

ORANGE COVE IRRIGATION DISTRICT

GROUNDWATER MONITORING AND DROUGHT PREPAREDNESS PROGRAM

Submitted to the Department of Water Resources

Local Groundwater Management Assistance Act of 2000
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Prepared by :



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List of Abbreviations

AB	Assembly Bill
AID	Alta Irrigation District
CEQA	California Environmental Quality Act
CFS	Cubic feet per second
CVP	Central Valley Project
DPP	Drought Preparedness Program
DWR	Department of Water Resources
ESRI	Environmental Systems Research Institute
GAC	Groundwater Advisory Committee
GIS	Geographic Information System
GMP	Groundwater Management Plan
GPM	Gallons per minute
GPS	Global Positioning System
HVID	Hills Valley Irrigation District
OCID	Orange Cove Irrigation District
P&P	Provost and Pritchard Engineering Group, Inc.
RTK	Real time kinematic
SB	Senate Bill
SCADA	Supervisory control and data acquisition
TDS	Total dissolved solids
TVWD	Tri-Valley Water District
USBR	United States Bureau of Reclamation
USGS	United States Geologic Survey
WSD	Water Storage District
WWTF	Waste water treatment facility



EXECUTIVE SUMMARY

The Orange Cove Irrigation District (OCID) was awarded a grant in June 2004 from the Local Groundwater Management Assistance Act of 2000 (Grant No. 4600003659) to prepare a Groundwater Monitoring and Drought Preparedness Program. This report includes the products, data, findings, and conclusions from the study.

The original goals of the study included the following:

- Updating of the OCID Groundwater Management Plan (GMP) to satisfy new State requirements.
- Groundwater quality testing in areas of concern and comparison of the results to historical water quality data.
- Completion of a report on a proposed Drought Preparedness Program (DPP) that includes incentives for groundwater pumpers to pump more groundwater in drought years and thereby reserve surface water supplies for growers that do not have a reliable groundwater supply.
- Development of a groundwater database linked to a Geographic Information System.
- Development of an expanded groundwater-level monitoring network and construction of new monitoring wells.
- Formation of a Groundwater Advisory Committee to review and advise on all major groundwater management decisions.

The actual work completed matched the original goals with the exception that groundwater quality testing was not performed due to reluctance from growers to share information with the public. With DWR approval, funding for groundwater quality testing was instead used for a public outreach program for the DPP, which OCID saw as a higher priority than groundwater quality testing.

Important information gained from the project included the following:

- Various information on the local groundwater was gathered and incorporated into the District's updated GMP, which will serve as a useful reference and guidebook for making future groundwater management decisions.
- A review of historical groundwater quality data showed that the water quality was suitable for irrigation uses, confirming previous beliefs.
- Detailed information on the local geology was gathered during the installation of six new monitoring wells.

In addition, the District now has several tools that will allow them to gather, store and evaluate groundwater data more efficiently. These tools include:

- Newly established and more comprehensive groundwater monitoring network.

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- New groundwater database linked to a Geographic Information System.
- Six new monitoring wells fitted with data loggers.
- The detailed framework for a DPP, including specific comments and recommendations from local growers. As a result, the District now has most of the guidelines needed to begin implementing a pilot DPP.

Some of the important recommendations/findings from the study include the following:

- The groundwater near the City of Orange Cove wastewater treatment plant has elevated levels of nitrates and dissolved solids. Although the groundwater quality is suitable for agricultural use, OCID should regularly review groundwater quality reports prepared by the City of Orange Cove to monitor for any changes.
- A pilot program is recommended to evaluate the feasibility of a district wide in-lieu groundwater recharge program (drought preparedness program). Monitoring wells and data loggers have been installed in System Area 9 where the pilot program would be performed. No other new facilities would be needed to implement the pilot program.
- A public outreach program indicates that there is some interest from local growers in the drought preparedness program.
- Other recommended measures to improve groundwater management include preparing annual groundwater reports (including groundwater contour maps), and holding annual Groundwater Advisory Committee meetings.

As a consequence of this study, OCID has clearly defined goals and guidelines for groundwater management, and has the tools to better monitor groundwater conditions and prepare annual groundwater reports. The Groundwater Advisory Committee, which was formed as part of the study, will continue to be an important aspect of managing the local groundwater supplies.



1 - INTRODUCTION

This report documents the findings from the Orange Cove Irrigation District's (OCID) Groundwater Monitoring and Drought Preparedness Program study. The report includes discussions on the scope of work, budget, schedule, and conclusions and recommendations from the studies and investigations. All data that was collected as part of the study is included in this report.

1.1 - Authority

The study was funded with a grant (No. 4600003659) from California Assembly Bill 303, the Local Groundwater Management Assistance Fund Act. The grant of \$250,000 was awarded to the Orange Cove Irrigation District (OCID). OCID hired Provost and Pritchard Engineering Group, Inc. (P&P or District's engineering consultant) to perform the majority of the work outlined in the scope of work. P&P hired Kenneth D. Schmidt and Associates, Mel Simmons and Associates, and Twining Laboratories as subconsultants, all for work related to hydrogeologic evaluations and construction of monitoring wells. All of the work was completed between September 2004 and July 2006. The scope of work for the study is included in **Appendix A**.

1.2 - Background Information on Orange Cove Irrigation District

The Orange Cove Irrigation District (OCID) is a political subdivision of the State of California, formed for the purpose of delivering water to growers. OCID was organized in February 1937, and, at the time, comprised an area of 12,587 acres. The Navelencia and East Orosi areas were annexed in March of 1946, and, with minor inclusions and exclusions, the service area has increased to the present total of approximately 28,000 acres.

OCID is located in both Fresno and Tulare Counties at the eastern edge of the San Joaquin Valley. Refer to **Exhibit 1.1** for a map of the District.

The water needs of OCID are approximately 76,000 acre-feet of water annually.¹ In a year with full CVP contract entitlement, OCID has 39,200 acre-feet of surface water. The safe yield of the groundwater underlying the surface area is 27,800 acre-feet². The surface water supply and groundwater safe yield are still about 9,000 acre-feet short of the total crop needs. In average and wet years, the shortage is made up from rainfall. In water short years, the only way to make up the shortfall is from water purchases on the open market and overdrafting the groundwater supplies.

¹ Friant Unit Contractors, *Water Needs Analysis*, March 7, 1988.

² USBR, *Geologic Study of the Orange Cove Irrigation District*, August 1947.

