

1.0 INTRODUCTION

1.1 STUDY AUTHORITY

This report presents the results of a supplemental feasibility study to the Santa Margarita River Recharge and Recovery Enhancement Program – Permit 15000 Feasibility Study for Marine Corps Base Camp Pendleton (Stetson Engineers, 2001), hereafter referred to as the Permit 15000 Study. The alternatives in this report also compliment the findings from the Conjunctive Use Study – Lower Santa Margarita River Basin (NBS Lowery, 1994), hereafter referred to as the NBS Lowery Report. The Fallbrook Public Utility District (Fallbrook PUD) authorized and funded this study on August 6, 2001.

1.2 PURPOSE OF STUDY

The purpose of this study is to analyze project alternatives that may be used to develop a conjunctive use program between the Fallbrook PUD and Camp Pendleton (Base). This study focuses on enhancing local water supplies, the recycling and reuse of tertiary treated wastewater effluent, and improving the Santa Margarita River Basin water quality. In addition to these objectives, the alternatives developed in this feasibility study may be used to perfect existing water rights permits and provide a physical solution to an ongoing legal dispute to the waters of the Santa Margarita River. While many of the physical alternatives presented in this study are based on the Permit 15000 Study, results from the NBS Lowery Report have also been incorporated for the purpose of completeness.

The alternatives developed in this study utilize the natural ability of the ground-water basins on the Base to capture and store waters of the Santa Margarita River. A MODFLOW™ ground-water model developed for the Permit 15000 Study was utilized and further refined to maximize the annual quantity of water that could be developed, while simultaneously protecting the natural habitat, for use in a conjunctive use project. The contiguous geographic location of the Fallbrook PUD and Camp Pendleton, combined with complimentary potable water demands of the two parties, presents an ideal situation for the development of a conjunctive use project.

The following chapters of this study present the hydrologic, engineering, and economic analyses that support two alternatives for a conjunctive use program. In addition to the analyses used to support the two project alternatives, discussions regarding water quality, regulatory requirements, and sources of funding are also presented. Recommendations and conclusions presented at the end of this study outline the implementation of these alternatives and their ability to meet future water demands and resolve litigation issues between the two parties.

1.3 LOCATION OF THE STUDY AREA

The study area is located in northern San Diego County (Figure 1-1) and includes the geographic boundaries of the Fallbrook PUD service area and the United States Naval Enclave, consisting of Marine Corps Base and Marine Corps Air Station Camp Pendleton, the Naval Hospital, Camp Pendleton (collectively “the Base”), and Naval Weapons Station Seal Beach, Fallbrook Annex (“NWS”) (Figure 1-2). Project alternatives in this study address the construction and use of facilities within the boundaries of the Santa Margarita River Watershed. The Santa Margarita River forms at the confluence of Temecula and Murrieta Creeks and flows in a southwest direction through the Fallbrook PUD, the NWS and the Base before terminating at the Pacific Ocean.

The Santa Margarita River Basin consists of 744 square miles of drainage area in both San Diego and Riverside counties. The Santa Margarita River Basin may be separated in to two watersheds referred to as the “Upper Basin” and the “Lower Basin” (Figure 1-3). The Upper Basin is located in Riverside County and is controlled by the drainage of the Temecula and Murrieta Creeks. The Lower Basin is controlled by the 27-mile long Santa Margarita River and contains major tributaries such as De Luz, Sandia, and Fallbrook Creeks. The occurrence of ground water is found in the alluvial basin located below the confluence of the Santa Margarita River and De Luz Creek, and to a lesser extent, in the shallow alluvium upstream of that confluence.

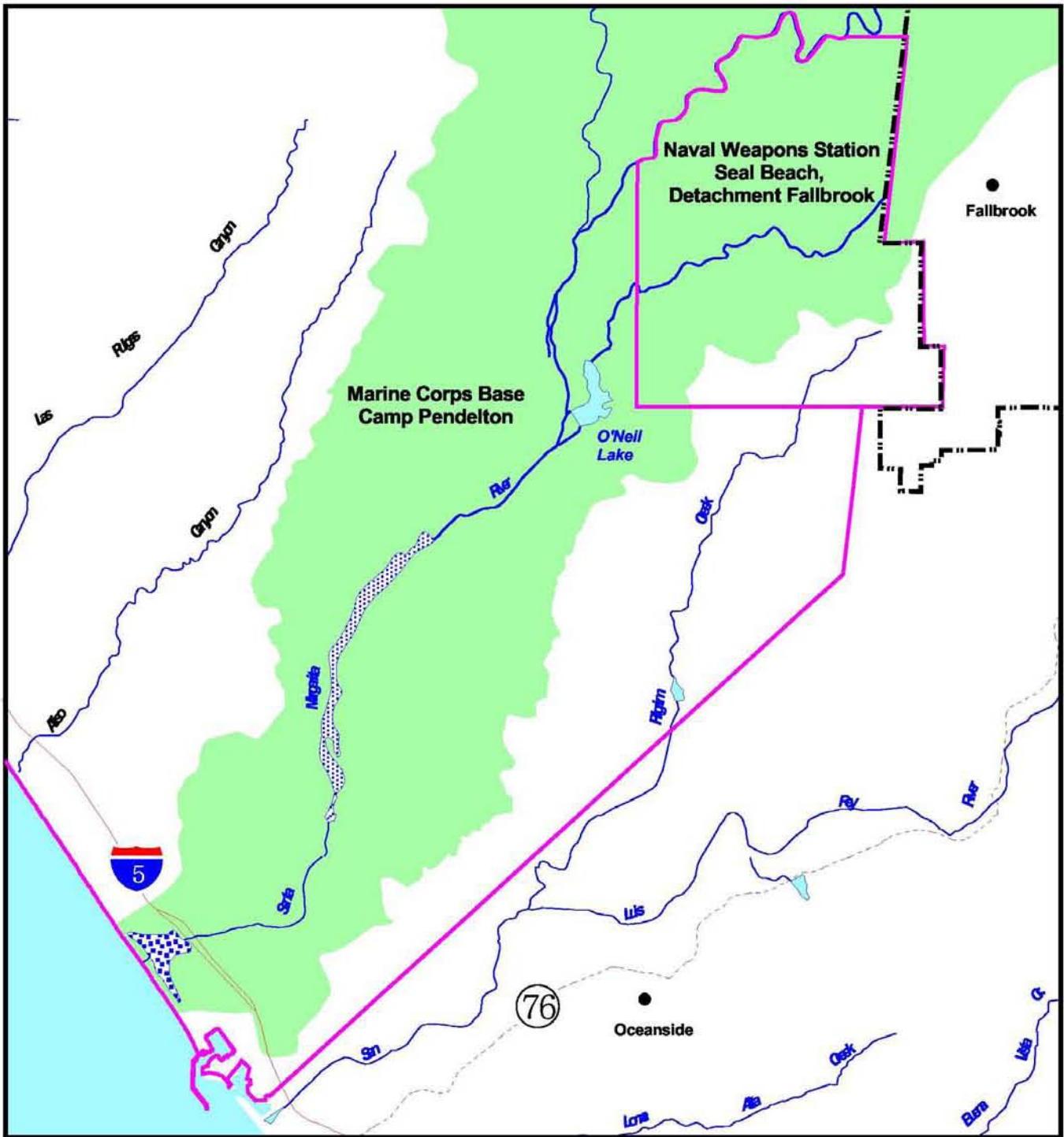
The alluvial basin located below the confluence of the Santa Margarita River and De Luz Creek is further divided into three separate sub-basins: the Upper Ysidora, Chappo, and Lower Ysidora sub-basins (Figure 1-4). The Upper Ysidora sub-basin is the most up-stream of the three basins and is characterized by coarse sediments, consisting mostly of sands and gravels. The Chappo sub-basin, located adjacent to the Upper Ysidora sub-basin, consists of sands, gravels and clays, and represents the largest of the three sub-basins. The farthest downstream sub-basin is the Lower Ysidora sub-basin, consisting predominately of sands and clays, representing the least ground-water productive of the three sub-basins. The three sub-basins range in width from less than one half mile in the Upper and Lower Ysidora sub-basins to over two miles for the Chappo sub-basin.

