6. DATA MANAGEMENT SYSTEM

This chapter includes an overview of the Cuyama Basin Data Management System (DMS), describes how the DMS works, and details the data used in the DMS. This chapter satisfies Section 352.6 of the SGMA regulations.

6.1 DMS Overview

The Cuyama Basin DMS uses the Opti platform, which is a flexible and open software platform that uses familiar Google maps and charting tools for analysis and visualization. The DMS serves as a data-sharing portal that enables use of the same data and tools for visualization and analysis. These tools support sustainable groundwater management and create transparent reporting on collected data and analysis results. Figure 6-1 is a screenshot of the Opti platform.
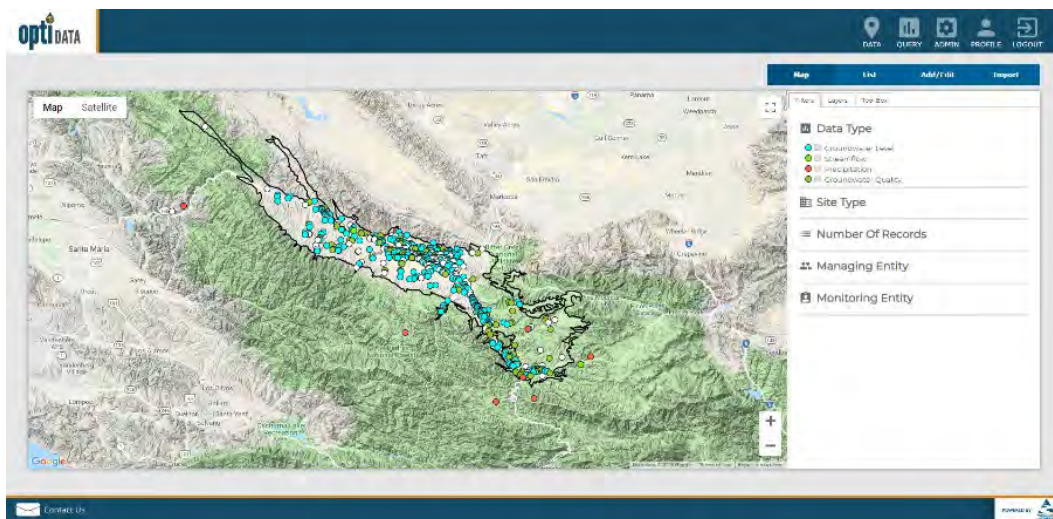

Figure 6-1: Screenshot of Opti Platform

The Cuyama Basin DMS is a web-based publicly accessible portal that may be viewed using common web browsers such as Google Chrome, Firefox, and Microsoft Edge. The DMS utilizes Google maps and other charting tools for analysis and visualization. The site may be accessed at http://opti.woodardcurran.com/cuyama.

6.2 DMS Functionality

The DMS is a modular system that includes numerous tools to support GSP development and ongoing implementation, including the following:

- User and data access permissions
- Data entry and validation
- Visualization and analysis
- Query and reporting

As the needs of the Cuyama Basin Groundwater Sustainability Agency (CBGSA) change over time, the DMS can be configured for additional tools and functionality. The following sections describe the DMS's currently configured tools. For more detailed instructions about how to use the DMS, refer to the Cuyama Basin Data Management System Opti Data Public User Guide (Appendix A).

6.2.1 User and Data Access Permissions

DMS user access permissions are controlled through several user types. These user types have different roles in the DMS as summarized in Table 6-1 below. These user types are broken into three high-level categories as follows:

- **System Administrator** – System administrators manage information at a system-wide level, with access to all user accounts and entity information. System administrators can set and modify user access permissions when an entity is unable to do so.
- **Managing Entity (Administrator, Power User, User)** – Managing entity users are responsible for managing their entity's site/monitoring data, and can independently control access to these data. Entity users can view and edit their entity's data and view (but not edit) shared or published data supplied by other entities. An entity's site information (i.e., wells, gages, etc.) and associated data may only be edited by system administrators and power users associated with the entity. The CBGSA is currently configured as the managing entity for all datasets in the DMS.
- **Public** – Public users may view data that are published, but may not edit any information. Public users may access the DMS using the guest login feature on the DMS login screen (Figure 6-2).

