Paso Robles Groundwater Basin Water Banking Feasibility Study

Description of Water Banking Alternatives

San Luis Obispo County Flood Control
And Water Conservation District

Date: June 2007
Project No: 064030

DRAFT

GEI Consultants
Bookman-Edmonston Division

Introduction

The Paso Robles Groundwater Basin (Basin) located in northern San Luis Obispo County (County) is one of the largest groundwater basins in the County (Figure 1). The Coastal Branch of the California State Water Project (SWP) enters the County and the Central Coast just east of the Basin near the town of Shandon and continues southwest across the Basin. These two features along with the County's unused allocation of SWP water led local water leaders to want to explore the feasibility of banking water in the Basin for the benefit of County residents.

This Description of Water Banking Alternatives summarizes information used to develop the water banking alternatives that are to be evaluated in the Paso Robles Groundwater Basin Water Banking Feasibility Study (Feasibility Study) and provides members of the Groundwater Banking Subcommittee (GBSC), Water Resources Advisory Committee (WRAC), Shandon Advisory Committee (SAC), and other interested parties an opportunity to review and comment on the alternatives prior to completing the technical analysis. This work was completed by the project team, which was lead by GEI Consultants, Inc. with hydrogeologic support by Fugro West and Cleath & Associates.

Project Background

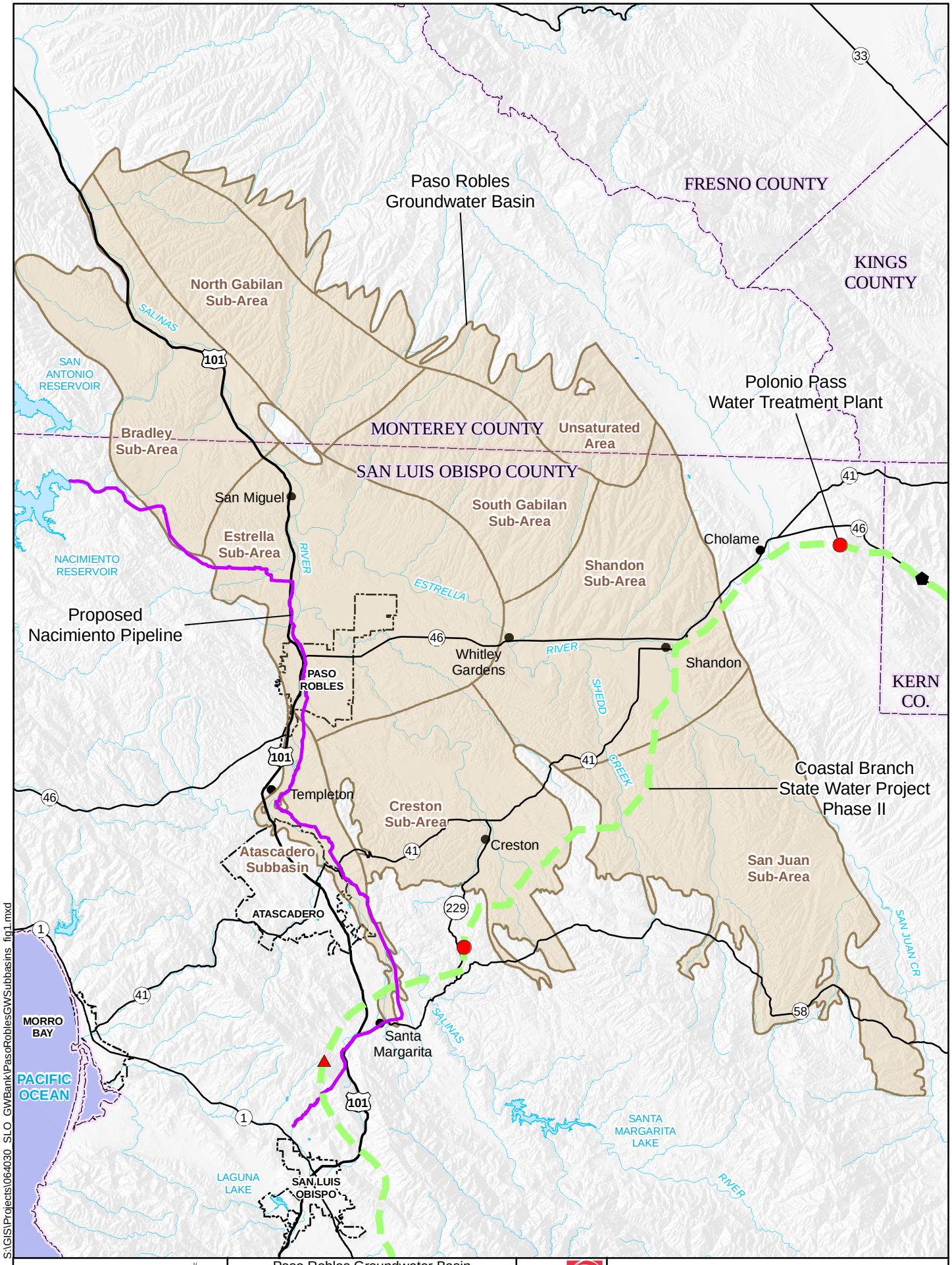
The Water Banking Feasibility Study for the Paso Robles Groundwater Basin is being led by the San Luis Obispo County Flood Control and Water Conservation District (District) in coordination with the GBSC of the WRAC.

