RECYCLE and REUSE STUDY

Conjunctive Use Project for the Lower Santa Margarita River Basin

Fallbrook Public Utility District

Supplemental Study to the Santa Margarita River Recharge and Recovery Enhancement Program - Permit 15000 Feasibility Study for Marine Corps Base Camp Pendleton

February 2002

STETSON ENGINEERS INC.
Stetson Engineers Inc.
San Rafael and West Covina, California
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ACRONYM AND ABBREVIATION LIST

AF .... Acre-foot or acre feet
AFY .... Acre feet per year
ACOE .... United States Army Corps of Engineers
BA .... Biological Assessment
BAP .... Biologically Available Phosphorus
BAT .... Best Available Technology
CAA .... Clean Air Act
CEQA .... California Environmental Quality Act
CCR .... California Code of Regulations
CERCLA .... Comprehensive Environmental Response, Compensation and Liability
Cfs .... Cubic Feet per Second
CMP .... Corrugated Metal Pipe
CWA .... Clean Water Act
CY .... Cubic yards
DHS .... California Department of Health Services
DIP .... Ductile Iron Pipe
DOD .... Department of Defense
EIR .... Environmental Impact Report
EIS .... Environmental Impact Statement
ESA .... Endangered Species Act
ET .... Evapotranspiration
EVWRP .... East Valley Water Recycling Project
FPUD .... Fallbrook Public Utilities District
Ft/day .... Feet per day
FWS .... Fish and Wildlife Service
GAP .... Green Acres Project
GIS .... Geographic Information System
GRWS .... Groundwater Replenishment System
HP .... Horse power
HRT .... Hydraulic Residence Time
IJ .... Interlocutory Judgment
In/year .... Inches per year
KWh .... Kilowatt-hour
LF .... Liner foot or linear feet
MCBCP .... Marine Corps Base Camp Pendleton
MCL .... Maximum Contaminant Level
MGD .... Million gallons per day
Mi2 .... Square miles
Ml .... milliliters
MOU .... Memorandum of Understanding
MWD .... Metropolitan Water District
N .... Nitrogen
NAGPRO .... Native American Graves Protection and Repatriation Act
NEPA .... National Environmental Policy Act

NH3 .... Ammonia
NHPA .... National Historic Preservation Act
NMFS .... National Marine Fisheries Service
NO3 .... Nitrate
NPDES .... National Pollutant Discharge Elimination System
NWS .... Naval Weapons Station
OCWD .... Orange County Water District
P .... Phosphorus
PGRRP .... Planned Groundwater Recharge Reuse Project
Psi .... Pounds per square inch
PUD .... Public Utility District
RCWD .... Rancho California Water District
RO .... Reverse osmosis
RWC .... Recycled Water Contribution
RWQCB .... Regional Water Quality Control Board
SARA .... Superfund Amendments and Reauthorization Act
SCAQMD .... South Coast Air Quality Management District
SCS .... Soil Conservation Survey
SHPO .... State Historic Preservation Officer
SMMWC .... Santa Margarita Mutual Water Company
SMP .... Santa Margarita Project
SMR .... Santa Margarita River
SMRRREP .... Santa Margarita River Recharge and Recovery Enhancement Program
SMW .... Santa Margarita Watershed
SWRCB .... State Water Regional Control Board
TDS .... Total Dissolved Solids
TOC .... Total Organic Carbon
US .... United States
USBR .... United States Bureau of Reclamation
USGS .... United States Geological Survey
VOC .... Volatile Organic Compound
WWTP .... Wastewater Treatment Plant
WY .... Water Year

GLOSSARY

Advanced Wastewater Treatment -	Any physical, chemical, or biological treatment process used to accomplish a degree of treatment greater than achieved by secondary treatment.
Alluvium -	A geologic term describing beds of sand, gravel, silt and clay deposited by flowing water
Aquifer -	A geologic formation or group of formations which store, transmit and yield significant quantities of water to wells and springs. See also "confined aquifer," Unconfined aquifer," and "semiconfined aquifer".
Aquitard -	A less permeable geologic unit that stores but does not readily transmit water.
Basin Plan -	The plan for the protection of water quality prepared by the Regional Water quality Control Board in response to the Porter-Cologne Water Quality Control Act. The Basin Plan for the San Diego Region is also known as the Water Quality Control Plan for the San Diego Basin (9) and contains Water Quality Standards for the federal Clean Water Act.
Beneficial Uses -	The uses of water necessary for the survival or well being of man, plants, and wildlife. These uses of water serve to promote the tangible and intangible economic, social, and environmental goals "Beneficial Uses" of the waters of the State that may be protected against include, but are not limited to, domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves. Existing beneficial uses are uses that were attained in the surface or ground-water on or after November 28, 1975; and potential beneficial uses are uses that would probably develop in future years through the implementation of various control measures. "Beneficial Uses" are equivalent to "Designated Uses" under federal law. [California Code Section 13050(f)].