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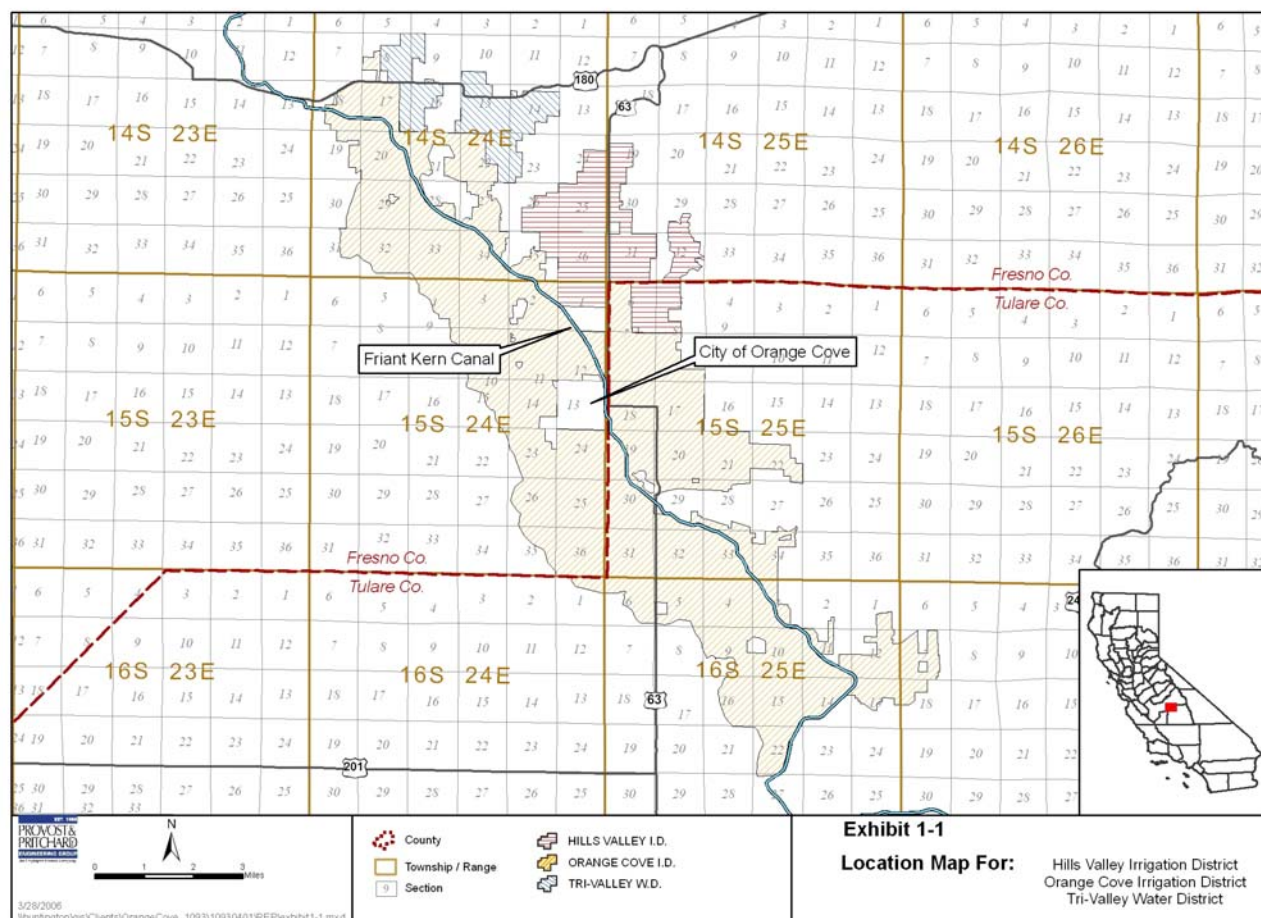


Exhibit 1-1: Orange Cove Irrigation District Map

OCID was formed to import surface water into the area to offset a fairly extensive reduction in cropping caused by over pumping of a very limited groundwater supply. In the mid 1930's, an extensive effort was made to secure a 250 cfs diversion entitlement from the Kings River. This effort was abandoned when an opportunity arose to contract for Central Valley Project (CVP) water.

OCID entered into a contract for CVP (Friant Division) water on May 20, 1949, and started deliveries that same year, starting the term of its first 40-year contract. A renewal contract was entered into on May 23, 1989, again for a 40-year term, but has encountered extensive legal challenges on whether the Bureau of Reclamation had adequately complied with federal environmental law. Following a series of interim renewal contracts, OCID executed a long-term renewal contract in February 2001.

The Friant-Kern Canal is the main source of water, with OCID having 15 turnouts located from milepost 35.87 to milepost 53.32 along the Canal. The OCID service area

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comprises a strip of land approximately 3 miles wide and 14 miles long along the western foothills of the Sierra Nevada Mountains.

The Orange Cove Irrigation District has defined a 9,000-acre area in the southern portion of the District as the 'Most Productive Groundwater Area'. This area lies south of South Avenue to the southern end of the District, and is enclosed by the Alta Canal on the west and the Friant-Kern Canal on the east. This area covers approximately one-third of the District and is the only portion of the District that has reliable wells with meaningful yields (>100 gpm). The groundwater monitoring program and drought preparedness program both focused on this area.

Refer to the Orange Cove Groundwater Management Plan (**Appendix B**) for detailed information on the geology and hydrogeology of the District.

1.3 - Goals and Objectives

The original goals of the study included the following:

1. Update the District's Groundwater Management Plan (GMP) to satisfy new State requirements.
2. Develop an updated GMP that will include goals and guidelines to steer groundwater management decisions.
3. Develop a more comprehensive well water-level monitoring network.
4. Upgrade the District's groundwater database to store data for an expanded well water-level monitoring network, include a link to a Geographic Information System, and have functions to assist with the development of annual groundwater reports.
5. Review historical groundwater quality data for comparison to present and future test results.
6. Perform groundwater quality testing throughout the usable groundwater area and in specific areas of concern to determine the state of the existing groundwater quality, and establish baseline data for future testing.
7. Establish a Groundwater Advisory Committee to assist with all major groundwater related decisions that are a part of this study and future groundwater management efforts.
8. Evaluate the engineering and hydrogeologic feasibility of a Drought Preparedness Program that provides incentives to some growers to pump more groundwater in dry years so that surface water supplies are available to growers that lack a reliable groundwater supply.

All of these goals were met except for new groundwater quality testing, which was replaced with an educational program for the drought preparedness program (see Section 1.4).

1.4 - Scope of Work

The scope of work for the project includes the following primary tasks:



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Task 1 - Update Existing Groundwater Management Plan to meet Senate Bill 1938 Requirements

Task 2 - Well Water Level Monitoring

Task 3 - Groundwater Quality Monitoring

Task 4 - Prepare Drought Preparedness Program

Task 5 - Project Reporting

See **Appendix A – Scope of Work** for a detailed description of the work in each of these tasks.

The original scope of work was revised to remove groundwater quality testing (Task 3.2 - Conduct Additional Water Quality Monitoring) and use the funds for an educational program for the drought preparedness program (Task 5.5 – Educational Program). This change was originally proposed by the Groundwater Advisory Committee (GAC) as described below.

Groundwater Quality Monitoring/Educational Program

At a meeting on November 2, 2005, the GAC members expressed reluctance in allowing groundwater quality testing from their wells because the information would be released to the public. (Task 3.2 – Conduct Additional Water Quality Monitoring, includes groundwater quality testing throughout the district to establish baseline data.) In addition, the GAC members, who are all local landowners, spoke to other landowners who showed similar reluctance with participating in a groundwater-quality testing program. OCID does not own any wells and would need permission from local landowners to perform groundwater quality sampling. As a consequence, at the next GAC meeting on December 6, 2005, the GAC members recommended that the groundwater quality testing not be pursued, due to a lack of available participants, and that the funds from Task 3.2 (\$17,560) instead be used for an education program for the Drought Preparedness Program.