The San Luis Obispo County Integrated Regional Water Management Plan (IRWM Plan) identified this feasibility study of the groundwater banking potential of the Basin as a high-priority project. Funding for this study, as well as several other planning projects identified in the San Luis Obispo County IRWM Plan, was provided in part by a Proposition 50 Chapter 8 Integrated Regional Water Management Program Fiscal Year 2005-2006 Planning Grant.

Project Goal

The goal of the Feasibility Study is to determine the water banking potential in the Basin. If feasible water banking opportunities are identified in this Feasibility Study, they can be compared to other water management options identified by the District to improve the long-term water supply reliability for the residents of the County and the Central Coast. Potential benefits of a water bank may include:

- Improving local groundwater conditions within the Basin.
- Increasing dry-year water supply reliability for local water users and possibly the residents of the County and the Central Coast.


Paso Robles Groundwater Basin
FRESNO COUNTY
KINGS COUNTY
North Gabilan Sub-Area
SALINAS
SAN ANTONIO RESERVOIR
101
Polonio Pass Water Treatment Plant
MONTEREY COUNTY
Unsaturated Area
Bradley Sub-Area
SAN LUIS OBISPO COUNTY
41
San Miguel
South Gabilan Sub-Area
Estrella Sub-Area
RIVER
Cholame
46
NACIMIENTO RESERVOIR
ESTRELLA
Shandon Sub-Area
Proposed Nacimiento Pipeline
Whitley Gardens
RIVER
Shandon
PASO ROBLES
SHEDD
KERN CO.
Templeton
GREEK
Coastal Branch State Water Project Phase II
Creston Sub-Area
Creston
Atascadero Subbasin
San Juan Sub-Area
ATASCADERO
229
SAN JUAN CR
MORRO BAY
Santa Margarita
SALINAS
58
PACIFIC OCEAN
SANTA MARGARITA LAKE
LAGUNA LAKE
SAN LUIS OBISPO
RIVER
3 1.5 0 3
Miles
Paso Robles Groundwater Basin
Water Banking Feasibility Study
San Luis Obispo County
Flood Control and Water Conservation District
GEI Consultants
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PASO ROBLES GROUNDWATER BASIN
JUNE 2007
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FIGURE 1
31-May-07 S:\GIS\Projects\064030 SLO GWBank\PasoRoblesGWSubbasins fig1.mxd

- Improving local groundwater quality in the Basin.
- Providing greater flexibility of water resources management in the County and the Central Coast.
- Reducing the County's dependence on imported water supplies in below-normal years.

Project Schedule

The evaluation and comparison of the water banking alternatives is scheduled to be completed during the summer of 2007, with the preliminary results presented at the August 2007 GBSC meeting. Each alternative will be evaluated using the same assumptions and project operations in order to easily compare the effects of the water banking operations on local groundwater conditions.

