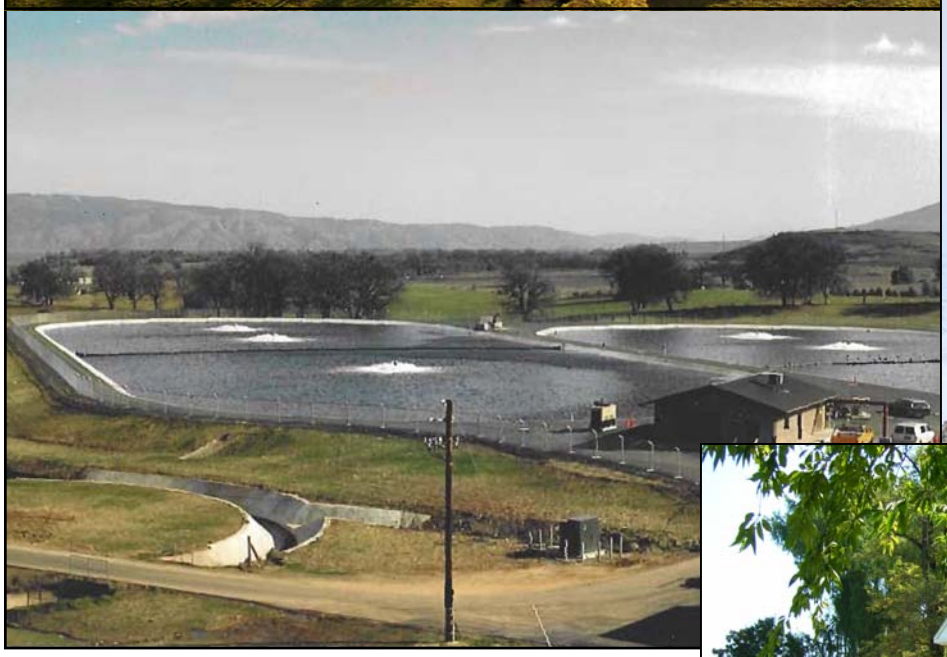
CITY OF LAKEPORT

2008 MASTER SEWER PLAN

JUNE 2008



PACE
CIVIL, INC.
REDDING, CA 96001

CITY OF LAKEPORT

2008 MASTER SEWER PLAN

FOR

CITY OF LAKEPORT

225 Park Street
Lakeport, CA 95453

JUNE 2008

Job No. 523.23

PACE
CIVIL, INC.
REDDING, CALIFORNIA

PACE
CIVIL, INC.

June 30, 2008

523.23

City Council
City of Lakeport
225 Park Street
Lakeport, CA 95453

Dear City Council:

Subject: City of Lakeport 2008 Master Sewer Plan

We are pleased to present our engineering report entitled:

CITY OF LAKEPORT
2008 MASTER SEWER PLAN

This report contains the results of our investigation of Lakeport's sewer system, including the sewage collection system, pumping stations, and wastewater treatment plant facilities. It includes conceptual plans, staging, and cost estimates for the major capital improvements that will be necessary as the City grows. Emphasis has been placed on the planning and staging of improvements necessary to correct existing deficiencies and to allow continued growth in the next 20 years.

A summary of the report, including our recommendations, follows the Table of Contents.

PACE Civil, Inc., is very pleased to have participated in this project. We thank your staff for their able assistance in its preparation. We will be happy to meet with you at your convenience to discuss the Master Sewer Plan in detail.

Sincerely,

Bruce A. Crom
Senior Engineer

BAC/MLW
Enclosures
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1730 SOUTH STREET • REDDING, CA 96001-1811 • (530) 244-0202 • FAX (530) 244-1978

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SUMMARY AND RECOMMENDATIONS

SUMMARY

Development of this Master Plan consisted of an engineering analysis of the Lakeport wastewater trunk system, lift stations, and treatment plant and what effects, current and future, wastewater flow conditions would have on each of these components. The wastewater collection system was analyzed using the H_2OMAP Sewer by MWHSoft computer program for wastewater flow determination and pipeline sizing. The analysis of the sewer system and treatment plant was accomplished with the cooperation and review of the City's Planners and Public Work's personnel.

Wastewater Collection System: The existing City of Lakeport wastewater collection system is shown on Plate 1. The City collection system consists of about 135,400 feet of collector sewer mains and 13,500 feet of interceptor sewers.

Based on current estimated peak wet weather conditions, it appears that the majority of the existing collection system has, in general, adequate capacity. However, several sewer segments within the existing collection system currently show some signs of moderate to severe surcharging during peak rain events and require further consideration for corrective action in order to increase sewer capacity (i.e., Main Street Sewer, 10th Street Sewer, etc.).

Portions of the existing City sewers are up to 60 years old and some of the collection system is made from clay pipe with cement mortar joints. Although the City has done significant infiltration and inflow (I&I) mitigation (i.e., video inspections, grout sealing, and replacement etc.) over the last 10 to 15 years, flows at the treatment plant can increase by seven times the average dry weather flows (ADWF) during peak rain events. Consequently, there is a significant I&I flow component that increases the wastewater flows at the City's treatment plant from an ADWF of about 0.38-million-gallons per day (MGD) during the summer to peak wet weather flows (PWWF) in excess of 2.8 MGD.

Sewage Lift Stations: There are presently nine public operated sewage lift stations in the City: Martin Street, Clearlake Avenue, Lakeshore Boulevard, Rose Street, C Street, Lakeport Boulevard, Lake County Lift Station No. 12, Lerrecou Lane, and Linda Lane Lift Stations. The Lake County Lift Station No. 12 is operated by the Lake County Sanitary District, but it discharges into the Lakeport collection system. The Lakeshore Boulevard Lift Station is the City's newest lift station and it discharges sewage into the Lake County Sanitary District collection system for treatment at the county treatment facilities.

The Clearlake Avenue Lift Station is a small lift station that is located within the flood plain of Clearlake. The small size of this lift station makes it difficult to access and it appears that some of the concrete manhole walls are showing signs of degradation (i.e., exposed aggregate) The station's wet well sits in the middle of Clearlake Avenue and is difficult to enter by City Utility Operators during routine maintenance. Additionally, the station's pumps and piping are antiquated and in need of replacement.

The Martin Street Lift Station wet well hatch needs rehabilitation due to corrosion. In addition, the hydraulic analysis suggests that the effective capacity (i.e., one sewage pump not operating) of this lift station may be deficient in the future due to estimated peak sewage flows.

Intermittent odor issues at the Linda Lane lift station have been noted by City personnel in the past and anticipated growth near this lift station in the future may exasperate this problem.

Effective monitoring and control of the major lift stations within the Lakeport collection system have been limited by the existing phone based communication alarm system and the lack of remote data acquisition.

Wastewater Treatment Plant: Based on the treatment plant water balance that was calculated for this Master Plan, it appears that the current Lakeport Wastewater Treatment Plant has an existing ADWF capacity of approximately 0.51 MGD. The design PWWF capacity of the plant is estimated at 3.0 MGD. The ADWF capacity is based on the treatment plants ability to store

and dispose of the annual effluent volume generated by Lakeport. Over the last 4 to 5 years, the summer ADWF has been estimated to be about 0.38 MGD. This is estimated to be about 75 percent of the current 100-year annual capacity of the effluent irrigation and storage facilities at the plant. Based on recent historical plant flows and the City's ongoing I&I reduction program, the estimated peak flow at the plant is roughly 2.8 MGD.

FUTURE SEWAGE FLOWS

The number of residential unit equivalents (RUEs) within the Master Plan study area is estimated to approximately 2,600. Based on the City's current general plan and proposed developments submitted to the City's planning department, it is estimated that over the next 20 years there will be a 1.1 percent growth rate equating to approximately 630 RUEs added to the City's wastewater collection system. Of these future RUEs, about 520 RUEs would be added to the City's main sewer area that is currently being served by the Lakeport treatment plant. This would result in an ADWF at the treatment plant of roughly 0.48 MGD at year 2028.

Existing and future I&I allowances were determined from analysis of recent flow-monitoring data and treatment plant wet weather flows. Although every effort has been made to assign reasonable I&I allowance values within the wastewater system, the flow-monitoring data was limited to only two negligible rain events in January 2008. **It is imperative that the City continue its flow-monitoring program in order to confirm that these estimated I&I allowances are valid.**

ANALYSIS AND RECOMMENDED IMPROVEMENTS

After reviewing the existing wastewater system deficiencies under current conditions, the wastewater collection system was analyzed under 2028 conditions. The primary improvement requirements defined by this analysis are as follows:

1. The City should focus its comprehensive I&I reduction program within the I&I target areas that was defined during wet weather monitoring in January 2008. The first stage of the program would involve having City crews continue to investigate and identify I&I sources within these target area. The second stage would involve rehabilitation and repair. The City's I&I staff should continue the flow-monitoring program that was developed as part of this Master Plan study in order to provide reliable data for verification of the estimated flows, as well as provide flow information needed for evaluating the ongoing I&I reduction program.

2. Parallel or replace existing sewers in order to relieve current or impending surcharging and possible blockages and; provide sufficient sewer capacity for the projected 20-year conditions. In some areas where I&I flows are extremely high or the sewers are in poor condition or where there is not enough room to install parallel sewers, it may be necessary to replace existing sections of sewer instead of adding a parallel relief sewer.
3. Renovate existing lift stations that are inefficient and are considered to have operational deficiencies.
4. Modify and improve the City's Wastewater Treatment Plant facilities in order to increase PWWF capacity of the chlorine contact pipeline to 3.4 MGD. Repair the aeration basin dikes and remove sludge to restore capacity. Replace the gas chlorine system with a hypochlorite system to increase safety at the plant and the surrounding areas.

Infiltration and Inflow Control: The proposed Master Plan assumes future I&I reductions will be made in the next 10 to 20 years. The flow projections developed for this Master Plan are based on the City achieving a net decrease in current I&I of about 0.94 MGD over the next

20 years. Phase 1 of this reduction program would be a continuation of the City's I&I reduction efforts focused within the I&I Target Areas shown on Plate 2. It would involve video inspection of sewers, mains, and laterals, as well as manhole inspections and inventory, smoke testing, and analysis of collected data. Emphasis should be placed on those areas nearest to the lake where flooding occurs over the public and private collection system. Once sewer defects are identified within the system, the repair and rehabilitation stage would be implemented. The repair and rehabilitation stage would involve such things as grout sealing, lining, and replacement of leaking sewers and laterals, and manhole repair or replacement. The estimated cost for addressing I&I in the Target Areas is approximately $1,976,000 and would have the potential for reducing about 0.9 MGD of existing I&I from the sewer system.

Sewer System Improvements: Analysis of the existing sewer trunk system indicates that the majority of the system has adequate capacity for the next 20 years, given the City's growth rate of 1.1 percent and provided that the City's I&I mitigation efforts continue. However, the analysis and past observations by City staff show that some sewer segments of the existing sewer along Main Street from 10th Street to C Street are at capacity during peak wet weather conditions. It is recommended that some of these Main Street sewer segments be replaced or paralleled with new sewer segments within the next 5 to 10 years starting with the 8-inch sewer between 6th Street and 10th Street. The analysis also suggests that existing segments of 8-inch sewers along 10th Street and Lakeshore Boulevard (see Plate 2) may also reach capacity during peak wet weather conditions and may experience surcharging. The analysis recommends that these segments be paralleled with 8-inch sewers.