The Fallbrook PUD is located approximately 5 miles northeast of the Upper Ysidora sub-basin and does not contain large alluvial basins that may be used to produce ground water. Presently, the Fallbrook PUD’s access to local ground-water supplies is limited to the shallow alluvial fill beneath the Santa Margarita River upstream of the Base boundary. The alluvial material found along the Santa Margarita River, within the boundaries of the Fallbrook PUD, are limited to 200 yards in width and approximately 30 to 50 feet in depth. Although limited supplies of ground water have historically been produced from shallow ground-water wells, the



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PROJECT VICINITY MAP AND STUDY AREA

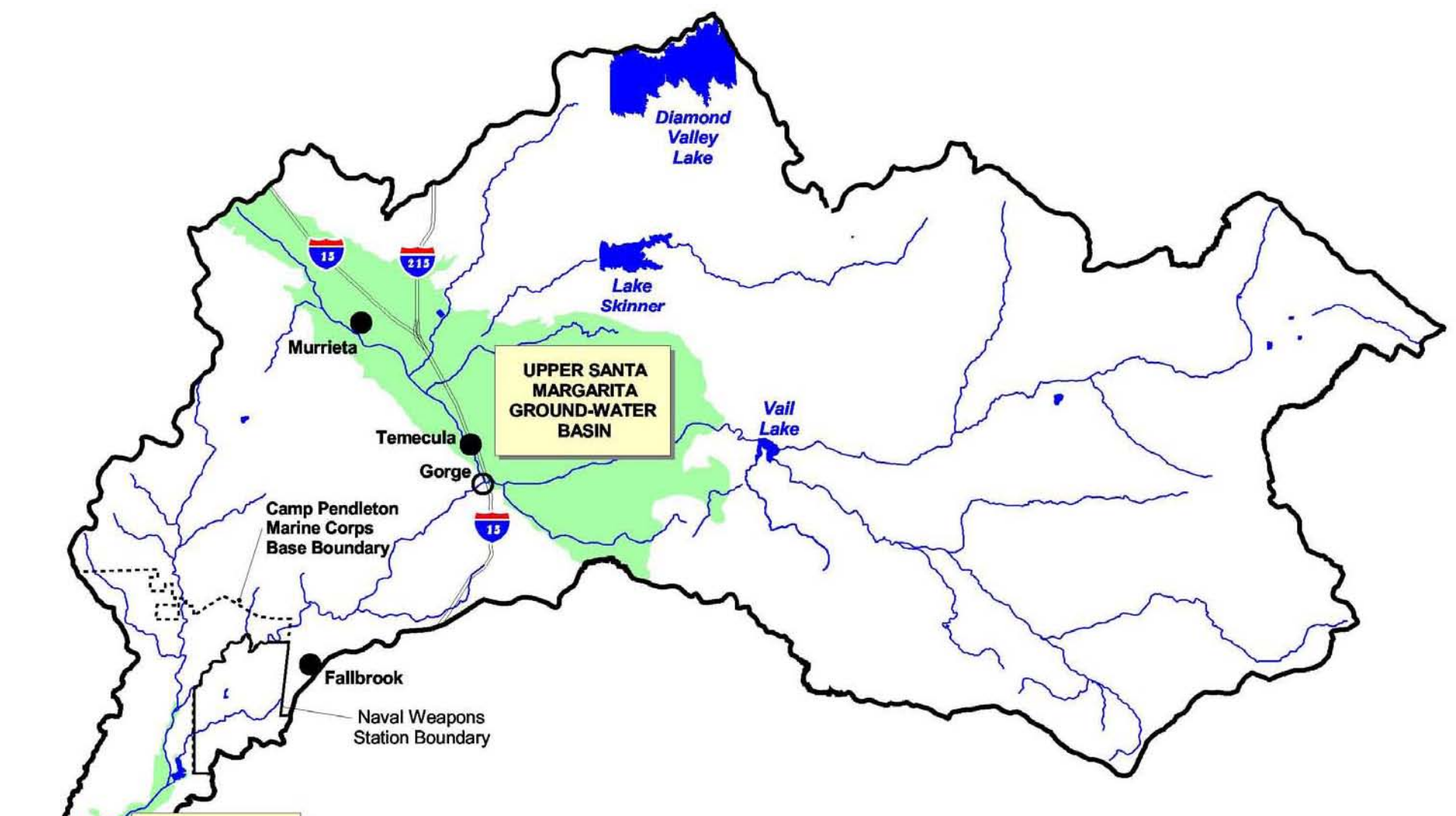


-  Fallbrook Utility District
-  Military Boundary
-  Streams
-  Intermittent stream
- Roads**
-  Class 1
-  Class 2
-  Cities
-  SMR Watershed
-  Project Study Area
-  Intermittent lake
-  Inundation area
-  Island
-  Lake
-  Marsh/Wetland/Swamp
-  Ocean
-  Ocean/Bay/Estuary
-  Reservoir
-  Stream
- Wash

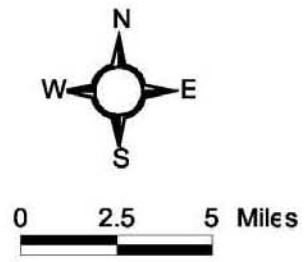


DETAILED MAP OF PROJECT STUDY AREA





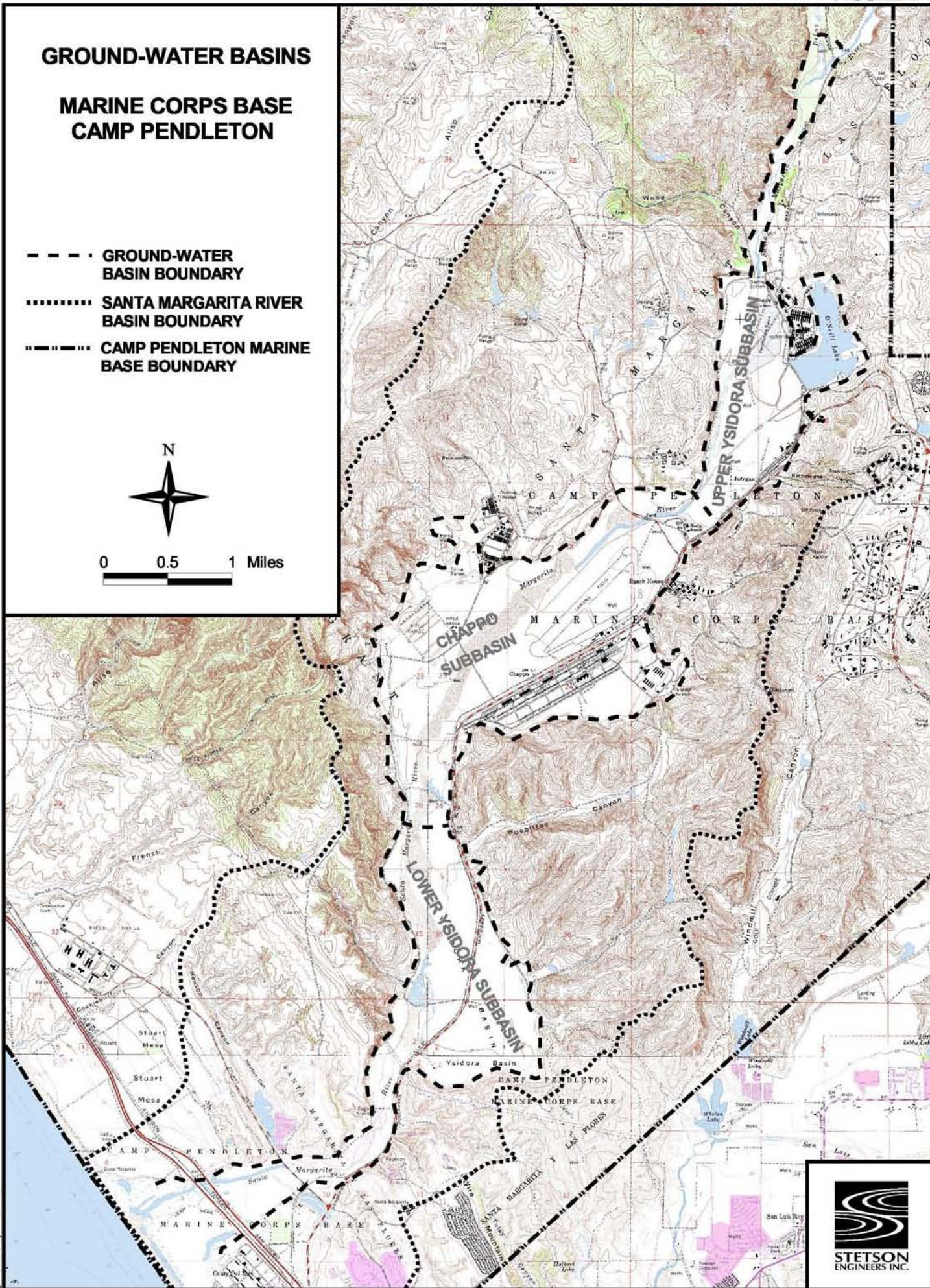
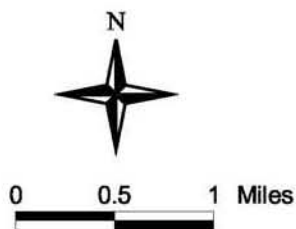
**GROUND-WATER BASINS IN THE
SANTA MARGARITA RIVER WATERSHED**



