each respective page when selected from the dropdown menu. For example, a new monitoring point can be added by selecting the “Add Monitoring Point” link at the top of the page that appears after “Monitoring Points” is selected from the “Data” dropdown menu (Figure 4-2). A data entry window will appear that allows the user to populate attribute fields. For bulk data upload, see Section 4.3.

## 4.3 Features Menu

The “Features” dropdown menu provides two general advanced tools that provide the user with the ability to 1) automatically plot hydrographs or water quality results for multiple wells on the same graph and 2) bulk upload data. Selecting the “Graph” item of the dropdown menu takes the user to the graphing page where they can select one of four different graph types from the dropdown menu at the top (Figure 4-3).

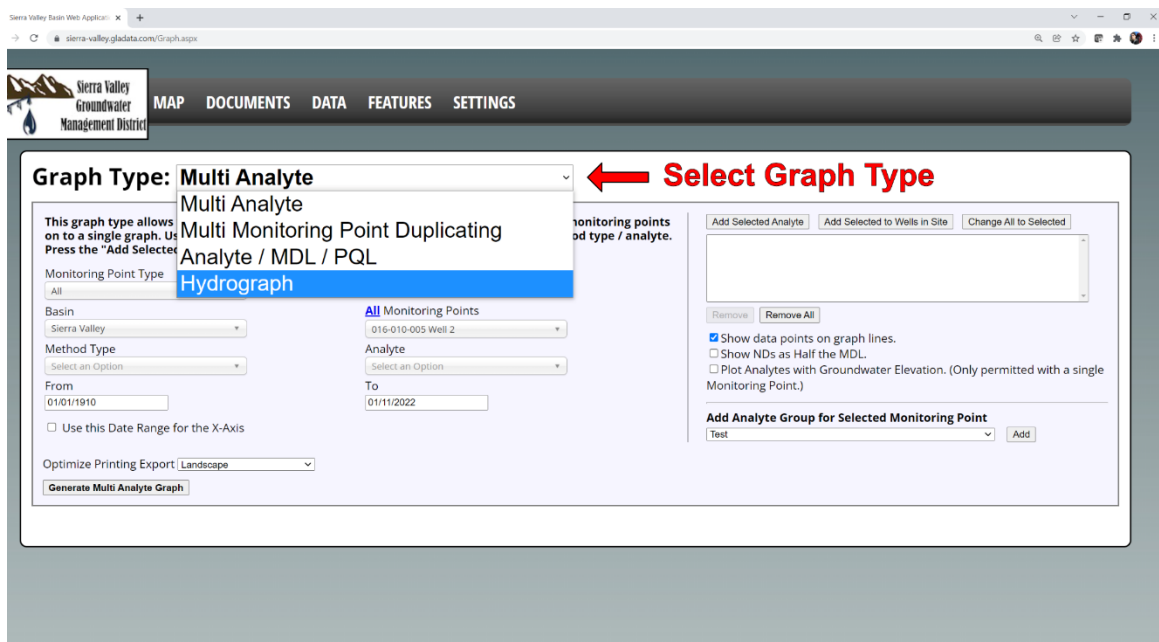
Bulk data uploads are accomplished by selecting the appropriate dropdown menu item and are available for the following data types: (1) analytical (water quality) data, (2) water level data, (3) well flow rates, and (4) well production volumes. Each of the data import pages contains





The screenshot shows the 'Monitoring Points' page of the Sierra Valley Groundwater Management District web application. The page has a navigation bar with 'MAP', 'DOCUMENTS', 'DATA', 'FEATURES', and 'SETTINGS'. The main content area is titled 'Monitoring Points' and includes a link to 'Add Monitoring Point' (annotated with a red arrow and 'Add New'). Below this is a 'Select fields below to build query' section with dropdown menus for Region, Basin, Monitoring Point, and Monitoring Point Type, and input fields for Monitoring Point Status and State Well Number (annotated with a red arrow and 'Query Fields'). A 'Run Query' button is at the bottom of this section. Below the query section is a table showing monitoring points. The first row is for 'EPA Region 09 California Central Valley', 'Sierra Valley', '3200020-001', 'Municipal Well', and 'Active'. The second row is for 'EPA Region 09 California Central Valley', 'Sierra Valley', '3200085-001', 'Municipal Well', and 'Abandoned'. A red arrow points to the 'Update', 'View', 'Samples', and 'Delete' links in the first row, annotated with 'View/Modify/Delete Existing'.