Existing sewers along Martin Street, Russell Street, and Berry Street appear to have moderate surcharging during current peak flows. The City's I&I reduction efforts should reduce flows through these sewers and diminish surcharging. It is recommended that the City perform further wet weather monitoring of these sewers. If it is determined that significant surcharging is occurring in these sewers, paralleling of these pipelines needs to be performed over the next 20 years. Other improvements include the replacement of the Clearlake Avenue Lift Station and improving the lift stations communication data acquisition systems.

Potential As Developed (AD) trunk sewers and lift stations are also shown on Plate 2 for the currently undeveloped Southern Development Area (SDA). The SDA is a speculative development that may involve the construction of over 1,500 single family households. A significant portion of the SDA encompasses converting the City's existing treatment plant into a golf course. These AD sewers are not included in the general sewer improvement category because they would normally be constructed as development occurs.

Wastewater Treatment Plant: The water balance that was created for this Master Plan suggests that the current effluent reservoir and irrigation deposal system at the treatment plant has an effective capacity to treat 0.51 MGD ADWF during a 100-year annual rain event. Based on this, the City's continued I&I reduction efforts, and a 1.1 percent growth rate, it appears the effluent reservoir and disposal facilities at the treatment plant have capacity for at least the next 20 years.

Recommended Improvements at the treatment plant would include the repair of the aeration basin slopes over the next 10 years. This repair is meant to correct erosion of the aeration basin earthen slopes and will require that during alternate years, each aeration basin be taken out of service and dried so that additional slope protection can be installed. Concurrently, it is recommended that while the aeration basins are out of service the City remove the accumulated sludge that has been collecting at the bottom of the ponds. This sludge, estimated at between 12 and 24 inches deep, diminishes the effective volume of these basins. It is suggested that this sludge could be dried on site; and then either applied on City land, or disposed of at an approved landfill.

The existing 16- to 48-inch chlorine contact pipe has a peak contact time of around 30 minutes at 3.0 MGD. Currently, it is estimated that peak flows at the plant are roughly 2.8 MGD however, growth over the next 20 years will probably increase peak flows to 3.3 to 3.4 MGD based on the City continuing to implement an aggressive I&I reduction program. Therefore, in order to re-establish the maximum volume within the chlorine contact pipe, the City should have the pipeline inspected and if it is determined that significant sediment has collected, have the pipeline cleaned. Ultimately, additional capacity will be needed in the chlorine contact pipeline

and it is proposed that a parallel 20-inch pipeline be constructed within the next 10 to 20 years to keep up with future peak flows.

Finally, the California Accidental Release Prevention Program (CALARP) has been implemented by the Lake County Environmental Health Department, requiring that the City prepare and submit a Risk Management Plan for all City facilities that use chlorine gas for disinfection. The CALARP Program was established in California to prevent accidental releases of those substances determined to potentially pose the greatest risk of immediate harm to the public and the environment. Although the City has had an excellent safety record in handling chlorine gas at their treatment plant, it is evident that the use of large quantities of chlorine gas near residential developments is coming under closer scrutiny at the County, State, and Federal level. Given this increased level of County involvement, and the safety of City workers and the public, Lake County Environmental Health Department has requested that the City evaluate its chlorine handling processes at the treatment plant and consider replacing the gas disinfection processes, in the near future, with a safer method of disinfection (e.g., sodium hypochlorite). In order to accommodate this goal, it is recommended that within the next 5 years the City consider switching from chlorine gas to a hypochlorite system at the treatment plant.

Master Plan Key Elements and Costs: The total cost for all sewer system general improvements (i.e., I&I Reduction Programs, upgrading existing collection system and lift stations, and future treatment plant improvements) is approximately $5,006,000 of which about $1,087,000 is needed in the next 5 years. The Master Plan of Improvements needed to correct existing sewer system deficiencies and to provide anticipated future capacity for 20-year development is shown on Plate 2 and Figure 2 at the end of this report. Plate 2 includes the sizes of future AD sewers needed to serve the outlying areas. A summary of the costs and recommended staging of sewer system and treatment plant improvements is shown in Table 14.

Table 14 along with Plate 2 and Figure 2 are in essence, the 2008 Master Sewer Plan. The sewer improvements shown in this Master Plan, and their proposed construction periods, are based on the computer model developed for the trunk sewer system and observed sewer deficiencies. As indicated hereinbefore, the I&I rates used in this model are based on limited flow-monitoring

information. Consequently, it is recommended that the City continue to pursue wet weather I&I monitoring before major expenditures are made on sewer capacity increases. The future improvement design process should include additional wet weather studies to confirm upstream I&I rates. In general, no inadequately sized sewer should be replaced or paralleled with a new relief sewer until it is either demonstrated that overflows or lateral flooding is imminent under very wet weather conditions or the sewer is shown to be poorly constructed and there is a potential for sewer blockage. Since the computer model only flags trunk sewers that are inadequately sized by normal standards with moderate surcharge taken into account, it is quite possible that some of the proposed sewer construction can be postponed by allowing greater surcharges to occur. Such sewers will require more constant monitoring during wet weather periods. Also, it is possible that subsequent flow measurements during very wet weather periods will show that some of the sewers improvements flagged for construction may be unnecessary if future I&I rates are actually lower than these Master Plan estimates. Because of the potential for postponement of some sewer construction and elimination of others shown in the Master Plan, it is likely that the construction costs in the long term may be lower than listed in the expenditure forecast.

The projected improvement costs for the Master Plan are as follows:

Time Period	I&I Reduction Program	General Gravity Sewer System Improvements	Wastewater Treatment Plant Improvements	Total
2008-2013 Near Term	$450,000	$262,000	$405,000	$1,117,000
2013 -2018 Intermediate Term	$564,000	$1,660,000	$200,000	$2,424,000
2018 -2028 to Long Term	$962,000	$333,000	$170,000	$1,465,000
GRAND TOTAL				$5,006,000

These figures are based on June 2008 dollars and do not include any allowance for inflation or financing costs.

The conceptual location and size of the new trunk sewers that will be needed to serve future developments are also shown on Plate 2, although they are not listed in Table 14 as general improvements. The City may want to consider contributing to the cost of oversizing sewers in

new developments, where such sewers are necessary for service to an area larger than just that development. This policy could lead to an orderly expansion of the sewer system in the future.

It is recommended that the City review this Master Plan report carefully, and if in agreement, that it be adopted as the City of Lakeport Master Sewer Plan, with any corrections or supplements as may be applicable.

INTRODUCTION

HISTORY

In September 2006, the City of Lakeport authorized PACE Civil, Inc., to work jointly with the City staff to prepare a Master Sewer Plan. The emphasis of this Master Plan was to review and analyze the existing sewer system and treatment plant and recommend improvements needed to handle potential development over the next 20 years. Plate 1 shows the City's 2008 existing sewer collection system. Plate 2 shows the location of the anticipated developments over the next 20 years (i.e., 2008 to 2028), including a conceptual sewer collection system at 2028 to serve anticipated growth. The findings of this evaluation of the wastewater collection system and the City's wastewater treatment plant are presented herein and make up the 2008 City of Lakeport Master Sewer Plan.

SCOPE OF WORK

The study area for the 2008 Master Sewer Plan is shown on Plate 2. This study reviews the current wastewater system and recommends improvements required over the next 20 years, with wastewater flow projections and main line sewers sized for potential 20 year flows; furthermore, the wastewater treatment facility, located south of Lakeport, was reviewed to determine what improvements are required to treat future wastewater flows generated from anticipated growth.

ABBREVIATIONS

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

ABM	Air blown mortar
ACFT	Acre foot
AD	As Developed
ADWF	Average dry weather flow. This is the average rate of wastewater flow during the summer months.
BOD	Biochemical Oxygen Demand
CALARP	California Accidental Release Prevention Program
CCTV	Close circuit television
CLMSD	City of Lakeport Municipal Sewer District
COL	City of Lakeport
EPA	Environmental Protection Agency
ETo	Evapotransport
GPAD	Gallons per acre per day
GPCD	Gallons per capita per day
GPD	Gallons per day
GPM	Gallons per minute
HP	Horsepower
I&I	Infiltration and inflow
LAFCO	Local Agency Formation Commission
LS	Lift Station
MG	Million gallons
MGD	Millions gallons per day
MPN	Most probable number
PDWF	Peak dry weather flow
PLC	Programmable logic controller
PPD	Pounds per day
PSI	Pounds per square inch
PWWF	Peak wet weather flow. This is the highest wastewater flows anticipated by a 10-year storm event.
RUE	Residential Unit Equivalent
CRWQCB	California Regional Water Quality Control Board
SCADA	Supervisory Control and Data Acquisition
SDA	Southern Development Area (development areas F, 19, and 20 Plate 2)
STEP	Septic Tank Effluent Pumping
SS	Suspended solids
USGS	United States Geologic Survey
WWTP	Wastewater Treatment Plant
WWF	Wet Weather Flow

SEWER SYSTEM REVIEW

The City of Lakeport Municipal Sewer District (CLMSD) owns and operates a wastewater collection and treatment system that serves the City and a minor portion of Lake County. A plan of the City of Lakeport wastewater collection system and treatment plant is shown on Plate 1 and Figure 2. Plates, figures, and tables are located at the end of the report.

WASTEWATER COLLECTION SYSTEM

.In 2008, the City of Lakeport Sewer System consisted of about 135,400 feet of collection sewers and 13,500 feet of 12- to 15-inch main interceptor sewers. In addition, there are over 540 manholes within the sewer collection system. Collection sewers are generally 6 to 10 inches in diameter and are used to collect wastewater from the building laterals. A significant amount of the collection sewers in the Lakeport system are 4-inch diameter (approximately 18,000 feet) pipe. The main branches of the collection system, typically called trunk or interceptor sewers, are 12-inch and larger sewer pipes, convey the wastewater to the treatment facility. The City of Lakeport's sewer piping materials consist of vitrified clay, Orangeburg, asbestos-concrete, plastic, PVC, and other assorted materials. Plate 1 shows the current Lakeport wastewater collection system.

As with any sewage collection system that has been in existence for over 60 years, there is a tendency for leakage into the sewer piping and manholes from groundwater, storm water run-off, and lake water in the case of the Lakeport system. Plate 1 indicates the recorded maximum Clear Lake water elevation (i.e., elevation 1329.7 feet recorded in February 1998) and the location of the City's collection system.

Leakage of unwanted water into the City's collection system is referred to as infiltration and inflow (I&I) and is a problem that the City of Lakeport has had to deal with for many years. I&I is a concern because it decreases the ability of the collection system to transmit sewage, it reduces the volume of the City's treatment plant effluent storage facilities, and it requires that the

City expend a significant amount of money in pumping and treating, what is in essence, large volumes of clean water.

