

ATTACHMENT 4. PROJECT DESCRIPTION

The Modesto Groundwater Basin Characterization and Recharge Study (Project) is a study proposed specifically to identify areas in the Modesto Groundwater Subbasin where either direct and/or indirect groundwater augmentation may occur to both aid in maintaining basin groundwater levels and to provide for storage of seasonally-available surplus treated surface water (obtained via existing infrastructure from the Modesto Regional Water Treatment Plant (MRWTP) as supplied under agreements with the Modesto Irrigation District [MID]) in the subsurface for future use. This Project is being submitted by the City of Modesto (City), which overlies both the Modesto and Turlock Groundwater Subbasins and is a member of the Stanislaus and Tuolumne Rivers Groundwater Basin Association (STRGBA), the Modesto Subbasin management entity. The Project will result in the preparation of an Integrated Groundwater Management and Augmentation Plan (IGMAP) that will present a conceptual model of the basin, prepared from the standpoint of basin management, groundwater banking, and conjunctive use, and will identify potential studies, projects and/or programs that may be implemented to further develop such a program. The proposed Project is a key step in understanding basin hydrodynamics for development of a long-term groundwater banking, conjunctive use and basin management program.

The proposed Project is located in Stanislaus County, which includes both the Modesto and Turlock Groundwater Subbasins (Figure 1). Both subbasins are part of the San Joaquin Valley Groundwater Basin and share similar geologic histories and structures; neither groundwater basin is adjudicated. This application and the resultant IGMAP are focused on the Modesto Subbasin.

The Modesto Subbasin is located in the northern portion of the San Joaquin Valley, a structural trough about 200 miles long and 70 miles wide. Primary hydrogeologic units in the Modesto Subbasin include both consolidated and unconsolidated sedimentary deposits. Consolidated deposits include the Ione Formation, the Valley Springs Formation and the Mehrten Formation. The consolidated deposits lie in the eastern portion of the subbasin and generally yield small quantities of water, except for the Mehrten Formation. The unconsolidated deposits include:

- Continental deposits
- Lacustrine and marsh deposits
- Older alluvium
- Younger alluvium
- Flood-subbasin deposits

The continental deposits and older alluvium are the main water-yielding units in the unconsolidated deposits. Figure 2, below, shows the general location of aquifers in the Modesto Subbasin, while Figures 3 and 4 provide geologic cross-sections of the basin.

The upper and lower geologic sequences in the western portion of the subbasin are separated by a clay layer known as the Corcoran clay. This clay layer is regionally extensive with hydrologic significance. Although numerous silt and clay beds occur above and below the Corcoran clay, they have not been correlated over large areas and are therefore only of local importance.

