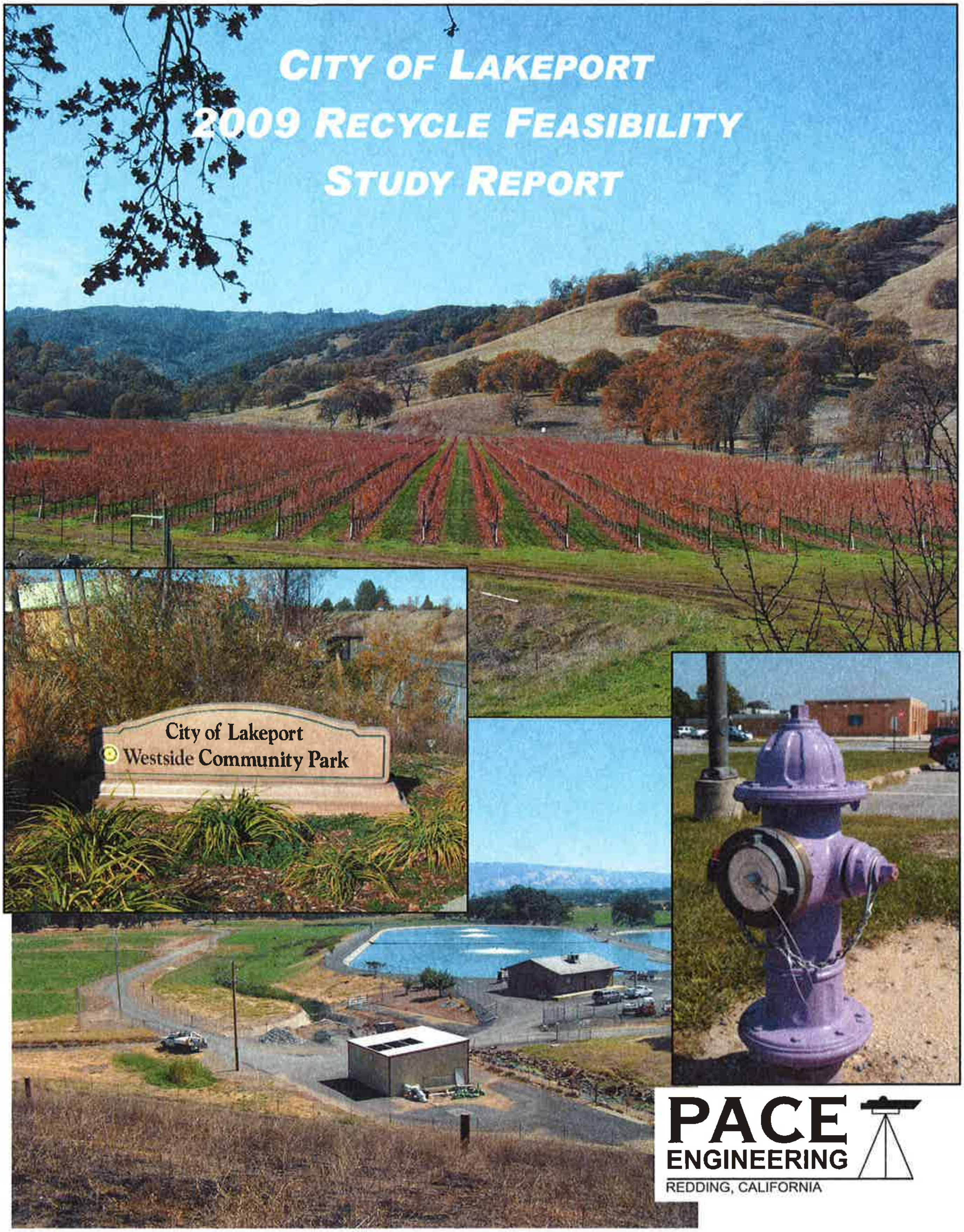
City of Lakeport 2009 Recycle Feasibility Study Report



PACE
ENGINEERING
REDDING, CALIFORNIA

CITY OF LAKEPORT

2009 RECYCLE FEASIBILITY STUDY REPORT

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ABBREVIATIONS

Certain terms and abbreviations have been used in this report for convenience. Definitions are as follows:

Ac-Ft	Acre foot
AD	As Developed
ADWF	Average dry weather flow. This is the average rate of wastewater flow during the summer months.
BF	Ballasted flocculation
BOD	Biochemical Oxygen Demand
CCR	California Code of Regulations
CDHS	California Department of Health Services
CDPH	California Department of Public Health
CEQA	California Environmental Quality
CLMSD	City of Lakeport Municipal Sewer District
CMF	Cloth media filters
CRWQCB	California Regional Water Quality Control Board
CT	Contact time
DAF	Dissolved air flotation
DWR	Department of Water Resources
ETo	Evapotransport
GPD	Gallons per day
GPM	Gallons per minute
HRC	High Rate Clarification
Hp	Horsepower
I&I	Infiltration and inflow
LACOSAN	Lake County Sanitation District
LAFCO	Local Agency Formation Commission
LGCD	Lakeport Golf Course Development
MDD	Maximum day demand
MF	Membrane microfiltration
MG	Million gallons
MGD	Millions gallons per day
MPN	Most probable number
MW	Megawatts
NEPA	National Environmental Policy Act
PDWF	Peak dry weather flow
PLC	Programmable logic controller
PSI	Pounds per square inch
PWWF	Peak wet weather flow. This is the highest wastewater flows anticipated by a 10-year storm event.
RD	USDA Rural Development Agency
RO	Reverse osmosis
RUE	Residential unit equivalent
RWQCB	Regional Water Quality Control Board
SAA	Southeast Agricultural Area
SCADA	Supervisory Control and Data Acquisition

ABBREVIATIONS – cont'd

SS	Suspended solids
SWRCB	State Water Resources Control Board
TSS	Total suspended solids
UV	Ultraviolet
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant
YCFCWCD	Yolo County Flood Control & Water Conservation District

2009 RECYCLED FEASIBILITY STUDY REPORT

I. INTRODUCTION

Recycled water projects have continued to be implemented throughout California to augment water supply as the cost of additional freshwater supplies continues to increase. High quality water is a valuable resource that continues to be in short supply throughout the State. A number of agencies in California are in short supply and are evaluating alternatives to meet future water demand.

The continued increase in the regulatory requirements associated with wastewater treatment and disposal in Lake County has resulted in many cities and agencies reevaluating their wastewater treatment and disposal options. The concept of expanding Lakeport's recycled water to provide this valuable resource to other entities within the community and region is appropriate to determine the most cost-effective strategy for meeting the City's future treatment plant regulatory requirements.

The City of Lakeport retained PACE Engineering to evaluate the feasibility of using the City's recycled water for other beneficial purposes within Lake County. The purpose of the Feasibility Study was to identify a cost effective water recycling project, or projects, that would meet the needs of both the City and the local region.

The City of Lakeport applied for, and secured, grant funding (Agreement No. 07-708-550-1) for the Feasibility Study from the State Water Resources Control Board (SWRCB) through the Water Recycling Facilities Planning Grant Program. The grant provides $66,000 in funding to the City to prepare this Feasibility Study Report; which includes an assessment of the recycled water market, review of regulatory requirements, development and evaluation of alternatives for water recycling of wastewater, selection of a recommended alternative(s), and an assessment of the feasibility of implementation of a regionalized wastewater treatment, and/or a recycled water project.

PROJECT GOALS AND OBJECTIVES

Drivers for recycled water projects can be linked to benefits related to wastewater treatment and disposal; water supply and quality; and environmental protection and benefit. These key drivers were used to develop goals and objectives for the project through discussions with the City of Lakeport utilities. The goals and objectives were:

- To meet the City's wastewater treatment and disposal needs.
- To help meet the City's water supply needs.
- Identify and rank projects based on criteria, including political feasibility, environmental feasibility, and cost effectiveness.
- Identify a recommended alternative, or alternatives, for further evaluation.

BACKGROUND

The City of Lakeport's existing wastewater treatment and reclamation facilities were upgraded in 1991 to an average dry weather flow (ADWF) capacity of 1.0 MGD and a peak wet weather capacity of 3.0 MGD. The City's wastewater is collected and pumped to the City's wastewater treatment plant (WWTP) where the wastewater is treated via the secondary treatment facility. The treated wastewater is chlorinated and stored at the effluent storage reservoir. During the 1991 expansion, the City's effluent storage reservoir was expanded to about 650 acre feet (Ac-Ft) (i.e., 211 MG), at reservoir elevation 1,432 feet. Treated effluent is stored in the reservoir until such time the water can be applied to the City's 332-acre irrigation facilities. The California Regional Water Quality Control Board (CRWQCB) wastewater discharge permit allows the City to irrigate all year long, so long as effluent irrigation practices do not occur during, or within 24 hours of precipitation on the irrigation area. Currently, the City's irrigated pasture land is leased to local farmers for grazing livestock.

Historically, the City has had sufficient reservoir capacity to store treated wastewater for those periods when irrigation practices cannot be used (i.e., periods of precipitation). However, wastewater will increase due to growth, placing additional demands on the reservoir capacity as the City population grows. To accommodate this growth in wastewater, the City will either have to increase storage volume by constructing larger reservoirs, or utilize more of the stored effluent during the irrigation and non-irrigation months.

As discussed, the current CRWQCB regulations (see Appendix C) allow Lakeport to use their secondary treated effluent on the City-owned pasture land. Due to the nature of the treated secondary effluent, the CRWQCB permit restricts the pasture land from public access.

II. STUDY AREA CHARACTERISTICS

Incorporated in 1888, the City of Lakeport encompasses approximately 1,600 acres on the west shore of Clear Lake, within Lake County northwest of Sacramento, see Plate 1. The current population is about 5,150, and the Lakeport water system has approximately 2,200 billed water services. The City's Master Water Plan calculates that these 2,200 water connections equates to approximately 2,607 Residential Unit Equivalents (RUE), which is defined as the water use from a single-family dwelling in the Lakeport service area. A typical RUE consumes roughly 553 gallons per day (GPD), during a maximum day demand (MDD), and around 352 GPD during an average day demand. Normally, seasonal water usage in the summer (June through September) can be two times greater then what is used throughout the other seasons. This is primarily due to an increase in irrigation and a rise in the population due to the tourist industry.

The City of Lakeport is located entirely within the Scotts Creek watershed (see Figure 1), next to Clear Lake. The City has a single water intake, located within Clear Lake, which provides a portion of the City's raw drinking water. Other sources of water for the City include four municipal wells located within the Scotts Creek drainage.

III. WATER SUPPLY CHARACTERISTICS AND FACILITIES

The City of Lakeport takes water from two sources: Clear Lake and the Scotts Valley Aquifer, both of which are located in the same watershed. The 2004 City of Lakeport Municipal Services Review reports there are no records showing that the City of Lakeport applied for historical water rights until September 1995. On that date, the City entered into an agreement with the Yolo County Flood Control and the Water Conservation District, whereby both parties agreed that the City's historical water rights were 750 Ac-Ft per year. Under the agreement, the 750 Ac-Ft of water is to be taken from wells that draw water from the Scotts Valley Aquifer, whose location is shown on Figure 1. The agreement also allows the City to purchase 2,000 Ac-Ft of water from the Yolo County Flood Control and the Water Conservation District to be drawn from either Clear Lake or the Scotts Valley Aquifer. The agreement is valid until January 1st, 2030, with an automatic 10-year extension, unless either party elects to terminate the agreement. The agreement states that "in the event that there is a shortage of water available from Clear Lake, municipal water use around Clear Lake shall have priority over other uses."

LAKEPORT MUNICIPAL WELLS

The City of Lakeport's water sources are from four wells (two Scotts Creek wells and two Green Ranch wells) and the water treatment plant. The four City wells pump their water from the Scotts Valley Aquifer and have a combined maximum pumping capacity of roughly 2.8 MGD. The two wells in Scotts Creek are the primary sources of supply during the months of May through October, while the wells at Green Ranch are the primary sources of supply during the winter months.

The water treatment plant (WTP) has a maximum capacity of 1.7 MGD, and can be used year round to supplement the City's well supply. The water treatment facility includes pH control, pre-ozonation, coagulation, upflow clarification, multimedia filtration, post-ozonation, activated carbon, and chlorine disinfection. The water treatment facility is considered to be an advanced treatment process because it needs to treat Clear Lake water that is laden with algae.

Current water production costs for the City are subject to many variables. For example, electrical costs to produce water from the City's existing wells and WTP are shown on Table 1. As can be seen, the electrical costs for producing water from the WTP is about $540 per million gallons ($174 per Ac-Ft), versus $130 dollars per million gallons (i.e., $42 per Ac-Ft) from the Scott Creek Wells. These costs do not include the costs for chemical, operations, and maintenance at the treatment plant. The table indicates that the electrical cost for treating Clear Lake water is over four times the cost of pumping it from the ground.

SCOTTS VALLEY AQUIFER

The addition of new municipal wells to supplement the existing Lakeport wells would undoubtedly draw water from the Scotts Valley Aquifer. Figure 1 shows the boundary of this aquifer. Based on the Department of Water Resources (DWR), Scotts Valley Groundwater Basin's Bulletin 118 (see Appendix A), the aquifer appears to be fully utilized. The DWR estimates the usable storage capacity of the aquifer to be approximately 4,500 Ac-Ft; however, it also estimates that 4,200 Ac-Ft is extracted for agricultural uses and 520 Ac-Ft for municipal/industrial uses annually. Therefore, the estimated 4,720 Ac-Ft of water drawn is 220 Ac-Ft above the estimated usable storage capacity of the aquifer; however, the DWR Bulletin indicates that the aquifer is currently not being overdrawn due to adequate sources of water replenishing this aquifer (i.e., Scotts Creek, Clear Lake, etc.).

Historically, during years of drought the groundwater levels of the aquifer have dropped up to 10 feet, but have then recovered to pre-drought levels relatively soon thereafter. Information estimating the reduced availability of water in the Scotts Valley Aquifer during times of drought has not been found.

Based on the DWR, Scotts Valley Groundwater Basin's Bulletin 118, the aquifer's water quality is influenced by calcium-magnesium bicarbonate with average dissolved solids of 158 mg/L. Iron, manganese, and boron concentrations in some of DWR's monitored wells have exceeded EPA maximum acceptable concentrations. Farmers located south of the Lakeport Treatment Plant have reported that elevated boron concentrations have been measured in their agricultural wells and may be a concern for some sensitive crops.

CLEAR LAKE WATER

The Clear Lake water supply to the City of Lakeport is of good quality and relatively easy to treat. Recent sampling of raw water entering the Lakeport WTP (see 2002 Clear Lake Watershed Sanitary Survey) indicates that constituents such as arsenic have been detected, but are below current federal standards. Aluminum, iron, and manganese have also been measured and can rise above the secondary MCL concentrations, but the City's existing treatment facility is effective in reducing these concentrations. Sizeable algae bloom within the lake during the summer and fall increases turbidity at the WTP. This increase in turbidity requires that WTP operator's adjust plant processes to compensate (i.e., adjust pH, increase ozone disinfection, additional clarifier backwashing, etc.).

As discussed above, the contract the City has with the Yolo County Irrigation and Flood Control District gives the City priority to the Scotts Valley Aquifer water during periods of drought. Therefore, it appears that during an extended drought, the City would receive its full allotment of 750 Ac-Ft, and possibly more, if the City had the pumping systems to remove the water from the ground. However, the fact that the City wells draw water from the Scotts Valley Aquifer and have historically experienced some reductions in pumping capacity due to decreased groundwater levels implies that the aquifer can be impacted by drought conditions and that the City's existing wells, and the possibility of future wells tapping this aquifer, could be subject to capacity reductions if significant droughts were to occur in the future. This possible reduction in City wells capacity during drought conditions would have to be made up with water conservation practices, recycling, and utilizing the City's WTP.

WATER SUPPLY VERSUS WATER USAGE

As discussed above, the City's current total water production capacity from its four wells and WTP is estimated at 4.5 MGD (i.e., 2.8 MGD from the wells, and 1.7 MGD from the WTP). Firm production capacity is a measure of the water systems ability to produce water with the largest continual water producer being out of service. The largest producer in the City's water system is the 8-inch Scotts Creek Well, which has a production capacity of between 1.0 to 1.3 MGD. Therefore, the City's current firm production capacity is estimated at about 2.7 MGD. However, due to summertime draw-down of groundwater levels at the City's Green Ranch Wells, it has been demonstrated in the past that these wells can be severely impacted during drought conditions possibly affecting the City's future firm production capacity during the summer months when water is needed the most. Further impacting the City's future water production from the Green Ranch Wells would be the complete loss of the Green Ranch Wells, if a new lease agreement cannot be reached between the current Green Ranch property owner and the City by 2014. An emergency water source from Lake County would be available to supplement the City's needs if the Green Ranch Wells were to be disrupted, but this source of water is controlled by Lake County with its own water needs.

The City's 2008 Master Water Plan indicates that the current MDD within the City is about 1.82 MGD, suggesting that Lakeport's current firm production capabilities (i.e., 2.7 MGD) exceed the current MDD water demands.

Correspondingly, the City's Master Water Plan predicts that over the next 20 years the City's growth rate is projected to be about 1.1 percent. Based on this growth, it appears that the City's MDD could reach about 2.3 MGD by Year 2028, which is still below the estimated firm production capabilities of the system. However, as discussed, some of the City's production capability is reliant on the Green Ranch Wells that may be subject to reductions in capacity due to drought conditions and also land ownership.

CITY OF LAKEPORT WATER COSTS

Currently, rate payers within the City of Lakeport are charged $16.69 for the first 1,000 cubic feet of water, and $2.85 per 100 cubic feet above 1,000 cubic feet, depending on monthly usage. This equates to approximately $1,230 per Ac-Ft of potable water.

IV. WASTEWATER CHARACTERISTICS AND FACILITIES

The City's original wastewater treatment plant (WWTP), located at Larrecou Lane, was constructed in 1939. It was expanded in 1959, and again in 1979. The original plant used a series of clarifiers and a trickling filter to treat the wastewater prior to pumping it to an effluent reservoir where it is stored and used for irrigation on City-operated pastures. In 1991, the City constructed a new wastewater facility at Linda Lane to replace the antiquated and inefficient

Larrecou Lane treatment plant. The City's current wastewater facility was designed for an ADWF treatment capacity of about 1.0 MGD and a peak wet weather flow (PWWF) capacity of approximately 3.0 MGD. As can be seen below, it is anticipated that the existing WWTP peak treatment capacity will be exceeded within the next 20 years.

In 2008, there were approximately 2,046 single-family RUEs served by the City of Lakeport sewer system. The projected 20-year RUE value for the City's existing City limits is 2,593. Based on projected growth rate of 1.1 percent, used in the 2008 City of Lakeport Master Sewer Plan, it is estimated that some of the City's WWTP processes will reach their capacity within the next 20 years (i.e., chlorine contact chamber and the aeration basins). The values shown below indicate projected wastewater flows based on the City's 2008 Master Sewer Plan.

	2008	2028
Average Dry Weather Flow, MGD	0.38	0.48
Potential Peak Wet Weather Flow, MGD	2.8	*3.4

*Assumes a 1.1 percent growth rate and infiltration and inflow (I&I) reduction projects will be successful in reducing PWWF.

The WWTP is considered to be a secondary treatment facility. The unit processes of the WWTP consist of a headworks with a mechanical bar screen, two parallel earthen aeration basins with two cells, an effluent pump station, 48-inch diameter 650-foot chlorine contact pipe, effluent reservoir, irrigation pumping station, and effluent irrigation fields. Most processes at the WWTP are automatically controlled by a programmable logic controller (PLC) that is located within the WWTP control building.

The facilities were designed to produce un-disinfected secondary effluent in accordance with California Department of Public Health, Title 22, Chapter 3, and Section 60304(d). The facility provides treated effluent with monthly average Coliform of 23 MPN/100mL, and settleable solids of 0.2 ml/l. Appendix B contains copies of recent laboratory test results of the effluent quality. Effluent is stored in the reclaimed water storage reservoir and used for pasture irrigation on the City disposal area.

The City's existing reclaimed water storage reservoir has a gross storage volume of about 650 Ac-Ft. After subtracting an allowance for freeboard and dead storage, there is a net available storage of about 600 Ac-Ft. The City is currently negotiating with the Regional Water Quality Control Board (RWQCB) to revise the WWTP discharge permit to increase the freeboard at the reservoir; thus, increasing the available storage to approximately 650 Ac-Ft.

The effluent reservoir was designed to retain the excess seasonal wintertime effluent flows and rainfall that cannot be applied to the effluent irrigation fields during periods of rain based on the current WWTP discharge requirements issued by the RWQCB. In order to achieve this goal, the current practice at the WWTP is to minimize the volume of stored effluent in the reservoir, prior to October of each year, in order to maximize the amount of storage volume in the reservoir for anticipated rains and increased winter sewage volumes. As discussed, the City accomplishes this goal by aggressively irrigating approximately 332 acres of pasture land between April and October, and then applying irrigation to the fields as precipitation conditions allow during other parts of the year. City records indicate that over the past 5 years (see Figure 2), the City has generated an average of about 605 Ac-Ft of recycled irrigation water per year. The recycled water generated at the City's WWTP is made up of two components: 1) influent coming into the plant from the City's sewer collection system; and 2) rain water falling on the City's storage reservoirs. Figure 2 compares the amount of yearly influent entering the WWTP and the amount of recycled water that is generated for irrigation. Given factors such as pond percolation rates, evaporation, precipitation amounts, and meter accuracy, the amount of influent entering the WWTP corresponds closely with the amount of recycled water that has been generated at the plant.

Commonly, the City irrigates those lands that have established pasture land first, followed by less productive grasslands, in order to utilize the recycled water efficiently. If the City were to irrigate the entire 332 acres, the average annual recycled water application rate that they would apply would be roughly 1.8 Ac-Ft per acre of irrigated property. As a comparison, the California DWR compiled agricultural water use data for different crops raised in Lake County, (see Table 2) indicates a pasture irrigation rate of about 3.1 Ac-Ft/year. Currently, average production of treated effluent at the City's treatment facilities falls well below what would typically be applied to 332 acres of pasture land in the Lake County area over a typical growing season. Based on this information, it appears that the City has a surplus of irrigated land versus average annual recycled water production.

Obviously, precipitation has a significant impact on how much recycled water is available for irrigation. For example, during the wet year of 2005 to 2006 (see Figure 2), the City collected and applied approximately 750 Ac-Ft of recycled water onto the irrigated land, but in the drought year of 2007 to 2008, only 483 Ac-Ft was discharged. For the purposes of this report, it is estimated that the current average annual effluent that is currently available for recycled water is approximately 605 Ac-Ft per year based on the past five years of recycled irrigation water generated at the WWTP. Based on the current average recycled water volume generated at the WWTP, and an annual growth rate of 1.1 percent, the projected 20-year annual recycled water volume would be approximately 753 Ac-Ft, per year, by Year 2029. By Year 2042, the volume will be roughly 870 Ac-Ft per year.

<u>City of Lakeport Sewer Rates</u>: Recycled water projects typically provide wastewater treatment and disposal benefits. These benefits allow a portion of the recycled water project to be funded through sewer rates and connection fees to the areas that receive the recycle water benefit. Currently, sewer rate payers within the City of Lakeport are charged $42.93 per month for a single-family dwelling sewer fee.

V. TREATMENT REQUIREMENTS FOR DISCHARGE AND REUSE

In general, recycled water operations in California are governed by California Department of Public Health regulations and guidelines. Current regulations are compiled in the publication California Health Laws Related to Recycled Water ("The Purple Book"), updated in June 2001. The Purple Book consists of excerpts from the Health and Safety Code, Water Code, and Titles 22 and 17 of the California Code of Regulations (CCR).

Title 22, Divisions 4, Chapter 3 Article 1 of the CCR serves as the source for regulations relating to recycled water. Important definitions and recycled water use categories are discussed below:

- **Disinfected Secondary – 23 Recycled Water** means recycled water that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed an MPN of 23 per 100 ml, utilizing the bacteriological results of the last seven days for which analysis have been completed, and the number of total coliform bacteria does not exceed, and MPN of 240 per 100 ml in more than one sample in any 30-day period.

- **Disinfected Secondary – 2.2 Recycled Water** 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 ml utilizing the bacteriological results of the last seven days for which analysis have been completed, and the number of total coliform bacteria does not exceed and MPN of 23 per 100 ml in more than one sample in any 30-day period.

- **Disinfected Tertiary Recycled Water** means a filtered and disinfected wastewater. Disinfection can be either by chlorine disinfected process following filtration that provides a contact time (CT) value of 450 milligrams-minutes per liter at all times and a modal CT of at least 90 minutes at peak dry weather flow (PDWF), or a disinfection process that when combined with filtration can remove 99.99 percent of the plaque-forming units of F-specific bacteriophage MS2, or the polio virus in the wastewater.

  Filtration process means an oxidized wastewater that has been coagulated and passed through natural undisturbed soils, or a bed of filter media; or has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis.

  Tertiary treated recycled water shall have a median coliform bacteria that does not exceed a MPN of 2.2 per 100 ml over a seven day period; a MPN of 23 per 100 ml in a 30-day period; and shall never have a MPN of 240 over 100 ml.

USES OF RECYCLED WATER

In the absence of any site-specific concern held by a local, state health, or water quality officials, all uses for recycled water are outlined in Table 3. The uses for recycled water outlined in this table do not apply to the use of recycled water on-site at a water recycling plant, or a wastewater treatment plant; provided access by the public to the area of on-site recycled water use is restricted. In all cases, there are restrictions on the application area as well as other requirements, including monitoring.

CURRENT LAKEPORT EFFLUENT

When discharging to the effluent storage reservoir, the City of Lakeport recycled water complies with the standards established by the California Department of Health Services (CDHS) for the statewide use of recycled water criteria effective June 2001 in Chapter 3, Article 1, and Title 22.

California Code of Regulations, Section 60301.225, Disinfected Secondary-23 Recycled Water. Currently, the City's WWTP discharge permit (see CRWQCB Waste Discharge Permit No. 98-207 in Appendix C) requires minimum effluent limits as shown in Table 4.

Table 5 includes recent laboratory results on the City's effluent quality characteristics. As can be seen, the City's recent effluent testing results indicate the current treatment processes appear to meet the CRWQCB requirements the majority of the time. In addition, the City's recent effluent sampling also indicates that the City's effluent biochemical oxygen demand (BOD) average is around 20.6 mg/L, and settleable solids is 0.1 ml/l.

Accordingly, the City's treated effluent is used to irrigate pasture land for grazing non-dairy cattle. Subsequently, Title 22 indicates that the City's current recycled water could be used for restricted irrigation applications such as the following uses:

- Orchards and vineyards where the recycled water does not come into contact with the edible portion of the crop.

- Non-food bearing trees.
- Fodder and fiber crops.
- Food crops that must undergo commercial pathogen-destroying processing before being consumed by humans.
- Ornamental nursery stock and sod farms.

The Department of Health Services, Title 22, Code of Regulations was consulted in order to determine the level of treatment needed for alternative off-site recycled markets discussed in this report. Because there is the potential for a significant number of off-site markets for the City's recycled water, and most of these markets could potentially be unrestricted (i.e., possible contact with the public), the CRWQCB has inferred that as a minimum treatment level, a disinfected secondary-2.2 recycled water standard, or disinfected tertiary standard may be necessary (see Title 22, Section 60301.220) for most of the off-site markets discussed in this Study. Based on other treatment facilities that abide by the secondary-2.2 standard, it is anticipated that the Lakeport discharge requirements for off-site markets would, as a minimum, be modified from what is shown in Table 5.

Unfortunately, it is very difficult to consistently reduce the Total Coliform bacteria concentration to less than 23 MPN/100 mL over a 24-hour period (see Table 5) using the current secondary treatment processes (aerated basins/chlorine disinfection) that are utilized at the Lakeport WWTP without some type of additional treatment. This is primarily due to the unpredictable concentrations of total suspended solids (TSS) within the aeration basin effluent, which may affect the disinfection process by shielding bacteria. For example, during spring when there is an increase in algae within the aeration basins, the TSS tends to rise significantly and coliform samples will exceed 23 MPN/mL. Therefore, it is very likely that some type of clarification/filtration treatment process (see Title 22, Section 60301.320) would be necessary to upgrade the existing WWTP if most of the proposed off-site recycled water markets (i.e., vineyards, unrestricted golf courses, parks, orchards, etc.) discussed in this report were established.

VI. RECYCLED WATER MARKET

This section summarizes the recycled water market assessment that was completed for the Lakeport area Feasibility Study. Potential customers throughout the local area were investigated to assess the opportunity for recycled water use.

Given the increasing demand and associated rising costs for water in California, the demand for recycled water is expected to continue to increase. Given the relatively rich water resources in Lake County, recycling has not taken off as it has in other parts of California. However, this is changing as Lake County water suppliers deal with increasing drought conditions and securing long-term water supplies. It should be noted, this market assessment represents a preliminary review of the potential markets. More detailed investigations are needed to assess customer needs, operations, and recycled water delivery. Additionally, market assurance would need to be obtained from potential customers if a recycled water project was found to be economically feasible and implemented by the City. The market assurance includes letters of intent, contracts with water customers, and/or a mandatory recycled water use ordinance. Obtaining market assurances was not part of this Feasibility Study.

One of the important aspects of defining the recycled water market for this study was costs of treatment and transmission of the water to prospective users. Undoubtedly, the closer the recycled markets are to the source of the recycled water the less expensive the conveyance costs will be. Therefore, the first step in identifying possible markets for the City's recycled water was to target those prospective recycled users closest to the source of the recycled water.

Prospective recycled water users within 2 miles of the WWTP were considered in close proximity to the City's treatment plant and were targeted with questionnaires (see City of Lakeport letter – Appendix D), correspondence, and site visits to discuss possible recycled use. Prospective recycled users beyond 2 miles were considered long distance from the plant and were reviewed based on tentative development plans, correspondence, previous study reports, and phone calls. Plate 2 illustrates typical recycled market areas from the City's current WWTP.

AGRICULTURAL MARKET

As can be seen from Figure 3, the City of Lakeport is located in an agriculture-rich Lake County. The County produces a number of crops, but primarily the biggest crops are grapes, pears, and walnuts. In addition, Lake County farmers devote a significant amount of land to pasture for livestock. In 2006, the agricultural output of the County was estimated at $68 million dollars (California Agricultural Resources Directory, 2007). Figure 3 shows the Lake County Important Farmland 2006, published by the California Department of Conservation. As can be seen from this map, a significant area southeast and northwest of Lakeport is designated as either prime farmland, or farmland that has statewide importance. Thus, it appears that there are considerable opportunities to utilize recycled water on agriculture land in Lake County; in particular, near the City's WWTP facilities.

Table 2 is a compilation of agricultural usage and annual irrigation demands for major agricultural practices in Lake County. As can be seen from this table, pasture land and deciduous orchards (i.e., pears and walnuts) use about twice as much water per season as grapes. In addition, a typical orchard and pasture irrigation season spans from March through October; whereas vineyards have an irrigation season from May through September. This seasonal difference would allow for an extended recycled water irrigation season and subsequently would require less storage requirements versus irrigation on vineyards.

In order to explore possible agricultural markets for the City's recycled water, the City sent out informational letters to a number of agriculture property owners within close proximity of the City's WWTP (see Appendix D) inviting them to an informal meeting to discuss recycled water potential. In addition, the City's consultant contacted the Lake County Farm Bureau and also performed site visits with local farmers, vintners, and ranchers to discuss recycled water use. From these discussions, it was determined that there was interest in using recycled water for agricultural use in the vicinity southeast of the City's WWTP. Some of the potential agricultural uses are discussed below.

PASTURE LAND

As discussed above, the City irrigates about 332 acres of pasture land with secondary un-disinfected recycled water at their WWTP. These pastures are leased to local ranchers that graze approximately 200-head of beef cattle. The current leasing agreement with the City brings in about $30,000 in revenues per year. The City's irrigation facilities are regulated by the CRWQCB Waste Discharge Permit (98-207). The discharge permit places strict controls on public contact, recycled water quality, monitoring, irrigation practices, and the amount of recycled water that can be discharged. WWTP records show over the past five years the City has generated and applied an average 605 Ac-Ft of recycled water a year onto their fields (see Figure 2). Based on Table 2, the average amount of recycled water produced at the WWTP (605 Ac-Ft) over the past five years could effectively irrigate approximately 195 acres of pasture land per year.

The Lake County Farm Bureau estimates that there was approximately 3,100 acres of pasture land being utilized in Lake County in 2001. Of this amount, it is estimated that there is approximately 200 to 300 acres of irrigated pasture land located within two miles of the WWTP. Although none of the farmers or ranchers that are currently raising pasture land south of the City Treatment Plant responded to the City's recycled water inquiry letter (see Appendix D), the Lake County Farm Bureau indicated that pasture is a large component of local farm practices. The Farm Bureau indicated that most farmers that raise pasture rely on groundwater pumping for their source of irrigation water. Although irrigation practices for pasture land can vary, a significant number of the farmers in Lake County use either spray irrigation or border irrigation.

As discussed above, the current estimated power costs for pumping groundwater is about $42 per Ac-Ft, and the estimated seasonal irrigation rate for pasture land (see Table 2) is about 3.1 Ac-Ft per acre of pasture. Therefore, the estimated irrigation cost per acre of pasture from water wells is about $130 per acre, per growing season.

VINEYARDS

The Lake County climate is ideal for grape production, and changes in the agricultural market over the last ten years (favorable to grapes, unfavorable to walnuts) have led to a considerable expansion of acreage planted in grapes. This is especially notable in acreage immediately south of the City's WWTP (see Plate 2). There are approximately 620 acres of vineyards within 2 miles of the City's treatment facilities. Several vintners were contacted (Kendall-Jackson, Devoto, etc.) during this report investigation concerning the possible use of recycled water and a significant number of the vintners that were contacted indicated that there was some interest in using recycled water in their operations in the future, especially as a possible supplement during drought conditions. Comments by vintners indicated that there was a great deal of interest in using recycled water for freeze protection irrigation, which would be a sprinkler type irrigation during the early growing season (i.e., April to May).

Table 2 indicates that in Lake County the average water use per acre of wine grapes is about 1.3 Ac-Ft, per growing season (i.e., May through September). Based on the current average of 605 Ac-Ft of recycled water generated at the Lakeport WWTP over the past 5 years, about 465 acres of grapes could be irrigated solely with Lakeport recycled water annually.

Vineyard irrigation supply is typically from groundwater wells and a number of the larger vintners use earthen impoundments to store water prior to discharge onto the field using either sprinklers or drip irrigation practices. As discussed above, current power costs for pumping groundwater is about $42 per Ac-Ft, and the estimated seasonal irrigation rate for vineyards is about 1.3 Ac-Ft per acre of grapes. Therefore, the estimated irrigation cost per acre of vines is about $55 per acre, per growing season; this cost does not include frost control irrigation.

While most of the agricultural users within a 2-mile radius of the WWTP, are relatively small, the 300-acre properties owned by Kendall-Jackson Winery, south of the WWTP (see Plate 2), were identified as a potential reclaimed water user. Preliminary discussions with Kendall-Jackson irrigation managers indicate that Kendall-Jackson may be interested in using recycled water in the future.

DECIDUOUS ORCHARDS

A significant amount of walnuts, pears, and apples are grown in Lake County. It is estimated that within 2 miles from the City's WWTP there are approximately 720 acres in orchard production at this time. Typical irrigation practices within the established orchards is through flood or spray irrigation taken from water wells. Table 2 indicates that in Lake County the average water use per acre of orchards is about 2.7 Ac-Ft, per acre of trees, per growing season (i.e., March through October). Based on the current average of 605 Ac-Ft of recycled water generated at the Lakeport WWTP over the past 5 years, about 224 acres of orchards could be irrigated solely with Lakeport recycled water annually.

As discussed above, current power costs for pumping groundwater is about $42 per Ac-Ft, and the estimated seasonal irrigation rate for orchards is about 2.7 Ac-Ft per acre of orchards. Therefore, the estimated irrigation cost per acre of orchards is about $114 per acre, per growing season; this cost does not include frost control irrigation.

After discussing the advantages and disadvantages of using recycled water with several off-site farmers and ranchers in the Lakeport area, it would seem that most ranchers and farmers would be more inclined to utilize the City's recycled water if there were limited restrictions on its use. Given the prospect of constructing mandatory tail-water facilities, having their operations monitored by state health officials, restrictions on the type of crop or livestock that is produced, and possibly having to construct a secondary recycled irrigation system, most ranchers and farmers that were contacted were reluctant to consider using recycled water. However, because of the potential for significant impacts on current groundwater supplies (i.e., lowering groundwater supplies) due to drought conditions, most farmers that were contacted were willing to consider recycled water as a viable option in the future. Certainly, if agricultural water wells and/or groundwater quality begin to degrade in the Lakeport area, other sources of water (i.e., recycled water) will be sought after by local farmers, especially if these other sources of water are economically competitive with groundwater supply. However, at this time it appears that groundwater pumping will be the main source of irrigation water for the local agriculture industry for the foreseeable future due to its apparent abundance and cost.

URBAN MARKETS

The potential urban market includes landscaping irrigation, industrial use, and other non-potable uses. Parks, golf courses, schools, industrial water use, and dual plumbing of new developments were identified as the potential urban markets. Existing and proposed landscaping irrigation demands for parks, golf courses, and schools were estimated based on a consumptive use methodology and Table 2 annual turf grass water demand.

Because the City of Lakeport's main industries are tourism and agriculture, there were no large traditional industries identified in the Lakeport area for this report that use a significant amount of water. Therefore, it appears that there are no current large industrial users within the Lakeport area that would benefit from using recycled water. In addition, there currently are no golf courses within the City's sphere of influence; however, there appears to be a potential for the construction of golf courses at the proposed Lakeport Golf Course Development (LGCD) and the Cristallago Development (see descriptions below). Article 7, Section 13550, of the California Water Code, declares the use of potable domestic water for irrigating golf courses as a waste, or an unreasonable use of the water if recycled water is available, which meets the quality standards for the intended use.

There is one large park (Westside Park) and several smaller parks within the City limits, that currently irrigate with either wells, raw lake water, or City supplied potable water (See Plate 2). The County of Lake operates the County fairgrounds on Martin Street, which includes irrigable park lands and baseball fields. The Lakeport Unified School District complex on Lange Street contains a significant amount of landscaped property that uses Lakeport potable water and lake water for irrigation. Table 6 summarizes the overall estimated landscaping irrigated acreage and the annual water demand for existing parks and schools within the City of Lakeport.

New developments provide a more cost effective opportunity to implement dual plumbed systems to allow for recycled water use. Plate 2 shows the location of proposed future developments within the vicinity of Lakeport that could occur over the next 20 years. Obviously, the location and size of each of these proposed developments is a major factor that could impact the feasibility of serving recycled water to some of these developments. As one can see from this Plate, several of the proposed developments are located at or near the City's WWTP and would lend themselves to receiving recycled water from the plant.

Table 7 represents estimated future areas of growth within the City over the next 20 years. This disbursement was based on the City Planning Departments proposed housing unit estimate and a growth rate of 1.1 percent annually.

Several of the more prominent urban markets are discussed below:

Lakeport Golf Course Development (LGCD): Starting in 2006, the City of Lakeport was contacted by a land developer (i.e., Boeger Land Development) in regard to acquiring a significant portion of the City's 740-acre property at the existing Lakeport WWTP to construct a new development called the proposed LGCD (see Plate 2 – 20-YEAR GROWTH AREA 19). The developers' proposal was to purchase the City's property and to convert some of the land into a 200-acre, 18-hole golf course. In addition, the developer would construct approximately 1,500 residential and commercial units surrounding the golf course. Irrigation for the golf course would be generated by updating the City's WWTP to a tertiary plant partially, or completely, funded by the developer. It was proposed that the proposed LGCD landscaping irrigation, water for flushing toilets, and other non-potable uses such as commercial car washing could also use recycled water generated from the City's updated WWTP.

Typically, the irrigated portion of most golf courses is about 67 percent of the actual size of the golf course area (Metcalf and Eddy, "Water Reuse"). Therefore, it can be assumed that roughly 133 acres of this potential golf course would need to be irrigated. The recycled water usage potential for a 200-acre golf course is based on Table 2 turf grass irrigation rates and equates to roughly 412 Ac-Ft, per growing season, which is about 68 percent of the average recycled water generated at the Lakeport WWTP currently. It is anticipated that a portion of the reclaimed water used within the golf course would be stored in on-site ponds and wetlands.

It is estimated that about half the area that is used by a single-family residence is used for irrigation and landscaping. Given that premise, the proposed development will encompass 600 acres of land for residential/commercial purposes; therefore, it is conceivable that 300 acres of this land could be irrigable.

<u>Cristallago Development</u>: Cristallago (proposed development) is a planned resort community that is located 5 miles north of the Lakeport WWTP (see Plate 2). The proposed development would have 650 single-family residential units, 325 resort units, community club, community pool, and a 189-acre, 18-hole golf course. The proposed development is located within the Lake County Special District Community Service Area No. 21. The Cristallago Development EIR (Water Works Administrative Draft EIR dated October 7, 2008) estimates that the irrigation for the golf course will come from reclaimed water. It is estimated that about 600 Ac-Ft of reclaimed water will be needed for the golf course irrigation annually.

Cristallago's EIR proposes that the golf course's recycled water will be supplied from the Lake County Sanitation District (LACOSAN) Northwest Regional Wastewater Treatment Plant (NWRWWTP). The NWRWWTP facility is adjacent to the proposed Cristallago Development property (see Plate 2).

Currently, the NWRWWTP is a WWTP that disposes the majority of its treated secondary effluent to the Geysers via the Basin 2000 Geysers Pipeline and Southeast Geysers Effluent Pipeline (SEGEP) (see Figure 4). The WWTP generates and pumps about 1,860 Ac-Ft per year to the Geysers. The Geysers is a 1,500-megawatt geothermal cogeneration electrical plant that collects wastewater effluent from four WWTPs around the north side of Clear Lake in order to inject this water into geothermal wells to enhance steam generation (see Groundwater Recharge Section of this report). The Cristallago plan would be to contribute to upgrading the NWRWWTP to a tertiary plant such that about 600 Ac-Ft per year of recycled water would be diverted from the Geysers to irrigate the proposed Cristallago golf course. This alternative would require that LACOSAN pump 600 Ac-Ft from Clear Lake to make up the difference to the Geysers. The LACOSAN/Geysers joint operating agreement (LACOSAN et al, 2001) requires that 11,000 Ac-Ft per year be supplied to the Geysers either from treated effluent, or Clear Lake make-up water.

Although the Cristallago development is currently within the Lake County Special District Community Service Area No. 21 sphere of influence, and is a significant distance from the City of Lakeport's WWTP, this development's proposed plan to use recycled water to irrigate the golf course may present an opportunity for the City of Lakeport and LACOSAN to work together to provide this development with a source of recycled water and also link Lakeport to the LACOSAN Basin 2000 Geysers Pipeline, as well as the Southeast Geysers Effluent Pipeline.

Westside Park: Westside Park is a City-operated park off of Westside Park Road (see Plate 2). The park contains about 3.5 acres of irrigated soccer fields, playgrounds, and picnic areas. Adjacent to the developed portion of the park, the City owns an additional 56 acres of property that the City is considering for expansion of the Westside Park complex. Several options for park expansion have been discussed, including an equestrian park and additional soccer fields which would require additional irrigation. Undoubtedly, the availability of irrigation water will be a big factor in the City's future development plans for this park.

Parallel Drive Development: Another source for recycle utilization is potential private and public developments along the west side of Parallel Drive between the City's WWTP and Westside Park (see Plate 2). Several land owners and developers within this area have discussed a strong interest in developing this area. The City's planning department has estimated that as many as 200 to 300 RUEs could be constructed within this area over the next 20 years (See Table 7). In addition, the City has been in discussions with Mendocino Community College, which is planning to construct a satellite campus along Parallel Drive.

Highway Landscaping: As can be seen from Plate 2, California State Highway 29 and State Route 175 run through the study area. A significant portion of Highway 29 through the City of Lakeport has a center median that is currently not landscaped primarily due to lack of funding and irrigation facilities. In addition, a portion of State Route 175 is also located adjacent to the Lakeport WWTP and is currently not landscaped. As a part of this study, inquiries with Caltrans District 1 officials concerning the potential of irrigating highway landscaping with Lakeport recycled water was posed. Caltrans officials indicated that at this time there are no plans for landscaping and irrigating these sections of highway.

GROUNDWATER RECHARGE

Using municipal recycled water as a source to recharge groundwater is an approved practice in California that is regulated by the California Department of Public Health (CDPH) and the RWQCB. The use of recycled water for groundwater recharge has many benefits:

- Provides a source of new water to supplement an over drafted groundwater basin, which ultimately limits the amount of water that can be economically and sustainably pumped in the long-term for potable and agricultural uses.
- Recycled groundwater recharge can limit or reduce an uncertain future reliability of Lake County groundwater water supplies due to factors such as climate change, earthquake, power outage, or environmental, and wildlife protection needs.
- It can limit future water treatment and conveyance capacity and increasingly stringent potable water quality standards.
- It can expand future wastewater effluent management options by providing a source for wintertime disposal.
- Decreases the need for expensive effluent reservoir storage improvements needed for future growth.

Since the 1960's treated recycled water has been used in Southern and Central California as a source of groundwater recharge to combat the intrusion of salt water into naturally occurring aquifers due to over use of pumping groundwater. LACOSAN has also been supplying treated secondary effluent for groundwater injection from its WWTPs to the geothermal fields at the Geysers for almost 14 years. This unique project supplements local groundwater with secondary treated recycled water for the conversion of steam into energy cogeneration.

There are two common techniques used in applying recycled water for groundwater recharge; percolation ponds (spreading basins) and direct injection into groundwater aquifers. Typically, groundwater recharge with recycled water is combined with other water sources such as storm water runoff in order to accommodate seasonal fluctuations in recycled water supply.

Percolation ponds, as the names implies, are constructed over pervious strata that is directly linked to unconfined aquifers. Recycled water that is stored in the percolation ponds slowly percolate into the ground supplying the aquifer with this surface water. In order to optimize the location of percolation ponds the site that is chosen would ideally have natural gravel and sand strata that is directly linked to a shallow unconfined aquifer with a hydraulic gradient that would tend to move the groundwater quickly away (i.e., getaway capacity) from the "mound" of groundwater created by a percolation pond. Typically, recycled water used in percolation ponds have less stringent treatment requirements then direct injection recharge methods (i.e., the use of advanced treatment such as reversed osmosis (RO) and microfiltration may not be necessary).

Direct injection of recycled water into a groundwater source utilizes a pump(s) to inject the recycled water underground. Typically these types of systems are used in those areas where an unconfined aquifer does not exist (i.e., a confined aquifer), or is too deep to allow direct percolation to be effective.

Current "draft" CDPH Groundwater Recharge and Reuse regulations (August 5, 2008) require that any agency that is considering a groundwater recharge and reuse project (GRRP) meet several requirements and conditions:

- Maintenance of a source control program that includes an assessment of the fate of CDPH-specified contaminants (i.e., inorganic, radionuclides, organic chemicals, lead, copper, and disinfection byproducts) through the wastewater and recycled municipal wastewater treatment systems must be implemented.
- Wastewater contaminant source investigations and contaminant monitoring that focus on CDPH-specified contaminants must be initiated.
- Other contaminates not specifically addressed by the CDPH such as pharmaceutical compounds and endocrine disruptors need to be tested in order to confirm that large concentrations of these are not passing through the recycle treatment process.

- A regularly updated inventory of contaminants the community discharges into the wastewater collection system so that new contaminants of concern can be readily evaluated.
- The wastewater to be used for the GRRP as recycled municipal wastewater shall be filtered disinfected tertiary recycled water. Additional treatment such as RO, or advanced oxidation treatment, may be necessary especially when direct groundwater injection is employed.
- The recycled municipal wastewater that is used for the GRRP shall be retained underground for a minimum of six months prior to extraction for use as a drinking water supply. To demonstrate that the minimum retention time of 6 months is being followed the agency shall initiate a tracer study utilizing an added tracer.
- The identification and location of all drinking water supply wells (public and private) and monitoring wells within three "gradient" years of the proposed GRRP, based on groundwater flow directions and velocities expected under operating conditions, shall be identified.
- An extensive monitoring program that involves installation of monitoring wells and collecting well samples from near-by potable water wells.
- An effluent nitrogen control program.