Elimination of Task 3.2 meant that OCID would not be able to collect groundwater samples for baseline data. However, the GAC stated that many growers already have groundwater quality data, and they are willing to share it with OCID, but typically not with the general public. At the meeting OCID also said that they were amenable to paying for groundwater quality tests with their own funds if it is ever deemed necessary. Hence, elimination of Task 3.2 was not anticipated to have a major impact on the District's groundwater quality management program.

As previously mentioned, the GAC recommended that the \$17,560 originally budgeted for groundwater quality testing (Task 3.2) instead be used for a program to educate growers on the Drought Preparedness Program (DPP). The GAC members were enthusiastic about the DPP and wanted to see more efforts to help launch the program. In addition, OCID is comprised of many small landholdings, and numerous growers will need to participate for the DPP to be effective. The program is a fairly complex and it was felt that small-group meetings with growers were necessary to educate them on the

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benefits, impacts, and economics of the program. Such an education program was not included in the original scope of work for the DPP. This work entailed the preparation of educational materials by the District's engineering consultant, and small group meetings between growers and a semi-retired OCID staff member who most of the growers have known and respected for many years. It was believed that the educational program will be beneficial in marketing the concept of the DPP, increasing participation, and allowing OCID to soon realize the benefits of the program.

A new task was added to the budget (Task 5.5 – Educational Program) to reflect the aforementioned modifications to the scope of work and budget. The revised budget has the same total (\$250,000) as the original budget, but with some funds moved in-between different tasks.

SCADA

The scope of work said that OCID will install 3-7 monitoring wells and will 'likely tie these monitoring wells into it's SCADA system for real time groundwater elevation data capabilities.' SCADA, or Supervisory Control and Data Acquisition, would have allowed OCID to remotely monitor groundwater levels in real time from their SCADA control system in their main office.

SCADA equipment would require a radio, solar panel, and either a programmable logic controller or remote telemetry unit at each well site. It was estimated that this would cost around \$12,000 to 15,000 per well. Therefore, if SCADA were installed then probably only two wells could have been constructed and fitted with data loggers (sensory devices installed in wells to measure and store water level data) with the available well construction budget of \$35,000. OCID determined two wells would not provide enough useful information, and instead six wells fitted with data loggers (but no SCADA) would provide a better network for monitoring groundwater levels. SCADA would also have limited benefits since 'real time' information is probably not needed for groundwater level monitoring and the data loggers can instead be accessed periodically by OCID field staff.

OCID installed six wells and fitted each with data loggers for a total cost of approximately \$23,800. The driller typically provides a geologist to oversee the drilling and log the soils, however the District's engineering consultant instead provided the geologist and his salary costs used the remainder of the budget for the monitoring well construction.

SECTION TWO**2 - PROJECT ADMINISTRATION****2.1 - Project Budget**

The project was completed within the original budget as outlined in the contract with DWR. **Table 2.1** summarizes the initial budget for each task with the actual expenditures.

Table 2.1 – Budget versus Actual Expenditures

Task No.	Description	Original Budget	Revised Budget¹	Estimated Expenditures²
1	Update Existing Groundwater Management Plan	\$32,840	\$32,840	\$33,500
2	Well Water Level Monitoring	\$109,900	\$109,900	\$109,850
3	Groundwater Quality Monitoring	\$28,620	\$11,060	\$11,500
4	Prepare Drought Preparedness Plan	\$50,440	\$68,000	\$67,300
5	Project Reporting	\$28,200	\$28,200	\$27,850
	Total	\$250,000	\$250,000	\$250,000

¹ See Section 1.4 – Scope of Work for discussions on the budget revision.

² The actual expenditures were not known at the time this report was completed, however the estimated expenditures are all anticipated to be close to the budgeted amounts. Refer to Payment Request No. 7 for the actual expenditures on each task.

2.2 - Project Schedule

The original schedule included work on the project from October 1, 2004 to April 30, 2006. Work actually began one month early in September 2004. The Orange Cove Irrigation District submitted a letter to DWR in April 2006 requesting a one-month extension on the contract deadline. The motive for the extension included: 1) The extremely wet weather that caused delays in construction of monitoring wells, and 2) time necessary to schedule meetings for a public outreach program which was recently added to the scope of work. The DWR granted a time extension of three months with a new contract deadline of August 1, 2006. Actual progress on most tasks and sub-tasks varied from the original schedule, but the project was still completed before the final modified deadline of August 1, 2006. **Exhibit 2.1** shows a comparison of the original schedule with actual progress.