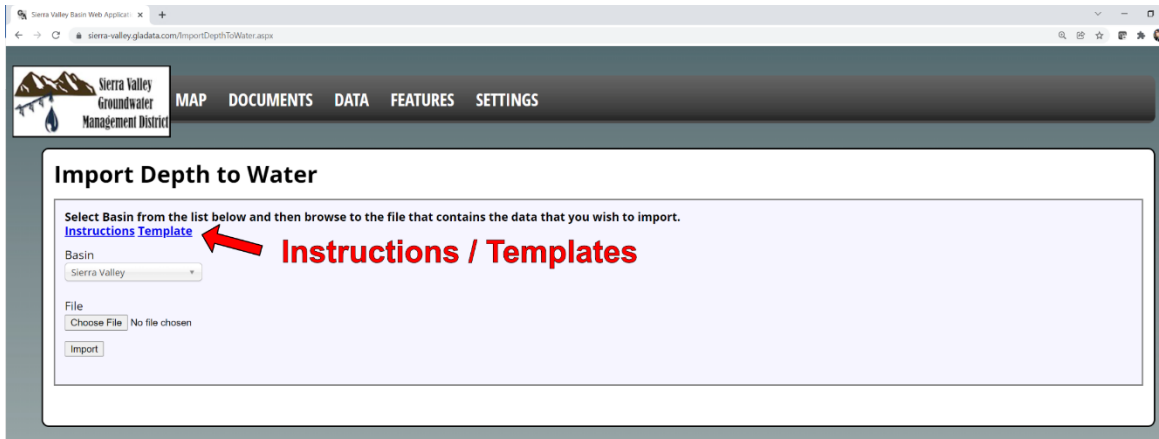
**Figure 4-2.** Annotated example of “Monitoring Points” menu item. All pages under the “Data” menu have similar structure.



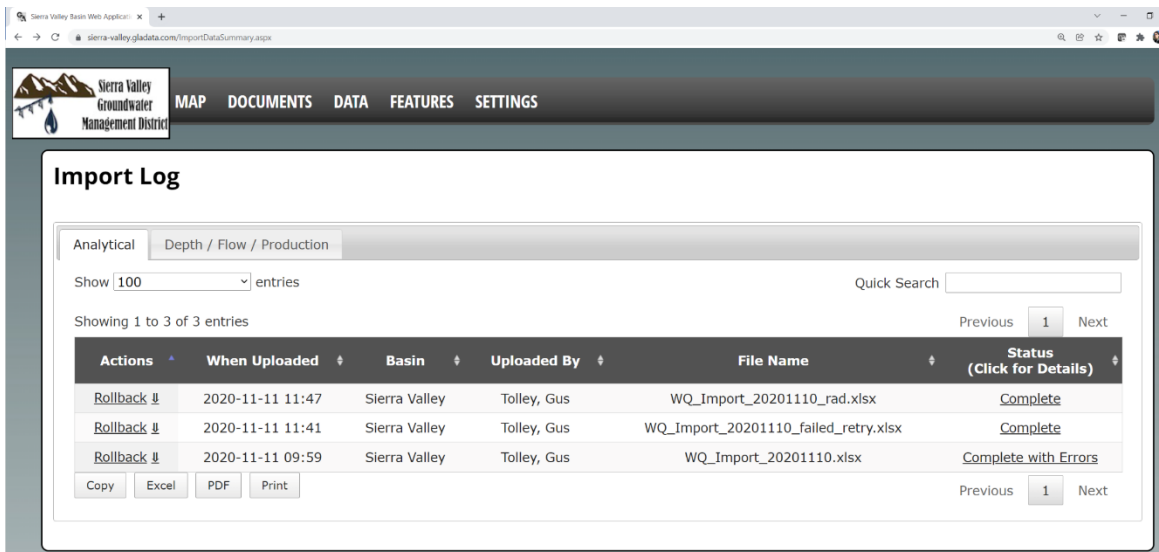
The screenshot shows the 'Graph Type' page of the Sierra Valley Groundwater Management District web application. The page has a navigation bar with 'MAP', 'DOCUMENTS', 'DATA', 'FEATURES', and 'SETTINGS'. The main content area is titled 'Graph Type: Multi Analyte'. A dropdown menu is open, showing options: 'Multi Analyte', 'Multi Monitoring Point Duplicating Analyte / MDL / PQL', and 'Hydrograph' (annotated with a red arrow and 'Select Graph Type'). Below the dropdown is a section for 'This graph type allows on to a single graph. Use Press the “Add Selected”'. It includes a 'Monitoring Point Type' dropdown (set to 'All'), a 'Basin' dropdown (set to 'Sierra Valley'), a 'Method Type' dropdown (set to 'Select an Option'), and a 'From' date field (set to '01/01/1910'). There is also a 'To' date field (set to '01/11/2022') and a checkbox for 'Use this Date Range for the X-Axis'. A 'Generate Multi Analyte Graph' button is at the bottom. On the right side, there is a section for 'Add Selected Analyte' with a list of monitoring points and a 'Change All to Selected' button. Below this is a section for 'Add Analyte Group for Selected Monitoring Point' with a 'Test' dropdown and an 'Add' button.