Conventional Treatment -	A treatment chain that utilizes a sedimentation unit process between the coagulation and filtration process and produces and effluent that meets the definition for disinfected tertiary recycled water.
Denitrification -	Part of a system to remove organic nitrogen from wastewater. Specifically refers to the conversion of nitrate/nitrite secondary treatment.
Direct Beneficial Use	The use of recycled water that has been transported from the point of treatment or production to the point of use without an intervening discharge to waters of the State.
Direct Non-Potable Water Reuse -	The direct discharge of suitably treated reclaimed water into a non-potable distribution system that provides service to customers who obtain their potable water from a separate system.
Direct Potable Reuse -	The direct discharge of highly treated reclaimed water meeting all potable water standards into a potable-water distribution system. This practice has not adopted by or approved for any community in the United States.
Direct Reuse -	When reclaimed water is put in a distribution system, including a reservoir, for delivery to a specified user.
Disinfected secondary-2.2 recycled water -	Recycled water that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed a most probable number (MPN) of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed, and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period.
Disinfected secondary-23 recycled water -	Recycled water that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed a most probable number (MPN) of 23 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed, and the number of total coliform bacteria does not exceed an MPN of 240 per 100 milliliters in more than one sample in any 30 day period.

Disinfected Tertiary - Recycled Water: A filtered and subsequently disinfected wastewater that meets the following criteria:

1. The filtered wastewater has been disinfected by either
   a. a chlorine disinfection process following filtration that provides a CT (the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with modal contact time of at least 90 minutes, based on peak dry weather design flow; or
   b. A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque-forming units of F-Specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration.
2. The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed an MPN of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 milliliters.

Disinfection - The killing of waterborne fecal and patheogenic bacteria and viruses in potable water supplies or wastewater effluents with disinfectant; an operational term that must be defined within limits, such as achieving an effluent with no more than 200 colonies fecal coliform/100 mL.

Effective Porosity - A fraction of the void space that forms part of the interconnected flow paths through the medium, per unit volume of porous medium (excluding void space in isolated or dead-end pores). Also known as “specific yield”.

Ephemeral - Water bodies, or segments thereof, that contain water only for a short period following precipitation events.

Evaporation -	The rate of liquid water transformation to vapor from open water, bare soil, or vegetation with soil beneath. The process by which water is changed from the liquid or solid state into the gaseous state through the transfer of heat energy.
Evapotranspiration -	A term embracing that portion of the precipitation returned to the air through direct evaporation or by transpiration of vegetation. No attempt is being made to distinguish between the two.
Fault -	A fracture in the earth's crust, with displacement of one side of the fracture with respect to the other.
Formation -	A geologic term that designates a body of rock or rock/sediment strata of similar lithologic type or combination of types.
Ground Water -	The water contained in interconnected pores located below the water table in an unconfined aquifer or located in a coffined or semi-confined aquifer
Head -	Energy, produced by elevation, pressure, or velocity, contained in a water mass.
Hydraulic Conductivity -	The measure of the ability of the soil to transmit water, dependent upon both the properties of the soil and those of the fluid.
Hydraulic Gradient -	The rate of change in total hydraulic head per unit distance of flow in a given direction (e.g. the slope of the water table).
Hydrologic Area -	A major logical subdivision of a hydrologic unit which includes both water-bearing and nonwater-bearing formations. It is best typified by a major tributary of a stream, a major valley, or a plain along a stream containing one or more ground-water basins and having closely related geologic, hydrologic, and topographic characteristics. Area boundaries are based primarily on surface drainage boundaries. However, where strong subsurface evidence indicates that a division of ground water exists, the area boundary may be based on subsurface characteristics.
Hydrologic Subarea -	A major logical subdivision of a hydrologic area which includes both water-bearing and nonwater-bearing formations.

Hydrologic Unit -	A classification embracing one of the following features which are defined by surface drainage divides: (1) in general, the total watershed area, including water-bearing and nonwater-bearing formations, such as the total drainage area of the San Diego River Valley; and (2) in coastal areas, two or more small contiguous watersheds having similar hydrologic characteristics, each watershed being directly tributary to the ocean and all watersheds emanating from one mountain body located immediately adjacent to the ocean.
Indirect Reuse -	The domestic or industrial use of treated (or, in some instances, untreated) wastewater which is discharged into fresh surface or underground water and is used again in its diluted form.
Infiltration -	The process of water entry into the soil surface from rainfall, snowmelt or irrigation, and the subsequent percolation downward through the soil. (Stored soil water may be consumptively used by vegetation, may percolate further downward to ground-water storage, or may exit the soil surface as seeps or springs).
Intermittent -	Water bodies, or segments thereof, that contain water for extended periods during the year, but not at all times.
Maximum Contaminant Level -	Legally enforceable standards regulating the maximum allowed amount of certain chemicals in drinking water. The MCL is the greatest amount of a contaminant that can be present in drinking water without causing a risk to human health, as determined by the USEPA.
Maximum Perennial Yield -	The maximum quantity of ground water perennially available if all possible methods and sources are developed for recharging the basin. In effect, this quantity depends upon the amount of water economically, legally, and politically available to the water producers.
Mound -	A localized, temporary elevation in a water table, above the surrounding regional ground water level, that builds up as a result of the localized downward percolation of water that have been discharged to a spreading area.