In an effort to try and reduce this I&I load on the system, the City has performed several rehabilitation projects throughout its history:

- A sewer system evaluation survey of the Lakeport sewer system was performed by Gillett-Harris-Duranceau Associates in 1976. This survey included smoke testing of the collections system to determine sources of inflow, comprehensive manhole inspections to identify I&I defects, video inspecting over 15 percent of the City's sewers, and some flow monitoring. From this study, several areas of the City's collection system were identified for rehabilitation work.
- In 1979 the City performed an extensive rehabilitation program made up of sewer reconstruction, sewer video inspection, and grout sealing of sewer joints. These improvements were based largely on the 1976 study discussed above.
- In 1991 to 1992 the City performed an I&I analysis of the entire sewer system. This analysis involved smoke testing of the collections system to determine sources of inflow, manhole inspections, and wet weather flow monitoring. From this comprehensive analysis, several areas within the collection system were identified as having moderate to severe I&I.
- Using the 1991 and 1992 I&I study discussed above, the City preformed a major collection system rehabilitation project in 1993 and 1994. This project involved video inspecting, testing, and grout sealing approximately 38,000 feet of main line sewer, and replacing 8,200 feet of 6-inch to 10-inch main sewer as well as 3,100 feet of 3-and 4-inch lateral sewers within the right-of-way areas. In addition, the City also expanded the C Street pump station with upgrades to the pumps, control equipment, and the control building. This upgrade also included the raising of the pump station wet well hatch 2 feet above the historical maximum lake level of 1329.6 feet.

Implemented in 2003, the City has an ongoing I&I reduction program and staff dedicated to reducing or eliminating I&I within the collection system. The City's I&I efforts have included:

- Aerial mapping of the city including GIS mapping of the collection system.
- Inventory of all sewer utilities (i.e., manholes, sewer sizes, etc).
- GIS utility atlas provided to field crews for constant update.
- Completion of City Sewer Spillage Geodatabase.
- Purchase of flow meters for sewage lift stations, 2004
- Installation of 44 sewer manhole covers, 2005
- Routine internal close circuit television (CCTV) inspection of all gravity sewer main lines and some laterals using City owned CCTV equipment.
- Systematic smoke testing to identify open clean outs, leaking manholes, and damaged sewers in areas prone to high I&I and flooding.
- Identification, documentation, repairs, and enforcement of damaged and illicit connections to the gravity sewer system.
- Scheduling of maintenance, restoration, and replacement of damaged sewers and laterals.
- Physical assessment, photographing, and cataloging of all sewer manholes within the Lakeport collection system.
- Rehabilitation of over 50 deteriorating manholes and lids from 2004 to 2006. Purchase and installation of leak proof manhole covers on a significant number of manholes throughout the system.

In addition, CLMSD is evaluating additional programs, such as creation of a Sewer System Management Plan, Overflow Emergency Response Program, FOG Control Plan, Capital Improvement Plan, and Hydraulic Capacity Estimates. Annual expenditures for I&I reduction efforts within the City of Lakeport, from 2004 to 2007, have averaged approximately $225,000 per year.

SEWAGE LIFT STATIONS

Due to the City's topography, generally sloping from west to east, the majority of the existing service area is served by gravity flow to several lift stations located at or near Clear Lake. Most the City's lift stations collect the raw sewage from the collection system and pump it to both the Larrecou and the Linda Lane Lift Stations, which are the main lift stations that pump raw sewage

to the City's wastewater treatment plant. The lift station locations and zones of service are shown on Figure 1 and their design capacities are summarized in Table 1.

C Street Lift Station: In 1993, the lift station was rehabilitated by installing new submersible pumps, upgrading the electrical controls, and increasing the height of the wet well lids to elevation 1331.7, which is 2 feet above the historical maximum lake level. The lift station consists of an 8-foot diameter wet well that contains two rail-mounted 47-HP submersible pumps that have an effective capacity of 1,100 gallons per minute (GPM).

The C Street controls are housed in a block control building next to the wet well. This building also houses the dedicated diesel generator for emergency use. Level control within the wet well is accomplished by using a sonic transducer and redundant float switches. The City recently installed a magnetic flow meter on the stations force main to better monitor flows coming from the lift station.

This lift station is considered to be one of the City's major pumping faculties serving approximately 711 residential unit equivalents (RUEs) and collecting sewage from Main Street, Park Avenue, and Esplanade Avenue (see Figure 1). Discharge from this lift station is pumped directly to the Larrecou Lift Station via an 8-inch force main.

Lakeshore Boulevard Lift Station: The lift station was constructed in 2005, making it the City's newest lift station. It was constructed to replace the Ashe Street Lift Station, which was outdated and unreliable. The Lakeshore Boulevard Lift Station consists of two 10-HP rail-mounted submersible pumps, contained in a 6-foot diameter wet well. Sewage from this lift station can either be pumped to the City of Lakeport collection system or the Lake County sewage collection system. Since 2002, all flows collected in the old Ashe Street lift station and the new Lakeshore Boulevard lift station have been pumped to the Lake County collection system. The effective capacity of the pumping facility is approximately 520 GPM. This lift station serves approximately 600 RUEs within the City of Lakeport and is considered to be one of the major lift stations within the City system.

The controls are housed in a wood framed control building next to the wet well and include: telephone based telemetry system for transmitting the lift station's alarms and a programmable logic controller. This building also houses the dedicated 40 kW diesel generator and automatic transfer switch for operating the lift station during power outages and other emergencies. Level controls within the wet well are accomplished using a conductive liquid level probe and redundant float switches. Flow is monitored using a 6-inch magnetic flow meter contained in a separate vault.

Clear Lake Lift Station: The lift station consists of a 4-foot diameter wet well and two 1-HP submersible pumps. The wet well is located within Clearlake Avenue, next to the Skylark Shores Motel. The lift station serves the motel and several single family homes and has an effective capacity of about 120 GPM. The close proximity of the lift stations wet well to the shore of Clear Lake and the poor construction of the wet well manhole makes this lift station prone to I&I due to high ground water and localized flooding during high lake levels (i.e., the rim elevation of the wet well is below the maximum lake level elevation).

Electrical controls are contained next to the wet well in a stand-alone electrical panel. The electrical control panel uses electrical relays to operate the lift station. Operation of the pumps is controlled by float switches within the wet well. The lift station pumps sewage to the gravity collection system on Main Street via a 4-inch force main. The alarm system is monitored via phone lines connected to the City's emergency response system.

A field investigation of this facility noted the following:

- Inspection and/or repair of wet well equipment, including the submersible pumps, require that City operators use confined space entry techniques to enter the wet well. Confined space entry procedures are required when there is the potential of injury or death to the person having to enter the wet well to make repairs.
- Access for maintenance and repair of the existing pumps within the wet well is difficult because of cramped space and the lack of a pump rail system for removing pumps from the surface.

- The concrete wet well is in poor condition with exposed aggregate around the wet well walls.
-

Rose Avenue Lift Station: This is a wet well style lift station that serves approximately 90 RUEs along Main Street between Rose Avenue and 16th Street. The lift station consists of a 6-foot diameter wet well that is located within Main Street. Two submersible sewage pumps, each with an effective capacity of 500 GPM, are installed. The pumps are on rails and can be removed from the wet well by operators using a truck mounted wench and boom. Level control within the wet well is performed using an ultra sound level transducer and redundant float switches. The lift station discharges to the gravity sewer system on North Main Street.

The electrical controls are housed within a lockable control panel next to the wet well between the sidewalk and curb. The electrical controls include a programmable logic controller, generator receptacle, and manual transfer switch for emergency operation of the lift station during power outages. Alarms at this lift station are transmitted via telephone to the City's operators.

The City of Lakeport and Lake County have been negotiating to have the Lake County Airport (Lampson Field) sewage pumped directly to the City of Lakeport wastewater treatment plant. In return to serving the airport, it has been agreed that sewage flows from the Rose Street Lift Station would be re-routed to the Lake County Treatment Plant via the Lakeshore Boulevard lift station. Although it is unclear when this "service swap" will take place, it is anticipated that it will occur within the next 10 to 20 years and it is assumed that the estimated sewage flows from the airport will equal flows from the Rose Avenue Lift Station.

Lake County Lift Station: The Lake County Lift Station (Lift Station No. 12) is located along south Main Street. As the name indicates, this lift station it maintained and operated by the Lake County Sanitation District, serving County Areas 9-1 and 9-3. Discharge from this lift station is through a 6-inch force main and enters the Lakeport collection system along Main Street south of Peckham Court. It is anticipated that this lift station's operation and maintenance will be

become the responsibility of the City of Lakeport once the area that the lift station is located in is annexed into the City within the next 3 to 4 years.

The lift station consists of a 6-foot wet well and two rail-mounted 10-HP submersible pumps with an estimated effective capacity of 450 GPM. The lift station currently serves approximately 180 RUEs.

Martin Street Lift Station: This lift station is one of the oldest sewage lift stations in the Lakeport system. It consists of a 6-foot diameter wet well that is located along Martin Street and serves approximately 240 RUE's west of Ester Street. Two rail-mounted submersible sewage pumps, each with capacity of 420 GPM, are installed. Level control within the wet well is performed using float switches. Field observations indicate that the existing wet well steel hatch is corroded and needs rehabilitation.

The electrical controls are housed within a lockable control panel next to the wet well. The lift station controls contain a manual transfer switch for connecting a trailer-mounted generator to operate the lift station during power disruption.

Alarms at this lift station are transmitted via telephone to the City's Fire Department emergency operator. The lift station flows are monitored using a magnetic flow meter within an on-site vault and all flows are pumped directly to the Larrecou Lift Station via an 8-inch force main. The lift station has a gravity overflow system such that if pumps are not in service flows can be diverted to the C Street Lift Station via the Martin Street and Main Street gravity sewer system.

Lakeport Boulevard Lift Station: This is a wet well style lift station that serves approximately 780 RUEs along Lakeport Boulevard and south Main Street. The lift station consists of a 6-foot diameter wet well that is located in a parking lot at the intersection of Main Street and Lakeport Boulevard. Two rail-mounted submersible sewage pumps, each with an effective capacity of 1,000 GPM, are installed. The pumps are on rails and can be removed from the wet well by City operators using the City's truck-mounted wench and boom. Level control within the wet well is performed using float switches.

The electrical controls are housed within a lockable control panel next to the wet well, behind the sidewalk. The controls include a generator receptacle and a manual transfer switch for emergency operation using the City's trailer-mounted generator. The existing controls are relay based.

All alarms generated at this lift station are transmitted as a common alarm via telephone to the City's Fire Department emergency operator who notifies the "on-call" City operator to respond. The lift station operation is not monitored via the City's SCADA and radio telemetry system. Recently, the City installed a magnetic flow meter to this lift station to monitor flows. The pump station pumps directly to the Larrecou Lift Station via a 6-inch force main.

Larrecou Lane Lift Station: The lift station was constructed in 1991, as a part of the treatment plant expansion. The Larrecou Lift Station consists of three 47-HP rail-mounted submersible pumps contained in three separate 6-foot diameter wet wells. There is also a 6-foot screening manhole up stream of the wet wells that traps large diameter debris (i.e., 3-inch and larger) from entering the wet wells and damaging the pumps. The Larrecou Lift Station is considered to be a major lift station serving approximately 2,000 RUEs within the City. Currently, all flows collected in this lift station are pumped to the Linda Lane Lift Station at the treatment plant via the 8-inch force main and 15- to 24-inch Parallel Drive gravity sewer. The effective capacity of the pumping facility is approximately 2,200 GPM (i.e., 3.2 MGD) with two of the three submersible pumps operating.

The controls for this lift station are housed within the adjacent old wastewater treatment plant control building. The state of the art controls contain SCADA and phone based telemetry system for remotely monitoring the lift station's operations and a programmable logic controller. This building also houses the dedicated 40 kW diesel generator and automatic transfer switch for operating the lift station during power outages and other emergencies. Level controls within the wet well are accomplished using an ultrasound sonic-level transducer and redundant float switches.