Figure 1: Modesto Subbasin

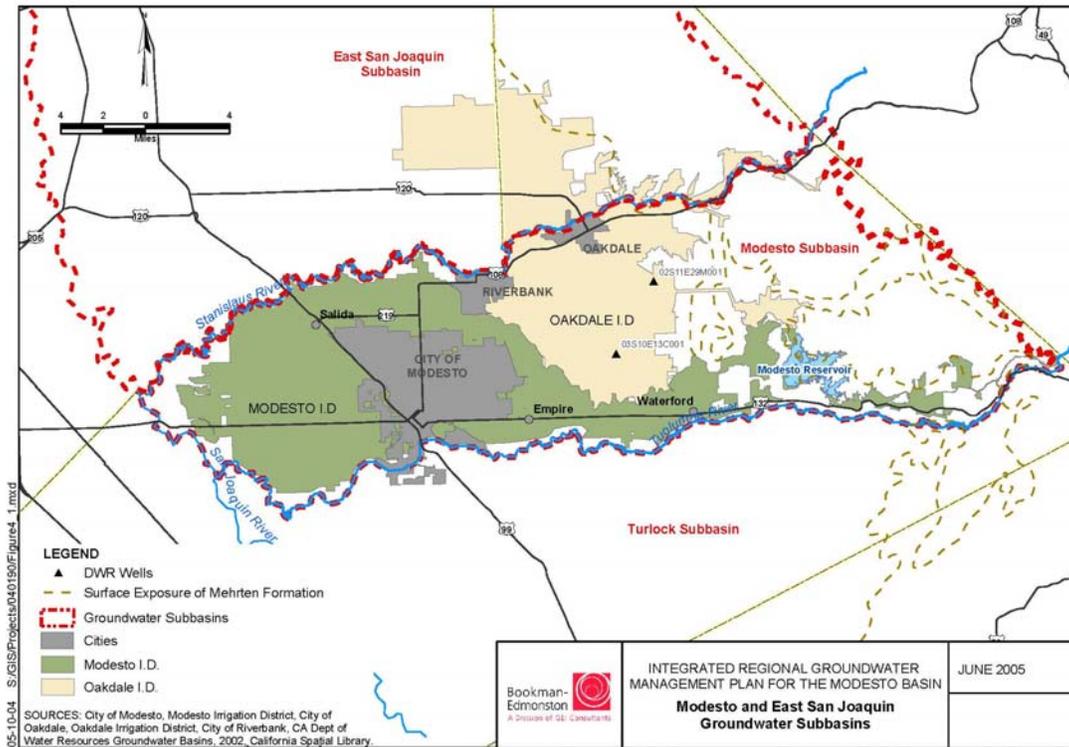


Figure 2: General Location of Aquifers, Modesto Subbasin

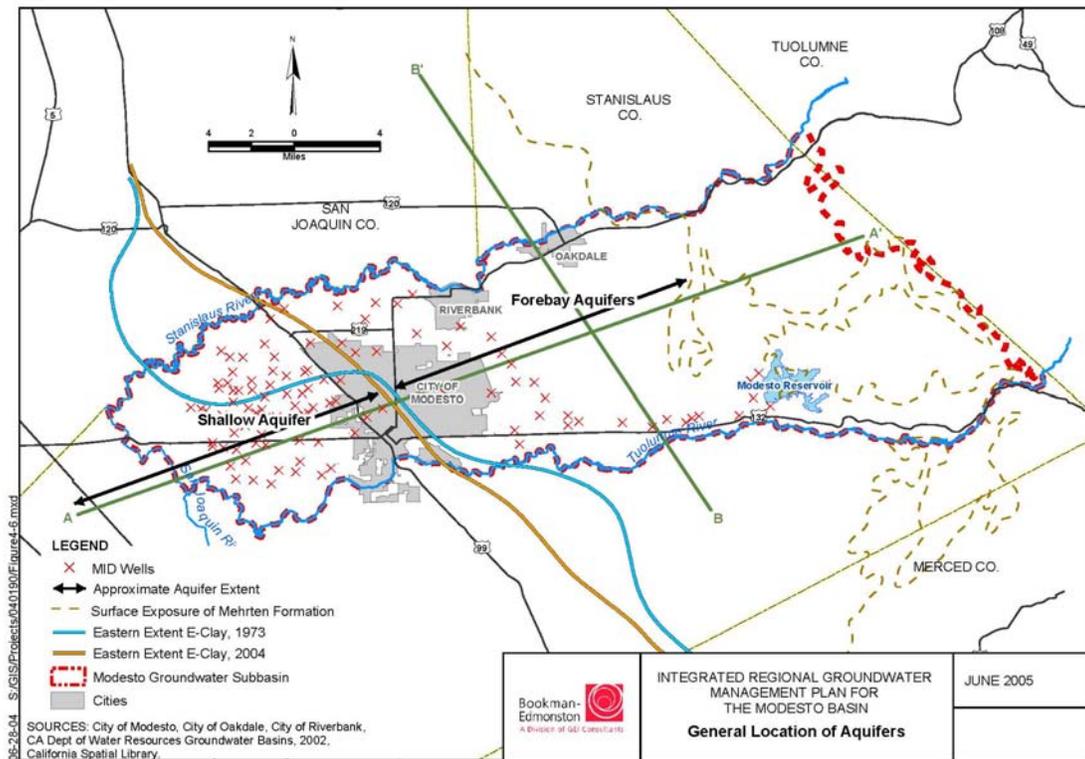
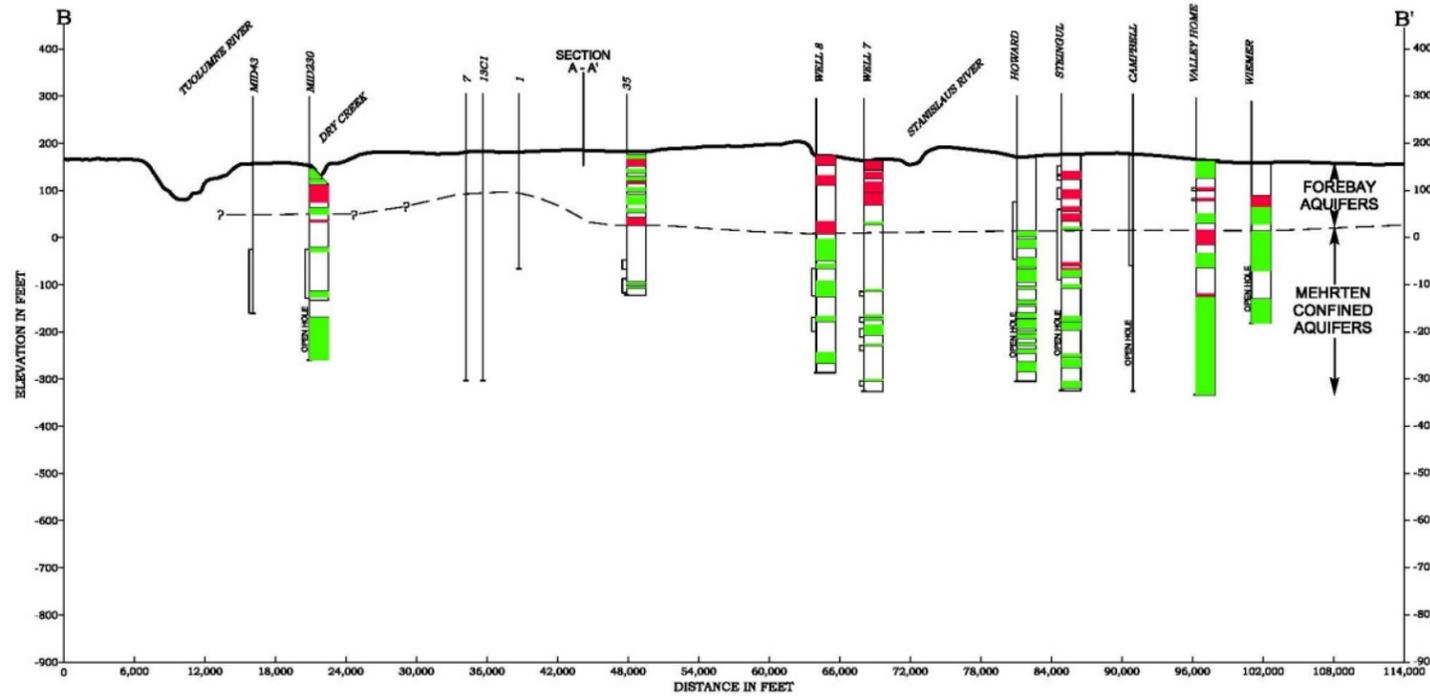