Table 6-1: Data Management System User Types/Access

| Modules/ Submodules	System Administrators	Managing Entity			Public
		Admin	**Power User**	**User**	
Data: Map	Access to all functionality	Access to all functionality	Access to all functionality	Access to all functionality	Access to partial functionality
Data: List	Access to all functionality	Access to all functionality	Access to all functionality	Access to all functionality	Access to partial functionality
Data: Add/Edit	Access to all functionality	Access to all functionality	Access to all functionality	--	--
Data: Import	Access to all functionality	Access to all functionality	Access to all functionality	--	--
Query	Access to all functionality	Access to all functionality	Access to all functionality	Access to all functionality	Access to partial functionality
Admin	Access to all functionality	--	--	--	--
Profile	Access to all functionality	Access to all functionality	Access to partial functionality	Access to partial functionality	Access to partial functionality
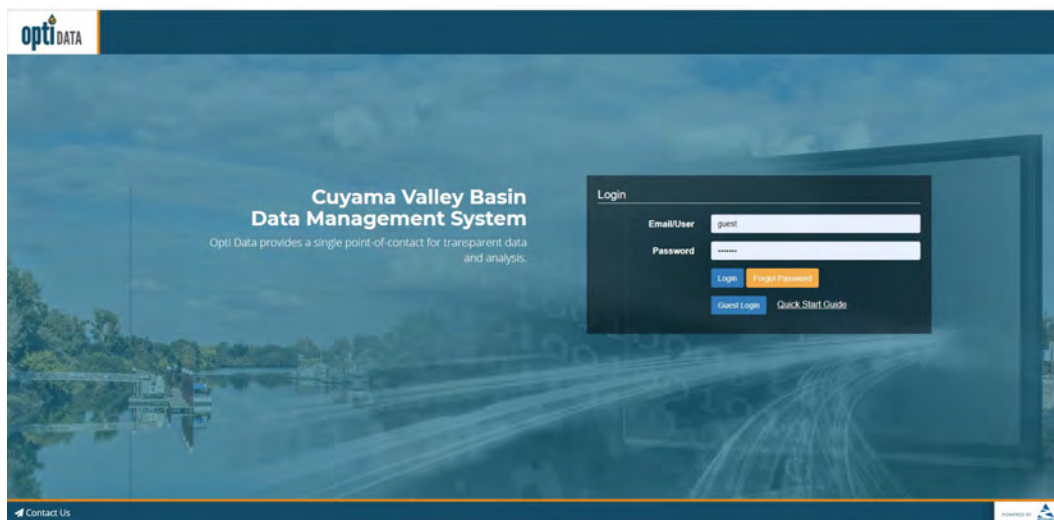
Figure 6-2: Screenshot of Opti Login Screen

Monitoring sites and their associated datasets are added to the DMS by managing entity administrators or power users. In addition to user permissions, access to the monitoring datasets is controlled through assigning one of three options to the data type as follows:

- **Private data** – Private data are monitoring datasets only available for viewing, depending on user type, by the entity's associated users in the DMS.

- **Shared data** – Shared data are monitoring datasets available for viewing by all users in the DMS, except for public users.

- **Public data** – Public data are monitoring datasets that are available publicly that can be viewed by all user types in the DMS; public datasets may also be published to other websites or DMSs as needed.

Managing entity administrators can set and maintain data access options for each data type associated with their entity.

6.2.2 Data Entry and Validation

To encourage agency and user participation in the DMS, data entry and import tools are designed to be easy to use, are accessible over the web, and help maintain data consistency and standardization. The DMS allows entity administrators and power users to enter data either manually via easy-to-use interfaces, or through an import tool using Microsoft Excel templates, so that data may be entered into the DMS as soon as possible after collection. The data records are validated by a managing entity's administrators or power users using a number of quality control checks prior to inclusion in the DMS.

Data Collection Sites

Users can input site information about groundwater wells, stream gages, and precipitation meters manually either through the data entry tool or when prompted in the import tool. Using the data entry tool, new sites may be added by clicking on "New Site." Existing sites may be updated using the "Edit Site" tool. During data import, the sites associated with imported data are checked by the DMS against an existing site list. If the site is not in the existing site list, the user is prompted to enter the information via the new site tool before the data import can proceed.

Table 6-2 lists the information that is collected for sites. Required information is indicated with an asterisk; all other information is considered optional.