Linda Lane Lift Station: Is identical to the Larrecou Lift Station and was also constructed during the expansion of the treatment plant in 1991. The Linda Lane Lift Station consists of three 47-HP rail-mounted submersible pumps contained in three separate 6-foot diameter wet wells. There is also a 6-foot screening manhole up stream of the wet wells that traps large diameter debris (i.e., 3-inch and larger) from entering the wet wells and damaging the pumps. The Linda Lane Lift Station is a major lift station pumping all of the City's sewage directly to the headworks at the wastewater treatment plant. The effective capacity of the pumping facility is approximately 2,600 GPM (3.74 MGD) with two of the three submersible pumps operating.

Odor control at this lift station is via a small blower and vent piping that evacuates air from the wet wells and blows it through activated carbon canisters next to the lift station control building. In addition, chlorine can be injected via the treatment plant chlorine system to the screening manhole at the lift station. City staff indicates that localized odor problems due to excess hydrogen sulfide within the wet wells has been a concern in the past.

The controls for this lift station are housed within a control building adjacent to the wet wells. The controls contain SCADA, radio telemetry, and a programmable logic controller. The control building also houses the dedicated 40 kW diesel generator and automatic transfer switch. Recently, the City replaced the sonic flow meter at the lift station with a new magnetic flow meter in order to monitor daily flows.

All of the City operated lift stations are provided with high wet well level alarms and power outage alarms that send a telephone signal to the City's Fire Department. In turn, the City's Fire Department notifies the City's on call operator of the nature of the failure. Furthermore, all lift stations that do not have a dedicated generator are equipped with manual transfer stations, which allow the City's portable generators to be safely connected to lift stations during a power failure.

WASTEWATER TREATMENT PLANT

The City's original treatment plant, 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 a effluent reservoir for use as irrigation. 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 average dry weather flow (ADWF) treatment capacity of about 1.0 million gallons per day (MGD) and a PWWF capacity of approximately 3.0 MGD. The treatment plant is considered to be a secondary treatment facility.

Processes: The unit processes of the treatment plant consist of headworks with a mechanical screen, two earthen aeration basins, an effluent pump station, 48-inch diameter chlorine contact pipe, effluent reservoir, irrigation pumping station, and effluent irrigation fields. Most processes at the treatment plant are automatically controlled by a programmable logic controller (PLC) that is located within the treatment plant control building.

Headworks: The headworks is a concrete structure with both manually cleaned and mechanically cleaned barscreens. The mechanically cleaned barscreen consisting of a motor driven stainless steel belt that is activated on a timer that moves the trapped screenings into a trash dumpster for disposal at a local landfill. The manual barscreen is used only if the mechanical barscreen is not functioning, such as in a power outage, and as the name suggests, has to be manually cleaned. The headworks has a high-water alarm that activates when water levels reach 2-feet from the top of the headworks wall.

Aeration Basins: Wastewater flows from the headworks into the two 11.8-million-gallon aeration basins. The aeration basins are about 15-feet deep and are constructed of earth with an air blown mortar (ABM) slope protection at the normal water level (the ABM apron is about 7 feet deep from the top of the dike). The wastewater detention time within each aeration basin at 1 MGD plant flow is approximately 24 days.

The influent from the headworks enters the bottom of the aeration basins where the settleable solids drop out and are spread over the bottom. These solids remain on the bottom where they can be further decomposed by anaerobic processes. It is estimated that every 8 to 10 years the accumulated solids (i.e., sludge and grit) at the bottom of the aeration basins need to be removed in order to restore the basins designed detention time. Removal of solids is accomplished by dredging of the ponds.

The aeration basins are divided into two equally sized cells (i.e., Cell 1 and 2) by a geo-fabric baffle curtain. Each pond is equipped with three 20-HP floating aerators, two aerators in Cell 1 and one aerator in Cell 2. The aerators provide two functions: they transfer oxygen into the basins required by the biological oxidation reactions, and they provide the mixing required for dispersing the oxygen and for contacting the reactants (that is oxygen, wastewater, and microbes). The aerators are controlled by timers within the control building.

Effluent from Cell 1 passes through an opening in the center baffle curtain to Cell 2. Cell 2 has one floating aerator and is quiescent at the discharge end to allow the suspended solids (SS) to settle out prior to discharge to the effluent pumping station.

Over the past several years, operators at the treatment plant have observed that due to wave and wind action, the earth below the 7-foot deep ABM apron has begun to erode causing undermining of the ABM apron along the aeration pond slopes. The worst slope erosion appears to be located around the aeration basin access ramps. Although the City has implemented temporary measures to try and slow this undermining of the ABM (i.e., reinforcing the ABM and placing temporary concrete fill under the ABM), the continued degradation of the slopes due to this erosion could possible cause further damage of the ABM slope protection and may lead to dike failure if left unchecked.

Effluent Pump Station: The effluent pump station consists of a wet well, three 20-HP vertical turbine pumps, and a flowmeter. The effluent pump station has an effective pumping capacity of approximately 3.5 MGD. Flow from each aeration basin enters the pump station from a screened

aeration basin outlet structure where it is pumped to the effluent reservoir via a 16-inch to 48-inch chlorine contact pipe.

Effluent Force Main and Chlorine Contact Pipe: The force main/chlorine contact pipe convey-treated effluent from the effluent pump station to the storage reservoir. This pipe is approximately 1,250 feet long (i.e., 600 feet of 16-inch and 650 feet of 48-inch pipe) and is constructed of 16-inch diameter PVC pipe. The 48-inch chlorine contact pipe is cement–lined, coated, welded steel pipe. The force main and the chlorine contact pipe provide the necessary flow detention for disinfection prior to discharge into the storage reservoir. The force main/chlorine contact pipes are designed to allow a 30 minute chlorine contact time at a peak design wet weather plant flow of 3.0 MGD.

Treatment Plant Chlorine Facilities: The treatment plant chlorine system is made up of two 1-ton chlorine gas cylinders that are stored in the chlorine storage room at the treatment plant control building. The chlorine storage room is ventilated and also contains a chlorine leak detector that activates local alarms at the plant when it detects concentrations of chlorine above one part per million. The 1-ton cylinders are transported to and from the treatment plant via trucks and are loaded and unloaded into the chlorine storage room via dedicated electric hoist.

The chlorine system also contains three chlorinators that are used to inject chlorine solution to different treatment plant processes. Two of the chlorinators have a maximum 400 pounds per day (PPD) capacity and the third chlorinator has a 200 PPD capacity. The No. 1 chlorinator serves to disinfect effluent at the effluent pumping station. The No. 2 chlorinator is used for irrigation chlorination and the No. 3 chlorinator is used for odor control at the Linda Lane Pump Station.

The chlorination system at the treatment plant serves three purposes:

- Used to pre-chlorinate the Linda Land Pump Station for odor control.
- Chlorinate effluent at the irrigation pump station prior to sprinkler irrigation.
- Effluent disinfection into the storage reservoir.

Chlorination of the effluent prior to entering the effluent reservoir is required in order to maintain an average monthly effluent Coliform level of 23 MPN that is mandated by the CRWQCB waste discharge permit (see Appendix A). Operators' report that, based on maintaining a 5 mg/l chlorine residual at the discharge of the chlorine contact pipe, current effluent chlorine dosage rates range from 90 to 120 pounds per day in the summer and 100 to 150 pounds per day during the winter months.

Disinfection of the effluent prior to irrigation is not required but it is recommended in order to protect treatment operators. Pre-chlorination of the Linda Lane Pump Station is only required as needed to control odors at the pump station and headworks.

Recently, the Lake County Environmental Health Department has requested that the City prepare a Risk Management Plan for all City facilities that use chlorine gas for disinfection. This Risk Management Plan is a part of the new regulations for the California Accidental Release Prevention Program (CALARP). The CALARP Program was established in California to prevent accidental releases of those substances determined to potentially pose the greatest risk of immediate harm to the public and the environment. Although the City has had an excellent safety record in handling chlorine gas at their treatment plant, it is evident that the use of large quantities of chlorine gas near residential developments is coming under closer scrutiny at the County, State, and Federal level. Given this increased level of County involvement and the safety of City workers and the public, Lake County Environmental Health Department has requested that the City evaluate its chlorine handling processes at the treatment plant and consider replacing the gas disinfection processes in the near future with a safer method of disinfection (e.g., sodium hypochlorite).

Effluent Reservoir: The plant contains an effluent storage reservoir with a maximum capacity of approximately 650 acre feet (ACFT) (i.e., 212 MG) at the spillway elevation of 1,432 feet. Treated water is stored in the effluent reservoir until such time that the treated effluent can be applied to the City's irrigation facilities, typically during April to October, when rain amounts are minimal. The California Regional Water Quality Control Boards (CRWQCB) Waste

Discharge Permit (see Appendix A) mandates that the City cannot operate its effluent irrigation facilities during and no sooner then 24 hours after a rain event. Furthermore, the CRWQCB has stipulated that the maximum reservoir level must not exceed 1,430 feet (i.e., 2 feet of free board below the spillway elevation), thus limiting the reservoir capacity to 600 ACFT.

In April 2006, City operators determined that the effluent reservoir was exceeding its mandated reservoir level of 1430 feet (i.e., 2 feet from the overflow). This maximum reservoir level was due to a number of factors including:

- Three months in the 2005-2006 rain year matching the 100-year rain event for that period. Rain in 2006 for the months of March and April exceeded the 100-year event by 150%.
- Based on the treatment plants discharge permit (see Appendix A) on average there are typically 63 days when conditions are right for the City to irrigate between January through April. In 2006, the number of available irrigation days for effluent irrigation was reduced by one-third preventing City operations from discharging onto the irrigation fields.
- Severe I&I entering the treatment plant from the collection system (a significant portion of this I&I was later determined to be from high lake levels flooding open sewer clean-outs along private properties near the lake).

In order to prevent the effluent reservoir from overflowing, the City applied approximately 26 MG of chlorinated and treated effluent onto the City's irrigation fields from April 13, 2006 to April 24, 2006. Of the amount that was discharged onto the irrigation fields, approximately 3.0 to 6.0 MG of treated effluent and rainwater was released from the treatment plant site in violation of the CRWQCB discharge permit.

Resulting from this occurrence, the CRWQCB issued a Cease and Desist Order No. R5-2007-0010 (see Appendix B) to the City requiring that the City perform several upgrades to their effluent irrigation system and to submit a Master Sewer Plan.

Effluent Irrigation System: In response to the April 2006 emergency release of treated effluent from the treatment plant effluent reservoir, discussed above, and to add irrigation capacity for future City growth, the CRWQCB required that the City of Lakeport make modifications to the treatment plant effluent irrigation system. The following is the main components of the 2007 Effluent Irrigation System Expansion:

- The irrigation spray fields were increased in size from 242 acres to 332 acres.
- Two new tail-water pump stations were constructed to capture and return runoff from the new spray irrigation fields.
- A third 125-HP "canned" vertical turbine pump was added to the existing irrigation pump station to increase the effective capacity (i.e., two pumps operating) of the station to approximately 2,800 GPM.
- A new magnetic flow meter was installed at the Linda Lane Lift Station to better monitor influent flows.
- A diversion ditch bypass pipe was installed to intercept surface runoff and divert it away from the plants recapture basins, thus increasing the storage capacity of the basins for effluent storage.