Figure 4: Cross-Section B-B' - Modesto Subbasin

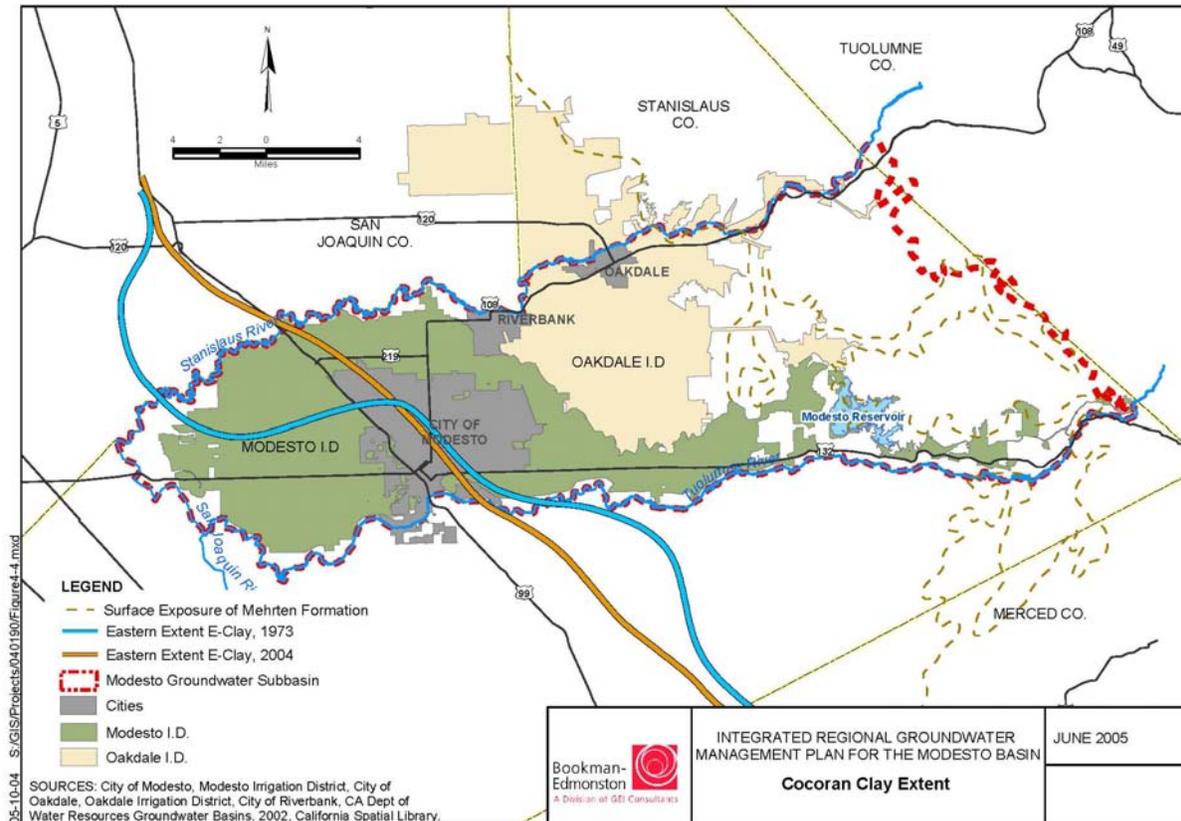


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INTEGRATED REGIONAL GROUNDWATER MANAGEMENT PLAN FOR THE MODESTO BASIN	Bookman- Edmonston <small>A Division of GEI Consultants</small>	SCHEMATIC PROFILE OF AQUIFERS - GEOLOGIC SECTION B - B'
MODESTO, CALIFORNIA	042190.1000	NOVEMBER 2004