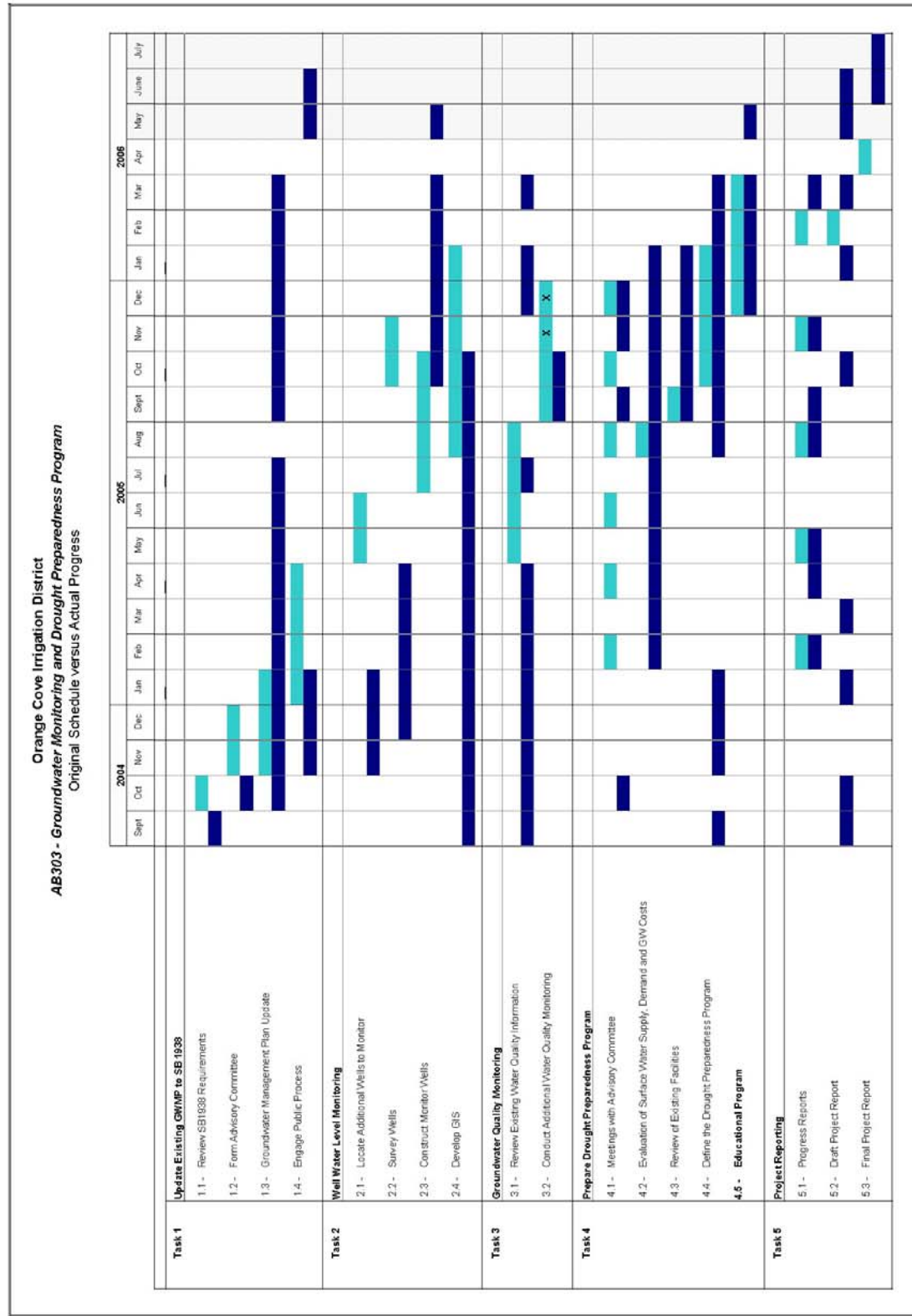
2.3 - Legal Matters

OCID legal counsel provided guidance on public participation requirements for the Groundwater Management Plan update. No other legal involvement has occurred as part of this project.

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Exhibit 2.1 - Project Schedule





3 - GROUNDWATER MANAGEMENT PLAN

The Orange Cove Irrigation District adopted a Groundwater Management Plan (GMP or Plan) on October 27, 1997. The GMP was prepared in accordance with the requirements prescribed in Assembly Bill No. 3030 (California water code section 10750 et seq.). The GMP has been updated to include some other required and recommended components and was adopted by the OCID Board of Directors on June 14, 2006. A copy of the GMP can be found in **Appendix B**. The tasks that were followed in updating and adopting the new GMP are described below.

3.1 - Review Senate Bill No. 1938 Requirements

In September 2002 the California State Senate passed Bill No. 1938 establishing new requirements for GMPs. In addition, the Department of Water Resources published some additional recommended components for GMPs in Appendix C of Department of Water Resources Bulletin 118 (2003 Update). Refer to **Table 3.1** for a comparison of the components in the 1997 OCID GMP to other required and recommended components. Table 3.1 showed that the 1997 OCID GMP needed to address the following additional topics:

- Groundwater Basin Description
- Basin Management Objectives
- Saline Water Intrusion
- Wellhead Protection
- Migration of Contaminated Water
- Well Abandonment
- Overdraft Mitigation
- Groundwater Replenishment
- Groundwater Extractions
- Water Recycling
- Well Construction Policies
- Operation of Facilities
- Land Use Planning
- Land Subsidence
- Changes in Surface Flow and Water Quality
- Monitoring Protocols
- Advisory Committee of Stakeholders
- Groundwater Reports
- Plan Re-evaluation
- Program Funding and Fees
- Monitor Well Map
- Monitor Well Data

SECTION THREE**Table 3.1 – New Components in Groundwater Management Plan**

Subject	New Sections Required	Existing OCID GWMP	Senate Bill 1938 Requirements	Other Components¹
Background and History		X		
Description of District		X		X
Groundwater Basin Description	X			X
Groundwater Monitoring Activities		X	X	
Water levels		X	X	
Water quality		X	X	
Historic conditions		X		X
Groundwater levels		X		X
Water quality		X		X
Basin Management Objectives	X		X	
Components of Groundwater Management Plan				
Saline Water Intrusion	X		X	
Wellhead Protection	X		X	
Migration of Contaminated Water	X		X	
Well Abandonment	X		X	
Overdraft Mitigation	X		X	
Groundwater Replenishment	X		X	
Groundwater Monitoring		X	X	
Groundwater Extractions	X		X	
Well Construction Policies	X		X	
Operation of Facilities	X		X	
Relationships with other Agencies		X	X	
Conjunctive Use		X	X	
Land Use Planning	X		X	
Land Subsidence	X		X	
Changes in Surface flow/water quality	X		X	
Plan to involve other agencies		X	X	
Monitoring Protocols	X		X	
Advisory Committee of Stakeholders	X			X
Groundwater Reports	X			X
Plan Re-evaluation	X			X
Program Funding and Fees	X			
Monitor Well Map	X			X
Monitor Well Data	X			X

¹Other Components includes sections that the DWR recommended be included in GMPs (see Appendix C of DWR Bulletin 118-2003)



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3.2 - Form Advisory Committee

A Groundwater Advisory Committee (GAC) was formed to assist with the development and review of the new GMP. The GAC also played an important role in reviewing and advising on other project tasks, particularly the Drought Preparedness Program (see Section 6). OCID surveyed local growers for their interest in participating in the study as a GAC member. Several growers showed interest and were invited to attend GAC meetings. The GAC also included members of OCID staff and an engineering consultant representing Hills Valley Irrigation District (HVID) and Tri-Valley Water District (TVWD). Specifically, the GAC members included the following:

- James Chandler, OCID Manager-Engineer (retired)
- John Roldan, OCID Manager-Engineer
- Dennis Keller, Keller-Wegley Consulting (engineering consultant for HVID and TVWD)
- David Brown, OCID Landowner
- Arlen Miller, OCID Landowner
- Jay Gillette, OCID Landowner
- Marco Rinaldi, OCID Landowner
- Robin Salwasser, OCID Landowner
- Patrick Kurihara, OCID Landowner

The GAC provides a broad representation of interests in the district as it includes landowners, OCID staff, engineering consultants, and a representative from neighboring water and irrigation districts.

3.3 - Groundwater Management Plan Update

The GMP was updated to satisfy requirements of Senate Bill No. 1938 and the recommended components for GMP's as described in Appendix C of DWR Bulletin 118-2003. A copy of the updated GMP is included in **Appendix B**. The GMP was expanded to include the topics listed in Section 3.1. In addition, many of the sections in the old GMP were updated and expanded. The new GMP also addresses the results and goals of this AB303 study. Similar to the 1997 GMP, the updated GMP is a regional effort and was prepared in cooperation with the neighboring Hills Valley Irrigation District and Tri-Valley Water District. Pertinent sections of the GMP were reviewed by OCID legal counsel.

3.4 - Engage Public Process

The public was involved in updating the GMP through public notices and public hearings. OCID also solicited comments on the draft GMP from the City of Orange Cove. Evidence of the public participation is included in the updated GMP (**Appendix B**). A broad representation of public interests was also present in the membership of the GAC who reviewed and commented on the draft GMP (see GAC meeting minutes in **Appendix C**).



4 - WELL WATER LEVEL MONITORING

4.1 - Locate Additional Wells to Monitor

OCID identified spatial gaps in their monitoring well network and located suitable wells to fill in the gaps and ultimately help generate more accurate groundwater contours. A discussion on the process that was followed is given below.