Groundwater from the Scotts Valley Aquifer is a major part of the water supply for the City of Lakeport. The principal water bearing formation in the Scotts Valley Aquifer is made up of sandstone (Santa Margarita Sandstone) that lies above shale. This sandstone stratum is the main source of groundwater for local wells. The aquifer is generally unconfined with semi-confined, or confined, conditions disbursed throughout the aquifer. Groundwater recharge occurs from the percolation of precipitation, seepage from streams, and subsurface flow from adjacent areas and formations. Percolation of precipitation is the most significant source of recharge (Muir, K.S. 1981. *Assessment of the Santa Margarita Sandstone as a Source of Drinking Waterfor the Scotts Valley Area, Santa Cruz, County, California*. Menlo Park: U.S. Geological Survey Water Resources Investigations, 1981). As discussed, an unconfined aquifer is well suited for a percolation pond type GRRP system.

The estimated safe yield of the Scotts Valley Aquifer groundwater basin is approximately 4,500 Ac-Ft per year. Currently, the estimated withdrawal from this aquifer is approximately 4,720 Ac-Ft per year (based on DWR Scotts Valley Groundwater Basin Bulletin 118). This evidence would indicate that the Scotts Valley Aquifer may be subject to current and future overdraft problems. Therefore, a groundwater recharge project to replenish the Scotts Valley aquifer using Lakeport recycled water might increase the annual groundwater basin safe yield.

As discussed above, regulatory requirements for a proposed Lakeport GRRP would necessitate that the City perform a site specific analysis in order to determine if a GRRP is viable. Some of the more critical preliminary analysis items would be:

- Investigate possible recharge sites that have natural occurring gravel and sands in close proximity to groundwater level. One such site may be near Scotts Creek where groundwater is known to be in close proximity to the surface and stream bed alluvium permeates the area.
- Perform an inventory of active potable water wells within the study area and potential GRRP sites.
- Conduct groundwater quality monitoring.
- Conduct site-specific, hydrogeologic testing to determine range of infiltration rates and "getaway" capacities. This may require the performance of a groundwater tracer study in order to determine a recharge site that would provide a CDPH mandated 6 month retention period.
- Complete a treatment plant pilot study that would determine the necessary treatment processes needed to achieve CDPH standards. A pilot study may require the use of advanced technologies such as RO, microfiltration, and/or nanofiltration if a direct injection project is desired.

Based on unknown site specific variables (percolation rates, aquifer depths, groundwater gradients, existing potable water wells, etc.), required to properly locate a groundwater recycle reclamation project, it is difficult to estimate costs and local impacts that could occur with such a project in the Lakeport area for this Study. Certainly, a much more rigorous analysis and selection process must be performed before a proposed GRRP can be considered. The goal of locating a GRRP within the Lakeport area should be to select a site at or near the Lakeport WWTP in order to reduce the expense of transporting treated water to a groundwater recharge facility else ware in the study area. Obviously, many site specific and treatment factors would have to be provided to the RWQCB and CDPH before a Lakeport GRRP would be considered by these agencies.

Lakeport Groundwater Recharge and Reuse Alternative: In order to compare a potential groundwater reclamation project with other alternatives discussed in this report, it was assumed that a direct injection groundwater reclamation project could be constructed at the existing Lakeport WWTP. This project would include expansion of the WWTP to tertiary treatment using RO technology and two groundwater injection wells. The expanded WWTP and injection wells would be sized to accommodate a future average day WWTP flows of roughly 0.55 MGD (i.e., 390 GPM).

In general, RO treatment processes would be preceded by a two-step pretreatment process. The first step would be the addition of a coagulant prior to clarification. The second step would be filtration most likely using a micro-filtration process. Following pretreatment, the water pressure is boosted to about 1,000 PSI and then it is fed to the RO membranes for treatment.

Groundwater Recharge the Geysers Project: As has been discussed, the Geysers geothermal field, the largest geothermal field in the world, is about 20 miles southeast of Lakeport, California. The Geyser facilities use deep wells tapping into subterranean geothermal steam to operate steam power turbines for generation of electrical power. The field started electrical production in 1960 with a 12 MW power plant. By 1987, steam production peaked at 250 billion pounds, generating approximately 1,500 MW. Unfortunately, steep declines in steam generation began in the late 1980's and were due to declining groundwater reservoir pressure. The root cause of this lack of groundwater was a combination of overdevelopment, lack of natural groundwater recharge, and low artificial recharge. It was estimated that without some type of artificial groundwater recharge, only 20% to 40% of the potentially recoverable electrical energy from the Geysers would actually be produced (depending on reservoir porosity), leaving the remaining 60% to 80% in the reservoir as unexploited heat. During this same period, the LACOSAN, which provides sewer service to the communities of Clearlake, Lower Lake, and Middletown, found its wastewater systems deficient in terms of disposal capacity of its treated wastewater effluent. These deficiencies prompted the state of California to require LACOSAN to find additional means of disposing of larger quantities of their effluent.

In 1995, several Federal, State, and local agencies (see list below) banded together to construct a regional recycled water system that would pump treated recycled water to the Geysers from the LACOSAN treatment facilities around the northern Clear Lake area (see attached Figure 4). The Southeast Geysers Effluent Pipeline Project was completed in 1997, at a cost of $45 million dollars, and included construction of a 30-mile pipeline linking LACOSAN treatment plants on the north side of Clear Lake with the Geysers steam fields. Included in the project was the construction of six pumping stations and improvements to two LACOSAN treatment plants (the Southeastern Regional WWTP in Clear Lake and the Middletown Treatment Plant facility). A second $30 million dollar phase (Basin 2000 Geysers Pipeline) to the LACOSAN Recycled Project, which included an additional 20 miles of recycled water pipeline linking two additional treatment plants to the Geysers was completed in 2003. The LACOSAN system now collects approximately 2.8 billion gallons annually of effluent from a total of four WWTPs, serving 22,000 persons, and 360 businesses in 10 Lake County communities. This represents approximately 85 percent of all effluent produced in Lake County, and equates to approximately 77 MW of power generated at the Geysers.

The proposed third stage of the Geysers Effluent Pipeline system is named the Full Circle Effluent Pipeline Project and the goal of this future pipeline project would be to construct a system of pumping stations and pipelines to convey treated wastewater from the existing WWTPs at Lakeport and Kelseyville, around the south side of Clear Lake, connecting with the existing SEGEP (see Figure 4). This 27-mile pipeline/pumping system would benefit the City of Lakeport by allowing the City to pump treated effluent all year round, thus reducing the need to store treated effluent in the City's effluent storage reservoir during the winter. The City's current 2008 Master Sewer Plan suggests that given the current City growth rate, and on-going I&I reduction program, the City's wastewater effluent reservoir has capacity until at least Year 2028.

However, after that period additional reservoir volume, or year round disposal will be needed; thus, the Full Circle Geysers Pipeline Project would be a solution to this perceived capacity limitation.

The estimated construction costs for the entire Full Circle Geyser Pipeline Project is roughly $65 million dollars (estimated costs do not include Clear Lake intake structures and pipelines). Given the magnitude, and costs of the proposed Full Circle Geyser Pipeline Project, it will be essential that the City of Lakeport meet with LACOSAN in order to identify and organize stakeholders for the project. Preliminary discussions with LACOSAN officials, as a part of this Feasibility Study, suggest that studies have been performed on the project (Preliminary Design Report Full Circle Effluent Pipeline for LACOSAN CH2M Hill November 2004), but there were no plans for implementing the Full Circle Geyser Pipeline Project due to the lack of commitment by many of the possible stakeholders. The following is a list of stakeholders that could directly benefit from the project, and/or were involved with the previous SEGEP and Basin 2000 Geysers Pipeline Projects:

- Lake County Sanitation District (LACOSAN)
- City of Lakeport
- Pacific Gas and Electric Company
- Lake County Flood Control and Water Conservation District
- Northern California Power Agency (NCPA) – Geysers operator
- Calpine Corporation - Geysers energy producer
- Unocal Corporation
- California Water Resources Control Board
- California Energy Commission
- U.S. Department of Energy
- U.S. Department of Commerce
- U.S. Army Corps of Engineers
- U.S. Department of Interior

Constructing of the entire Full Circle Geyser Pipeline Project will take a considerable effort, both economically and politically, by all of the stakeholders mentioned above.

In the interim, the City of Lakeport could consider implementing initial stages of the Full Circle Geyser Pipeline Project as a part of its recycled water plan. One of these staged improvements would be the development and construction of WWTP upgrades, pumping stations, and pipelines to serve prospective agricultural users (see Agricultural Market section of this report), south of the WWTP, along the proposed Full Circle Geyser Pipeline alignment. Construction of the first stage of the Full Circle infrastructure to serve agricultural users would require that pipelines and pumping facilities be sized to accommodate ultimate operating capacities for future Full Circle operations.

Another possible opportunity for Lakeport to utilize the Geysers for disposal of the City's recycled water is to connect to the LACOSAN Basin 2000 Geysers Pipeline/Pumping system on the north side of the City. Currently this system is located within 5 miles of the City of Lakeport, starting at the LACOSAN Northwest Regional WWTP (NWRWWTP).

Discussions with LACOSAN officials suggested that the current Basin 2000 and SEGEP system of effluent reservoirs, pumping stations, and pipelines was sized to serve ultimate build out (UBO) of the north and northeast Clear Lake communities (i.e., City of Clear Lake, Upper Lakeport, Nice, etc.) and there would be no capacity to serve the City of Lakeport. However, a subsequent review of an investigation by Water Works Engineers for the Cristallago Development (Cristallago Development Wastewater Collection, Treatment, Effluent Reuse and Golf Course Irrigation Administrative Draft EIR, April 9, 2008) suggests that there may be UBO capacity remaining in the LACOSAN effluent reservoirs (i.e., NWRWWTP and Southeast Regional WWTP SERWWTP effluent reservoirs) and Basin 2000 pipeline/pumping systems to accommodate additional effluent flows from other sources (such as the Cristallago development and possibly the City of Lakeport). The Water Works EIR hydraulic analysis suggests that the NWRWWTP and SERWWTP effluent reservoir capacities "are not exceeded" when using ultimate build out and wet weather annual conditions. Furthermore, the Water Works report goes on to suggest that under UBO (including the Cristallago development), and wet year conditions, the Basin 2000 Geysers Effluent Pipeline had a maximum annual flow rate of 3,070 Ac-Ft per year. Currently, the estimated maximum annual pipeline capacity is 4,340 Ac-Ft, per year, thus leaving approximately 1,270 Ac-Ft per year of UBO capacity in the pipeline system.

This apparent surplus of LACOSAN reservoir and pipeline capacity could be augmented if the proposed Cristallago 600 Ac-Ft golf course irrigation were diverted from the existing LACOSAN Geysers pipeline system. As a minimum, the City of Lakeport and LACOSAN officials should jointly discuss and examine what capacity is remaining in the existing Basin 2000 pipeline and the existing LACOSAN effluent reservoirs in order to determine if the proposed Full Circle Geyser Pipeline Project is the best alternative for transmitting Lakeport recycled water to the Geysers, or a northern pipeline connection to the Basin 2000 system is possible.

ENVIRONMENTAL USE

Environmental use of recycled water is generally driven by the anticipated environmental benefit as opposed to actual water demand. Potential opportunities for environmental uses include stream flow augmentation, wildlife habitat restoration, wetland enhancement, and other related environmental purposes. Environmental uses of recycled water would need to be evaluated in a future study to assess the potential impacts to local groundwater supplies, lake water quality, agricultural lands, and other environmental habitats. One potential environmental use would be augmentation of summer lake levels in Clear Lake with disinfected tertiary recycled water. Based on discussions with the RWQCB, direct augmentation of Clear Lake with recycled water is not currently viewed as a benefit to the region, and would require a significant environmental review by State and Federal agencies before it could be considered a viable alternative.

Recycled water could also be used to develop constructed wetlands to provide habitat for endangered species and other wildlife. Since the late 1800's, the Clear Lake area has lost over 85 percent of its native wetlands due to development and agriculture. Wetland restoring projects have been accomplished within this region. For example, Lake County's Lyons Creek Wetlands at the Northwest Regional WWTP is a 22-acre wetlands effluent polishing system to treat secondary effluent prior to disposing of it at the Geysers. The Lyons Creek wetlands represent a major restoration of riparian habitat in this drainage. Construction and developing wetlands similar to the Lyons Creek Project in the Lakeport area would probably require conversion of agricultural land, or modification of other land uses near the City's treatment facilities.

In addition, recycled water quality is a significant consideration for any environmental use since pharmaceuticals, trace elements, pesticides, and other constituents could potentially result in adverse impacts to aquatic species. The quality of recycled water required for environmental use is dependent on the specific uses of the water. For example, the use of recycled water for a stream flow augmentation project into Clear Lake would most likely require advanced tertiary treatment such as RO, multi-stage flash, or possibly mechanical vapor compression in order to obtain approval from regulatory agencies and the public. Treatment requirements, potential wetland sites, water quality goals and acquisition of a NPDES Permit should be evaluated in the future as specific environmental projects are identified.

VII. PROJECT ALTERNATIVE ANALYSIS

PLANNING AND DESIGN ASSUMPTIONS

Recycled Water Quality: The use of recycled water for irrigation, and possibly groundwater recharge, raises a number of water quality issues related to public health and water chemistry, which affects suitability for irrigation and other potential uses. The public health aspects of recycled water irrigation are regulated by Title 22 of the California Code. Given that the City of Lakeport's market areas include agricultural crops that may be consumed raw; the potential for direct public contact in parks, golf courses, and schools; the possible use of recycled water within proposed urban development landscaping; and the provisions of Title 22, disinfected tertiary recycled water would most likely be required for any off-site market. This would generally provide for unrestricted water use for irrigation from a public health perspective. This same level of treatment, however, would not be required for continuation of the existing disposal operations at the Lakeport Treatment Plant that utilize treated effluent for fodder crop irrigation.

The suitability of recycled water for irrigation is closely related to the type and concentration of chemical constituents present. Concerns include salinity, sodium hazard, and potential toxicity to plant foliage and roots from specific constituents. The tolerance of crops to various water quality constituents differ by crop/plant type. Furthermore, different varieties of the same plant can exhibit markedly different growth responses to water of similar quality. Crop tolerance to constituents in the irrigation water, soil conditions, method of irrigation, prevailing climate, and management are important factors in assessing the suitability of a particular water for irrigation purposes.

Generally, the tolerance of the most sensitive crop to the water quality constituents is the basis for assessing the suitability of the recycled water for irrigation. It is important to engage service area water users during the planning process to obtain additional guidance on water quality issues. Furthermore, water quality will be an important consideration for area districts in negotiating agreements for recycled water deliveries.

Researchers have studied crop tolerance to salinity and other constituents, and have published water quality guidelines for many agricultural crops and landscape plants. The University of California has compiled this data and developed general guidelines for assessing the suitability of water for irrigation. These guidelines, shown in Table 8, are general and flexible and are often modified based on local experience and special conditions of plant, soil, and method of irrigation.

The City of Lakeport provided some water quality data from the secondary effluent reservoir and is shown in Table 9. Based on the treated effluent data shown in this table, the water quality of the potential Lakeport recycled water supply appears to be within acceptable range for agricultural and landscaping irrigation as shown on Table 8. Additional testing of the City's effluent for the other constituents, shown on this table, should be regularly performed in order to confirm that there are no adverse constituents that may impact crops and plants. If these subsequent tests indicate that the City's effluent water quality is not suitable for crop production the potential recycled water supply could be enhanced by treating a portion of the flow with a RO process and blending it with less suitable treated recycled water.

Other then the City's current recycled irrigation fields at the WWTP, and possibly groundwater recharge, the market research for this Study indicates that the largest potential for utilizing the City's recycled water is for off-site use. Subsequently, DPHS, Title 22, Code of Regulations was consulted in order to determine the level of treatment needed for alternative off-site recycled markets discussed in this report. Because there is the potential for a significant number of off-site markets for the City's recycled water, and most of these markets could potentially be unrestricted (i.e., possible contact with the public), the CRWQCB has inferred that as a minimum treatment level, a disinfected secondary-2.2 recycled water standard may be necessary (see Title 22, Section 60301.220), and that tertiary treatment could be required for most of these off-site markets. As discussed, Title 22 also allows for recycled water to be used for groundwater recharge on a case by case basis. Certainly, if groundwater recharge is to be considered as a possible market for the City's recycled water, some type of tertiary treatment with possibly advanced treatment processes would most likely be needed as a minimum in order for the DPHS and CRWQCB to consider this a viable alternative.

WASTEWATER TREATMENT PLANT UPGRADE ALTERNATIVES

In order to generate the recycled water quality mandated by Title 22 Recycled Water Standards from the existing Lakeport WWTP, there appears to be several treatment additions that could be implemented into the existing WWTP. As was discussed, some type of clarification/filtration process would be necessary to treat the stored effluent at the existing WWTP to meet secondary-2.2, or tertiary standards. Several WWTP processes were examined as a part of this investigation in order to determine what process has the best potential.

Conventional Clarifiers: The current ADWF at the WWTP t is roughly 0.38 MGD and peak flows can reach 2.8 MGD. Estimated growth over the next 20 years will increase these flows to 0.55 MGD ADWF and above 3.0 MGD peak flows. In order to treat this span of flow with a conventional clarifier, the overflow rate would have to be approximately 600 GPD/ft^2. In order to achieve this overflow rate, a conventional clarifier would have to be approximately 80 feet in diameter

Traditional clarifiers are typically not used to treat aerated pond system effluent due to elevated suspended solids (SS) that are generated from algae. The sedimentation rates for algae tend to be very low and often require chemical, or physical settling aids in order to have algae settle. Furthermore, the Lakeport aeration ponds have an estimated detention time of about 12 days during average flows, which is significantly longer than most conventional clarifier processes. Typically, any SS that pass through the aeration ponds are not likely to settle in a conventional clarifier with a much shorter detention period.

High Rate Clarification (HRC): Several HRC processes were examined in order to determine their suitability in upgrading the existing treatment plant and treating the prevalence of SS generated by algae within the existing Lakeport treatment processes. Common to most HRC treatment processes is the use of physical and chemical treatment to improve flocculation and sedimentation within a clarification process. HRC processes typically have a much smaller "footprint" then a conventional clarifier and, as the name implies, take less time to produce low SS effluent. Additional advantages, over traditional clarifiers, include better suitability for fluctuations in flow, have the ability to be started quickly, and are more reliable in producing low turbidity and SS effluent.

- Dissolved Air Floatation (DAF): In DAF, air is dissolved under pressure in the water to be treated followed by depressurization. Stream micro-bubbles are produced during the reduction of pressure in the waste. The bubbles surround slow-settling particles and float them to the surface whereby they are collected and removed. In the United States, DAF has been commonly used to treat oxidation pond effluent which can be high in algae. It is likely that for DAF to be effective for the Lakeport Treatment Facility, a coagulant and polymer will have to be added.

  Depending on the type of coagulant and/or polymer that is added, the maximum loading rate that a typical DAF unit can achieve is between 2 to 6 GPM/ft^2.

- Ballasted flocculation (BF): The BF process (Actiflo™) uses a polymer to attach coagulated particles to micro-sand for rapid settling in a lamella tube settler system. The micro-sand is separated from the sludge in a hydrocyclone and recycled to the process for use. This process has a high loading rate and responds well to high solids loading. BF processes have been shown to effectively treat algae concentrations in raw water. However, when compared with other clarifier processes, BF is expensive to operate due to energy and chemical costs.

  Typical surface loading rates for BF clarifiers is between 15 to 30 GPM/ft^2.

Other HRC processes were also examined (i.e., lamella plate clarifiers, etc.), but these other processes appear to be limited when it comes to algae removal and costs.

Filtration Alternatives: Title 22 (Section 60301.310) characterizes several filter processes that are acceptable for filtration of wastewater. All filter technologies perform the same basic function of filtering particle matter from wastewater in order to provide effective pre-treatment for downstream disinfection processes.

Granular media filters are required to produce an average turbidity of 2 NTU within a 24-hour period and also maintain 5 NTU or less than 5 percent of the time during a 24-hour period. At no time can the granular filter effluent turbidity exceed 10 NTU.

Flow rates across granular filters shall not exceed 5 GPM per square-foot except that traveling bridge filters shall have a maximum flow of 2 GPM per square-foot. Some of the more notable granular filter types that the State recognizes include upflow, or downflow deep bed continuous backwash filters; conventional deep bed filters; shallow bed continuous backwash travelling bridge filters; and shallow pulsed bed filters.

In addition, Title 22 allows for other filtration technologies such as microfiltration, nanofiltration, and RO membranes so long as these filter technologies can achieve 0.2 NTU turbidity 5 percent of the time within 24 hours and less than 0.5 NTU continuously.

In September 2008, the CDPH issued the "Treatment Technology Report for Recycled Water" (see Appendix E) listing filtration equipment that has demonstrated an ability to meet the Title 22 recycle requirements discussed above.

Although there is not one ideal filter selection for the Lakeport system in achieving Title 22 recycled water standards, there are guidelines for using an applicable filter technology. Some of those guidelines include preferences by treatment plant staff, costs, and effectiveness of treatment. Based on this standard, several different filtration processes were considered:

- Conventional Downflow Filters: These filters generally consist of single-, dual-, or multi-media filter material that is contained in a gravity filter chamber. Wastewater is introduced at the top of the media bed and (as the name implies) flows downward through the media material capturing suspended materials in the wastewater.

  Backwash of the media is instituted either by elapsed time, headloss measured across the media, or solids breakthrough. The source of backwash water is typically stored filter effluent that is pumped upward through the filter media by backwash pumps. Typical backwash water volumes are between 6 to 10 percent of the effluent generated. Filter backwash water blow down is typically held in a storage tank where it is slowly metered back into the upstream treatment processes (i.e., the headworks) in order to reduce disruptions in the WWTP.

- Upflow Continuous Backwash Filters: Wastewater to be filtered is introduced into the bottom of the filter where it flows upward through a series of riser tubes and is distributed evenly into the downward moving sand bed. Treated water exits from the sand bed via an overflow weir. At the same time, sand particles, along with trapped solids, are drawn downward into the suction of an airlift pipe. Air is introduced into the pipe creating a turbulent flow, which separates the solid contaminates from the sand. Upon reaching the top of the airlift pipe, the dirty slurry spills over into a reject compartment where a steady side stream of clean filtrate carries away the waste solids. Because the sand has higher settling velocity than the removed solids, the sand settles back into the filter chamber. Typical backwash recovery rates are between 5 to 8 percent of filter output.

An advantage of upflow filters versus conventional filters is that there is no need for backwash pumps and backwash supply holding tanks. Because the system is continuously backwashed, there is a constant stream of backwash that can be metered back into the headworks, this eliminates the need for a backwash waste holding tank. However, there are several drawbacks to this filter technology. The units need a reliable compressed-air supply system. The airlift tubes have a potential for becoming plugged and can be worn out due to sand abrasion. Upflow filters also tend to be more sensitive to high solids loading process upsets.

This type of filter technology has been used at water and wastewater treatment plants for a number of years. For example, the City of Lakeport utilizes this type of filter process at the City's WTP, and City operators are familiar with this technology.

- Cloth Media Filters (CMF): As the name implies, CMFs are made up of filter cloth covered vertical discs within a concrete, or steel-filter tank. The vertical orientation of the discs allows for a large amount of filter area in a small footprint. Wastewater enters a central filter collector tube where it flows to final discharge over an overflow weir. As solids collect on the cloth, resistance to flow increases. When headloss through the cloth medium reaches a predetermined set-point, the discs are backwashed. Solids are backwashed from both sides of the disc by liquid suction. Vacuum suction heads, located on either side of the CMF, draw filtrate water from the filter collector tube back through the fabric while the disc is rotating. Typical backwash recovery rates are around 3 percent of filter output.

The advantages of CMF technology are the small footprint and low capital cost to install, especially for a package plant. Backwash rates are considerably less than the upflow or downflow filters discussed above. These types of filters also have low power needs and have high solids loading capabilities. The disadvantages of CMFs include replacement of filter fabric every 5 to 6 years, they contain moving parts, and they are a new technology in the United States.

- Membrane Microfiltration (MF): MF involves the passage of wastewater through a thin membrane for the purpose of removing particulate material, pathogens, organic matter, nutrients, and dissolved substances not removed by upstream treatment processes. MF systems have a small footprint and can be constructed as packaged systems that can be delivered to a site via trucks. MF systems are generally highly automated, thus reducing labor requirements. These systems can remove large contaminates such as protozoan and cysts and can also reduce some bacteria and viruses thus reducing treatment chemicals.

  MF utilizes significantly more power than other conventional treatments. Membranes are expensive to replace and have a life of about 5 years. Scale formation on the membranes can be a serious problem and is difficult to predict. The biggest disadvantage to MF systems is that when treating algae-laden wastewater, the MF treatment units have to be backwashed and cleaned-in-place too often to be cost effective.

- Reverse Osmosis (RO): RO is similar to the membrane filtration treatment process discussed above. However, there are key differences between RO and filtration. The predominant removal mechanism in membrane filtration is straining, or size exclusion, so the process can theoretically achieve perfect exclusion of particles regardless of operational parameters such as influent pressure and concentration. However, RO involves a diffusive mechanism so that separation efficiency is dependent on influent solute concentration, pressure, and water flux rate. It works by using high pressure (i.e., 1,000 PSI) to force a solution through a membrane, retaining the solute on one side and allowing the pure solvent to pass to the other side.

  Due to the nature of their spiral wound design, pre-treatment is important when working with RO membranes. The material is engineered in such a fashion to allow only one-way flow through the system. As such, the spiral wound design does not allow for backpulsing with water, or air agitation to scour its surface and remove solids. Since accumulated material cannot be removed from the membrane surface systems, they are highly susceptible to fouling (loss of production capacity). Therefore, pretreatment is a necessity for any RO system. Typically, pretreatment includes clarification and filtration usually using a microfiltration system. RO treatment plants are a very expensive treatment process to construct ($6/gallon) and to operate. RO would only be considered as a viable treatment option for direct injection groundwater recharge, or direct lake augmentation projects.

Packaged Plant Filtration System: A packaged plant filtration system is categorized as "new" treatment technology. These types of systems are different from a custom-design treatment plant in that, as the name implies, a packaged plant is constructed in a factory, skid mounted, and transported when already assembled to the treatment plant site. Most packaged plants contain the conventional processes of coagulation, flocculation, sedimentation, and filtration. Packaged plants have garnered great success in the treatment of surface water for removal of turbidity, color, and coliform. This type of plant is very familiar with City of Lakeport operators. Currently, the City's WTP uses a packaged adsorption clarifier package plant to treat Clear Lake water for the City's potable water use.

There are two types of contact clarifier/filtration packaged plants:

- Adsorption Clarifier Packaged Plant: This type of plant utilizes an upflow filter with low density plastic bead media to replace the flocculation and sedimentation basin, thereby combining the two processes. A mixed-media filter downstream of the adsorption clarifier completes the treatment.

  Absorption clarifiers can achieve 95 percent, or greater removal at 10 GPM/ft^2.

- Tube-Type Clarifier Plant: As the name implies, this type of packaged plant contains tube settlers to reduce the average time water remains in the tank chamber. In this plant, chemicals (disinfection, coagulant, and polymers) are added prior to a flash mixer. After mixing the water enters the flocculation chamber where the water is gently mixed for 10 to 20 minutes. The flocculated water then enters the tube settlers, which consist of multiple 1-inch deep tubes. Due to the large surface area of the tubes, floc settles within 15 minutes of entering the settling chamber. Finally, the water enters a gravity flow mixed-media filter.

Large tube-type clarifier packaged plants can treat from 200 to 1,400 GPM influent flows.

RECOMMENDED TREATMENT PLANT UPGRADE ALTERNATIVES

There are two primary alternatives for upgrading the Lakeport WWTP in order to achieve tertiary treatment standards for unrestricted off-site recycled water supply: adsorption clarifier filter package plant and DAF/cloth media filters (CMF). These alternatives are shown in Table 10 along with estimated costs and Figures 5 and 6. Alternative 1 uses an adsorption clarifier filter package plant similar to the City's current water treatment filter plant, which has a history of treating algae loaded lake water. In addition, the concept of using a treatment plant process that is currently being used by City operators will allow the City to cross train City staff to operate and maintain both City facilities. In addition, critical spare parts and treatment chemicals can be purchased in bulk and stockpiled for both plants.

The second alternative is the combination of DAF and CMF. CMF is proving to be a reliable and cost-effective technology for the production of Title 22 quality effluent in conventional secondary treatment plants. Cloth filters do not, however, have a track record for applications where algae removal is a priority because algae cells are smaller than the nominal pore size of the cloth. Therefore, CMF will likely require extensive pretreatment to produce Title 22 quality effluent.

Therefore, the treatment process with the best potential for treating the City's existing effluent to Title 22 standards would be Alternative 1(adsorption clarifier filter package plant) which uses a treatment process that has a proven track record for treating algae-loaded water and is familiar to the City of Lakeport. The success of this alternative will be highly dependent on the chemical feed system and the type of algae present in the effluent. Therefore, this process must be pilot-tested before being pursued further. The pilot testing study would be used to optimize coagulant and polymer selection, dosage for clarification, and to establish design-loading rates for the clarifiers and the filters. It would define the chemical dosages, backwash rates, and costs associated with each of the treatment processes. Pilot testing should be conducted when the wastewater and secondary effluent has the highest algae-formation potential of the year (i.e., spring or summer).

Effluent Storage: Storage of recycled water is a critical link between the WWTP and the recycled markets. Storage is needed for the following reasons:

- To equalize daily variations in flow from the WWTP and to store excess when average wastewater flow exceeds irrigation demands.
- To meet peak recycled demands in excess of the average wastewater flow.
- To minimize the effects of disruption in the operations of the WWTP and the recycled user. Storage is used to provide insurance against the possibility of unsuitable reclaimed wastewater entering the irrigation system and to provide additional time to resolve water quality problems.

As was discussed, the City's 650 Ac-Ft earthen effluent reservoir was designed to store the City's annual influent flows and a 100-year annual rain event falling on the reservoir area over the October to April winter months. The hydraulic water balance shown on Table 11 suggests that the current effluent reservoir and irrigation disposal system have an effective capacity to treat and dispose of an ADWF of about 0.55 MGD during a 100-year annual rain event. Based on the City's continued I&I reduction efforts and a 1.1 percent effluent growth rate, it appears the existing effluent reservoir has adequate volume until at least 2042, so long as the City can dispose of the majority of the stored recycled water prior to October of each year. Beyond this date, it appears that additional storage will have to be constructed unless a reliable year-round recycled disposal source can be identified (e.g., the Geysers, domestic toilets, industrial, etc.).

For the purposes of the agricultural and urban irrigation markets (except for the LGCD Golf Course Development), it appears that the current seasonal storage reservoir operation is well-matched for supplying at least a portion of the City's stored recycled water volume to some of the potential irrigation markets discussed. Figure 7 compares the historical effluent storage volume with that of several irrigation uses (i.e., vineyards, orchards, etc.). It is no surprise that the current seasonal variation in recycled storage volume corresponds closely with local agricultural irrigation requirements since the City's current recycled operations are for irrigating pasture land on a limited year-round basis. However, the figure indicates that typical orchard and pasture/landscaping irrigation within Lake County tends to begin around March and lasts until October. Given the current CRWQCB discharge restrictions require that the City restrict discharge of treated effluent during precipitation from October to April, new discharge regulations will have to be negotiated with the CRWQCB if an off-site orchard, pasture, or golf course irrigation recycled water customer is established. Clearly, any potential discharge of the City's recycled water to an off-site user would trigger a review by the CRWQCB and at that time a revised discharge permit could be negotiated. This new permit would most likely take into consideration the potential recycled water users recapture facilities, the quality of the recycled water generated, and the establishment of new monitoring criteria for off-site disposal areas.

Over the past five years, the City has been able to effectively generate and store approximately 605 Ac-Ft per year of treated effluent for use in irrigating its pasture operations at the treatment plant. Yearly fluctuations can occur (e.g., 480 Ac-Ft to 750 Ac-Ft over the past five years) due to many factors (amount of rain, drought conditions, operational irrigation adjustments, etc.). For the purpose of estimating a reliable volume of recycled water for potential irrigation markets, it would seem logical to consider drought conditions impacting not only the irrigation needs of the potential users, but also the volume of recycled water produced and stored at the City's recycled storage reservoir. Therefore, it is recommended that the City consider offering prospective irrigation users 80 percent of what has been generated and stored at the treatment plant over a five year period. Based on the current 605 Ac-Ft (i.e., average 2003 to 2008), this would equate to a yearly supply of approximately 484 Ac-Ft per year for potential irrigation use. Any oversupply of recycled water could either be provided to irrigation users that requested it, or applied onto the City's current irrigated pastures. Any under-supply of recycled water would have to be made up by other sources such as recycled user's on-site irrigation wells.

Finished Recycled Water Storage: In order to provide a reliable source of recycled water for some of the off-site irrigation markets (parks, golf courses, agricultural, etc.) that have been discussed in this report, a finished recycled water reservoir will need to be constructed in order to store treated recycled water. This stored water would be used for periods of WWTP disruption, such as during filter backwash and equipment failure. Although each of the potential markets that have been reviewed for this report have their own estimated daily water usage and need for recycled water storage, it appears from the analysis that a 0.4 to 1.0 million-gallon recycled water reservoir would provide the City with adequate recycle storage to overcome equalization and emergency storage considerations for most of the off-site irrigation markets that were examined for this report (see Table 12). Obviously, factors such as the size of the irrigation area served, on-site storage at each water user property, and the availability of alternative sources of water makes a significant impact on the size of the recycled water storage and further negotiations with prospective markets must be performed before a storage facility can be sized.

Conveyance Pressure Criteria: A number of the existing and potential off-site markets (i.e., agricultural, golf courses, parks, and recycled domestic uses) discussed in this report currently operate, or are expected to operate, with some type of pressure system in order to supply their water needs (sprinkler, drip irrigation, toilets, etc.). In order to maintain flexibility in providing these prospective markets with recycled water from the Lakeport WWTP, the following conveyance criteria are shown in Table 13.

PROJECT PLANNING PERIOD

Due to the volume limitations of the existing effluent reservoir at the City's water reclamation facility, the current maximum ADWF capacity at the plant is approximately 0.55 MGD. Currently, the City's ADWF is about 0.38 MGD and with an estimated 1.1 percent growth rate, the effluent reservoir's storage capacity could be exceeded within the next 34 years. In order to expand its treatment and disposal capacity beyond 0.55 MGD, the City will need to do one of the following:

- Increase the capacity to store treated effluent by expanding the existing 650 Ac-Ft reclaimed water storage reservoir, or developing new reservoirs, by Year 2042.

- Develop a way to permanently discharge effluent water year-round without limitations due to precipitation.

Some of the potential recycle alternatives that were examined in this report have the potential to reduce the need for added effluent storage. Certainly, the construction of the Full Circle Geysers Pipeline Project, or possibly connecting to the LACOSAN Basin 2000 Geysers Pipeline through the Cristallago Development could offer year-round discharge capabilities. Additionally, the two golf course developments (Cristallago and the LGCD) refer to on-site reservoirs to store irrigation water and also act as water traps within the golf course and may offer some additional recycled water storage during the winter months. Furthermore, the idea of a local groundwater recharge system may also offer some ability to reduce the need for effluent storage in the future provided that advanced treatment processes and site selection can be determined.

The recycled irrigation alternatives (i.e., agriculture, landscaping, etc) discussed in this report are seasonal in nature, similar to the City's current pasture irrigation operations and would require the City to continue to operate effluent storage during the winter. However, because most of the irrigation alternatives would require disinfected tertiary treatment, it is speculated that the RWQCB would modify the effluent storage discharge parameters to allow irrigation during periods when precipitation is occurring, thus reducing necessary winter storage volume and postponing the need for additional effluent storage.

Although other urban uses, such as using recycled water flushing toilets, car wash water, construction, etc., would utilize recycled water all year round, it appears from this analysis that potential domestic recycled water use is a small market and would not impact effluent storage significantly.

Therefore, in order to address the apparent future limitation to the City's effluent reservoir capacity, the City should explore the following alternatives within the next 30 years:

- Locate potential reservoir sites in close proximity to the existing WWTP (see Plate 2 for possible reservoir sites).
- Meet with LACOSAN and other agencies to discuss funding and construction of the Full Circle Geysers Pipeline Project. Also, explore the option to build a pipeline from Lakeport to the LACOSAN Basin 2000 Pipeline System for year-round discharge.
- Discuss modifications to the City's discharge permit if tertiary treatment is implemented and recycled water is provided to off-site markets.

WATER CONSERVATION BENEFITS

Currently, many of the developments (i.e., Cristallago, LGCD, urban growth areas, etc.) being considered for use of recycled water are planning to use either treated municipal water or well water for irrigation purposes. The existing parks and schools within Lakeport use either City potable water, Clear Lake raw water, or have their own wells drawing from the Scotts Valley Aquifer. The proposed 20-year urban growth developments shown in Plate 2 will also need to connect to the City's water system, or draw from wells. The majority of the Southeast Agricultural Area (SAA) draws their water from agricultural wells. The two proposed developments (Cristallago and the LGCD) have indicated that they will be reliant on recycled water to irrigate golf courses and other irrigable lands, but without a source of recycled water, these developments will be dependent on groundwater, municipal water, or will be forced to reduce a large portion of their irrigated areas. Development of any of these sites to accommodate recycled water would free up municipal, raw water from the lake, or groundwater supplies for other uses.

The concept of using the City's recycled water to recharge the Scott's Valley aquifer would also act to support conservation by increasing the aquifers yield; thus, providing more water to other wells in the area.

RECYCLE CONVEYANCE ALTERNATIVES

Potential pipeline routes were laid out based on the most direct route between the proposed expanded Lakeport WWTP and the proposed site. The wastewater conveyance evaluation only investigated the one alignment option for each alternative. Additional evaluations will need to be completed in subsequent phases of the recycle design. The goal of the evaluation for this study was to define an order of magnitude cost estimate that could be used to assess the potential of conveying recycled water to each alternative site. Plate 2 shows the relative location of the proposed pipeline alignments to the sites being considered for use of recycled water.

An attempt was made to locate the pipelines in existing public rights-of-way, easements, or other utility easements in order to minimize impacts to private property. Where private property needed to be crossed, effort was made to minimize impacts by locating the pipeline on undeveloped parcels, or as far from existing development as possible. Each of the recycle alternative sites is described in greater detail below:

No Project Alternative: The Lakeport No Recycle Project Alternative is considered the baseline project and is used to assess the future treatment and disposal options that would likely be undertaken by the City of Lakeport if a recycled water project was not implemented. The estimated cost of this baseline alternative is also used to assess the treatment and disposal benefits associated with the other recycle alternatives. Specific assumptions for this alternative are as follows:

- Assume steady 1.1 percent population growth rate over the next 33 years.
- City of Lakeport will continue to reduce I&I into the collection system.

- Estimated Year 2042 annual average dry weather influent flow of 0.54 MGD.
- Current WWTP effluent storage capacity of 650 Ac-Ft.
- Estimated Year 2042 average annual effluent volume 868 Ac-Ft.
- Current on-site irrigation area 332 acres of pasture land.
- Average annual irrigation requirements for 332 acres of pasture land; 1,000 Ac-Ft, per year (based on 3.1 Ac-Ft /acre).
- Additional effluent reservoir capacity needed after Year 2042.
- Lakeport to continue to lease City owned pasture land (current lease agreement $30,000 per year).
- Existing WWTP shall continue to generate secondary disinfected 23 MPN effluent.

Given that the current effluent storage volume and recycle fields have apparent capacity over the next 34 years, it appears that there are no major changes in effluent storage that are needed for the No Project Alternative. However, beyond this 34-year period, the City will have to expand the WWTP effluent reservoir to accommodate increasing wastewater.

The apparent primary limitation beyond Year 2042 will be wintertime effluent storage. In order to accommodate storage constraints beyond Year 2042, the City will have two options. Either increase the wintertime storage capabilities at the plant, by constructing additional storage capacity, or find a source for discharging effluent year-round without precipitation constraints mandated by the CRWQCB. It is certain that the City of Lakeport will continue to grow, and constructing larger and larger effluent storage reservoirs in the future to contain increased wastewater flows is economically unsustainable. Therefore, year-round effluent discharge must be considered as the ultimate goal for the City of Lakeport beyond the 34-year time span.

Lakeport Golf Course Development Alternative: The proposed LGCD is an 800-acre development that proposes to purchase the City's WWTP irrigation fields and construct a 1,500 RUE subdivision that will contain a 200-acre golf course. The proposed area for this development is shown on Plate 2. The plan is to expand the City's existing WWTP to tertiary treatment and use the recycled water to irrigate the proposed golf course and other development irrigation needs, such as residential landscaping and possibly some domestic water, such as flushing toilets.

The construction of an additional 1,500 RUEs would add approximately 0.275 MGD ADWF to the existing WWTP flows. The 20-year ADWF at the WWTP would increase from 0.38 to about 0.76 MGD, and the estimated Year 2029 PWWF could increase to 5.0 MGD. It is estimate that doubling of the ADWF influent at the WWTP would double the average annual recycled water production from 604 Ac-Ft to almost 1,200 Ac-Ft per year.

These estimated increases in plant flows would impact the existing WWTP processes and would most likely require the following plant upgrades:

- The PWWF capacity of the headworks, effluent pump station, chlorination equipment, and chlorine contact chamber would need to be expanded.
- Based on the current wastewater discharge permit requiring storage of effluent during the winter months, it is estimated that an additional 200 Ac-Ft of effluent storage would have to be constructed.
- The irrigation area would have to be expanded from 332 acres to approximately 520 acres in order to properly discharge the effluent during a 100-year annual rain period (see LGCD Golf Course Development hydraulic balance Table 14).

In addition, tertiary treatment plant processes would have to be added to allow for unrestricted discharge onto the proposed golf course, residential landscaping, and possibly domestic use (such as toilets).

Although there is no definite plan on how the LGCD would be constructed, the proposed recycle conveyance system would most likely be incorporated as a part of the overall development infrastructure. Depending on how the recycled water is used (i.e., golf course, urban landscape, etc.), it is envisioned that the recycle distribution system would be centralized around the golf course, which would incorporate a system of on-site earthen ponds and satellite pumping stations to store and manage recycled irrigation to the golf course. This system of ponds and reservoirs may be designed to store wintertime tertiary effluent. Recycled water to the urban landscaping (and possibly domestic toilets) would be stored in a recycle storage tank and pumped via a recycle pump station to supply recycled water "on demand" to residential users. It is estimated that two 100-Hp recycle pumps would be needed.

Southeast Agricultural Area Alternative: The SAA is shown on Plate 2. This area was selected as a possible market for the City's recycled water for a number of reasons:

- It is one of the richest agricultural regions in Lake County.
- It is within 2 miles of the City's WWTP, thus keeping conveyance costs down.
- It is populated with several large agricultural owners that have an interest in possibly using recycled water in the future.
- The conveyance system to serve this area corresponds to the future Full Circle Geysers Pipeline Project.

The SAA contains approximately 620 acres of vineyards and 360 acres orchards that have the potential of utilizing recycled water. Because this region would be considered as unrestricted, the recycled water would need to be treated to tertiary standards.

Although it is speculative at this stage to estimate the amount of recycled water that could be used by prospective agricultural operators in the SAA, it is assumed that for this preliminary report the southeast agricultural market will use at least 80 percent of the recycled water that is available from the Lakeport WWTP in the future. Currently, the average recycled water generated at the plant is about 605 Ac-Ft, which equates to 484 Ac-Ft at 80 percent. Based on 484 Ac-Ft of available recycled water, the estimated amount of vineyards or orchards the recycled water could support would be roughly (i.e., 360 acres vineyards or 180 acres of orchards) 50 percent of the vineyards or orchards in the southeast agricultural region (see Table 12). By Year 2029, the 80-percent recycled water target would be roughly 602 Ac-Ft. This volume would be enough recycled water to satisfy 450 acres of vineyards (about 70 percent of the current vineyard operations) or about 223 acres of orchards (60 percent of current orchard operations).

As has been discussed, constructing pumping facilities and pipelines to serve the southeast agricultural markets could also correspond with the first phase of constructing the Full Circle Geysers Pipeline Project. It is proposed that the segment between the WWTP and Mathews Road (see Plate 2, Point 1 to Point 12) corresponds to the Full Circle Geysers Pipeline alignment that was discussed in the CH2M Hill Full Circle Effluent Pipeline Preliminary Design Report. In that report, there were several alternative pipeline sizes analyzed (i.e., 10-inch, 12-inch, 16-inch) for the proposed project based on different agricultural uses and Geyser needs. The 16-inch alternative would have an estimated peak monthly flow of approximately 2.7 MGD (based on a 20-year flow projection). Similarly, for this analysis it is estimated that a 20-year peak monthly flow of 1.9 MGD would be needed to irrigate about 450 acres of vineyards within the SAA, based on 70 percent of the average annual recycled water used for irrigation and the remaining 30 percent sent to the Geysers. This peak flow would require a 16-inch recycle main between Points 1 to 12 (see Plate 2), which is consistent with the previous Full Circle Report.

A 10-inch pipeline extension could be added to the 16-inch main on Mathews Road in order to expand recycled water service to agricultural users along Highland Springs Road (See Plate 2, Point 12 to Point 13). This 10-inch extension could be considered a subsequent phase to the SAA pipeline, based on the City's success in acquiring and serving additional agricultural users beyond the initial Mathews Road service area.

Full Circle Geysers Alternative: As has been discussed the Full Circle Geysers Alternative (see Figure 4), this concept has been investigated by LACOSAN (see LACOSAN Full Circle Effluent Pipeline Preliminary Design Report). The Full Circle Geysers Pipeline Project would link the Lakeport and Kelseyville WWTPs (operated by Lake County) with a 26-mile pipeline system that would transport recycled water to the Geysers for steam cogeneration. Several alternatives for this pipeline were examined in the LACOSAN investigation:

- Pump secondary treated water from WWTPs to the Geysers.
- Supply tertiary treated water and pump the water to agricultural users and the Geysers along the proposed pipeline.
- Supply tertiary treated water and Clear Lake make-up water and distribute the water to agricultural users and the Geysers along the pipeline.

It appears that all of the alternatives discussed in the LACOSAN Study utilize Lakeport's recycled water for beneficial use. However, given the magnitude of costs for the construction of the entire Full Circle Geysers Pipeline Project (estimated at $65 million dollars to connect Lakeport and Kelseyville treatment plants to the Geysers) one would assume that a phased pipeline construction would be more feasible, especially if a partnership between power companies, cities, County, State, and Federal governments cannot be formed, as was the case with the previous pipeline projects. A phased approach to the Full Circle Geysers Pipeline Project would necessitate tertiary treatment of the effluent, since the initial segments of the Full Circle Pipeline Project would provide recycled water to proposed agricultural markets (see SAA alternative).

For this study, it was assumed that the City of Lakeport's component of the Full Circle Pipeline system would include the expansion of the existing WWTP to tertiary treatment, the construction of a 7.8 mile 16-inch diameter pipeline segment from the existing Lakeport WWTP (Point 1 on Plate 2) to the connection with the proposed pipeline near Kelseyville (Point 14 on Figure 4), a dual pump effluent pump station with 140-Hp pumps, and a recycle storage tank. Estimated maximum flow would be based on a maximum month irrigation rate of 2.7 MGD.

It was assumed for this report that in order to complete the Full Circle Geysers Pipeline Project as planned, the City would also share in the costs of extending the 16-inch pipeline from Kelseyville (Point 14, on Figure 4) to the intertie with the existing South East Geysers Effluent Pipeline, south of the City of Clear Lake at the intersection of Highway 29 and Highway 53 (see Point 16, on Figure 4), approximately 20 miles. At this preliminary stage of planning, it is not clear which shareholders, if any, discussed would financially assist the City in constructing this segment of the pipeline. However, Kelseyville would certainly benefit if such a pipeline were built and it is assumed that the cost of this pipeline segment would be shared between both the City of Lakeport and Lake County, which operates the Kelseyville Treatment Plant.

Lakeport Groundwater Recharge and Reuse Project (GRRP) Alternative: As was previously discussed the construction of a proposed Lakeport GRRP Project was considered as one of the alternatives for this study. It was assumed that such a facility could be constructed entirely at the existing WWTP site (see Plate 2, Point 1) if conditions were suitable for this type of direct injection recharge system, thus eliminating a significant amount of conveyance costs. However, it is unclear at this time whether the Lakeport WWTP site meets all of the regulatory (i.e., existing well locations), hydrogeological, and public constraints necessary for an effective

GRRP site. Certainly, a much more rigorous analysis and selection process must be performed before a proposed GRRP site can be remotely considered anywhere in the study area including the existing WWTP. Any other location for such a facility would significantly impact conveyance costs used for this study.

<u>Westside Park/Parallel Drive Development Alternative</u>: In order to convey recycled wastewater from the expanded WWTP to the City's Westside Community Park property, approximately 14,000 feet of reclaimed water pipeline must be constructed from the WWTP along Parallel Drive to Westside Park (see Plate 2, Point 1 to Point 7). It is proposed that the pipeline would be constructed within the public right-of-way along Parallel Drive and Westside Drive.