Supporting Information

The project approach and assumptions leading to the development of these alternatives are documented in the Preliminary Engineering Technical Memorandum (PETM) and the presentation materials presented to the GBSC, which are available on the SLOC water resources website under the IRWM Quicklink at: www.slocountywater.org. Some of the specific subjects discussed and presented included:

- Review of potential recharge methods,
- Identification of the technical evaluation criteria to evaluate and compare water banking alternatives,
- Evaluation of the State Water Project water supply availability and reliability for water banking operations,
- Initial estimates of the facility requirements to convey water to and from banking sites,
- Identification of potential end users of banked water, and
- Hydrogeologic evaluation and field investigation.

Engineering Considerations in the Development of Alternatives

This section defines the operational scenarios and facility requirements that will identify engineering aspects of water banking alternatives.

Project Participants

The project participants listed below have a potential role in developing and evaluating the feasibility of water banking in the Paso Robles Groundwater Basin for the following reasons:

- They supply water for banking,
- They use banked water, or
- They may be involved in recharge and recovery operations.

Future efforts will need to identify the specific coordination and cooperation among local and state agencies as well as local land owners, additional stakeholders, and interested parties to implement technically feasible water banking projects.

San Luis Obispo County Flood Control and Water Conservation District (SLOCFCWCD) – SLOCFCWCD has the SWP contract that is being used as the water supply for banking. It also has the contract with Central Coast Water Authority to treat and convey water to the existing M&I contractors in San Luis Obispo County.

Central Coast Water Authority (CCWA) – CCWA owns and operates the Coastal Branch Aqueduct and the Polonio Pass WTP. CCWA also represents potential urban water users that may be interested in receiving banked water. For the purposes of this study, CCWA is used to represent the end user.

Local Agricultural Water Users – Local agricultural water users are included to estimate local agricultural in-lieu recharge opportunities. The local agricultural areas are identified based on a 2006 San Luis Obispo County land use survey prepared by the San Luis Obispo County Agricultural Commissioner's Office. Coordination with agricultural land owners that may choose to participate in a feasible water banking project would occur under future efforts.

Water Banking Facilities

In order to evaluate alternatives, water banking facilities will be developed to meet the stated recharge and recovery goal of 1,500 acre-feet per month. The recharge and recovery goal was based upon water supply availability and water demand patterns in the region.

The water banking facilities identified to this point include the primary facilities needed to convey water to the banking location, recharge water, recover water, and deliver it to the end users.

Conveyance Facilities

Conveyance facilities will consist of the main project pipelines and pumpstations necessary to deliver raw water from the SWP to the banking location(s) and return recovered water to the Polonio Pass WTP for treatment and delivery to the end user (i.e., CCWA).

Recharge Facilities

Recharge facilities will consist of the pipelines and pumpstations necessary to deliver water from the main project pipeline to the recharge areas. Recharge basins are needed for direct recharge operations. Additional pipelines and pumpstations may be needed to deliver water to selected agricultural areas for agricultural in-lieu recharge operations.

Recovery Facilities

Recovery facilities will consist of new wells and pipelines needed to extract the banked water and deliver it to the main conveyance pipeline described above. The wells will be located to reduce the potential impact of groundwater recovery operations on existing wells and other recovery wells in the area.

Simulated Water Banking Operations

The water banking operations include both recharge and recovery components. The recharge operations will test the ability of the groundwater basin to accept and store banked water, while the recovery operations will identify the impacts associated with recovering "banked" water from the basin.

The existing groundwater model developed in 2005 for the Paso Robles Groundwater Basin (Fugro, 2005) will be used to evaluate the impacts of the water banking project operations on the groundwater basin. The recharge and recovery operations will be applied on top of the local land and water use conditions included in the model, which represent the 1981 to 1997 period. This 17-year simulation period includes a range of hydrologic conditions that will test both the recharge and recovery aspects of the water banking operations.