OCID's original groundwater database had water level information on 28 wells (the database included locations for 14 other wells but with no groundwater level data). The wells did not provide an adequate spatial distribution for generating groundwater contours and analyzing area-wide changes in groundwater levels. Existing wells within these spatial gaps were identified using District records and drillers logs acquired from the California Department of Water Resources (DWR). The District asked numerous landowners that owned wells in these spatial gaps for permission to regularly measure groundwater levels in their wells; most well owners were fully cooperative. An expanded groundwater-level monitoring network was thus established that included 31 additional wells. In addition, groundwater level data was downloaded from the DWR website for some wells in the District's old database that had no water level data. Four of the wells in the original network were abandoned so the new network includes $28+14+31-4 = 69$ wells. Refer to **Exhibits 4.1 and 4.2** for a comparison of the old and new well monitoring networks in the northern and southern portions of OCID, respectively. The target area for the expanded monitoring network is the 'most productive groundwater area' in the southern portion of OCID, although some monitoring will still be performed in the remainder of OCID. All of the wells in the expanded monitoring network were surveyed (see Section 4.2) and their well attributes were collected and added to the OCID groundwater database (see Section 4.4)

Development of accurate groundwater contours requires some data points outside of the area of interest. The Alta Irrigation District (AID) is located due west of OCID and represents one of these areas. AID has established a goal to survey their wells and create a groundwater database, however, this will only be completed when funding is available. OCID will maintain contact with AID staff on the status of their groundwater database, and, in the future, hope to establish an agreement to share groundwater level data.

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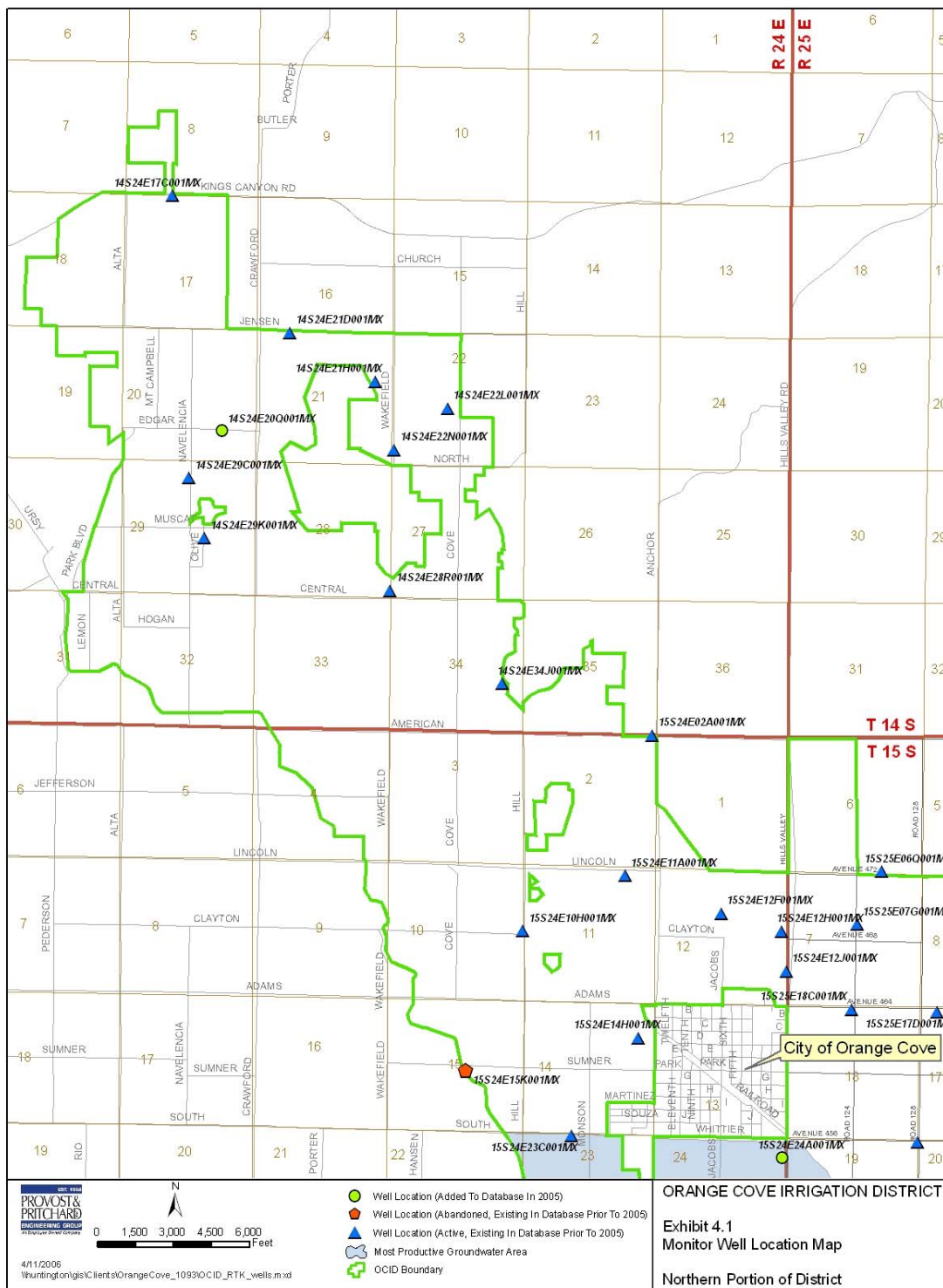


Exhibit 4.1 – Monitor Well Location Map: Northern Portion of District



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4.2 - Survey Wells

A complete survey of all wells in the new monitoring network was performed to determine or verify their location and elevation, and collect well attribute information for inclusion in the District's new groundwater database. The work was overseen by a California licensed land surveyor.

Control Survey

A control survey was performed to establish benchmarks and establish horizontal and vertical control for surveying the locations and elevations of monitoring wells in OCID. Six new control points were established and the elevations of three existing benchmarks were verified. New control points were established because existing benchmarks were either not present in the area, or because existing benchmarks could not be accessed with global positioning system (GPS) base station equipment. The new benchmarks are aluminum disks set in concrete and stamped with the control point identification number. A sufficient number of control points were established to provide coverage over the entire District. **Appendix D** includes the locations and elevations of the control points, as well as maps and aerial photographs showing their locations.

GPS Survey/Well Canvass

After the control network was established, the location and elevation of all 69 wells in the new monitoring well network were surveyed. The wells were surveyed using a real-time kinematic GPS signal. Previously, the location of the wells was only known according to the 40-acre tract they were located in.

During the well survey, specific well attributes were also collected and the information was entered into the District's new GIS linked groundwater database. Attributes that were recorded for each well included:

- Well type
- Status
- Foundation
- Power supply
- Horsepower
- Discharge pipe diameter
- Discharge direction
- PG&E Tag No.
- Well casing diameter
- Ground surface elevation
- Reference point elevation

In addition, a digital photograph was taken of each well. The data available on each well is contained in the OCID groundwater database. A printout of the well attribute information can be found in **Appendix E**.

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4.3 - Construct Monitor Wells

Six monitoring wells were installed in System Area 9 of OCID to assist with monitoring groundwater levels. System Area 9 comprises about 4,100 acres and is located within the southern portion of OCID (see Exhibit 4.1 in Appendix L). System Area 9 is also located within the 'Most Productive Groundwater Area in OCID.' The wells will be used primarily to measure groundwater level changes resulting from a future in-lieu groundwater banking project, and to help ensure that the groundwater levels do not encroach on the root zone and cause waterlogging problems. The wells will also become part of the district's regular monitoring network. A summary of the wells is provided in the table below:

Monitor Well No.	Depth (ft)	Well Completion Report No. ¹
1	39.3	0900527
2	54	0900528-0900529
3	84.5	0900530-0900531
4	74.5	0900532-0900534
5	74.5	0900535-0900536
6	53.3	0900537

¹ The State Well ID Numbers had not been assigned to these wells at the time this report was completed. They should be available later in 2006 and can be matched with the Well Completion Report Number.