GROUND-WATER BASINS

**MARINE CORPS BASE
CAMP PENDLETON**

- - - GROUND-WATER BASIN BOUNDARY
- SANTA MARGARITA RIVER BASIN BOUNDARY
- CAMP PENDLETON MARINE CORPS BASE BOUNDARY



Fallbrook PUD does not currently extract surface or ground water from the Santa Margarita River. The domestic, agricultural, and commercial water demands within the Fallbrook PUD are exclusively met by imported water supplies purchased from the San Diego County Water Authority (CWA). Based on records published by the Santa Margarita River Watermaster's office, 15,983 acre-feet of water was purchased from the CWA during water year 2000.

Except for the Naval Weapons Station, the Base relies exclusively on ground water to supply two separate and unconnected water systems, the northern and southern water systems. The northern water system draws from ground-water wells in the San Mateo and San Onofre basins. The Base's southern water system relies on ground-water supplies from the Santa Margarita and Las Pulgas basins. The total domestic, agricultural and military water demand for the southern water systems was 7,061 acre-feet during water year 2000, all of which was supplied by the three sub-basins in the Santa Margarita Watershed. The NWS imported 104 acre-feet from the CWA via the Fallbrook PUD.

1.4 PERMITS AND WATER RIGHTS

Beginning in the 1920s, the Fallbrook PUD began investigations in the upper watershed to create a dependable source of water to meet its growing domestic and agricultural demands. After years of studies in the 1920s and 1930s, the Fallbrook PUD pursued investigations to construct a dam in the lower watershed near the confluence of the Santa Margarita River and Sandia Creek. Following further investigations with the United States Bureau of Reclamation (USBR) and the Base, the Fallbrook PUD applied for water rights permits to divert and store water from the Santa Margarita River. Issued in 1946 and 1947, the Fallbrook PUD was granted three 10,000 acre-foot permits (Table 1-1) for the diversion and storage of water from the Santa Margarita River at the proposed Fallbrook Reservoir site.

In 1963, the state issued a 165,000 acre-foot permit to the United States to divert and store water from the Santa Margarita River. The water was to be used in a two dam project for the Fallbrook PUD and the Base, termed the Santa Margarita Project. The Santa Margarita Project consisted of the 36,500 acre-foot Fallbrook Dam and Reservoir; the 142,950 acre-foot De Luz Dam and Reservoir; the Fallbrook Pumping Plants and Conveyance Line; the Cross-Base Aqueduct and Pumping Plants; recreation and fishing facilities; and wildlife conservation and enhancement management areas. The average project yield varied from 10,400 AF under initial conditions to 11,500 AF under 2020 conditions. Sixty percent of the yield was allotted to Camp Pendleton and forty percent to the Fallbrook PUD.

TABLE 1-1
SELECTED APPROPRIATIVE WATER RIGHTS
SANTA MARGARITA RIVER BASIN
PERMITS AND LICENSES

Application Number	Current Status	Owner	Date Filed	Storage Site	Annual Amount (AF)	Storage Period
11518	Permit	Rancho California Water District	08/19/46	Vail Reservoir	40,000	11/01 – 04/30
11587	Permit	Bureau of Reclamation	10/11/46	Fallbrook Reservoir	10,000	01/01 – 12/31
12178	Permit	Bureau of Reclamation	11/28/47	Fallbrook Reservoir	10,000	01/01 – 06/01
12179	Permit	Bureau of Reclamation	11/28/47	Fallbrook Reservoir	10,000	01/01 – 06/01
21471 A	License	U.S. Navy	09/23/63	Underground	4,000	10/01 – 06/30
21471 B	Permit	Bureau of Reclamation	09/23/63	De Luz Reservoir	165,000	01/01 – 12/31

The USBR completed the Final Environmental Impact Statement (USBR, 1971) for the proposed Santa Margarita Project in 1971. Eventually, following additional studies in the 1970s and 1980s, it was determined that the Santa Margarita Project was not feasible and other means should be used to secure additional water supplies and implement flood control measures using other methods (Leedshill/Herkinoff, 1989). Since that time, the Fallbrook PUD has worked to perfect one of its three 10,000 acre-foot water rights permits by transferring the point of diversion to Lake Skinner. The Base has also worked to perfect Permit 15000 by investigation of various alternatives throughout the watershed as described in the Permit 15000 Study (Stetson Engineers, 2001).

The two remaining water rights permits held by the Fallbrook PUD and the single permit held by the Base provide the legal basis for appropriating water for a joint conjunctive use project. The use of these permits in a joint Fallbrook/Camp Pendleton project would also provide the means for the two parties to reach a physical solution to their water rights dispute as agreed upon in the 1968 Memorandum of Understanding (MOU). In addition to the settlement of the existing litigation, the goal of a conjunctive use project would be to provide a dependable supply of local water for the Fallbrook PUD while allowing the Base to meet its domestic, agricultural, and military water requirements.

1.5 CONJUNCTIVE USE PROJECT GOALS

Implementation of conjunctive use projects allows water managers to satisfy a multitude of legal, economic, and ecological factors associated with developing water supplies. The development of a conjunctive use project (Project) between the Fallbrook PUD and Camp Pendleton creates an opportunity to satisfy not only future water demands and economic factors associated with the purchasing of imported water, but also the ecological demands of sensitive habitat that depends on both the surface and ground water in the Santa Margarita River Basin. The conjunctive use project described herein seeks to expand the beneficial use of water from the Santa Margarita River for domestic, municipal, agricultural, military, and ecological demands for both parties.

A conjunctive use project between the Fallbrook PUD and Camp Pendleton would rely on maximizing ground-water extractions from the lower Santa Margarita basin located on the Base. Due to the seasonal supply of surface water from the Santa Margarita River, ground-water production from the lower basin would be closely managed to maximize the amount of water that may be diverted from the river for recharge to the lower basin. In order to successfully operate a conjunctive use project in the lower Santa Margarita Basin, ground-water extractions are maximized in the fall and winter months in order to create storage space in the aquifer for the diversion and recharge of wintertime flows. Simultaneously, ground-water levels and surface flow are carefully monitored for protection of the ecology that relies on maintenance of the riparian habitat.

An additional element included in the Project provides for the recycle and reuse of tertiary treated wastewater effluent from the Fallbrook sewage treatment plant. The use of these waters are managed to support habitat in the lower basin while maintaining elevated ground-water pumping rates during the dry summer and fall months. The inclusion of Fallbrook's wastewater in the Project represents an additional supply of water to the basin that normally would have been discharged to the ocean without benefit to man or habitat. As described later in this document, wastewater releases from the Fallbrook PUD, or other third parties, are managed such that they may improve water quality and protect the environment during dry months and hydrologically dry years.

The link that allows for a successful conjunctive use project between the Fallbrook PUD and the Base is a conveyance pipeline that extends from the ground-water producing lower basin to the Fallbrook PUD's boundary. The conveyance pipeline represents a connection to local ground-water supplies for the Fallbrook PUD and a source of access to imported water supplies for the Base. Although the Project is designed to meet all of the Base's water demand from ground water in the lower basin, the conveyance pipeline is designed to reverse flow direction and allow for deliveries of imported water supplies during periods of extended drought or other

emergencies. The design and cost of the conveyance pipeline between the Base and the Fallbrook PUD is addressed in the NBS Lowery Report.