In addition to serving the City's needs at the park, it is envisioned that existing and future development along Parallel Drive could also benefit from the availability of Title 22 disinfected tertiary treated recycled water. Plate 2 shows several potential urban developments along Parallel Drive (see Urban Growth areas 20, D, E, and F) and Westside Drive (Areas 14 and 15). It is estimated that this region could have as much as 120 acres of landscape area, which would require about 370 Ac-Ft of recycled water per year. During peak irrigation demand periods, it is estimated that about 500 GPM would be needed.

The conveyance system would include 8-inch pipelines, two 40-Hp recycle pumps, and a 360,000-gallon steel recycle storage reservoir located northwest of the existing WWTP.

<u>Westside Park/Recycle Service Zone Development Alternative</u>: A subsequent phase to the Westside Park/Parallel Drive system discussed above, would be the construction of a recycle distribution system that would serve additional developments and large urban landscape areas identified within the 2 mile recycle service zone on the east side of Highway 29 (see Plate 2, Urban Growth areas B, C, 11, 12, 16, and 17). Currently, it is estimated that there is an additional 60 acres of land that is already landscaped (i.e., the Martin Street Lake County Fairgrounds and baseball fields), or has the potential to develop over the next 20 years. By providing this area with recycled water for irrigation, it is estimated that an additional 186 Ac-Ft

per year of potable water could be saved.

The addition of the area east of Highway 29 would increase maximum daily flows from 0.8 MGD to about 1.2 MGD and would require that the pipeline along Parallel Drive be increased to a 12-inch main. The recycle pump station would require two 60-Hp pumps. A 0.54 MG recycled water tank would be needed to provide recycle equalization and emergency storage to the system. This reservoir could be located on a hill northwest of the existing WWTP.

One notable component of the recycle distribution systems discussed above would be the installation of recycled water supply hydrants ("purple" hydrants) disbursed along the proposed Parallel Drive pipeline. It is proposed that these hydrants could be used by the City to provide tertiary recycled water to contractors for construction purposes such as construction site dust control and possible street cleaning.

Cristallago Golf Course Alternative: Service to this proposed development would be the construction of a 5.4 mile 12-inch pipeline from Point 1 to Point 10 on Plate 2. As can be seen, the majority of the pipeline alignment would be within the Parallel Drive, Hill Road, Mountain View Road, and Highway 29 rights-of-way.

The distribution of the recycled water at the proposed golf course would be through a system of earthen ponds and satellite pumping stations that would store the water and manage recycled irrigation to the golf course. It is estimated that two 110-Hp recycle pumps located at the WWTP would be needed to pump from the plant to the proposed development golf course.

Supplying recycled water to the Cristallago Development from the Lakeport WWTP may also allow the City to utilize the LACOSAN Basin 2000 Geysers Pipeline system. As previously discussed, pumping the City's effluent to the Basin 2000 Pipeline system would allow the City to discharge recycled water year-round to the Geysers and would decrease the need for additional effluent reservoir volume in the future. In order to tap into the LACOSAN Basin 2000 Geysers Pipeline System, the proposed 12-inch pipeline would need to be extended an additional

1.9 miles from the Cristtallgo Development to the Northwest Regional WWTP (see Plate 2, Points 10 to 15). The alignment of the pipeline could be through the proposed development's property and could form the recycle distribution pipeline backbone for using the recycled water on the golf course. It is recommended that the City would need to discuss this option with Lake County and Cristallago Developers in order to determine if this is a viable opportunity.

RECYCLE CONVEYANCE & TREATMENT ALTERNATIVE COSTS

In order to compare the alternatives discussed above, pipeline costs, pumping costs, and treatment plant expansion costs have been prepared using information from comparable projects in the area where construction contracts were competitively bid. Pipeline construction costs from previous projects, projected to March 2009 costs, and an Engineering News Record Index (ENR) of 8534 are illustrated on Figure 8. Pipeline costs include normal pipeline appurtenances such as valves and air relief stations.

Table 15 lists preliminary capital costs, Operation and Maintenance (O&M) unit costs, and annualized costs for conveyance. Table 10 compares the cost for expanding the treatment plant to tertiary treatment including an Adsorption Clarifier filter package plant and a DAF/CFM WWTP (see Figures 5 and 6). In addition, Table 10 also provides an estimate for expanding the treatment plant to a microfiltration/RO treatment facility based on anticipated treatment standards necessary for direct injection into the groundwater. Included in the treatment plant table is the cost for a finish recycle tank; performing a pilot study; 30 percent contingency; and 30 percent for engineering, contract administration, and environmental expenses.

Tables 16 to 24 present the estimated costs for each of the recycle alternatives that were evaluated for this Study. Note that these estimates are based, in many instances, on preliminary information. An example of this is the cost of constructing a new effluent reservoir in order to expand the City's reservoir capacity around Year 2042 (see Table 16). The location, size, and configuration of the proposed reservoir are based on an assumed new 200 Ac-Ft reservoir location (see Plate 2). Obviously, this proposed site may or may not be suitable for a new reservoir site. Variables such as percolation rates, environmental constraints, land acquisition, and others all contribute to select such a site. Furthermore, at this initial report stage the alignment of the proposed recycle pipelines are subject to many variables, as well. Conditions such as groundwater, rock excavation, and conflicts with existing utilities will affect the final design and construction of these pipelines. The cost indicated on Tables 16 to 24 cannot be properly evaluated until final design. Consequently, the estimates in this report should be considered as "order-of-magnitude" estimates, which may vary considerably from the actual construction cost for a particular project element, but the overall Recycle Feasibility Study costs shown in these tables should be reasonably close and satisfactory for the basis of comparing the proposed alternatives.

By comparing these tables, one can see that unit implementation cost per Ac-Ft of recycled water varies from about $1,740 per Ac-Ft (No Project with new reservoir) to $3,690/Ac-Ft for the Full Circle Geysers Pipeline Project "Geysers" with Tertiary Treatment Alternative. As can be seen, a significant portion of the costs for all of the off-site recycle markets is the need of WWTP improvements to tertiary treatment, which adds between 2.9 to 5.4 million dollars to the raw construction costs. Tables 19 and 23 show a comparison of costs for the Full Circle and Cristallago/Basin 2000 Alternatives with and without upgrades to the Lakeport Treatment Plant (tertiary treatment would not be needed if effluent was pumped directly to the Geysers).

POTENTIAL ALTERNATIVE BENEFITS

Besides project costs, there are a number of potential financial and non-financial benefits that must be considered when selecting a project. These benefits include sale of recycled water, potable water supply benefit, avoided cost of disposal capacity upgrades, avoided cost of water supply facility upgrades, and supply reliability. It should be noted that some of the potential benefits for the project are dependent on the market being serviced and the undertaking of additional action for the benefit to be realized. The potential project benefits are discussed below and summarized on Table 25.

Recycled Water Cost Recovery Benefit: Recycled water is a valuable commodity that could be sold to recover costs of the project. Like any commodity, market conditions will govern the sale of recycled water. For existing Lakeport customers, rates for recycled water would need to be similar to existing potable water rates. The City of Lakeport water rate for potable water uses is about $1,230 per Ac-Ft. Similarly, the estimated cost to pump groundwater, based on the City of Lakeport well pumping electrical costs, is roughly $42 per Ac-Ft. However, the City currently receives approximately $30,000 per year to lease the City's pasture land to farmers to graze cattle. This value equates to about $50 per Ac-Ft of effluent irrigation per year (based on 605 Ac-Ft per year).

Additional discussion with potential customers and economic evaluations are needed to identify feasible rates. For this benefit assessment it was assumed that recycled water has a value of about $1,230 per Ac-Ft for urban use within the City of Lakeport and about $50 per Ac-Ft for agricultural users.

<u>Potable Water Supply Benefit</u>: Water use in the City of Lakeport service area is expected to increase by approximately 250 Ac-Ft per year, over the next 20 years, based on the current Lakeport Water Master Plan (PACE, April 2008). Serving recycled water within the City of Lakeport service area would reduce the use of higher quality water supplies. These higher quality supplies could then be used for other beneficial uses that required potable water supplies. Both economic and non-economic benefits could be realized by conserving these higher quality water supplies. The City of Lakeport rate schedule for water service uses a tiered water charge. The current potable water rate for a residence in the City is approximately $1,230 per Ac-Ft. This water rate is expected to increase in the future. In order to realize the financial benefit associated with the conservation of potable water, the water would need to be served to another customer. New residential, or business development, could be supported by the freed-up potable water supply if recycled water is used for other purposes. The City of Lakeport would realize this benefit only if recycled water is served within the City's service area (e.g., the Westside Park and Parallel Drive Alternative).

<u>Avoided Cost of Wastewater Disposal Capacity Upgrades</u>: Implementation of a recycled water project may reduce the need for future disposal capacity upgrades at the WWTP. Recycled water use is a disposal option that would reduce the need to construct alternative disposal

measures, such as reservoir capacity. Under the No Project Alternative, reservoir capacity upgrades would need to be constructed within the next 33 years. The avoided, or postponed, cost of building a new reservoir would be a significant financial benefit to the City. The unit cost estimate of $1,740 per Ac-Ft for the No Project Alternative (see Table 16) can be used as an estimate of either avoiding, or postponing, the cost of building a new reservoir within the next 33 years if some of the other alternatives are constructed (such as the Full Circle Geysers Pipeline Project). The seasonal nature of recycled water demand and the treatment requirements for many of these alternatives needs to be considered when evaluating this benefit. As has been discussed, it is likely that the RWQCB would allow the discharge of treated recycled water to year-round use without restrictions for some of the alternatives if the City expands the WWTP to tertiary treatment per Title 22 Standards.

Avoided Cost of Water Supply Capacity Upgrades: As discussed above, recycled water use would reduce the use of existing potable water supplies. Conservation of potable water supply also results in an avoided cost associated with increased water supply capacity. Future capacity upgrades are expected as development and population increase in the City service area. This avoided cost should be considered when assessing the value of a recycled water project. This benefit is realized if recycled water is used to offset potable water use in the City service area. This benefit value was estimated based on the estimated cost of WTP upgrades to provide water to meet future demand increases of about 238,000 GPD. The WTP upgrades would include the addition of a third packaged filter unit with the capacity of about 600 GPM (0.86 MGD). The estimated cost of the WTP and Lake Pump Station upgrades is $4.9 million (see Lakeport Master Water Plan, April 2008). Assuming 100% production (0.86 MGD for 365 days), the estimated cost of this project is approximately $960 per Ac-Ft. The City of Lakeport would realize this benefit if recycled water is used within its service area, such as the Westside Park and Recycle Service Zone areas. Under the other alternatives, such as the SAA Alternative, the City of Lakeport would not realize this benefit as recycled water would not conserve any potable water supply for the City.

Avoided Cost of Future Water Supply Acquisition: All of Lakeport's water supply comes from two main sources; groundwater wells and Clear Lake. Currently, the City has a water contract with the Yolo County Flood Control and Water Conservation District (YCFWCD) to purchase a maximum of 2,750 Ac-Ft per year of water. This is in the form of 750 Ac-Ft per year that can be drawn from the Scotts Valley Aquifer, via the City's four municipal wells, and an additional 2,000 Ac-Ft that can be drawn from Clear Lake. The current cost for acquiring this water is approximately $52.50/Ac-Ft and the YCFWCD contract stipulates that this fee shall increase by 5 percent annually.

Currently, the City uses about 1,100 Ac-Ft per year (see Figure 10). At a 1.1 percent growth rate it would take roughly 85 years (i.e., Year 2094) for the City to exceed its current water supply allotment (i.e., 2,750 Ac-Ft). Therefore, the estimated avoided cost for using recycled water versus acquiring future (Year 2094) water supply from Yolo County is estimated at $3,321/Ac-Ft.

Water Supply Reliability: Water supply reliability is a significant issue for the region as surface water supplies that are hydrologically dependent make up a significant portion of the water supply. To some extent, groundwater supply is also hydrologically dependent as it has been observed that some of the City's wells have reduced groundwater recharge during drought years. Recycled water is a reliable supply that is considered to be hydrologically independent (wastewater is generated during drought conditions). Increased recycled water use would enhance the overall reliability of the Lakeport water supply and would provide a valuable resource during drought conditions. By converting some of the City's non-critical water uses (i.e., landscaping irrigation, construction dust control, etc.) from treated potable water to recycled water the City's potable water supply, treatment, and distribution systems will be more dependable in providing water during critical drought conditions.

Figure 11 shows the annual water production of the City of Lakeport between 1995 to 2006. As can be seen from Figure 11, water production typically increases by as much as 50 percent (approximately 120 Ac-Ft/month) in the summer months (June through September) over what is typically produced in the winter months (less than 60 Ac-Ft/month). This typical annual production pattern primarily reflects the increased use in water for landscape irrigation in the summer.

In order to generate supplementary water to compensate for summertime irrigation, the City has to produce an additional 450 GPM (i.e., 60 Ac-Ft per month). By replacing a portion of this potable water production for irrigation with recycled water, the City can increase reliability to serve the residences during critical drought conditions. The City's primary source of water is from groundwater wells that have a capacity of between 300 to 800 GPM. It is estimated that one of these wells is needed to supply the additional water for irrigation in the summer (about 240 Ac-Ft for four months). The current Lakeport Master Water Plan (April 2008) suggests that the cost of constructing a new 450 GPM water well is roughly $660,000. Over the life of a new well (assumed to be 30 years) this equates to an equivalent uniform annual amount of roughly $43,000/year (based on a 5 percent interest rate for 30 years). In order to provide the required additional 240 Ac-Ft per year needed for the summertime irrigation, the estimated equivalent uniform cost per Ac-Ft/year delivered by a new well would be roughly $179/Ac-Ft. Therefore, this would be the assumed cost for increasing the City's water production reliability when replacing potable water irrigation with recycled water.

<u>Regionalization Benefit</u>: A regional recycled project such as the Full Circle Geysers Pipeline Project would allow for cost-sharing opportunities and economy of scale benefits for the participating stakeholders. The Full Circle and Pipeline 2000 conveyance alternatives provide an opportunity for Lakeport to participate with other stakeholders in one regional project that not only benefits the City of Lakeport, but also Lake County and the State of California. The financial benefit of regionalization is difficult to quantify; however, a study by M. Ali Khan called "The Geysers Geothermal Field, an Injection Success Story" indicates that over the past 10 years the rate of electricity that has been produced from the injection of effluent at the Geysers equates to about 40.7 MW per Ac-Ft of injected effluent. Based on an average electrical cost of $120 per MW in California this equates to about $4,900 per Ac-Ft of water injected at the Geysers.

A groundwater recharge project would provide a regional groundwater supply benefit by supplementing groundwater to the Scotts Valley Aquifer. The regional benefit for recharging water to the aquifer is assumed to equal the cost ($53/Ac-Ft) of obtaining water from the Yolo

County Flood Control and Water Conservation District (see – Avoided Cost of Future Water Supply Acquisition section above).

Summary of Benefit Values: Table 25 summarizes the benefit values and assumptions for each of the benefits above. The values can be compared to estimated alternative costs to assess the feasibility of the project alternatives and develop conclusions. It should be noted that these benefit values only represent a cursory evaluation. The estimated benefits represent a conceptual planning level analysis with a number of assumptions. As part of the next steps, beyond this initial feasibility study, the benefit values should be refined.

ALTERNATIVE ASSESSMENT

Table 26 presents a summary of costs for the Recycle Water Alternatives that were evaluated.

It should be noted that, the alternatives discussed in this report have only been evaluated to a feasibility level. Additional work is necessary to refine project elements and costs. In addition to project costs, the project benefits discussed above should be considered when selecting a recommended alternative. Potential benefits are related to water supply, wastewater disposal, supply, avoided costs, water supply reliability, and regionalization. Other factors such as ease of implementation, public acceptance, and political feasibility should also be considered. Given the conceptual nature of this evaluation, only preliminary conclusions can be drawn regarding a recommended recycled water alternative. The following paragraphs highlight some of the benefits and considerations associated with each alternative.

The alternative benefits were compared to the estimated costs to implement each of the project alternatives and develop conclusions. Figure 9 shows a comparison of the unit implementation cost and estimated unit benefit costs of each evaluated alternative. Benefit value of the alternatives may exceed project implementation costs which in turn would provide a net benefit. The following paragraphs provide additional discussion of the alternatives.

As can be seem from Figure 9 and Table 26, the No Project and Southeast Agricultural Area Alternatives have a negative benefit to implementation cost ratio. The unit cost for constructing these projects is significantly more than the apparent recycle benefit to the City. Based on the other alternatives discussed below these two alternatives appear to be the least attractive from a benefit to unit cost perspective.

Although utilizing tertiary treated recycled water to recharge groundwater has a net apparent benefit of approximately $713/Ac-Ft. The apparent benefits that can be easily quantified for a GRRP is the delay or elimination of a future increased effluent reservoir and to supplement groundwater supply in Scotts Valley Aquifer. Given that this alternative has a significant O&M cost (i.e., estimated O&M $440,000/year) that would have to be paid for by the City's rate payers, and that there are other alternatives that provide a larger financial benefit to the City of Lakeport, this alternative does not appear to be cost effective.

The LGCD would serve future urban customers by providing recycled water to a proposed private golf course and possibly domestic use (i.e., toilets, landscaping, etc.). The apparent benefits would include use of recycled water for irrigation supply on a private golf course as well as water supply upgrade benefits. The quantity of recycled water produced for this alternative would be significantly more than any of the other alternatives since the proposed 1,500 RUEs envisioned for this development would increase flows at the City's treatment plant beyond the projected 1.1 percent annual growth rate. Furthermore, the proposed development would also have to pay for the upgrade to the City's water treatment plant in order to increase capacity to serve the increased number of LGCD residences.

The LGCD Alternative would demonstrate the beneficial use of recycled water; thus, building community support for using recycled water in the future. However, the cost of constructing the required improvements to the City's water and wastewater treatment plants in order to provide service to the proposed 1,500 RUEs would require significant private financing that may not be currently available based on the current depressed housing market. Furthermore, the desire to acquire the City's public effluent disposal area for a private golf course may not be politically or operationally attractive.

Similar to the LGCD Project, the Cristallago Golf Course Project has an estimated benefit to cost ratio of about $1,090/Ac-Ft. The primary benefits for such a project is the utilization of the City's treated recycled water on an urban golf course and the avoiding construction of a new effluent reservoir in the future (Items 1 and 3 on Table 25).

As can be seen, the proposed development is located in the Lake County Special District Community Service Area No. 21 and it has been proposed by the developer that recycled water be acquired from the County's Northwest Regional WWTP. Although the developers have a desire to use recycled water, the project site location is outside of the City's sphere of influence (see Plate 2); thus, requiring that LAFCO review and approve an extension of recycled water services from Lakeport to the proposed development. This would most likely trigger some type of annexation review by LAFCO and it is assumed that Lake County would be wary of relinquishing service revenues and taxes to Lakeport if annexation was required by LAFCO. Further discussions with the developer, Lake County, and LAFCO will have to be performed before this alternative can be considered a viable option.

The Full Circle Geysers Pipeline Project with and without Tertiary Treatment Alternatives have the highest cost for implementation (i.e., between $3,100 to $3,690/Ac-Ft) than any of the other alternatives. This is primarily due to the significant cost of constructing the 26 miles of pipeline needed to convey recycled water to the Geysers. The biggest advantage for both of these alternatives is the regional benefit of generating electricity (estimated at $4,900/Ac-Ft). The Full Circle Tertiary Treatment option would provide flexibility to the project by allowing the phased construction of the conveyance pipeline and providing a source of recycled water to prospective agricultural users along the initial phases of the pipeline. Unfortunately, a phased approach to the project would limit the maximum benefit of the project until such time that the project was completed and recycled water was flowing to the geysers cogeneration plant. Furthermore, there has been some local interest by agricultural land owners for utilizing recycled water for possible irrigation usage (see SAA), but there are also significant concerns about recycled water costs, disruption of existing irrigations facilities and regulatory oversight of agricultural practices that would need to be overcome.

The Full Circle Geyser Pipeline Project alternatives are also the most costly to operate then any of the other alternatives reviewed for this study. O&M costs for both of the alternatives are estimated at between $430,000 to $579,000 per year (see Table 19).

The Full Circle Geysers Pipeline Project without Tertiary Treatment Alternative would require that all of the capital costs for constructing the project (estimated at $65 million) be available at the time of construction. This will most likely require that Lakeport and Kelseyville (i.e., Lake County) partner with other shareholders (electrical companies, Federal and State government agencies, etc.) in order to generate this amount of funding. At the present time, there has been no extensive discussion with other shareholders to implement either Full Circle Geysers Pipeline Project in the near future and it would be cost prohibitive for the City of Lakeport and Kelseyville (i.e., Lake County) to attempt to fund this project on their own.

The Cristallago/ Basin 2000 Geysers Pipeline with or without tertiary treatment alternatives would be similar to the Full Circle alternatives discussed above. The benefit to unit cost ratios for both Cristallago/ Basin 2000 Geysers Pipeline alternatives is $5,760 to $6,400/Ac-Ft, which makes them the highest unit cost to benefit alternatives investigated for this study. O&M costs for the Cristallago/ Basin 2000 Geysers Pipeline Tertiary Treated Alternative is estimated at around $308,000 which makes it one of the more costly projects to operate.

The Cristallago/ Basin 2000 Geysers Pipeline alternatives would require that the City of Lakeport partner with the Cristallago developer, private power companies, and, more importantly, with Lake County. As was discussed above, concerns about relinquishing service fees and taxes from Lake County to Lakeport due to annexation would certainly be negatively scrutinized by the County.

The major benefit for the Full Circle and Cristallago/ Basin 2000 Geysers Pipeline alternatives discussed above is the regional benefit for electrical cogeneration by private power companies operating the Geysers facility. Currently, the private power companies and the public agencies that provide the recycled water to the Geysers, have formed a mutual partnership that benefit both private and public agencies. Historically, this partnership has worked well and there is no indication that this will change in the near future for existing and future recycle water providers. However, with any private company there is a need to generate profits in order to stay in business. Competition, efficiency, management, and the company's customer base can change over time creating unknown conditions that may alter profit, and ultimately, the company's use of recycled water at the Geysers.

Although the Geysers ability to generate steam over the near term appears to be viable, it appears that steam production is declining ("The Geysers Geothermal Field, an Injection Success Story", M. Ali Khan). Currently, the power companies feel that the geothermal steam field appears to be under-saturated and additional recycled water can be injected in order to optimize the Geysers ability to produce steam. However, as the steam fields age and additional sources of recycled water are made available, there may be a point where saturation of the fields could occur and the discharge of recycle water into the Geysers from recycled water providers may be reduced, or possibly eliminated. If this were to occur the Full Circle Geysers Pipeline and Cristallago/2000 Basin Alternatives would be significantly impacted.

As can be seen from Figure 9, the Westside Park/Parallel Drive Alternative and the Westside Park/ Recycle Service Zone Developments would provide a high benefit to unit cost ratio (i.e., $4,500 to $5,200/Ac-Ft). The apparent benefits for these alternatives come from utilizing Lakeport City recycled water to supplement the City's potable water system versus sending the recycled water to users outside of the City (i.e., Full Circle, Cristallago, etc.). The benefits (see Table 25) for the Westside Park Alternatives include providing a recycled water supply to City users, extending the City's potable water supply, avoiding or postponing scheduled water system upgrades, avoiding future water supply acquisition costs, and increasing the City's water system reliability.

Furthermore, the Westside Park recycled water alternatives have garnered local support from several organizations (see support letters Appendix E). Both the Westside Community Park Committee and Lake County Fair have contacted the City indicating their desire to utilize recycled water if it is made available. Given that the Westside Park alternatives has the greatest impact to the local community, and that local organizations within the City are supporting the use of recycled water within Lakeport, the Westside Park alternatives are considered to be the desired alternatives.

VIII. RECOMMENDED FACILITIES PROJECT PLAN

This section identifies a recommended strategy for the City of Lakeport Recycle Plan. Based on the benefits and the ability to implement each of the alternatives described in Section VII, and the goals and objectives for the project, it was recognized that implementation of the Westside Park/Parallel Drive Project be the first phase of the City's recycled water (see Figure 12). It is also recognized that an in-depth engineering design is necessary to develop the details of the recommended phased project. With these factors in mind, a project approach was developed to continue planning of the recommended project. This approach was developed through discussions with the City of Lakeport staff with the goal of evaluating the steps necessary to meet the interests and goals of the City of Lakeport and the proposed stakeholders. This section includes an implementation strategy that identifies the major tasks for pursuing the Phase 1 Westside Park/Parallel Drive Project.

There are many important tasks that the City should begin if it wishes to pursue the proposed project. A tentative project implementation schedule is presented in Table 27, which lists the critical tasks necessary for achieving the project goals. The Phase 1 Project approach is spread out over about 40 months culminating in the construction of the Phase 1 recycle project for the City of Lakeport.

Because the proposed Westside Park Recycle Project would require the use of tertiary treatment to meet CRWQCB and CDHS water quality standards necessary for off-site unrestricted use, the CRWQCB and CDHS will need to be contacted in order to discuss the proposed project. These agencies will most likely require that the City perform a treatment plant pilot study to verify that the proposed treatment processes will meet the necessary tertiary treatment standards for unrestricted recycle water use.

As discussed, the preferred tertiary treatment process would be an absorption clarifier/filter package plant similar to the treatment process that is currently used at the WTP. Pilot testing would involve the City contracting with one of the package plant manufacturer's to perform a two-week test utilizing a skid-mounted adsorption clarifier treatment plant to evaluate the effectiveness of treating the City's wastewater effluent. Scheduling of the pilot test should be performed during the spring when effluent water quality may be impacted by algae. Once this pilot study has been accomplished, a preliminary Phase 1 Engineering Design Report should be completed outlining the pilot study results, WWTP expansion details, and a preliminary pipeline design. This report should be sent to the CRWQCB and CDHS for their review and consideration. Funding for the pilot study and preliminary engineering design report could come from a Rural Development RUS Water and Waste Disposal project loan or grant.

The City of Lakeport should implement a recycled water public outreach program and a market assurance investigation for the proposed Phase 1 Project area. Meetings with the Westside Park Committee, Mendocino Community College, and future urban developers will be needed to develop water quality and quantity criteria, as well as identification of future developments in the recycle service area. Local property owners and developers should be invited to a discussion of what the Phase 1 Project involves and how it may be funded, including a proposed assessment district engineering report.

The City should assign personnel to implement a funding strategy to pursue grants and loans (see Project Financing section below) as well as acquiring interim financing from a recycle water assessment district. Applications to funding agencies, such as Rural Development (RD) and the California State Water Resources Control Board, for project grants and low interest loans should be started as soon possible once the pilot study and preliminary design report has been completed. A bond council would be employed by the City to administer the interim financing of the project.

An assessment district engineering report is required to establish the assessments on properties for the proposed recycle project. Distribution of the total amount to be assessed in proportion to benefit received through an assessment shall be determined in the report. Pursuant to Proposition 218, the assessment district process requires a mailed information package with an estimated amount and mail-in ballot. Two public meetings are also required; the first is an informational meeting and the second is the final protest hearing. Each property owner is requested to mail-in their ballots indicating their approval or disapproval of the assessment prior to the protest hearing.

A Phase 1 Preliminary Environmental Evaluation (see Appendix F) has been prepared to evaluate environmental compliance with the California Environmental Quality Act (CEQA) for the proposed project. The preliminary evaluation provides recommendations for mitigating possible environmental impacts that are attributed to the proposed Phase 1 Project. An environmental initial study will need to be prepared and submitted to the State clearinghouse once the preliminary engineering design of the project has been completed. Environmental compliance with the Federal National Environmental Policy Act (NEPA) may also be required if RD federal funding is authorized (see Project Financing Section below). Once the initial environmental study has been reviewed by all applicable agencies, a final environmental document will be prepared and adopted by the City Council.

Once the environmental analysis has been completed and financing commitments have been established (i.e., assessment district, grants, loans) the project design shall be completed and the project publicly bid and constructed.

PROJECT FINANCING

Project Construction Cost Estimate: The detailed cost analysis of the proposed Phase 1 Project is shown on Table 28, and summarizes the construction cost of the various recommended project components, and indicates a Total Improvement Project Cost of roughly $8,805,000 in March 2009 dollars. This estimated construction cost includes 30 percent contingency and 30 percent for engineering, legal, administration, and environmental analysis. These estimated costs are preliminary at this stage of the analysis and can only be used for an order-of-magnitude budgeting analysis of the proposed project.

As was discussed above the Phase 1 portion of the project would include the following:

- Expansion of the City's WWTP to a tertiary treatment using a packaged adsorption clarifier/filtration unit, UV disinfection, recycle pumping station with two VFD driven recycle pumps, chemical feed system, and miscellaneous process piping (see Figure 5).
- The construction of a 0.54 MG recycle water storage tank.
- Approximately 14,000 feet of 8 to 12-inch recycle purple-water pipeline from the expanded WWTP to the Westside Community Park along Parallel Drive. The recycle distribution system would include service taps for future connections to Parallel Drive properties, recycle fire hydrants, and piping stub-outs for future connections to the properties east of Highway 29.

Annual Operating Budget: Preliminary cost estimates indicate that operations and maintenance of the Phase 1 expanded treatment plant, pumping station, reservoir, and pipeline is approximately $263,000/year (see Table 20). It is proposed that the cost of O&M for the new recycle facilities would come from recycled water service charges, similar to the City's water rates. Currently, the City's water rate is about $1,230/Ac-Ft.

Table 7 estimates that the Westside Park/Parallel Drive project area (i.e., Development Areas 14, 15, 20, E, and F) will serve an area of about 210 acres with the potential of about 590 RUEs over the next 20 years. Table 12 estimates that this area would contain about 120 acres of irrigable property including residential landscaping and parks and that this area would require about 373 Ac-Ft/year of recycled water (see Table 2). This equates to roughly 0.63 Ac-Ft/RUE/year.

Based on the estimated O&M cost ($263,000) for generating and conveying recycle water to this area, the O&M cost for the Phase 1 Project would be approximately $705/Ac-Ft, or roughly $450/RUE/year. This value is about 43 percent less than what is being charged for potable water within the City at the present time.

Funding Sources: It is proposed that the City would fund the construction of the Phase 1 Westside Park/Parallel Drive Project through two main sources; A Water Recycling Funding Program construction grant from the California State Water Resources Control Board (SWRCD) and a RD Rural Utilities Service (RUS) Water and Waste Disposal Loan and Grant. The following are brief descriptions of these two funding sources:

SWRCD Water Recycling Funding Program (WRFP)

Funding for the construction of water recycling facilities is primarily provided from Proposition 50 and the SRF loan program. WRFP construction grants are limited to 25 percent of the eligible construction costs of the project or $5 million, whichever is less. Eligible costs include allowances for construction of project, design, legal tasks, construction management, and engineering during construction. Acquiring funding from this source is competitive and is based on a candidate submitting a financial assistance application package.

RD RUS Water and Waste Disposal Loans and Grants

This program includes both grants of up to 45 percent of the project costs and a low interest loans, for up to 40 years, at interest rates from 2.75 to 4.5 percent. In order to be considered eligible for this funding source, a community has to be considered a rural area which is defined as a city or town with a population of 10,000 or less. Eligible costs include allowances for construction of project, design, legal tasks, construction management, environmental analyses, fiscal advisory, engineering during construction, and acquiring land and rights-of-way. Only loan funds may be used for interest on construction financing, initial operating expenses, and refinancing of eligible debts.

There are no maximum amounts for RD funding. However, limits may exist depending on availability of funds and/or project feasibility. Projects must be based on taxes, assessments, income, fees, or other satisfactory sources of revenues in an amount sufficient to provide for the successful facility operation, maintenance, and realistic debt repayment. A bond counsel is required to prepare the appropriate security instrument for the loan financing of the project. Construction projects require that the applicant obtain interim construction financing from other sources.

Given that the estimated construction cost for the proposed Phase 1 Project is roughly $8,805,000, and assuming that the City can acquire both a WFRP 25-percent grant and a RUS 45-percent grant and low interest loan, the estimated funding schedule for the Phase 1 Recycle Project looks like this:

Funding Source	Dollars ($)
WFRP 25% Grant	$2,200,000
RUS 45% Grant	$3,962,000
RUS Low Interest Loan	$2,643,000
TOTAL Construction Cost	$8,805,000

It is assumed that the RUS loan portion of the project would have to be secured by assessment district bonds. The creation of a recycle water assessment district, distributing the total amount to be assessed in proportion to benefit received, requires an Engineer's Report and is outside of the scope of this study. However, the creation of a recycle water assessment district will require that the area of benefit be defined and that those parcels within the benefit area would receive an assessment.

There are many avenues by which benefits could be determined for the proposed recycle water assessment district. Typically, benefits such as pipeline front footage fees, treatment plant improvement costs, capital improvement fees, etc., have been considered for other water and wastewater assessment districts.

The idea that the proposed project's recycled water will be used for beneficial use on a City operated park (i.e., Westside Park) could be used to justify the creation of a benefit assessment district. Benefit assessments are used by local governments to place an annual levy on property that receive a "special benefit" from the assessment. The assessment may be used to pay the costs of providing special services, such as street lighting, tree planting, and park capital improvements. A City-wide benefit assessment for the construction of the Westside Park expansion and recycle water system would be a viable financial instrument for the City to support its wastewater reuse efforts.

TABLES

TABLE 1

City of Lakeport
2009 Recycle Feasibility Study Report

WATER PRODUCTION ELECTRICAL COSTS

WATER TREATMENT PLANT ELECTRICAL COSTS

PG&E Rate Schedule: A10S Medium General Demand-Metered Service

Summer Rate:	$/Kwh	$	0.10364	(1)
	Avg $/MG:	**$**	**543.16**	

LAKEPORT WATER WELLS

PG&E Rate Schedule: A6 Small General Time-of-Use Service

Summer Rates:(2)				
Peak:	$/Kwh	$	0.31617	(1)
Partial-Peak:	$/Kwh	$	0.15737	(1)
Off-Peak:	$/Kwh	$	0.09511	(1)
Scott Creek Wells:	Avg $/MG:	**$**	**131.79**	
	Avg $/MG @ Peak:	$	342.38	
	Avg $/MG @ Partial-Peak:	$	169.92	
	Avg $/MG @ Off-Peak:	$	102.25	
Green Ranch Wells:	Avg $/MG:	**$**	**191.62**	
	Avg $/MG @ Peak:	$	475.55	
	Avg $/MG @ Partial-Peak:	$	235.64	
	Avg $/MG @ Off-Peak:	$	141.51	

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(1) September 2006 PG&E rate

(2) Summer Months: May 1 through October 31

Peak:	12 noon to 6 p.m.	Monday through Friday
Partial-Peak:	8:30 a.m. to 12 noon & 6 p.m. to 9:30 p.m.	Monday through Friday
Off-Peak:	9:30 p.m. to 8:30 a.m.	Monday through Friday
	All day	Weekends and holidays

TABLE 2

City of Lakeport
2009 Recycle Feasibility Study Report
EVAPOTRANSPIRATION FOR LAKE COUNTY CROPS PER GROWING SEASON*

	Evapotranspiration per Crop Type		
Month	Vineyards Wine Grapes (inches)	Irrigated Pasture/Turfgrass (inches)	Deciduous Orchards (inches)
Jan	0.0	0.0	0.0
Feb	0.0	0.0	0.0
Mar	0.0	2.4	1.4
Apr	0.0	3.4	2.4
May	2.9	5.0	4.2
Jun	4.3	5.9	5.3
Jul	4.6	7.1	6.8
Aug	2.9	6.2	6.0
Sep	1.2	4.6	4.2
Oct	0.2	2.7	2.2
Nov	0.0	0.0	0.0
Dec	0.0	0.0	0.0
TOTAL (inches)	16.1	37.3	32.5
TOTAL (acre-feet)	1.3	3.1	2.7
TOTAL (gallons)	437,184	1,012,855	882,514

* From Vegetative Water Use In California, 1974, Department of Water Resources

TABLE 3

Recycled Water Uses Allowed[1] in California

This summary is prepared for WateReuse Association from the December 2, 2000-adopted Title 22 Water Recycling Criteria and supersedes all earlier versions.

Use of Recycled Water	Disinfected Tertiary Recycled Water	Treatment Level Disinfected Secondary-2.2 Recycled Water	Disinfected Secondary-23 Recycled Water	Undisinfected Secondary Recycled Water
Irrigation of:				
Food crops where recycled water contacts the edible portion of the crop, including all root crops	**Allowed**	Not allowed	Not allowed	Not allowed
Parks and playgrounds	**Allowed**	Not allowed	Not allowed	Not allowed
School yards	**Allowed**	Not allowed	Not allowed	Not allowed
Residential landscaping	**Allowed**	Not allowed	Not allowed	Not allowed
Unrestricted-access golf courses	**Allowed**	Not allowed	Not allowed	Not allowed
Any other irrigation uses not prohibited by other provisions of the California Code of Regulations	**Allowed**	Not allowed	Not allowed	Not allowed
Food crops, surface-irrigated, above-ground edible portion, and not contacted by recycled water	**Allowed**	**Allowed**	Not allowed	Not allowed
Cemeteries	**Allowed**	**Allowed**	**Allowed**	Not allowed
Freeway landscaping	**Allowed**	**Allowed**	**Allowed**	Not allowed
Restricted-access golf courses	**Allowed**	**Allowed**	**Allowed**	Not allowed
Ornamental nursery stock and sod farms with unrestricted public access	**Allowed**	**Allowed**	**Allowed**	Not allowed
Pasture for milk animals for human consumption	**Allowed**	**Allowed**	**Allowed**	Not allowed
Nonedible vegetation with access control to prevent use as a park, playground or school yard	**Allowed**	**Allowed**	**Allowed**	Not allowed
Orchards with no contact between edible portion and recycled water	**Allowed**	**Allowed**	**Allowed**	**Allowed**
Vineyards with no contact between edible portion and recycled water	**Allowed**	**Allowed**	**Allowed**	**Allowed**
Non food-bearing trees, including Christmas trees not irrigated less than 14 days before harvest	**Allowed**	**Allowed**	**Allowed**	**Allowed**
Fodder and fiber crops and pasture for animals not producing milk for human consumption	**Allowed**	**Allowed**	**Allowed**	**Allowed**
Seed crops not eaten by humans	**Allowed**	**Allowed**	**Allowed**	**Allowed**
Food crops undergoing commercial pathogen-destroying processing before consumption by humans	**Allowed**	**Allowed**	**Allowed**	**Allowed**
Supply for impoundment:				
Nonrestricted recreational impoundments, with supplemental monitoring for pathogenic organisms	**Allowed[2]**	Not allowed	Not allowed	Not allowed
Restricted recreational impoundments and publicly accessible fish hatcheries	**Allowed**	**Allowed**	Not allowed	Not allowed
Landscape impoundments without decorative fountains	**Allowed**	**Allowed**	**Allowed**	Not allowed
Supply for cooling or air conditioning:				
Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or spraying that creates a mist	**Allowed[3]**	Not allowed	Not allowed	Not allowed
Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative condenser, or spraying that creates a mist	**Allowed**	**Allowed**	**Allowed**	Not allowed

Recycled Water Uses Allowed[1] in California

This summary is prepared for **WateReuse Association** from the December 2, 2000-adopted Title 22 **Water Recycling Criteria** and supersedes all earlier versions.

Use of Recycled Water	Treatment Level			
	Disinfected Tertiary Recycled Water	Disinfected Secondary-2.2 Recycled Water	Disinfected Secondary-23 Recycled Water	Undisinfected Secondary Recycled Water
Other uses:				
Groundwater Recharge	**Allowed** under special case-by-case permits by RWQCBs[4]			
Flushing toilets and urinals	**Allowed**	Not allowed	Not allowed	Not allowed
Priming drain traps	**Allowed**	Not allowed	Not allowed	Not allowed
Industrial process water that may contact workers	**Allowed**	Not allowed	Not allowed	Not allowed
Structural fire fighting	**Allowed**	Not allowed	Not allowed	Not allowed
Decorative fountains	**Allowed**	Not allowed	Not allowed	Not allowed
Commercial laundries	**Allowed**	Not allowed	Not allowed	Not allowed
Consolidation of backfill material around potable water pipelines	**Allowed**	Not allowed	Not allowed	Not allowed
Artificial snow making for commercial outdoor uses	**Allowed**	Not allowed	Not allowed	Not allowed
Commercial car washes, not heating the water, excluding the general public from washing process	**Allowed**	Not allowed	Not allowed	Not allowed
Industrial process water that will not come into contact with workers	**Allowed**	**Allowed**	**Allowed**	Not allowed
Industrial boiler feed	**Allowed**	**Allowed**	**Allowed**	Not allowed
Nonstructural fire fighting	**Allowed**	**Allowed**	**Allowed**	Not allowed
Backfill consolidation around nonpotable piping	**Allowed**	**Allowed**	**Allowed**	Not allowed
Soil compaction	**Allowed**	**Allowed**	**Allowed**	Not allowed
Mixing concrete	**Allowed**	**Allowed**	**Allowed**	Not allowed
Dust control on roads and streets	**Allowed**	**Allowed**	**Allowed**	Not allowed
Cleaning roads, sidewalks and outdoor work areas	**Allowed**	**Allowed**	**Allowed**	Not allowed
Flushing sanitary sewers	**Allowed**	**Allowed**	**Allowed**	**Allowed**

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[1] Refer to the full text of the December 2, 2000 version of Title 22: California Code of Regulations, Chapter 3 Water Recycling Criteria. This chart is only an informal summary of the uses allowed in this version.

The complete and final 12/02/2000 version of the adopted criteria can be downloaded from: http://www.dhs.ca.gov/ps/ddwem/publications/Regulations/recycleregs_index.htm

[2] Allowed with "conventional tertiary treatment." Additional monitoring for two years or more is necessary with direct filtration.

[3] Drift eliminators and/or biocides are required if public or employees can be exposed to mist.

[4] Refer to Groundwater Recharge Guidelines, available from the California Department of Health Services.

Prepared by Bahman Sheikh and edited by EBMUD Office of Water Recycling, who acknowledge this is a summary and not the formal version of the regulations referenced above.

TABLE 4

City of Lakeport

2009 Recycle Feasibility Study Report

LAKEPORT WASTEWATER EFFLUENT DISCHARGE REQUIREMENTS

Constituents	Monthly Average	Daily Maximum
Settleable Solids	0.2 mL/L	0.5 mL/L
Coliform	23 MPN/mL	500 MPN/mL

TABLE 5

City of Lakeport

2009 Recycle Feasibility Study Report

2007 Treatment Plant Effluent Water Quality Analysis

Month	Daily Maximum Coliform (MPN)	Monthly Average BOD (mg/l)	Monthly Average TSS (ml/l)	Monthly Average TDS (mg/l)
Jan	<1	21.5	<0.1	400.0
Feb	<1	15.7	<0.1	330.0
Mar	30	17.3	<0.1	330.0
Apr	<1	22.9	<0.1	340.0
May	20	24.6	<0.1	360.0
Jun	250	26.1	<0.1	380.0
Jul	40	22.8	<0.1	360.0
Aug	280	20.5	<0.1	340.0
Sep	<1	21.9	<0.1	360.0
Oct	<1	18.3	<0.1	420.0
Nov	510	14.7	<0.1	430.0
Dec	20	20.3	<0.1	430.0
AVERAGE	188.3	20.6	-	368.2

TABLE 6

City of Lakeport

2009 Recycle Feasibility Study Report

SUMMARY OF ESTIMATED IRRIGATED PARKS AND SCHOOLS IN LAKEPORT

Use Type	Irrigated Acreage (acres)	Unit Water Demand (acre-ft/acre)[a]	Total Demand (acre-ft/yr)
Existing City Schools	28	3.1	90
Existing City Parks	25	3.1	78
Total	53		168

Footnotes:

a. Irrigation unit water demands based on Lake County evapotranspiration rates. See Table 2.

TABLE 7

City of Lakeport

2009 Recycle Feasability Study Report

20-YEAR GROWTH PROJECTION

Proposed Development Number[1]	Development Type	Estimated RUEs	Estimated Developed Area (Ac)	Estimated Irrigation Area[5] (Ac)	Estimated Annual Irrigation (Ac-Ft)[6]	
1	Residential[2]	36	4.8	2.4	7.4	
2	Residential[2]	4	1.2	0.6	1.9	
3	Residential[2]	4	2.6	1.3	4.0	
4	Residential[2]	28	4.0	2.0	6.2	
5	Residential[2]	8	4.0	2.0	6.2	
6	Residential[2]	35	14.3	7.2	22.2	
7	Residential[2]	6	1.6	0.8	2.5	
8	Residential[2]	8	2.4	1.2	3.7	
9	Residential[2]	32	7.2	3.6	11.2	
10	Residential[2]	10	2.7	1.4	4.2	
11	Residential[2]	30	8.9	4.5	13.8	
12	Residential[2]	60	5.3	2.7	8.2	
13	Residential[2]	6	1.0	0.5	1.6	
14	Residential[2]	28	6.7	3.4	10.4	
15	Residential[2]	96	22.3	11.2	34.6	
16	Residential[2]	96	7.1	3.6	11.0	
17	Residential[2]	70	7.9	4.0	12.2	
18	Residential[2]	8	0.5	0.3	0.8	
A	Commercial[3]	1	1.6	0.8	2.5	
B	Commercial[3]	10	3.4	1.7	5.3	
C	Commercial[3]	19	6.7	3.4	10.4	
D	Commercial[3]	4	1.0	0.5	1.6	
E	Commercial[3]	29	10.2	5.1	15.8	
F	P.O.	99	23.0	11.5	35.7	SOUTHERN DEVELOPMENT AREA (SDA)
19 (LGCD)	Residential[2]	1000	800.0	400.0	1240.0	
20	Residential[2]	340	95.1	47.6	147.4	
	TOTAL RUEs[4]	2,067	1,046	523	1,621	

[1] See Plate 2 for development locations.

[2] Assumes one RUE per residence.

[3] RUEs based on similar Lakeport developments.

[4] For this study only 660 RUEs are projected over the next 20 years based on a 1.1% growth rate. The 2,067 RUEs proposed in this table are estimates from the City Planning Department and includes the Southern Development Area which is anticipated to be developed beyond 2028.

[5] Irrigation area based on 1/2 the developed area.

[6] Based on turf grass irrigation needs from Table 2.

M:\Jobs\0523\0523.27\FINAL REPORT\Spreadsheets\TABLE 7 20 Year Growth Projections.xls

4/19/2010

TABLE 8

City of Lakeport
2009 Recycle Feasibility Study Report

GUIDELINES FOR INTERPRETATION OF WATER QUALITY FOR IRRIGATION[1]

CONSTITUENT OF CONCERN	UNITS	Water Quality Guidelines		
		Minor affect on plants	Increasing Affect on Plants	Severe Affect on Plants
Salinity[2]				
Electrical Conductivity	mmhos/cm	<0.75	0.75-3.0	>3.0
Total Dissolved Solids (TDS)	mg/l	<480	480-1,920	>1,920
Permeability				
Adjusted SAR/RNA[3]	units	<6.0	6.0-9.0	>9.0
Specific ion toxicity from root absorption[4]				
Adjusted SAR/RNA	units	<3.0	3.0-9.0	>9.0
Chloride	mg/l	<142	142-355	>355
Boron	mg/l	<0.5	0.5-2.0	2.0-10.0
Foliar adsorption (Sprinkler applications)[5]				
Sodium	mg/l	<69	>69	-
Chloride	mg/l	<109	>106	-
Miscellaneous				
HCO3	mg/l	<90	90-520	>520
NH_4-N and NO_2-N	mg/l	<5	5-30	>30

(1) Source: Ayers 1977
(2) Assumes water for crop plus needed water for leaching requirements will be applied.

TABLE 9

City of Lakeport

2009 Recycle Feasibility Study Report

SUMMARY OF SECONDARY EFFLUENT WATER QUALITY CONSITUENTS OF CONCERN[1]

SEONDARY EFFLUENT CONSTITUENT OF CONCERN	UNITS	RESULTS
Total Dissolved Solids (TDS)	mg/l	360
Ammonia (as N)	mg/l	4.4
Total Nitrate	mg/l	20
pH		6.9
Sodium	mg/l	45
Chloride	mg/l	73
Specific Conductance	mmhos/cm	580

(1) Data taken from July 16, 2008 Lakeport effluent water sample.