The Corcoran clay is present at a depth of about 200 feet below the ground surface (bgs) in the western portion of the Modesto Subbasin (Page and Balding, 1973). The approximate extent of the Corcoran clay parallels Highway 99, and is shown on Figure 5 (Burrow et al., 2004). To the east and north, the clay becomes more silty and difficult to recognize along the edges, where the unit either grades into coarser materials of the same age or wedges out (Davis et. al., 1959). Near the confluence of the Stanislaus and San Joaquin Rivers, a small portion of the Corcoran clay may be thin or missing and replaced with coarse-grained sediments.

Figure 5: Extent of Corcoran Clay, Modesto Subbasin



In summary, groundwater is present in the consolidated and unconsolidated deposits of the Modesto Subbasin. There are two principal aquifers in the western portion of the basin, separated by the Corcoran clay, and one aquifer east of the Corcoran clay. Underlying all these aquifers is a fourth aquifer (Bookman-Edmonston, 2005), the confined Mehrten Formation. These aquifers are as follows:

- The shallow aquifer that is present generally west of Highway 99, above the Corcoran clay.
- The deep aquifer that is also located west of Highway 99, but is below the Corcoran clay and the shallow aquifer.
- The forebay aquifers located east of the Corcoran clay and merge with the shallow and deep aquifers west of Highway 99.
- The confined aquifers within the Mehrten Formation that underlie all of these aquifers.

While there is a large amount of knowledge regarding the hydrogeology of the Modesto Subbasin, little work has been completed to date with regards to comprehensive mapping of potential recharge areas within the subbasin considering existing land use and local land planning, nor have the basin aquifers been evaluated with respects to the feasibility of direct and/or indirect recharge.

Groundwater management activities for the Modesto Groundwater Subbasin are coordinated through the Stanislaus and Tuolumne Rivers Groundwater Basin Association. A groundwater management plan (GWMP) entitled *Integrated Regional Groundwater Management Plan for the Modesto Subbasin* (IRGMP) was prepared and adopted for the subbasin; the City of Modesto adopted the GWMP on June 28, 2005. Both the Modesto and Turlock Groundwater Subbasins underlie the East Stanislaus Integrated Regional Water Management (ESIRWM) planning region; the East Stanislaus IRWM Plan (ESIRWMP) is currently being prepared.

The Modesto Subbasin underlies the City, MID, the City of Oakdale, a portion of Oakdale Irrigation District (OID), the City of Riverbank and the communities of Salida, Empire, and Waterford. All of these entities, except for Salida, Empire, and Waterford, are also members of the STRGBA. The City provides domestic water service within its incorporated boundaries and to several other areas as two distinct customer location categories; (1) the contiguous (interconnected) service area, and (2) outlying service areas. The City's contiguous service area is primarily defined by the current sphere of influence (SOI), Empire, Salida, North Ceres and some unincorporated Stanislaus County "islands" within or adjacent to the SOI. The outlying service areas include the City of Waterford, portions of the cities of Ceres and Turlock, the communities of Del Rio, Grayson, and Hickman. The City manages, operates, and maintains these outlying service areas as independent satellite systems, in addition to the contiguous service area. The City of Oakdale water service area is contiguous to the City's boundaries, and includes three areas outside the City limits (the airport, Oakdale Wastewater Treatment Plant, and Kerr Park). Similar to the City of Oakdale, the City of Riverbank's water services area is contiguous with the City's general planning area.

MID and OID currently hold surface water rights on the Tuolumne and Stanislaus Rivers, respectively; however, both irrigation districts also pump groundwater to supplement surface irrigation water supplies and do not deliver groundwater to urban users. All cities overlying the Modesto Subbasin, except for the City of Modesto and those cities in its service area, rely solely on groundwater as their source of potable water supply. The City has two water supply sources for delivery to customers - groundwater pumped from various wells scattered throughout the contiguous and outlying service areas, and treated surface water purchased from MID.