2.0 OVERVIEW OF PERMIT 15000 FEASIBILITY STUDY

In October 1999, the United States Marine Corps Base Camp Pendleton commenced a study to determine the feasibility of a water supply project using an existing water rights permit to divert and use water from the Santa Margarita River. Following engineering and economic studies of various physical solutions, Camp Pendleton published the Santa Margarita River Recharge and Recovery Enhancement Program in March of 2001 (Permit 15000 Study). The Permit 15000 Study outlined four alternatives, including a “no project” alternative, describing the required facilities, project yield, and the cost of developing Permit 15000. A summary of the Permit 15000 Study is provided in this chapter to present the background for the projects and nomenclature used throughout this Study.

The Bureau of Reclamation currently holds Permit 15000 for Camp Pendleton allowing for the diversion and storage of up to 165,000 AF of surface water per year from the Santa Margarita River. Originally issued in 1965, Permit 15000 was intended to be used to appropriate water from the Santa Margarita River for storage in the Santa Margarita Project’s De Luz Reservoir, located on the main stem of the Santa Margarita River. Following the completion of the 1989 Basewide Water Requirement/Availability Study, it was concluded that the two-dam Santa Margarita Project was no longer a feasible solution to water supply.

The primary goal of the Permit 15000 Study was to analyze the feasibility of alternatives and projects that would utilize surface water from the Santa Margarita River, appropriated under Permit 15000. Equally important as the primary purpose of this project, an additional goal that was addressed in this study included the review of the existing diversion facilities for the continued use and diversion of water under Camp Pendleton’s existing water rights. Continued urban and agricultural development upstream of Camp Pendleton will likely jeopardize existing water rights licenses and permits to water of the Santa Margarita River, necessitating the need to perfect Permit 15000 and demonstrate the continued appropriation and beneficial use of water diverted under the Base’s existing rights.

2.1 LEGAL BACKGROUND

In 1924, Rancho Santa Margarita y Las Flores brought suit against the Vail Ranch, predecessors to the Rancho California Water District (RCWD). At that time, the two ranches were the only major water users on the Santa Margarita River and its tributaries. In 1930, after 444 court days, 55,171 pages of transcripts, and 2,201 exhibits the court rendered its decision. On appeal by the Vail Ranch, the California Supreme Court overturned the 1926 decision and a new trial was ordered. In October 1930, an injunction was issued to Vail Rancho to reduce ground-water pumping and the adverse impact it caused to the flow of the Santa Margarita River.

In the 1930s, following the Supreme Court's order to retry the case, both litigation and negotiations between the two parties re-commenced. The result was a Stipulated Judgment issued in 1940 allocating 2/3 of the natural water crop of the Santa Margarita River to Rancho Santa Margarita y Las Flores and 1/3 to the Vail Ranch. As successors in interest to these parties, the United States and Camp Pendleton are allocated 2/3 of the natural flow of the Santa Margarita River while the RCWD retains the remaining 1/3 share of the river. In addition to the division of streamflow between the two parties, the 1940 Stipulated Judgment also addressed issues such as minimum base flows, ground-water pumping, and surface storage of flood flows.

One of the many provisions of the 1940 Stipulated Judgment established a minimum flow requirement of 3 cfs at the head of the Santa Margarita River between May 1st and October 31st of each year. The minimum flow of the river helped to provide surface water to the Santa Margarita y Las Flores Ranch and two other interveners to the state lawsuit. Although there are many other provisions of the 1940 Stipulated Judgment, the division of the natural flows of the Santa Margarita River and the establishment of a base flow during the summer irrigation season provided a basis for the recent settlement discussed in Section 2.1.4 below.

2.1.1 United States v Fallbrook Public Utilities District

In 1945, investigations toward a more dependable water supply were initiated by the Fallbrook Public Utility District, the Department of the Navy, and the Bureau of Reclamation. A tentative agreement to build a reservoir at the De Luz dam-site was reached between the parties in January 1949. Before a final agreement was reached, the United States brought suit against the Fallbrook PUD in 1951 to settle its title to the waters of the Santa Margarita River. The defendants to this lawsuit included not only the Fallbrook PUD, but also approximately 6,000 landowners in the Santa Margarita River basin. The State of California acted as an intervener for its own rights as well as for the rights of its citizens.

On April 6, 1966, the District Court issued its Modified Final Judgment and Decree; adopting 44 Interlocutory Judgments and reinstating the 1940 Stipulated Judgment. The District Court retains continuing jurisdiction of all surface waters and supporting ground waters of the Santa Margarita River system. Water extracted from lands where subsurface flow does not add to, contribute to and support the Santa Margarita River stream system was found to be outside the Court's jurisdiction.

2.1.2 The 1968 Memorandum of Understanding

In 1968, following seventeen years of litigation in Federal Court, the division and allocation of water between the United States and the Fallbrook PUD had yet to be established. Therefore, the United States and the Fallbrook PUD entered into an agreement to jointly pursue a

physical solution to the litigation and share the water produced by the project. Under the terms of the agreement, referred to as the 1968 Memorandum of Understanding (MOU), the United States, through the Department of the Interior, agreed to conduct a feasibility study of the two-dam Santa Margarita Project.

Based on the 1968 MOU, if the project was determined to be feasible, the yield of the project would be divided 60 percent to the United States and 40 percent to the Fallbrook PUD. The 4,000 AFY apportioned to Camp Pendleton through its existing 1963 license would continue to be delivered through the De Luz Dam (BOR, 1971). The Base would be allowed to fulfill all their water rights regardless of project yield, granted that the Fallbrook PUD would receive credit when their share of the project yield was less than 40%.

2.1.3 The Santa Margarita Project

The Santa Margarita Project consisted of the 36,500 acre-foot Fallbrook Dam and Reservoir; the 142,950 acre-foot Deluz Dam and Reservoir; the Fallbrook Pumping Plants and Conveyance Line; the Cross-Base Aqueduct and Pumping Plants; recreation and fishing facilities; and wildlife conservation and enhancement management areas. The average project yield varied from 10,400 AF under initial conditions to 11,500 AF under 2020 conditions. Sixty percent would go to Camp Pendleton and forty percent to Fallbrook PUD.

As part of the Santa Margarita Project, a cross-base aqueduct was designed to deliver water to training camps in the central and northern part of the Base through an 18-mile pipeline varying in diameter from 10 inches to 24 inches. The maximum capacity of the aqueduct would be 10 cfs near the dam site, decreasing to 2.5 cfs near the terminus. The Fallbrook conveyance line consisted of 1.6 miles of aqueduct, pumping plants, and other related facilities to lift the water 560 vertical feet from the toe of the Fallbrook Dam to a distribution tank. The maximum capacity of the pipeline and pumping facilities was designed to be 28 cfs.

Approximately 450 acres of private land near the Fallbrook Reservoir site were to be acquired for recreation facilities to include campsites and related structures, fishing and boat launching facilities, access roads and parking, and other related facilities. Two plans were developed for fish and wildlife management and conservation areas. The first consisted of 1,800 acres of public domain and private land while the second totaled over 3,000 acres of both public and private land.

2.1.4 Recent Settlement with Rancho California

The 1924 State Court water rights case culminated with the 1940 Stipulated Judgment, which was eventually upheld by the Federal Court in 1968. This established the division of

water between Camp Pendleton and the RCWD, successors to the original plaintiff and defendant, respectively. Based on the Stipulated Judgment, Camp Pendleton would receive 2/3 of the natural flow of the Santa Margarita River while the RCWD would be allocated the remaining 1/3 share of the river. As previously discussed, the 1940 Stipulated Judgment and the 1966 Modified Final Judgment and Decree allowed for other provisions of water management and allocation, including the construction of storage reservoirs, pumping of ground-water basins, and continuing jurisdiction of ground water that supports and contributes to the flow of the Santa Margarita River.

Referred to throughout the remainder of the feasibility study as “Augmented Flows,” the RCWD will supplement daily streamflow in the Santa Margarita River in order to replicate, to the extent agreed to in the Agreement, two-thirds of the natural baseflow. The Agreement is structured such that baseflows will match monthly variations as well as variations due to changes in hydrologic conditions. Four different hydrologic conditions have been established that prescribe flows for “Extremely Dry,” “Below Normal,” “Above Normal” and “Very Wet” conditions. The flow requirements to the Santa Margarita River are further defined for Winter and Non-Winter periods for each hydrologic condition. While a single flow requirement has been established for the January through April winter period, monthly streamflow requirements have been established for the May through December non-winter period.