Table 6-2: Data Collection Site Information		
Basic Information	**Well Information**	**Construction Information**
Site Type* Opti Site Name* Local Site Name* Additional Name Latitude/Longitude* Description County Managing Entity* Monitoring Entity* Type of Monitoring Type of Measurement Monitoring Frequency	State Well ID MSC (Master State Well Code) USGS Code CASGEM ID Ground Surface Elevation (feet) Reference Point Elevation (feet) Reference Point Location Reference Point Description Well Use Well Status Well Type Aquifers Monitored Groundwater Basin Name/Code Groundwater Elevation Begin/End Date Groundwater Elevation Measurement Count Water Level Measurement Method Groundwater Quality Begin/End Date Groundwater Quality Measurement Count Comments	Total Well Depth Borehole Depth Casing Perforations Top/Bottom Elevation Casing Diameter Casing Modifications Well Capacity Well Completion Report Number Comments
Notes: ID = identification number MSC = Master State Well Code USGS = United States Geological Survey CASGEM = California Statewide Groundwater Elevation Monitoring Program		

Monitoring Data Entry

Monitoring data, including groundwater elevation, groundwater quality, streamflow, and precipitation may be input either manually through the data entry tool or by using templates in the import tool. Figure 6-3 is a screenshot of the data entry interface.
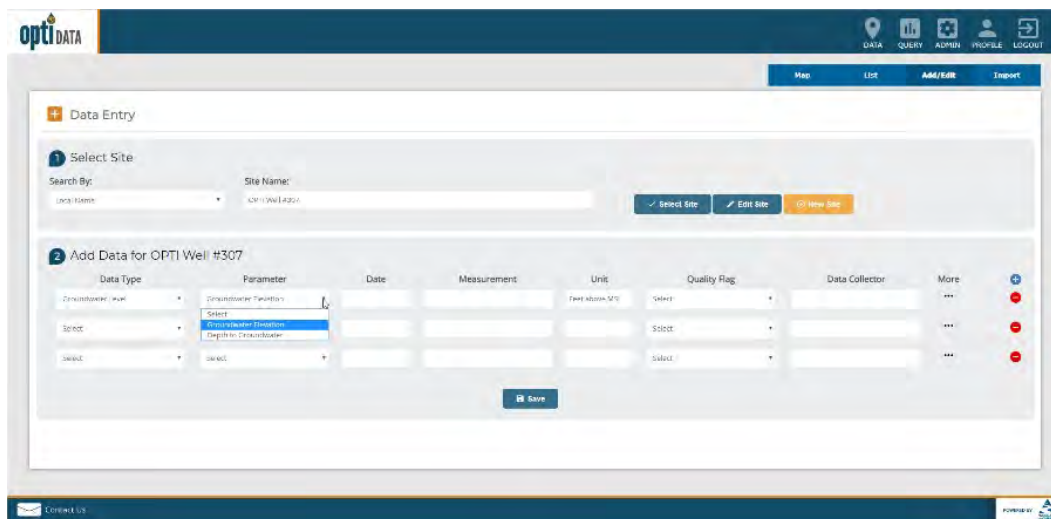

Figure 6-3: Screenshot of Data Entry Tool Interface

The data entry tool allows users to select a site and add data for the site using a web-based form. The following information is collected:

- Data type (e.g. groundwater elevation, groundwater quality, streamflow, or precipitation)
- Parameter for selected data type, units populate based on selection
- Date of measurement
- Measurement value
- Quality flag (i.e., quality assurance description for the measurement such as "Pumping," "Can't get tape in casing," etc. as documented by the data collector)
- Data collector
- Supplemental information based on data type (i.e., reference point elevation, ground surface elevation, etc.)

Data import templates include the same data entry fields and are available for download from the DMS. The Microsoft Excel-based templates contain drop-down options and field validation similar to the data entry interface.

Data Validation

Quality control helps ensure the integrity of the data added to the DMS. The entities that maintain the monitoring data loaded into the DMS may have performed previous validation of that data; no effort was made to check or correct that previous validation, and it was assumed that all data records provided were valid. While it is nearly impossible to determine complete accuracy of the data added to the DMS since the DMS cannot detect incorrect measurements due to human error or mechanical failure, it is possible to verify that the data input into the DMS meets some data quality standards. This helps promote user confidence in the data both stored and published for visualization and analysis.

Upon saving the data via the data entry interface or by importing the data using the Microsoft Excel templates, the following data validation checks are performed by the DMS:

- **Duplicate measurements** – The DMS checks for duplicate entries based on the unique combination of site, data type, date, and measurement value.
- **Inaccurate measurements** – The DMS compares data measurements against historical data for the site and flags entries that are outside the historical minimum and maximum values.
- **Incorrect data entry** – Data field entries are checked for correct data type (e.g., number fields do not include text, date fields contain dates, etc.).

Users are alerted to any validation issues and may either update the data entries or accept the values and continue with the entry/import. Users may access partially completed import validation through the import logs that are saved for each data import. The partially imported datasets are identified in the import log with an incomplete icon under the status field. This allows a second person to also access the imported data and review prior to inclusion in the DMS.