Irrigation System Water Balance: As established by the CRWQCB Cease and Desist Order, this Master Plan has developed a water balance in order to evaluate the current and future capacity of the effluent reservoir and effluent deposal system to provide sufficient storage capacity. The water balance is shown in Table 2 and the following discusses the factors in preparing the water balance:

- A 100-year annual rain event, which for the Lakeport area, has been set at 58.25 inches of rain annually based on Station Lakeport 2NW Precipitation Long-Duration-Frequency Table 3 from DWR Bulletin 195, October 1976. The 100-year rainfall was spread (see table below) in proportion to average monthly rainfall data for years 1941-2001 from the Western Regional Climate Center for Lakeport Station 0440701.

Table 3 100-Year Rainfall Event Proportioned By Average Year Rainfall		
Month	**Average Year**	**100 Year**
January	6.16	12.36
February	4.82	9.67
March	3.62	7.26
April	1.91	3.83
May	0.72	1.44
June	0.28	0.56
July	0.04	0.08
August	0.11	0.22
September	0.34	0.68
October	1.74	3.49
November	4.03	8.09
December	5.26	10.55
Total	**29.03**	**58.25**

- Maintenance of 2 feet of freeboard within the effluent storage reservoir as established by the CRWQCB. This equates to a reservoir capacity of roughly 600 ACFT.
- Irrigation disposal rates based on the treatment plants wastewater discharge permit, which stipulates that no spray irrigation of effluent can occur during period of rain and for at least 24 hours after cessation of rain. Reclaimed water is agronomically applied, based upon the pasture evapotransportation rate minus any precipitation. This would typically mean that irrigation can only occur during the months of May through September. The CRWQCB Waste Discharge Requirements for Lakeport require that no irrigation take place 24 hours before or after a rainfall event. However, historical off-season irrigation rates and daily rainfall events over the past five years from the Scotts Valley weather station (UC Cooperative Extension Service) were analyzed to determine historically there are a number of available irrigation days between October and April that are used for irrigation, albeit at a much reduced rate. The off season days were incorporated into the water balance at a reduced off-season irrigation rate of 0.25 inches per day, as opposed to the typical application rate of 1.1 to 1.4 inches per day during May through September.

- Pasture evapotransportation ratio determined from DWR Bulletin 73-79, November 1979.
- Potential evapotransport (ETo) based on 12 years of data for Station Lakeport Evaporation from Water Surface, DWR Bulletin 73-79, November 1979.
- The amount of sewage entering the plant is a function of the ADWF plus estimated I&I. A historical monthly I&I multiplier was determined based upon plant flow data from 2004 to 2006. Based on the monthly multiplier the 100 year water balance shows that the annual treatment plant flow into the plant is estimated at approximately 297 acre feet per year. This value is approximately, 90 acre feet above the average annual flow into the plant over the past 5 years and approximately 50 acre feet more than what the plant saw in 2005 to 2006 (i.e., 246 acre feet).
- Maintenance of at least 45 to 50 acre feet of water within the reservoir at the end of the irrigation season.
- The newly expanded effluent irrigation field area of 332 acres.

Table 2 is the water balance for this Master Plan and the table estimates that the reservoir and the irrigation system currently has capacity to handle an annual ADWF treatment plant flow of approximately 0.51 MGD during a 100-year annual rain event given the above criteria.

Irrigation Recycle System: Runoff from the irrigation fields is collected in a system of diversion ditches and recycle pumping stations that collect irrigation runoff and transport it to Recycle Reservoir No. 1. Recycle Reservoir No. 1 is an earthen reservoir with a storage capacity of approximately 3.5 ACFT. Recycle Pumping Stations 2, 3, and 4 collect runoff from their individual irrigation areas and pump it back to Reservoir No. 1. Recycle Pumping Station No. 1 contains two vertical turbine pumps (10-HP and a 15-HP) that maintains Reservoir No. 1 levels based on reservoir level switches. Runoff is pumped back to the overland disposal fields.

The existing plant facilities are shown schematically on Figure 2. A summary of the design criteria for the existing facilities is shown in Table 4.

WASTEWATER FLOWS

SERVICE AREA

For this Master Plan's study area, the City's planning department has determined that the City's current LAFCO boundary, and potential areas of service immediately adjacent to the current LAFCO boundary, would be included in the sewer study area. The study area boundary is illustrated on Plate 2.

The 2008 Master Plan outlines the 20-year sewer requirements that will be needed to service the near-term growth, as shown on Plate 2. To determine the 20-year collection system needs of the City, the study area was divided into 33 sub-areas. The RUE wastewater loadings were then estimated for each sub-area based on the City's current General Plan. The sub-area boundaries were established using existing sewer locations, topography, and other pertinent factors such as lot lines, existing streets, and existing drainages.

EXISTING WASTEWATER FLOWS

RUE Determination

A residential unit equivalent is defined as the ADWF generated from a single-family household dwelling. In order to determine ADWF per RUE the Lakeport wintertime household water consumption was calculated from the City's water billing records. It was assumed that the winter water use would be a gauge of the dry weather sewage flow at the treatment plant, based on the assumption that the preponderance of winter water usage (i.e., 80 percent billed) is discharged directly into the sewage collection system. The 2006 average winter time water usage for the City of Lakeport was determined from February 2006 water meter readings. The City's February 2006 water billing records indicate that approximately 0.46 MGD of water was consumed within the main Lakeport water zone (the main zone does not include properties served by the Lakeshore Boulevard Lift Station). Taking 80 percent of this value yields a winter

water rate of roughly 0.37 MGD, which is approximately the same value as the wastewater treatment plant ADWF recorded over the summer of 2004 to 2007 (i.e., 0.38 MGD).

Of the 0.38 MGD treatment plant ADWF approximately 0.13 MGD is associated with the top 40 water users based on their winter water use (see Table 5). The remaining dry weather flow (i.e., 0.25 MGD) at the plant would be considered the dry weather sewage flow generated by the remaining active water service connections, which are assumed to be single RUEs. Based on these calculations it is estimated that the average dry weather flow per RUE is approximately 180 GPD. However, in order to allow for unoccupied "vacation" residences within Lakeport (i.e., RUEs) during the winter months the ADWF/RUE was increased by 10 percent. Thus, for this study the ADWF/RUE is estimated at 200 GPD/RUE and the number of RUEs within the system equates to approximately 2,050.

The 200 GPD per RUE rate compares reasonably well with similar Northern California communities. For example, Weaverville and the City of Yreka use a 200 GPD per household equivalent (HE) rate and the City of Mount Shasta uses 230 GPD per HE. Therefore, for the purposes of this study, a flow factor of 200 GPD per RUE was used for the existing and future development throughout the Lakeport sewer service area.

Inflow and Infiltration

Based on review of the 2004 to 2007 influent flow records from the wastewater treatment plant, the ADWF is estimated at about 0.38 MGD (see Table 6 and Figure 3) and the instantaneous peak dry weather daily flow has been estimated at 0.90 MGD (based on a 2.3 peaking factor see Figure 4). A review of historical wet weather flows at the treatment plant indicated that after 2002 (the year that the Ashe Street Lift Station began pumping to the Lake County treatment plant) peak wet weather flows (PWWF) at the treatment plant have exceeded 2.2 MGD approximately six times and during December 31, 2005, the plant experienced a flow of 3.09 MGD.

Table 6 Historic Flow Data					
Year	2004	2005	2006	2007	Average
ADWF $_{Aug\text{-}Oct}$ (MGD)	0.39	0.41	0.38	0.34	0.38
Max Day Wet Weather (MGD)	2.69	3.09	2.13	1.33	2.31

Comparing the past peak wet weather flow of 3.09 MGD with that of the peak dry weather flow (PDWF) at the treatment plant results in a difference of approximately 2.2 MGD. This difference is the estimated historical peak I&I component within the collection system.

Infiltration refers to groundwater that leaks into cracks and breaks in the sewers and manholes. Inflow refers to storm water that enters the sewer system directly from such sources as illicit roof drain connections, cross connections to storm drains, surface drainage that directly enters cleanouts without lids or leaky manhole covers, etc. Infiltration tends to be prolonged leakage until the groundwater table subsides, and inflow tends to be more noticeable during a storm event when surface water is present (this is very important in Lakeport due to the close proximity of the lake to the City's collection system). Since the two are often very hard to separate, it is common practice to simply refer to the entire leakage problem as I&I.

I&I has a significant impact on sizing of sewers in a collection system and can increase costs significantly. The total I&I rate that occurs at the worst condition is referred to as peak I&I and although this may last for only a short time, such as minutes in a small system or an hour or so in larger systems, the sewer facilities must be sized to handle this peak. Thus, the size of wastewater collection system, interceptor facilities, and lift stations are governed mainly by the combination of peak I&I and peak wastewater flow components, with I&I often being the largest component. The second type of I&I that affects the cost of a sewer system is simply the total amount of I&I usually referred to as the annual I&I. This affects the annual operating costs which include pumping, treating, and disposal of the I&I.

In Lakeport, high lake levels coincide with elevated ground water levels within the Lakeport region. Plant flow data indicates that when the lake level exceeds the elevation of 1,325 feet there is a moderate elevation of sewage flow into the treatment plant. For example, in March and April 2000 the Lakeport treatment plant recorded average daily flows of approximately 0.92 MGD for 14 days during a period when there was no rainfall and the lake level was approximately elevation 1,325 feet (See Figure 5). This average rate is 0.54 MGD above the current ADWF into the plant and would suggest that a significant amount of the excess flow was infiltration from either high ground water levels, or possibly high lake levels, entering the City's collection system.

It is possible that flooding of the City's collection system due to high lake levels can contribute a significant amount of inflow. Plate 1 shows the recorded maximum lake level (1329.6) in relationship to the City's collection system. As can be seen from this Plate, several areas along Park Street, Esplanade Avenue, Lakeshore Avenue, and Clearlake Avenue can be flooded due to high lake levels. Flooding impacts the City's sewers by allowing water to enter open pick holes and joints in manhole lids, open sewer cleanout caps, and house drains illegally connected to the sewer system. Lake flooding and rain in February 1998 caused the treatment plant flows to exceed 2.0 MGD for approximately 23 consecutive days.

Although considerable effort by the City to reduce I&I in the City's main collection system have been performed, a significant component of the I&I is generated from private sewers and house connections that are more difficult to address due to their location within private property. Several studies have suggested that 50 percent of all I&I entering a public collection system is from private property. For example, in March and April 2006 flooding was reported within a private RV park west of the C Street Lift Station adjacent to Clearlake. Lake levels during that period were estimated at about 1,326 feet and combined with several days of rain, resulted in treatment plant flows between 1.0 and 2.0 MGD from March 2006 to the end of April. While investigating high I&I rates from this area it was determined by City Staff that several of the private sewer cleanouts that had been under lake water had open lids allowing lake water to inflow into the City's collection system. From this single incident it was estimated that as much as 300,000 to 500,000 gallons of lake water per day could have entered the City's collection

system. To date, the City has eliminated or repaired all identified sources of I&I within this private sewer system.