The analyses provided in the Permit 15000 Study show the importance of the augmented flows to both the Base water supply and riparian ecological uses. Elevated base flows in both the summer and winter months will provide the Base with dependable water supplies that can be managed to meet existing water rights. The Agreement will provide augmentation to the Santa Margarita River varying between 3 cfs and 11.5 cfs, with a maximum annual augmentation not to exceed 4,000 AF. In addition to the daily augmentation flows, the Base will have the ability to draw 2,250 AFY from a ground-water storage bank during periods of extreme drought and/or emergencies. The augmentation of water to the Santa Margarita River is an important aspect to the success of the feasibility of a joint project, allowing both parties to produce ground water to satisfy its current and future needs.

2.2 STUDY AREA DESCRIPTION

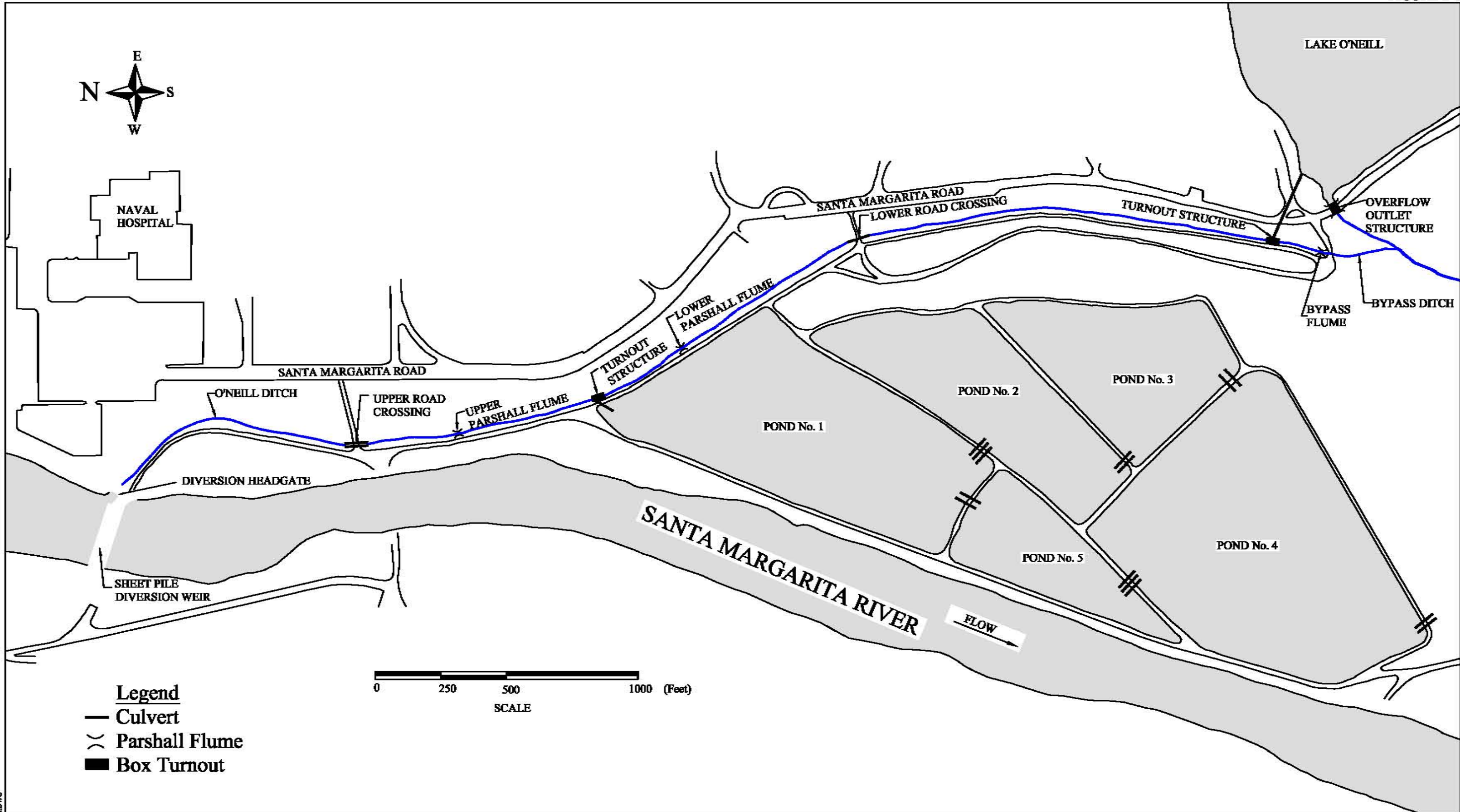
The 744 square mile Santa Margarita River Basin lies within the counties of San Diego and Riverside in southern California. Hydrological conditions within the basin are controlled by wintertime tropical and northern pacific storm events; and, to a minor degree, summer monsoon events. While most of the precipitation occurs as rainfall throughout the watershed, snowfall may occur in the higher mountain ranges located in the upper reaches of the watershed. The confluence of the Murrieta and Temecula Creeks, which drain the upper parts of the watershed, forms the 27-mile-long Santa Margarita River, which flows to the Pacific Ocean.

Over 60 square miles of the Santa Margarita River Basin are located in the southern portion of Camp Pendleton. The Santa Margarita River flows from the coastal mountains to the coastal floodplain that begins near the Naval Hospital. The Santa Margarita River experiences extreme peak events during winter rains and minimum base flows during the dry summer months, typical of many southwestern stream systems. The following sections describe the physical facilities on Camp Pendleton that are used to divert, recharge, and store water from the Santa Margarita River.

2.2.1 Existing Diversion Facilities

Information regarding the size and capacity of Camp Pendleton's surface water diversion and ground-water recharge facilities was obtained from Camp Pendleton's Office of Water Resources, field investigations conducted by Stetson Engineers, and previous studies and reports prepared by others. The general location of the existing diversion weir, ditch, and ground-water recharge facilities is shown on Figure 2-1. The diversion weir diverts surface flow of the Santa Margarita River into the O'Neill Ditch, which carries flows to both the ground-water recharge ponds and Lake O'Neill.

A sheet pile weir located in the Santa Margarita River channel allows water to be collected and diverted into the O'Neill ditch through an existing headgate and diversion structure located on the eastern bank of the river. The O'Neill Ditch conveys water either to the five ground-water recharge ponds or Lake O'Neill, depending on the time of year, available supply, and required demand. During the diversion season, a series of control structures and measuring devices allows Base personnel to manage, control and measure the diversion to each of the different facilities. The operation of each of these facilities is discussed in the following sections of this report. Table 2-1 summarizes the existing diversion facilities on Camp Pendleton that are used to divert water from the Santa Margarita River.



Diversion and Ground-Water Recharge System - Existing Facilities
Santa Margarita River

TABLE 2-1
Summary of Existing Facilities
Santa Margarita River Diversion and Ground-Water Recharge System

FACILITY	DESCRIPTION	CAPACITY
<u>CONVEYANCE FACILITY</u>		
River Diversion Dam	Steel sheet pile weir, 283 feet in length	----
River Diversion Inlet	60-inch × 48-inch slide gate mounted on concrete headwall 65-inch × 40-inch × 45-foot arch corrugated metal pipe	75 CFS
<u>O'NEILL DITCH</u>		
Earthen Channel	Unlined earth ditch approximately 5,100 feet in length	73-174 CFS
Road Crossing (Double Culvert)	36-inch corrugated metal pipe and 36-inch reinforced concrete pipe	60 CFS
Upper Flume	5-foot Parshall flume; concrete block and concrete lined	105 CFS
Recharge Pond Turnout Structure	Concrete turnout structure with two 48-inch slide gates	82 CFS
Lower Flume	3-foot Parshall flume; concrete block and concrete lined	62 CFS
Road Crossing (Single Culvert)	42-inch corrugated metal pipe	39 CFS
Lake O'Neill Turnout Structure	Concrete turnout structure with 24-inch slide gate	20 CFS
<u>STORAGE FACILITIES</u>		
Ground-Water Recharge Ponds	5 ground-water recharge ponds totaling 49 acres	260 AF
Lake O'Neill	Lake formed by earthen levee	1,200 AF

**Note: Capacity of conveyance facilities calculated based on river water levels equal to crest height of the sheet pile weir.*

2.2.2 Santa Margarita River Diversion Structure

The existing Santa Margarita River diversion structure was constructed in 1982 and consists of a steel sheet pile weir approximately 280 feet long. The sheet pile weir was constructed as a more permanent structure to replace previous rock weir designs that washed out during large flood events. According to the 1982 construction drawings, the sheet piles are 30 feet in length and were driven to a depth that fixed the weir crest elevation at 115.5 feet.