**Figure 4-3.** Different types of graphs available for plotting data from multiple wells.





**Figure 4-4.** Example data import page with location of downloadable instructions and template files indicated.



**Figure 4-5.** Example data import page with location of downloadable instructions and template files indicated.

downloadable instructions and template files for uploading data (Figure 4-4). The DMS automatically performs a validity check on the uploaded data and rejects the entire upload if an error is found.

Users with sufficient privileges can also access the “Import Log” page located in the “Features” dropdown menu. This page shows a summary of data imports including the upload date, user, filename, and upload status (Figure 4-5). If an error is later discovered in the upload, then all data associated with the upload can be easily removed from the database using the “Rollback”

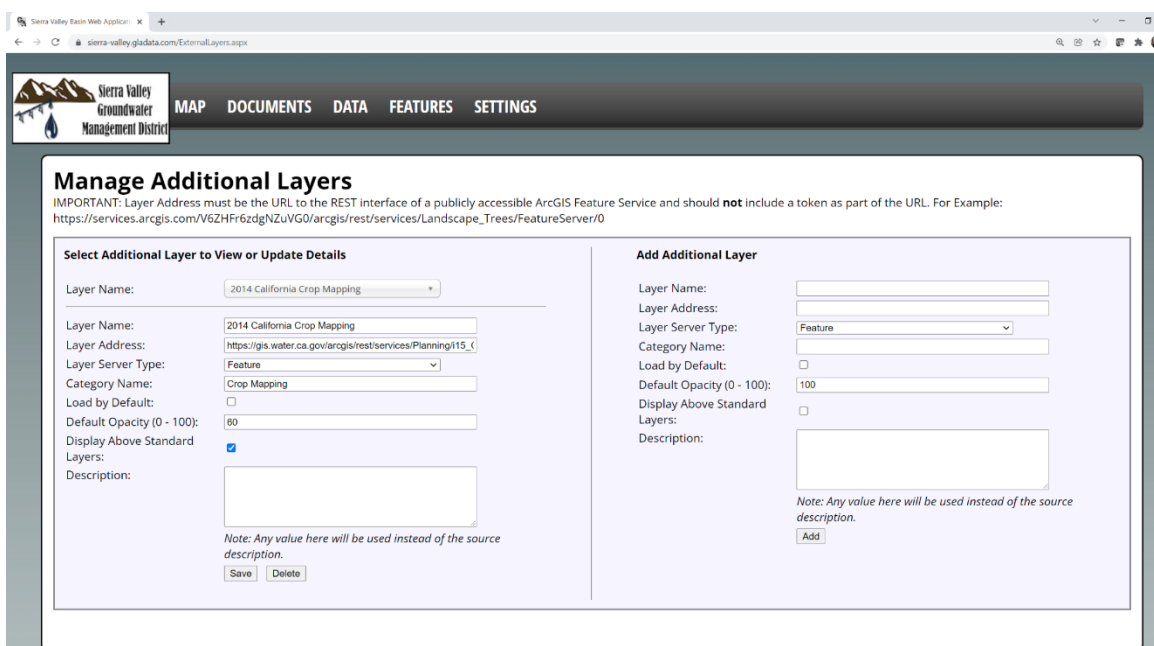
feature. It is recommended that only high-level users are granted access to this functionality in order to preserve database integrity.

## 4.4 Managing Spatial Features and Coverages

The “Manage Additional Layers” page (Figure 4-6) can be found under the “Settings” dropdown menu and allows the user to add, modify, or delete shapefile and coverages that can be displayed in the DMS web browser. Existing items are shown on the left side of the window, and can be selected using the “Layer Name” dropdown menu located near the top.