Recharge Operations

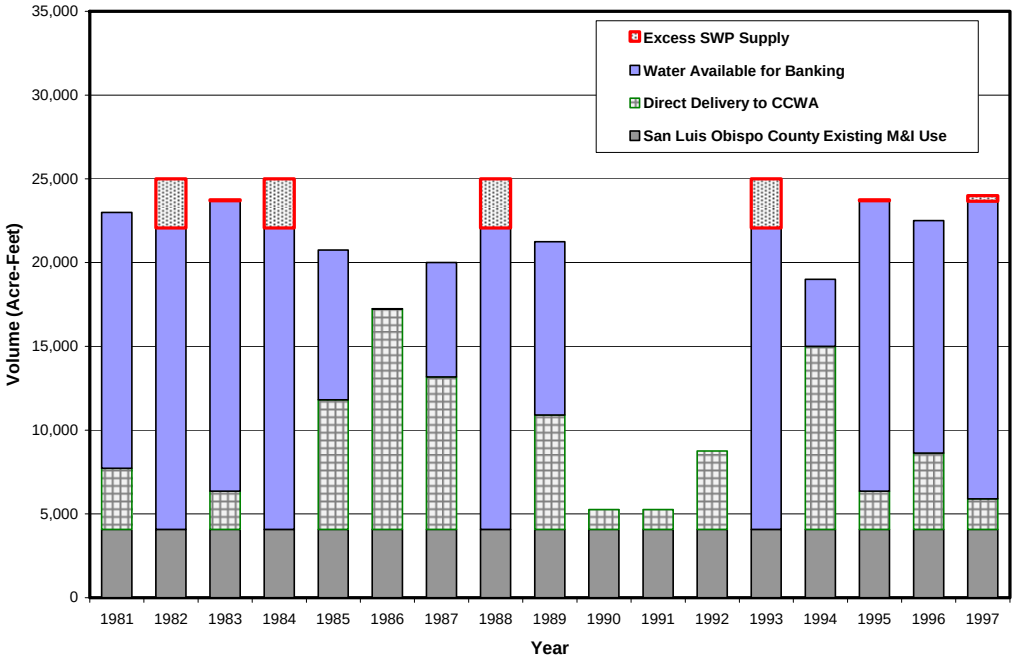
The water supply for groundwater recharge operations was developed based upon the SLOCFCWCD State Water Project Table A allocation. The SLOC SWP Table A contract totals 25,000 acre-feet per year at a delivery rate of 35 cubic feet per second (approximately 2,083 acre-feet per month). The actual supply available in a single year varies based on annual hydrologic conditions and SWP operations. The California DWR recently estimated the long-term water supply delivery reliability for the SWP under different conditions using CALSIM II (a state-wide water planning model), the results of which are presented in *The State Water Project Delivery Reliability Report 2005* (DWR,

2006). The recharge and recovery operations for water banking analysis were developed based upon the water supply availability for Year 2030 conditions.

The recharge operations for this analysis were developed based on the variable SWP water supply availability described above, and the water delivery priorities described below.

- **Priority 1: SLOC Existing M&I Use** – The existing SLOC deliveries of SWP water to M&I contractors have the highest priority for delivery in every year. For purposes of this study, deliveries to the SLOC M&I contractors were estimated at Year 2006 deliveries (about 4,080 acre-feet per year) as shown on Figure 2. The 4,080 af/yr SLOC M&I deliveries account for a drought buffer, which may be needed in any single year to meet the total annual delivery goal. For years when the drought buffer is not needed to meet the delivery goal, it would be available for the other uses described below.

Figure 2 - Utilization of SWP Water Supply



- **Priority 2: Direct Delivery to CCWA** – SLOC and CCWA are currently exploring the possibility of delivering surplus SLOC Table A supplies directly to CCWA. This would reduce the amount of water available for banking, thereby reducing the size of the facilities and O&M costs associated with water banking. This water delivery option is the second priority because of the overall benefit and cost savings associated with direct delivery of the water. As shown on Figure 2, the amount of water available for direct delivery to CCWA varies annually and

direct delivery occurs in 13 of the 17 years. Direct deliveries to CCWA range from about 1,200 to 13,100 acre-feet per year and average about 4,100 acre-feet per year.

- **Priority 3: Water Available for Banking** – Based on the available water supply and water demand patterns for water recharge and recovery efforts, supplies available for banking are available in about 13 of the 17 years, ranging from about 4,000 to 20,900 acre-feet per year and averaging 11,500 acre-feet per year (Figure 2). The groundwater recharge goal may be met by a combination of in-lieu recharge and direct recharge facilities. The actual location of in-lieu and direct recharge facilities will be developed based upon the recent (2006) land use mapping completed by the County and the hydrogeologic mapping and reconnaissance level mapping completed to date.

- **Excess SWP Supplies** – Excess SWP supplies (as defined for this analysis) occur in wet years, when it was determined that CCWA did not need direct delivery of water from SLOC and available supplies for banking exceeded the 1,500 acre-foot per month recharge goal. As shown on Figure 2, this occurs in seven of the 17 years.