Municipal Wastewater -	Wastewater derived from domestic, commercial, and industrial sources.
National Pollution Discharge Elimination System (NPDES)	These permits pertain to the discharge of waste to surface water only. All State and Federal NPDES permits are also WDRs.
Non-Potable Reuse -	The use of reclaimed water for non-potable purposes, such as farm or landscape irrigation, or industrial uses.
NTU -	(Nephelometric Turbidity Unit) A measurement of turbidity as determined by the ratio of the intensity of light scattered by the sample to the intensity of incident light as measured by method 2130 B. in Standard Methods for the Examination of Water and Wastewater, 20^{th} ed; Eaton, A.D. Clesceri, L.S., and Greenberg, A.E., Eds; American Public Health Association: Washington, DC, 1995; p.2-8.
Overdraft -	The temporary condition of a ground-water basin where the amount of water withdrawn by pumping exceeds the amount of water replenishing the basin over a period of time.
Percolation -	The vertical migration of water through the soil or alluvium to the ground-water table.
Permeability -	The capability of soil or other geologic formations to transmit water. The term is used to separate the effects of the medium from those of the fluid on the hydraulic conductivity (see also intrinsic permeability).
Phreatophyte -	(1) Literally, a water-loving plant, one that thrives in wet sites and/or has the ability to tap deep saturation zones. (2) A deep rooted plant that obtains its water from the water table. (3) A plant that habitually obtains its water supply from the Zone of Saturation, either directly or through the Capillary Fringe.
Potable Reuse -	The use of reclaimed water in water supplies which are fit or suitable for drinking and ingestion; usually taken to mean treated wastewater that goes directly to the water treatment plant.

Potable Water -	Water of high quality intended for drinking, cooking, and cleaning. This grade of water would conform to the drinking water quality requirements of State and Federal regulatory agencies (Pronounced with Long O).
Potential Evaporation -	The quantity of water evaporated per unit area, per unit time, from an idealized, extensive, free water surface under existing atmospheric conditions.
Primary Treatment -	Removal of suspended solids, both fine and coarse, which either float or settle out from raw sewage.
Recharge -	Flow to ground-water storage from precipitation, infiltration from streams, and other sources of water.
Recharge Basin -	A surface facility, often a large pond, used to increase the infiltration of surface water into a ground-water basin.
Reclaimed Waste Water -	Waste water that becomes suitable for a specific beneficial use as a result of treatment or brackish water demineralized for use. General types of reclaimed waste water include: (1) Primary Effluent / reclaimed water that only has had sewage solids removed and is typically used only for surface irrigation of tree, fodder, and fiber crops; (2) Secondary Effluent / reclaimed water that has had sewage solids removed and has been oxidized and disinfected and is used to irrigate golf courses and cemeteries and provide water for pasture and food crops; and (3) Tertiary Recycled Water / water produced by conventional sewage treatment followed by more advanced procedures including filtration and disinfection providing it with the broadest range of uses.
Reclaimed Water -	or “recycled water” means water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource.

Recycled Water - (1) Water that is used more than one time before it passes back into the natural hydrologic system; (2) Water that is used more than one time by the same users. Also referred to as Recirculated Water.

Recycled Water Contribution - The fraction of the total PGRRP recharge water that is of recycled water origin as defined by the RWQCB.

Reuse of Water - (1) Water that is discharged by one user and is used by other users. (2) Repeated use of the same water by subsequent users in sequential systems. Sometimes, it also means water discharged by one unit and used by other units in the same plant. Also referred to as Recycled Water.

Reverse Osmosis - (1) (Desalination) Refers to the process of removing salts from water using a membrane. With reverse osmosis, the product water passes through a fine membrane that the salts are unable to pass through, while the salt waste (brine) is removed and disposed. This process differs from electrodialysis, where the salts are extracted from the feedwater by using a membrane with an electrical current to separate the ions. The positive ions go through one membrane, while the negative ions flow through a different membrane, leaving the end product of freshwater. (2) (Water Quality) An advance method of water or wastewater treatment that relies on a Semipermeable Membrane to separate water from pollutants. An external force is used to reverse the normal osmotic process resulting in the solvent moving from a solution of higher concentration to one of lower concentration.

Safe Yield - The maximum quantity of water that can be continuously withdrawn from a ground-water basin without adverse effects. Due to its vague definition and the implication of a fixed quantity of extractable water based on the average annual basin recharge, the term has fallen into disfavor as compared to the term “maximum perennial yield”.

Secondary Treatment - Generally, a level or treatment that produces removal efficiencies for biochemical oxygen demand (BOD) and suspended solids (SS) of #85%. Sometimes used interchangeably with the concept of biological wastewater treatment, particularly the activated sludge process.

Specific Capacity - An expression of the productivity of a well, obtained by dividing the rate of discharge of water from the well by the drawdown of the water level in the well.

Specific Storativity - The volume of water that a unit volume of porous medium releases from or takes into storage per unit change in hydraulic head.

Storativity - The volume of water that an aquifer releases or takes into storage per unit change in hydraulic head.

Tertiary Treatment - The treatment of wastewater beyond the secondary or biological stage. Includes filtration or the removal or nutrients, such as phosphorous and nitrogen, and a high percentage of suspended solids.

Total Nitrogen - The summation of ammonia, nitrate, nitrite, and organic nitrogen , expressed as units of nitrogen.

Total Organic Carbon - The oxidizable organic carbon present in the recycled water measured by an approved laboratory using an approved analytical method.

Total Dissolved Solids (TDS) - The quantity of minerals (salts) in solution in water.