TABLE 10

City of Lakeport

2009 Recycle Feasibility Study Report

LAKEPORT WWTP UPGRADE ALTERNATIVE COST ESTIMATE

ALTERNATIVE 1: ADSORPTION CLARIFIER PACKAGE PLANT COST ESTIMATE

Item	Unit	No. of Units	Unit Costs ($)	Total Costs ($)
Adsorption Clarifier Package Plant	ea	2	$520,000	$1,040,000
Building	ls	1	$364,000	$364,000
Yard Piping	ls	1	$90,000	$90,000
Site Work	ls	1	$90,000	$90,000
Misc. Treatment Plant Pumps[(1)]	ls	1	$110,000	$110,000
Electrical/Controls	ls	1	$270,000	$270,000
Misc Chlorine and Chemical Feed System	ls	1	$160,000	$160,000
Recycle 12-inch Main to Storage Tank	ft	3,400	$94	$319,600
Recycled Water Storage Tank (0.54 MG)	ea	1	$500,000	$500,000
			Sub Total	$2,943,600
		Contingency	30%	$883,000
			Sub Total	$3,827,000
Engineering, Contract Administration, & Environmental			30%	$883,000
			Sub Total	$4,710,000
		Pilot Study	1%	$50,000
			TOTAL	**$4,760,000**

(1) Does not include the cost for the recycled water pump station.

ALTERNATIVE 2: DAF/CFM PLANT COST ESTIMATE

Item	Unit	No. of Units	Unit Costs ($)	Total Costs ($)
DAF Clarifier	ea	1	$310,000	$310,000
Cloth Media Filter (CFM)	ea	2	$325,000	$650,000
Building	ls	1	$364,000	$364,000
Yard Piping	ls	1	$90,000	$90,000
Site Work	ls	1	$90,000	$90,000
Misc. Treatment Plant Pumps[(1)]	ls	1	$110,000	$110,000
Electrical/Controls	ls	1	$270,000	$270,000
Misc and Chemical Feed System	ls	1	$160,000	$160,000
Recycle 12-inch Main to Storage Tank	ft	3,400	$94	$319,600
Recycled Water Storage Tank (0.54 MG)	ea	1	$500,000	$500,000
			Sub Total	$2,863,600
		Contingency	30%	$859,000
			Sub Total	$3,723,000
Engineering, Contract Administration, & Environmental			30%	$859,000
			Sub Total	$4,582,000
		Pilot Study	1%	$50,000
			TOTAL	**$4,632,000**

ALTERNATIVE 3: MICROFILTRATION/RO PLANT COST ESTIMATE (Groundwater Recharge)

Item	Unit	No. of Units	Unit Costs ($)	Total Costs ($)
Clarifier	ea	1	$310,000	$310,000
Mcrofiltration/RO Treatment	ls	1	$1,500,000	$1,500,000
Building	ls	1	$364,000	$364,000
Yard Piping	ls	1	$90,000	$90,000
Site Work	ls	1	$90,000	$90,000
Misc. Treatment Plant Pumps[(1)]	ls	1	$110,000	$110,000
Electrical/Controls	ls	1	$270,000	$270,000
Misc and Chemical Feed System	ls	1	$160,000	$160,000
Recycled Water Storage Tank (0.25 MG)	ea	1	$300,000	$300,000
Injection Wells (12-inch)	ea	2	$330,000	$660,000
			Sub Total	$3,854,000
		Contingency	30%	$1,156,000
			Sub Total	$5,010,000
Engineering, Contract Administration, & Environmental			30%	$1,156,000
			Sub Total	$6,166,000
		Pilot Study	1%	$65,000
			TOTAL	**$6,231,000**

(1) Does not include the cost for the recycled water pump station.

TABLE 11

City of Lakeport

2009 Recycle Feasibility Study Report

100-YEAR RAINFALL EVENT, 650 AF RESERVOIR & ADWF WATER BALANCE
RESERVOIR & EFFLEUNT IRRIGATION SYSTEM WATER BALANCE

File: Table 11A Water Balan
Job #: 523.27/Report Spreads
Date: 4/19/2010
By: BAC

			PASTURE				SEWAGE				RESERVOIR & OXIDATION PONDS								
												EVAPORATION							
MONTH	RAINFALL [1,2] Inch/Month	ET_o RATE [3] Inch/Month	PAN TO PASTURE COEFFICIENT [4]	PASTURE ET Inch/Month	AGRONOMIC IRRIGATION [5] Inch/Month	MINIMUM IRRIGATION [6] Days	Q_{MONTH}/ ADWF [7] DESIGN RATIO	TO STORAGE MG/Month	TO STORAGE Ac-Ft/Month	RAINFALL ON STORAGE Ac-Ft/Month	PAN TO RESERVOIR COEFFICIENT [8]	Inch/Month	Ac-Ft/Month	IRRIGATION Ac-Ft/Month	RESERVOIR PERCOLATION [9] Ac-Ft/Month	TAILWATER RETURN Ac-Ft/Month	CHANGE IN STORAGE Ac-Ft	ESTIMATED TOTAL IN STORAGE Ac-Ft	Evap Pan A Lakeport A80 470100 (mm)	Average Annual Rainfall [2] (Inches)
																		100		
OCT	3.49	2.6	0.76	1.9	0.0	17	1.01	17.22	52.9	9.9	0.881	2.3	5.4	114.1	1.5	7.2	-51.1	48.9	65	1.74
NOV	8.09	0.7	0.73	0.5	0.0	8	1.06	18.07	55.5	22.9	0.801	0.5	1.3	54.0	2.8	3.4	23.8	72.7	17	4.03
DEC	10.55	1.1	0.71	0.8	0.0	0	1.63	27.79	85.3	29.9	0.801	0.9	2.1	0.0	4.3	0.0	108.8	181.5	28	5.26
JAN	12.36	0.6	0.72	0.5	0.0	3	2.26	38.53	118.3	35.0	0.801	0.5	1.2	20.8	5.3	1.3	127.4	308.9	16	6.16
FEB	9.67	1.3	0.74	1.0	0.0	0	2.23	34.34	105.4	27.4	0.801	1.0	2.5	0.0	5.8	0.0	124.6	433.4	33	4.82
MAR	7.26	2.2	0.76	1.6	0.0	0	2.52	42.97	131.9	20.6	0.801	1.7	4.2	0.0	6.5	0.0	141.8	575.2	55	3.62
APR	3.83	3.9	0.78	3.0	0.0	6	2.31	38.12	117.0	10.9	0.744	2.9	7.0	41.5	6.5	2.6	75.5	**650.7**	99	1.91
MAY	1.44	5.9	0.78	4.6	3.8	18	1.66	28.30	86.9	4.1	0.744	4.4	10.5	103.9	6.5	6.5	-23.4	627.3	149	0.72
JUN	0.56	6.9	0.78	5.3	5.7	20	1.36	22.44	68.9	1.6	0.744	5.1	12.2	158.7	6.3	10.0	-96.8	530.5	174	0.28
JUL	0.08	8.5	0.78	6.6	7.8	28	1.21	20.63	63.3	0.2	0.744	6.3	15.1	216.5	5.3	13.6	-159.7	370.8	215	0.04
AUG	0.22	7.7	0.78	6.0	7.0	28	1.08	18.41	56.5	0.6	0.744	5.7	13.8	192.5	4.5	12.1	-141.5	229.3	196	0.11
SEP	0.68	5.6	0.78	4.3	4.4	24	1.02	16.83	51.7	1.9	0.744	4.1	9.9	121.1	3.8	7.6	-73.6	155.7	141	0.34
TOTAL	58.25	46.8		36.2	28.7	151		323.7	993.3	165.0		35.5	85.2	1023.2	58.8	64.5	55.7		1188	29.03

CONSTANTS

Storage pond runoff area (acres):	A	34		
Average storage pond water surface (acres):	B	26		
Total oxidation cell area (acres):		2.82		
Irrigation area (acres):	X	332		
Storage pond percolation rate @ 12 ft WL (in/day):	Z	0.1	4.6E-07	cm/sec
Design ADWF (MGD):	E	**0.55**	51.3	Ac-Ft/Month
Irrigation Application Efficiency Factor	Y	1.2		
Offseason Irrigation Rate (in/day)	G	0.25		
Tailwater recovery percent of applied water		0.063		

NOTES:

1. 100-year rainfall based on Station Lakeport 2NW Precipitation Long-Duration-Frequency Table from DWR Bulletin 195, October 1976.
2. 100-year rainfall of 58.25 inches spread in proportion to average monthly rainfall data for years 1941-2001 from Western Regional Climate Center.
3. Potential ET_o based on 12 years of data for Station Lakeport Evaporation from Water Surface, DWR Bulletin 73-79, November 1979.
4. Pasture evapotranspiration ratio determined from DWR Bulletin 73-79, November 1979.
5. Effluent applied May through September. Application rate = (ET - Precipitation) * 1.2 Irrigation Application Efficiency Factor
6. Effluent applied between October and April based upon minimum irrigation days and historical offseason irrigation rate.
7. Sewage flow based upon 2003-2005 monthly average dry weather flow sent to reservoir, Qmonth/ADWF Design Ratios x Design ADWF.
8. Reservoir and oxidation ponds evaporation pan ratios from "Penman-Monteith Estimates of Reservoir Evaporation"; Marvin E. Jensen, Hon. M.ASCE; Avry Dotan; and Roland Sanford.
9. Reservoir percolation and evaporation rates take into account the surface area inundated. Evaporation includes oxidation pond area.
10. The 3-year ADWF for Aug-Oct 2004-2007 = 0.38 MGD. There are an estimated 1,836 Residential Unit Equivalents contributing to CLMSD. Therefore, the ADWF/RUE = 200 GPD. Based upon this spreadsheet, CLMSD has an ADWF capacity of 0.56 MGD. Thus there is an estimated remaining ADWF capacity of 170,000 GPD or 770 RUEs. This is predicated on an extremely aggressive irrigation effort taking advantage of every possible irrigation day.
11. Normalized I&I = [321 MG/Yr - (0.56 MGD * 365 Days/Yr)] / 0.56 MGD = 208 MG/MGD

TABLE 12

City of Lakeport

2009 Recycle Feasibility Study Report

ESTIMATED RECYCLE WATER USAGE AND PROPOSED MARKET ALTERNATIVES

Potential Market Alternatives	Potential Market Area (acres)	Maximum Market Area Served (acres)[3]	Irrigation Period	Average Annual Recycle Water Supply (Ac-Ft)	Average Maximum Month Water Usage (Ac-Ft)	Estimated Maximum Daily Water Usage (gal/day)	Estimated Maximum Daily Water Usage[7] (GPM)	Estimated Maximum Daily Water Usage[7] (MGD)	Estimated[15] Max Hour Demand (GPM)	Estimated Finished Recycle Water Storage[1] (MG)
Lakeport Golf Course Development[12]										
Golf Course	200	133	March to October	413	79	855,000	594	0.9	950	0[10]
Urban Landscaping	600±	243	March to October	755	144	1,562,000	1,085	1.6	1,736	0.70
Domestic Water Use (Toilets)[9]	N/A	N/A	Year Round	34	2.8	30,000	21	0.03	33	0.01
Lakeport Golf Course Development Total		376		1,202 [8]	225	2,447,000	1,699	2.4	2,719	1.10
Cristallago Golf Course	189	189	March to October	587	112	1,215,000	844	1.2	1,350	0[10]
Cristallago/Basin 2000 Pipeline	N/A	N/A	Year Round	750 [14]			1,040	1.5	1,664	0.67
Westside Park/Parallel Drive[5][13]	120	120	March to October	373	71	771,000	535	0.8	857	0.35
Westside Park/Recycle Service Zone Developments[6][11]	180	180	March to October	560	107	1,157,000	803	1.2	1,286	0.54
Southeast Agricultural Area[2]										
Vineyards	620	450	May to September	604	173	1,874,000	1,301	1.9	2,082	0.84
Orchards	370	223	March to October	604	126	1,373,000	953	1.4	1,526	0.62
Full Circle Project "Geysers"	N/A	N/A	Year Round	750 [14]			1,040	1.5	1,664	0.67
Lakeport GRRP	N/A	N/A	Year Round	750 [14]						

(1) Based 20% MDD equalization + 25% MDD emergency storage.
(2) Potential agricultural fields within 2 miles of Lakeport WWTP.
(3) Maximum market area served is based on providing 80 percent of 2029 Lakeport recycled water available (i.e., 604 Ac-Ft).
(4) Potential urban 20-year developments within 2 miles of Lakeport WWTP.
(5) Based on irrigation of 50 acres of City's park property.
(6) Based on irrigation of 50 percent of developed area.
(7) Based on an 24-hour irrigation day.
(8) Estimated annual recycled water volume is 1,200 Ac-Ft based on a ADWF of 0.76 MGD generated by adding LGCD 1,500 RUEs.
(9) Estimated amount of water used in toilets 10 gallons per day/toilet. Assume two toilets per household and 1,500 RUEs or 30,000 GPD.
(10) Assumes "on-site" golf course reservoirs.
(11) Proposed 20-year developments within 2 mile recycle service zone, see Plate 2 (does not include CLSB Golf Couse Development).
(12) Lakeport Golf Course Development shown as Area 19 and 20 on Plate 2.
(13) Includes 20-year development areas 14, 15, 20, E and F on Plate 2.
(14) Estimated annual recycled water generated at the Lakeport Treatment Plant by 2029.
(15) From 2008 Lakeport Master Water Plan MHD:MDD = 1.6

TABLE 13

City of Lakeport

2009 Feasibility Recycle Study

PRELIMINARY PIPELINE DESIGN CRITERIA

Description	Units	Design Criteria
Minimum Delivery Pressure	PSI	60
Maximum Flow Velocity	Feet/second	5
Hazen Williams Coefficient (C)	–	130
Minimum Recycle Pipe Size	Inches	8

TABLE 14

City of Lakeport

2009 Recycle Feasibility Study Report

100-YEAR RAINFALL EVENT, RESERVOIR & AVERAGE DRY WEATHER FLOW (ADWF) WATER BALANCE
LAKEPORT GOLF COURSE DEVELOPMENT RESERVOIR & EFFLEUNT IRRIGATION SYSTEM WATER BALANCE

File: Water Balance Submitta
Job #: 523.28/Report Spreadsl
Date: 4/19/2010
By: BAC

MONTH	RAINFALL [1,2] Inch/Month	ET_o RATE [3] Inch/Month	PASTURE: PAN TO PASTURE COEFFICIENT [4]	PASTURE: PASTURE ET Inch/Month	PASTURE: AGRONOMIC IRRIGATION [5] Inch/Month	PASTURE: MINIMUM IRRIGATION [6] Days	SEWAGE: Q_{MONTH}/ ADWF [7] DESIGN RATIO	SEWAGE: TO STORAGE MG/Month	SEWAGE: TO STORAGE Ac-Ft/Month	RAINFALL ON STORAGE Ac-Ft/Month	RESERVOIR & OXIDATION PONDS: PAN TO RESERVOIR COEFFICIENT [8]	RESERVOIR & OXIDATION PONDS: EVAPORATION Inch/Month	RESERVOIR & OXIDATION PONDS: EVAPORATION Ac-Ft/Month	IRRIGATION Ac-Ft/Month	RESERVOIR PERCOLATION [9] Ac-Ft/Month	TAILWATER RETURN Ac-Ft/Month	CHANGE IN STORAGE Ac-Ft	ESTIMATED TOTAL IN STORAGE Ac-Ft	Evap Pan A Lakeport A80 470100 (mm)	Average Annual Rainfall [2] (Inches)
																		100		
OCT	3.49	2.6	0.76	1.9	0.0	17	1.01	23.80	73.0	9.9	0.881	2.3	1.7	178.8	1.5	11.3	-87.7	12.3	65	1.74
NOV	8.09	0.7	0.73	0.5	0.0	8	1.06	24.17	74.2	22.9	0.801	0.5	0.6	84.5	2.8	5.3	14.5	26.8	17	4.03
DEC	10.55	1.1	0.71	0.8	0.0	0	1.63	38.40	117.9	29.9	0.801	0.9	1.5	0.0	4.3	0.0	142.1	168.9	28	5.26
JAN	12.36	0.6	0.72	0.5	0.0	0	2.26	53.25	163.4	35.0	0.801	0.5	1.0	0.0	5.3	0.0	192.2	361.1	16	6.16
FEB	9.67	1.3	0.74	1.0	0.0	3	2.23	47.45	145.6	27.4	0.801	1.0	2.2	32.5	5.8	2.0	134.6	495.7	33	4.82
MAR	7.26	2.2	0.76	1.6	0.0	0	2.52	59.37	182.2	20.6	0.801	1.7	4.2	0.0	6.5	0.0	192.1	687.8	55	3.62
APR	3.83	3.9	0.78	3.0	0.0	6	2.31	52.67	161.6	10.9	0.744	2.9	7.0	65.0	6.5	4.1	98.1	785.9	99	1.91
MAY	1.44	5.9	0.78	4.6	3.8	18	1.66	39.11	120.0	4.1	0.744	4.4	10.5	162.8	6.5	10.3	-45.4	740.5	149	0.72
JUN	0.56	6.9	0.78	5.3	5.7	20	1.36	31.01	95.2	1.6	0.744	5.1	11.8	248.6	6.3	15.7	-154.3	586.2	174	0.28
JUL	0.08	8.5	0.78	6.6	7.8	28	1.21	28.51	87.5	0.2	0.744	6.3	12.5	339.1	5.3	21.4	-247.8	338.4	215	0.04
AUG	0.22	7.7	0.78	6.0	7.0	28	1.08	25.44	78.1	0.6	0.744	5.7	10.0	301.5	4.5	19.0	-218.3	120.2	196	0.11
SEP	0.68	5.6	0.78	4.3	4.4	24	1.02	23.26	71.4	1.9	0.744	4.1	6.1	189.7	3.8	11.9	-114.3	5.9	141	0.34
TOTAL	58.25	46.8		36.2	28.7	151		446.4	1370.1	165.0		35.5	69.0	1602.5	58.8	101.0	-94.1		1188	29.03

CONSTANTS

Storage pond runoff area (acres):	A	34		
Average storage pond water surface (acres):	B	26		
Total oxidation cell area (acres):		2.82		
Irrigation area (acres):	C	520		
Storage pond percolation rate @ 12 ft WL (in/day):	D	0.1	4.6E-07	cm/sec
Design ADWF (MGD):	E	0.76	70.9	Ac-Ft/Month
Irrigation Application Efficiency Factor:	F	1.2		
Offseason Irrigation Rate (in/day):	G	0.25		
Tailwater recovery percent of applied water:		0.063		

NOTES:

1 100-year rainfall based on Station Lakeport 2NW Precipitation Long-Duration-Frequency Table from DWR Bulletin 195, October 1976.

2 100-year rainfall of 58.25 inches spread in proportion to average monthly rainfall data for years 1941-2001 from Western Regional Climate Center.

3 Potential ET_o based on 12 years of data for Station Lakeport Evaporation from Water Surface, DWR Bulletin 73-79, November 1979.

4 Pasture evapotranspiration ratio determined from DWR Bulletin 73-79, November 1979.

5 Effluent applied May through September. Application rate = (ET - Precipitation) * 1.2 Irrigation Application Efficiency Factor.

6 Effluent applied in October through April based upon minimum irrigation days and historical offseason irrigation rate.

7 Sewage flow based upon 2004-2007 monthly ADWF sent to reservoir, Qmonth/ADWF Design Ratios x Design ADWF.

8 Reservoir and oxidation ponds evaporation pan ratios from "Penman-Monteith Estimates of Reservoir Evaporation"; Marvin E. Jensen, Hon. M.ASCE; Avry Dotan; and Roland Sanford.

9 Reservoir percolation and evaporation rates take into account the surface area inundated. Evaporation includes oxidation pond area.

10 The 4-year ADWF for Aug-Oct 2004-2007 = 0.38 MGD. The ADWF/RUE = 200 GPD. Based upon this spreadsheet, CLMSD has an ADWF capacity of about 0.56 MGD remaining in the treatment plant reservoir/effluent disposal . Thus there is an estimated remaining ADWF capacity of approximatley 0.18 MGD ADWF. This is predicated on an extremely aggressive irrigation effort taking advantage of every possible irrigation day and continued reduction in I&I within the collection system overthe next 20 years.

11 Normalized I&I = [296.6 MG/Yr -(0.51 MGD * 365 Days/Yr)] / 0.51 MGD = 222.4 MG/MGD.

TABLE 15

City of Lakeport

2009 Recycle Feasibility Study Report

CONVEYANCE, O&M AND ANNUALIZATION UNIT COST ASSUMPTIONS

Description	Unit	Unit Cost
Capital Cost		
Pipeline & Appurtenance Costs	Per Foot	See Figure 8
Pump Stations	Per Hp	$3,500
Right of Way/Land Acquisition	Per Acre	$20,000
Construction Contingency	% of Total Construction Cost	30
Engineering, Legal, Admin, Environmental	% of Total Construction Cost + Contingency	30
Annual O&M Costs		
Pipelines	% of Construction Cost	1
Treatment Processes	% of Treatment Plant Construction Cost	8
Pump Stations	Per Flow Rate (MGD)	$91,000/MGD(1)/Year
Annualized Capital Costs		
Recovery Period	Years	30
Interest Rate	%	6

(1) Based on $250/MG

TABLE 16

City of Lakeport

2009 Recycle Feasiblity Study Report

ESTIMATED COST OF RECYCLED WATER ALTERNATIVES

No Recycle Project Alternative

Description		Estimated Cost ($)
Treatment		
Effluent Reservoir Volume 200 Ac-Ft (new resrvoir site)[6]	$	3,500,000
Treatment Plant Construction Costs	$	3,500,000
Recycled Water Distribution		
Pipelines & Appurtenances[1][6]	$	1,780,000
New Reservoir Effluent Pump Station	$	400,000
Distribution Construction Costs	$	2,180,000
Subtotal Raw Construction Costs	**$**	**5,680,000**
Construction Contingency (30%)	$	1,704,000
Total Construction Cost	**$**	**7,384,000**
Right-of-Way/Reservoir Land Acquisition[4]	$	7,000,000
Engineering, Legal, Admin, Environmental (30%)	$	2,215,000
Total Capital Cost	**$**	**16,599,000**
Annualized Capital[2]	$	1,206,000
Pipeline System O&M	$	21,800
Pumping Station O&M (based on 2.4 MGD)	$	220,000
Treatment Plant O&M[3]	$	70,000
Combined Annual O&M	$	312,000
Total Annualized Cost	**$**	**1,518,000**
Annual Recycle Yield (Ac-Ft per Year)[5]		870
Annualized Cost/(Ac-Ft/Year)	**$**	**1,740 /Ac-Ft**

(1) Based on a 12-inch recycle pipeline from proposed reservoir site to irrigation area at existing WWTP (see Plate 2).

(2) Annualized costs are based on a 30-year recovery period at 6% interest.

(3) Based on 2% of new reservoir site construction costs.

(4) Assumed 350-acre reservoir site.

(5) Assumes Lakeport 2042 average annual recycled water generation (870 Ac-ft).

(6) Construction costs are Inflated to 2042 values (3% annually).

TABLE 17

City of Lakeport

2009 Recycle Feasilbility Study Report

ESTIMATED COST OF RECYCLED WATER ALTERNATIVES

Lakeport Golf Course Development Alternative

Description		Estimated Cost ($)
Treatment		
Modify Headworks	$	197,000
Increase Effluent Pump Station Capacity	$	150,000
Increase Effluent Reservoir Volume 200 Ac-Ft	$	3,000,000
Expand Chloring Contact Chamber and Equipment	$	180,000
Tertiary Treatment Plant Expansion - Alternative 1	$	2,943,000
Treatment Plant Pilot Study	$	50,000
Treatment Plant Construction Costs	$	6,520,000
Recycle Water Distribution		
Pipelines & Appurtenances (Point 1 to 11 Plate 2)(1)	$	651,000
Recycle Distribution Pumping Station (100 Hp)	$	350,000
Distribution Construction Costs	$	1,001,000
Subtotal Raw Construction Costs	**$**	**7,521,000**
Construction Contingency (30%)	$	2,256,000
Total Construction Cost	**$**	**9,777,000**
Right-of-Way/Land Acquistiion(4)	$	-
Engineering, Legal, Admin, Environmental (30%)	$	2,933,000
Total Capital Cost	**$**	**12,710,000**
Annualized Capital(2)	$	923,000
Pipeline System O&M	$	10,000
Pumping Station O&M (based on 2.4 MGD)	$	220,000
Treatment Plant O&M(3)	$	326,000
Combined Annual O&M	$	556,000
Total Annualized Cost	**$**	**1,479,000**
Annual Recycle Yield (Ac-Ft per Year)(5)		1,202
Annualized Cost/(Ac-Ft/Year)	**$**	**1,230 Ac-Ft**

(1) Based on a 16-inch recycle pipeline backbone, does not include golf course and residential recycle distribution system.

(2) Annualized costs are based on a 30-year recovery period at 6% interest.

(3) Based on 5% of treatment plant construction costs.

(4) Assumed pipeline alignment and new reservoir site within Lakeport Golf Course Development.

(5) Assumes expanded Lakeport 2042 annual recycled water generation from development.

TABLE 18

City of Lakeport

2009 Recycle Feasibility Study Report

ESTIMATED COST OF RECYCLED WATER ALTERNATIVES

Southeast Agricultural Area Alternative

Description		Estimated Cost ($)	
Treatment			
Tertiary Treatment Plant Expansion - Alternative 1	$	2,943,000	
Treatment Plant Pilot Study	$	50,000	
Treatment Plant Construction Costs	$	2,993,000	
Recycle Water Distribution			
Pipelines & Appurtenances (Point 1 to 13 Plate 2)(1)	$	2,341,000	
Recycle Distribution Pumping Station (114 Hp Pumps)	$	400,000	
Distribution Construction Costs	$	2,741,000	
Subtotal Raw Construction Costs	**$**	**5,734,000**	
Construction Contingency (30%)	$	1,720,000	
Total Construction Cost	**$**	**7,454,000**	
Right-of-Way (approximatley 8 acres)	$	160,000	
Engineering, Legal, Admin, Environmental (30%)	$	2,236,000	
Total Capital Cost	**$**	**9,850,000**	
Annualized Capital(2)	$	716,000	
Pipeline System O&M	$	27,000	
Pumping Station O&M (based on 1.9 MGD)	$	175,000	
Treatment Plant O&M(3)	$	150,000	
Combined Annual O&M	$	352,000	
Total Annualized Cost	**$**	**1,068,000**	
Annual Recycle Yield (Ac-Ft per Year)		604	
Annualized Cost/(Ac-Ft/Year)	**$**	**1,770**	**/Ac-Ft**

(1) Based on a 16-inch and 10-inch recycle pipeline.

(2) Annualized costs are based on a 30 year recovery period at 6% interest.

(3) Based on 5% of treatment plant construction costs.

TABLE 19

City of Lakeport

2009 Recycle Feasiblity Study Report

ESTIMATED COST OF RECYCLED WATER ALTERNATIVES

Full Circle Alternative

Description	Estimated Cost w/ Tertiary Treatment ($)	Estimated Cost w/o Tertiary Treatment ($)
Treatment		
Tertiary Treatment Plant Expansion - Alternative 1	$ 2,943,000	$ -
Treatment Plant Pilot Study	$ 50,000	$ -
Treatment Plant Construction Costs	$ 2,993,000	$ -
Recycled Water Distribution		
Pipelines & Appurtenances (Point 1 to 14 Plate 2 & Figure 4)(1)	$ 7,420,000	$ 7,420,000
Pipelines & Appurtenances (Point 14 to 16 Figure 4)(2)	$ 10,400,000	$ 10,400,000
Recycle Distribution Pumping Station (140 Hp Pumps)	$ 490,000	$ 490,000
Distribution Construction Costs	$ 18,310,000	$ 18,310,000
Subtotal Raw Construction Costs	**$ 21,303,000**	**$ 18,310,000**
Construction Contingency (30%)	$ 6,391,000	$ 5,493,000
Total Construction Cost	**$ 27,694,000**	**$ 23,803,000**
Right-of-Way (approximatley 11 acres)	$ 220,000	$ 220,000
Engineering, Legal, Admin, Environmental (30%)	$ 8,308,000	$ 7,141,000
Total Capital Cost	**$ 36,222,000**	**$ 31,164,000**
Annualized Capital(3)	$ 2,631,000	$ 2,264,000
Pipeline System O&M	$ 183,000	$ 183,000
Pumping Station O&M (based on 2.7 MGD)	$ 246,000	$ 246,000
Treatment Plant O&M(4)	$ 150,000	$ -
Combined Annual O&M	$ 579,000	$ 429,000
Total Annualized Cost	**$ 3,210,000**	**$ 2,693,000**
Annual Recycle Yield (Ac-Ft per Year)	870	870
Annualized Cost/(Ac-Ft/Year)	**$ 3,690 /Ac-Ft**	**$ 3,100 /Ac-Ft**

(1) Based on a 16-inch recycle pipeline from the Lakeport WWTP to the proposed connection near the Kellseyville WWTP (Point 14 on Figure 4).

(2) Shared 16-inch pipeline costs between Lakeport & Kelseyville.

(3) Annualized costs are based on a 30-year recovery period at 6% interest.

(4) Based on 5% of treatment plant construction costs.

TABLE 20

City of Lakeport

2009 Recycle Feasiblity Study Report

ESTIMATED COST OF RECYCLED WATER ALTERNATIVES

Westside Park/Parallel Drive Alternative

Description		Estimated Cost ($)	
Treatment			
Tertiary Treatment Plant Expansion - Alternative 1	$	2,943,000	
Treatment Plant Pilot Study	$	50,000	
Treatment Plant Construction Costs	$	2,993,000	
Recycle Water Distribution			
Pipelines & Appurtenances (Point 1, 2, 3, 6, & 7 Plate 2)(1)	$	2,006,000	
Recycle Distribution Pumping Station (40 Hp Pumps)	$	140,000	
Distribution Construction Costs	$	2,146,000	
Subtotal Raw Construction Costs	**$**	**5,139,000**	
Construction Contingency (30%)	$	1,542,000	
Total Construction Cost	**$**	**6,681,000**	
Right-of-Way (approximatley 6 acres)(4)	$	120,000	
Engineering, Legal, Admin, Environmental (30%)	$	2,004,000	
Total Capital Cost	**$**	**8,805,000**	
Annualized Capital(2)	$	640,000	
Pipeline System O&M	$	21,000	
Pumping Station O&M (based on 1.0 MGD)	$	92,000	
Treatment Plant O&M(3)	$	150,000	
Combined Annual O&M	$	263,000	
Total Annualized Cost	**$**	**903,000**	
Annual Recycle Yield (Ac-Ft per Year)		373	
Annualized Cost/(Ac-Ft/Year)	**$**	**2,420**	**/Ac-Ft**

(1) Based on a 12-inch recycle pipeline from the Lakeport WWTP to Westside Park along Parallel Drive.

(2) Annualized costs are based on a 30-year recovery period at 6% interest.

(3) Based on 5% of treatment plant construction costs.

(4) Assumed pipeline construction within public ROW + purchase 6 ac reservoir site.

TABLE 21

City of Lakeport
2009 Recycle Feasibility Study Report

ESTIMATED COST OF RECYCLED WATER ALTERNATIVES

Westside Park/Recycle Service Zone Developments Alternative

Description		Estimated Cost ($)
Treatment		
Tertiary Treatment Plant Expansion - Alternative 1	$	2,943,000
Treatment Plant Pilot Study	$	50,000
Treatment Plant Construction Costs	$	2,993,000
Recycle Water Distribution		
Pipelines & Appurtenances (Point 1, 2, 2A, 3, 4, 5, 6, 7, 8, 9 Plate 2)[(1)]	$	2,250,000
Recycle Distribution Pumping Station (60 Hp Pumps)	$	224,000
Distribution Construction Costs	$	2,474,000
Subtotal Raw Construction Costs	**$**	**5,467,000**
Construction Contingency (30%)	$	1,640,000
Total Construction Cost	**$**	**7,107,000**
Right-of-Way (approximatley 6 acres)[(4)]	$	120,000
Engineering, Legal, Admin, Environmental (30%)	$	2,132,000
Total Capital Cost	**$**	**9,359,000**
Annualized Capital[(2)]	$	680,000
Pipeline System O&M	$	25,000
Pumping Station O&M (based on 1.2 MGD)	$	110,000
Treatment Plant O&M[(3)]	$	150,000
Combined Annual O&M	$	285,000
Total Annualized Cost	**$**	**965,000**
Annual Recycle Yield (Ac-Ft per Year)		560
Annualized Cost/(Ac-Ft/Year)	**$**	**1,720 /Ac-Ft**

(1) Based on a 12-inch recycle pipeline from the Lakeport WWTP to Westside Park along Parallel Drive and 8-inch recycle distribution on the east side of Highway 29 (see Points 4, 5, 8, & 9).

(2) Annualized costs are based on a 30-year recovery period at 6% interest.

(3) Based on 5% of treatment plant construction costs.

(4) Assumed pipeline construction within public ROW + purchase 6 ac reservoir site.

TABLE 22

City of Lakeport

2009 Recycle Feasiblity Study Report

ESTIMATED COST OF RECYCLED WATER ALTERNATIVES

Cristallago Golf Course Alternative

Description		Estimated Cost ($)
Treatment		
Tertiary Treatment Plant Expansion - Alternative 1	$	2,943,000
Treatment Plant Pilot Study	$	50,000
Treatment Plant Construction Costs	$	2,993,000
Recycle Water Distribution		
Pipelines & Appurtenances (Point 1, 2, 3, 6, & 10 Plate 2)(1)	$	3,250,000
Recycle Distribution Pumping Station (110 Hp Pumps)	$	385,000
Distribution Construction Costs	$	3,635,000
Subtotal Raw Construction Costs	**$**	**6,628,000**
Construction Contingency (30%)	$	1,988,000
Total Construction Cost	**$**	**8,616,000**
Right-of-Way (approximatley 11 acres)(4)	$	220,000
Engineering, Legal, Admin, Environmental (30%)	$	2,585,000
Total Capital Cost	**$**	**11,421,000**
Annualized Capital(2)	$	830,000
Pipeline System O&M	$	36,000
Pumping Station O&M (based on 1.2 MGD)	$	110,000
Treatment Plant O&M(3)	$	150,000
Combined Annual O&M	$	296,000
Total Annualized Cost	**$**	**1,126,000**
Annual Recycle Yield (Ac-Ft per Year)		600
Annualized Cost/(Ac-Ft/Year)	**$**	**1,880 /Ac-Ft**

(1) Based on a 12-inch recycle pipeline from the Lakeport WWTP to Cristallago Development along Parallel Drive and Highway 29 ROW.

(2) Annualized costs are based on a 30-year recovery period at 6% interest.

(3) Based on 5% of treatment plant construction costs.

(4) Assumed pipeline construction within public ROW + purchase 6 ac reservoir site.

TABLE 23

City of Lakeport

2009 Recycle Feasibility Study Report

ESTIMATED COST OF RECYCLED WATER ALTERNATIVES

Cristallago/Basin 2000 Pipeline Alternative

Description		Estimated Cost w/ Tertiary Treatment ($)		Estimated Cost w/o Tertiary Treatment ($)
Treatment				
Tertiary Treatment Plant Expansion - Alternative 1	$	2,943,000	$	-
Treatment Plant Pilot Study	$	50,000	$	-
Treatment Plant Construction Costs	$	2,993,000	$	-
Recycle Water Distribution				
Pipelines & Appurtenances (Point 1, 2, 3, 6, 10, & 15 Plate 2)(1)	$	4,323,000	$	4,323,000
Recycle Distribution Pumping Station (140 Hp Pumps)	$	490,000	$	490,000
Distribution Construction Costs	$	4,813,000	$	4,813,000
Subtotal Raw Construction Costs	**$**	**7,806,000**	**$**	**4,813,000**
Construction Contingency (30%)	$	2,342,000	$	1,444,000
Total Construction Cost	**$**	**10,148,000**	**$**	**6,257,000**
Right-of-Way (approximatley 11 acres)(4)	$	220,000	$	220,000
Engineering, Legal, Admin, Environmental (30%)	$	3,044,000	$	1,877,000
Total Capital Cost	**$**	**13,412,000**	**$**	**8,354,000**
Annualized Capital(2)	$	974,000	$	607,000
Pipeline System O&M	$	48,000	$	48,000
Pumping Station O&M (based on 1.2 MGD)	$	110,000	$	110,000
Treatment Plant O&M(3)	$	150,000	$	-
Combined Annual O&M	$	308,000	$	158,000
Total Annualized Cost	**$**	**1,282,000**	**$**	**765,000**
Annual Recycle Yield (Ac-Ft per Year)(5)		870		870
Annualized Cost/(Ac-Ft/Year)	**$**	**1,470 /Ac-Ft**	**$**	**880 /Ac-Ft**

(1) Based on a 12-inch recycle pipeline from the Lakeport WWTP to LACOSAN NWRWWTP along Parallel Drive, Highway 29 ROW and through Cristallago Development.
(2) Annualized costs are based on a 30-year recovery period at 6% interest.
(3) Based on 5% of treatment plant construction costs.
(4) Assumed pipeline construction within public ROW + purchase 6 ac reservoir site.
(5) Assumes Lakeport 2042 annual recycled water generation.

TABLE 24

City of Lakeport

2009 Recycle Feasibility Study Report

ESTIMATED COST OF RECYCLED WATER ALTERNATIVES

Groundwater Recharge and Reuse Project Alternative

Description		Estimated Cost ($)	
Treatment			
Tertiary Treatment Plant w/ RO Expansion - Alternative 3 (1)	$	3,854,000	
Treatment Plant Pilot Study	$	65,000	
Treatment Plant Construction Costs	$	3,919,000	
Recycle Water Distribution (4)			
Recharge Pumping Station (50 Hp Pumps)	$	175,000	
Distribution Construction Costs	$	175,000	
Subtotal Raw Construction Costs	**$**	**4,094,000**	
Construction Contingency (30%)	$	1,228,000	
Total Construction Cost	**$**	**5,322,000**	
Engineering, Legal, Admin, Environmental (30%)	$	1,597,000	
Total Capital Cost	**$**	**6,919,000**	
Annualized Capital (2)	$	503,000	
Pipeline System O&M	$	2,000	
Pumping Station O&M (based on 0.57 MGD)	$	52,000	
Treatment Plant O&M (3)	$	314,000	
Combined Annual O&M	$	368,000	
Total Annualized Cost	**$**	**871,000**	
Annual Recycle Yield (Ac-Ft per Year) (5)		806	
Annualized Cost/(Ac-Ft/Year)	**$**	**1,080**	**/Ac-Ft**

(1) Based on construction of the two groundwater injection wells located at the existing WWTP.

(2) Annualized costs are based on a 30-year recovery period at 6% interest.

(3) Based on 8% of treatment plant construction costs.

(4) Assumes gorundwater recharge system located @ existing Lakeport WWTP.

(5) Assumes Lakeport 2042 annual recycled water generation.

TABLE 25
City of Lakeport
2009 Recycle Feasibility Study Report
ASSUMPTIONS FOR THE BENEFIT COST CURVE

Benefit Number	Benefit	Benefit Value per acre-foot	Comment
1	Recycled Water Supply	$1,230 City $50 Agriculture	This benefit value is the assumed estimated rate that could be charged for recycled water. This rate is based on current potable water rate for the City of Lakeport. For recycled water within the City of Lakeport , it is assumed that recycled water would replace potable water. For agricultural markets, it is assumed that recycled water has a $50/Ac-Ft value.
2	Potable Water Supply	$1,230 City	Potable water supply would be freed up by serving recycled water to the existing customer that uses potable supplies for irrigation. The potable water supply is expected to increase in the future. This value was estimated based on City residential water rate of $1,230 for a water service meter.
3	Avoided Cost of Disposal Capacity Upgrade	$1,740	A benefit value was estimated based on the "No Project" alternative. This amount was developed assuming purchase of additional land and the construction for a new reservoir within 33 years.
4	Avoided Cost of Water Supply Facilities Upgrade	$960	This benefit value was estimated based on the estimated cost of water treatment plant upgrades to provide water to meet future long-term demands. The estimated cost of the treatment plant upgrades (0.86 MGD) is approximately $4.8 million.
5	Avoided Cost of Future Water Supply Acquisition	$3,321	This benefit is associated with acquiring future water supply sources . This benefit value can be estimated based on the cost of having to acquire more water to meet long-term water use versus using recycle water. This benefit value is assumed to be $3,321/Ac-Ft based on projecting the current cost to the City of acquiring water ($52.50/Ac-Ft) from the Yolo County Flood Control and Water Conservation District to year 2094 (growth 5%/year), which is when the City is projected to require additional water supply based on a current 1.1 percent growth rate.
6	Water Supply Reliability	$180	Reliability benefit is based on maintaining or increasing the amount of potable water available for critical uses (i.e., drinking, bathing, cooking, etc.) versus non-critical uses (landscape irrigation, car washing, etc.). Reliability can be enhanced by replacing some of the non-critical potable water used in a system with recycle water. It is estimated that Lakeport consumes about 240 Ac-Ft per year for landscape irrigation, this equates to the production of one of its municipal well pumps (450 GPM). The annualized cost for a new 450 GPM well for the City is roughly $660,00 or roughly $180/Ac-Ft of production (based on 30 years & 5%).
7	Regional Benefits (electrical cogeneration) (ground water recharge)	$4,900 $53	Regional benefits are difficult to quantify; however, it is estimated that for every Ac-ft of water injected at the Geysers about 41 MW of power can be produced. At $120 per MW this equates to $4,900 per Ac-ft. Groundwater recharge benefits based on current Yolo County acquisition water rates of $53/Ac-Ft

TABLE 26

City of Lakeport

2009 Recycle Feasiblity Study Report

SUMMARY OF ALTERNATIVE ESTIMATED COSTS & BENEFITS

Project Alternative	Raw Construction Costs ($)	Total Construction Cost ($)	Total Capital Cost ($)	Total Annualized Cost ($)	Unit Implmentation Cost $/Ac-Ft	Unit Benefit Cost $/Ac-Ft	Benefit Number[1]	Benefit to Implementation Unit Cost $/Ac-Ft
Southeast Agricultural Area	$ 5,734,000	$ 7,454,000	$ 9,850,000	$ 1,068,000	$ 1,770	$ 50	1[2]	$ (1,720)
No Project	$ 5,680,000	$ 7,384,000	$ 16,599,000	$ 1,518,000	$ 1,740	$ 50	1[2]	$ (1,690)
Groundwater Recharge & Reuse Project	$ 4,094,000	$ 5,322,000	$ 6,919,000	$ 871,000	$ 1,080	$ 1,793	3, 7[4]	$ 713
Lakeport Golf Course Development	$ 7,521,000	$ 9,777,000	$ 12,710,000	$ 1,479,000	$ 1,230	$ 2,190	1[3], 4	$ 960
Cristallago Golf Course	$ 6,682,000	$ 8,616,000	$ 11,421,000	$ 1,126,000	$ 1,880	$ 2,970	1[3], 3	$ 1,090
Full Circle Project "Geysers" w/ Tertiary Treatment	$ 21,303,000	$ 27,694,000	$ 36,222,000	$ 3,210,000	$ 3,690	$ 6,690	1[2], 3, 7	$ 3,000
Full Circle Project "Geysers" w/o Tertiary Treatment	$ 18,310,000	$ 23,803,000	$ 31,164,000	$ 2,693,000	$ 3,100	$ 6,640	3, 7	$ 3,540
Westside Park/Parallel Drive	$ 5,139,000	$ 6,681,000	$ 8,805,000	$ 903,000	$ 2,420	$ 6,921	1[3], 2, 4, 5, 6	$ 4,501
Westside Park/Recycle Service Zone Developments	$ 5,467,000	$ 7,107,000	$ 9,359,000	$ 965,000	$ 1,720	$ 6,921	1[3], 2, 4, 5, 6	$ 5,201
Cristallago/Basin 2000 Pipeline w/o Tertiary Treatment	$ 4,813,000	$ 6,257,000	$ 8,354,000	$ 765,000	$ 880	$ 6,640	3, 7	$ 5,760
Cristallago/Basin 2000 Pipeline w/ Tertiary Treatment	$ 7,806,000	$ 10,148,000	$ 13,412,000	$ 1,282,000	$ 1,470	$ 7,870	1[3], 3, 7	$ 6,400

(1) See Assumption for the Benefit Cost, Table 24.
(2) Irrigation of agricultural land.
(3) Irrigation of urban golf course or landscaping with recycled water.
(4) Based on groundwater recharge rate see, Table 24.

TABLE 27

City of Lakeport

2009 Recycle Feasibility Study Report

TENTATIVE PHASE 1 PROJECT IMPLEMENTATION SCHEDULE

PHASE 1 PROJECT WORK TASKS	SCHEDULE																																															
	2010												2011												2012												2013											
Months	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Contact CRWQCB & CDHS on proposed Westside Park recycle project																																																
Perform Treatment Plant Pilot Study																																																
Prepare Pilot Study & Preliminary Design Engineering Report; Submit to City, CRWQCB, & CDHS																																																
City to hold public outreach workshop to discuss recycle water advantages.																																																
Consult with private property owners to acquire support for use of recycle water and to determine intrest in recycle assessment district.																																																
City to perform recycle water ordinace investigation and implement recycle use ordinaces.																																																
Prepare and submit Draft Preliminary Recycle Assessment District Engieers Report to City for review.																																																
Phase 1 CEQA & NEPA environmental initial study prepared and sent to State Clearinghouse.																																																
Submit RD pre-application for RUS water and wastewater grant/loan																																																
Submit SWRCD Water Recycling Funding Program (WRFP) application																																																
Informational hearing on Recycle Assessment District																																																
Final Protest Hearing on Recycle Assessment District																																																
Submit Final Assessment District Engieering Report																																																
Final Environmental Documents for proposed project are adopted by City Council.																																																
Submit Final Application to RD for RUS Grant/Loan																																																
Apply for Interim Financing																																																
Receive Letter of Conditions from RD & SWRCD																																																
Design and right-of-way acquisiton authorized																																																
Prepare of Plans and Specifications and obtain all permits																																																
Agency Review Period																																																
Advertise for Construction Bids																																																
Open Construction Bids																																																
City obtain interim financing																																																
Award Project																																																
Construction Period (10 months)																																																
Completion of Project																																																

TABLE 28

City of Lakeport
2009 Recycle Feasibility Study Report
ESTIMATED COSTS FOR PHASE 1 - WESTSIDE PARK/PARALLEL DRIVE RECYCLE PROJECT

NO.	DESCRIPTION	QTY	UNIT	INSTALLED COST UNIT	INSTALLED COST TOTAL	TOTAL COST
Recycle Reservoir Site Work						
1	Site work & piping	1	LS	$180,000	$180,000	$180,000
2	0.54 MG Recycle Reservoir (bolted steel)	1	LS	$200,000	$200,000	$200,000
3	18' Access road to tank	2,720	FT	$70	$190,400	$190,400
12-INCH RECYCLE WATER MAIN (From proposed recycle plant to 0.54 MG recycle reservoir)						
1	12" C900 W/ "A4"	660	FT	$97	$64,020	$64,020
2	12" C900 W/ "A4" w/ road	2,700	FT	$100	$270,000	$270,000
12-INCH RECYCLE WATER MAIN (From Linda Lane PS to proposed recycle plant)						
1	12" C900 W/ "A4"	2,500	FT	$97	$242,500	$242,500
2	12" C900 W/ "A1"	350	FT	$115	$40,250	$40,250
3	12" GV	4	EA	$2,500	$10,000	$10,000
12-INCH RECYCLE WATER MAIN (From Linda Lane PS to Intersection of Todd & Parallel Drive)						
1	12" C900 W/ "A4"	6,000	FT	$97	$582,000	$582,000
2	12" C900 W/ "A1"	690	FT	$115	$79,350	$79,350
3	FIRE HYDRANT (PURPLE), COMPLETE	5	EA	$5,500	$27,500	$27,500
4	12" GV	10	EA	$2,500	$25,000	$25,000
5	ABOVE GND ARV ASSEMBLY, COMPLETE	8	LS	$3,000	$24,000	$24,000
6	BOX CULVERT CROSSING	2	LS	$5,000	$10,000	$10,000
7	SERVICE W/ SADDLE AND CORP STOP ONLY	20	EA	$500	$10,000	$10,000
8	SHEETING, SHORING, AND BRACING	1	LS	$30,000	$30,000	$30,000
9	TEE W/ VALVE CLUSTER (3 GV'S)	1	LS	$8,000	$8,000	$8,000
12-INCH & 8-INCH RECYCLE WATER MAIN (From Todd & Parallel Drive to Westside Park)						
1	8" C900 W/ "A1"	1,750	FT	$86	$150,500	$150,500
2	8" C900 W/ "A4"	2,050	FT	$78	$159,900	$159,900
3	12" C900 W/ "A1"	770	FT	$115	$88,550	$88,550
4	12" GV	1	EA	$2,500	$2,500	$2,500
5	8" GV	4	EA	$1,300	$5,200	$5,200
Install irrigation system in Westside Park (based on Lakeport Treatment Plant Irrigation Project Costs)(2)						
1	Recycle Irrigation System	45	ACRES	$8,800	$396,000	$396,000
TERTIARY TREATMENT PLANT EXPANSION COSTS						
1	Packaged Treatment Units Adsorption Clarifier (2 units)	2	EA	$520,000	$1,040,000	$1,040,000
2	Plant building (45'X60' block building)	2,700	FT	$150	$405,000	$405,000
3	Recycle water pumping station	1	LS	$140,000	$140,000	$140,000
4	Site work	1	LS	$200,000	$200,000	$200,000
5	Electrical controls	1	LS	$270,000	$270,000	$270,000
6	Chemical Feed System	1	LS	$160,000	$160,000	$160,000
7	Backwash pumping station & storage tank	1	LS	$170,000	$170,000	$170,000
8	T.P. Misc Yard Piping	1	LS	$125,000	$125,000	$125,000

SUBTOTAL FOR PHASE 1 RECYCLE WATER SYSTEM	$5,305,670
Contingency @ 30%	$1,591,701
SUBTOTAL FOR PHASE 1 RECYCLE WATER SYSTEM CONSTRUCTION	$6,897,371
INDIRECT COSTS	
Treatment Plant Pilot Study (two weeks)	$50,000 (1)
Architectural and Engineering Fees	$1,293,257
Administration	$40,000
Legal (Other than Bond Counsel)	$30,000
Land & Rights-of-Way Acquisition (reservoir site)	$120,000 (1)
Reimbursed Planning Fees	
Preliminary Engineering Design Report	$36,000
Environmental Clearance	$40,000
Other Architectural Engineering Fees	$50,000
Project Inspection Fees	$140,000
Bond Counsel & Misc. Bond Fees	$56,000 (3)
Interim Financing Interest $2.6 million, 6 months @ 4%	$52,000
INDIRECT COSTS SUBTOTAL	$1,907,257
TOTAL PHASE 1 PROJECT COSTS	**$8,805,000**

POSSIBLE FUNDING SOURCES

Proposition 50 Construction Funding (25% of eligible construction costs)	$2,158,750
RD RUS Water and Wastewater Grant (45% of eligible construction costs)	$3,962,250
Remaining project costs for other funding sources (i.e., Low Interest RUS Loan).	$2,684,000

(1) Not eligible for Proposition 50 grant funding
(2) Does not include Westside Park site grading.
(3) Bond counsel may not be required if bonds are not issued for this project.