Additional local or imported water sources have been identified and may be available for water banking operations. These additional supplies do not need to be evaluated at this time to test the feasibility of water banking in the Paso Robles Basin. Some of the additional supplies that may be evaluated in the future include:

- Nacimiento Water Project,
- Santa Barbara County (SBC) FCWCD – reacquisition of SWP supplies,
- SWP Article 21 water, and
- SWP Turnback water.

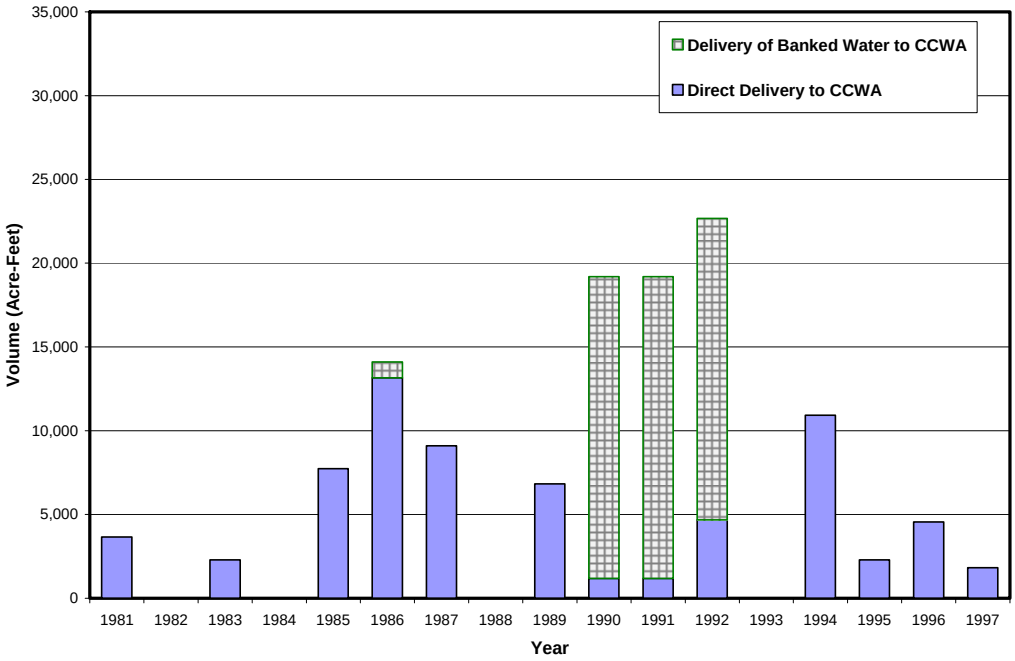
Recovery Operations

The approach used to develop the recharge operations described above was also used to develop the groundwater recovery pattern used in this analysis. The recovery pattern was developed with the goal of providing CCWA with 100 percent of the SBCFCWCD Table A allocation (45,485 acre-feet per year) in all years during the simulation period. It should be noted that the recovery operations reflect the available capacity in the Polonio Pass WTP and the Coastal Branch when SBC does have its full Table A allocation, not actual CCWA operations of the Coastal Branch or facilities within Santa Barbara County.

The recovery operations for this analysis were developed based on the variable SWP water supply availability described above, and CCWA water delivery priorities described below:

- **Priority 1: Direct Delivery to CCWA** – This is the same as the Groundwater Recharge Priority 2 described above (shown on Figure 2 above). In four years (1982, 1984, 1988, and 1993) full Table A allocations are available, so deliveries to CCWA are not needed (see Figure 3), but 13 years of the simulation period do not meet the 100-percent delivery goal. In nine of the 13 years, when SBCFCWCD allocations are less than 100 percent, direct delivery to CCWA meets the recovery goal.

Figure 3 - Delivery of Banked Water



- **Priority 2: Delivery of Banked Water to CCWA** – The delivery of banked water to CCWA was developed based on supply availability and the water demand patterns for CCWA. The direct delivery of SLOC water to CCWA meets the CCWA water supply goal (developed for this analysis) in 13 of the 17 years as shown on Figure 3. The effectiveness of the direct delivery program reduces the number of years when recovery from the groundwater basin is needed. As shown on Figure 3, recovery of banked water is needed in only four of the 17 years. Three of the years (1990, 1991, and 1992) represent a significant recovery from the groundwater basin. In these three years, the recovery of banked water totals 1,500 acre-feet per month for 12 months, totaling 18,000 acre-feet per year.