Total Porosity - Fraction of void space per unit volume of porous medium.

Transmissivity - Rate of flow of water through an aquifer. The product of hydraulic conductivity and the layer thickness.

Transpiration - That pert of the total evaporation which enters the atmosphere from the soil through the plants; the process by which water vapor escapes from a living plant and enters the atmosphere; the evaporation of water absorbed by the crop and transpired and used directly in the building of plant tissue, in a specified time.

Unconfined Aquifer - A permeable geologic unit with the water table forming its upper boundary.

Waste Discharge Requirements (WDRs)- The name of permits issued by the Regional Water Quality Control Board for the discharge of waste to land. The discharge of waste to land may potentially impact ground water quality. These permits require that waste not be discharged in a manner that would cause an exceedance of applicable water quality objectives or adversely affect beneficial uses designated in the Basin Plan.

Water Budget - An evaluation of all the sources of supply and the corresponding discharges with respect to an aquifer or a drainage basin.

Water Reclamation - The recovery of wastewater for useful purposes through treatment processes and subsequent return to either a surface or ground-water source.

Water Reuse - water, either surface or underground-which is drawn, generally after additional treatment, for distribution for non-potable purposes to customers who obtain their potable water from a separate system.

Water Table - The surface where ground water is encountered in a water well in an unconfined aquifer.

Water Quality Criteria - Numerical or narrative limits for constituents or characteristics of water designed to protect specific designated uses of the water. When criteria are met, water quality will generally protect the designated use [40 CFS Section 131.3(b)]. This term is also used to describe scientific information on the relationship that the effect of a constituent concentration has on human health, aquatic life, or other uses of water, such as the criteria in the USEPA "Gold Book". California's water quality criteria are called "water quality objectives". See "water quality standard".

Water Quality Goal - The most stringent, applicable, numerical water quality limit for a constituent or parameter of concern in a specific body of ground or surface water at a specific site that is chosen to protect either (1) existing water quality or (2) beneficial uses of water. In their first case, the water quality goal is set equal to the background level in the body of water. In the second case, the water quality goal is set at the less stringent of either (a) the numerical limit which implements all applicable water quality objectives or (b) the background level.

Water Quality Objectives -	Numerical or narrative limits on constituents or characteristics of water designed to protect designated beneficial uses of the water.[California Water Code Section 13050(h)]. California's water quality objectives are established by the State and Regional Water Boards in the Water Quality Control Plans. See "water quality standards".
Water Quality Standards -	Provisions of State or Federal law which consist of a designated use or uses for waters of the United States and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the Act [40 CFS Section 131.3(I)]. A water quality standard under the Federal Clean Water Act is equivalent to a beneficial use designation plus a water quality objective. In California, water quality standards are promulgated by the State and Regional Water Boards in Water Quality Control Plans. Water quality standards are enforceable limits for the bodies of surface or ground waters for which they are established.

ES EXECUTIVE SUMMARY

The following study presents the analysis and results of a feasibility level study that investigates the implementation of a conjunctive use project between the Fallbrook Public Utility District (Fallbrook PUD) and the U. S. Marine Corps Base Camp Pendleton (Base). This study investigates two sources of supply to be applied for beneficial use: naturally occurring streamflow and tertiary treated wastewater. The investigation regarding the diversion and recharge of naturally occurring streamflow commenced with the Santa Margarita River Recharge and Recovery Enhancement Program – Permit 15000 Feasibility Study for Marine Corps Base Camp Pendleton (Stetson Engineers, 2001), hereinafter referred to as the Permit 15000 Study. The second source of supply, tertiary treated wastewater effluent, is introduced in a Recycle and Reuse program in this study. The conceptual design, engineering, and economics of incorporating both of these sources of water into a conjunctive use program are explained in detail throughout the body of this report.

The Fallbrook PUD has been investigating the use of local water supplies since Mr. J. B. Lippincott published his engineering study in 1925. The results of that investigation suggested delivering water to the Fallbrook PUD from a proposed ground-water well field to be constructed in Temecula Creek. Investigations toward the development of a dependable local water supply continued over the next two decades, culminating in the mid 1940s with a proposal to build the Fallbrook Dam near the confluence of the Santa Margarita River and Sandia Creek. Although the Fallbrook PUD developed and operated a source of supply from the Santa Margarita River between 1930 and 1968, the investigation toward the development of a long-term dependable source of local supply continues today.

During water year 1999-2000, the Fallbrook PUD distributed more than 15,900 acre-feet of water to its domestic, commercial, and agricultural users throughout their district boundary. One hundred percent of that water was supplied from the San Diego County Water Authority (CWA), originating in either the Colorado River Basin or northern California. Since the failure of the Fallbrook Sump on the Santa Margarita River in 1968, more than 98% of the water used in the Fallbrook PUD was supplied as imported water. The Fallbrook PUD's dependence on imported water from CWA underscores the need to develop alternative sources of supply, including the development of local surface water and ground-water supplies discussed in this study. Equally important to the Fallbrook PUD's dependence on imported supplies is the cost of that water paid by its customers. The successful development of a conjunctive use project that relies on local water supplies is also based on economics incentives that provide the Fallbrook PUD's customers with relief from expensive CWA imports.