I&I Flow Monitoring

In 1991 to 1992, the City performed an extensive I&I analysis and monitoring program (September 1992 Lakeport Sewer Infiltration and Inflow Analysis) that reviewed and identified several areas within the Lakeport collection system that had significant I&I rates. From this analysis the City implemented the 1993 to 1994 collection system rehabilitation program that involved sewer rehabilitation and replacement in those high I&I areas. To update the previous I&I flow monitoring study, PACE and the City of Lakeport partnered to perform a systematic flow measurement program in the winter of 2007 and 2008. The flow monitoring consisted of measuring instantaneous wastewater flows at different monitoring station manholes during wet weather conditions to estimate I&I flow rates. The collection system flows were measured or observed at 18 strategic manholes and lift stations disbursed throughout the Lakeport collection system (see Plate 1 and Table 7) during each of the monitoring events. The monitoring manholes were selected on the basis of upstream service area, historical observed flows, flow isolation, and sewer size.

The field flow-monitoring effort consisted of going through the collection system at night and early morning, when the wastewater component of the flow was minimal, to measure the flow at the designated manholes. In some cases, the measured flow would include the flow(s) measured in upstream monitoring stations, which was deducted from the measured flow to derive the I&I contributions from the lone service area. Because the measurements are taken at different times, and flows do vary over time, this can compound errors; however, the data is meaningful and provides a basis for the master planning effort.

WWF monitoring took place on two occasions in January 2008 (i.e., January 4th to the 5th, 2008 and January 25th to 26th, 2008). Table 7 summarizes the dates, rainfall amounts, lake levels, and wastewater treatment plant flows during those events. Note that peak flows at the treatment plant during the flow monitoring events were estimated at about 2.0 MGD by City staff.

A statistical interpretation of the rain that occurred during the two January 2008 events (rain gauge maintained by the City of Lakeport at the Wastewater Treatment Plant) suggests that the rainfall over a period of 20 days prior to the monitoring (from December 15, 2007 to January 4, 2008 and from January 5, 2008 to January 25, 2008) was a one in a 2-year occurrence. In other words, over a 20-day period prior to the flow monitoring, an observer would probably record that much rainfall once every 2 years. In comparison, the 15-day rainfall that occurred prior to the historical peak flow (3.09 MGD) at the treatment plant on December 31, 2005, was determined to be a one in 50-year event and the lake level during that period was at (1326 Feet). Therefore, the flow monitoring data that was collected during the January 2008 events were obtained during a rain period that had minimal rainfall and relatively low lake levels.

The primary indication of the severity of the I&I conditions is the magnitude of the flows measured at the treatment plant. As indicated hereinbefore, the dry weather peak instantaneous flow at the Lakeport Treatment Plant is estimated at 0.90 MGD, and at night the treatment plant would expect to receive half of the ADWF or 0.19 MGD. During the January 2008 monitoring events, it was reported that the treatment plant peak flow was estimated at around 2 MGD. This peak flow is approximately 35 percent less than the historical treatment plant flow recorded in December 2005 (i.e., 3.09 MGD).

A summary of the flow-monitoring data is presented in Table 7. Column 3 indicates the estimated sewered area, in acres, for each monitoring sub-area during each monitoring event. Columns 7 and 12 show the estimated net wet weather flow per sub-area per monitoring event. The net flow value is the flow measured at the monitoring station less any flow(s) measured upstream of that sub-service area. The measured I&I flow rates for each sub-area, shown in Columns 9 and 14, were calculated by taking the measured flow and dividing it by the sewered area in each monitored area. The extrapolated I&I values are shown in Column 10 and 15 of Table 7 and are based on increasing the measured flows in proportion to the peak treatment plant flows measured at the time of the monitoring (estimated at 2.0 MGD) and the treatment plant peak flow on December 31, 2005 (i.e., 3.09 MGD).

Typically, sewered areas that have I&I rates at or below 1,500 gallons per acre per day (GPAD) are considered to be within industry limits. As can be seen from Column 16 of Table 7 and Plate 1, a number of the monitoring stations had extrapolated values less than 1,500 GPAD, indicating that the sewers in these areas appear to be relatively tight. I&I rates in excess of 3,500 GPAD are considered high and indicate that these sewers have defects that are sources for I&I. Table 7 indicates there are 11 monitored areas that had average extrapolated I&I rates above 3,500 GPAD and out of these, six monitored areas (Stations 3C, 4B, 7C, 9C, 9B, and 13A) had I&I rates in excess of 5,000 GPAD, indicating that these areas are potential sources for severe I&I. These 11 monitoring areas represent about 1.6 MGD of the estimated extrapolated I&I flows or about 50 percent of the historical daily peak I&I flow entering the treatment plant during a 10-year rain event and an elevated lake level (i.e., above 1,329 feet).

GROWTH PROJECTIONS

The current study estimates the number of RUEs being served by the Lakeport treatment plant to be approximately 2,050 (see Table 5) and that there is an additional 550 RUE's being served through the Lakeshore (Ashe) Lift Station to the Lake County treatment plant (i.e., total RUEs within the Lakeport study area is estimated at around 2,600).

20-Year Growth Projections

The State Department of Finance (DOF) has estimated the City's population increased from 4,820 in 2000 to 5,060 people in 2007. This is a population increase of approximately 0.7 percent per year. Although population growth rate could be used to predict future sewage flows, the population growth rate alone tends to neglect other factors that can affect wastewater production. For example, increases or decreases in commercial and industrial water use and the current trend for water saving appliances can impact the production of wastewater in the future.

In order to estimate the number of additional households that will connect to the system in the next 20 years, the growth rates used in this Master Plan were based on the minimum growth

alternative of 1.1 percent defined in the May 14, 2007, City of Lakeport Draft General Plan. The General Plan growth rate was based on 1990 to 2000 Lakeport growth data. It must be noted that, since 1997 the City's growth has slowed to around 0.55 percent. Obviously, one of the biggest contingencies in any planning document, such as a master plan, is growth. If actual growth projections turn out to be greater than the 1.1 percent growth used in this analysis, some of the recommended sewer improvements discussed in this Master Plan will need to be constructed sooner than anticipated. If growth is less than estimated, master plan sewer improvements can be delayed.

Therefore, using a 1.1 percent growth rate over the next 20-year period, the estimated increase in the number of RUEs within the current study area would be roughly 630 (i.e., 3,230 total RUEs) by year 2028. Of these future RUEs about 520 RUEs would be within the City's main sewer area that is currently being served by the Lakeport treatment plant. This would result in an estimated ADWF at the City's treatment plant of roughly 0.48 MGD at year 2028 (see Figure 3).

As discussed, the general plan also proposes that there is interest in developing land that is south of the current City limits (see Area 19 and 20 on Plate 2) near the City's wastewater treatment plant (i.e., the Southern Development Area - SDA). It has been suggested that this southerly area has the potential of adding 1,000 to 1,500 RUEs, mainly as residential developments, to the City's sphere of influence. For this study, it was decided to evaluate the potential impacts of this southerly area as a part of the Master Plan, assuming that the growth in this southern development area would occur beyond the next 20 years and that the sewer system and treatment plant improvements needed to sustain these southerly developments would be financed and constructed by the developers on a as needed basis.

The location and size of each development proposed in the next 20 years was compiled by the City's Community Development Department and is shown in Appendix C (see Housing Units Proposed in the City of Lakeport April 2007) and are also indicated on Plate 2. This list was used in disbursing future RUEs throughout the Lakeport Study Area.

Figure 3 represents estimated future treatment plant dry weather flows based on the 1.1 percent growth rate within the areas served by the treatment plant. As can be seen from this figure and the water balance Table 2, projected treatment plant ADWFs will exceed the current 100-year annual rain event capacity of the plant effluent reservoir and irrigation system (i.e., 0.51 MGD) within the next 25 years (roughly an additional 650 RUE capacity remains) unless additional capacity can be acquired.

FUTURE WASTEWATER AND INFILTRATION AND INFLOW

To obtain meaningful flow projections to use in developing a plan to meet the year 2028 sewer needs, it is important to predict how much growth is expected to occur in the next 20 years and where growth will likely occur in the City of Lakeport. It is also important to estimate the wastewater loadings on the sewer system at ultimate development.

The anticipated 20-year developments were spread throughout the study area with the assistance of the City Planning Department staff. Plate 2 shows the approximate location of the areas where growth is anticipated to occur over the next 20 years, and Table 8 details that growth. Of particular importance is development areas F, 19, and 20 on Plate 2. For this Master Plan these areas will be referred to as the Southern Development Area. The Southern Development Area (SDA) encompasses proposed residential developments that will convert the City's existing treatment plant irrigation areas into a golf course. Although tentative at this point, the SDA has been examined in this Master Plan based strictly on the impact of adding residential units into the Lakeport system. Obviously, if the SDA were to occur in its present configuration, it would modify the City's current treatment plant and irrigation system and these impacts would have to be addressed as a part of the SDA planning and environmental review.

After estimating the expected growth in specific sub-areas and determining the number of RUEs associated with that growth, the existing 2008 and 2028 sewage and I&I flow contributions were estimated for each sub-area. The estimated 20-year flows were used to determine the required sewer size needed to serve each sub-service area.

The sub-area boundaries are shown on Plate 1 and are approximate limits of service. The boundaries can often be shifted slightly to change the sub-area without significantly impacting sewer sizing. However, large changes in service areas should be reviewed to determine if downstream sewers are impacted.

In existing sub-areas with measured I&I values of less than 1,500 GPAD, it was assumed that the I&I rates would gradually increase due to degradation of the collection system over time to 1,500 GPAD under ultimate conditions. I&I flows in sub-areas that had values above 3,500 GPAD in 2008 were reduced in future years based on the assumption that the City will reduce future I&I in those areas. Table 10 shows the reduction rates used for the 20-year model. In existing sub-areas that had values between 1,500 and 3,500 GPAD, it was assumed they would remain the same in the future. All future sewered areas were assigned an I&I allowance of 1,500 GPAD.

All of the above mentioned estimates of RUEs, sewered area, and I&I rate data for each sub-area are summarized in the Service Area Tabulation sheets for all service areas as shown in Table 8. Based on these factors, it was estimated that the ADWF at the plant would increase from its current rate of 0.38 MGD to 0.48 MGD by 2028 if all proposed development occurs within the current City limits (i.e., not including the SDA).

If the SDA is included, the ADWF would increase to approximately 0.8 MGD by 2028. Peak treatment plant flows are much more difficult to predict. Based on aggressively reducing I&I within the identified high I&I areas as shown on Table 10, maintaining current I&I rates in other areas and the predicted increase in RUEs within the City limits over the next 20 years, it is estimated that peak treatment plant flows could reach or exceed 3.4 MGD by year 2028 based on a 50-year 15-day rain event. The addition of the SDA would theoretically increase peak flows to the treatment plant to 5.5 MGD at total build out. The inclusion of the SDA development would require that the treatment plant be significantly expanded to accommodate this added flow and it is proposed that this expansion would be paid for by the SDA development.

DESIGN CRITERIA SUMMARY

Sewer sizing was based upon handling the PWWF, which equals to the average dry weather wastewater flow rate times a peaking factor plus the peak I&I allowance. The typical diurnal curve shown on Figure 4 was developed based on pump station records. This diurnal curve was used in the hydraulic model to simulate the affect of daily flows into the Lakeport collection system.

HYDRAULIC COMPUTER MODELING

H2OMAP Sewer by MWHSoft was used to model the City's collection system. Two computer models were created for this Master Plan: Existing (2008) PWWF model and a 20-year PWWF model (2028). The existing PWWF model was created using the existing Lakeport collection system. City "Record Drawings" of the existing collection system were used to confirm collection system pipe size, slope, length, and material for input into the modeling software. Lift station flow meter and elapsed time meter data were used as a gauge in modeling the performance of the lift stations. Sewage flow measurements taken during the January 2008 I&I flow-monitoring efforts for this Master Plan were then combined with estimated PDWFs to create the 2008 PWWF hydraulic model.