TABLE 29
City of Lakeport
2009 Recycle Feasability Study Report
PHASE 1 WESTSIDE PARK/PARALLEL DRIVE RECYCLE PROJECT
Potential Recycle Users

Proposed Development Description	Street Location or Address[1]	Development Type	Estimated Recycle Water Connection Date	Estimated Developed Area (Ac)	Estimated Irrigation Area[2] (Ac)	Estimated Annual Irrigation (Ac-Ft)/Yr[3]
Westside Park	1402 Westside Park Road	Park	Present	50	50	155
Mendocino College Facilities	2565 Parallel Drive	School	Present to 2013	25.3	12.7	39
14	Craig Road	Residential	2010 to 2029	6.7	3.4	10
20	Parallel Drive	Residential	2010 to 2029	75	37.3	115
D	Parallel Drive	Commercial	2010 to 2029	1	0.5	2
E	Parallel Drive	Commercial	2010 to 2029	10.2	5.1	16
F	Parallel Drive	Commercial	2010 to 2029	23	11.5	36
			TOTAL	191	120	373

(1) See Figure 12 for development locations.

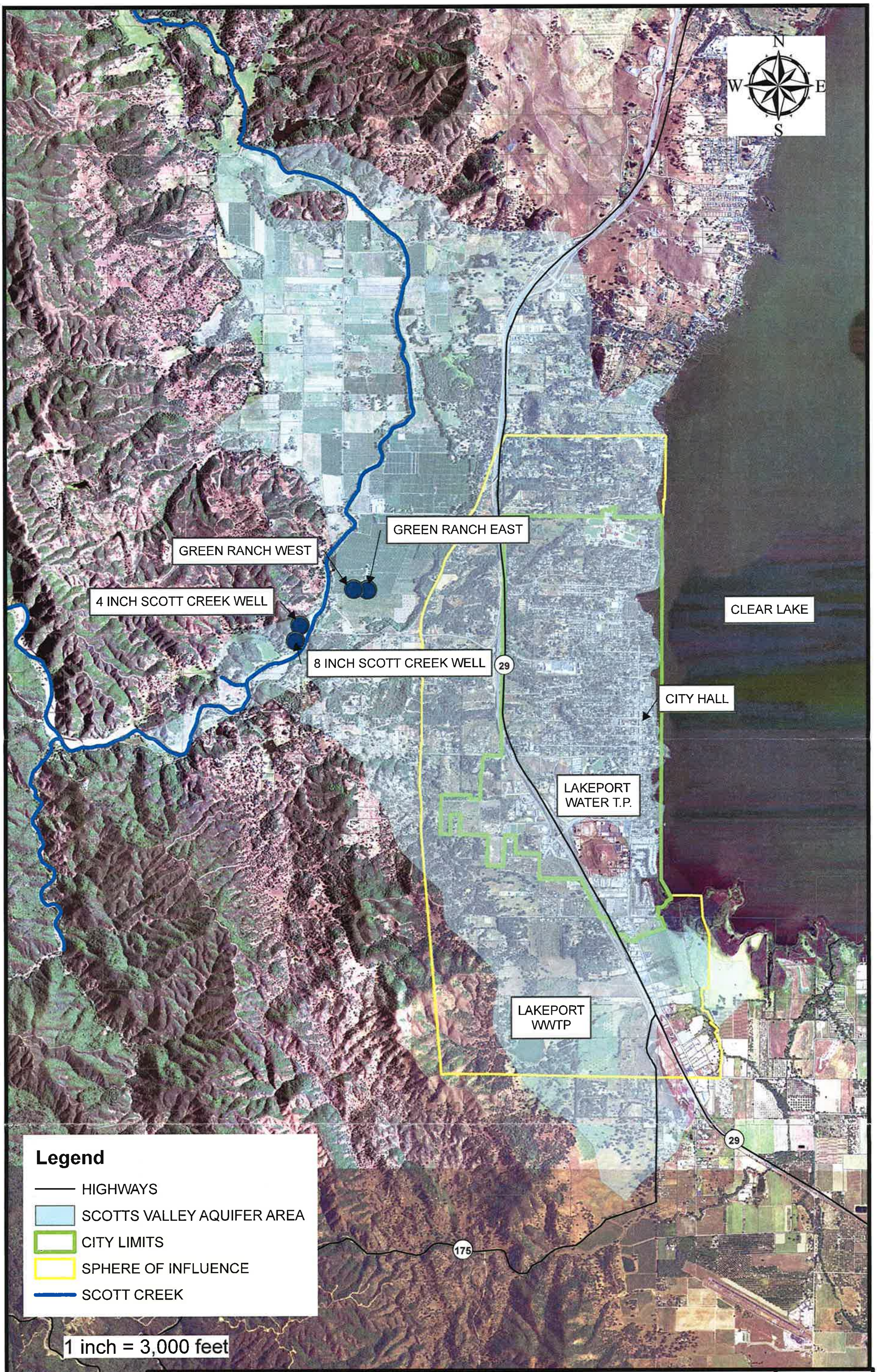
(2) Commercial, residential and school irrigation area based on 1/2 the developed area.

(3) Based on turf grass irrigation needs from Table 2.

M:\Jobs\0523\0523.27\FINAL REPORT\Spreadsheets\Table 29 Potential Recycle Users Phase 1.xls

2/16/2010

FIGURES

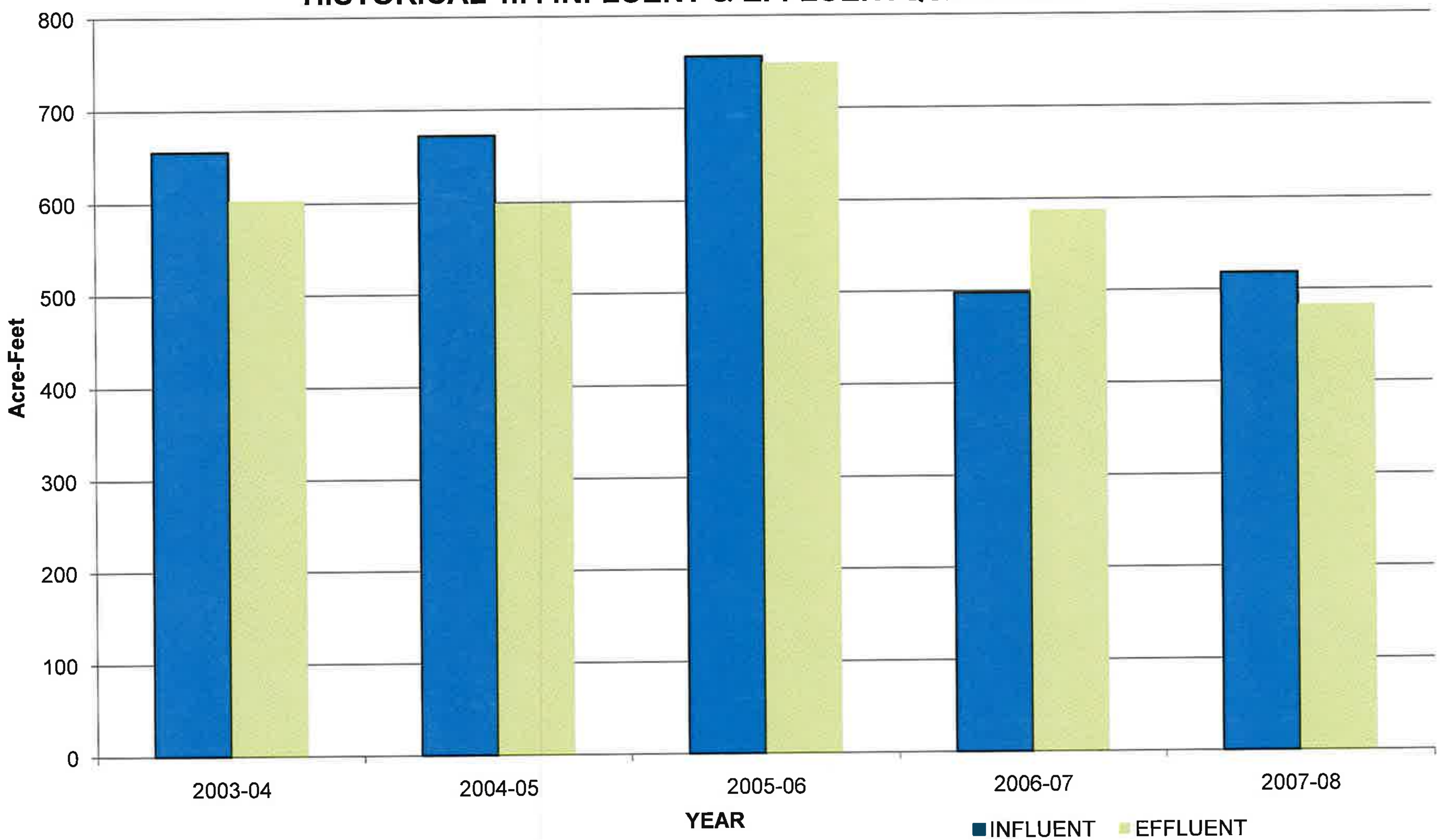


PACE ENGINEERING
REDDING, CALIFORNIA

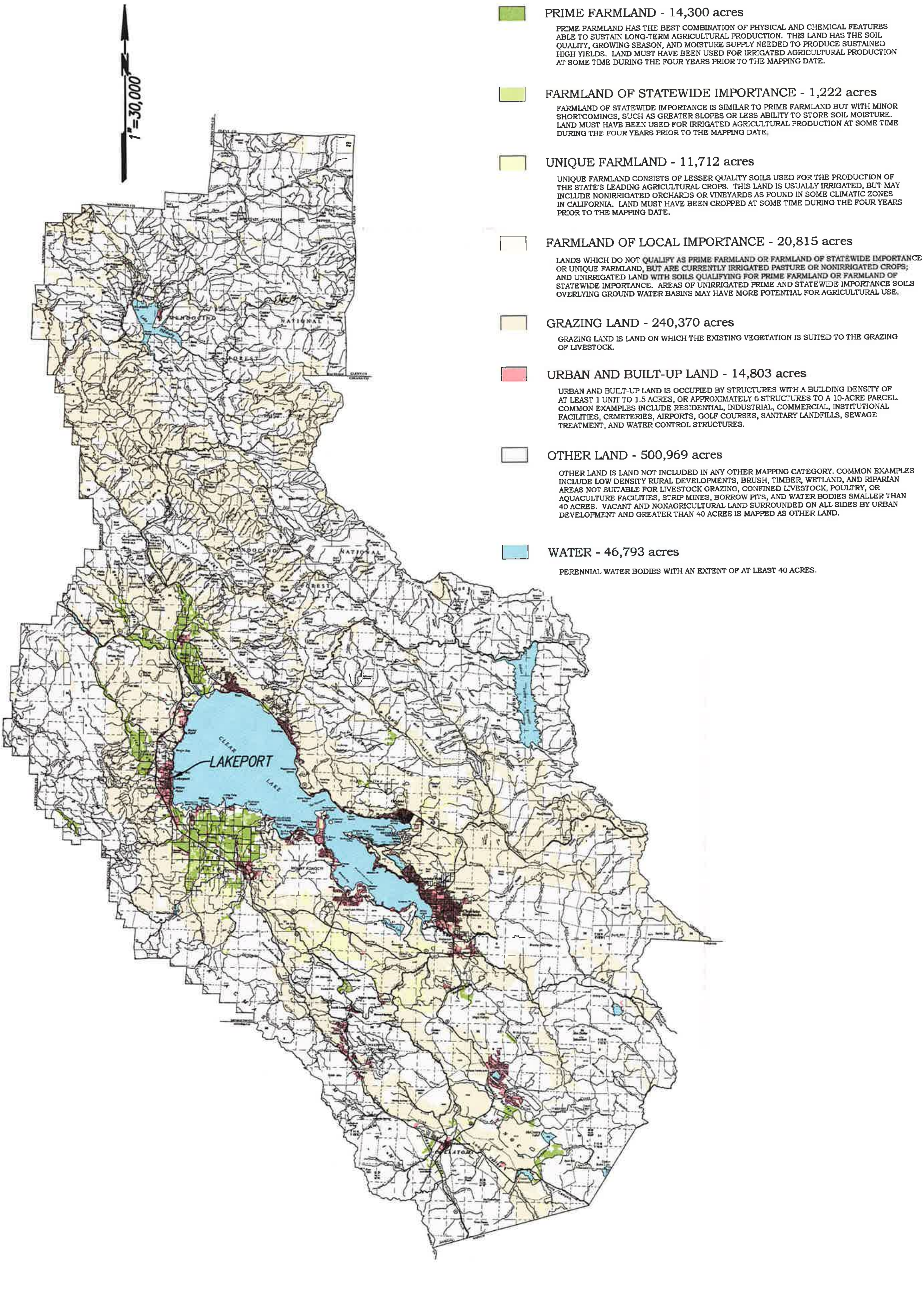
CITY OF LAKEPORT
2009 RECYCLE FEASIBILITY STUDY
SCOTTS VALLEY AQUIFER BOUNDARY

FIGURE 1
DATE 3/09
JOB# 523.27

FIGURE 2
CITY OF LAKEPORT
2009 RECYCLE FEASIBILITY STUDY
HISTORICAL T.P. INFLUENT & EFFLUENTQUANTITIES



4/1/2009M:\Jobs\0523\0523.27\DRAFT REPORT\Figures\FIGURE 2 2000 TO 2008 PLANT FLOWS 1-27-09.xls



PACE ENGINEERING REDDING, CALIFORNIA	CITY OF LAKEPORT 2009 RECYCLE FEASIBILITY STUDY LAKE COUNTY IMPORTANT FARMLAND	FIGURE 3 DATE 3/09 JOB # 523.27

Plot Date: April 01, 2009 - 8:11 am Login Name: gmaxwell
File Name: M:\Land Projects\052327 LAKEPORT RECYCLE\FIGURE 3.dwg, Layout: FIG3

NOTE: FULL CIRCLE PIPELINE ALIGNEMNT TAKEN FROM LAKE COUNTY SANITATION DISTRICT CH2MHILL FULL CIRCLE PIPELINE FINAL REPORT, NOVEMBER 2004

PACE ENGINEERING
REDDING, CALIFORNIA

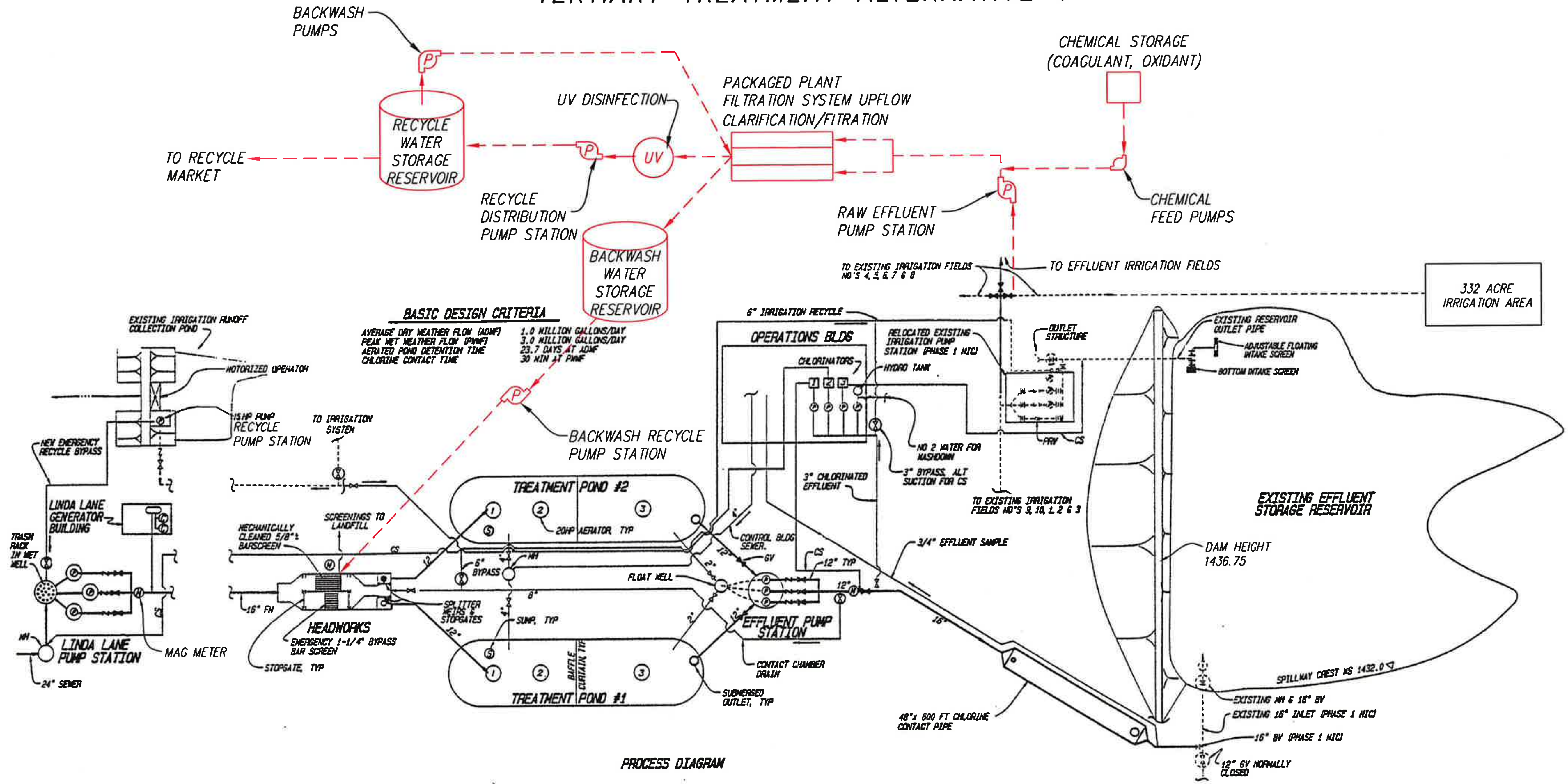
CITY OF LAKEPORT
2009 RECYCLE FEASIBILITY STUDY
LAKE COUNTY GEYSERS FULL CIRCLE SYSTEM

FIGURE 4

DATE 3/09

JOB # 523.27

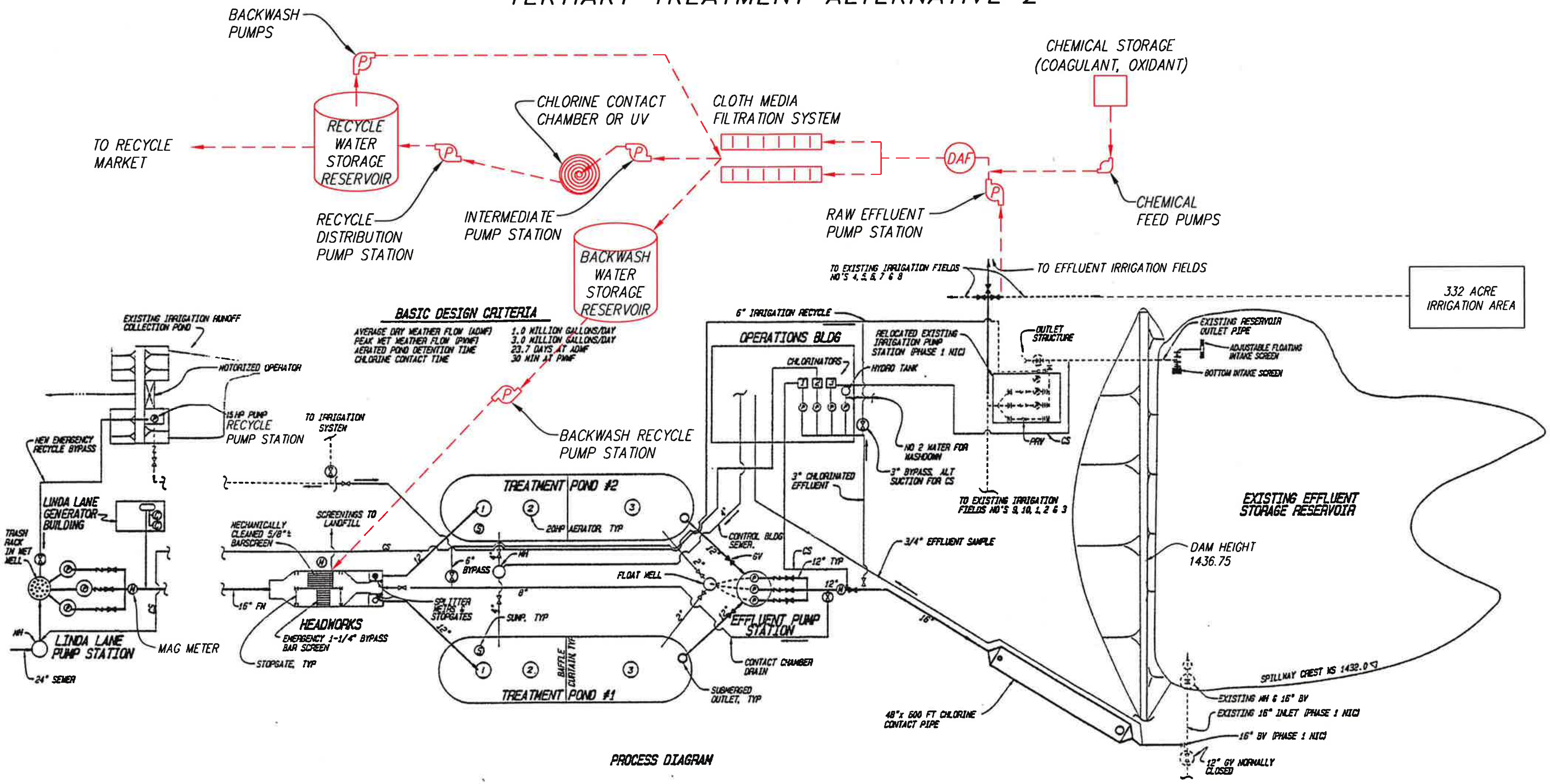
TERTIARY TREATMENT ALTERNATIVE 1



PACE ENGINEERING REDDING, CALIFORNIA	CITY OF LAKEPORT 2009 RECYCLE FEASIBILITY STUDY TREATMENT PLANT TITLE 22 RECYCLE WATER IMPROVEMENTS	FIGURE 5 DATE 03/09 JOB # 523.27

Plot Date: April 19, 2010 - 9:32 am Login Name: lmccollum
File Name: M:\Land Projects\052327 LAKEPORT RECYCLE\Figure 5 Figure 6.dwg Layout: ALT 1

TERTIARY TREATMENT ALTERNATIVE 2



PACE ENGINEERING
REDDING, CALIFORNIA

CITY OF LAKEPORT
2009 RECYCLE FEASIBILITY STUDY
TREATMENT PLANT TITLE 22
RECYCLE WATER IMPROVEMENTS

FIGURE 6
DATE 03/09
JOB # 523.27

Plot Date: April 19, 2010 - 9:33 am Login Name: lmccollum
File Name: M:\Land Projects\052327 LAKEPORT RECYCLE\Figure 5 Figure 6.dwg, Layout: ALT 2

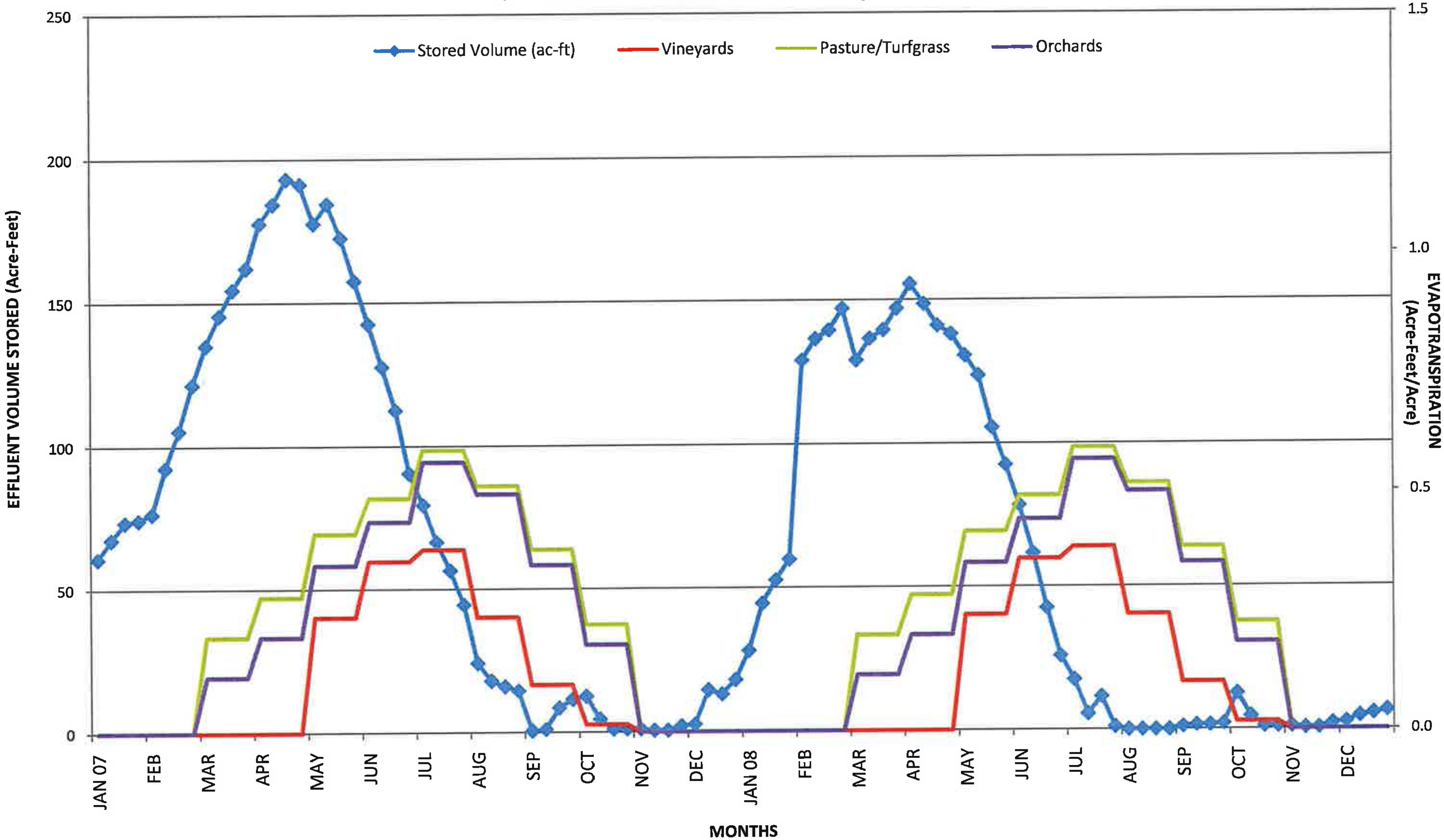
FIGURE 7

CITY OF LAKEPORT

2009 RECYCLE FEASIBILITY STUDY

EFFLUENT RESERVOIR STORAGE

vs. POTENTAIL IRRIGATION REQUIREMENTS



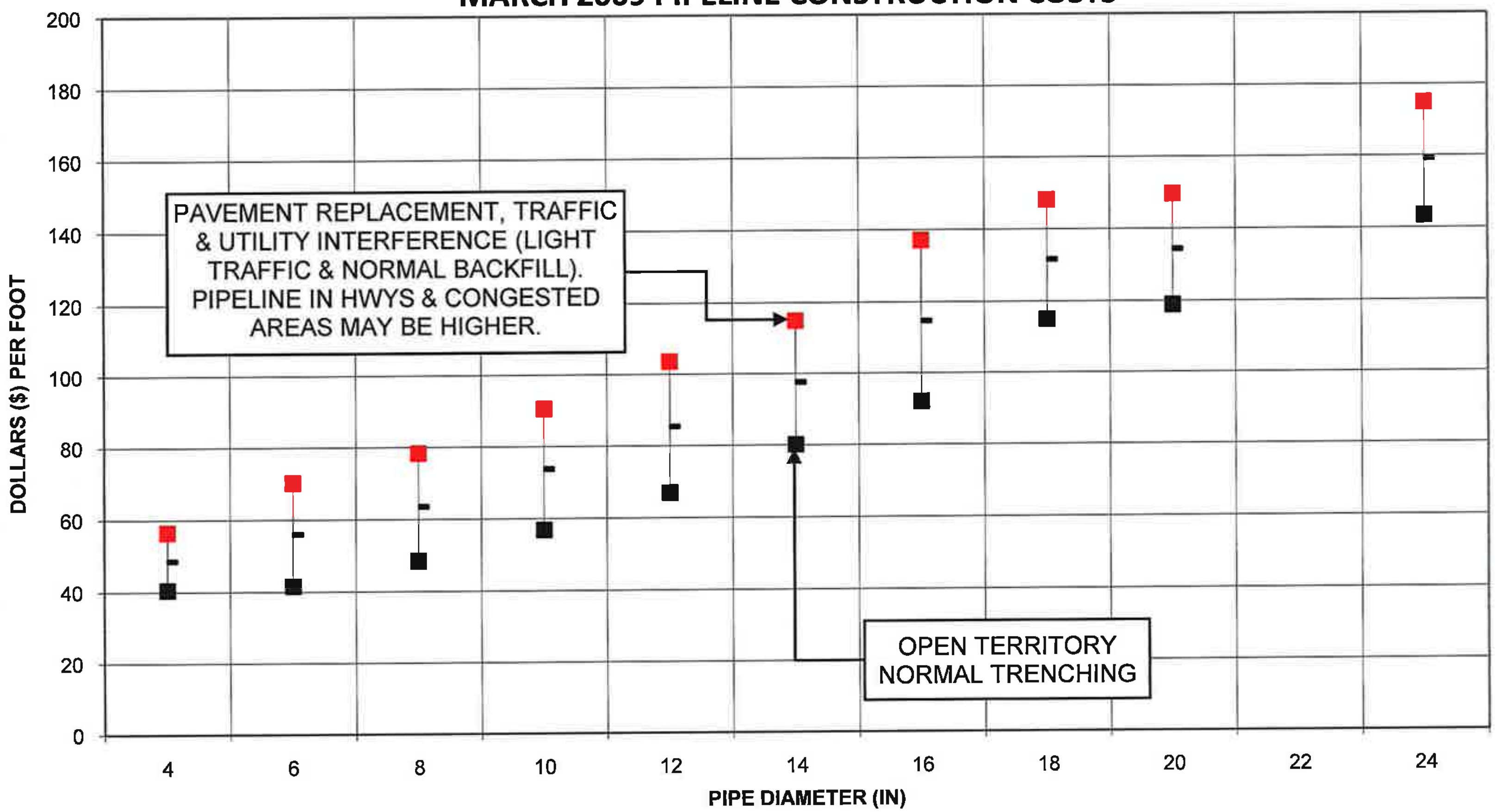
4/1/2009M:\Jobs\0523\0523.27\DRAFT REPORT\Figures\FIGURE 7 Reservoir volumes VS IRRIGATION.xls

FIGURE 8

CITY OF LAKEPORT

2009 RECYCLE FEASIBILITY STUDY

MARCH 2009 PIPELINE CONSTRUCTION COSTS



NOTES:
1. COSTS INCLUDE VALVES & NORMAL APPURTENANCES BUT DOES NOT INCLUDE ENGINEERING OR CONTINGENCIES OR OTHER INCIDENTAL COSTS. COSTS DO NOT INCLUDE FIRE HYDRANTS, INTERTIES, OR SERVICES.
2. REPLACEMENT PIPELINES MAY BE CONSIDERABLY MORE COSTLY.
3. MARCH 2009 ENR 8534.

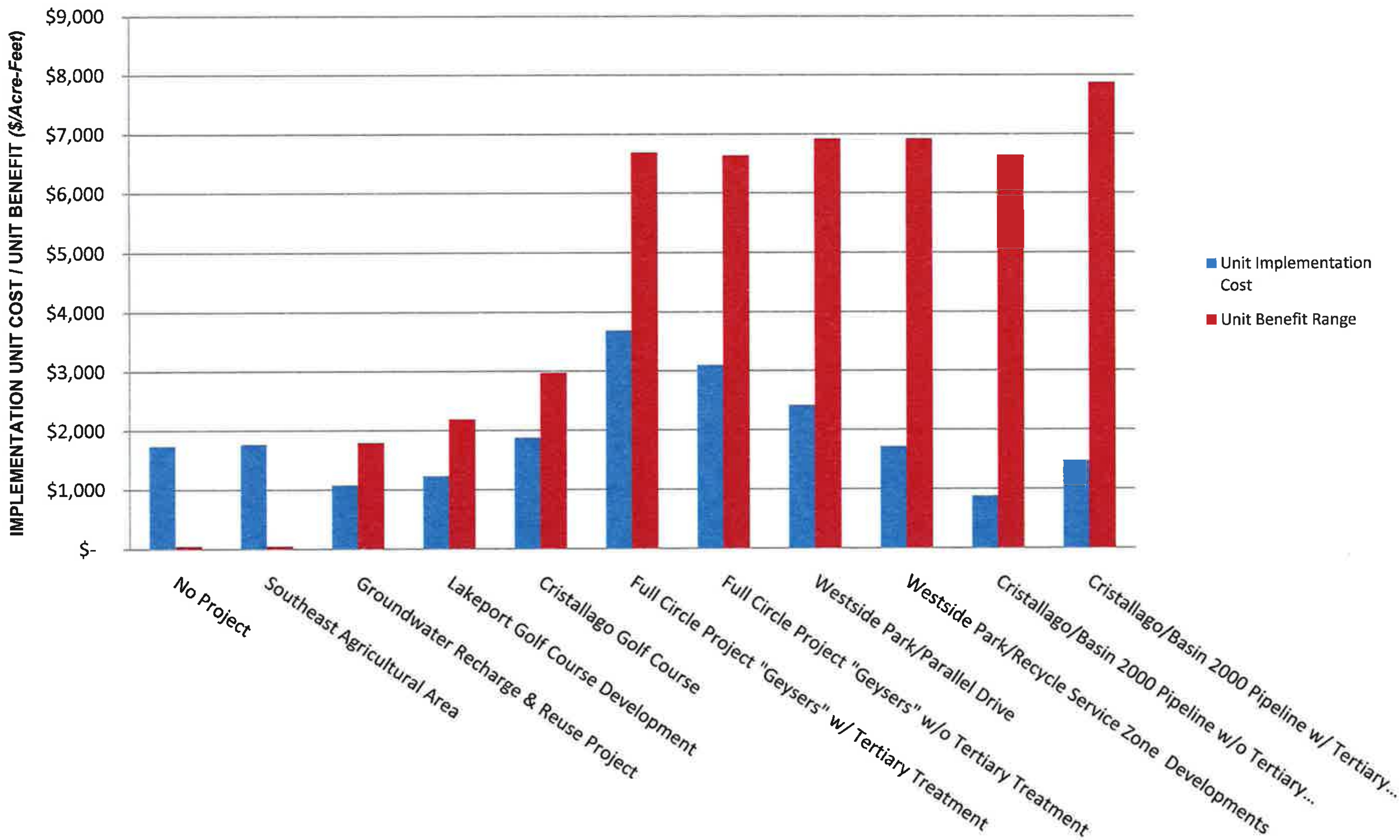
4/1/2009
M:\Jobs\0523\0523.27\DRAFT REPORT\Figures\Figure 8 Pipe Costs(March 2009).xls

FIGURE 9

CITY OF LAKEPORT

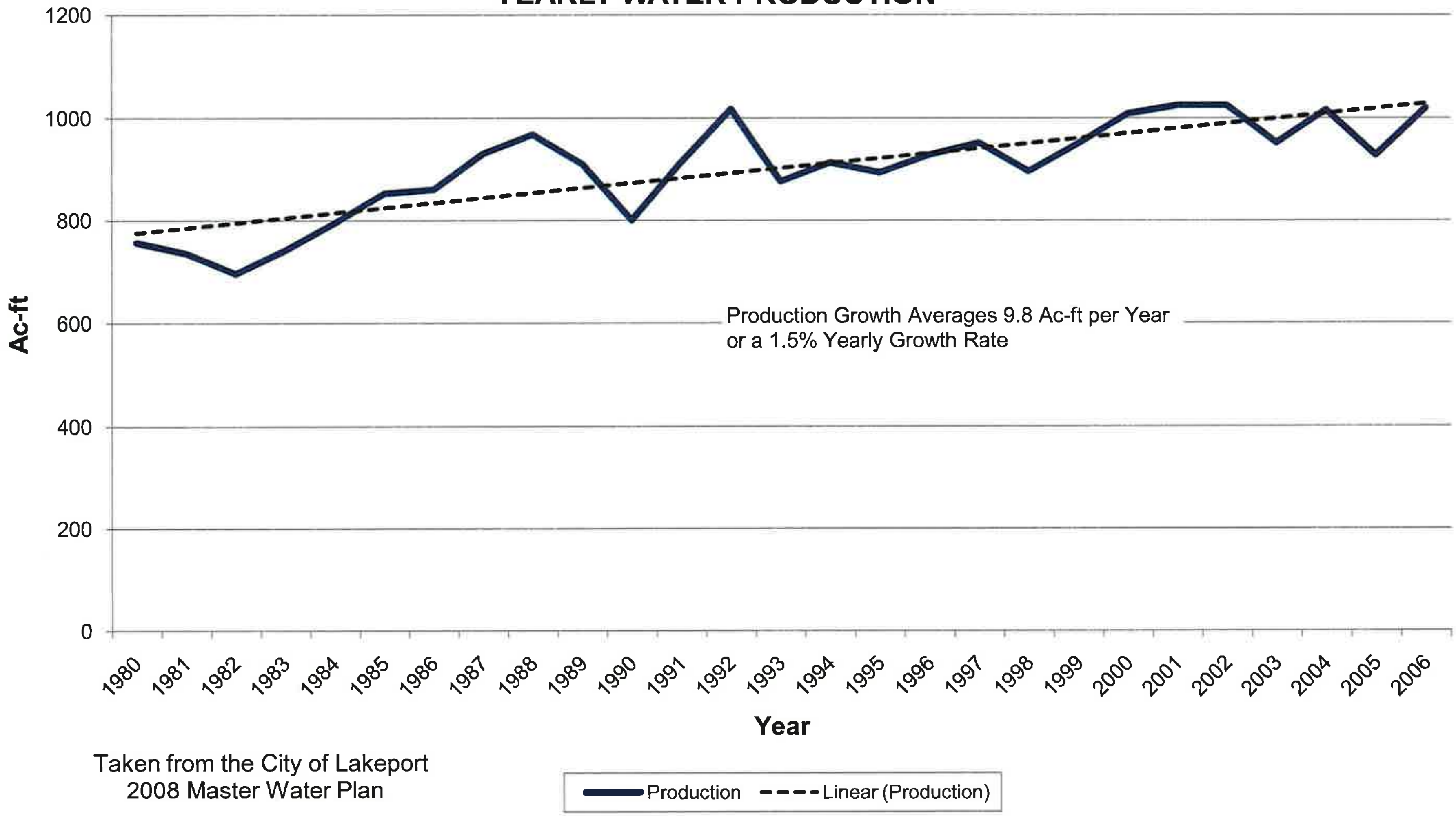
2009 RECYCLE FEASIBILITY STUDY

ESTIMATED UNIT IMPLEMENTATION COST & ASSOCIATED BENEFIT



M:\Jobs\0523\0523.27\FINAL REPORT\Figures\Figure 9 Benefit to Unit Costs Alternatives.xls

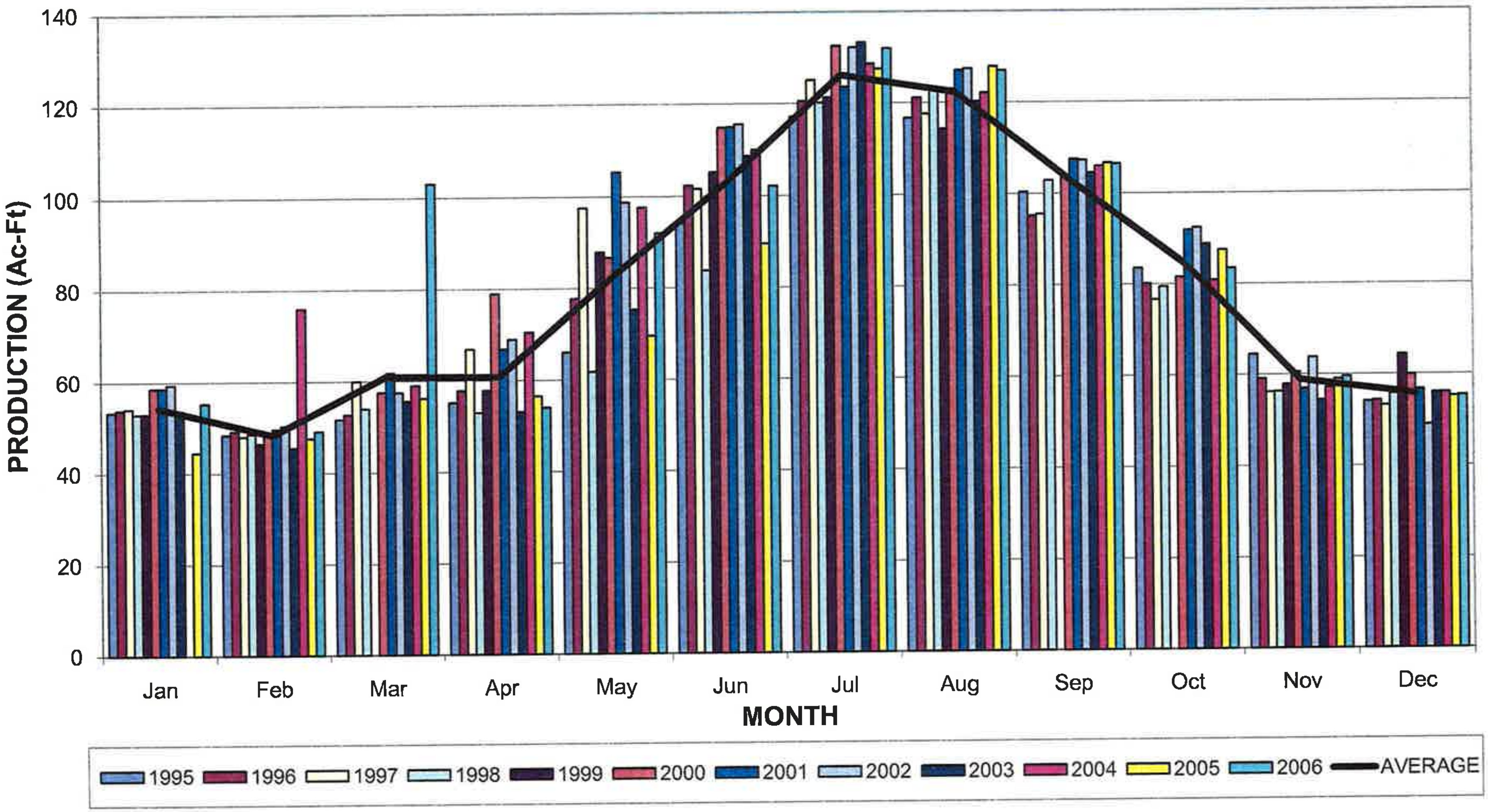
FIGURE 10
CITY OF LAKEPORT
2009 RECYCLE FEASIBILITY STUDY
YEARLY WATER PRODUCTION



Taken from the City of Lakeport
2008 Master Water Plan

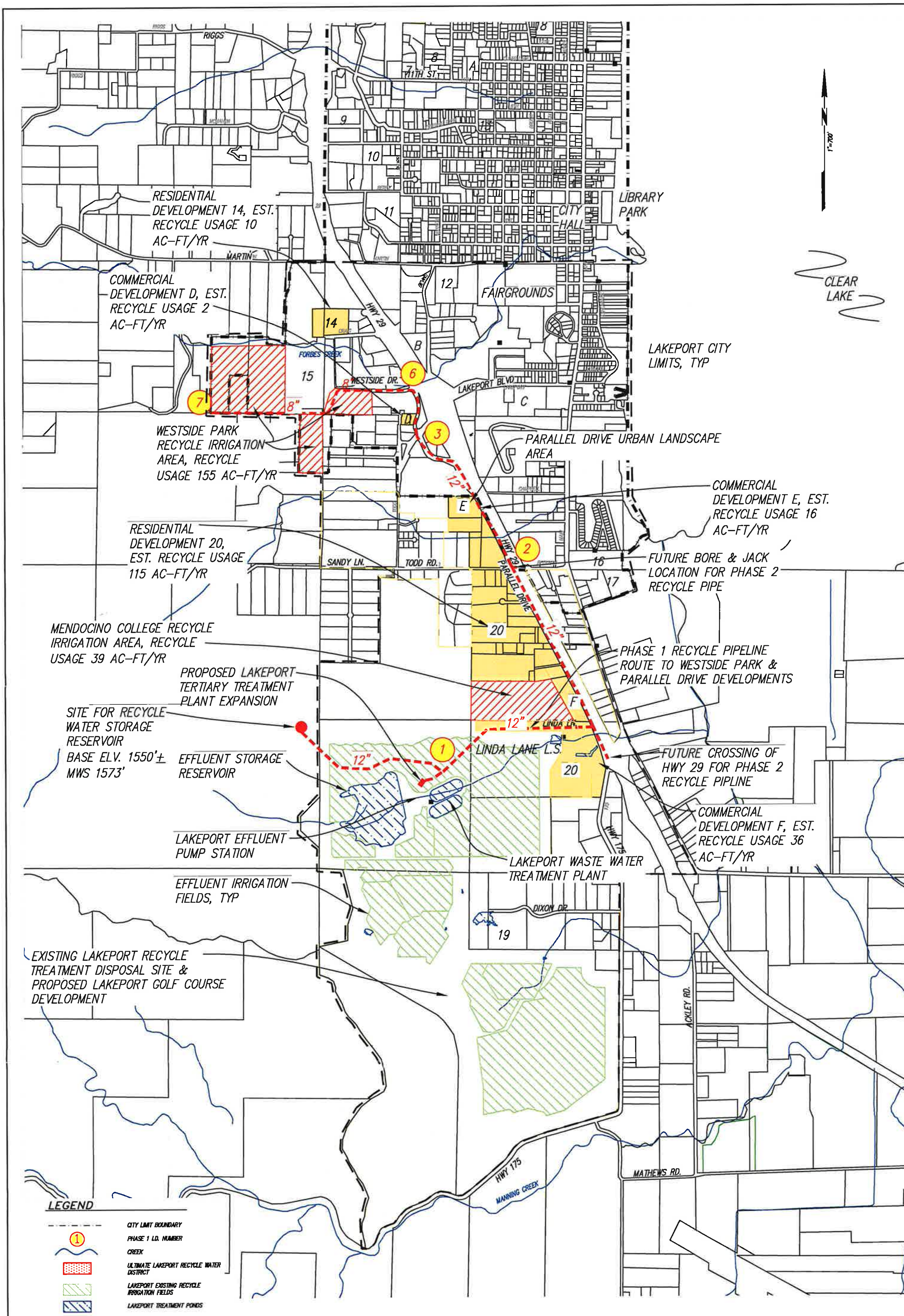
FIGURE 11
CITY OF LAKEPORT
2009 RECYCLE FEASIBILITY STUDY
MONTHLY WATER PRODUCTION 1995-2006

Taken from the City of Lakeport
2008 Master Water Plan



2/19/2010

Figure - Monthly Water Production 1995-2006.xls



DATE	PACE ENGINEERING, INC. REDDING, CALIFORNIA	CITY OF LAKEPORT RECYCLED WATER FEASIBILITY STUDY PHASE 1 WESTSIDE PARK/PARALLEL DRIVE RECYCLE PROJECT	FIGURE
2/10			12

APPENDIX A

Scotts Valley Basin

- Groundwater Basin Number: 5-14
- County: Lake
- Surface Area: 7,320 acres (11 square miles)

Basin Boundaries and Hydrology

The Scotts Valley Basin lies adjacent to the west side of Clear Lake and extends northwesterly along Scotts Creek north to Hidden Lake. The valley is bordered to the east by the shoreline of Clear Lake and bounded on the west and the north by the Jurassic-Cretaceous Franciscan complex of metamorphic and sedimentary rocks which constitute the basement rock in the basin (Jennings 1969). The basin shares a boundary with the Big Valley Basin to the south and may be hydrologically contiguous. Annual precipitation in the basin ranges from 31- to 35-inches, increasing the northwest.