Summary of Recharge and Recovery Operations

The recharge and recovery operations developed for this analysis reflect the historic hydrologic variability experienced in California. The 17-year simulation period representing the 1981 to 1997 period includes nine years of primarily recharge operations prior to a three-year recovery period (typical of a multi-year drought), followed by five years of recharge operations. It is expected that this recharge and recovery pattern will test the ability of the groundwater system to recharge and store a large amount of water and the impacts of heavy multi-year groundwater pumping.

Water Banking Alternatives

The locations of the water banking alternatives to be evaluated in this feasibility study were identified in part based on the local hydrogeologic conditions. The following hydrogeologic considerations were used to identify appropriate areas to test water banking feasibility:

- Hydrogeologic conditions
- Near surface conditions
- Occurrence and movement of groundwater
- Groundwater storage capacity
- Water quality conditions

These hydrogeologic considerations were presented in the PETM and discussed at several of the GBSC meetings. The three selected alternatives presented below were developed based on the review of the existing available information and field investigation to verify local conditions.

For evaluation purposes, each of the three alternatives consists of a combination of direct recharge and agricultural in-lieu recharge. Each of the recharge areas is currently being evaluated to determine the combination of direct and in-lieu recharge based upon the existing land use and local hydrogeologic conditions as described above.

For the recovery of banked water, the new recovery wells will be located to minimize drawdown interference during recovery operations with existing wells and other recovery wells while limiting infrastructure requirements. The actual number and distribution of recovery wells will be based on existing well locations and local hydrogeologic conditions.

Alternative 1 – Shell Creek/Camatta Creek and Lower San Juan Creek Recharge Areas

The purpose of this alternative is to evaluate the groundwater banking potential in the San Juan Subarea shown on Figure 4. The aquifer system in the San Juan Subarea is approximately 450-feet thick, with an average specific yield of about 10 percent, resulting in an estimated groundwater storage capacity of about 4.2 million acre-feet. The aquifer consists of clays interbedded with sand and gravel. Previous field investigations have observed significant stream recharge in Shell/Camatta Creek.

Potential areas that may support direct recharge have been located along Shell/Camatta Creeks and San Juan Creek. In addition, the agricultural areas (primarily vineyards) present in the Shandon area and along Shell Creek may provide in-lieu recharge opportunities.

The water banking alternatives would be simulated using a combination of agricultural in-lieu recharge and direct recharge. This combination of in-lieu and direct recharge would disperse the recharge activities over a large area in order to access as much of the aquifer system as possible. This area is not subject to current groundwater level declines at this time.

Groundwater recovery would take place throughout the area receiving recharge water. Wells in this area can produce from 1,000 to 2,000 gallons per minute. It is expected that new groundwater recovery wells would be located along the conveyance pipeline to recover the banked water and return it to the Polonio Pass WTP.

This alternative would include approximately 23 miles of pipelines to deliver water to the recharge areas and return recovered water to the Polonio Pass WTP for treatment and distribution. The pipeline diameter would be reduced as needed to match the recharge and recovery operations.

Alternative 2 – Creston Recharge Area

The purpose of this alternative is to evaluate the groundwater banking potential in the Creston Subarea (see Figure 4). The aquifer system in the Creston Subarea is approximately 450-feet thick with an average specific yield of about 9 percent resulting in an estimated groundwater storage capacity of about 2 million acre-feet. This area has a 2-layered aquifer system, with the shallow alluvial (Qa) aquifer system overlying the Paso Robles Formation (QTP).

The sand and gravel zones of the Creston basin sediments appear to be in direct contact with the shallow alluvial sand and gravel deposits of the Huer Huero Creek, which may provide direct recharge to the basin. Groundwater quality is generally good in the shallow zones, with increased mineralization from the southwest to the northeast.