In the early 1990s, the City and MID formed a partnership to use a portion of MID's historic surface water rights on the Tuolumne River for municipal uses. Completed in 1995, the resulting Modesto Regional Water Treatment Plant (MRWTP), a facility owned and operated by MID, provides the City's contiguous service area with an annual average potable supply of approximately 30 million gallon per day (mgd), that is combined with groundwater sources to meet the City's demands. The completion and operation of the MRWTP and the associated shift to surface water supplies has allowed the City to stabilize groundwater pumping rates and provide for groundwater recovery (West Yost Associates, 2011). According to Bulletin 118, the groundwater levels in the Modesto Subbasin rose approximately six feet from 1996 to 2000 (CA DWR, 2004), demonstrating the ability of the groundwater basin to recover. Figures 6, 7 and 8 show groundwater elevation fluctuations between 1969 and 2003.

Figure 6: Historical Groundwater Elevations in the Shallow Aquifers

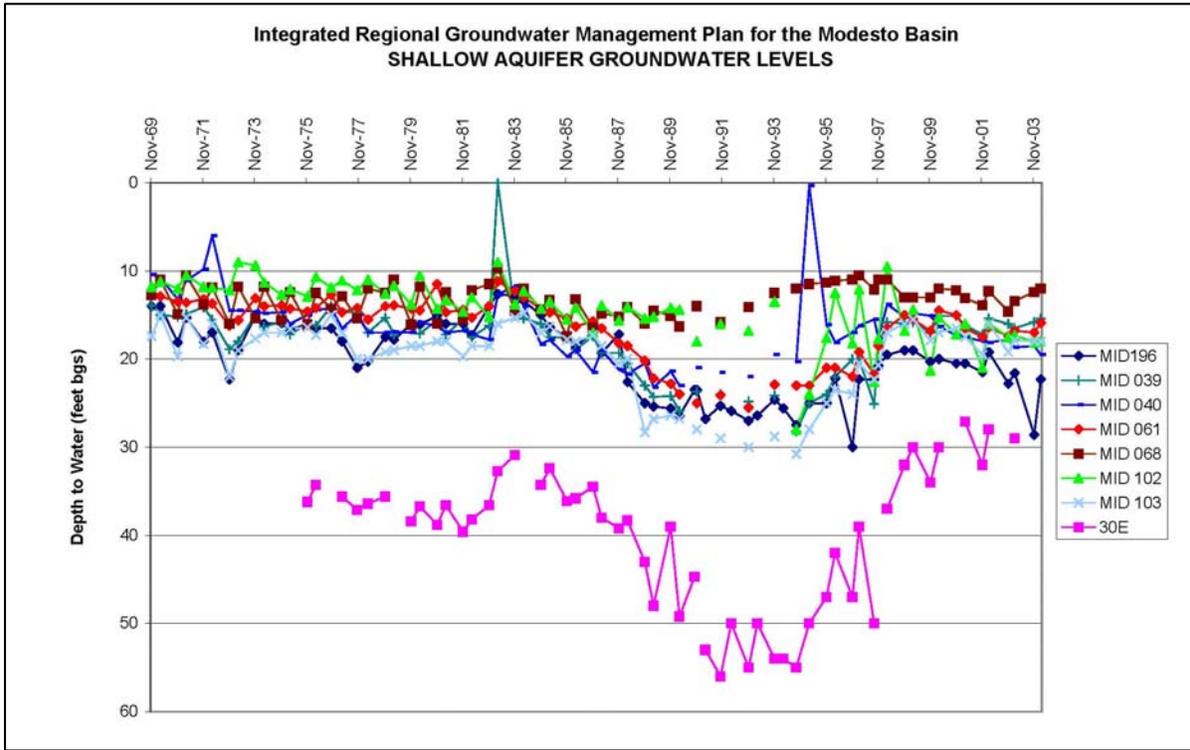


Figure 7: Historical Groundwater Elevations in the Forebay Aquifers

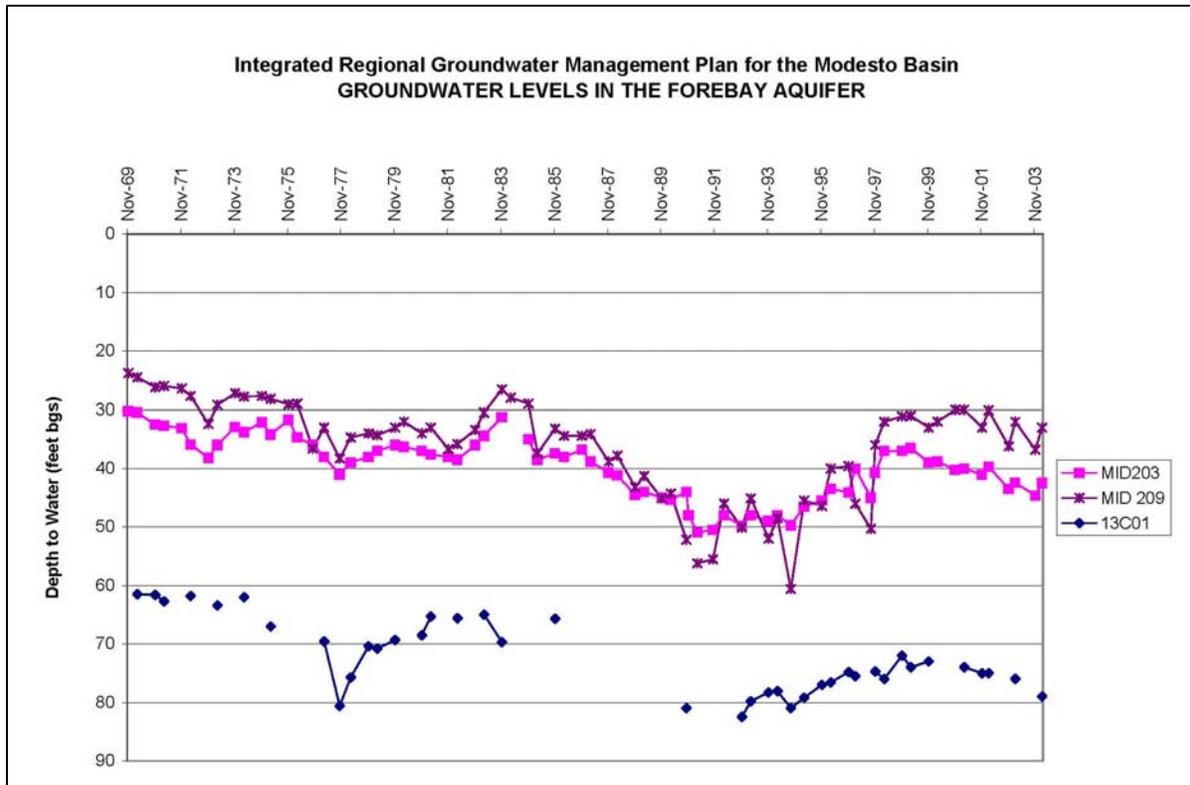
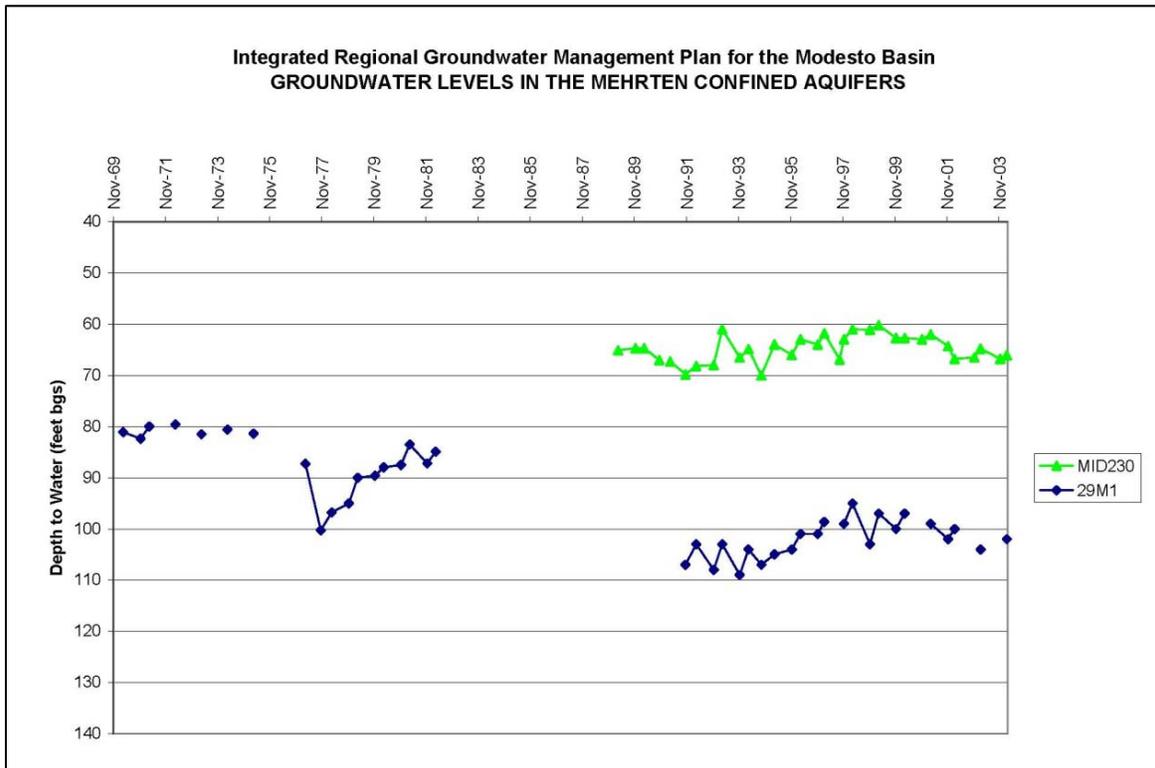


Figure 8: Historical Groundwater Elevations in the Deep Aquifer (Mehrten Formation)



At present, the safe yield of the Modesto Subbasin has not been calculated; however, according to DWR, the subbasin is not currently in overdraft condition.