Water impounded behind the sheet pile weir may be diverted through a 60-inch by 48-inch (span by rise) slide gate mounted on a concrete headwall on the eastern bank of the river. The existing slide gate was constructed as a result of the Department of Public Work's 1970 plans to repair the flood damaged diversion system. The slide gate is manually operated to pass river diversions through a 45-foot long section of arch corrugated metal pipe (CMP) having dimensions of 65-inches by 40-inches. The invert elevation of the arch CMP at the entrance of the diversion is 112.1 feet according to the 1982 construction drawings. The capacity of the arch CMP diversion pipe is estimated to be 75 cubic feet per second (cfs) with a water surface elevation 3.4 feet (115.5 feet - 112.1 feet) above the pipe inlet.

2.2.3 Lake O'Neill

Lake O'Neill is a man-made reservoir formed by an earthen levee located on Fallbrook Creek, a tributary to the Santa Margarita River. The lake is filled primarily from Santa Margarita River diversions conveyed to the lake through the O'Neill Ditch. The capacity of the Lake is approximately 1,200 AF. The levee that impounds water in Lake O'Neill and the diversion canal from the river to the lake were constructed in 1883 as part of a farm system (Leedshill-Herkenhoff, 1988). The water rights associated with Lake O'Neill carry a priority date of 1883 and stipulate a maximum diversion rate to the lake at 20 cfs, not to exceed 1,500 AF (including evaporation losses) annually.

Diversions from O'Neill Ditch to the lake are made through a concrete turnout structure and a 24-inch reinforced concrete pipe located at the lower end of O'Neill Ditch. Adjacent to the 24-inch pipe that fills the lake, is a concrete overflow outlet structure with four 60-inch reinforced concrete pipes (RCP). The overflow outlet structure returns reservoir spills to a ditch that eventually drains back to the river. Lake water can also be returned to the river through an outlet pipe located in the southern corner of the lake.

2.2.4 Percolation Ponds

The Santa Margarita River diversion system conveys water to either Lake O'Neill or to ground-water recharge ponds consisting of five interconnected ponds. The ground-water recharge pond system was constructed between 1955 and 1962 and Santa Margarita River diversions to the recharge ponds were first recorded in October 1960. The total surface area of the five-pond system is approximately 49 acres and the capacity of the ponds is estimated to be approximately 260 AF. Table 2-2 summarizes the five existing ground-water recharge ponds.

TABLE 2-2
Capacity of Existing Ground-Water Recharge Ponds
Camp Pendleton Marine Corps Base

Pond Number	Surface Area (Acres)	Average Water Depth (Feet)	Volume (AF)
1	13.9	3.2	44.5
2	7.0	6.1	42.7
3	7.0	8.4	58.8
4	16.5	5.4	89.1
5	4.7	5.1	24.0
Total	49.1		259.1

** Approximate average depth of existing ponds based on 1962 survey map*

The capacity of each pond shown in the table above is based on estimating the average pond depths from information provided on a 1962 survey map, and multiplying the estimated average pond depths by their respective pond areas. The actual bottom elevation of each pond will likely vary from the 1962 survey map due to the operation and maintenance practice of scraping and disking the soil in the ponds as well as sediment accumulating in the ponds due to sediment laden surface water. The exact dates that maintenance has been performed on the ponds have not been recorded and were not available for review.

The recharge ponds are formed by sand levees approximately 10-feet in height and are interconnected by buried non-gated CMP pipes that pass flow, uncontrolled, between recharge ponds. The locations of the CMP pipes that are currently available to pass water between recharge ponds were previously shown in Figure 2-1. The flow rate through each CMP varies depending on water levels in each pond and diversion rate from the Santa Margarita River.

Specific flow rates between each pond were not identified since they do not represent a restriction in the capacity of the system.

Under the current recharge pond operations, water is diverted from O'Neill Ditch into the recharge pond system through a single 79-inch by 49-inch CMP pipe at the head of Pond No. 1. When the water level in Pond No. 1 rises to the pond's outlet pipe invert elevations, flow passes ("spills") from Pond No. 1 into either Pond Nos. 2 or 5. The pipe invert elevations from Pond No. 1 to Pond No. 2 are slightly lower (3-4 inches) than the pipe invert elevations from Pond No. 1 to Pond No. 5, therefore, water first spills from Pond No. 1 into Pond No 2 before spilling into Pond No. 5.

Water filling above the invert elevation of the outlet pipes from Pond No. 2 spills into Pond No. 3 and water filling above the outlet pipes from Pond No. 3 spills into Pond No. 4. Similarly, water filling above the invert elevation of the outlet pipes from Pond No. 5 spills into Pond No. 4. At the lower end of Pond No. 4 (the last pond in the system), two 30-inch CMP pipes exist to return spills from Pond No. 4 to the river. Based on the recollection of the Office of Water Resources staff, Pond No. 4 only spilled in March of 1983 and has only filled twice since that time (Malloy, 2000).

2.3 PROJECT ALTERNATIVES

The Permit 15000 Study developed various project alternatives that provided for additional surface diversion and ground-water yield from Camp Pendleton's aquifers. Prior to development of the project alternatives, the Permit 15000 Study identified maintenance and repair projects required to restore the existing diversion facilities to the performance that they were originally designed to meet. Based on a performance review of the historical diversions, it was determined that the existing headgate was required to be relocated and rehabilitation to the existing recharge ponds was required for the Base to meet the original design capacity of the existing diversion facilities. The project alternatives and yields described below assume that the maintenance and repair projects identified in the Permit 15000 Study are completed and operational.

2.3.1 Alternative 1 - No Project

Alternative 1 is considered the "No Project" alternative and provides baseline conditions for comparison to other alternatives. The baseline condition provided in this alternative assumes that all maintenance and repair projects are properly designed and constructed. In addition, Alternative 1 also includes the augmented flows to the Santa Margarita River provided by the 2000 agreement between Camp Pendleton and the Rancho California Water District. The No

Project alternative also assumes that all of the Base's wastewater is exported from the Santa Margarita basin to the Oceanside outfall.

A ground-water model scenario was run to represent baseline conditions under the No Project conditions. Assumptions and conditions of this model included: augmented stream flow, no wastewater discharge to the basin, full diversions to the recharge ponds and Lake O'Neill under the existing license and water right, and historical ground-water pumping. The results of this model run are used to compare impacts from Alternatives 2 through 4 to baseline conditions. The disposition of the wastewater will not change until the completion of the P002 project currently being investigated by Camp Pendleton.