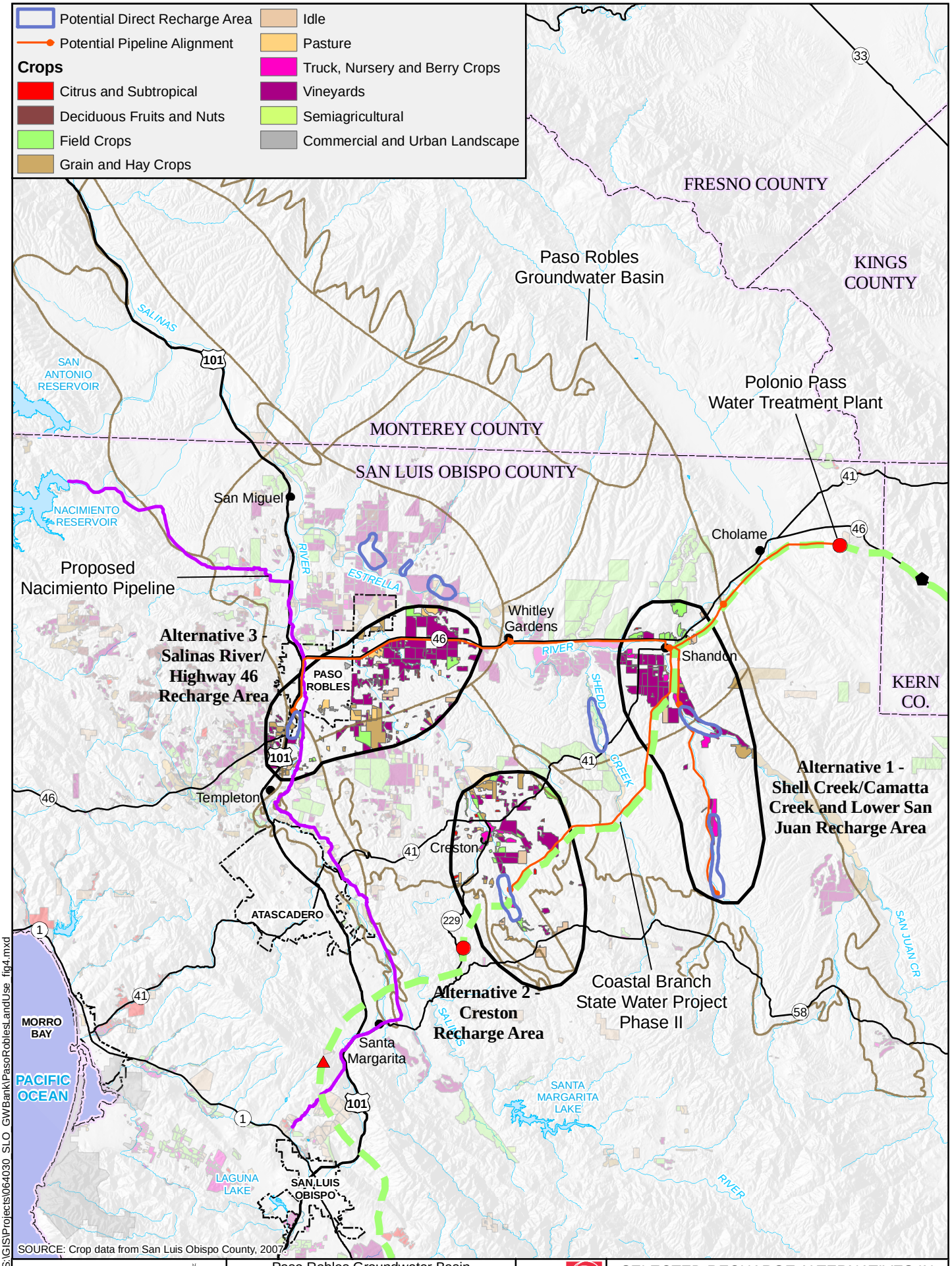

Potential Direct Recharge Area
Potential Pipeline Alignment
Crops
Citrus and Subtropical
Deciduous Fruits and Nuts
Field Crops
Grain and Hay Crops
Idle
Pasture
Truck, Nursery and Berry Crops
Vineyards
Semiagricultural
Commercial and Urban Landscape
FRESNO COUNTY
KINGS COUNTY
KERN CO.
MONTEREY COUNTY
SAN LUIS OBISPO COUNTY
Paso Robles Groundwater Basin
Polonio Pass Water Treatment Plant
Proposed Nacimiento Pipeline
Alternative 3 - Salinas River/ Highway 46 Recharge Area
Alternative 1 - Shell Creek/Camatta Creek and Lower San Juan Recharge Area
Alternative 2 - Creston Recharge Area
Coastal Branch State Water Project Phase II
SALINAS RIVER
SAN ANTONIO RESERVOIR
NACIMIENTO RESERVOIR
ESTRELLA RIVER
SHEDD CREEK
SAN JUAN CR
SANTA MARGARITA LAKE
LAGUNA LAKE
PACIFIC OCEAN
MORRO BAY
San Miguel
Templeton
PASO ROBLES
Whitley Gardens
Cholame
Shandon
Creston
ATASCADERO
Santa Margarita
SAN LUIS OBISPO
SOURCE: Crop data from San Luis Obispo County, 2007
3 1.5 0 3
Miles
Paso Robles Groundwater Basin
Water Banking Feasibility Study
San Luis Obispo County
Flood Control and Water Conservation District
GEI Consultants
Bookman-Edmonston Division
SELECTED RECHARGE ALTERNATIVES IN PASO ROBLES GROUNDWATER BASIN
JUNE 2007
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FIGURE 4
1-Jun-07 S:\GIS\Projects\064030 SLO GWBank\PasoRoblesLandUse fig4.mxd

The East Branch of the Huer Huero Creek has been identified as a potential recharge area. In addition, the agricultural areas (primarily vineyards) present in the Creston area may provide in-lieu recharge opportunities.

The water banking alternatives would be simulated primarily using direct recharge along the Huer Huero recharge area and secondarily using agricultural in-lieu in the Creston Area. This combination of in-lieu and direct recharge would disperse the recharge activities over a large area in order to access as much of the aquifer system as possible. Groundwater levels in this area are relatively stable.

Groundwater recovery would take place throughout the area receiving recharge water from the shallow alluvial aquifer and the Paso Robles Formation. Wells in this area can produce from 300 to 400 gallons per minute. It is expected that new groundwater recovery wells would be located along the pipeline to recover the banked water and return it to the Polonio Pass WTP.