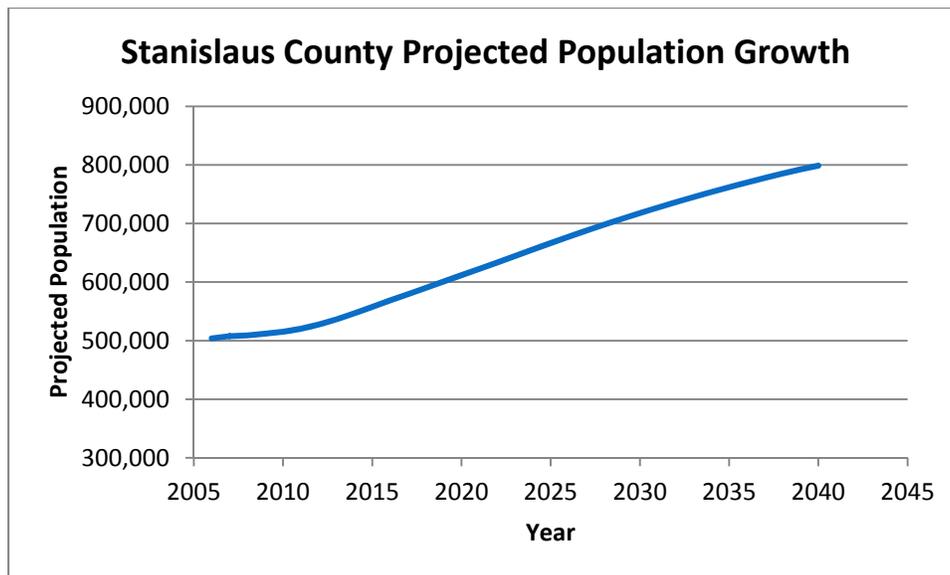
At present, current groundwater production in the Modesto Subbasin appears to be less than historical highs and overdraft conditions have not occurred. However, population growth projections for Stanislaus County have indicated that, county-wide, employment will return to pre-recession levels by 2014, and long-term, the County will grow at a rate exceeding the state average. The County's 2010 population was approximately 516,000 and it is expected to increase to approximately 800,000 by the year 2040, as shown in Figure 9 below (CA DOT, 2011). While much of this growth will be centered around the City of Modesto as the largest urban center in the County, growth in outlying areas (dependent solely on groundwater) is also anticipated.

For a number of years, the City and MID have been working together on the MRWTP Phase Two Expansion, which is currently under construction (approximately 90% complete) and will provide an additional treated water supply of 30 mgd for an annual average total capacity of 60 mgd. The MRWTP Expansion will help replace reliable groundwater production capacity that has been lost due to groundwater quality concerns and is required to address both current and future water supply needs. The cost of the MRWTP Expansion will be shared by existing and future customers.

In summary, throughout most of the year, treated surface water from the MRWTP provides the base source of supply within the City's contiguous service area, supplemented with groundwater to help meet peak demands of operational, emergency, and/or fire-flow requirements. The combination of these two water supply sources allows the City to employ a conjunctive use operational strategy for water delivery within the contiguous service area. Outlying service areas and those areas outside the City's Sphere of Influence do not receive treated surface water from the MRWTP and rely solely on groundwater. Extensive future development of groundwater in the basin could result in a return

of overdraft conditions. Additionally, anticipated future climate changes will influence the availability of water in the region (both surface and groundwater), both in the form of reduced surface runoff and potential reductions to natural basin recharge. Understanding the groundwater basin and having the ability to manage it effectively will be essential to the region's ability to adapt to climate change in the near future. And one available adaptation strategy to achieving the long-term sustainability of the basin will be groundwater storage/banking. The MRWTP Phase Two Expansion, once operational, will have excess capacity. Seasonally-available surplus treated surface water from this plant is one source of water that can be stored in the Modesto Subbasin to prepare for and meet future demands. The IGMAP, resulting from the proposed Project, will provide the roadmap to achieving a successful basin management program.

Figure 9: Projected Population Growth – Stanislaus County



The proposed Project is a study that will result in the preparation of an Integrated Groundwater Management and Augmentation Plan. The study will consist of seven tasks, as follows:

- Task 1: Grant Administration, Project Management and Coordination** – this task covers needed administration activities to meet the terms of the funding agreement and to provide for communication and coordination between the City, the STRGBA, and other participating stakeholders.
- Task 2: Groundwater Data Collection and Analysis** – existing hydrogeologic and water quality data will be collected under this task and analyzed to identify data gaps. Data will be collected from local, state and federal agencies using existing means of communications available to the City of Modesto, such as its membership in the STRGBA and its coordination with the USGS in basin studies.
- Task 3: Identify Basin Needs and Develop Basin-wide Vision** – this task will result in the identification of future groundwater needs from the Modesto Subbasin, and a basin-wide vision for future groundwater augmentation and/or management projects.
- Task 4: Develop Methodology to Prioritize Projects** – under this task, a method will be developed to prioritize studies, projects, and/or programs developed under Task 6 to provide a focused list of recommend next-steps for near-term implementation.