6.2.3 Visualization and Analysis

Transparent visualization and analysis tools enable use of the same data and methodologies, allowing stakeholders and neighboring GSAs to use the same data and methods for tracking and analysis. In the DMS, data visualization and analysis are performed in both map and list views, as described below.

Map View

The map view displays all sites (i.e., groundwater wells, stream gages, precipitation meters, etc.) in a map-based interface (Figure 6-4). The sites are color-coded based on associated data type and may be filtered by different criteria, such as number of records or monitoring entity. Users may click on a site to view the site detail information and associated data. The monitoring data records are displayed in both chart and table formats. In these views, the user may view different parameters for the data type. The chart and table may be updated to display selected date ranges, and the data may be exported to Microsoft Excel.
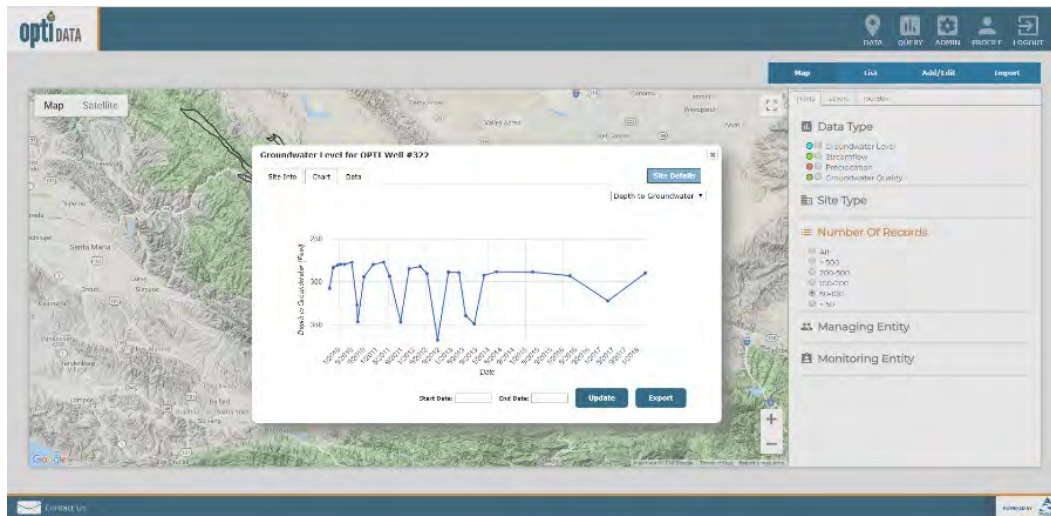
Figure 6-4: DMS Map View

List View

The list view displays all sites (i.e., groundwater wells, stream gages, precipitation meters, etc.) in a tabular interface. The sites are listed according to names and associated entities. The list can be sorted and filtered by different criteria such as number of records or monitoring entity. Similar to the map view, users may click on a site to view the site detail information and associated data. The monitoring data records are displayed in both chart and table formats. In these views, the user may view different parameters for the data type. The chart and table may be updated to display selected date ranges, and the data may be exported to Microsoft Excel.

Analysis Tools

The toolbox is available in the map view and offers administrative and entity users access to the well tiering tool to support monitoring plan development. The DMS' flexible platform allows for the development and addition of future analysis tools, including contouring, total water budget visualization, and management area tracking.

6.2.4 Query and Reporting

The DMS has the ability to format and export data and analysis at different levels of aggregation, and in different formats, to support local decision making and for submission to various statewide and local programs (i.e., SGMA, CASGEM Program, GAMA Program, etc.).

Ad Hoc Query

Data in the DMS can be queried and reported using the query tool. The query tool includes the ability to build ad hoc queries using simple options. The data can be queried by the following criteria:

- Monitoring or managing entity
- Site name
- Data type

Once the type of option is selected, the specific criteria may be selected (e.g., groundwater elevation greater than 100 feet). Additionally, users may include time periods as part of the query. The query options can build upon each other to create reports that meet specific needs. Queries may be saved and will display in the saved query drop-down menu for future use.

Query results are displayed in a map format and a list format. In both the map and list views, the user may click on a well to view the associated data. Resulting query data may be exported to Microsoft Excel.

Standard Reports

The DMS can be configured to support wide-ranging reporting needs through the reports tool. Standard report formats may be generated based on a predetermined format and may be created at the click of a button. These report formats may be configured to match state agency requirements for submittals, including annual reporting of monitoring data that must be submitted electronically on forms provided by DWR.