Hydrogeologic Information

Water-Bearing Formations

The aquifer system in Scotts Valley Basin is composed primarily of Quaternary alluvial and terrace deposits, and Plio-Pleistocene to Pleistocene lake and floodplain deposits. Plio-pleistocene Cache Formation sediments overlie bedrock.

Quaternary Alluvium. The channel deposits of Scotts Creek and the uppermost valley deposits in the southern portion of basin are composed of Quaternary alluvium. The active channel of Scotts Creek is underlain by uncemented gravel and sand, with silt and clay lenses. Sands and gravels within the alluvium have moderate to high permeability while the silt and clay lenses have a relatively low permeability. In the southern part of the valley, gravels and clays are interbedded at shallower depths representing portions of former stream channels. Wells extract variable amounts of water from these zones. Wells installed in sand and gravel lenses yield an average of about 230 gpm (DWR 1957). Surficial lake deposits of sandy and silty clay are located in the northern portion of the basin. Underlying these deposits is a fairly continuous gravel stratum in which water is under artesian pressure. Groundwater is confined in the northern portion of the valley and is essentially unconfined in the southern portion. The confined aquifer is 3- to 10-feet thick and underlies approximately 2.4 square miles of valley floor at depths ranging between 85- to 105-feet. The unconfined aquifer underlying the southern valley floor varies in thickness from 40- to 70-feet (Ott Water Engineers 1987).

Quaternary Lake and Floodplain Deposits. The northern part of Scotts Valley is underlain by lake deposits of sandy and silty clay ranging in thickness from 60- to 90-feet (DWR 1957). Permeability in the fine grained lake deposits is low with specific yields ranging from about 3- to 5-percent.

Quaternary Terrace Deposits. Terrace deposits lie directly on bedrock or on older lake and floodplain deposits. These deposits are a continuation of terrace deposits as seen in the Western Upland aquifer system of Big Valley Basin to the south. They consist of poorly consolidated clay, silt, and sand, with some gravel lenses. Thickness of the deposits ranges from 50- to 100-feet (SMFE 1967). These deposits generally have low permeability due to high clay content. Available well records indicate reddish brown clays with little potential for significant water yield (ESA 1978).

Plio-Pleistocene Cache Formation. Pre-terrace sediments that exist in Scotts Valley area are identified as the Cache Formation based on the stratigraphic position and the lithologic similarity to known beds of that formation. The Cache Formation is largely made up of lake deposits; however, some stream deposits and volcanic ash lenses are likely included (DWR 1957). The Cache Formation is identified from water well driller reports as a blue clay layer containing some gravel lenses that is several hundred feet thick. Permeability of the Cache Formation is generally low due to its high clay content; however, yields of groundwater extracted from gravel or ash lenses within the Cache Formation may be appreciable (DWR 1957).

Recharge Areas

Recharge to the confined aquifer takes place in the forebay or unconfined zone in the southern portion of the valley. Percolation from Scotts Creek is the principal source of recharge with minor amounts from precipitation and applied irrigation water.

Groundwater Level Trends

Evaluation of the groundwater level data shows an average seasonal fluctuation ranging from 5- to 10-feet for normal and dry years for wells located in the vicinity of Scotts Creek and Clear Lake. For wells located closer to the Coastal Range the average seasonal fluctuation is approximately 20- to 40-feet for normal and dry years.

Long-term comparison of spring-spring groundwater levels indicates a slight decline in groundwater levels of up to 10-feet associated with the 1976-77 and 1987-94 droughts, followed by a recovery in levels to pre-drought conditions of early 1970's and 1980's. Overall there does not appear to be any increasing or decreasing trend in the groundwater levels.

Data indicates that lowering of groundwater levels accompanied by subsidence has occurred in Scotts Valley. Gravel has been extracted to average depths of 4- to 6-feet and up to 10- to 15-feet within Scotts Creek channel. This extraction has apparently resulted in the lowering of the stream channel and adjacent unconfined groundwater levels by about 3- to 4-feet in the southern portion of the valley (Ott Water Engineers 1987).

Groundwater Storage

The average specific yield for the depth interval of 0- to 100-feet is estimated to be 8 percent based on review and analysis of well logs (DWR 1957). The storage capacity for the basin is estimated to be 5,900 acre-feet based on the above depth interval and estimate of specific yield (DWR 1957). DWR (1960) estimates the useable storage capacity to be 4,500 acre-feet.

Groundwater Budget (Type B)

Estimates of groundwater extraction for Scotts Valley Basin are based on surveys conducted during the year 1995. The survey included land use and sources of water. Groundwater extraction for agricultural use is estimated to be 4,200 acre-feet. Groundwater extraction for municipal/industrial uses is estimated to be 520 acre-feet. Deep percolation of applied water is estimated to be 1,000 acre-feet.

Groundwater Quality

Characterization. Calcium-magnesium bicarbonate is the predominant groundwater type in the basin (SWRCD 1978). Total dissolved solids range between 140- to 175-mg/L, averaging 158 mg/L (DWR unpublished data).

Impairments. Iron, manganese, and boron concentrations exceed EPA maximum acceptable concentrations for continuous irrigation for selected wells (SWRCB 1978).

Water Quality in Public Supply Wells

Constituent Group[1]	Number of wells sampled[2]	Number of wells with a concentration above an MCL[3]
Inorganics – Primary	7	1
Radiological	6	0
Nitrates	9	1
Pesticides	4	0
VOCs and SVOCs	5	0
Inorganics – Secondary	7	1

[1] A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).
[2] Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.
[3] Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

Well Characteristics

	Well yields (gal/min)	
Municipal/Irrigation	Range: 6 – 1200	Average: 171 (11 Well Completion Reports)
	Total depths (ft)	
Domestic	Range: 5 – 408	Average: 125 (497 Well Completion Reports)
Municipal/Irrigation	Range: 28 – 600	Average: 127 (132 Well Completion Reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR	Groundwater levels	3 wells measured semi-annually
Lake County	Groundwater levels	6 wells measured semi-annually
DWR	Miscellaneous water quality	1 well biennially
Department of Health Services	Title 22 water quality	9

Basin Management

Groundwater management:	Lake County adopted a groundwater management ordinance in 1999.
Water agencies	
Public	County of Lake, City of Lakeport WSA, Scotts Valley WCD
Private	

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Errata

Changes made to the basin description will be noted here.

APPENDIX B

RECEIVED
OCT 10 2008

alpha
Alpha Analytical Laboratories Inc. e-mail: clientservices@alpha-labs.com
Corporate: 208 Mason St., Ukiah, CA 95482 • Phone: (707) 468-0401 • Fax: (707) 468-5267
Service Center: 6398 Dougherty Rd., Suite 3, Dublin, CA 94568 • Phone: (925) 828-6226 • Fax: (925) 828-6309

CHEMICAL EXAMINATION REPORT

Lakeport, City of
591 Martin St.
Lakeport, CA, 95453
Attn: Matt Johnson

Report Date: 07/16/08 14:27
Project No: 6010-930-000/ C. Fletcher, sampler
Project ID: Sanitation Dept

Order Number	Receipt Date/Time	Client Code	Client PO/Reference
08G0091	07/02/2008 13:40	LKPRTCTY	

Alpha Analytical Laboratories, Inc.

	METHOD	BATCH	PREPARED	ANALYZED	DILUTION	RESULT	PQL	NOTE
Effluent (08G0091-01)			Sample Type: Water			Sampled: 07/02/08 09:00		
Metals by EPA 200 Series Methods								
Calcium	EPA 200.7	AG81007	07/10/08	07/15/08	1	33 mg/l	1.0	
Iron	"	"	"	"	"	0.19 "	0.10	
Magnesium	"	"	"	"	"	24 "	1.0	
Manganese	"	"	"	"	"	0.050 "	0.020	
Potassium	"	"	"	"	"	12 "	1.0	
Sodium	"	"	"	"	"	45 "	1.0	
Conventional Chemistry Parameters by APHA/EPA Methods								
Hardness, Calcium	SM2340B	AG81007	"	07/15/08	1	84 mg/l	2	
Hardness, Magnesium	"	"	"	"	"	97 "	3	
Total Anions	SM1030F	AG81404	07/14/08	07/15/08	"	5.87 meq/l	1.00	
Total Cations	SM1030E	AG81007	07/10/08	07/15/08	"	5.86 "	1.00	
Bicarbonate Alkalinity as CaCO3	SM2320B	AG80215	07/02/08	07/02/08	"	150 mg/l	5.0	
Carbonate Alkalinity as CaCO3	"	"	"	"	"	ND "	5.0	
Hydroxide Alkalinity as CaCO3	"	"	"	"	"	ND "	5.0	
Total Alkalinity as CaCO3	"	"	"	"	"	150 "	5.0	
Bicarbonate	"	"	"	"	"	180 "	5.0	
Carbonate	"	"	"	"	"	ND "	5.0	
Hardness, Total	SM2340B	AG81007	07/10/08	07/15/08	"	181 "	5	
pH	SM4500-H+ B	AG80215	07/02/08	07/02/08	"	6.9 pH Units	1.0	T-14
Specific Conductance (EC)	EPA 120.1	"	"	"	"	580 umhos/cm	20	
Total Dissolved Solids	SM2540C	AG80702	07/07/08	07/07/08	"	360 mg/l	10	
Total Kjeldahl Nitrogen	SM4500-Norg B	AF83002	07/07/08	07/08/08	"	5.1 "	1.0	
Turbidity	EPA 180.1	AG80215	07/02/08	07/02/08	"	25 NTU	0.10	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Bruce L. Gove
Laboratory Director

7/16/2008

alpha
Alpha Analytical Laboratories Inc. e-mail: clientservices@alpha-labs.com
Corporate: 208 Mason St., Ukiah, CA 95482 • Phone: (707) 468-0401 • Fax: (707) 468-5267
Service Center: 6398 Dougherty Rd., Suite 3, Dublin, CA 94568 • Phone: (925) 828-6226 • Fax: (925) 828-6309

CHEMICAL EXAMINATION REPORT

Lakeport, City of
591 Martin St.
Lakeport, CA, 95453
Attn: Matt Johnson

Report Date: 07/16/08 14:27
Project No: 6010-930-000/ C. Fletcher, sampler
Project ID: Sanitation Dept

Order Number	Receipt Date/Time	Client Code	Client PO/Reference
08G0091	07/02/2008 13:40	LKPRTCTY	

Alpha Analytical Laboratories, Inc.

	METHOD	BATCH	PREPARED	ANALYZED	DILUTION	RESULT	PQL	NOTE
Effluent (08G0091-01)		**Sample Type: Water**				**Sampled: 07/02/08 09:00**		
Anions by EPA Method 300.0								
Nitrate as NO3	EPA 300.0	AG80213	07/02/08	07/03/08	1	20 mg/l	1.0	
Chloride	"	"	"	07/03/08	10	73 "	5.0	
Fluoride	"	"	"	07/03/08	1	0.27 "	0.10	
Nitrate as N	"	"	"	"	"	4.4 "	0.20	
Sulfate as SO4	"	"	"	"	"	23 "	0.50	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Bruce L. Gove
Laboratory Director

7/16/2008

Alpha
Alpha Analytical Laboratories Inc.
e-mail: clientservices@alpha-labs.com

Laboratory: 208 Mason Street, Ukiah, CA 95482
707-468-0401 • Fax: 707-468-5267

Service Center: 6398 Dougherty Road, Suite 3, Dublin, CA 94568
925-828-6226 • Fax: 925-828-6309

Chain of Custody Record

Reports and Invoices will be delivered by e-mail in .pdf format.

Lab No. 0860091 Page 1 of 1

Report To:
Company: CITY OF LAKEPORT
Attn: MATT JOHNSON
Address: 591 MARTIN ST LAKEPORT CA 95453
Phone/Fax: 263-3578/2631514
E-mail Address:
Samplers Signature:
Print:

Send Invoice To:
Company (if different):
Attn:
Address:
P.O. #:
E-mail Address:

Project
Project Name:
Project Address:
Project #:

Signature below authorizes work under terms stated on reverse side.

Sample Identification	Sampled Date	Sampled Time	40ml VOA	Poly	Amber	Sleeve	HCL	HNO3	H2SO4	None	Water	Soil	Total Number of Containers	TOTAL DIS. SOLIDS	NITRATE	TOTAL KJELDAHL NITROGEN	STANDARD MINERALS
EFFLUENT	7-2-08	0900		✓							✓			✓	✓		
EFFLUENT	7-2	0900		✓							✓					✓	
EFFLUENT	7-2	0900		✓							✓						✓

TAT: ○ 24 hr ○ 48 hr ○ 1 wk ○ 2 wk (standard) Other: ___ days

Lab Approval Required For Rush TATs

Sample Notes (lab use only)
Temperature: 2.8 deg. C
Shipment Method:
Custody Seals: ○ Yes ○ No

Relinquished By:	Received By:	Date	Time
Craig Fletcher	[signature]	7/2/08	445AM
[signature]	Bob Schultz	7/2/08	1215
Bob Schultz	[signature]	7/2/08	1340

California EDF Report? ○ Yes ○ No
Sampling Company Log Code:
Global ID:
EDF to (Email Address):
Drinking Water State System/Source Number:
Travel and Site Time: Mileage: Misc. Supplies:

APPENDIX C

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. 98-207

WASTE DISCHARGE REQUIREMENTS
FOR
CITY OF LAKEPORT
MUNICIPAL SEWER DISTRICT
LAKE COUNTY

The California Regional Water Quality Control Board, Central Valley Region, (hereafter Board) finds that:

1. The City of Lakeport Municipal Sewer District (hereafter Discharger) owns and operates a wastewater collection, treatment and disposal system which serves the City of Lakeport. The property (Assessor's Parcel No(s). 007-003-43 and 46, and 005-035-06, 16 and 18) is owned by the Discharger.

2. Waste Discharge Requirements Order No. 92-196, adopted by the Board on 25 September 1992, prescribed requirements for a discharge from the City of Lakeport Municipal Sewer District No. 1 to a storage reservoir and land application area.

3. Order No. 92-196 is neither adequate nor consistent with current plans and policies of the Board.

4. Currently, the Discharger treats approximately 1.05 million gallons per day (mgd) of municipal sewage in a baffled pond system. The effluent is disinfected prior to discharge to a storage reservoir and then to a land application area on Parallel Drive, southwest of downtown Lakeport, as shown in Attachment A, which is attached hereto and part of the Order by reference. The capacity of the storage reservoir is 650 acre-feet and the land application area consists of approximately 340 irrigated acres.

5. The City of Lakeport's treatment and storage system is in Section 36, T14N, R10W, MDB&M, and the land application area is in Section 1, T13N, R10W, MDB&M, with surface water drainage to Clear Lake, as shown in Attachment B, which is attached hereto and part of the Order by reference.

6. The Board adopted a Water Quality Control Plan, Fourth Edition, for the Sacramento River and San Joaquin River Basins (hereafter Basin Plan), which contains water quality objectives for all waters of the Basin. These requirements implement the Basin Plan.

7. The beneficial uses of Clear Lake are municipal, industrial, and agricultural supply; recreation; aesthetic enjoyment; navigation; ground water recharge; fresh water replenishment; hydropower generation; and preservation and enhancement of fish, wildlife, and other aquatic resources.

8. The beneficial uses of underlying ground water are domestic, industrial, and agricultural supply.

9. The Basin Plan encourages reclamation.

10. The action to update waste discharge requirements for this facility is exempt from the provisions of the California Environmental Quality Act (CEQA), in accordance with Title 14, California Code of Regulations (CCR), Section 15301.

11. This discharge is exempt from the requirements of Consolidated Regulations for Treatment, Storage, Processing, or Disposal of Solid Waste, as set forth in Title 27, CCR, Division 2,

Subdivision 1, Section 20005, et seq. (hereafter Title 27). The exemption, pursuant to Section 20090(b), is based on the following:

a. The Board is issuing waste discharge requirements, and

b. The discharge complies with the Basin Plan, and

c. The wastewater does not need to be managed according to Title 22, CCR, Division 4.5, Chapter 11, as a hazardous waste.

12. The Board has notified the Discharger and interested agencies and persons of its intent to prescribe waste discharge requirements for this discharge and has provided them with an opportunity for a public hearing and an opportunity to submit their written views and recommendations.

13. The Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that Order No. 92-196 is rescinded and the City of Lakeport Municipal Sewer District, its agents, successors, and assigns, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, shall comply with the following:

A. Discharge Prohibitions:

1. Discharge of wastes to surface waters or surface water drainage courses is prohibited.

2. Bypass or overflow of untreated or partially treated waste is prohibited.

3. Discharge of waste classified as 'hazardous', as defined in Sections 2521(a) of Title 23, CCR, Section 2510, et seq. (hereafter Chapter 15), or 'designated', as defined in Section 13173 of California Water Code, is prohibited.

B. Discharge Specifications:

1. The monthly average dry weather discharge flow shall not exceed 1.05 mgd.

2. The maximum daily discharge shall not exceed 3.8 million gallons.

3. The discharge shall not cause degradation of any water supply.

4. Objectionable odors originating at this facility shall not be perceivable beyond the limits of the wastewater treatment and disposal areas.

5. As a means of discerning compliance with Discharge Specification No. 4, the dissolved oxygen content in the upper zone (1 foot) of wastewater in ponds and the storage reservoir shall not be less than 1.0 mg/l.

6. The treatment facilities shall be designed, constructed, operated and maintained to prevent inundation or washout due to floods with a 100-year return frequency.

If the State Water Resources Control Board and the Regional Water Quality Control Boards are given the authority to implement regulations contained in 40 CFR 503, this Order may be reopened to incorporate appropriate time schedules and technical standards. The Discharger must comply with the standards and time schedules contained in 40 CFR 503 whether or not they have been incorporated into this Order.

4. The Discharger is encouraged to comply with the State Guidance Manual issued by the Department of Health Services titled *Manual of Good Practice for Landspreading of Sewage Sludge.*

D. Wastewater Reclamation Prohibitions:

1. Spray irrigation of orchards and vineyards with undisinfected reclaimed water is prohibited.

2. Grazing of milking animals within the area irrigated with effluent is prohibited.

E. Wastewater Reclamation Specifications:

1. Use of reclaimed water shall be limited to surface irrigation of orchards, vineyards, and fodder, fiber and seed crops.

2. If spray irrigation of orchards and vineyards is initiated, reclaimed water shall be adequately disinfected, oxidized, coagulated, clarified and filtered as required by Title 22, CCR, Division 4, Section 60301, et seq. For adequate disinfection, the 7-day median number of coliform organisms shall not exceed 23 MPN per 100 milliliters.

3. Public contact with reclaimed water shall be precluded through such means as fences, signs and irrigation management practices. Fence and sign requirements will be at the direction of the County Health Officer.

4. Areas irrigated with reclaimed water shall be managed to prevent breeding of mosquitoes. More specifically,

   a. Tail water must be returned and all applied irrigation water must infiltrate completely within a 48-hour period.

   b. Ditches not serving as wildlife habitat should be maintained free of emergent, marginal and floating vegetation.

   c. Low-pressure and unpressurized pipelines and ditches accessible to mosquitoes shall not be used to store reclaimed water.

5. Reclaimed water for irrigation shall be managed to minimize erosion, runoff and movement of aerosols from the disposal area.

6. Direct or windblown spray shall be confined to the designated reclamation area and prevented from contacting drinking water facilities.

7. The Discharger may not spray irrigate effluent during periods of precipitation and for at least 24 hours after cessation of precipitation, or when winds exceed 30 mph.

3. The Discharger shall comply with the following time schedule to resolve capacity issues related to high inflow and infiltration (I/I).

Task	Compliance Date
a. Status Report on I/I Impacts to WWTP due to lake level and high ground water	**Annually, 1 June**
b. I/I assessment report describing I/I correction plan, critical areas, time schedule and costs	**1 June 1999**

4. The Discharger shall comply with the "Standard Provisions and Reporting Requirements for Waste Discharge Requirements", dated 1 March 1991, which are attached hereto and by reference a part of this Order. This attachment and its individual paragraphs are commonly referenced as "Standard Provision(s)."

5. In the event of any change in control or ownership of land or waste discharge facilities described herein, the Discharger shall notify the succeeding owner or operator of the existence of this Order by letter, a copy of which shall be immediately forwarded to this office.

6. At least 90 days prior to termination or expiration of any lease, contract, or agreement involving disposal or reclamation areas or off-site reuse of effluent, used to justify the capacity authorized herein and assure compliance with this Order, the Discharger shall notify the Board in writing of the situation and of what measures have been taken or are being taken to assure full compliance with this Order.

7. The Discharger must comply with all conditions of this Order, including timely submittal of technical and monitoring reports as directed by the Executive Officer. Violations may result in enforcement action, including Board or court orders requiring corrective action or imposing civil monetary liability, or in revision or rescission of this Order.

8. A copy of this Order shall be kept at the discharge facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.

9. The Board will review this Order periodically and will revise requirements when necessary.

I, GARY M. CARLTON, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 23 October 1998.

GARY M. CARLTON, Executive Officer

AMENDED
wac/lsb:lakeport.wdr

SLUDGE MONITORING

A composite sample of sludge shall be collected annually in accordance with EPA's *POTW Sludge Sampling and Analysis Guidance Document, August 1989*, and tested for the following metals:

Cadmium	Copper	Lead
Chromium	Zinc	Nickel

Sampling records shall be retained for a minimum of five years. A log shall be kept of sludge quantities generated and of handling and disposal activities. The frequency of entries is discretionary; however, the log should be complete enough to serve as a basis for part of the annual report.

WATER SUPPLY MONITORING

A sampling station shall be established where a representative sample of the municipal water supply can be obtained. Water supply monitoring shall include at least the following:

Constituents	Units	Sampling Frequency
pH	pH unit	Annually
Electrical Conductivity @ 25°C	μmhos/cm	Annually
Total Dissolved Solids	mg/l	Annually
Standard Minerals	mg/l	Annually

GROUND WATER MONITORING

Ground water shall be monitored quarterly for the first year after installation of the monitoring wells and semi-annually thereafter. Monitoring wells shall be tested for the presence of coliform organisms, pH, specific conductivity, Nitrates as NO_3, ground water elevation and flow gradients.

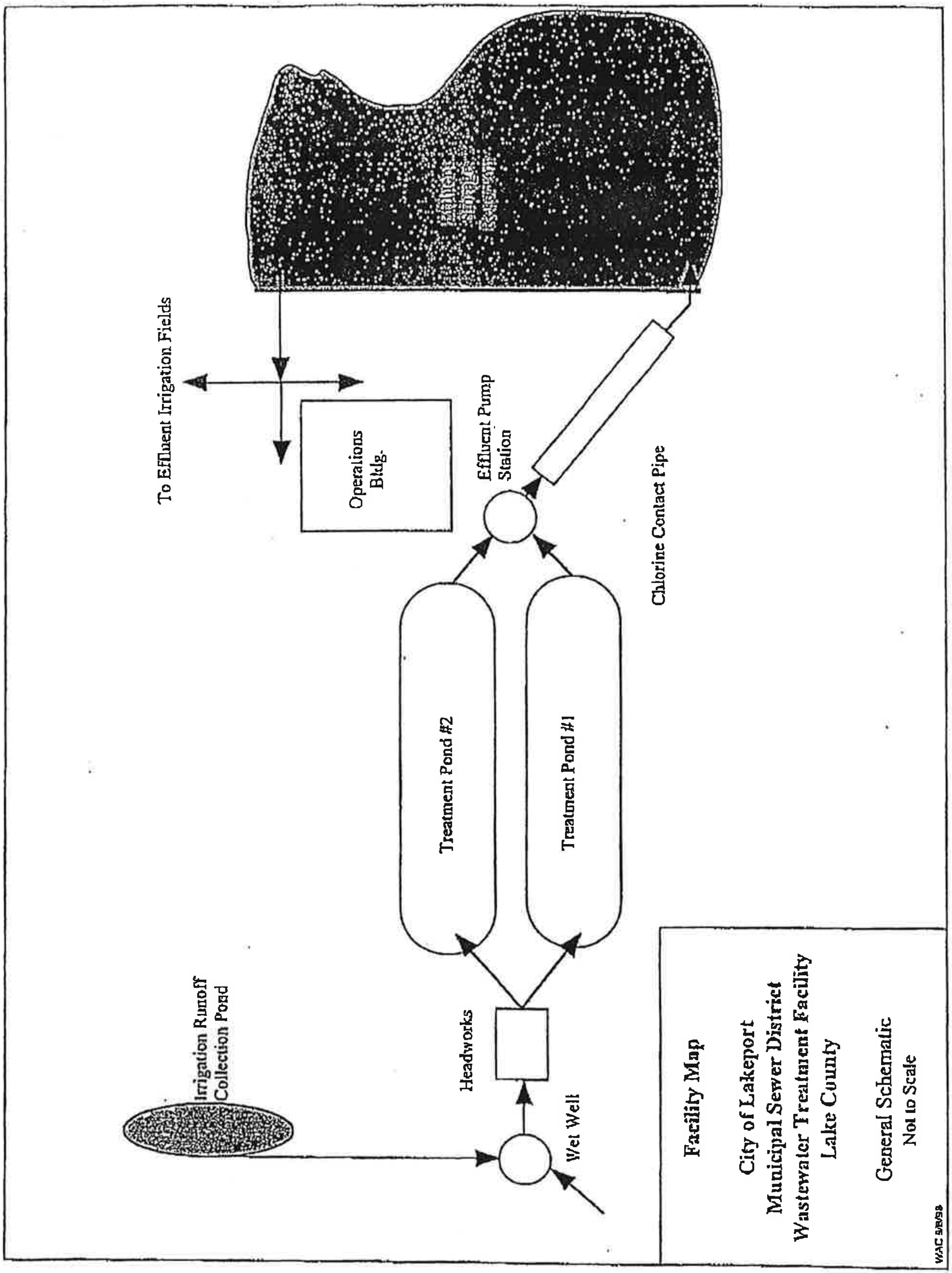
REPORTING

In reporting the monitoring data, the Discharger shall arrange the data in tabular form so that the date, the constituents, and the concentrations are readily discernible. The data shall be summarized in such a manner to illustrate clearly the compliance with waste discharge requirements.

Monthly monitoring reports shall be submitted to the Board by the 15th day of the following month.

The results of any monitoring done more frequently than required at the locations specified in the Monitoring and Reporting Program shall be reported to the Board.

ATTACHMENT A



INFORMATION SHEET

CITY OF LAKEPORT
MUNICIPAL SEWER DISTRICT
LAKE COUNTY

The City of Lakeport is on the northwestern shore of Clear Lake in Lake County. The City currently treats approximately 1.05 mgd of municipal sewage in a baffled pond system. After treatment and disinfection, the effluent is pumped into a storage reservoir and used for land application. The maximum daily discharge shall not exceed 3.8 million gallons. The storage capacity of the storage reservoir is 650 acre-feet and the land application area consists of approximately 340 irrigated acres. The property used for wastewater reclamation is owned by the City of Lakeport. Ground water monitoring will be conducted to assess the impact of the facility on ground water.

The beneficial uses of Clear Lake are municipal, industrial, and agricultural supply; recreation; aesthetic enjoyment; navigation; ground water recharge; fresh water replenishment; hydropower generation; and preservation and enhancement of fish, wildlife, and other aquatic resources.

The beneficial uses of underlying ground water are domestic, industrial, and agricultural supply.

The surface water drainage is to Clear Lake.

APPENDIX D

October 15, 2008

Mark & Pierrette Snyder
195 Mathews Road
Lakeport, CA 95453

SUBJECT: City of Lakeport – Reclaimed Water Feasibility Study

The City of Lakeport is currently conducting a study regarding the possible usage of their reclaimed water for various land applications. Reclaimed water can potentially be used for a number of different applications including: irrigation for lawns; orchards and pastures; environmental enhancement such as maintenance of wetlands; and industrial uses.

The purpose of this letter is to inform you that the City of Lakeport is studying ways on how it might be able to use its reclaimed water and to see if you, as a property owner, would be interested in learning more about using this valuable resource. It is expected that there would be several benefits in using reclaimed water (i.e., recycle water costs could be competitive with other sources of water, using reclaimed water would save ground water).

If you are interested in learning more about using recycled water, the City will be conducting an informational meeting on Friday, November 14, 2008 at 12 o'clock noon at the City of Lakeport Council Chambers, at 225 Park Street in Lakeport. If you would like to attend this meeting, please call Renée Perez at (707) 263-5615 extension 25 at City Hall.

For further information, you can also call PACE Civil Engineering at (530) 244-0202.

Sincerely,
Matthew Johnson
Utilities Superintendent

MJ/rp

APPENDIX E

State of California—Health and Human Services Agency
California Department of Public Health

MARK B HORTON, MD, MSPH
Director

ARNOLD SCHWARZENEGGER
Governor

STATE OF CALIFORNIA
DIVISION OF DRINKING WATER
AND
ENVIRONMENTAL MANAGEMENT

TREATMENT TECHNOLOGY REPORT FOR RECYCLED WATER

September 2008

(Replaces January 2007 Report)

This document has been developed to serve as a reference source for those seeking information concerning technologies that have been recognized by the California State Department of Public Health (CDPH) as being acceptable for compliance with treatment requirements of the California Recycled Water Criteria. NOTE: The former California Department of Health Services became the CDPH effective July 1, 2007. This is a "living" document that will be updated periodically as needed. Readers who find errors or omissions should contact Jeff Stone of the CDPH Recycled Water Unit at Jeffrey.Stone@cdph.ca.gov or Brian Bernados at Brian.Bernados@cdph.ca.gov .

Recycled Water Unit/Technical Operations Section/Technical Programs Branch
1180 Eugenia Place, Suite 200, Carpinteria, California 93013
Phone: (805) 566-1326; Fax (805) 745-8196
Internet address: http://www.CDPH.ca.gov

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH
DIVISION OF DRINKING WATER
AND
ENVIRONMENTAL MANAGEMENT

TREATMENT TECHNOLOGY REPORT FOR RECYCLED WATER

September 2008

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APPENDIX

'A' - California Department of Health Services Requirements for Demonstration of Reduction of Virus and Bacteria by Filtration and Disinfection

'B' - Memorandum concerning cleaning of UV quartz sleeves

State of California
Department of Public Health
Division of Drinking Water

Treatment Technology Report for Recycled Water

September 2008

1. INTRODUCTION

The purpose of this document is to provide general reference information concerning those treatment technologies that are being utilized for meeting the filtration performance and disinfection requirements for compliance with the California Recycled Water Criteria (Title 22, et. seq.). The information contained herein was generated from a review of files and correspondence of the California State Department of Public Health (CDPH), and discussions with Field Operations Branch District Staff, SWRCB Staff, industry representatives and manufacturers. All referenced reports, letters and other documents are on file with the Department's Recycled Water Unit. This reference document may not reflect all treatment technologies in place in California, but will be updated as additional information is obtained.

The California Water Recycling Criteria (adopted December 2000) define Disinfected Tertiary Recycled Water as a wastewater, which has been oxidized and meets the following:

A. Has been coagulated* and passed through natural undisturbed soils or a bed of filter media pursuant to the following:

1. At a rate that does not exceed 5 GPM/ft^2 in mono, dual or mixed media gravity or pressure filtration systems, or does not exceed 2 GPM/ft^2 in traveling bridge automatic backwash filters; and

2. The turbidity does not exceed any of the following; a daily average of 2 NTU, 5 NTU more than 5% of the time within a 24-hour period, and 10 NTU at any time.

*Note: Coagulation may be waived if the filter effluent does not exceed 2 NTU, the filter influent is continuously measured, the filter influent turbidity does not exceed 5 NTU, and automatically activated chemical addition or diversion facilities are provided in the event filter effluent turbidity exceeds 5 NTU.

OR

B. Has been passed through a micro., nano., or R.O. membrane following which the turbidity does not exceed any of the following: 0.2 NTU more than 5% of the time within a 24-hour period and 0.5 NTU at any time.

AND

C. Has been disinfected by either:

1. A chlorine disinfection process that provides a CT of 450 mg-min/l with a modal contact time of not less than 90 minutes based on peak dry weather flow, or

2. A disinfection process that, when combined with filtration, has been demonstrated to achieve 5-log inactivation of virus.

2. GENERAL GUIDANCE

The following guidance is consistent with the Water Recycling Criteria and will serve as the basis for CDPH review and acceptance of treatment technologies for compliance with the filtration and disinfection requirements of the Criteria.

FILTRATION

Filters meeting the definition of "filtered wastewater" under Section 60301.320 (a&b) outlined in the Water Recycling Criteria are allowed the option of either disinfection approach outlined in Section 60301.230 without additional restrictions or requirements.

The Department considers a properly filtered and disinfected recycled water meeting the turbidity performance and coliform requirements outlined in the criteria to be essentially pathogen free. As noted by Asano et al.[1], "To achieve efficient virus removal or inactivation in tertiary treatment, two major criteria must be met: 1) the effluent must be low in suspended solids and turbidity prior to disinfection to prevent shielding of viruses and chlorine demand, and 2) sufficient disinfectant must be applied to the wastewater." Treatment requirements determined necessary to meet the disinfected tertiary - 2.2 criteria outlined in the Criteria include media filtration to reduce turbidity to less than a daily average of 2 NTU or membrane filtration to reduce turbidity to less than a daily average of 0.2 NTU, and disinfection to ensure a minimum CT of 450 milligram-minutes per liter at all times. This treatment scheme is intended to remove solids (including some pathogens)

and properly prepare the water for effective disinfection in order to achieve an approximately five-log reduction of virus.

However, with respect to many existing technologies, there has yet to be a demonstrated correlation between turbidity and pathogen concentration. The current turbidity performance standards for media and membrane filtration are based on achievable turbidity performance and do not necessarily assure any specific minimum level of pathogen removal. This is a recognized issue in the regulations that is being reviewed by the Department.

Since the Pomona Virus Study[2], biological treatment has introduced additional variables into the picture, as the type of biological treatment can impact the particle size distribution and downstream filter and disinfection performance. However, the integration of these processes, into a process train, are not well understood at this time and must be addressed by industry and regulators. Nevertheless, it remains the intent of the Department to produce an essentially pathogen free effluent by maintaining a 5-log virus removal/inactivation barrier through filtration and disinfection.

Additional information concerning treatment technologies may be found in **Appendix A** (California Department of Health Services-Reduction of Virus and Bacteria by Filtration and Disinfection, October 2001).

It must be recognized that the Title 22 filtration performance requirements, as outlined under Section 60301.320, must be reliably met by all filtration technologies. The Department strongly recommends that recycled water producers develop and implement plant performance optimization plans and make a reasonable effort to minimize effluent turbidity levels. Furthermore, all treatment facilities should be operated in accordance with the manufacturer's recommendations and specific conditions of approval developed by CDPH.

---

1. Asano, T.; Tchobanoglous, G.; and Cooper, R.C (1984), "Significance of Coagulation-Flocculation and Filtration Operations in Wastewater Reclamation and reuse", in Symposium Proceedings, The Future of Water Reuse, Water Reuse Symposium III, San Diego, California, August 26-31, 1984. American Waterworks Association Research Foundation.

2. County Sanitation Districts of Los Angeles County (1977), "Pomona Virus Study, Final Report", Prepared for Calif. State Water Resources Control Board, Sacramento, Calif., and USEPA, Washington, D.C

UV DISINFECTION

UV Disinfection Guidelines were first published in 1993 by the National Water Research Institute (NWRI). Since that time, the field of ultraviolet disinfection has taken great strides forward. As a result of the progress made in understanding the UV disinfection process, the CDPH and the NWRI agreed that it was time to revise and update the guidelines. NWRI and the American Water Works Association Research Foundation (AWWARF) pooled their resources in order to revise the original guidelines, which now cover water recycling and drinking water UV disinfection applications. As a result of these efforts the *"Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse"* were published by NWRI/AWWARF in December 2000 and revised as a Second Edition dated May 2003. CDPH endorses the May 2003 Guidelines and refers to them when evaluating UV disinfection proposals. One major recommendation of the guidelines is that all UV equipment (including previously approved equipment) be tested and validated under these new guidelines before being accepted by the Department. For existing systems approved under earlier guidelines, documentation of compliance with the May 2003 guidelines should be provided when permits issued by the Regional Water Quality Control Boards come up for renewal. It is believed that existing UV disinfection systems that were properly designed should comply with the elements of the revised guidelines. Re-validation of such existing systems is typically performed by bioassays on-site, however alternative methods are being considered by industry. Department approved protocols must be followed in all instances.

The implication of the recommendations contained in the revised guidelines is that even the horizontal low-pressure low intensity UV systems must be validated before they are accepted for a UV disinfection application. Previously accepted UV technologies that were considered to be nonconforming under the 1993 guidelines will also have to be retested using the recommended testing procedure. The UV technologies listed herein include a note indicating whether compliance with the most recent 2003 guidelines has been demonstrated by the manufacturer. Re-validation of such existing systems is typically performed by bioaasays on-site, however alternative methods are being considered by industry. Department approved protocols must be followed in all instances.

Agencies that are in the stages of planning or early design have the most flexibility and should be able to require completion of UV validation testing before they accept delivery of the UV equipment. Therefore, the agency can plan and begin the design work around a given UV system, but not allow delivery of

equipment until validation testing is completed. This will allow comparison of the UV reactor design to the validation test results in order to ensure adequate sizing and performance of the UV system. This could be done as part of design review process, i.e., while the design is not yet complete.

If the design process has been completed and the contract for equipment has been signed, there will be fewer recourses for the utility. However, the utility can require a demonstration of performance or performance guarantee on the equipment for their own protection.

It is important to note that these are only "guidelines" and are therefore not limiting with respect to alternative approaches a manufacturer or project proponent may propose for consideration on a case-by-case basis. It is possible however that future regulations may be based on these guidelines.

Appendix B is an advisory memo dated November 1, 2004 that the Department sent to the Regional Water Quality Control Boards in California concerning the importance of cleaning of UV quartz sleeves and outlines recommendations to help ensure effective disinfection.

PASTEURIZATION DISINFECTION

Use of pasteurization has recently been recognized as an acceptable disinfection method for meeting the inactivation criteria in Title 22. Pilot studies conducted in California in 2006 and 2007 satisfactorily demonstrated the ability of this technology to achieve a minimum 4-log reduction in seeded MS2 coliphage (which is considered to be a conservative reduction equivalent to 5-log poliovirus reduction) under defined minimum contact time and temperature conditions.

(Continued on next page)

3. FILTRATION TECHNOLOGIES

The following technologies have demonstrated their ability to meet the performance objectives of current Water Recycling Criteria (Title 22). The "STATUS" designation gives an indication as to which technologies have been given formal Departmental recognition. For projects proposing a technology which is not listed herein or whose "STATUS" is unknown, a review of the proposal should be conducted by the Recycled Water Unit prior to acceptance.

NOTE: *The Department strongly recommends that when utilities consider a particular filtration technology, they carefully evaluate its appropriateness for their particular water being treated. The net production capacity of some technologies are especially sensitive to assumptions about how much flow can be processed per operating unit or module, and assuming a flow rate that is too high can result in a filtration plant that is too small to meet system capacity requirements. Depending on the treatment process being employed, consideration must be given to solids loading from the secondary treatment process on the filter medium which can have a significant effect on loading/flux rate, TMP, filter run times, backwashing efficiency and other O&M and design elements. These concerns are best addressed by piloting the treatment process being considered to ensure it will meet the required treatment criteria outlined in the Water Recycling Criteria.*

Granular Media Type Filters

Dynasand **Status--Accepted**
Parkson Corporation

Description: Upflow deep bed continuous backwash

Media configuration:

Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
sand: 40	1.30	1.50

Acceptance / Reference:
- -Listed in the CDPH Direct Filtration Guidelines (1988)
- -Conditional acceptance letter dated 12/1/86 from CDPH
- -Conditions of acceptance include: 1) media design specs. as noted above, 2) complete recycling of filter medium every three to four hours.

- -Letter dated 4/23/97 from the San Francisco District Office to the Sewerage Agency of South Marin
- -Memo dated 7/18/97 from Mike Finn (CDPH) re: two performance studies (S.F. Bureau of water Pollution Control and Sewerage Agency of South Marin)

Comments: Classified as direct filtration.

Installations: Sewerage Agency of Southern Marin (Evaluation outlined in a Pilot Test Final Report for the Agency dated June 1989); San Francisco-Bureau of Water Pollution Control has a pilot unit at the Oceanside WWTP, and others.

WATERLINK SuperSand **Status--Accepted**
Waterlink Separations, Inc.

Description: Upflow deep bed continuous backwash

Media configuration:

Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
sand: 40	1.30	1.50

Acceptance / Reference:
- -Conditional acceptance letter dated 1/14/2000 from CDPH.
- -Conditions of acceptance include: 1) media design specs. as noted above, 2) complete recycling of filter medium every three to four hours.

-Note: Waterlink holds the patents for the design of the filter approved as the "DynaSand" marketed by Parkson Corp. under licensing agreements. Master file contains all documentation.

Comments: Classified as direct filtration. NOTE: Waterlink was purchased by Parkson Corporation.

Installations: Proposed for Delta Diablo Sanitation District (Pittsburg, CA), Coachella Valley and Escondido.

WESTECH TECHNASAND **Status--Accepted**
Westech Engineering, Inc.

Description: Upflow deep bed continuous backwash

Media configuration:

Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
sand: 40	1.30	1.50

Acceptance / Reference:
-Conditional acceptance letter dated 4/5/2002 from CDPH.
-Conditions of acceptance include: 1) media design specs. as noted above, 2) complete recycling of filter medium every three to four hours.

-Note: Manufacturer has indicated they will warrant the Technasand Filter to meet Title 22 filtration requirements. Same principle as the Parkson Dynasand. Master file contains all documentation.

Comments: Classified as direct filtration.

Installations: Proposed for Carmel Valley Ranch.

US Filter Astrasand **Status--Accepted**
US Filter Davco Products

Description: Upflow deep bed continuous backwash

Media configuration:

Media Depth (meters)	Effective Size (mm)	Uniformity Coefficient
sand: 1.5	1.0-1.5	1.50

Acceptance / Reference:
-Conditional acceptance letter dated 12/5/2005 from CDPH.
-Conditions of acceptance include: 1) media design specs. as noted above, 2) complete recycling of filter media every three to four hours

Comments: Classified as direct filtration.
Installations: Unknown

Centra-flo **Status--Accepted**
Applied Process Technology, Inc

Description: Upflow deep bed continuous backwash

Media configuration:

Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
sand: 40	0.92-0.95	1.50

Acceptance / Reference:
-Conditional acceptance letter dated 3/14/2006 from CDPH.
-Conditions of acceptance include: 1) media design specs. as noted above, 2) complete recycling of filter media every three to four hours

Comments: Classified as direct filtration.

Installations: Unknown

Hydro-Clear **Status--Accepted**
U.S. Filter
Zimpro Environmental, Inc.

Description: Shallow pulsed bed filter

Media configuration:

Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
sand: 10-12	0.45	1.50

Acceptance / Reference:
-Listed in the CDPH Direct Filtration Guidelines (1988)
-Conditional acceptance letter dated 11/17/81 from CDPH.
-Conditions of acceptance include: 1) minimum bed depth of 10-inches of sand with E.S. of 45 mm, 4) at least 6 minutes between pulses and no more than 25 pulses per filter run.
-U.C. Davis Evaluation Report; "Evaluation of the Pulsed-Bed Filter For Wastewater Reclamation in California", 1981.

Comments: Classified as direct filtration

Installations: Moulton Niguel WD, San Luis Obispo, San Clemente, Rancho Murrieta, Fallbrook, and others.

Infilco-Degremont, Inc. **Status--Accepted**
Automatic Backwash (ABW)

Description: shallow bed, traveling bridge

Media configuration:

Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
sand: 11	0.55	1.50

Acceptance / Reference:
-Listed in the CDPH Direct Filtration Guidelines (1988)
-U.C. Davis Evaluation Report; "Evaluation of the Enelco ABW Automatic Backwash Filter For Wastewater Reclamation in California", dated November 1988.

Comments: Loading rate limited to 2 gpm/ft^2; Max. influent turbidity <10 NTU.

Installations: Sacramento County, Sepulveda Water Reclamation, Folsom WWTP, Victor Valley WWRP, LA City-Tillman WRP, Shasta Lake WWTP, and others.

Aqua-Aerobic Systems, Inc. **Status--Accepted**
Automatic backwash filter (AquaABF)

Description: Shallow bed traveling bridge

Media configuration:

Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
sand: 11	0.55	1.50

Acceptance / Reference:
-Listed in the CDPH Direct Filtration Guidelines (1988)
-U.C. Davis Evaluation Report entitled "Evaluation of the Aqua-Aerobic Automatic Backwash Filter For Wastewater Reclamation in California" dated July 1986.

Comments: Loading rate limited to 2 gpm/ft^2; Max. influent turbidity <10 NTU.

Installations: Unknown

US Filter Gravisand **Status--Accepted**
US Filter Davco Products

Description: Shallow bed traveling bridge

Media configuration:

	Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
anthracite:	6	1.1 - 1.2	1.5
sand:	5	.55 - .65	1.5
support	-	.8 - 1.2	1.5

Acceptance / Reference:
-Conditional acceptance letter dated 11/08/05 from CDPH.
-Conditions of acceptance include: 1) media design specs.
As noted above, Loading rate limited to 2 gpm/ft^2; Max. influent turbidity <10 NTU.

Comments:

Installations: Unknown

Tetra Technologies, Inc. **Status--Accepted**
Tetra-Denit.

Description: Tetra Deep Bed-Denitrification Filters

Media configuration:

Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
Silica sand: 48-72	2.2	1.35

Acceptance / Reference:
-Conditional acceptance letter signed by M. Kiado (CDPH) re: LADWP dated 3/17/92
-Letter dated 10/6/97 from Parsons Engineering Science regarding LA-Glendale Water Reclamation Plant pilot study.

Comments: Mono-media granular sand; 4-6 foot depth; intended for direct filtration with chemical addition.

Installations: City of Los Angeles (Glendale WWTP), Lake Arrowhead CSD, Padre Dam MWD, Scotts Valley WD.

Centra-flo
Applied Process Technology **Status--Accepted**

Description: Centra-flo Gravity Sand Filter
Downflow Continuous Wash Filter

Media configuration:

Media Depth (inches)	Effective Size (mm) (graded)	Uniformity Coefficient
sand: 40	0.5 - 3.0	1.50

Acceptance: CDPH letter dated January 6, 1999 for landscape irrigation

Comments: Pilot testing conducted at Union Sanitary District's Alvarado WWTP (1994); loading rate up to 4.4 GPM/ft^2.