Task 5: Aquifer Hydrogeologic Characterization and Aquifer Recharge Analysis – data collected under Task 2 will be analyzed with an eye towards development of groundwater augmentation, conjunctive use, and basin management projects. This task will result in a conceptual model that will be used to facilitate implementation of the remaining tasks and future associated projects.

Task 6: Project and Opportunity Identification and Prioritization – a list of potential future studies, projects and/or programs will be identified and described as part of this task. This list will then be prioritized using the methodology developed under Task 4.

Task 7: Prepare Integrated Groundwater Management and Augmentation Plan – the results of Tasks 2 through 6 will be compiled and presented in the IGMAP. This document will be available for review by interested stakeholders via the STRGBA website and East Stanislaus IRWM planning websites. The IGMAP will provide a roadmap for future groundwater basin management.

The resulting IGMAP will present a conceptual model of the basin with focus on groundwater banking/storage, conjunctive use and active basin management, and will identify potential studies, projects and/or programs that may be implemented to further develop such programs. This study envisions using seasonally-available surplus treated surface water as supplies for groundwater augmentation, and will provide essential information, such as the location of formation outcroppings and highly permeable areas and localized water quality impacts, for incorporation into land use and water resource planning to protect and sustain the use of groundwater as a long-term, reliable water supply. Specifically, the goal of the proposed Project is preparation of an IGMAP that will identify areas in the Modesto Groundwater Subbasin where either direct and/or indirect groundwater augmentation may occur to both maintain basin groundwater levels and to provide for subsurface banking. The IGMAP will also provide recommendations for future studies, pilot testing, and projects as next steps in furthering program development and for inclusion in the ESIRWMP and updates to the IRGMP. In fact, the City of Modesto has included approximately \$100,000 in its Fiscal Year (FY) 2012/2013 budget to further results documented in the IGMAP through the implementation of site-specific field studies and/or pilot testing identified during completion of the proposed Project.

The Project is consistent with and supports the IRGMP (the groundwater management plan prepared for the Modesto Subbasin) and the ESIRWMP (under development). Specifically, Section 5.2 of the IRGMP includes “Maintain Groundwater Levels”, “Control Degradation of Groundwater Quality”, and “Protect Against Potential Inelastic Land Surface Subsidence” as three of its basin management objectives (BMOs). The following are some of the specific management area BMOs documented in the IRGMP:

- Correct existing supply deficiencies by providing the water needed to meet demands;
- Identification and mapping of the basin’s natural recharge areas;
- Protection of groundwater recharge areas;
- Development of a water budget to determine if the basin is in overdraft and, if so, to determine the amount of overdraft;
- Feasibility evaluation of artificial recharge projects;
- In-lieu recharge through importation of a surface water supply to areas currently relying on groundwater;

- Maintaining groundwater levels to control the movement of poor quality water into and within the basin;
- Conducting a detailed geologic assessment of the basin to identify sources of poor water quality; and
- Continuing to support the development of in-lieu recharge projects in urban areas with poor water quality.

Implementation of the proposed Project will provide information necessary to identify and develop studies, projects and/or programs that, when implemented, will support these BMOs, and will provide recommendations that can be implemented both in the short- and long-term to achieve these BMOs. Additionally, the ESIRWMP regional goals include the following water supply goal:

To protect existing water supplies and water rights, and improve regional water supply reliability

Embedded in this goal are the objectives of :

- Promoting the use of groundwater storage and conjunctive use options to reduce groundwater overdraft; and
- Supporting monitoring and research to improve understanding of water supplies and needs.

Finally, the proposed Project will provide key data necessary to develop projects that will:

- Correct existing supply deficiencies by providing the water needed for existing and future demands (developing new wells has been problematic due to groundwater quality issues);
- Avoid further over-drafting of the groundwater supply;
- Improve water quality;
- Increase basin reliability and sustainability; and
- Create operational flexibility by improving the adaptability of the region to changing hydrologic conditions.

The work products resulting from the proposed Project will be made available on both the STRGBA and East Stanislaus Regional Water Management Partnership (ESRWMP) websites for dissemination to the public. These websites are available at www.strgba.org and www.eaststanirwm.org, respectively. Additionally, both the STRGBA and other participating stakeholders will be provided the opportunity to comment on draft and final work products as part of the study.

The proposed Project is a key step in understanding basin hydrodynamics for development of a long-term groundwater banking, conjunctive use and basin management program to ensure the ability of the region to meet future demands and to adapt to changing climate and hydrologic conditions.

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