Changing attributes of a spatial item simply requires selecting the layer, modifying the information in the fields, and selecting the “Save” button near the bottom. Similarly, deleting an existing spatial item requires the user to select the layer from the dropdown list and then select the “Delete” button near the bottom. New layers can be added using the right side of the “Manage Additional Layers” page. The “Layer Address” is the URL to the ArcGIS REST interface with the token removed. These addresses will typically contain the text “FeatureServer/0”.

It should be noted that the DMS does not store the spatial data, it only displays it. The data and display options are stored on a separate GIS server which is not part of the DMS. Appropriate access to the GIS server the spatial data is stored in is necessary to modify any display preferences other than transparency. If a shapefile does not display when selected, it is likely the spatial data or address have been modified, and the entry in the DMS must be updated accordingly.



Sierra Valley Groundwater Management District

MAP DOCUMENTS DATA FEATURES SETTINGS

### Manage Additional Layers

IMPORTANT: Layer Address must be the URL to the REST interface of a publicly accessible ArcGIS Feature Service and should **not** include a token as part of the URL. For Example:  
[https://services.arcgis.com/V6ZHFr6zdgNZuVG0/arcgis/rest/services/Landscape\\_Trees/FeatureServer/0](https://services.arcgis.com/V6ZHFr6zdgNZuVG0/arcgis/rest/services/Landscape_Trees/FeatureServer/0)

**Select Additional Layer to View or Update Details**

Layer Name: 2014 California Crop Mapping

Layer Name: 2014 California Crop Mapping

Layer Address: [https://gis.water.ca.gov/arcgis/rest/services/Planning115\\_0/FeatureServer/0](https://gis.water.ca.gov/arcgis/rest/services/Planning115_0/FeatureServer/0)

Layer Server Type: Feature

Category Name: Crop Mapping

Load by Default: ☐

Default Opacity (0 - 100): 60

Display Above Standard Layers: ☒

Description:

Note: Any value here will be used instead of the source description.

Save Delete

**Add Additional Layer**

Layer Name:

Layer Address:

Layer Server Type: Feature

Category Name:

Load by Default: ☐

Default Opacity (0 - 100): 100

Display Above Standard Layers: ☐

Description:

Note: Any value here will be used instead of the source description.

Add

Figure 4-6. Manage additional layers page.

# Appendix A

## DMS Tables and Affiliations

Database	Table	Description	Primary Key	Affiliated Tables
Shared	AnalyteGroupForReportItems	Analytes can be grouped to ease their selection as a collection in reports. This table stores analytes that are in a user-defined group.	analyte_group_item_id	AnalyteGroupForReports, analytes
	AnalyteGroupForReports	Analytes can be grouped to ease their selection as a collection in reports. This table stores top-level group data.	analyte_group_id	
	AnalyteGroupItems	Analytes can be grouped to ease their selection as a collection on graphs. This table stores analytes that are in a user-defined group.	analyte_group_item_id	AnalyteGroupss, analytes, methods
	AnalyteGroups	Analytes can be grouped to ease their selection as a collection in graphs. This table stores analytes that are in a user-defined group.	analyte_group_id	
	analytes	Stores analytical data that is used for redings, graphing, reporting and validation when importing data.	analyte_id	
	analytes_to_methods	Links analytes and methods together in many-to-many relationship.	anayte_id, method_id	
	basins	Contains region lookup item for application sites.	basin_id	
	flags	Dereferences flat abbreviations for reported analytical data.	flag	
	lst_doc_type	Look up values for types for documents added to the database.	doc_type	
	lst_elevation_survey_methods	Look up values for elevation survey methods associated with a well.	elevation_survey_method	
	lst_method_types	Method types that a method can be associated with and used for report grouping.	method_type_id	
	lst_monitoring_status	Look up values for monitoring status for a well.	monitoring_status	
	lst_photo_library_categories	Look up values for categories that photos can belong to that are associated with a well.	photoLibraryCategoryID	

Database	Table	Description	Primary Key	Affiliated Tables
Shared	lst_well_icons	When wells are displayed on the map, they appear as an icon that is defined through the meta data in this table as associated with the well status.	well_type, well_status	
	lst_well_status	Look up values for the status of a well.	well_status	
	lst_well_types	Look up values for the type of well.	well_type	
	lst_xy_survey_methods	Look up values for the survey methods that are used in association with a well.	xy_survey_method	
	mcls	State-specific MCL reports can be generated as part of the historic report. This table contains those MCL values.	stateMcId	analytes
	methods	Stores top-level method information as it relates to analytical results associated with a monitoring point.	method_id	
	synonyms	When analytical data is imported, associated with wells, if the analyte for the record being imported is not found in the analytes table, a check is made to see if the value being imported is found in the synonym table. If so, the analyte associated with the synonym is substituted.	synonymID	analytes
	xlImportAllSURFACEwq	Not used in web application.		
Sierra Valley	aquifers	Not used in web application.		
	change_log	Stores information related to actions performed by users against certain tables.	change_log_id	samples, readings, sites, wells, photo_library_items, documents, methods, analytes
	conversions	Not used in web application.		
	documents	Stores metainformation about documents that relate to sites and/or wells.	doc_id	sites, wells