2.3.2 Alternative 2 – Diversion Weir and Ditch Improvements

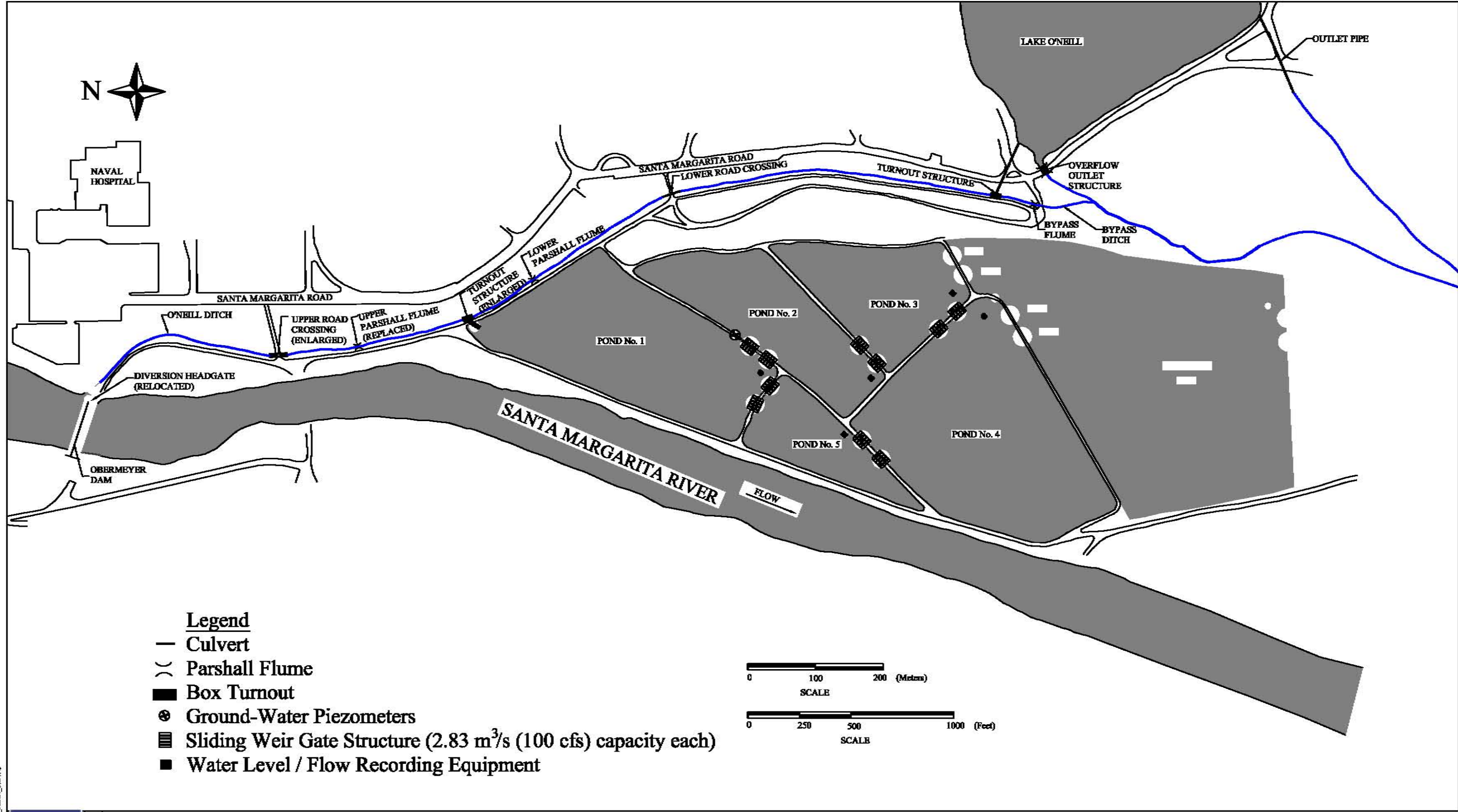
Alternative 2 includes the construction of a new diversion weir, improvements to the existing ditch capacity and expansion of the instantaneous capacity of the head-gate diversion from 60 cfs to 200 cfs. In addition to these improvements, augmented flow from the RCWD agreement is included in the streamflow analysis, and new ground-water wells have been added to increase the extractions from the ground-water basins. This alternative was considered for further investigation because it minimized the impact to the environment, increased diversions from the Santa Margarita River by 8,000 AF, and allowed for 3,000 AFY of additional ground-water production.

Alternative 2 includes the replacement of the existing sheet pile diversion dam with an Obermeyer spillway gate system consisting of a single span five feet high and 280 feet long installed on a concrete foundation. This alternative will also increase the existing instantaneous capacity of the headgate and ditch facilities from approximately 60 cfs to 200 cfs. Additional improvements to the ditch and recharge ponds include a new control structure from the ditch to the ponds and additional control and monitoring structures between each of the five recharge ponds. The upper road crossing will be increased from an instantaneous capacity of 60 cfs to 200 cfs, removing the existing bottleneck on the diversion system.

2.3.3 Alternative 3 – Diversion Weir, Ditch Improvements and Construction of New Recharge Ponds

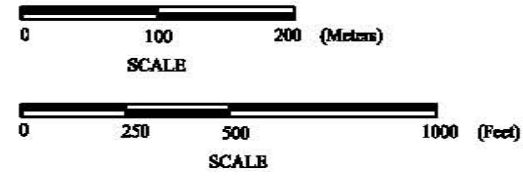
The Alternative 3 project includes the replacement of the existing sheet pile diversion weir on the Santa Margarita River with an Obermeyer Dam, expansion of the diversion headgate, expansion of the existing ditch, improvement to the five existing recharge ponds, and construction of two additional recharge ponds (Figure 2-2). The instantaneous capacity of the O'Neill diversion and ditch will increase from 60 cfs to 200 cfs, allowing the system to capture

FIGURE 2-2



Legend

- Culvert
-) (Parshall Flume
- Box Turnout
- ⊕ Ground-Water Piezometers
- ▨ Sliding Weir Gate Structure (2.83 m³/s (100 cfs) capacity each)
- Water Level / Flow Recording Equipment



**Diversion and Ground-Water Recharge System - Proposed Facilities (Alternative 3)
Santa Margarita River**

higher peak flows and use the available storage in the existing and new recharge ponds. The construction of two new ground-water recharge ponds will increase the available surface water storage on Camp Pendleton by 240 AF. This alternative was considered for further investigation because it minimized the impact to the environment, increased the annual diversions from the Santa Margarita River by 16,300 AFY, and increased average annual ground-water well production by 5,250 AFY.

Similar to Alternative 2, surface water is diverted from the Santa Margarita River to the ground-water recharge ponds at a maximum rate of 200 cfs. The addition of the new recharge ponds will provide the Base with the flexibility to capture a greater percentage of the high flow events that would normally flow to the ocean. Using best management practices, the addition of the new recharge ponds will also allow the Base to maximize the infiltration rate in the recharge basins due to greater flexibility in the movement of water between basins. In addition to all of Alternative 2 facilities and the two additional recharge ponds, Alternative 3 included six new ground-water wells.

2.3.4 Alternative 4 – Diversion Weir, Ditch Improvements, and Construction of New Recharge Ponds and Off-Stream Reservoirs

Alternative 4 includes the construction of a new diversion weir, improvements to the existing ditch capacity, expansion of the instantaneous capacity of the head-gate diversion from 60 cfs to 200 cfs, construction of new recharge ponds, and construction of off-stream reservoir sites and related facilities. Similar to Alternatives 2 and 3, augmented flow and new ground-water wells have been included in this alternative. This alternative was considered for further investigation because it provided seasonal storage, increased the annual amount of water available for diversion by 21,000 AFY and provided water for drought relief during extended dry periods. This alternative is expected to increase the annual ground-water production by 6,000 AFY.

The facilities associated with the off-stream storage reservoir will include a 40 cfs pump station located adjacent to recharge Pond No. 6 and a 36-inch pipeline from the pump station to the proposed reservoir. The pump station will deliver surplus river diversions from Pond No. 6 to an off-stream reservoir located in the upper reaches of Pilgrim Creek, approximately two miles west of the ground-water recharge pond system. The location selected for the off-stream storage reservoir is the result of a reconnaissance level investigation that considered numerous potential reservoir sites and evaluated each site in terms of storage capacity, construction cost, environmental concerns, and project feasibility

The Alternative 4 reservoir is designed to have a storage capacity of approximately 4,800 AF with a water surface elevation at 460 feet mean sea level (msl). The surface area of the reservoir with a water level at capacity will be approximately 55 acres. The proposed reservoir will be filled primarily with surplus river water diversions pumped directly from surface storage in the newly constructed ground-water recharge Pond No. 6. Water pumped directly from the pond will be conveyed in a buried steel pipeline running generally east along the southern boundary of the Fallbrook Naval Annex. The pumping plant will lift Santa Margarita River water 360 feet through approximately 12,000 feet of pipeline. The capacity of the pipeline will be approximately 40 cfs.

2.3.5 Alternatives 5 through 8

Four additional alternatives were identified, but dropped from further review due to environmental or economic limitations. Alternative 5 included the use of Aquifer Storage and Recovery (ASR) wells to inject Santa Margarita River water in various geographic locations of the ground-water basin. Alternative 6 reviewed the recharge and recovery of storm water in the Murrieta-Temecula ground-water basin. Alternative 7 addressed the enlargement of Lake O'Neil to store additional flood-water of the Santa Margarita River. Alternative 8 considered the construction of on-stream reservoir sites for the purpose of diverting large flood events from the Santa Margarita River. Each of these four alternatives was dropped from further investigation due to environmental and/or economic issues that constrained the feasibility of the project.