The 2008 PWWF model was then used as the base for the 20-year model. The 2028 model includes estimated growth projections and locations obtained from the City's planning department. Future trunk sewers and lift stations needed to serve future areas were determined and inserted into the model. I&I data was based on the sewer design flow criteria shown on Table 10.

As indicated, the model I&I allowances were estimated by an analysis of the adjusted monitoring station wet weather flows. The model assumes that all sewer pipes have free flow. As the City investigates the areas known to have high I&I, it may discover that some of the sewer flows are impeded or have other problems not reflected by the model.

The 2008 PWWF model was based upon flows generated by a 15-day rainfall event in December 2005, which is expected to occur once every 50 years and a lake level of 1,326 feet. Rain events, greater than this 50-year event, combined with a maximum lake level (i.e., elevation 1329), may cause sewage flows to increase above what is estimated in the 2008 PWWF model.

Once both hydraulic models were created, they were analyzed and collection system limitations were addressed. Where modeled sewer capacities were limited, parallel or larger replacement sewers were calculated in order to resolve these limitations in the model. Table 12 summarizes hydraulic model results and also shows sewer capacities needed to reduce the potential of existing or future sewer surcharge.

ANALYSIS AND RECOMMENDED IMPROVEMENTS

GENERAL

The first step in analysis of the sewer system was to compare the capacity of the existing gravity trunk sewer lines with calculated 2008 and 2028 estimated PWWFs using the hydraulic models. Plate 1 represents the existing sewer collection system.

The next step in the analysis was to determine the approximate location and size of future sewers in areas not presently served by the City in order to model service to those areas. Establishing approximate routes for trunk sewers was determined by examining the City's topographic map data and placing trunk lines along major drainages in the area to service sub-areas. For example, minor drainages were used for sewer routes in Subservice Area 19 near the wastewater treatment plant (see Plate 2). Once the routes were established, the surface grade was estimated along these routes to estimate sewer sizes. Where surface topography or existing development prohibited the use of gravity sewers to serve an area, a lift station and force main was proposed as an alternative.

Future sewer lines marked AD (As Developed) on Plate 2 represent sewers that are not currently scheduled for construction. Most of these sewers would be constructed either as the areas develop or as existing septic systems fail and a sewer system becomes mandatory. These sewers will typically be funded by development projects or by assessment districts, as the areas are sewered. On the other hand, new sewers needed to parallel or replace existing sewers that will be inadequate in the future have been designated as General Improvements and it is anticipated that they be paid for by City capacity charges.

The lines shown AD are nebulous at this point; this is especially true where they are providing service to undeveloped perimeter areas. In these cases, the extent of future development is undetermined at this time and consequently pipe sizes may need to be revised, if conditions change. In order to effectively utilize this Master Plan, it is recommended that the service area tabulations shown in Table 9 of this report be reviewed prior to construction of major trunk

sewers. If the actual development is significantly more or less dense than anticipated, then appropriate adjustments in the proposed sewer size and downstream sewer sizes should be made. The locations of lines shown for new development are approximate and should be considered schematic based upon the available topographic mapping. In flatter areas, their final location will be dependent upon obtaining more definitive topographic information and the actual pattern of future development.

Where existing sewers are not large enough to convey the 20-year flows, a new parallel or replacement sewer is indicated on the Master Sewer Plan. Parallel sewers have been sized based on handling the differential flow between ultimate demand and existing capacity. This assumes the existing sewer will remain in service and that it can be restored to acceptable standards utilizing currently available rehabilitation techniques, if necessary. Prior to paralleling or replacement of any existing sewer, a detailed review including a video inspection should be made of the existing sewer to determine whether it is desirable to keep it in service. Obviously, the capital cost of a total sewer replacement, which would require a larger new sewer and lateral re-connections, is considerably greater than installing a parallel relief sewer.

INFILTRATION AND INFLOW REDUCTION PROGRAM

Sizing of parallel relief sewers and replacement sewers; and future expansions of the treatment plant are often dependent on estimated existing and future I&I rates. As previously mentioned, these estimates represent the largest contingency in the development of this Master Sewer Plan. In view of the large expenditures required to install parallel relief sewers and upgrading of the wastewater treatment plant, it is imperative that the City continue investing in long-term I&I reduction programs. Reducing I&I will result in long-term savings to the City by reducing the volume of sewage treated at the wastewater treatment facility and delay or possibly eliminate the need for parallel or replacement sewers.

Our experience has been that installing relief sewers without correcting major sources of I&I will only relieve existing bottlenecks and result in even higher PWWF downstream. Sewer systems

in poor condition continue to deteriorate and, if not corrected, the volume of I&I will only increase with time.

The average peak I&I rate for all of the sewers within the City of Lakeport is about 2,400 GPAD. However, flow monitoring data indicates that there are eleven flow-monitoring areas that have extrapolated I&I flow rates that are significantly higher than the majority of the service areas (See Plate 1 and Tables 9 and 13). The total net peak sewage flow from the 11 highest flow-monitoring areas resulting from a 50-year rain storm is about 1.59 MGD, which represents about 51 percent of the total estimated City system peak flow of 3.09 MGD. In addition, these areas only comprise about 300 sewered acres or 15 percent of the total existing 2,000 sewered acres within the City limits. Therefore, it appears that 15 percent of the City's sewered area contributes 51 percent of the peak flows entering the collection system.

For this Master Plan, it was assumed that the City will continue to aggressively correct I&I in the future. The design flow criteria in Table 10 estimates, that the City's continued I&I reduction program will focus on the high I&I areas (i.e., areas with I&I greater than 3,500 GPAD) and reduce I&I in these areas by between 10 and 30 percent over the next 20 years. Historically, the City has aggressively identified and implemented major I&I reduction projects. During the spring of 2006 the City identified 10 to 14 open lateral clean outs at a private mobile home park along Park Street that had been flooded by high lake levels and were allowing inflow to enter the City's collection system. Although it is difficult to determine the exact amount of I&I that was eliminated from this repair it is estimated that by plugging one 3-inch clean out a savings of about 0.3 MGD (200 GPM) has been prevented from entering the collection system (based on 12-inches of flood water over the clean out opening).

The City's I&I reduction program has been able to identify and repair numerous I&I sources within the existing collection system. Many of these sources are easy to identify and repair. However, future sources of I&I may be more difficult to define. For example, during the January flow monitoring effort it was determined that an 8-inch sewer connected to the manhole at the intersection of Main and Martin Street (Monitoring Station 4) was discharging approximately 15 GPM into the collection system. Further investigation by City staff concluded

that this existing sewer was no longer in service and it was plugged. By abandoning this sewer approximately 22,000 GPD of I&I was eliminated from the system.

Laterals and House Connection I&I

In order for the City's I&I reduction program to be effective, the City will need to address leakage from laterals and private building sewers. There have been several studies that point to sewer laterals and building connections as contributors of up to half of the I&I entering a collection system.

In a study for the U.S. Environmental Protection Agency (EPA), Conklin (1981) noted that many sewer rehabilitation programs that did not address sewer laterals, had a maximum I&I removal rate of about a 30 percent. Furthermore, the EPA study also concluded that the building connections and private sewer laterals contributed 50 percent of the total I&I into the system. Therefore, with a continued City committment to eradicate I&I from the laterals and private house connections, the best that can be hoped for in any I&I reduction program is about a 30 percent reduction.

Typically, the sewer pipe from the house to the property line is called the "building sewer" or the "private sewer lateral" and the sewer pipe from the property line to the sewer main is called the sewer "lateral." Generally, the lateral is located in the public right-of-way. In the City of Lakeport the property owner is responsible for the maintenance of the private sewer lateral from the house to the private property line.

Currently, the City's newly adopted sewer ordinance has addressed some of the issues attributed to I&I coming from the private sewer laterals. The City's ordinance requires that private laterals be periodically cleaned, inspected, and tested for I&I by the private property owners at predetermined scheduled events, such as when applying for a building or plumbing permit. Furthermore, the City's ordinance also stipulates that approved cleanouts must be installed within the existing private sewer laterals whenever the laterals are replaced or when the lateral is to be tested. Testing of private sewer laterals involve an exfiltration pressure test that measures the amount of pressure loss within the private sewer lateral over a set period of time. The

ordinance stipulates that if the mandatory exfiltration test fails, the private property owner would be required to repair the lateral and retest or possibly be fined a noncompliance fee.

Future I&I Reduction Programs

During the flow monitoring that was performed for this Master Plan several subservice areas have been identified as being high I&I areas. It is in these identified target areas the City should focus near term I&I reduction efforts such as smoke and dye testing of the sewers, internal video inspection of both the main line sewers and laterals (where access is possible) to determine defects and sources of I&I, and continued inspection of manholes during rain events to try and identify I&I sources that are caused by poor manhole construction, flooding, and degradation. Of special interest are those areas nearest the lake where flooding can occur (i.e., subservice areas 13A, 3C, etc.). An extensive effort in addressing private sewer connections should also be implemented in these areas based on the newly created sewer ordinance. The City should routinely evaluate (e.g., dye and smoke test) areas adjacent to the lake on a regular basis (i.e., once every three to four years) in order to evaluate potential new sources of I&I.

As new field data is collected, the City should compare this information with past inspections to determine if sewer facilities have deteriorated or been damaged. This phase would also involve reviewing the field data, summarizing and tabulating where sources of I&I are evident within the system, and formulating the best way to repair these defects. Most of the I&I sources can be easily repaired by City crews as they are identified.

However, other more extensive sources of I&I, may require the City go out for public contract to have this work performed by contractors. Repairing defects, such as major root intrusions, failing sewer pipes, sewer sags, and deteriorating manholes may require specialty contractor skills. Some of these work items may include grouting of sewers and lateral joints, lining, pipe bursting, or replacing main line sewers and manholes, and addressing laterals by installing cleanouts so that specific laterals can be evaluated and, repairing if needed. It might be possible to combine general sewer improvements recommended in this Master Plan with major I&I reduction repairs that are identified in the I&I target areas.

Plate 2 shows the six sub-service areas that contribute the highest I&I into the collection system and constitute the Initial I&I Target Areas. In particular, Subservice Area 9B and 9C north of the Fairgrounds, Subservice Area 4B on the east side of the Fairgrounds, Area 3C along Park Street, 13A along North Main Street, and a small Subservice Area 7C along North Street. From these six areas it is estimated that as much as 0.9 MGD of I&I is generated during significant (i.e., 10-year or greater) rain events. It is in these Initial I&I Target Areas that the City should continue to focus its I&I reduction efforts over the next ten years (i.e. 2008 to 2018). In addition, the City should budget for subsequent I&I reduction efforts in the remaining high I&I areas in the collection system (see 1 Subareas 1B, 7A, 7B, 9A, and 10B), once the Initial I&I Target Area has been systematically investigated and repaired.