Refer to **Appendix G** for a copy of the record drawings, specifications, subconsultant geology report, borehole logs, and DWR Well Completion Reports for the six wells. Public bidding was not necessary since the total construction cost was less than \$25,000. An informal public bid was performed and bids were received from three California licensed and experienced well drillers on January 27, 2006. The contract was awarded to the lowest bidder, Twining Laboratories of Fresno, California. **Table 4.1** summarizes the unit prices provided by each bidder.

Regulatory requirements for the wells included relevant County permits and the CEQA process. The wells were determined to be Categorically Exempt from CEQA based on a Class 3 Exemption: New Construction of Limited Small New Facilities. OCID submitted a Notice of Exemption on March 13, 2006.

All of the wells were constructed in System Area 9, which has one of the most productive groundwater supplies in OCID and was also selected for a pilot program for the Drought Preparedness Program. Wells were sited to fill gaps in the existing monitoring well network, avoid underground utilities, and provide the most beneficial information for evaluating the pilot Drought Preparedness Program. All of the wells were constructed in county road right-of-ways.

Twining Laboratories of Fresno, California installed the wells. Refer to **Appendix H** for photographs of the drilling and well construction. The wells were drilled with an 8" hollow stem auger and samples were logged at 5-foot intervals. The wells depths



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varied from about 40 to 85 feet deep. Final depths were determined by the field geologist at the time of drilling according to the depth to bedrock and groundwater level at each location. The location and elevation of each well was surveyed (see Appendix G).

Data Loggers manufactured by Instrumentation Northwest, Inc. were installed in each of the six wells to provide a temporal record of groundwater levels. Refer to **Appendix I** for manufacturer's information on specific data loggers that were installed. The data loggers are capable of measuring and storing groundwater level data. The data can be downloaded to a hand held device and then downloaded to a personal computer. Barometric correction devices were also purchased to correct water levels for changes in atmospheric pressure. A Supervisory Control and Data Acquisition (SCADA) system was not installed due to its high cost. Refer to Section 1.4 for more discussions on the scope of work for constructing monitoring wells.

A geologist from the District's engineering consultant observed the drilling operations at all of the well locations. Refer to Appendix G for a report discussing the field observations, subsurface conditions, and hydrogeologic implications for performing the proposed in-lieu groundwater-banking program.

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Table 4.1 - SUMMARY OF CONTRACTOR BIDS ORANGE COVE IRRIGATION DISTRICT AB303 GROUNDWATER STUDY - OBSERVATION WELL CONSTRUCTION									
Bid Opening Date <u>1/20/2006</u> Prevailing Wages Required <u>Yes</u>		Project Manager <u>OEK</u> Project Engineer <u>OEK</u>		PROVOSTA & PRITCHARD ENGINEERING GROUP <small>EST. 1968</small>					
Item No.	Item Description	Quantity	Unit	BSK			Technicon		
				Unit Price	Item Total		Unit Price	Item Total	Twining
1	Mobilization/Demobilization, Bonds, and Insurance, Permits	1	LS	\$400.00	\$400.00		\$480.00	\$480.00	\$75.00
2	Miscellaneous Facilities, Operations, and Worker Protection, USA	1	LS	\$200.00	\$200.00		\$130.00	\$130.00	\$25.00
3	Drill 8-inch Diameter Borehole	32	LF	\$25.00	\$800.00		\$8.67	\$277.44	\$17.50
4	Furnish and Install 2-inch (nominal) Diameter Perforated Casing (0.020")	15	LF	\$3.50	\$52.50		\$6.20	\$93.00	\$2.20
5	Furnish and Install 2-inch (nominal) Diameter Blank Casing	15	LF	\$2.25	\$33.75		\$4.13	\$61.95	\$1.70
6	Furnish and Install Filter Pack	20	LF	\$3.50	\$70.00		\$15.87	\$317.40	\$3.80
7	Furnish and Install Bentonite Seal	2	LF	\$5.50	\$11.00		\$11.56	\$23.12	\$0.70
8	Furnish and Install Annular Seal	10	LF	\$15.00	\$150.00		\$14.65	\$146.50	\$1.40
9	Construct Wellhead Facilities	1	EA	\$350.00	\$350.00		\$250.00	\$250.00	\$160.00
10	Well Development	1	LS	\$425.00	\$425.00		\$200.00	\$200.00	\$155.00
Total for Each Observation Well					\$2,492.25			\$1,979.41	\$1,124.90
Total for 8 Observation Wells					\$19,938.00			\$15,835.28	\$8,999.20
NOTES: Quantities are not guaranteed. Final payment will be based on actual quantities.									



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4.4 - Develop Geographic Information System

The Orange Cove Irrigation District (OCID) had a groundwater database prior to implementation of this study. The database was significantly upgraded to make it easier to use, and includes new features, additional data, and a link to a Geographic Information System.

Old Database

OCID's old groundwater database was prepared in Microsoft Access. The database held data specific to 28 well locations throughout the district as well as a collection of precipitation, water delivery, and transpiration data. Most of the data in the old database was transferred to the new database.

Development of New Database

A new database (Groundwater Database) was also developed in Microsoft Access with the goal of being a comprehensive groundwater management tool for OCID. The new database includes all of the information collected during the real-time kinematic GPS survey of the wells in OCID and is linked to a Geographic Information System (GIS). The database includes a series of tables, queries, and forms to improve the process of data entry and reporting. Refer to **Appendix E** for an electronic copy of the database on CD, and sample hardcopies of the tables and reports from the database. Following are discussions on the major features in the new database:

- **Well location and identification.** Numerous parameters describing the wells were collected during the GPS survey (See section 4.2). These attributes are included in two separate tables in the database.
- **Current static water levels.** New groundwater level data can be entered into the database through an entry form.
- **Historical static water levels.** To establish a record of historic measurements for well locations, online data available from DWR (<http://wdl.water.ca.gov/gw/>) was downloaded and entered in the database. Currently there are 44 wells with data, creating 4,471 measurement records. Historic static water levels were also available from the District's old database.
- **Water quality testing results.** Water quality results can be entered through a specific entry form. Historic water quality results were entered from past studies within or near the District (refer to Section 5.1 for more information).
- **Driller's reports.** Driller's reports were collected for the sections encompassing the southern portion of the District. Since over 400 driller's reports were collected they are not held in the database but were placed in their own directory and organized by the public land survey system. The database includes a button for accessing driller's logs that have been linked to a well in the database. The driller's logs from the six new monitoring wells are linked to the database. Attempts were made to link older wells to driller's logs. However, most of the old driller's logs have no maps or very poor maps and no links could be made with certainty.