A conjunctive use project also provides "emergency supplies" that ensures an alternative water supply for the Fallbrook PUD during CWA cutbacks. As environmental and human factors continue to affect the dependability of imported supplies, the development of local water will provide independence and dependability for the Fallbrook PUD. Anticipated reductions in Colorado River imports and environmental demands on Bay-Delta water will likely reduce water supplies in both the near and extended future. Combined with the anticipated growth in demand throughout southern California, the development of a local water supply becomes an even greater need.

The development of a conjunctive use project with Camp Pendleton may also provide a solution to the on-going dispute of the *United States v. Fallbrook PUD* case. Filed in federal court in 1951, this case addresses the allocation of the waters of the Santa Margarita River Basin between the Fallbrook PUD, the United States, and approximately 6,000 other defendants. Based on a Memorandum of Understanding (MOU) signed in 1968, the two principal parties agreed to settle their dispute by seeking a "physical solution". The development of a conjunctive use program, including a recycle and reuse component, provides the means to achieve a physical solution that has been sought for 33 years.

ES.1 PERMIT 15000 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.

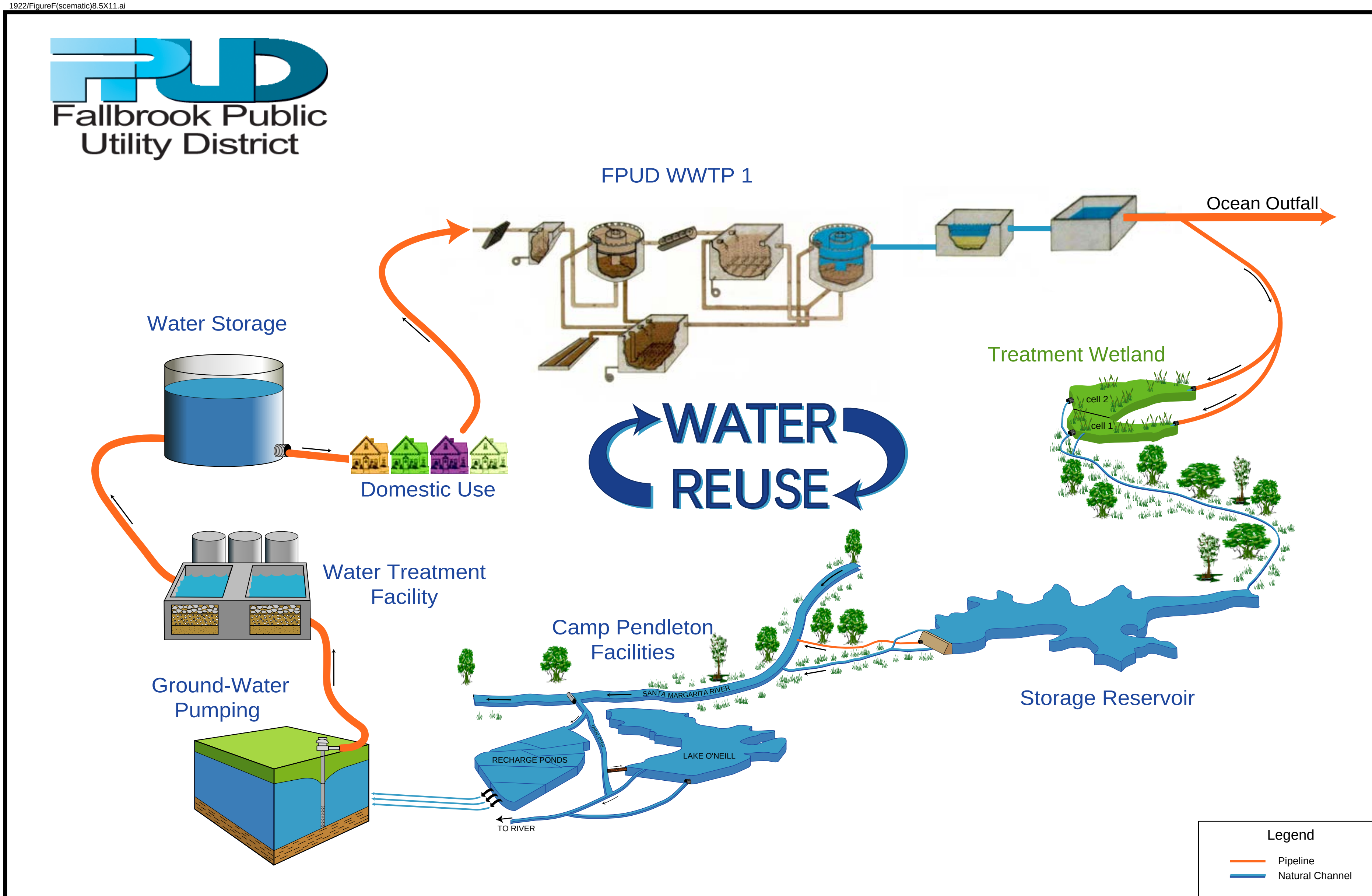
The results of this study found that Alternative 2, 3, and 4, would provide 11,800 AFY, 14,050 AFY, and 14,800 AFY of ground water, respectively. The facilities in the various alternatives included all or some of the following components: a new diversion structure, enlarged diversion ditch capacity, additional recharge ponds, and off-stream surface storage. The estimated cost of these facilities ranged from $3.5 million for Alternative 2 to $47.7 million for the off-stream reservoir scenario of Alternative 4. The findings of this study suggest that additional supplies are available for development, provided the Base adopts an adaptive management role and actively manage its surface and ground-water supplies in a conjunctive use fashion.