6.3   Data Included in the DMS

Because many monitoring programs operate in the Basin at both the local and state/federal levels, a cross-sectional analysis was conducted during GSP development in the Cuyama Basin to document and assess the availability of water-related data in the Basin. Statewide and federal databases that provide data relevant to Basin were also assessed.

The DMS can be configured to include a wide variety of data types and associated parameters. Based on the analysis of existing datasets from the Basin and GSP needs, Table 6-3 lists the data that are identified and currently configured in the DMS. The DMS includes 730 wells, of which 488 have historical groundwater elevation data and 294 have historical groundwater quality measurements.

Table 6-3: Data Types and Their Associated Parameters Configured in the DMS

Data Type	Parameter	Units	Currently Has Data in DMS
Groundwater Elevation	Depth to Groundwater	feet	Yes
	Groundwater Elevation	feet	Yes
Groundwater Quality	TDS	mg/L	Yes
	Nitrate (NO_3)	mg/L	Yes
	Arsenic	µg/L	Yes
	Benzene	µg/L	--
	Chloride	mg/L	--
	Hexavalent Chromium (Cr(VI))	µg/L	--
	1,2-Dibromo-3-Chloropropane (DBCP)	µg/L	--
	Methyl Tertiary-Butyl Ether (MTBE)	µg/L	--
	Perchlorate	µg/L	--
	Tetrachloroethylene (PCE)	µg/L	--
	Specific Electrical Conductivity (SC)	micromhos per centimeter (µmhos/cm)	--
	1,1,1-Trichloroethane (111-TCA)	µg/L	--
	Trichloroethylene (TCE)	µg/L	--
	1,2,3-Trichloropropane (123-TCP)	µg/L	--
	Chloride (CL)	parts per million (ppm)	--
	Electrical Conductivity (EC)	millimhos (mmhos)	--
	TDS	ppm	--
Streamflow	Streamflow	cubic feet per second (cfs)	Yes
Precipitation	Precipitation	inches	Yes
	Reference Evapotranspiration (ETo)	--	--
	Average Air Temperature	--	--
Subsidence	Subsidence	vertical (in millimeters)	Yes

Additional data types and parameters can be added and modified as the DMS grows over time.

The datasets were collected from a variety of sources, as shown in Table 6-4. Each dataset was reviewed for overall quality and consistency prior to consolidation and inclusion in the database. In many cases, there were discrepancies between the ground surface elevation (GSE) of a well from different sources. In these cases of discrepancy, the GSE of the well was updated using the USGS digital elevation model (DEM).

The groundwater wells shown in the DMS are those that included datasets provided by the monitoring data sources for groundwater elevation and quality. These do not include all wells currently used for production, and may include wells historically used for monitoring that do not currently exist. Care was taken to minimize duplicate well information in the DMS. As datasets were consolidated, sites were evaluated based on different criteria (e.g., naming conventions, location, etc.) to determine if the well was included in a different dataset. Data records for the wells were then associated with the same well, where necessary.

After the datasets were consolidated and reviewed for consistency, they were loaded into the DMS. Using the DMS data viewing capabilities, the datasets were then reviewed for completeness and consistency to ensure imports were successful.

Table 6-4: Sources of Data Included in the Data Management System

Data Source	Datasets Collected	Date Collected	Activities Performed
US Geological Survey (USGS)	• Groundwater Elevation • Streamflow • Precipitation	5/4/2018	• Removed duplicate records • Recalculated GSE based on DEM on select wells
DWR CASGEM Program/WDL	• Groundwater Elevation	4/18/2018	• Removed duplicate records • Recalculated GSE based on DEM on select wells
San Luis Obispo County	• Groundwater Elevation • Groundwater Quality	4/2/2018	• Removed duplicate records • Recalculated GSE based on DEM on select wells
SBCWA	• Groundwater Elevation • Precipitation	3/27/2018	• Removed duplicate records • Recalculated GSE based on DEM on select wells
Ventura County	• Groundwater Elevation • Groundwater Quality • Precipitation	3/8/2018	• Removed duplicate records • Recalculated GSE based on DEM on select wells
DWR Natural Resources Agency	• Groundwater Quality	6/14/2018	• Removed duplicate records
GeoTracker	• Groundwater Quality	6/5/2018	• Removed duplicate records
CEDEN	• Groundwater Quality	8/29/2018	• Removed duplicate records
National Water Quality Monitoring Council	• Groundwater Quality	6/1/2018	• Removed duplicate records
UNAVCO	• Ground Surface Elevation	3/12/2018	• None
Local Data	• Groundwater Elevation • Groundwater Quality • Other	Various	• Removed duplicate records • Recalculated GSE based on DEM on select wells