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- **Digital images of well sites.** All wells in the database were photographed with a digital camera and the images are available in the database. Individual well reports can be viewed with GPS survey data or with a photo and site description data.
- **Well hydrographs.** Hydrographs can be created in the Groundwater Database for all wells that have well water measurements. The hydrographs can plot data for individual wells or average water levels for all the wells within the area of most productive groundwater. The hydrographs can include depth to water surface or groundwater elevation. The hydrographs can be printed or exported as .pdf images to be later linked to the GIS if desired.
- **Groundwater reports.** Quarterly, annual, five-year, and ten-year groundwater storage change reports can be created in the Groundwater Database. These can be printed or exported as .pdf images.
- **Contour mapping.** Contours of depth to groundwater or groundwater elevations can be created with custom tools installed in the District's GIS. These tools allow the user to select a year and season of well water measurements, then create contours of either equal depth or elevation. The contours can be saved by exporting them to the geodatabase for later recall.
- **Geographic Information System.** A single user license of ESRI ArcView 9.0 was installed on a computer at the OCID office. Newly created and publicly available GIS feature layers were packaged into a geodatabase for mapping within the District. These layers included the District boundary, water service areas, roads, public land survey system, USGS 1:24,000 topo rasters, major canals, District area of most productive groundwater, a digitized contour layer for depth to granite, and established survey controls.
- **Other features.** Several Adobe .pdf figures were set up to open within the Groundwater Database as reference documents. These documents include a map of the District with well locations and service areas, and a map of depth to granite contours within the District.

GIS was integrated with the Groundwater Database in the following ways:

1. When the user enters well depth readings the database runs several Visual Basic macro scripts that send updated data tables to the GIS Geodatabase. These tables include all of the measurement data as depth to well water or calculated elevation of well water, and a table summarizing quarterly water level data. In other words, each time the Groundwater Database is updated, the GIS Geodatabase is automatically updated.
2. In ArcView the GIS Geodatabase contains a master data set of surveyed well locations. These data will link to a measurements table by the unique identifier assigned to each well. Through a series of custom tools using Spatial Analyst extension, a query can be performed for measurement data for a specific time period. Well locations with associated measurement data can then be used to create groundwater contours of equal elevation or depth in GIS.



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Training

The OCID Manager was given basic training on the function of the GIS software and use of the Groundwater Database. A User's Manual was also prepared to aid in the use of the database (**Appendix F**). The User's Manual includes numerous screen shots and step-by-step instructions for entering, viewing, and editing data, and creating reports. The User's Manual is available from a link on the Groundwater Database.



5 - GROUNDWATER QUALITY MONITORING

5.1 - Review Existing Water Quality Information

The Orange Cove Irrigation District does not perform groundwater quality testing, and, prior to this study, had no records on the local groundwater quality. The lack of groundwater quality monitoring was attributed to the generally acceptable quality of the groundwater (according to local growers) and the absence of District owned wells where testing could be performed. In addition, OCID was aware that other agencies have already been testing groundwater quality in the local area. Despite the generally acceptable quality of the groundwater, OCID found it prudent to collect all available data to confirm the state of groundwater quality, identify areas of concern, if any, and to archive the data for comparison to the results of any future testing.

Historical water quality that was researched and all available data was reviewed, and, when practical, placed in the new OCID groundwater database (data from one source was voluminous and thus was not entered into the OCID database). Refer to **Appendix J** for a map showing the locations with historical groundwater quality data and a table with all the collected data.

Following is a discussion on the sources of groundwater quality data that were investigated.

Historical Reports. Historical reports prepared by government agencies, such as DWR, USBR, etc. were reviewed for groundwater quality data. Some limited groundwater quality data was found in the two following reports:

1. USBR, *Supplemental Irrigation Suitability Land Classification Report, Central Valley Project, Friant Division, Hills Valley - Tri-Valley Area*, March 1982.
2. USGS, *Water-Quality Data, San Joaquin Valley, California, April 1987 to September 1988, USGS Open-File Report 91-74*, 1991.

The data includes groundwater quality test results from the 1980's for wells within and just outside of OCID.

United States Geologic Survey. Historical groundwater quality data was found for six wells within OCID on the website for the United State Geologic Survey. The data covered the years of 1963, 1987 and 1989. The data is not recent, however, due to the limited amount of other data found it was added to the OCID database.

East Orosi Community Services District. The East Orosi Community Services District was identified as a possible source of groundwater quality data near the southwest border of OCID. They were contacted as part of this study but did not return any phone calls.



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City of Orange Cove Wastewater Treatment Plant. The City of Orange Cove operates a wastewater treatment facility (WWTF) approximately one mile southeast of the City of Orange Cove. Historically, effluent was delivered via pipelines to OCID for irrigation use. However, OCID suspended the program in 2002 due to concerns over the quality of the treated water. The City of Orange Cove now delivers the water to recharge ponds.

The City of Orange Cove monitors groundwater quality upgradient and downgradient of the WWTF. Elevated levels of TDS and nitrates have been found in wells near the WWTF. However, the groundwater is still considered suitable for agricultural uses. The groundwater quality data collected by the City of Orange Cove is voluminous and therefore was not entered into the OCID groundwater database. It is recommended that OCID staff regularly review groundwater monitoring reports prepared by the City of Orange Cove to determine if the WWTF is adversely impacting the groundwater quality.

Private Groundwater Quality Data. Many growers and corporate farms perform periodic groundwater quality testing. OCID did not ask them to submit their data since it was already pointed out at the Groundwater Advisory Committee (GAC) meetings that growers would be reluctant to share their data with the public. However, some of the GAC members noted that growers might be willing to share their data with OCID on a case-by-case basis. Sharing the data would be contingent on OCID not releasing it to the public and using it for a project that would benefit district growers. OCID will consider this action in the future if they have the need for more groundwater quality data.

Appendix J includes a table entitled “Comparison of Groundwater Quality to Recommended Guidelines for Agricultural Water Quality”. The table includes historical ranges for several groundwater constituents, and recommended concentrations of constituents for agriculture. The table also lists USBR guidelines for water quality in the Friant-Kern Canal, which is based on agronomic as well as operational criteria, so its use as a guideline should be considered carefully. Based on the limited data available, groundwater quality in OCID has been suitable for agriculture except for one sample in 1987 that exceeded the DWR recommendation for TDS for sensitive crops. The groundwater quality is generally well below recommended maximum levels for most constituents and would be suitable for sensitive crops. This has confirmed previous beliefs and the general observations of the local farmers that the groundwater is suitable for cropping. The groundwater quality was not evaluated with respect to its suitability for domestic water use.

No definitive links were made between the wells with water quality data and those recently surveyed and entered into the new groundwater database.

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5.2 - Conduct Additional Water Quality Monitoring

This task was removed from the scope of work and replaced with Task 4.5 – Educational Program for Drought Preparedness Program. Refer to Section 1.4 for more details on the reasons for the change in the scope of work.



6 - DROUGHT PREPAREDNESS PROGRAM

The proposed Drought Preparedness Program (DPP) would provide incentives to some growers to increase surface water use in wet years to provide in-lieu groundwater recharge, and later increase groundwater pumping in dry years so their surface water supply can be delivered to growers with a less sustainable groundwater supply. The products of this task are primarily documented in the Drought Preparedness Program report, which is included in **Appendix K**. Following are discussions on the subtasks found in the scope of work.