ES.2 PROJECT ALTERNATIVES

Including the alternatives developed in the Permit 15000 Study, a total of ten alternatives have been investigated to enhance the recharge and recovery of Santa Margarita River water for the development of a conjunctive use project. The Permit 15000 Study investigated a total of eight alternatives, including the four described in the previous section. The other four alternatives addressed in that study 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 lower 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.

Alternatives 9 and 10 (Figure ES-1) are described in detail throughout the remainder of this study. Specifically, Alternative 9 was developed to investigate the yield and cost of a recycle and reuse project that included tertiary treated wastewater as a source of supply. Tertiary treated effluent discharged from the Fallbrook Wastewater Treatment Plant (WWTP) is routed through treatment wetlands and temporary storage, in order to "polish" the water of excess nutrients, before being released in the Santa Margarita River channel. The timing of the release of the polished water corresponds to the driest period of the year when riparian habitat demands are at their greatest. As described in detail throughout the remainder of this study, the additional supply developed in the recycle and reuse program enhances the ability to pump ground water and meet the demands of a conjunctive use project. Two additional components of the recycle and reuse program include advanced water treatment and the construction of a conveyance pipeline to the Fallbrook PUD. Although not specifically addressed in this study, advanced water treatment may likely include a combination of micro-filtration and reverse osmosis.

Alternative 10 not only includes the recycle and reuse component outlined in Alternative 9, but also includes the diversion and recharge component described in Alternative 3 of the Permit 15000 Study. Alternative 3 facilities include the construction of a new Obermeyer diversion structure, enhanced canal capacity, and the construction of two additional artificial recharge ponds located above Camp Pendleton's ground-water basin. Combined with the recycle and reuse project, Alternative 10 provides the greatest ground-water yield that may be used to support a conjunctive use project between the two parties. The detailed surface and ground-water modeling that was used to support this finding assures the protection of the riparian corridor and ecology that rely on the waters of the Santa Margarita River.



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Conceptual Model
Conjunctive Use Water Recycling Project

FIGURE ES-1

Both Alternatives 9 and 10 provide positive impacts to the ground-water basin. As a result of the advanced water treatment process, a greater proportion of water supplied to both the Fallbrook PUD and the Base will have greatly diminished levels of TDS and other water impairing constituents. The effect on the quality of the wastewater effluent will be direct and immediate. Releases of tertiary treated effluent, from either the Fallbrook PUD or the Base, into the Santa Margarita River system will improve the quality of both the surface and ground water that exists there today.

ES.3 Conceptual Conjunctive Use Project

Advantages of developing a viable conjunctive use project for the Fallbrook PUD include: reduced dependency on imported water supplies, development of a local water supply, and reduced costs. Similarly, Camp Pendleton will benefit from the establishment of a connection to imported water supplies and upgrades to the existing ground-water diversion and recovery facilities. Both parties would benefit from improved potable water treatment, improved basin water quality, and possible settlement of the *United States v. Fallbrook PUD* case.

As part of a conjunctive use project a recycle and reuse component could be adopted in order to develop an additional supply of water. To provide an alternative source of supply, tertiary treated wastewater will be released from the Fallbrook PUD’s existing ocean outfall to a set of treatment wetlands located on the Naval Weapons Station. The treatment wetlands will be maintained and managed to lower the total nitrogen level in the effluent from an average of 7 mg/l to approximately 1 mg/l. An off-stream storage reservoir would be constructed to store the “polished” effluent for release during the dry summer months. Although not quantified in this study, up to 80% phosphorus removal may occur in the treatment wetlands and reservoir through sorption and absorption, depending on specific site characteristics. In order to achieve maximum beneficial use of the water, the stored water would be released during the summer and fall months when streamflow in the Santa Margarita River is at a minimum.

The conjunctive use management of the lower basin would include increased ground-water pumping rates during the winter months and reduced ground-water withdrawals during the summer months. The water produced beyond the Base’s demand would be conveyed to the Fallbrook PUD using a proposed conveyance pipeline. The conjunctive use pumping schedule maximizes the surface water that is diverted from the Santa Margarita River and stored in the lower basin, while at the same time protecting the riparian corridor from adverse impacts due to lower ground-water level.

A summary of the four conjunctive use projects is shown in Table ES-1. Alternative 1A is identical to Alternative 1 except for the quantity of ground-water extracted from the lower Santa Margarita River basin. Alternative 1A maximizes the amount of ground-water pumped, compared to Alternative 1 that only accounted for historical maximum use by Camp Pendleton. As shown in this table, Alternative 10 includes all facilities included with both the Recycle and Reuse component, as well as the Diversion and Recharge component, of the conjunctive use project. The design and cost of the advanced water treatment facilities and the return conveyance pipeline are not included in this study.