This alternative would include approximately 26 miles of pipelines to deliver water to the recharge areas and return recovered water to the Polonio Pass WTP for treatment and distribution. The pipeline diameter would be reduced as needed to match the recharge and recovery operations.

New recovery wells will be located along the conveyance pipeline to minimize drawdown interference during recovery operations with existing wells and other recovery wells while limiting infrastructure requirements.

Alternative 3 – Salinas River/Highway 46 Recharge Area

The purpose of this alternative is to evaluate the groundwater banking potential along Highway 46 and in the Salinas River Area (see Figure 4). The aquifer system in the Estrella Subarea averages about 700 feet of thickness with an 8-percent specific yield resulting in an estimated groundwater storage capacity of about 8.8 million acre-feet. This area has a 2-layered aquifer system, with the shallow alluvial (Qa) aquifer system overlying the Paso Robles Formation (QTP). Groundwater quality is generally good east of the Salinas River; however, elevated nitrate levels are present in some areas.

Within the Subarea, the Estrella River north of Highway 46 does have some areas that may provide favorable surface recharge, but the connection of these areas to the main aquifer system is not clearly understood at this time.

The Salinas River just south of Paso Robles has been identified as a potential recharge area. In addition, the agricultural areas (primarily vineyards) present along Highway 46 may provide in-lieu recharge opportunities.

Groundwater levels along Highway 46 and near Paso Robles have experienced the greatest declines in the basin. It is expected that groundwater recharge alternatives in this

area may reduce the rate of groundwater-level declines and may allow for the recovery of groundwater levels during recharge operations.

Groundwater recovery would take place throughout the area receiving recharge water from the shallow alluvial aquifer and the Paso Robles Formation. Wells in this area can produce up to 1,000 gallons per minute. Groundwater recovery wells may have to be disbursed over a large area to reduce the impacts of recovery operations on existing groundwater users.

This alternative would include approximately 31 miles of pipelines to deliver water to the recharge areas and return recovered water to the Polonio Pass WTP for treatment and distribution. The pipeline diameter would be reduced as needed to match the recharge and recovery operations.

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