6.1 - Meetings with Advisory Committee

Four meetings were held with the Groundwater Advisory Committee (GAC), primarily to discuss the proposed Drought Preparedness Program (DPP). Refer to Section 3.2 for more information on the membership of the GAC. The meetings were held in October 2004, September 2005, November 2005, and December 2005. Minutes were not recorded at the first GAC meeting in October 2004 since its purpose was only for project orientation and no substantial comments were provided by GAC members. Minutes were recorded at the three other meetings and can be found in **Appendix C**. The GAC members provided important input on the development of the DPP, particularly regarding grower incentives and grower education.

6.2 - Evaluation of Surface Water Supply, Demand and Groundwater Costs

The issues of surface water supply, demands, and groundwater costs are discussed in the Drought Preparedness Program Report (**Appendix K**), particularly in Sections 3 – Surface and Groundwater Use and Section 5 - Project Benefits and Impacts. In summary, a simulation was performed and estimated that OCID could bank 45,000 acre-feet over a 30-year period.

6.3 - Review of Existing Facilities

Initially, it was proposed that growers could pump groundwater into the OCID distribution system to serve areas with an inadequate water supply in dry years. However, this alternative presented several challenges and concerns. Firstly, many of the growers would need new conveyance and metering facilities to deliver water into the OCID distribution system. Also, water quality concerns from other growers may reduce the popularity of this alternative. Therefore, it was concluded that growers would contribute instead by pumping additional groundwater and using it all on their *own* land, and thus avoiding the aforementioned problems. As a result, no new facilities would be needed to deliver water to the OCID distribution system. In addition, no new District facilities would be needed for the program.

Nevertheless, limitations in grower pumping capacity can limit how much water grower's should exchange. For example, if a grower banks groundwater and agrees to relinquish all of their surface water rights in dry years, then the grower's groundwater pumping capacity must be able to meet their entire irrigation demand. It was not considered practical to evaluate the well systems of all the farmers. Instead, a worksheet was

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prepared to give them a tool for evaluating their own system. The worksheet provided guidance in estimating a grower's groundwater pumping capacity, groundwater pumping energy costs, and the financial incentives needed for them to benefit from the program. The worksheet was explained at the educational outreach meetings (see Section 6.5) and can be found in **Appendix L**.

6.4 - Define the Drought Preparedness Plan

A complete description of the proposed DPP is provided in the Drought Preparedness Report in **Appendix K**. The report discusses all aspects of the proposed program including:

1. Alternatives for drought protection in OCID
2. Description of surface and groundwater uses in OCID
3. Requirements for grower participation in the DPP
4. Incentives for growers participating in the DPP (including adjustments to OCID water rates)
5. Triggers for implementing the DPP
6. Monitoring requirements
7. Public participation in developing the DPP
8. Proposed pilot program (including proposed area for pilot program)
9. Economic analysis of DPP
10. Discussion on other benefits of the DPP
11. Potential impacts and environmental concerns
12. Recommendations for future studies

The report does not include a review of needed facilities for the reasons described in Section 6.3.

In April 2006, OCID conducted several educational sessions to solicit input and gauge interest from the growers. The response from most growers was favorable and OCID will probably proceed with the DPP. A recommended implementation schedule follows (note that the tasks listed below are not part of the scope of work for this study):

- Submit CEQA Initial Study (August 2006)
- OCID Board of Directors vote on resolution to adopt DPP (Sept 2006)
- Prepare and sign formal agreements with growers (Oct 2006 – Dec 2006)
- Begin implementing DPP (Jan 2007)

It is anticipated that OCID will submit a CEQA Initial Study on the proposed drought preparedness plan (see Section 6). However, this was not part of the scope of this study, and it is not anticipated to be done until OCID has held further negotiations with the growers and the OCID Board of Directors have approved the final Drought Preparedness Program.



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6.5 - Educational Program

An educational outreach program was conducted to inform local growers on the mechanics and benefits of the DPP, solicit their comments, and gain a better understanding of their interest in the program.

Educational materials were prepared to facilitate the outreach program and can be found in **Appendix L**. These include:

- Informational Brochure
- Powerpoint Presentation
- Pilot Program Example
- List of Frequently Asked Questions
- Participant Worksheet

Three meetings were held with landowners from April 4-6, 2006. The three meetings were held with large, medium, and small landowners, respectively. The minutes and sign in sheets from all three meetings are provided in **Appendix C**. Generally, response to the program was positive, although a few attendees showed little interest during the meetings. The growers offered some useful comments and ideas and the DPP was modified accordingly.

The growers were contacted by phone approximately two weeks after the meetings to gauge their overall understanding of the program and possible interest in participating. A few growers expressed interest and a few were not interested, while a large number of growers were still undecided. OCID may perform more public outreach in the near future to encourage participation and, hopefully, implement a pilot program before the 2007 irrigation season begins.



7 - PROJECT REPORTING

7.1 - Progress Reports

The following progress reports were submitted to DWR:

Progress Report No. 1: September 2004 to January 2005

Progress Report No. 2: February 2005 to April 2005

Progress Report No. 3: May 2005 to July 2005

Progress Report No. 4: August 2005 to October 2005

Progress Report No. 5: November 2005 to January 2006

Progress Report No. 6: February 2006 to April 2006

Progress Report No. 7: May 2006 to July 2006

The progress reports followed the format outlined in Exhibit E – Quarterly Report Format in the Grant Agreement between OCID and DWR. Each progress report was accompanied by a payment request. The progress reports were previously submitted to DWR and therefore are not included as part of this report.

7.2 - Project Report

This project report was prepared in compliance with the following:

- Scope of Work (see Appendix A)
- *Final Report Information Guidelines* provided by DWR
- *Exhibit F - Data Submittal Requirements* found in the contract between OCID and DWR

SECTION EIGHT**8 - REFERENCES**

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5. California Regional Water Quality Control Board - Central Valley Region, *Order No. R5-2004-0008, Waste Discharge Requirements for City of Orange Cove Wastewater Treatment Facility, Fresno County*, 2004.
6. California State Senate, *Senate Bill No. 1938, Chapter 603, Groundwater Management: State Funding*, 2002.
7. County of Fresno, *Fresno County Groundwater Management Plan*, March 11, 1997.
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12. Thomson West, *California Water Code, 2003 Desktop Edition, Chapter 3 – Groundwater Management Plans*, 2003.
13. United States Bureau of Reclamation, *Supplemental Irrigation Suitability Land Classification Report, Central Valley Project Friant Division, Hills Valley – Tri-Valley Area*, March 1982.
14. United States Department of the Interior Bureau of Reclamation Region II, *Geologic Study of the Orange Cove Irrigation District*, August 1947.



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15. United States Department of the Interior Bureau of Reclamation Region II, *Water Supply Study of the Orange Cove Irrigation District, Fresno and Tulare Counties, California*, September 1947.
16. United States Department of the Interior Bureau of Reclamation Region II, *Land Use Study of the Orange Cove Irrigation District, Fresno and Tulare Counties, California*, August 1947.
17. United States Geological Survey, *Water Quality Data, San Joaquin Valley, California, April 1987 to September 1988, Open File Report 91-74*, 1991.