Table ES-1
Summary of Conjunctive Use Alternatives

Item	Alternative 1A	Alternative 9	Alternative 3	Alternative 10
Ground-Water Wells	●	●	●	●
Diversion and Recharge Component				
Obermeyer Diversion Dam			●	●
O'Neill Ditch Enlargements			●	●
Recharge Ponds 1-5 (Flow Structures)			●	●
New Recharge Pond Nos. 6 and 7			●	●
Recycle and Reuse Component				
Wetland Pipeline		●		●
Treatment Wetland		●		●
Dam and Storage Reservoir		●		●
Reservoir Discharge Pipeline		●		●

Note: Alternative 1A is identical to Alternative 1 with maximum pumping.

ES.4 HYDROLOGIC MODELING

Hydrologic analyses for the conjunctive use program include the use of both surface and ground-water models to account for the flow of water through surface impoundments and their subsequent release to the river and ground-water systems. The focus of the various analyses was to account for the flows associated with both components of the conjunctive use project. The use of these models allow engineers to accurately account for released flows, as well as naturally occurring flows, that impact the required design of each of the facilities. Hydrologic analyses incorporate an iterative process that allows the engineer to optimize the design of the project based on a given set of assumptions.

Results of the surface water analysis suggest that approximately 90% of the Fallbrook PUD's release of tertiary treated wastewater is available for beneficial reuse. The ground-water model suggests that the releases remain in the Santa Margarita River and support the sensitive riparian corridor, allowing for sustained ground-water pumping during dry summer and fall months. Modeling results during extended drought conditions, similar to the late 1980s, further suggest that pumping levels during the dry season can be maintained at higher levels without impact to the environment. Combined with the Diversion and Recharge component of the conjunctive use plan, the modeling efforts show that a conjunctive use program can be successful on a year-around basis, including periods of extended drought.

Table ES-2 provides the results of the surface and ground-water modeling for each component of the conjunctive use project. The median annual project yield, extracted from the ground-water basins located on Camp Pendleton, is 14,000 acre-feet and 16,200 acre-feet for Alternatives 9 and 10, respectively. An annual total of 2,150 acre-feet of recycled water is released to the Santa Margarita River for habitat maintenance for each alternative. The effect of these releases is a direct increase in ground-water pumping by 2,150 AF.

TABLE ES-2
SUMMARY OF MODELING RESULTS

ITEM	ALTERNATIVE 1A (AFY)	ALTERNATIVE 9 (AFY)	ALTERNATIVE 3 (AFY)	ALTERNATIVE 10 (AFY)
Recycle and Reuse Contribution	0	2,150	0	2,150
Diversion and Recharge Contribution	11,850	11,850	14,050	14,050
Median Annual Project Yield	**11,850**	**14,000**	**14,050**	**16,200**
Maximum Additional Surface Water Diversion (AFY)	13,300	13,900	19,200	21,800

ES.5 ENGINEERING AND ECONOMIC ANALYSIS

The results of the hydrologic modeling allowed for the accurate planning and design of the engineering facilities required for each alternative. The size and cost of the facilities included in each component of the conjunctive use project are outlined in Table ES-3.

TABLE ES-3
SUMMARY OF ALTERNATIVE 10 COSTS

Facilities	Quantity or Capacity	Cost (Million $)
Ground-Water Wells	8 each	**4.0**
Diversion and Recharge Components		
Obermeyer Dam and Headgate	200 cfs	0.970
Improved Ditch	200 cfs	0.170
Flow Control	200 cfs	0.687
Additional Recharge Ponds	300 AF	0.676
Total		**2.503**
Recycle and Reuse Components		
Wetland Pipeline	9,000 feet @ 12 inch	0.814
Treatment Wetland	18 acres	0.419
Storage Reservoir	1,600 AF	10.625
Reservoir Discharge Pipeline	5,900 feet @ inch	0.981
Total		**12.839**
Total Project		**19.342**

Note: Costs include Contingencies, Engineering and Planning

The alternatives were compared on the basis of the total estimated annual cost, unit cost per acre-foot of water, and project yield. Project yields for Alternatives 9 and 10 are based on the total ground-water yield of each alternative. Table ES-4, presents a summary of the total estimated capital cost, annual cost, unit cost and annual project yield for all three scenarios of Alternative 9 and 10.

The total estimated capital cost of Alternative 9 was $15.8 million, including the cost of Alternative 1A ground-water wells. The total estimated capital cost of Alternative 10 was $19.3

million, including Alternative 3 facilities. The estimated ground-water yield was 14,000 AF for Alternative 9 and 16,200 acre feet for Alternative 10. The unit costs per water were $130/AF and $140/AF for Alternative 9 and 10, respectively.

TABLE ES-4
SUMMARY OF PROJECT COST ESTIMATES

Project Alternative & Scenario	Estimated Capital Cost (Million $)	Estimated Annual Cost[1] (Million $)	Annual Project Yield[2] (AF)	Unit Cost[3] ($/AF)
Alternative 9				
Scenario 1[4]	15.1	1.7	13,100	133
Scenario 2[4]	15.8	1.8	14,000	139
Scenario 3[4]	17.7	2.0	14,600	135
Alternative 10				
Scenario 1[4]	18.5	2.1	15,300	139
Scenario 2[4]	19.3	2.2	16,200	136
Scenario 3[4]	21.2	2.4	16,900	140

1) Annual costs are based on capital costs amortized over 30 years at 8 percent interest plus power and labor to maintain and operate the facilities.