Installations: Tejon Ranch Development '99 (I-5 @ Tejon Pass)

Fluidsand
Fluidyne Corporation **Status--Accepted**

Description: Fluidyne Fluidsand Filter
Upflow Continuous Backwash Filter

Media configuration:

Media Depth (inches)	Effective Size (mm) (graded)	Uniformity Coefficient
silica sand: 40	0.8 - 1.0	1.6

Acceptance / Reference:
- -Conditional acceptance letter dated 5/03/2000 from CDPH.
- -Conditions of acceptance include: 1) media design specs. as noted above, 2) complete recycling of filter medium every three to four hours.
- -Engineering Report dated June 9, 1997 submitted by Questa Engrg. for the Canada Woods Reclamation Facility.

Comments: Classified as direct filtration. Designed for waters containing TSS up to 20 mg/l (per manufacturer); Performance data submitted by the manufacturer demonstrates this technology's ability to comply with the turbidity performance standards. Design and operation conceptually similar to Dynasand.

Installations: Tenaya Lodge located in Fish Camp (Evaluated in a "facilities Review" report by Carollo Engineers dated September 1990). Canada Woods Development ('99) in the Monterey area (without CDPH approval). Castanoa Ranch ('99) in San Mateo County.

Hydrasand **Status--Accepted**
Andritz Ruthner, Inc.

Description: Upflow, continuous wash filter

Media configuration:

Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
silica sand: 40	1.3	1.5

Acceptance / References:
- -Conditional acceptance letter dated June 23, 2000 from CDPH.
- -Conditions of acceptance include: 1) media design specs. as noted above, 2) complete recycling of filter medium every three to four hours.
- -Report available entitled "Microbial Assessment of the Lanai Auxiliary Reclamation Facility to Produce Wastewater Effluent for Unrestricted, Non-potable Reuse" dated October 1998.

Comments: Manufacturer has indicated they will warrant the Hydrasand Filter to meet Title 22 requirements. Same principle as the Parkson DynaSand.

Installations: None in California (proposed for City of Corona), installed in Trumansburg NY and Lanai City, HI.

Strata-Sand
Ashbrook Corporation **Status--Accepted**

Description: Strata-Sand Gravity Sand Filter
Downflow Continuous Wash Filter

Media configuration:

Media Depth (inches)	Effective Size (mm) (graded)	Uniformity Coefficient
sand: 40	multi-	AWWA B-100

Acceptance: Conditional acceptance letter dated July 29, 2003 from CDPH.

Comments: Performance report submitted dated June 11, 2003.

Installations: City of Oceanside (San Luis Rey WWTP)

Micromedia Filtration, Inc. **Status--Accepted**

Description: "Cleanstream" Continuous Backwash Up-flow Sand Filter

Media configuration:

	Media Depth (inches)	Effective Size (mm)	Uniformity Coefficient
silica sand:	40	0.9 - 1.3	1.5

Acceptance / References:
-Conditional acceptance letter dated September 26, 2006 from CDPH.
-Conditions of acceptance include: 1) media design specs. as noted above, 2) shall be preceded by a secondary wastewater treatment process that meets the definition of an "oxidized wastewater" in accordance with Section 60301.650.
-Performance evaluations conducted at Las Gallinas Valley Sanitary District and Santa Margarita Water District (Chiquita Water Reclamation Plant).

Comments: Same principle as the Parkson DynaSand.

Installations: Unknown

Nordic Water, Inc. **Status--Accepted**

Description: "Nordic Water Continuous Sand Filter"

Media configuration:

	Media Depth (meters)	Effective Size (mm)	Uniformity Coefficient
silica sand:	1.5	1.0 - 1.5	1.5

Acceptance / References:
-Conditional acceptance letter dated March 7, 2007 from CDPH.
-Conditions of acceptance include: 1) media design specs. as noted above, 2) Maximum loading rate of 5 GPM/FT^2

Comments: Same principle as the Parkson DynaSand.

Installations: Unknown

Volcano ***Status—NOT YET ACCEPTED***

Description: Continuous wash downflow sand filter

Acceptance / References:
-Documentation of CDPH approval does not exist. The Recycled Water Unit has no technical data on this process.

Comments: Future proposals for use of this filtration technology will require an acceptability assessment prior to approval.

Installations: Boulder Creek G.C. (Santa Cruz County), Sierra Heights WWTP (Santa Clarita), Carmel Valley WWTP, Shelter Cove (Humbolt)

Other Media Type Filters

Fuzzy Filter
Schreiber LLC **Status--Accepted**

Description: "Fuzzy Filter"-compressible synthetic fiber filter media - upflow design

Media configuration:

	Media Depth (inches)	Effective Size (")	Uniformity Coefficient
Synthetic: Plastic	30 (variable)	(1.25")	1.50

Media is quasi spherical, highly porous and compressible

Acceptance / Reference:
-Conditional acceptance letter date February 24, 2003 from CDPH.

-Conditions of acceptance include: 1) media design specs. as noted above, 2) filtration rate not to exceed 30 gpm/ft^2, 3) all Title 22 installations shall have design changes as outlined by Schreiber in correspondence dated January 21, 2003 (i.e. - backwash with filtered water, wash outlet below filtered outlet, valving position alarms), 4) individual operations plans shall include recommended operational configurations (i.e. percent compression and loading rate) based on secondary quality.

-Evaluated by U.C. Davis (Report dated September 1996)

Comments: Evaluated at loading rates up to 30 GPM/ft^2; media configuration/porosity/depth varies based on percent compression; water passes through media rather than around media.

Installations: City of Yountville

Membrane Technologies

NOTE: Many of the membranes listed below were originally approved with maximum flux rates based on studies under which performance data was generated. However, references to maximum flux rates are no longer deemed necessary since they become self-limiting from a filter run and operational perspective. If operational parameters (e.g. flux, TMP) adversely impact filtration performance from a turbidity compliance or operational perspectives, process control measures will likely be necessary to reliably insure compliance.

ZENON
Zenon Environmental Services, Inc.

Cycle-Let (Thetford) **Status--Accepted**

Description: Membrane ("Ultra") filtration (originally marketed as Thetford Cycle-Let); complete package unit including pretreatment, biological oxidation, membrane ultra-filtration, GAC and U.V.

Acceptance / References:

-CDPH acceptance memorandum to LARWQCB dated November 12, 1993 regarding the Water Gardens Project.

-Report entitled "Evaluation of the Thetford Cycle-Let Reclamation System's Ability to Meet Title 22, prepared by Engineering-Science, dated August 1991.

-Report entitled "Thetford Systems Inc. Cycle-Let Wastewater Treatment and Recycling System - Water Garden Project, Santa Monica, CA" dated July 1993 prepared by CDM

Comments: Membrane approved has average pore size of .005 micron. Tested on municipal wastewater.

Installations: "Water Gardens" (Santa Monica), Sony Music Campus (Santa Monica).

ZeeWeed / Zenogem 500 Series **Status--Accepted**

Description: Variant of the Cycle-Let, OCP Bio-reactor / Microfiltration process

Acceptance / References:

-Conditional acceptance letter from CDPH dated August 12, 1999

-Draft Final Report "California DHS Certification Testing-for Zenon (ZeeWeed) Membrane" prepared by Montgomery Watson (1/8/99).

-Final Report "Assessing the Ability of Membrane Bioreactor to Meet Existing Water Reuse Criteria (Zenon Environmental, Inc.)" prepared by Montgomery Watson (March 2001).

Comments: Includes 500a, 500b, 500c and 500d membrane systems. Approval based on use of the "OCP" (re-designated to "PVDF-UF" per letter from CDPH dated February 17, 2005) membranes only. Conditions of approval include: membrane integrity tests required. Tested in MBR process with high solids loading.

Installations: Unknown

ZeeWeed 1000 UF **Status--Accepted**

Description: Submerged Hollow Fiber Ultrafiltration Membrane

Acceptance / References:

-Conditional acceptance letter from CDPH for T-22 compliance dated October 12, 2001

-Report entitled "California Department of Health Services Certification Testing For Zenon ZeeWeed 1000 Membrane", prepared by Montgomery Watson (June 2001). This report was prepared for demonstrating compliance with the California Surface Water Treatment Rule.

Comments: Approval based on use of the hollow fiber polymer "ZeeWeed 1000 UF Membrane" with a 0.02 micron nominal pore size.

Conditions of approval require membrane integrity tests required. Tested on raw surface water.

Installations: Unknown

SIEMENS - MEMCOR

Memcor -S10V, L10V and L20V **STATUS -- Accepted**

Description: Siemens Memcor S10V, L10V and L20V polyvinylidene fluoride (PVDF) membrane filtration treatment units with a nominal 0.04 micron pore size. The membranes operate under positive pressure.

Acceptance / References:
- -Conditional acceptance letter from CDPH dated 1/10/2000.
- -Report submitted by MWH, Consulting Engineers, dated August 2004, outlining study results conducted for compliance with the Surface Water Treatment Rule.
- -Updated model numbers for S10V and L10V from Siemens by letter dated August 8, 2007.
- L20V conditional acceptance letter from CDPH dated 6/17/2008.

Comments: Membrane integrity test required. Tested on raw surface water at the Aqua De Lejos Water Treatment Plant in Upland, California.

Installations: Unknown

Memcor - M10V **STATUS -- Accepted**

Description: 0.1 micron *Polyvinylidene Fluoride* (PVDF) Hollow Fiber Micro-Filtration - Pressure Filtration

Acceptance / References:
- -Conditional acceptance letter from CDPH dated 1/10/2000
- -Approved under the SWTR using 0.2 micron membrane.
- -Updated model numbers in letter from Siemens by letter dated August 8, 2007.

Comments: Membrane integrity tests required. Tested on raw surface water.

Installations: West Basin MWD, Orange County Water District, City of Livermore, Dublin/San Ramon SD

Memcor - M10B and M10C **STATUS -- Accepted**

Description: 0.2 micron *Polypropylene* Hollow Fiber Micro-Filtration - Pressure Filtration

Acceptance / References:
- -Conditional acceptance letter from CDPH dated 1/10/2000
- -Approved under the SWTR using 0.2 micron membrane.
- -Updated model numbers in letter from Siemens by letter dated August 8, 2007.

Comments: Membrane integrity tests required. Tested on raw surface water.

Installations: West Basin MWD, Orange County Water District, City of Livermore, Dublin/San Ramon SD

Memcor – S10T **STATUS -- Accepted**

Description: 0.2 micron *Polypropylene* Hollow Fiber Micro-Filtration - Submerged/Vacuum Filtration

Acceptance / References:
- -Conditional acceptance letter from CDPH dated 1/10/2000
- -Updated model numbers in letter from Siemens by letter dated August 8, 2007.

Comments: Membrane integrity tests required. Tested on raw surface water.

Installations: Unknown

U. S. Filter/Jet Tech Products-Memjet[tm] **STATUS--Accepted**

Description: 0.1 micron *Polyvinylidene Fluoride* (PVDF) Hollow Fiber Micro-Filtration - SBR/Vacuum Filtration

Acceptance / References:
- -Conditional acceptance letter from CDPH dated 10/7/2002
- -Conditional acceptance letter from CDPH dated 11/18/05 concerning the "B30R' module.

Comments: Membrane integrity tests required. Tested in MBR process with high solids loading.

Installations: Unknown

PALL Corporation **STATUS -- Accepted**

Description: PVDF Hollow Fiber Microza Microfiltration 0.1 micron (P/N XUSV-5203)

Acceptance / References:
- -Conditional acceptance letter from CDPH dated 1/10/2000
- -Approved for compliance under the SWTR based on report entitled "California Department of Health Services Certification Testing for Pall (Microza) Microfiltration Membrane" prepared by Montgomery-Watson (July 1999).
- -Performance study conducted at OCWD Water Factory 21 (SLS Report 7725) "Long-Term Testing of Pall Microza 0.1 um MF System on Secondary Effluent at Water Factory 21, Fountain Valley, CA" (September 23, 1998).

Comments: Membrane integrity tests required. Tested on secondary effluent.

Installations: Unknown

PALL Corporation **STATUS -- Accepted**

Description: Microza Microfiltration using the following:
(P/N USV-5203)
(P/N USV-6203)
(UNA-620A)
(UNA-620A-1)

Acceptance / References:
- -Conditional acceptance letters from CDPH dated 7/19/2004.
- -Approved for compliance under the SWTR.
- -UNA-620A-1 conditional acceptance letter from CDPH dated 1/3/2007.

Comments: Membrane integrity tests required. Tested on raw surface water.

Installations: Unknown

MITSUBISHI
Mitsubishi International Corp. **STATUS -- Accepted**

Description: Mitsubishi Membrane Bioreactor (MBR) Sterapore HF 0.4 micron hollow fiber polyethylene

Acceptance / References:
- -Conditional acceptance letter from CDPH dated April 23, 2001
- -Report entitled "Assessing the Ability of Membrane Bioreactor to Meet Existing Water Reuse Criteria (Mitsubishi Rayon Co., Ltd.)" prepared by Montgomery-Watson (March 2001).

Comments: Membrane integrity tests required. Tested in MBR process with high solids loading.

Installations: Unknown

KUBOTA Corporation **STATUS -- Accepted**

Description: Kubota Membrane Bioreactor (MBR); Type 510 and Type 515, 0.4 micron chlorinated polyethylene flat sheet membrane

Acceptance / References:
- -Conditional acceptance letter for the Type 510 from CDPH dated March 18, 2003, amended April 29, 2004 for higher flux rate. Acceptance of the Type 515 membrane granted by letter dated July 5, 2005.

- -Report entitled "Assessing the Ability of the Kubota Membrane Bioreactor to Meet Existing Water Reuse Criteria" prepared by Montgomery-Watson-Harza (February 2003).
- -Conditional acceptance letter for the Type 515 from CDPH dated July 5, 2005.
- -Report entitled "Equivalency of The Kubota Type 515 and Type 510 Membrane Cartridges" (2005).

Comments: Tested in MBR process with high solids loading.
Installations: Unknown

Ionics, Inc. **STATUS -- Accepted**

Description: Norit X-Flow Hollow Fiber Ultrafiltration 0.05 micron, Polyethersulfone Membrane

Acceptance / References:
- -Conditional acceptance letter from CDPH dated 10/21/2003
- -Approved for compliance under the SWTR based on report entitled "Draft Final Report, California Department of Health Services Certification Testing for Ionics UF Membrane" prepared by Montgomery-Watson (June 2001).

-Performance study conducted at Gwinnett County, Georgia using secondary effluent; "Membrane Pilot and Demonstration-Scale Treatment for Water Reclamation at Gwinnett County, Georgia" (CH2M HILL, 2001).

Comments: Acceptance specific to the Ionics filtration technology tested using the Norit X-Flow S225, 0.05 micron, polyethersulfone hollow fiber membrane. Membrane integrity tests required. Tested on secondary effluent.

Installations: Unknown

Koch Membrane Systems **STATUS -- Accepted**

Description: Koch Membrane Systems Puron™ Membrane Bioreactor (MBR) utilizing the Polyethersulfone hollow fiber KMS-L1 membrane with nominal 0.05 micron pore size. Submerged membrane operates under vacuum.

Acceptance / References:
-Conditional acceptance letter from CDPH dated May 4, 2006 and amended December 18, 2007 to allow for elongated fiber up to 2.0 meters.
-Report entitled "Assessing the Ability of the Puron™ Membrane Bioreactor to Meet Existing Water Reuse Criteria" prepared by Montgomery-Watson-Harza (March 2006).

Comments: Tested in MBR process with high solids loading.

Installations: Unknown

Huber Technology, Inc. **STATUS -- Accepted**

Description: Huber Vacuum Rotation Membrane VRM® Bioreactor (MBR) utilizing the Polyethersulfone flat sheet NADIR P-150F ultrafiltration membrane with nominal pore size of 0.038 micron. Submerged membrane operates under vacuum.

Acceptance / References:
-Conditional acceptance letter from CDPH dated June 22, 2006.
-Report entitled "Assessing the Ability of the Huber Vacuum Rotation Membrane VRM® Bioreactor and Membrane Clearbox® to Meet Existing Water Reuse Criteria" prepared by Montgomery-Watson-Harza (April 2006).

Comments: Tested in MBR process with high solids loading.

Installations: Unknown

Parkson Corporation **STATUS -- Accepted**

Description: Dynalift™ Membrane Bioreactor (MBR) utilizing external PVDF tubular membranes with a nominal pore size of 0.03 micron. The tubular membranes operates under pressure and are placed externally from the bioreactor.

Acceptance / References:
-Conditional acceptance letter from CDPH dated September 7, 2006.
-Report entitled "Assessing the Ability of the Dynalift™ Membrane Bioreactor to Meet Existing Water Reuse Criteria" prepared by Montgomery-Watson-Harza (July 2006).

Comments: Tested in MBR process with high solids loading.

Installations: Unknown

Ashbrook Simon-Hartley **STATUS -- Accepted**

Description: Ashbrook Simon-Hartley Integrated Membrane Activated Sludge (IMAS) filtration treatment unit utilizing the spiral wound (Spirasep) polyethersulfone ultrafiltration membrane module with nominal 0.05 micron pore size. The membranes operate under vacuum.

Acceptance / References:
-Conditional acceptance letter from CDPH dated January 25, 2007.
-Report submitted entitled "Pilot/Demonstration System" (undated) outlining study results conducted at Eastern Municipal Water District.

Comments: System utilizes separate biological and membrane filtration units but marketed as a package plant.

Installations: Unknown

METAWATER Co., (formerly NGK Insulators) **STATUS -- Accepted**

Description: METAWATER Co., Ltd. Ceramic Membrane Filtration System with a nominal 0.1 micron pore size. The membranes operate under positive pressure.

Acceptance / References:

-Conditional acceptance letter from CDPH dated March 7, 2007. Amendment letter dated August 19, 2008, recognizing ownership change from NGK to METAWATER.

-Report submitted by MWH, Consulting Engineers, dated October 2005, outlining study results conducted for compliance with the Surface Water Treatment Rule.

Comments: Tested on raw surface water at the Aqua De Lejos Water Treatment Plant in Upland, California. Part number for the NGK ceramic membrane tested is 431011.

Installations: Unknown

Asahi-Kasei Chemicals Corporation **STATUS -- Accepted**

Microza & Water Processing Division

Description: Asahi-Microza MUNC-620A and MUDC-620A hollow fiber polyvinylidene fluoride (PVDF) membrane/ bioreactor filtration treatment units with a nominal 0.1 micron pore size. The membranes operate under vacuum. Acceptance has been granted for the following membrane designations: MUNC-620A and MUDC-620A

Acceptance / References:

-Conditional acceptance letter from CDPH dated May 8, 2007 for the hollow fiber MUNC-620A membrane.

-Conditional acceptance letter from CDPH dated July 19, 2007 for the hollow fiber MUDC-620A membrane.

-Report "Assessing the Ability of the Microza™ Membrane Bioreactor to Meet Existing Water Reuse Criteria" submitted by MWH, Consulting Engineers, dated March 2007, outlining study results conducted for compliance with the Water Recycling Criteria. NOTE: This report evaluated the MUNC-620A membrane.

--Report "Assessing the Ability of the Microza™ (MUDC-620A Membrane Bioreactor to Meet Existing Water Reuse Criteria" submitted by MWH, Consulting Engineers, dated June 2007, outlining study results conducted for compliance with the Water Recycling Criteria. NOTE: This report evaluated the MUDC-620A membrane.

Comments: Membrane integrity test required. Tested using an MBR process comprised of an anoxic tank followed by an aerobic tank, followed by the submerged membrane tank.

Installations: Unknown

Norit X-Flow **STATUS -- Accepted**

Description: Norit Xiga™ and Aquaflex™ Membrane Filtration Systems with a nominal 0.025 micron pore size. The membranes operate under positive pressure.

Acceptance / References:

-Conditional acceptance letter from CDPH dated June 1, 2007. This acceptance was based on previous acceptance of this membrane (letter from CDPH dated March 14, 2006) for performance compliance under the California Surface Water Treatment Rule.

Comments: The Xiga configuration is horizontally mounted and the Aquaflex is vertically mounted. Both configurations utilized the SXL-225 hydrophilic polyethersulfone - polyvinylpyrolidine (FSFC) membrane.

Installations: Unknown

Hydranautics **STATUS -- Accepted**

Description: Hydranautics HYDRAcap Ultrafiltration Membrane

Acceptance / References:

-Conditional acceptance letter from CDPH dated April 1, 2008

-Approved for compliance under the SWTR (letter dated October 19, 1999)

Comments: Utilizes a 0.2 micron polyethersulfone hollow fiber membrane.

Installations: Unknown

DOW Ultrafiltration Membranes **STATUS -- Accepted**

Description: Dow Pressurized Ultrafiltration Membrane

Acceptance / References:
-Conditional acceptance letter from CDPH dated September 8, 2008 for recycled water applications.
-Approved for compliance under the SWTR by letter from CDPH dated July 17, 2008.

Comments: Utilizes a 0.03 micron pressure driven polyvinylidene fluoride (PVDF) hollow fiber membrane.

Installations: Unknown

Cloth Filter Technologies

AQUA-AEROBIC Systems, Inc. **Status--Accepted**

NOTE: See *Endnote #1* concerning accepted cloth fabrics

Description: **Submerged Cloth-Media Rotating Disk Filter (Utilizing the 102 needle felt fabric)**

Acceptance / References:
-Conditional acceptance letter from CDPH dated June 29, 2001 and amended September 24, 2002.
-Report entitled "Evaluation of the Aqua-Aerobic Systems Cloth-Media Disk Filter (CMDF) for Wastewater Recycling Applications in California" prepared by UC Davis (March 2001).
-Report entitled "Evaluation of Aqua-Aerobics Systems AquaDisk® Filter Technology at Orange County Water District, Fountain Valley, California" (February 25, 2000).

Comments: Utilizes the "102 needle felt fabric", operates under vacuum. Conditions of acceptance: loading rate not to exceed 6 gpm/ft^2; Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22); acceptance limited to the random woven NF-102 needle felt cloth media having openings ranging from 10 to 30 microns and a thickness of 3.8 mm; turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22); Operations plan shall specify minimum FTW cycle following high pressure wash based on displacement of two filtrate volumes and effluent turbidity below 2 NTU; scheduled inspections of cloth conditions; ensure adequate sludge wasting.

Installations: Unknown

ENDNOTE #1: Both the Submerged Cloth Media Rotating Disk (AquaDisk®) and the Submerged Fixed Cloth Media (AquaDiamond®)

designs are acceptable for use with the following CDPH accepted filter fabrics; 102 needle felt fabric, PA-13 nylon pile fabric, MMK2-13 acrylic pile fabric and PES-13 woven polyester fabric.

Description: **Submerged Cloth-Media Rotating Disk Filter (Utilizing the PA-13 nylon pile fabric)**

NOTE: See *Endnote #1* concerning accepted cloth fabrics

Acceptance / References:
-Conditional acceptance letter from CDPH dated May 6, 2002) and amended on September 24, 2002
-Report entitled "Use of PA-13 Pile Fabric, Supplement to: Evaluation of the Aqua-Aerobic Systems Cloth-Media Disk Filter (CMDF) for Wastewater Recycling Applications in California" prepared by UC Davis (February 2002).

Comments: Utilizes the "PA-13 nylon pile fabric", operates under vacuum. Conditions of acceptance: loading rate not to exceed 6 gpm/ft^2; Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22); acceptance limited to the PA-13 nylon pile fabric (as tested); turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22); scheduled inspections of cloth conditions; ensure adequate sludge wasting.

Installations: Unknown

ENDNOTE #1: Both the Submerged Cloth Media Rotating Disk (AquaDisk®) and the Submerged Fixed Cloth Media (AquaDiamond®) designs are acceptable for use with the following CDPH accepted filter fabrics; 102 needle felt fabric, PA-13 nylon pile fabric, MMK2-13 acrylic pile fabric and PES-13 woven polyester fabric.

Description: **Submerged Cloth-Media Rotating Disk Filter (Utilizing the MMK2-13 acrylic pile fabric)**

NOTE: See *Endnote #1* concerning accepted cloth fabrics

Acceptance / References:
-Conditional acceptance letter from CDPH dated July 21, 2006.
-Report entitled "Comparative Evaluation of the Aqua-Aerobic Systems, Inc. MMK2-13 Acrylic Pile Filter Media To Meet California's Title 22 Reuse Criteria" (April 2006).

Comments: Utilizes the "MMK2-13 acrylic pile fabric", operates under vacuum. Conditions of acceptance: loading rate not to exceed 6 gpm/ft^2; Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22); turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22); scheduled inspections of cloth conditions; ensure adequate sludge wasting.

Installations: Unknown

ENDNOTE #1: Both the Submerged Cloth Media Rotating Disk (AquaDisk®) and the Submerged Fixed Cloth Media (AquaDiamond®) designs are acceptable for use with the following CDPH accepted filter fabrics; 102 needle felt fabric, PA-13 nylon pile fabric, MMK2-13 acrylic pile fabric and PES-13 woven polyester fabric.

Description: **Submerged Cloth-Media Rotating Disk Filter (Utilizing the PES-13 woven polyester pile fabric)**

NOTE: See *Endnote #1* concerning accepted cloth fabrics

Acceptance / References:
- -Conditional acceptance letter from CDPH dated November 14, 2007.
- -Report entitled "Evaluation of the Aqua-Aerobic Systems, Inc. PES-13 Cloth Media Filter for Wastewater Reuse Applications" (September 2007).

Comments: Utilizes the "PES-13 woven polyester fabric". Conditions of acceptance: loading rate not to exceed 6 gpm/ft^2; Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22); turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22); scheduled inspections of cloth conditions; ensure adequate sludge wasting.

Installations: Unknown

ENDNOTE #1: Both the Submerged Cloth Media Rotating Disk (AquaDisk®) and the Submerged Fixed Cloth Media (AquaDiamond®) designs are acceptable for use with the following CDPH accepted filter fabrics; 102 needle felt fabric, PA-13 nylon pile fabric, MMK2-13 acrylic pile fabric and PES-13 woven polyester fabric.

Description: **Submerged Fixed Cloth-Media Filter -AquaDiamond® Filtration System (Utilizing NF-102 Needle Felt or the PA-13 Nylon Pile Fabric)**

NOTE: See *Endnote #1* concerning accepted cloth fabrics

Acceptance / References:
- -Conditional acceptance letter from CDPH dated May 12, 2004).
- -Design and process control report on file.

Comments: Same filtration principle as the rotating disk filters noted above but differs in design and operation; operates under vacuum.
Conditions of acceptance: loading rate not to exceed 6 gpm/ft^2; filtration process must be complimented with a disinfection process which is compliant with Section 60301.230 (T-22); acceptance limited to the NF-102 needle felt fabric and the PA-13 nylon pile fabric. Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22); scheduled inspections of cloth conditions; ensure adequate sludge wasting.

Installations: Unknown

ENDNOTE #1: Both the Submerged Cloth Media Rotating Disk (AquaDisk®) and the Submerged Fixed Cloth Media (AquaDiamond®) designs are acceptable for use with the following CDPH accepted filter fabrics; 102 needle felt fabric, PA-13 nylon pile fabric, MMK2-13 acrylic pile fabric and PES-13 woven polyester fabric.

I. Kruger Inc. **Status--Accepted**

Description: **Cloth-Media Disk Filter - Hydrotech (Utilizing the PET mono-filament filter fabric)**

Acceptance / References:
- -Conditional acceptance letter from CDPH dated October 2, 2003.
- -Report entitled "Evaluation of the Hydrotech Filter for Compliance With Title 22 For Recycled Water Applications" prepared by Water 3 Engineering, Inc. (August 2003).

Comments: Utilizes the PET mono-filament, 2:2 twill weave, 11 micron (+/-2.0) mesh opening, 523.2 (n/inch), 60 micron thickness, wt. rating of 1.48 oz./sq.yd., stabilized finish. Conditions of acceptance: loading rate not to exceed 6 gpm/ft^2;

Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22); turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22); scheduled inspections of cloth conditions.

Installations: Unknown

Nordic Water Cloth-Media Disc Filter **Status--Accepted**

Description: **Cloth-Media Disk Filter - Nordic water (Utilizing the Type 20/30 Polyester Fabric Filter)**

Acceptance / References:
- -Conditional acceptance letter from CDPH dated March 7, 2008.
- -Report entitled "Nordic Water Disc Filter Validation Report" prepared by Eco-Logic Engineering (March 22, 2007).

Comments: Utilizes the Type 20/13 polyester fabric. Conditions of acceptance include: loading rate not to exceed 6 gpm/ft^2; Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22); turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22); scheduled inspections of cloth conditions.

Installations: Unknown

Parkson Corporation - DynaDisc **Status--Accepted**

Description: **Submerged Cloth-Media Rotating Disk Filter (Utilizing the PA-13 nylon pile fabric)**

Acceptance / References:
- -Conditional acceptance letter from CDPH dated November 5, 2007.
- -Report entitled "Parkson DynaDisc™ Cloth Media Filter" dated September 27, 2007.

Comments: Utilizes the "PA-13 nylon pile fabric", operates under vacuum. Conditions of acceptance: loading rate not to exceed 6 gpm/ft^2; Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22); acceptance limited to the PA-13 nylon

pile fabric (as tested); turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22); scheduled inspections of cloth conditions; ensure adequate sludge wasting.

Installations: Unknown

Siemens Water Technologies **Status--Accepted**

Description: **Forty X Cloth-Media Disk Filter (Utilizing the PET mono-filament filter fabric)**

Acceptance / References:
- -Conditional acceptance letter from CDPH dated June 3, 2008.
- -Performance data report for the Forty X Disc Filter submitted to CDPH (May 2008).

Comments: Utilizes the Siemens 11/5, PET (polyester) mono-filament, 2:2 twill weave, 11 micron mesh opening, 523 (n/inch), 60 micron thickness, wt. rating of 1.5 oz./sq.yd., stabilized finish. Conditions of acceptance: loading rate not to exceed 6 gpm/ft^2; Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22); turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22); scheduled inspections of cloth conditions.

Installations: Unknown

Five Star Filtration **Status--Accepted**

Description: **Five Star Cloth-Media Disk Filter (Utilizing the "Yellow Jersey Knit Fabric")**

Acceptance / References:
- -Conditional acceptance letter from CDPH dated September 12, 2008.
- -Title 22 Validation Testing Report dated August 1, 2008 submitted to CDPH.

Comments: Utilizes the Yellow Jersey Knit Fabric (20% acrylic/80% polyester face, 100% polyester backing yarn, acrylic latex back coating). Conditions of acceptance: loading rate not to exceed 6 gpm/ft^2; Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22); turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22); scheduled inspections of cloth conditions.

Installations: Unknown

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4. DISINFECTION TECHNOLOGIES

Gaseous chlorine or hypochlorite are the most commonly used disinfectants, however alternative technologies are recognized as being acceptable including UV, Ozone and Pasteurization.

ULTRAVIOLET DISINFECTION

Trojan Technologies, Inc.

Description:		
	UV 4000 (Medium Pressure/ Low Intensity)	**Status—Accepted***
	UV 3000 (Low Pressure/ Low Intensity)	" **
	UV 3000+ (Low Pressure/ High Output)	" ***

Acceptance/References:
- -Conditional acceptance letter from CDPH dated September 8, 1995 for UV4000.
- -Conditional acceptance letter from CDPH dated July 3, 2003 for UV 3000+ (including modified end-of-lamp-life factor of 0.82). Amended October 30, 2003, October 24, 2005 (concerning lamp spacing), October 5, 2006 (concerning sleeve fouling factor of 0.95).
- -"Trojan System UV4000 UV Disinfection Pilot Study. Riverside, California", May 1995
- -"Equivalency of the Trojan System UV4000 and System UV3000 in Meeting California Wastewater Reclamation Criteria at Pacifica, California", June 1994
- -"Technical Review: Ultraviolet Disinfection of Wastewater to California Wastewater Reclamation Criteria (Title 22, Division 4, Chapter 3, of the California Code of Regulations) Using Trojan Technologies' System UV4000 (High Intensity UV Lamp Technology", August 1995.

Comments: Acceptance for the UV4000 conditioned on 1) continuous monitoring/recording of filter effluent turbidity (pre UV), daily coliform monitoring (disinfected effluent) and 3) provide UV dose of at least 100 mW-sec/cm^2 under worst operating

conditions at peak daily instantaneous flow with a minimum of three banks in operation and a UV dose of at least 140 mW-sec/cm2 with a minimum of four banks in operation, subject to all of the conditions indicated in the NWRI Guidelines.

Installations: City of Pacifica, City of Vallejo, Central Contra Costa S.D., City of Corona, City of San Diego (South Bay WRF), Western Riverside RWF, Olivenhain WD, City of Santa Rosa

***Acceptance granted under the outdated 1993 NWRI Guidelines. Compliance with the May 2003 NWRI/AWWARF Guidelines has not been demonstrated.**

****Acceptance granted under the December 2000 NWRI/AWWARF Guidelines.**

*****Acceptance granted under the May 2003 NWRI/AWWARF Guidelines.**

Wedeco **Status—Accepted***

-Specktrotherm 33-TAK UV

Description: (Low pressure/High Intensity)

Acceptance/References
- -Conditional acceptance letter dated 3-31-98 from CDPH and follow-up letter dated 5/21/99 transferring approval from Aquafine to Wedeco).
- -Tested at OCWD as the AWES-Spectrotherm TAK UV System

Comments: Currently marketed as the PCI-Wedeco Spectrotherm 33 TAK UV System. Requires UV dose of 160 mWs/cm^2 at max. week flow, 120 mWs/cm^2 at peak flow (max. day), and an average of $\geq$160 mWs/cm^2 and conform to NWRI Guidelines.

Installations: Leucadia CWD(proposed)

***Acceptance granted under the outdated 1993 NWRI Guidelines. Compliance with the May 2003 NWRI/AWWARF Guidelines has not been demonstrated.**

Wedeco - LCI-20L **Status—Accepted***

Description: (Low pressure/High Intensity)
Model LCI-20L

Acceptance/ References
-Conditional acceptance letter from CDPH dated 2-23-99 for Tejon Ranch.
-Report entitled "Ultraviolet Dose Bioassay of the Ideal Horizons Horizontal Lamp Disinfection System" by HydroQual, Inc. (September 1998).

Comments:

Installations: Tejon Ranch Development (I-5 @ Tejon Pass)

***Acceptance granted under the outdated 1993 NWRI Guidelines. Compliance with the May 2003 NWRI/AWWARF Guidelines has not been demonstrated.**

Wedeco - TAK 55 **Status—Accepted****

Description: (Low pressure/High Intensity/open channel)
TAK 55

Acceptance/References
-Conditional acceptance letter dated 12-4-01 from CDPH.
-Report entitled "Wedeco-Ideal Horizons Low-Pressure, High Intensity Ultraviolet Disinfection System Pilot Study at Orange County Water District" by CH2M Hill (November 2000)
-Revised end-of-lamp age factor for SLR 32143 HP lamp modified from 0.91 to 0.88 at 10,074 hours per letter from CDPH dated May 19, 2005.

Comments:
Installations: Unknown
****Acceptance granted under the December 2000 NWRI/AWWARF Guidelines.**

Wedeco - TAK 55HP **Status—Accepted*****

Description: (Low pressure/High Output/open channel)
TAK 55HP

Acceptance/References
-Conditional acceptance letter dated 11-24-03 from CDPH.
-Report entitled "Wedeco Ultraviolet Technologies TAK 55HP Validation Report by Carollo Engineers (October 2003).
-Revised end-of-lamp age factor for SLR 32143 HP lamp modified from 0.91 to 0.88 at 10,074 hours per letter from CDPH dated May 19, 2005.

Comments:

Installations: Unknown

*****Acceptance granted under the May 2003 NWRI/AWWARF Guidelines.**

Wedeco - LBX 1000 **Status—Accepted*****

Description: (Low pressure/High Output/closed vessel)
LBX 1000

Acceptance/References
-Conditional acceptance letter dated 12-14-07 from CDPH.
-Report entitled "LBX 1000 UV Disinfection System Validation Report" by Carollo Engineers (December 2007).

Comments: -Acceptance letter addresses 10 conditions (see letter for more details).
-Tested on potable water; therefore acceptance is limited to membrane filtered effluent per NWRI.
-This system has a 65.5-cm chamber and forty 330-w LPHO lamps applicable for flow rates ranging from 0.58 to 3.51 MGD (403 to 2,438 GPM) at UTVs ranging from 54 to 77 percent, and sensor intensities ranging from 1.9 to 7.5 mW/cm^2.

Installations: Unknown

*****Acceptance granted under the May 2003 NWRI/AWWARF Guidelines.**

Wedeco - LBX 400 **Status—Accepted*****

Description: (Low pressure/High Output/closed vessel)
LBX 400

Acceptance/References
-Conditional acceptance letter dated 8-14-08 from CDPH.
-Report entitled "LBX UV Disinfection System Validation Report" by Carollo Engineers (July 2008).
-Tested on potable water; therefore acceptance is limited to membrane filtered effluent per NWRI.
-This system has a 38.1-cm chamber and sixteen 330-w LPHO lamps applicable for flow rates ranging from 0.25 to 1.37 MGD (174 to 951 GPM) at UTVs ranging from 46 to 75 percent, and sensor intensities ranging from 2.8 to 9.2 mW/cm^2.

Comments: Acceptance letter addresses 11 conditions (see letter for more details).

Installations: Unknown

*****Acceptance granted under the May 2003 NWRI/AWWARF Guidelines.**

Wedeco – LBX 90 **Status–Accepted*****

Description: (Low pressure/High Output/closed vessel) LBX 90

Acceptance/References
- -Conditional acceptance letter dated 8-21-08 from CDPH.
- -Report entitled "LBX UV Disinfection System Validation Report" by Carollo Engineers (July 2008).
- -Tested on potable water; therefore acceptance is limited to membrane filtered effluent per NWRI.
- -This system has a 20.8-cm chamber and four 330-w LPHO lamps applicable for flow rates ranging from 0.037 to 0.432 MGD (26 to 300 GPM) at UTVs ranging from 55.6 to 77 percent, and sensor intensities ranging from 2.1 to 8.0 mW/cm^2.

Comments: Acceptance letter addresses 11 conditions (see letter for more details).

Installations: Unknown

*****Acceptance granted under the May 2003 NWRI/AWWARF Guidelines.**

Aquionics, Inc. **Status–Accepted***

Description: (Medium Pressure/In-line)

Acceptance/Reference:
- -Conditional acceptance letter dated 2-28-00 from CDPH.
- -CH2M Hill, "Aquionics Medium Pressure, High-Intensity Ultraviolet Disinfection System Pilot Study at Orange County Water District" by CH2M Hill (May 1999)

Comments:

Installations: Unknown

***Acceptance granted under the outdated 1993 NWRI Guidelines. Compliance with the May 2003 NWRI/AWWARF Guidelines has not been demonstrated.**

Service Systems International, Ltd. **Status–Accepted***

ULTRAGUARD UV System

Description: (Open Channel/Low Pressure/High Intensity/vert. lamp)

Acceptance/Reference:
- -Conditional acceptance letter dated 2-1-00 from CDPH.
- -Report: Chen, C. L.; El Jacj, Z; Kuo, J., "UV Inactivation of Bacteria and Coliphages in Tertiary Effluent Using Low-Pressure High-Intensity Lamps", November 18, 1999, County Sanitation Districts of Los Angeles County.

Comments:

Installations: Unknown

***Acceptance granted under the outdated 1993 NWRI Guidelines. Compliance with the May 2003 NWRI/AWWARF Guidelines has not been demonstrated.**

Aquaray – Degremont

Aquaray 40 VLS **Status–Accepted*****

Description: Vertical lamp/low Pressure/low intensity

Acceptance: Conditional acceptance letter dated 10/24/97.

Comments: Evaluation memo dated 4/30/97 from CDPH concerning transmittance restriction be set at >55%.

Installations: Scotts Valley, Town of Windsor, Dublin/San Ramon CSD

*****Acceptance granted under the May 2003 NWRI/AWWARF Guidelines.**

Aquaray 40 HO VLS **Status–Accepted*****

Description: Vertical lamp/low Pressure/high intensity

Acceptance: Conditional acceptance letter dated 10/24/03 with subsequent correspondence dated 2/23/04, 4/13/04, 10/04/06 and 1/12/07.

Comments: Evaluation memo dated 4/30/97 from CDPH concerning transmittance restriction be set at >55%.

Installations: Unknown

*****Acceptance granted under the May 2003 NWRI/AWWARF Guidelines.**

Aquaray 3X HO **Status–Accepted*****

Description: Horizontal lamp/low Pressure/high intensity

Acceptance: Two conditional acceptance letters (one is a cover letter, the second is the actual acceptance letter) dated May 30, 2008.

Comments: -Acceptance letter addresses 24 conditions (see letter for more detail).
-This system has dimensions of 0.74-m wide, 0.91-m long and 2.25 m in height, inclusive of top enclosure. There are thirty-six 160-W LPHO Amalgam lamps in a staggered six by six array oriented vertical to the flow in an open channel. An air scrub sleeve cleaning system is typically provided.
-applicable for flow rates ranging from 2 to 12 MGD at UVTs ranging from 55 to 75 percent, lamp current ranging from 2.8 to 4.5 amps, and Effective Output (EO) ranging from 0.42 to 1.00.
-Testing was performed using both granular media and membrane-filtered effluent. Two similar operating equations were developed with different constants for granular media filtration or membrane filtration.

Installations: Unknown

*****Acceptance granted under the May 2003 NWRI/AWWARF Guidelines.**

UltraTech Systems

Terminator **Status–Accepted***

Description: Vertical/Low Pressure/Low Intensity

Acceptance/References
-Conditional acceptance letter dated October 23, 2000 from CDPH
-Report entitled "Ultraviolet Dose Bioassay of the Ultratech Systems Vertical Lamp Disinfection System (65% Transmittance)" by HydroQual, Inc. (February 2000).

Comments:

Installations: Unknown

***Acceptance granted under the outdated 1993 NWRI Guidelines. Compliance with the May 2003 NWRI/AWWARF Guidelines has not been demonstrated.**

Quay Technologies, Ltd.
OCS 6000 Microwave UV **Status–Accepted*****

Description: Electrodeless UV lamps

Acceptance/References
-Conditional acceptance letter dated June 8, 2007 from CDPH
-Report entitled "Quay Technologies, Ltd. OCS 6000 Microwave UV Validation Report" by Carollo Engineers (September 2006).

Comments: Piloted at City of Roseville. Instead of utilizing electrodes, microwave energy is generated by magnetrons and directed through wave guides into the quartz lamp sleeves containing the gas filling. The directed microwave energy excites the argon atoms, which in turn excite the mercury atoms to produce radiation.

Installations: Unknown

*****Acceptance granted under the May 2003 NWRI/AWWARF Guidelines.**

PASTEURIZATION

Ryan Pasteurization and Power

Description: Pasteurization disinfection process

Acceptance/References
-Conditional acceptance letter dated July 25, 2007 from CDPH
-Report entitled "RP&P Wastewater Pasteurization System Validation Report" by Carollo Engineers (July 2007).
-Conditions of acceptance include (see acceptance letter for more detail): 1) Pasteurization temperatures must ≥180 degrees F with temperature maintained continuously for a minimum of 10 seconds, 2) Upon completion of construction and prior to operation, the minimum contact time and temperature must be demonstrated to the Department, spanning a range of flow from the low flow to the high flow, with two intermediate flow points 3), For new installations, a 6-

point bioassay must be performed on the pasteurization unit using seeded MS2 coliphage, 4) The accuracy and repeatability of the on-line temperature probes (thermocouples) must be demonstrated, 5) On-line monitoring of flow and temperature must be implemented in a manner similar to that documented in the July 2007 report from Carollo Engineers. The temperature throughout the cross-section of the vessel should be uniform, 6) All future proposals shall employ the operational and maintenance criteria outlined under Section 6.3 of the July 2007 report from Carollo Engineers, and 7) Ryan Pasteurization must be preceded by filters meeting the definition of "filtered wastewater" under CCR, Title 22, Section 60301.320 (a & b) or those demonstrating equivalency under Section 60320.5 ("Other Methods of Treatment") outlined in the Water Recycling Criteria. Additionally, CDPH recommends that pilot testing of pasteurization prior to design be conducted to document any impacts from a water quality that is different from the water quality documented in the July 2007 report from Carollo Engineers.

Comments: Pilot studies were conducted at the City of Santa Rosa's Laguna Wastewater Treatment Plant.

Installations: Unknown

See: Appendix A
Appendix B

APPENDIX A

Recognized Filtration and Disinfection Technologies
For Recycled Water

CALIFORNIA DEPARTMENT OF HEALTH SERVICES
REDUCTION OF VIRUS AND BACTERIA BY FILTRATION AND DISINFECTION
(October 2001)

Title 22 of the California Code of Regulations (Recycled Water Criteria) requires extensive treatment of wastewater that is to be used for irrigation of parks and playgrounds or for spray irrigation of food crops. Recycled water for such irrigation is to be oxidized, filtered, and disinfected. Section 60301.320 defines filtered wastewater and Section 60301.230 defines disinfected tertiary recycled water. Additionally, Section 60320.5 allows for "other methods of treatment" provided they are found acceptable to the Department.

Treatment equivalent to that stipulated in sections 60301.320 and 60301.230 is prescribed to greatly reduce the concentration of viable enteric viruses in wastewater. Such a reduction makes it very unlikely that a person would contaminate his hands with a virus when touching a surface wet with reclaimed water. Enteric viruses are excreted by individuals with an intestinal virus infection. They can cause incapacitating disease states in susceptible persons. Those disease states include meningitis, hepatitis, and others.

<u>Capability of Treatment That Sections 60301.320 and 60301.230 Cite</u>

The County Sanitation Districts of Los Angeles County (CSDLAC, 1977) determined the capability of treatment that sections 60301.320 and 60301.230 cite, to reduce the concentration of viable virus in activated sludge effluent. CSDLAC added laboratory-cultured poliovirus and 150 milligrams of alum coagulant per liter of the activated sludge effluent and passed it through pilot-scale treatment facilities comprised of a clarifier and a sand filter to meet the turbidity limits that section 60301.320 cites in the definition of filtered wastewater: turbidity shall not exceed 2 turbidity units as a daily average and shall not exceed 5 turbidity units more than five percent of the time. Filter effluent was chlorinated in a chamber with a two-hour theoretical contact period and a 90-minute actual, modal contact period.

Such treatment reduced the concentration of virus plaque-forming units to 1/100,000th of the concentration in wastewater upstream from the filter, when the chlorine residual was at least 5 milligrams per liter and at least sufficient to reduce the concentration of total coliform bacteria to less than 2 per hundred milliliters. Sections 60301.320 and 60301.230 require that disinfection shall limit the concentrations of total coliform bacteria in the effluent so that the median of consecutive daily samples does not exceed 2.2 per hundred milliliters, as determined from the bacteriological results of the last seven days for which analyses have been completed.

Equivalent Treatment By Granular Media Bed Filtration and Disinfection

Section 60320.5 of Title 22 allows the regulatory agency to accept processes other than those that Sections 60301.320 and 60301.230 cite if the applicant demonstrates to the satisfaction of DHS that the other processes will assure an equal degree of treatment. DHS deems other treatment equivalent to that cited in sections 60301.320 and 60301.230 when: (1) a proponent demonstrates that the proposed alternative treatment consistently reduces the concentration of viable virus to a level 1/100,000th of the concentration of seeded virus in influent to the filter; and (2) the proponent will provide reliability features equivalent to those that Title 22 cites, and will comply with all other applicable stipulations of Title 22.

Past demonstrations are sufficient to allow DHS to accept the combination of granular media bed filtration and disinfection of oxidized wastewater as equivalent to treatment that sections 60301.320 and 60301.230 cite, when the following four conditions are obtained:

(1) coagulant is added when the turbidity of the oxidized wastewater (i.e. secondary effluent) exceeds 5 NTU for more than 15 minutes (or exceeds 10 NTU at any time) upstream from the filter;

(2) the turbidity of filter effluent does not exceed a daily average of 2 NTU, 5 NTU more than 5 percent of the time, and 10 NTU at any time;

(3) the concentration of viable total coliform bacteria in the final effluent does nct exceed 2.2 per hundred milliliters as a median in samples taken in seven consecutive days, and does not exceed 23 per hundred milliliters in more than one sample in a 30-day period; and

(4) the disinfection process complies with (a) or (b) below:

(a) if chlorination is used it provides a CT (chlorine concentration times modal contact time) value not less than 450 milligram-minutes per liter at all times with a modal contact time at least 90 minutes at the peak daily flow rate; or

(b) if ultraviolet light irradiation is used, the design and operation of the UV light disinfection process complies with the stipulations of the NWRI/AWWARF document cited below under the heading References Cited.