Database	Table	Description	Primary Key	Affiliated Tables
Sierra Valley	edd_staging	Utility table used to store analytical data as it is being imported.	edd_staging_id	edd_summary
	edd_summary	Stores top-level analytical data import information.	edd_summary_id	
	ErrorLog	Not used in web application.		
	ExcelAnGrpItems	Not used in web application.		
	ExcelImportTable	Not used in web application.		
	externalLayers	Stores metainformation about optional layers displayed on map that come from external sources.	externalLayerId	
	FileDownloadLog	Not used in web application.		
	ImportFlowData	Stores individual flow data items during import process. Related to ImportLogs through groupGUID field.	ImportFlowDataId	ImportLogs
	ImportLogs	Top-level import information related to non-analytical data imports.	importLogId	
	ImportProductionData	Stores production data items during import process. Related to ImportLogs through groupGUID field.	ImportProductionDataId	ImportLogs
	ImportWaterLevels	Stores water level data items during import process. Related to ImportLogs through groupGUID field.	ImportWaterLevelID	ImportLogs
	ImportWQPSs	Not used in web application.		
	lab_references	Not used in web application.		
	lithology	Lithology observations related to wells, typically obtained from well logs.	lithology_id	wells
	lst_aquifers	List of aquifers that a well can be associated with.	aquifer	wells
	lst_entities	List of entities that a well can be associated with.	entity_name	wells

Database	Table	Description	Primary Key	Affiliated Tables
Sierra Valley	lst_monitoring_point_data_source	List of data sources that a well can be associated with.	monitoring_point_data_source	wells
	lst_rep_mon_site	List of Representative Monitoring Site that a well can be associated with.	rep_mon_site	wells
	PassFail_DupCheck	Not used in web application.		
	PassFail_Fail	When processing the import of analytical data, rows that fail data checks are copied to this table.	pff_ID	edd_summary
	PassFail_Pass	When processing the import of analytical data, rows that pass data checks are copied to this table.	pfp_ID	edd_summary
	PassFail_QC	When processing the import of analytical data, rows that are noted as QC, as indicated by the SAMP_ID field of the import record, are copied to this table.	pfq_ID	edd_summary
	photo_library_items	Stores metainformation about images related to wells.	photoLibraryItemID	wells
	readings	Bottom level analytical data in the sites-wells-sample-readings hierarchy that stores the actual results of a reading.	reading_id	samples, wells, analytes (shared db), methods (shared db), edd_summary
	report_order	Not used in web application.		
	samples	Mid-level analytical data in the sites-wells-sample-readings hierarchy that stores information on the group of readings handled as a collection.	sample_id	wells, edd_summary
	sites	Top-level table that stores location data, in the form of a multi-polygon, into which wells are grouped.	site_id	
	SpecialDataFeatures	Not used in web application.		
	user_layer_items	Not used in web application.		

Database	Table	Description	Primary Key	Affiliated Tables
Sierra Valley	user_layers	Not used in web application.		
	user_queries	Not used in web application.		
	userFavoriteWellLists	Users can create custom groups wells that are used in different aspects of the web application. This table contains the top-level information about those lists.	userFavoriteWellListId	users
	userFavoriteWells	Wells that are associated with a group list. Linking table between users and userFavoriteWellLists.	userFavoriteWellId	users, userFavoriteWellLists
	users	Log In credentials, settings and information for application users	user_id	
	water_levels	Groundwater level observations related to wells.	water_level_id	wells
	water_levels_hf	Not used in web application.		
	well_aquifers	Not used in web application.		
	well_types	Not used in web application.		
	WellFlows	Flow rate observations related to wells.	wellFlowId	wells
	WellLinks	URLs that are listed and associated with a well.	wellLinkId	wells
	WellProduction	Production data observations associated with wells.	wellProductionId	wells
	wells	Top level well information including location data stored as a point.	well_id	sites, wells
	WQPSs	Water Quality Protection Standard data associated with a well and used for concentration layer on map.	wqpsID	wells, analytes (shared db)