2 Project yields for Alternative 9 scenarios are base on Fallbrook Supplemental Feasibility Study. Project yields for Alternative 10 scenarios are base on Alternative 9 yields plus additional yields from Camp Pendleton's Recharge and Recovery Enhancement Program.

3) Unit Costs are based on annual project yields.

4) Scenarios 1, 2, and 3 represent 1,500 AFY, 2,500 AFY, and 3,500 AFY possible reservoir sizes of the Recycle and Reuse component.

ES.6 CONCLUSION AND RECOMMENDATIONS

The feasibility of developing a conjunctive use project between the Fallbrook PUD and the Base is predicated on the implementation of two components, Diversion and Recharge and Recycle and Reuse. The Diversion and Recharge component was developed in the Permit 15000 study and includes the diversion of naturally occurring streamflow from the Santa Margarita

River for recharge to the aquifers in the lower ground-water basin. The Recycle and Reuse component developed in detail throughout this study includes the development of an alternative source of water supply from the Fallbrook PUD.

The Diversion and Recharge component of this project includes the construction of new facilities in the Upper Ysidora subbasin on Camp Pendleton. Specifically, these projects include the construction of a new diversion structure and recharge ponds, enhancement to the existing canal capacity, and installation of new ground-water wells. The anticipated median yield of this component is 14,050 AFY with associated capital costs of $5.5 million.

The Recycle and Reuse component of the conjunctive use project develops an alternative source of water supply for beneficial use by both parties. This study has found that tertiary treated wastewater from the Fallbrook PUD can be beneficially used as an alternative source of water supply for the lower Santa Margarita basin. The facilities included in this component include the construction of a treatment wetland and storage reservoir, a delivery pipeline from the Fallbrook PUD's ocean outfall to the wetlands, and a pipeline from the reservoir to the Santa Margarita River. Combined with the Diversion and Recharge component, the cost of developing an additional 2,150 AFY, providing a median project yield of 16,200 AFY, is estimated to be $19.3 million.

The cost of the facilities required to develop 16,200 AFY is not credited with the value of developing an emergency water supply and local ground-water supply for the Fallbrook PUD. The development of an emergency water supply provides insulation from future reductions of imported water supplies originating from the MWD. During periods of extended drought and forced cutbacks from the MWD, the Fallbrook PUD will be able to call upon the local ground-water supplies on the Base. Due to the development of the Recycle and Reuse component of the project, these ground-water supplies will be available even during years of extend drought in the Santa Margarita watershed. Because it is difficult to quantify the monetary value of the availability of an emergency supply, the Fallbrook PUD and its customers will need to determine if this component of the project is a requirement to meet their future goals.

The development of a conjunctive use project also provides a physical solution to the ongoing legal dispute *U.S. v Fallbrook*. As agreed to in the 1968 MOU, the conjunctive use project provides a means to reach a physical solution to the division of waters of the Santa Margarita River. Failure of the two parties to reach a joint physical solution may result in costly litigation or an inferior project that may not provide either the Fallbrook PUD or the Base with a viable long-term solution to future water demands. While the Fallbrook PUD benefits from the development of a local ground-water supply, the Base will benefit from the direct connection to imported water supply. In both cases, the project will provide a means for both parties to ensure that future water demands, even during periods of extend drought, will be met by the development of the conjunctive use project.

The results of the Fallbrook PUD Supplemental Study show that it is possible to develop a conjunctive use program that contains a Diversion and Recharge and a Recycle and Reuse component. Although both Alternatives 9 and 10 were presented in this study, the latter alternative provides a more reasonable and viable option to be implemented as part of a conjunctive use program. Alternative 10 may also be addressed as a viable conjunctive use project without the Recycle and Reuse component, identical to Alternative 3, with the exception that it will not provide an alternative supply of water that proves crucial to a successful project during the dry summer months and periods of extend drought. The following recommendations have been provided to successfully implement a conjunctive use project between the Fallbrook PUD and the Base.

1) Adopt a conjunctive use policy that will utilize the safe yield of the ground-water basin on Camp Pendleton. The policy should specifically address, but not be limited to, the use of recycled water, surface and ground-water management of the Santa Margarita River, development of emergency supplies for the Fallbrook PUD, and improvement to potable and basin water quality.

2) Proceed with the NEPA/CEQA environmental analysis to determine the environmental feasibility of each alternative.

3) Investigate third party sources of tertiary treated wastewater. Scenario 3, which includes the 3,500 AFY reservoir scenario, indicates that the unit cost of developing the project is identical to the Scenario 2 unit cost. Additional yield from the ground-water basin could be realized from a larger Recycle and Reuse component.

4) Complete feasibility level design work for the conveyance pipeline from the Base to the Fallbrook PUD. Adjust capacity to account for the F3 pumping schedule. Investigate the best alignment for a dual purpose, multi-directional, pipeline to meet both the Fallbrook PUD's and the Bases future needs.

5) Continue to 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.

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

7) Improve the model with field data measurements of gaining and loosing stream reaches, and streambed conductance. This would help to better define the relationship between surface and ground water.

8) Develop a complete and up-to-date 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.

9) Investigate the availability, and/or construction, of a brine line that could be used to discharge reject water from the proposed advanced treatment facilities to be located on the Base.