Results and Conclusions

A summary of the facilities, cost, and annual ground-water yield of each of the four alternatives is presented in Table 2-3. Each of the three projects' facilities include construction of a new Obermeyer diversion weir and improvement to the existing ditch capacity. As development in the upper portions of the watershed continues in the future, the Base will need to divert higher quantities of water during shorter periods of time. Each of the three project alternatives listed below will allow the Base to meet its future water demand as changing conditions develop in the upper watershed.

TABLE 2-3: Summary of Alternatives 1 Through 4

Project	Alternative 1	Alternative 2	Alternative 3	Alternative 4
New Diversion Dam		●	●	●
Improve Existing Ditch Capacity		●	●	●
New Recharge Ponds			●	●
New Off-Stream Storage Reservo				●
Alternative Capital Cost (\$ Mil)	0	3.5	5.5	47.7
Additional Median Ground-Water Yield (AFY)	N/A	3,000	5,250	6,000
Annual Cost Per Acre-Foot	N/A	\$120	\$100	\$730

Note: Annual Cost per Acre-Foot based on the Alternative's Capital Cost and incremental Additional Median Ground-Water Yield above 8,800 AFY.

A summary of the water rights for the four alternatives, including the increase in average annual project yield is shown in Table 2-4. The row labeled Maximum Existing License Yield represents the maximum water that Camp Pendleton may divert from the Santa Margarita River under license 21471A. The Maximum Pre-1914 Right Yield shows the maximum water, not including evaporation losses, which may be diverted to Lake O'Neill for use as a water supply. The Maximum Alternative Riparian Water Right Yield varies between 3,200 AFY, as determined by historical water use, and 3,700 AFY based on build-out conditions in the Santa Margarita River Basin. Finally, the Maximum Additional Ground-Water Yield describes the annual median amount of water, for each alternative, that could be developed under Permit 15000. The Total Annual Project Yield represents the total amount of water that may be recovered from the ground-water aquifers on Camp Pendleton for each alternative. Due to varying hydrologic conditions and the availability of water, the maximum diversion under any one water right or license may not be realized every year. The Total Annual Project Yield represents the long-term median annual ground-water yield of each alternative, not the total of all water rights and licenses held by Camp Pendleton. While some years may provide available water for maximum diversion under license 21471A and Permit 15000, drier than normal hydrologic conditions may prevent the Base from pumping its maximum riparian water right. During conditions similar to those described above, the riparian water right would be not be extracted from the ground so that it may remain in the aquifer and allowed to prevent seawater intrusion in the Lower Ysidora sub-basin.

TABLE 2-4:**Summary of Water Rights and Project Yield**

Water Right	Alternative 1 (AFY)	Alternative 2 (AFY)	Alternative 3 (AFY)	Alternative 4 (AFY)
Maximum Existing License Yield	4,000	4,000	4,000	4,000
Maximum Pre-1914 Rights Yield	1,100	1,100	1,100	1,100
Maximum Alternative Riparian Water Right Yield	3,200	3,700	3,700	3,700
Minimum Additional Ground-Water Yield (AFY)	N/A	3,000	5,250	6,000
Total Annual Project Yield	8,300	11,800	14,050	14,800
Maximum Additional Surface Water Diversion (AFY)	N/A	8,600	16,300	21,000

Note: The Minimum Additional Ground-Water Yield for Alternatives 2, 3, and 4 is based on an existing yield of 8,800 acre-feet per year.

The minimum additional ground-water yield shown in the third to last line is the average annual increase in recoverable ground water with respect to Alternative 1. Alternative 2 projects increase the median annual ground-water yield to a total of 11,800 AFY, representing an increase of 6,300 AFY above the historical ground-water baseline conditions of 5,500 AFY. Similarly, Alternatives 3 and 4 increase total ground-water yield to 14,050 AFY and 14,800 AFY, respectively. Diversions to Lake O'Neill average more than 1,500 AFY, with an average yield of 1,100 AFY after evaporative losses.

The impact of each project with respect to Permit 15000 is measured by the amount of surface water available for diversion from the Santa Margarita River. As shown in Table 2-4, Alternatives 2, 3, and 4 increase the average annual amount of water diverted from the Santa Margarita River by 8,600 AFY, 16,300 AFY, and 21,000 AFY based on the 20-year hydrology from 1980 through 1999. Similar, but opposite in trend, the amount of surface water that infiltrates between the stream and the ground-water aquifer also increases above no project conditions. The ground-water model indicates that the median annual increase in recharge to the ground-water system is 4,600 AFY, 2,800 AFY, and 2,400 AFY for Alternatives 2, 3 and 4, respectively. The reverse trend in infiltration of surface water to ground water between Alternatives 2 through 4 is expected since greater amounts of surface water are diverted and recharged to the ponds under each successive alternative, leaving less available for recharge from the stream.

The alternatives described above dictate that amount of water that may be appropriated under Permit 15000. Similar to the original intent of the two-dam Santa Margarita Project design to capture large flood flow events to be used during subsequent dry years, the alternatives described above are also based on large surface water diversions during wet years to help ground-water conditions during dry years. Based on the 1980 to 1999 surface water hydrology with augmented surface flows, the maximum amount of water diverted from the Santa Margarita River would be 26,500 AFY, not including the 4,000 AFY license and 1,500 AFY pre-1914 water right. The 26,500 AFY maximum annual diversion is required to achieve the average annual increase in ground-water yield shown in Alternative 4.

2.4 SUMMARY AND RECOMMENDATIONS

The results of the Permit 15000 Study show that it is possible to expand the existing recharge and recovery program to perfect Permit 15000. The three project alternatives provide facilities that could be constructed to increase recharge and ground-water production from the lower Santa Margarita River ground-water basin. It is recommended that the Base implement the construction of the maintenance and repair projects required to meet the original design capacity of the facilities. The construction of the maintenance and repair projects will allow the Base to fully exercise its existing water rights to the Santa Margarita River and increase the efficiency of the existing diversion facilities. A summary of the recommendations from the Permit 15000 Study is shown below.

- 1) Perform a new land survey of the diversion and pond facilities.
- 2) Design and construct the recommended Maintenance and Repair projects.
 - A. Relocate headwall and install sluice way.
 - B. Scrape ponds 1 through 3.
 - C. Install control structures and monitoring devices in ponds and install two new ground-water piezometers.
- 3) Use the Model as a predictive, investigative, and design tool to study potential hydrogeologic and environmental impacts prior to management decisions. It is recommended that the Model be updated with future field data, thereby continually improving its reliability.
- 4) Develop a complete and up-to-date cross-division/cross-department ground-water management and monitoring plan. This could potentially reduce detrimental impacts of contaminated sites on drinking water wells, potential salt water intrusion, reduce unnecessary or duplicate sampling and monitoring, and streamline the planning and development process.

- 5) Expand the ground-water flow model with particle tracking and contaminant transport models to study issues specific to each sub-basin:

Upper Ysidora: Contaminant transport issues, residence time of infiltrated water, drinking water quality concerns.

Chappo: Contaminant transport issues, drinking water quality concerns.

Lower Ysidora: Salt water intrusion, study estuary impacts from changes in the hydrologic regime, irrigation water quality concerns.

- 6) Improve the model with field data measurements of gaining and losing stream reaches, and streambed conductance. This would help to better define the relationship between surface and ground water.
- 7) Install three data loggers to measure water levels over a full year, with each data logger located in a central well in each sub-basin, to better quantify background ground-water flow under different pond infiltration, precipitation, and pumping conditions.

In order to increase the capacity of the existing diversion and recharge recovery program and reduce operation and maintenance cost associated with sediment removal, the following minimum recommendations should be followed. The following recommendations apply to Alternatives 2 through 4

- 8) Install new Obermeyer spillway gate system to reduce sediment accumulations and increase diversion capacity.
- 9) Enlarge or replace the portions of O'Neill ditch that restrict flow including: the upper road crossing, restricted ditch areas above the turnout to the ground-water recharge ponds, the upper Parshall flume, and the turnout to the recharge pond system.
- 10) Install new ground-water production wells to lower the water table below the recharge ponds, thereby creating ground-water storage, increasing recharge, and minimizing mounding effects.