Demonstration With Other Filtration and Disinfection Processes

The particle size distribution (PSD) of secondary sewage treatment effluent filtered by a membrane, cloth, or similar medium will differ significantly from that of effluent of a granular media bed filter, insofar as PSD affects the effectiveness of the downstream disinfection process. The term "size distribution" refers to the number of particles per milliliter in each of several specific ranges of sizes. Polycarbonate membrane laboratory filters with pore sizes of 12, 8, 5, 3, 1, and 0.1 micron can be used (Levine, et al., 1985; NCC, 1984), with minimal equipment requirements. A particle counter can be used to determine PSD for the following size ranges, in microns: 1.2 to 2, 2 to 5, 5 to 10, 10 to 20, 20 to 50, 50 to 100, 100 to 200, and larger than 200 (Stahl et al., 1994).

If a filter other than a granular media bed filter is proposed to be used and the use of reclaimed water requires equivalence with treatment that section 60301.320 or 60301.230 cites, the proponent must undertake a demonstration to show DHS what operating conditions guarantee that the filter and disinfection process will consistently reduce the concentration of virus to 1/100,000th of the virus concentration in wastewater upstream from the filter and limit the concentration of total coliform bacteria to comply with concentrations that sections 60303 and 60313(b) cite. The demonstration will involve operation of the filter and disinfection process under the following conditions:

- the filter receives the type of wastewater from which recycled water is proposed to be produced;
- the range of qualities of wastewater received by the filter includes qualities that are expected to occur when recycled water is produced, and are the most challenging to the

effectiveness of the filter and disinfection process (e.g., concentration of suspended solids is at the maximum);

- laboratory-grown viruses are added to the wastewater upstream from the filter;
- samples are taken upstream from the filter and downstream from the disinfection process for determination of numbers of plaque-forming units of virus per volume of sample;
- samples are taken of wastewater upstream and immediately downstream from the filter for determination of concentration of total suspended solids;
- turbidity of the filter effluent is continuously measured by a continuous recording turbidimeter;
- samples of disinfected effluent are taken for determination of the concentration of total coliform bacteria;
- additionally if disinfection is by chlorination, samples are taken of wastewater upstream from the filter for determination of concentration of ammonia and samples of disinfected effluent are taken for determination of concentration of chlorine residual;
- additionally if disinfection is by UV irradiation, fluid transmittance at 254 nm (% T) and flow rate of filter effluent are continuously measured and recorded;
- The greatest appropriate time between backwashes, or other actions that renew filter yield or efficacy, is determined by experiment, with turbidity of filter effluent allowed to range as high as needed for economically practicable treatment (but not to exceed 2 NTU as a daily average, 5 NTU more than 5 percent of the time, or 10 NTU at any time); and

A test run is comprised of one continuous operation between two consecutive backwashes (or other actions that renew filter yield or efficacy). A demonstration shall have at least three test runs during which the quality and/or flow rate of influent to the filter is most challenging for the disinfection process.

Qualities most challenging to UV disinfection might include high concentration of suspended solids, high turbidity and low transmittance. Qualities most challenging to chlorine disinfection might include high concentration of suspended solids, high turbidity and high chlorine demand.

If the proponent wants to propose a CT value or minimum chlorine contact time that differs from that cited above under the heading Equivalent Treatment By Granular Media Bed Filtration and Disinfection, or a UV dose that differs from what the NWRI/AWWARF Guidelines cite, the proponent shall perform as many test runes as necessary to construct a dose-response curve for virus reduction. The curve shall show the required value(s) of such parameters at which the concentration of viable viruses in the disinfected effluent is reduced to $1/100,000^{TH}$ of the concentration in the influent to the filter.

During each test run, viruses shall be added to wastewater in numbers sufficient to determine whether the concentration in disinfected effluent is less than $1/100,000^{th}$ of the concentration in wastewater upstream from the filter. The viruses added to wastewater upstream from the filter shall be F-specific bacteriophage MS2, polio virus, or other virus that is at least as resistant to disinfection as polio virus. F-specific bacteriophage MS2 is a strain of a specific type of virus that infects coliform bacteria that is traceable to the American Type Culture Collection (ATCC 15597B1) and is grown on lawns of E. coli (ATCC 15597). Chlorine residual in samples of chlorinated effluent taken for determination of concentrations of virus plaque-forming units and total coliform bacteria shall be neutralized with a reducing agent approved by DHS, when those samples are taken.

The proponent shall submit to DHS a proposed protocol for all work to be undertaken in the demonstration. The proponent will undertake the demonstration only pursuant to a protocol DHS has approved.

The demonstration must identify operating conditions that consistently achieve that virus reduction and compliance with the above-cited limits on the concentration of total coliform bacteria. The regulatory agency will cite those operating conditions and will stipulate that they will be maintained.

The combination of a filtration process and a separate disinfection process provides multiple barriers to limit the concentration of viable viruses somewhat when the other malfunctions. DHS will not accept filtration alone, or disinfection alone, as complying with Title 22.

REFERENCES CITED

Levine, A.D., Tchobanoglous, G., and Asano, T., "characterization of the Size Distribution of Contaminants in Wastewater: Treatment and Reuse Implications," Journal **Water Pollution Control Federation**, July 1985, pages 805-816.

NCC (Nuclepore Corporation Catalog), "Innovations in Membrane Filtration," Pleasanton, California, 1984.

National Water Research Institute / American Waterworks Association Research Foundation), Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, December 2000. That document is available for purchase from National Water Research Institute, P.O. Box 20865, Fountain Valley, CA 92728-0865, telephone (714) 378-3278.

Stahl, J.F., Kuo, J.F., Chen, C., and Horvath, R.W., "Evaluation of Four Different Tertiary Filtration Plants for Turbidity Control", presented at 65th Annual Conference of Water Environment Federation, September 20-24, 1992, New Orleans (paper published in November/December 1994 issue of the Journal of the Water Environment Federation).

APPENDIX B

State of California **Department of Health Services**

Memorandum

Date: November 1, 2004

To: Regional Water Quality Control Boards Executive Officers

From: David P. Spath, Ph.D., P.E., Chief
Division of Drinking Water and
Environmental Management
1616 Capitol Avenue, MS 7400
449-5577

Subject: Cleaning of UV Quartz Sleeves

In recent years the use of ultraviolet (UV) radiation for disinfection of recycled water has increased significantly. As a relatively new technology for wastewater disinfection the Department of Health Services has been attempting to learn more about the operation of these UV facilities at recycled water plants. It has recently come to our attention that at some recycled water plants these UV facilities may be operated in a manner that could significantly compromise the disinfection treatment barrier. Specifically, we have been advised that these recycled water plants are following the practice of using the detection of coliform organisms in the treated effluent as a basis for determining how frequently to clean the quartz sleeves that protect the UV lamps. As the appropriate regulatory agency we are requesting that the Regional Water Quality Control Boards (RWQCB) look into this situation. In addition, we are recommending that the RWQCBs establish a more conservative set of requirements for all recycled water plants practicing UV disinfection to ensure that an appropriate disinfection treatment barrier is achieved. The following provides a brief discussion of the issue including background information, the problem that exists and our recommended requirements.

Background

Cleaning the quartz sleeves of a UV system is critical to ensuring the proper functioning of a UV system. Because the UV lamp is surrounded by a quartz sleeve, any coating on the surface of the quartz sleeve will reduce the transmission of UV into the wastewater thereby reducing the quantity of UV reaching or penetrating the wastewater for the purpose of disinfection. Unless this reduction in UV transmission is compensated for in the design and operation of the UV facility, the UV disinfection barrier can and will be reduced (compromised) concomitantly, i.e., the amount of disinfection being delivered will not be sufficient to meet minimum dose delivery requirement.

The National Water Research Institute (NWRI)/American Water Works Association Research Foundation (AWWARF) UV disinfection guidelines recognize this issue and recommend a 0.8 sleeve fouling factor be used in the design of UV systems. This increases the minimum dose delivery requirement in a linear manner, increasing the number of lamps required to achieve the minimum delivered dose during operation with the realization that quartz sleeve fouling is a never ending process.

Unless the UV system is operated using a sensor on the outside of a quartz sleeve for controlling the delivered dose, one does not know when or how much of an impact fouling has on UV dose delivery. Therefore, the delivered dose requirement is increased by the quartz sleeve-fouling factor to account for quartz sleeve fouling over time. While this accounts for quartz sleeve fouling in the design of the system, this approach assumes the quartz sleeve never exceeds a level of fouling that would reduce the UV dose delivery by 20 percent at any time. Such an approach is fine as long as the UV transmission through the quartz sleeve is not reduced by more than 20 percent. Unfortunately in actual operation, unless the quartz sleeve fouling rate has been established, one does not know when the limits of this fouling factor have been exceeded.

What the NWRI/AWWARF guidelines do not establish is the frequency with which the quartz sleeves should be cleaned to remove any scale or film that has been deposited on the sleeve. This is not a deficiency of the guidelines, but a reflection of inexact science and incomplete understanding of the nature of quartz sleeve fouling.

Problem

The problem that has resulted is that some water recycling plants may be using the presence of coliform organisms in the treated effluent as an indicator to determine when the quartz sleeves should be cleaned. In our opinion this is problematic. The recycled water coliform limit for filtered secondary effluent was established at a time when chlorination was used almost exclusively to provide disinfection. This limit along with requirements for total chlorine residual and contact time was established to ensure effective inactivation of viral pathogens. UV radiation, while very effective at inactivating coliform bacteria, is a much less effective viricide than chlorine. Therefore, the quantity of UV needed to meet the coliform discharge limits of less than 2.2/100mL is significantly less than the minimum dose delivery to inactivate viruses, as required in the NWRI/AWWARF UV Disinfection Guidelines.

The guidelines call for a minimum UV dose delivery requirement of 100 mJ/cm^2 for standard media filtered secondary effluents. Typical coliform concentrations in media filtered secondary effluents run about 10^4-10^6 MPN/100mL. The minimum UV delivered dose needed to achieve a 4 to 6 log reduction of coliforms is about 10-20 mJ/cm^2. Since 4 to 6 logs of inactivation should reduce the coliforms to nondetectable levels, this means that if coliforms are being detected the dose delivery in the system is probably around 10-20 mJ/cm^2 which is 5 to 10 times below the minimum dose delivery

recommended by the UV guidelines as the minimum needed for an effective disinfection barrier.

Recommended Requirements

Based on the preceding discussion we are recommending the following requirements be established by the RWQCBs:

Include a provision in permits for water recycling treatment plants employing UV disinfection that requires the water recycling plant operator to establish quartz sleeve cleaning frequencies that ensure the minimum required UV dose delivery is consistently met.

Include a provision in water-recycling permits that requires water recycling plant operators use a fixed cleaning frequency to define the quartz sleeve cleaning intervals, and not use the presence of coliform organisms in the treated effluent as a factor to determine cleaning intervals. Because the water quality parameters for establishing fouling rates are not known and because of the site-to-site variability in wastewater quality, the Department further recommends that such cleaning frequencies be established on a site-specific basis.

Include a provision in water-recycling permits that specifies the minimum delivered UV dose that must be maintained (as recommended by the NWRI/AWWARF UV Disinfection Guidelines), in addition to the coliform standard.

If you have any questions concerning this matter, please contact Dr. Rick Sakaji with this Department at (510) 849-5050.

APPENDIX F

City of Lakeport
Westside Community Park

WESTSIDE COMMUNITY PARK COMMITTEE
CITY OF LAKEPORT
225 PARK STREET
LAKEPORT, CA. 95453

TAX # 68-0415643

November 2, 2009

To whom it may concern:

This letter is to inform you of the Westside Community Park Committee's (WCP) support for the City of Lakeport's consideration of a wastewater recycling/reuse program.

The WCP is a registered nonprofit corporation developing and managing a 60 acre active recreation park to be dedicated to the City of Lakeport. Currently four acres have been dedicated as parkland and eleven acres are under active development. At completion, approximately 70% of the total acreage will be irrigated for use as a variety of sports fields.

In the event the City offers recycled water to current and future water customers, the Committee would be very interested in discussing options on how to receive it for irrigation, thereby reducing the need for potable water at Westside Community Park.

Sincerely,

Dennis A. Rollins
Chairperson, Westside Community Park Committee

RECEIVED
NOV 16 2009

LAKE COUNTY FAIR
49TH DISTRICT AGRICULTURAL ASSOCIATION

November 13, 2009

To whom it may concern:

This letter is to inform you of my support for the City of Lakeport's consideration of a wastewater recycling/reuse program.

Non-potable water can be a great means of reducing the use of a variety of resources, and can provide for many of the irrigation needs of facilities like the Lake County Fairgrounds. I have observed the use of highly treated wastewater at other fairgrounds, and similar uses could be found here.

In the event the City offers recycled water to current and future water customers, I would be very interested in discussing options on how the Lake County Fairgrounds might receive it for irrigation, thereby reducing the need for potable water for that purpose.

Sincerely,

Richard Persons
CEO, Lake County Fair

401 Martin Street ▪ P.O. Box 70 ▪ Lakeport, CA 95453 ▪ (707) 263-6181 ▪ FAX (707) 263-7706 ▪ www.lakecountyfair.com

APPENDIX G

Preliminary Environmental Evaluation
City of Lakeport
Phase 1 - Westside Park/Parallel Drive
Recycle Water Project

Prepared for:

PACE Engineering, Inc.
032-14

November 13, 2009

Prepared by:

ENPLAN
Environmental Scientists and Planners
www.enplan.com

INTRODUCTION

The City of Lakeport is proposing to expand its secondary wastewater treatment plant to a tertiary treatment plant in order to utilize the recycle water generated for offsite unrestrictive landscape irrigation at the Westside Park. The proposed Westside Park/Parallel Drive Project would be the first phase in the creation of a recycle water district within the south City area.

The wastewater treatment plant is located approximately ¼-mile west of Highway 29 near its intersection with Highway 175. Access to the site is provided via Linda Lane. The Westside Park/Parallel Drive project would pump tertiary treated recycle water to a new 540,000-gallon recycle water storage reservoir located northwest of the wastewater treatment plant. Pumping would be accomplished through use of two 40-horsepower pumps that would be sited at the expanded treatment facility. The recycled water would be used to irrigate the City's Westside Park property, and could potentially be used for urban landscaping along the pipeline route in the future. Approximately 14,000 feet of reclaimed water pipeline would be constructed from the wastewater treatment plant to Westside Park. The 8-inch to 12-inch pipeline would be constructed within the public right-of-way along Linda Lane, Parallel Drive, and Westside Drive (see Figure 12 in main report).

The proposed Westside Park recycle irrigation area would consist of approximately 3.5 acres of irrigated soccer fields and 47 acres of undeveloped land. As part of the proposed project, the soccer field irrigation system would be converted from potable water to recycle water. The presently undeveloped park acreage previously supported a walnut orchard; most of the trees have been removed, and the remaining trees are not maintained. Forbes Creek flows near the northern boundary of the parcel. It is intended that the recycled water would be distributed over approximately 40 acres of the park site using sprinklers with surface and subsurface piping to irrigate landscaping, equestrian trails, bike trails, soccer/softball fields, or similar recreational uses in the future. A minimum 50-foot setback from the Forbes Creek riparian zone would be maintained.

This Preliminary Environmental Evaluation addresses the potential environmental impacts of the proposed project. The evaluation is based on field reconnaissance of the site by ENPLAN staff in April 2008, as well as aerial photograph interpretation and review of the City of Lakeport's General Plan EIR[1].

ANALYSIS OF POTENTIAL ENVIRONMENTAL IMPACTS

1. Aesthetics

The proposed project would involve expansion of the wastewater treatment system at the existing treatment plant site, construction of a water storage reservoir on a low knoll northwest of the treatment plant site, installation of recycle water main in road rights-of-way, and sprinkler irrigation at the Westside Park and possibly at locations along the pipeline route. Proposed work at the treatment plant site would have negligible

[1] Quad Knopf. November 2008. City of Lakeport General Plan Update Draft Environmental Impact Report.

aesthetic effects as the proposed facilities would be of similar character to the existing facilities, new facilities would be centrally located within the large treatment plant site, and the nearest viewers are over a quarter-mile from the treatment facility expansion site.

Installation of the recycle water main would have a temporary but insignificant effect on visual resources. Although soil and vegetation would be disturbed during construction, pre-existing contours would be restored following construction and the disturbed soils would be seeded. No permanent impacts would occur because no mature trees would be removed during pipeline construction, and the pipeline would be underground.

Conversion of the soccer field irrigation system from potable to recycle water would have no aesthetic impact. Installation of a sprinkler system in the currently undeveloped park site and irrigation of ±40 acres of the site would change its visual character. The proposed irrigation site would primarily be viewed by the residents of a parcel surrounded on three sides by the park, as well as future park users. The irrigation site currently has low visual quality, with visual elements consisting of denuded and disturbed soils, mounds of fill material, and the remains of an old walnut orchard. With the proposed irrigation, perennial grasses are expected to cover the site. Some walnut trees may be removed during pipeline installation, but most trees are expected to remain in place. The anticipated changes in the visual character of the site are not considered significant. It should be noted that provision of irrigation water could promote future development of the site with recreational uses. However, no such uses are currently planned, and the effects of uses that may be proposed in the future would be addressed in separate environmental documentation.

The proposed recycle water storage tank may be partially visible from Highway 29 and surrounding lands. However, the tank would be part of the background viewshed and no sensitive visual receptors are located in close proximity to the tank site. To minimize tank visibility, the tank should be sited below the ridgeline if possible, grading should be minimized to the extent possible, existing trees in the immediate vicinity of the tank should be retained during construction, and the tank should be painted with non-reflective, neutral colors. If necessary, additional trees could be planted around the tank to provide further visual screening. The need for additional planting should be determined during final design of the tank, once its site, elevation, dimensions, and the extent of cut and fill slopes have been determined.

2. Agricultural Resources

The City of Lakeport General Plan Update EIR shows that the recycle water storage tank site is designated under the California Department of Conservation's Farmland Mapping and Monitoring Program as grazing land, and that the Westside Park irrigation area is designated as grazing land and farmland of local importance. The existing soccer fields are classified as "other lands". Policy C 7.2 of the General Plan Update calls for continued expansion of the use of recycle water for irrigation of agricultural uses, parkland, highway medians, and other appropriate uses. Because the proposed project would not affect farmlands of statewide importance and would be consistent with the above General Plan policy, no significant impacts on agricultural lands are anticipated.

3. Air Quality

Lakeport lies within the Lake County Air Basin and the Lake County Air Quality Management District. The Lake County Air Basin currently meets both state and federal ambient air quality standards. The General Plan Update EIR shows that no sensitive air quality receptors are located in the vicinity of the proposed work areas.

Project implementation may result in temporary air quality impacts during construction, particularly in the form of dust emissions. Compliance with existing requirements regarding dust emission control would ensure that the project does not result in significant air quality impacts, including exposure to naturally occurring asbestos during project construction. Air emissions associated with painting the recycle water storage tank and other facilities can be minimized through use of materials with low concentrations of volatile organic compounds (VOCs).

Air quality emissions generated during project operations would consist primarily of those from vehicle use by treatment plant staff and pumping of the recycled water. Siting of the new treatment facilities at the existing wastewater treatment plant site would serve to minimize vehicle usage and associated emissions. Because the proposed pumps would be powered by electricity, not diesel, pump emissions would be negligible. Accordingly, operational emissions would be less than significant.

Both construction and operational emissions would contribute to generation of greenhouse gases. The City of Lakeport does not currently have any standards with respect to greenhouse emissions. However, the objective of the proposed project is to increase the use of recycle water; project implementation would be self-mitigating in that use of recycle water would reduce the need for construction of domestic water sources, treatment systems, and distribution networks. Although quantification of emissions and offsets is not possible, it is anticipated that emission reductions associated with recycle water use would offset the minor increase in greenhouse gas emissions associated with construction and operation of the proposed facilities.

4. Biological Resources

Habitat types present in the study areas include blue oak woodland at the recycle tank site, agricultural lands at the Westside Park site, and ruderal (roadside) vegetation along the pipeline route. Oak woodlands have moderate to high value for wildlife and may support several special-status plant and wildlife species. Agricultural lands have a low value for wildlife and, because of past disturbances, are less likely to support special-status species. Both the oak woodlands and agricultural lands may provide for migration and movement of native wildlife species, as well as provide opportunities for nesting of migratory birds. Ruderal vegetation has minimal biological value.

Loss of oak woodlands due to construction of the recycle water tank and its access road is a potentially significant impact. This impact can be reduced to a less-than-significant level through development and implementation of a revegetation plan. The revegetation plan should be prepared in conjunction with the final design plans, once the extent of vegetation disturbance has been quantified.

Although agricultural lands may be temporarily disturbed during irrigation system installation, no long-term impacts are anticipated as the irrigated lands would provide similar biological values.

The project site, particularly the recycle water tank site, has a moderate to high potential to support nesting by raptors and migratory birds. Potential nesting habitat for these birds occurs in the trees scattered throughout the site. If present, active nests could be lost during vegetation removal or could be disturbed by on-site construction activities, potentially resulting in nest abandonment and mortality of chicks and eggs.

To ensure that active nests of raptors and migratory birds are not disturbed, vegetation removal should be avoided during the nesting season (generally February 1 to July 31), to the extent possible. If vegetation removal must occur during the nesting season, a focused survey should be conducted by a qualified biologist to identify active nests in and adjacent to the project site. The survey should be conducted no more than 30 days prior to the beginning of construction or tree removal. If nesting birds are found during the focused survey, the nest tree(s) should not be removed until after the young have fledged. Further, to prevent nest abandonment and mortality of chicks and eggs, no construction should occur within 500 feet of an active nest, unless a smaller buffer zone is authorized by the Department of Fish and Game (the size of the construction buffer zone may vary depending on the species of nesting birds present).

A number of special-status plant and wildlife species are known to occur in the general Lakeport vicinity. However, according to California Natural Diversity Data Base records (CNDDB, April 2008), no special status species are recorded as occurring on or adjacent to the proposed project areas. The potential for special status species to occur at the work site was further evaluated through field investigation by an ENPLAN biologist on April 25 and 26, 2008. The field investigation covered the Westside Park irrigation lands and most of the proposed recycle water pipeline route. Although no special-status species were observed, additional field investigation is necessary.

5. Cultural Resources

According to the City of Lakeport General Plan Update Final EIR, as of 2004 the City was known to contain 12 recorded Native American archaeological resources listed with the Historical Resources Information System. In addition, several properties in the City appear to be eligible for listing on the National Register of Historic Places and/or California Register of Historical Resources. Lands in the project study areas have a range of sensitivity for the presence of Native American and historic-period archaeological resources, with the more sensitive areas including lands near Forbes Creek. A site-specific cultural resources records search and field survey would need to be completed prior to project implementation. Even if no cultural resources are observed during the field survey, subsurface resources may be encountered during construction. If this occurs, all work in the vicinity shall be terminated until a qualified archaeologist can evaluate the site and implement appropriate measures.

6. Geology and Soils

The City of Lakeport is located in the northern portion of the Coast Range geomorphic province. More specifically, the City lies on a shelf forming the western shore of Clear Lake. Lakeport's bedrock consists of the marine Franciscan complex overlaid with alluvium, lake, and terrace deposits. The Franciscan rock is fairly hard and stable, while that of the other deposits is softer and poorly consolidated. Four soil types are present in the study area, as noted in Table 1. The soils in general have low permeability, moderate susceptibility to erosion, and high shrink-swell potential.

Lakeport is located in a highly active earthquake area and the potential exists for a significant seismic event in the future. As mapped in the General Plan Update EIR, a potentially active fault (with Quaternary displacement) appears to run through or adjacent to the wastewater treatment plant site.

The proposed project facilities could potentially be exposed to geologic and soils impacts, including rupture of an earthquake fault, seismic ground shaking, seismic-related ground failure, liquefaction, landslides, lateral spreading, subsidence, collapse, and soil expansivity. Compliance with existing standards, including the California Building Code and City ordinances with respect to erosion control, will ensure that geologic and soils impacts are less than significant.

Table 1
Soil Types and Characteristics

Soil Name	Erosion Hazard (Off-road, Off-trail)	Hydric Rating	Farmland Classification
Westside Park Soccer Fields			
Wappo loam, 2 to 8 percent slopes	Slight	Partially Hydric	Not prime farmland
Westside Park Extension			
Cole Variant clay loam	Slight	Partially Hydric	Prime Farmland if irrigated
Still loam, stratified substratum	Slight	Partially Hydric	Prime Farmland if irrigated
Wappo loam, 2 to 8 percent slopes	Slight	Partially Hydric	Not prime farmland
Wappo loam, 8 to 15 percent slopes	Moderate	Partially Hydric	Not prime farmland
Reservoir Site			
Bressa-Millsholm Loams, 15 to 30 percent slopes	Moderate	Not hydric	Not prime farmland

Source: Natural Resources Conservation Survey Web Soil Survey <http://websoilsurvey.nrcs.usda.gov>. Last updated 11/11/2009.

7. Hazards and Hazardous Materials

The proposed project may involve transportation, use, and/or storage of hazardous materials during project construction and operation. Hazardous materials handling is subject to numerous laws and regulations at all levels of government, including the Federal Emergency Planning and Community Right to Know Act (EPCRA) of 1986, the California Hazardous Materials Release Response Plans and Inventory Law of 1985 (Business Plan Act), as well as other regulations enforced by the California Occupational Safety and Health Administration (Cal-OSHA), Federal Occupational Safety and Health Administration (Fed-OSHA), California Department of Toxic Substances Control, state Office of Emergency Services, U.S. Department of Transportation, California Highway Patrol, and the California Department of Transportation. Compliance with the applicable federal and state laws would reduce the potential for exposure of workers, the general public, and the environment to hazardous materials to a less-than-significant level.

The project site is located more than 1.5 miles from the nearest airport, and would not be subject to undue safety hazards associated with airport operation. The project would not impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan. Although project construction activities could temporarily increase the potential for wildland fires, the overall effect of the project would be neutral, as the irrigated sites would have a reduced fire hazard.

8. Hydrology and Water Quality

The purpose of the Hydrology and Water Quality section is to evaluate and describe the potential impacts of the proposed project on surface and groundwater resources, and the potential for the proposed project site to generate runoff that could affect flooding or drainage characteristics (both on- and off-site), or be affected by flooding from storm events.

Effects on surface and groundwater resources would be positive to the extent that use of recycle water reduces the need to rely on surface and groundwater sources for water supply. In the short term, project construction activities would have some potential to increase soil erosion and degrade the quality of receiving waters. However, a general construction activity storm water permit and Storm Water Pollution Prevention Plan (SWPPP) will be required prior to project construction. Compliance with the erosion control and spill prevention standards contained in the SWPPP would ensure that the potential for construction-related water quality degradation is less than significant.

In the long term, the potential for degradation of surface water and groundwater quality due to irrigation is negligible in that the wastewater would receive tertiary treatment prior to discharge. Project implementation would require issuance of a National Pollutant Discharge Elimination System (NPDES) permit by the Regional Water Quality Control Board, which would further ensure that water quality is not degraded.

With the possible exception of minor portions of the recycle pipeline route, the project area is located outside the 100-year and 500-year flood zones, as designated by the Federal Emergency Management Agency. Further, project implementation would not alter drainage patterns, increase runoff volumes, or otherwise contribute to flooding.

9. Land Use and Planning

The City of Lakeport General Plan designates the wastewater treatment plant site as "Public and Civic Use" and the Westside Park site irrigation areas as "Open Space Parkland." Zoning for the two sites is "Open Space District" and "Public and Civic Uses District," respectively. Project implementation would be consistent with the General Plan designations and zoning classifications. Impacts with respect to land use and planning would be less than significant.

10. Mineral Resources

No mining or mineral extraction operations are located in or adjacent to the project study areas, and such activities are prohibited within the City Limits. Project implementation would have no impacts with respect to mineral resources.

11. Noise

Project implementation could result in short-term increases in noise levels during project construction as well as long-term increases as a result of project operation. Construction related noise levels increases are not expected to be significant because most construction activities will be either in relatively isolated areas (i.e., the wastewater treatment plant site) with no nearby noise-sensitive uses, or along busy road corridors that already experience high noise levels. Nonetheless, the impacts of construction-related noise levels should be minimized by confining construction activities to the daytime hours of 7 a.m. to 7 p.m., Monday through Saturday.

Noise generation during project operation would be confined to recycle water pump noise, occasional vehicle traffic, and periodic maintenance activities. Pump noise would not be audible at the wastewater treatment plant boundaries and is not considered significant. Noise associated with occasional vehicle use and maintenance activities would be less than significant.

12. Population and Housing

Implementation of the proposed project would have no adverse effects on population or housing in that it would not induce substantial population growth or displace any existing housing or people.

13. Public Services

Implementation of the proposed project would have no adverse effects on law enforcement, fire protection, medical services, schools, or other public services.

14. Recreation

Implementation of the proposed project would not contribute to the physical deterioration of publicly provided recreation facilities nor would it increase demand for recreational facilities or displace existing recreational opportunities. Use of recycle water is compatible with recreational uses, and its use in parklands and recreational facilities is encouraged by the City of Lakeport.

15. Transportation/Traffic
Project construction is expected to result in minor increases in traffic volumes as well as increased congestion and possible lane closures along local roads during pipeline installation. With implementation of standard safety practices, the effects of construction-related traffic disruptions would not be significant.

In the long term, the project would add a small number of vehicle trips to the local street system. However, this impact would not be directly or cumulatively significant. Project implementation would not affect air traffic patterns, result in inadequate parking capacity, increase hazards on area roadways due to incompatible uses, affect emergency access, or conflict with policies, plans, or programs supporting alternative transportation modes.

16. Utilities and Service Systems
Project implementation may result in a slight increase in solid waste generation, especially during the construction phase, as well as a slight increase in energy consumption associated with wastewater treatment and pumping. However, these minor impacts would be more than offset by the beneficial effects of the project with respect to a reduction in the need for potable water consumption. No effects on storm water drainage facilities are anticipated.

SUMMARY OF POTENTIAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

AESTHETICS
Construction of the proposed recycle water storage tank on the hillside northwest of the wastewater treatment plant could change the scenic character of the area. With implementation of the following mitigation measure, this impact would be reduced to a less-than-significant level.

Mitigation Measure 1. To minimize the visibility of the recycle water storage tank, the tank shall be sited below the ridgeline if possible, grading shall be minimized to the extent possible, existing trees in the immediate vicinity of the tank shall be retained during construction, and the tank shall be painted with non-reflective, neutral colors. If necessary, additional trees shall be planted around the tank to provide further visual screening. The need for additional planting shall be determined during final design of the tank, once its site, elevation, dimensions, and the extent of cut and fill slopes have been determined.

BIOLOGICAL RESOURCES
Project implementation would result in the loss of oak woodlands, possible "take" of nesting migratory birds, and possible loss of special-status plant or wildlife species and/or their habitats. These impacts can be reduced to a less-than-significant level through implementation of the following mitigation measures.

Mitigation Measure 2. A revegetation plan acceptable to the City of Lakeport Community Development Department Director shall be prepared prior to project implementation. The plan shall quantify the extent of oak woodland lost due to project implementation, identify the lands to be revegetated, specify the type and number of trees to be planted, identify the planting methodology, designate planting success criteria, establish a monitoring and reporting program, and provide a list of potential remedial measures that may be implemented if the designated success criteria are not met.

Mitigation Measure 3. To ensure that active nests of raptors and migratory birds are not disturbed, vegetation removal shall be avoided during the nesting season (generally February 1 to July 31), to the extent possible. If vegetation removal must occur during the nesting season, a focused survey shall be conducted by a qualified biologist to identify active nests in and adjacent to the project site. The survey shall be conducted no more than 30 days prior to the beginning of construction or tree removal. If nesting birds are found during the focused survey, the nest tree(s) shall not be removed until after the young have fledged. Further, to prevent nest abandonment and mortality of chicks and eggs, no construction shall occur within 500 feet of an active nest, unless a smaller buffer zone is authorized by the Department of Fish and Game (the size of the construction buffer zone may vary depending on the species of nesting birds present). Although no special-status species were observed, additional field investigation is necessary.

Mitigation Measure 4. Supplemental biological surveys shall be undertaken by a qualified biologist(s) to document the presence/absence of special-status plant and wildlife species. If such species may be adversely affected by project implementation, the biologist, in consultation with the City of Lakeport, shall develop measures to reduce the impacts to a less-than-significant level. Such measures may include modifying the planned construction corridors, scheduling construction so that the special-status species would not be affected, or preparing and implementing a plan to replace the species/habitats that would unavoidably be affected by project implementation. California Department of Fish and Game, the National Marine Fisheries Service and/or U.S. Fish and Wildlife Service staff shall be consulted, and any needed permits and approvals shall be obtained from these agencies.

CULTURAL RESOURCES

Mitigation Measure 5. A site-specific cultural resources records search and field survey shall be completed by a qualified archaeologist prior to project implementation. If cultural resources are observed, they shall be properly recorded, an evaluation of their significance shall be conducted, and the archaeologist shall recommend measures to avoid a significant loss of cultural resource values. This may entail relocation of the proposed work areas or implementation of a data recovery program. Implementation of such measures shall be the responsibility of the City of Lakeport. Even if no cultural resources are observed during the field survey, subsurface resources may be encountered during construction. If this occurs, all work in the vicinity shall be terminated until a qualified archaeologist can evaluate the site and implement appropriate measures.

NOISE

Mitigation Measure 6. Construction-related noise generation shall be minimized by:

- Restricting the hours of operation of noise-producing equipment to 7 a.m. to 7 p.m. Monday through Saturday.
- Installing effective mufflers on both gas- and diesel-powered construction equipment.

APPENDIX H

City of Lakeport
2009 Recycle Feasability Study Report

DESIGN ASSUMPTIONS

PIPELINE DESIGN STANDARDS

1	Minimum Recycle Pipeline main diameter =	8-inch
2	Minimum Recycle System Pressure at Service Connection (1),(2)	60 PSI
3	Hazen Williams "C" Value	130
4	Economic Pipeline maximum velocity	5 fps

PUMP STATION DESIGN STANDARDS

1	Two pump station design with one pump effective capacity.	
2	Pump capcity to deliver maximum day demand (MDD) to recycle storage from recycle treatment plant .	
3	Pump station base elevation.	1380'

RECYCLE RESERVOIR DESIGN STANDARDS

1	Finished recycle storage reservoir to be sized for 20% MDD Equalization + 25% MDD Emergency Storage(3)	
2	Base Elevation of reservoir	1550'
3	Estimated Maximum water surface elevation.	1573'

(1) Assume 10 PSI drop through backflow preventor.
(2) Based on ultimate maximum hour demand.
(3) Based on City of Lakeport Master Water Plan storage requirements.

ASSUMPTIONS:

TOTAL IRRIGATED AREA IN PHASE 1 AREA	120 Ac
AVERAGE ANNUAL RECYCLE WATER REQ'D (BASED ON REPORT TABLE 2)	373 Ac-Ft/yr
AVERAGE RECYCLE WATER - MAXIMUM MONTH	71 Ac Ft
MAXIMUM DAY DEMAND - MDD	535 GPM
MAXIMUM HOUR DEMAND - MHD	857 GPM

(BASED ON LAKEPORT MASTER WATER PLAN MHD: MDD = 1.6)

PIPELINE DESIGN (SEE DESIGN STANDARDS APPENDIX H)
PHASE 1 (SEE FIGURE 12)

PIPELINE LENGTHS

RESERVOIR TO POINT 1	2750'
POINT 1 TO POINT 2	3200'
POINT 2 TO POINT 3	3000'
POINT 3 TO POINT 6	770'
	9720'

POINT 6 LOCATION OF WESTSIDE PARK 8-INCH SERVICE.

ESTIMATE PIPELINE DIAMETER TO MAINTAIN MINIMUM 60 PSI WATER PRESSURE @ MHD (857 GPM) @ POINT 2 (SEE FIGURE 12.

RESERVOIR MWS	1573'
POINT 2 ELEVATION	1390'
STATIC HEAD	183'
	79.2 PSI

PIPELINE DESIGN <CONT>

A.) FRICTIONAL PIPELINE LOSS @ MHD.

MHD = 857 GPM = 1.234 MGD
ASSUME ~~10"~~ 12" PIPELINE
FRICTIONAL LOSS THROUGH ~~10"~~ 12" @ C = 130 = ~~4.3~~ 2.0 ft/1000'

RESERVOIR TO POINT 2 PIPE LENGTH = 5950'

TOTAL FRICTIONAL HEADLOSS H_L = ~~4.3~~ 2.0 × 5.95 = ~~25.6'~~ 11.9

DETERMINE HEAD @ POINT 2 = 183' − ~~25.6'~~ 11.9' = ~~157.4~~ 171
~~68.1~~ 74.1

ASSUME 10 PSI DROP THROUGH BACKFLOW PREVENTOR @ POINT 2. 10.0 PSI

SERVICE PRESSURE ~~58.1~~ 64.1 psi

→ ∴ USE 12" MAIN FROM RESERVOIR TO POINT 2.

ESTIMATE NEEDED PIPELINE DIAMETER FROM POINT 2 TO POINT 6.

B.) FRICTIONAL PIPELINE LOSS @ 1/2 MHD.

FLOW 857 GPM / 2 = 430 GPM = 0.62 MGD
ASSUME ~~10"~~ 12" PIPELINE
FRICTIONAL LOSS THROUGH ~~10"~~ 12" @ C = 130 = ~~1.4~~ 0.56 '/1000'

POINT 2 TO POINT 6 (POINT 6 IS SERVICE TO WESTSIDE PARK) = 3,770'

TOTAL FRICTIONAL HEADLOSS H_L = ~~1.4~~ 0.56 × 3.77 = ~~5.3'~~ 2.1

DETERMINE HEAD @ POINT 6 = 171' (FROM A.) − ~~5.3'~~ 2.1 = ~~165.7'~~ 168.9

PACE ENGINEERING

Subject CITY OF LAKEPORT

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PIPELINE DESIGN <CONT>

STATIC HEAD @ POINT 6

MWS @ RESERVOIR	= 1573'
GROUND ELEVATION POINT 6	= 1395'
STATIC HEAD	178'
FRICTIONAL LOSS RESERVOIR TO POINT 2 THROUGH 12" (FROM A.)	= -11.9'
FRICTIONAL LOSS POINT 2 TO POINT 6 THROUGH ~~10"~~ 12"	= -~~5.3'~~ 2.1'
PRESSURE HEAD @ POINT 6	= ~~160.8'~~ 164
	= ~~69.6~~ 71 PSI
ASSUME 10 PSI DROP THROUGH BACKFLOW PREVENTER	- 10.0
	~~59.6~~ PSI
	61 PSI OK

59.6 < 60 PSI ∴ NG, USE 12" MAIN POINT 2 TO 6.

→ 61 PSI > 60 PSI ∴ OK USE 12" MAIN FROM POINT 2 TO POINT 6 (LOCATION OF SERVICE LINE TO WESTSIDE PARK.

RECYCLE WATER STORAGE RESERVOIR SIZING
(SEE DESIGN STANDARDS APPENDIX H)

RESERVOIR SIZING BASED ON SUPPLYING
20% OF MDD FOR EQUALIZATION +
25% OF MDD FOR EMERGENCY STORAGE.

PHASE I MAX DAY DEMAND (MDD) = 535 GPM = 0.8 MGD

EQUALIZATION STORAGE = 0.8 x 0.20 = 0.16 MG
EMERGENCY STORAGE = 0.8 x 0.25 = 0.20 MG

→ ∴ PHASE I RECYCLE STORAGE = 0.36 MG

PACE ENGINEERING

Subject LAKEPORT

By BC Date 12/09

Sheet No. 5 of 5

Project No. 523.27

RECYCLE WATER PHASE 1 PUMP DESIGN

ASSUMED:

PUMPING RATE = MDD = 535 GPM

FINISHED RECYCLE WATER P.S. ELEVATION = 1380'

RECYCLE RESERVOIR MWS = 1573'

EFFECTIVE PUMP CAPACITY / 1 PUMP OUT OF 2 PUMPS.

CALCULATIONS

STATIC HEAD (FT) 1573 - 1380 = 193'

DETERMINE PIPELINE LOSES FROM PUMP STATION TO RESERVOIR

PIPE SIZE = 12"

PIPE LENGTH = 2,750

PIPELINE FRICTIONAL LOSES @ 535 GPM = 0.78'/1000'

TOTAL FRICTIONAL LOSES = 0.78 X 2.75 = 2.14'

ASSUMED MINOR LOSES @ PUMP STATION = 5.0'

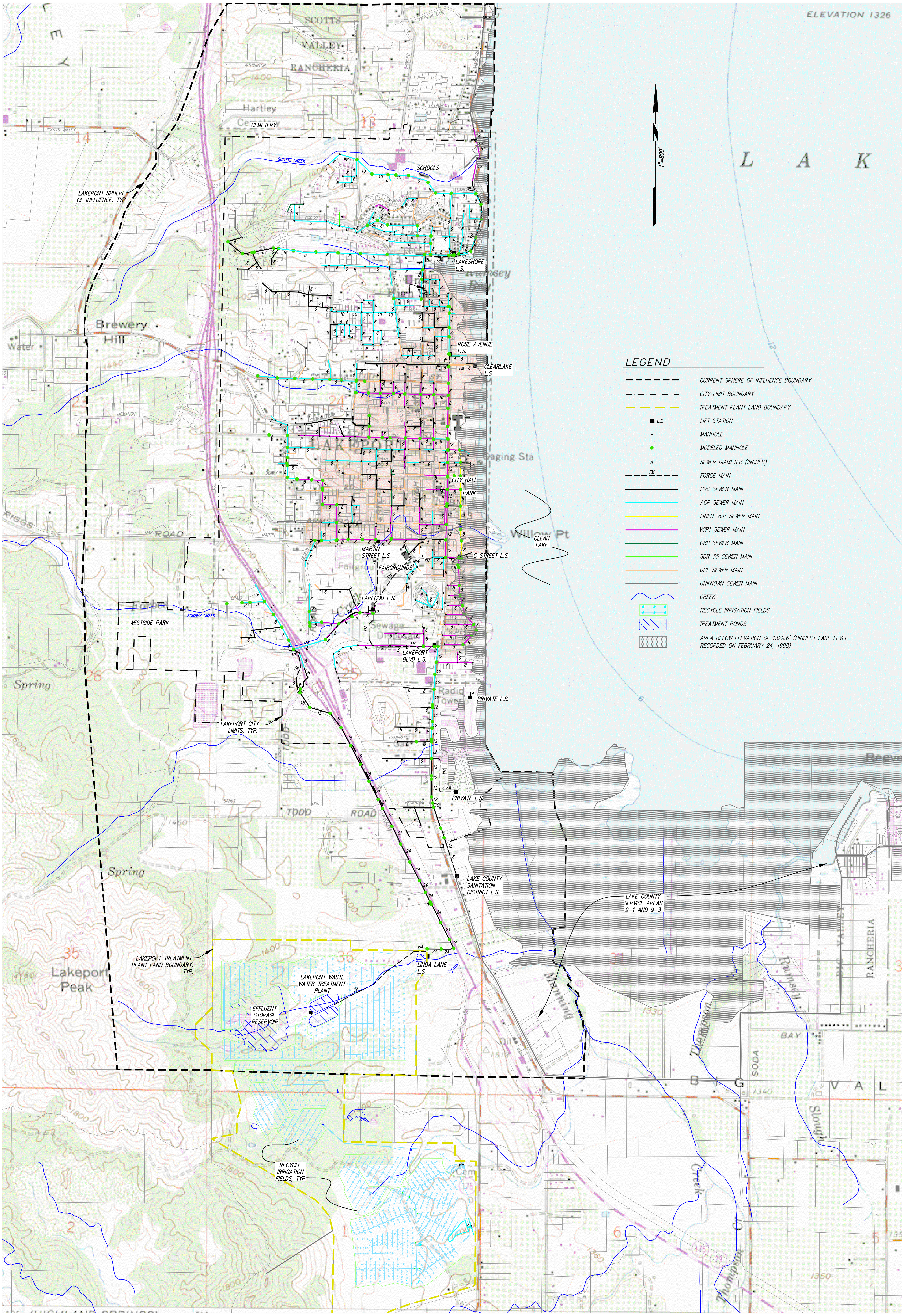
ESTIMATED TOTAL PUMP STATION HEAD = 193' + 2.14' + 5.0' = 200.1' SAY = 200'

→ ∴ PUMP SELECTION BASED ON

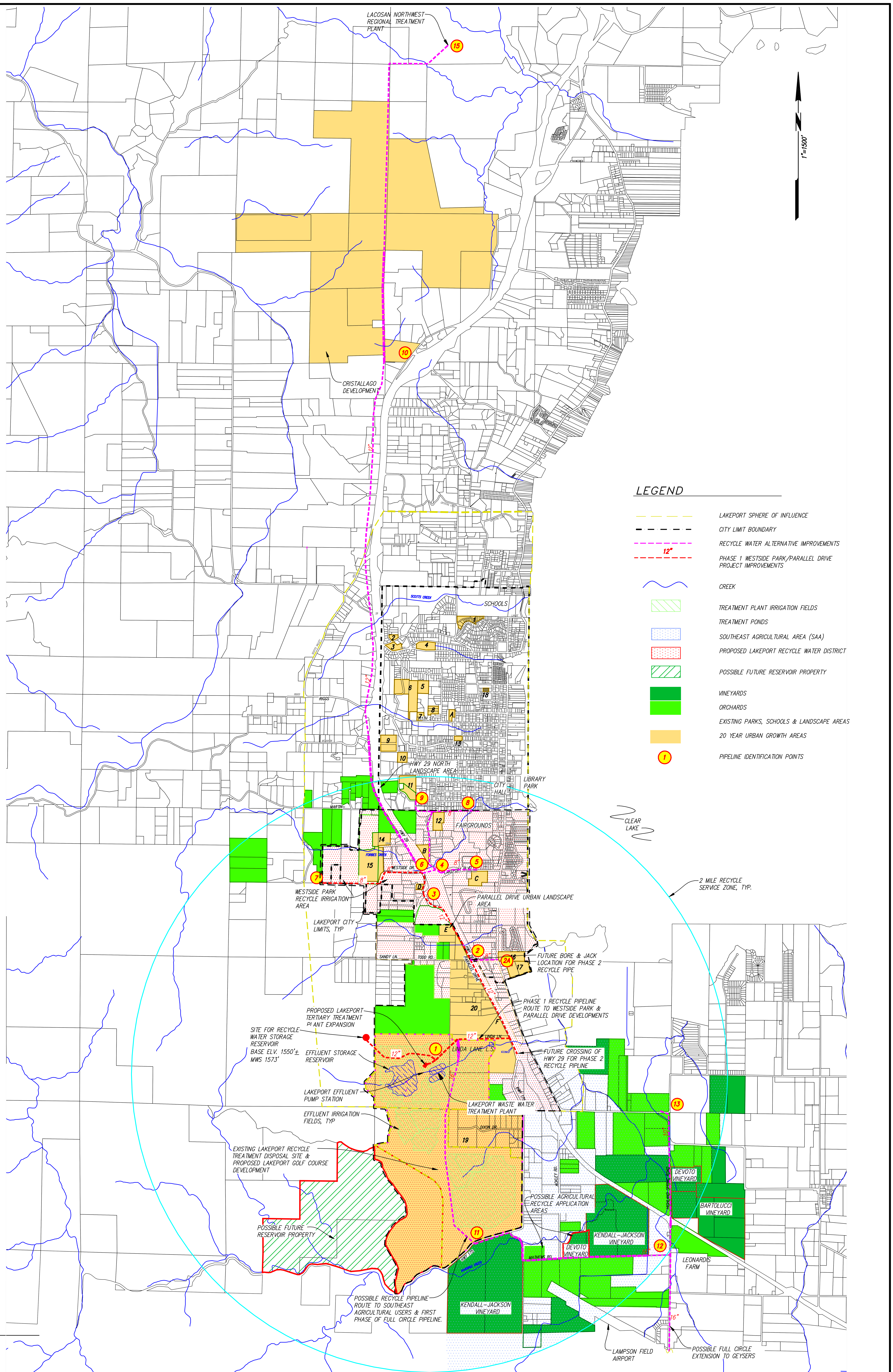
FLOW = 540 GPM

TDH = 200'

ESTIMATED PUMP HP = 40



DATE			PLATE
11/09	PACE ENGINEERING REDDING, CALIFORNIA	CITY OF LAKEPORT 2009 RECYCLE FEASIBILITY STUDY EXISTING SEWER & RECYCLE SYSTEM	1



DATE	PACE ENGINEERING REDDING, CALIFORNIA	CITY OF LAKEPORT 2009 RECYCLE FEASIBILITY STUDY REPORT POTENTIAL RECYCLE WATER MARKET AREAS & IMPROVEMENTS	PLATE
11/09			2