Table 14 indicates a preliminary cost estimate for a comprehensive I&I reduction program within the City over the next 20 years and beyond. Assuming that City staff will perform all of the investigative work (i.e., smoke and dye testing, video sewer inspections, manhole inspections, etc.) as a part of there on going I&I reduction program the table provides estimated "order of magnitude" costs for performing the repair portion (Phase 2) of the work with Contractors through public bidding. Table 14 also includes objectives for the amount of I&I reduction to be achieved in each of the monitoring areas. If these I&I reduction objectives can be realized, then it is estimated that approximately 0.5 MGD of I&I could be removed from the Initial Target Area and about 0.4 MGD would be removed in the remaining high I&I service areas (this depends a great deal on how effective the City is in having private property owners repair leaky building sewers).

Phase 2 costs were projected by assuming that approximately 20 percent of all of the sewers, laterals, and manholes in the high I&I areas will need some type of rehabilitation or replacement. Estimated quantities within this table should be considered as an <u>order of magnitude</u> estimate for planning purposes. Costs for performing the Phase 2 work cannot be accurately forecast until such time that the Phase 1 work has been completed and the field data is reviewed. All costs include 25 percent for planning and engineering and 15 percent for contingency.

Finally, any I&I reduction program that is performed should be verified by subsequent flow monitoring. Using the flow monitoring data generated for this and successive Master Plans as a basis, subsequent flow monitoring data in those areas that have been rehabilitated will need to be gathered and compared in order to verify reductions in I&I. It is strongly recommended that the City perform such flow monitoring of the existing system during peak rain events and elevated lake levels.

SEWER IMPROVEMENTS

The recommended sewer improvements are shown on Plate 2. Trunk sewer design flows and the required sewer sizes were determined for the 2008 and 2028 conditions, as described below. As was discussed, the specific improvements recommended below are based on the City's commitment to controlling and reducing I&I in the sewer system. Table 10 establishes I&I reduction goals for the next 20 years. If these goals cannot be achieved, peak sewage flows in the system will be higher than estimated, which will result in future sewer capacity issues and the need for the construction of additional relief sewers and treatment plant capacity.

The PWWF for each reach of trunk sewer was determined using the H_2OMAP Sewer by MWHSoft computer program. The summary of the H_2OMAP program output is shown in Table 12 in the back of this report. The table indicates the analysis year, model pipe number, sewer length, diameter, slope, capacity, model PWWF, surcharge depth, and recommended replacement or parallel sewer. Using an input sewer slope and diameter of the existing trunk sewer, if there is one, together with compiled PWWF, the program computes the existing sewer capacity. Table 12 also indicates a recommended size of a parallel sewer if the existing sewer is inadequate. In addition, a replacement sewer size is also shown on the table in case the existing sewer is to be abandoned.

North Main Street Sewer: The analysis indicates that during present day peak wet weather conditions, several segments of the 8-inch Main Street Sewer between 6th Street to 10th Street (see Points 1 to 2 on Plate 2) can encounter surcharging conditions during PWWF. This

surcharging condition has been observed in the field as City crews have reported several overflows within this segment of sewer over the past 5 to 10 years. In order to relieve this potential surcharge condition, it is recommended that the existing 8-inch sewer be either paralleled with a 10-inch sewer or replaced with a new 12-inch sewer. The hydraulic analysis also suggest that if the Rose Avenue Lift Station is diverted to the north, as is being negotiated between the City and County, future peak sewage flows on the Main Street sewers will be lowered. The analysis indicates that the Rose Avenue lift station diversion to the north would require that an 8-inch parallel sewer would be needed versus the 10-inch sewer suggested above.

In addition, the hydraulic analysis indicates that a significant segment of existing 12-inch sewer along Main Street, from Sixth Street to C Street (see Points 1 to 3 on Plate 2), can also experience moderate surcharging during estimated PWWF. This is probably caused by the shallow slope of several segments of this sewer (i.e., some segments have slopes of 0.1 percent) and the influence of upstream lift stations such as the Rose Avenue and Clearlake Avenue lift stations. In order to relieve estimated peak flows within this sewer, the hydraulic analysis indicates that a parallel 15-inch relief sewer should be constructed. Similarly, the diversion of the Rose Avenue lift station to the north would improve this estimated surcharging condition such that instead of requiring a parallel 15-inch sewer along Main Street from 6th Street to C Street a parallel 12-inch sewer from 6th Street to Armstrong Street would be required.

<u>Lakeshore Boulevard</u>: Currently, the existing 8-inch sewer that connects High Street to Giselman Street, along Lakeshore Boulevard (see Points 4 to 5), appears to have moderate surcharge during PWWF. This surcharge was seen in the hydraulic analysis for 2008 and 2028. It is proposed that within the next 5 to 10 years (2013 to 2018), this segment of sewer be paralleled with a second 8-inch sewer to increase its current capacity.

<u>North High Street Sewer</u>: The analysis indicates that the existing 6-inch High Street sewer between 17th Street and Via Del Lago Street (see Points 6 to 7 on Plate 2) has potential surcharge conditions during current and 20-year PWWF conditions. It is recommended that this 400-foot sewer segment be replaced with an 8-inch sewer within the next 10 years. Furthermore, if the Rose Avenue lift station flow is diverted to the north it is expected that this sewer will be

impacted with more peak sewage in the future. The hydraulic analysis indicates that the additional Rose Avenue lift station flows will necessitate that the existing High Street sewer from 17th Street to Via Del Lago Street be replaced with a 10 inch and that an additional 200 feet of parallel 8-inch sewer be installed between Via Del Lago Street and Lakeshore Boulevard.

Martin Street Sewer: The hydraulic model suggests that the 8-inch Martin Street sewer upstream of the Martin Street Lift Station (see Points 11 to 12 on Plate 2) may be under surcharging conditions during current PWWF's. It is suggested that the I&I Reduction Program will reduce the PWWF on this sewer segment appreciably reducing the potential for surcharging. It is recommended that the City monitor this sewer segment during wet weather conditions to determine if sewer capacity is an issue. A parallel 8-inch sewer may be necessary within the next 5 to 10 years if I&I reductions do not occur or are ineffective.

Compton to Russell Street Sewer: The analysis indicates that during present day peak wet weather conditions, two 6-inch segments of the Compton to Russell Street sewer (see Points 13 to 14 on Plate 2) can encounter surcharging conditions during PWWF. Although it is hoped that I&I reductions in service area 10B may eliminate this potential for surcharging the City should monitor this segment of sewer during wet weather conditions and if needed replace this sewer with an 8-inch over the next 10 to 20 years.

Martin Street Lift Station: Currently, the lift stations wet well hatch is corroded and should be rehabilitated by sand blasting and applying a non-corrosive paint system in order to prevent further degradation of the hatch.

The current Martin Street lift station has an estimated effective pumping capacity (i.e., one pump operation) of about 425 GPM (0.61 MGD). Because this lift station serves several subservice areas with moderate to severe I&I rates (see Plate 1) the Master Plan analysis predicts that during wet weather conditions, flows into the lift station can exceed approximately 500 GPM (0.86 MGD). It is hoped that the proposed I&I reduction program within the high I&I areas (i.e., subservice areas 9B and 9C) can reduce flows into this lift station over the next 20 years. However, if I&I reductions cannot be achieved, flows at this lift station may increase over time

necessitating that the City evaluate replacing the existing pumps with higher capacity pumps. Furthermore, several developments upstream of this lift station (see Plate 2 developments 9, 10, 11, and 12) are planned over the next 20 years and could impact the capacity of this lift station even more. The City should continue monitoring pump operation at this lift station during high flow conditions. If it is determined that both Martin Street Pumps are required to keep up with peak flows, the City should consider replacing them with larger capacity pumps within the next 10 to 20 years, possibly requiring that future developments upstream of this lift station enter a reimbursement agreement with the City for upgrading.

The Martin Street Lift Station is considered to be one of the City's primary lift stations. In order to improve monitoring of this lift station it is recommended that the City look at equipping this lift station with radio telemetry and SCADA capabilities in the future (see SCADA radio telemetry section below).

Clear Lake Lift Station: The Clear Lake Lift Station is old and requires City operators to perform confined space entry when having to repair the pumps and other wet well equipment. As noted in the recent field review of this facility, the lift station has the potential of being flooded due to high lake levels. Furthermore, access into the wet well is also limited due to the small diameter of the wet well. It also appears that there is some deterioration of the concrete wet well walls (i.e., evidence of exposed aggregate within the walls).It is recommended that the City consider renovating this lift station within the next 5 to 10 years to improve access.

Rose Avenue Lift Station: The City of Lakeport and Lake County have been negotiating a service swap such that the City would collect and treat waste water from the County's facilities at the airport in return for taking flows from the Rose Avenue Lift Station and pumping them to the Lake County Treatment Plant to the north via the Lakeshore Boulevard Lift Station. In order to pump sewage from the Rose Avenue Lift Station to the Lake County treatment facilities a new 6- to 8-inch force main would be needed from the lift station to the existing collection system on North High Street (see Point 6 to 15 on Plate 2) approximately 1,600 feet.

Linda Lane Lift Station: Current odor problems at the Linda Lane lift station are probably due to an undersized blower venting the lift station wet wells. It is recommended that the City replace this blower with a larger capacity blower in order to better exhaust the wet wells through the activated carbon odor scrubbers. In addition, the City has the ability to inject chlorine into the Linda Lane wet wells from the treatment plant chlorine system in order to neutralize excessive hydrogen sulfide odors. It is recommended that operators utilize chlorine injection during those periods when odors are excessive.

Lift Station SCADA and Radio Telemetry: In order to improve the monitoring and maintenance of the City's lift stations and to better track sewage flows throughout the collection system it is recommended that improvements to the major lift station controls be implemented over the next five and ten years. Installation of radio telemetry equipment and supervisory control and data acquisition (SCADA) hardware and software at Rose Street, C Street, Martin Street, Lakeshore Boulevard and the Lakeport Boulevard Lift Stations would allow City operators to better monitor these main lift stations within the Lakeport system.

WASTEWATER TREATMENT PLANT IMPROVEMENTS

The existing Wastewater Treatment Plant was originally designed for an ADWF of about 1.0 MGD and a PWWF of 3.0 MGD. As discussed in this report, the current expanded effluent irrigation system has a current 100-year rainfall capacity of about 0.51 MGD. The summer 2003 to 2007 ADWF at the treatment plant was estimated to be about 0.38 MGD, which is 74 percent of the expanded effluent irrigation plant capacity. At a 1.1 percent ADWF growth rate (see Figure 3), it is estimated that the effluent reservoir/irrigation system will be at capacity by 2033.

Since 2002, (the year that the Ashe Street Lift Station started diverting sewage flow from the Lakeport Treatment Plant to the Lake County Sanitary facilities) there has been one instance for which the peak wet weather flow at the treatment plant exceeded 3.0 MGD (i.e., December 31, 2005, flows were estimated at 3.09 MGD). It appears that this incident was an isolated occurrence, and as discussed, the City was able to identify a significant source of some of this excessive flow and reduce it. It is estimated that by capping and plugging the 10 to 14 open clean-outs that were flooded along Park Street in April 2006, as much as 0.3 MGD of potential I&I could have been eliminated from leaking into the collection system due to lake flooding at this location. Although lake levels above elevation 1326 have not occurred since these repairs were made it is estimated that because of these repairs current peak flows at the plant are around 2.8 MGD given the same peak lake and rain conditions that were seen in the winter of 2005 to 2006.

Future peak flows at the treatment plant are much more difficult to predict. It is anticipated that the City's ongoing I&I reduction program and implementation of the City's new sewer ordinance will work to control some of the existing and future I&I flows. However, some of the City's sewers are over 60 years old and it is inevitable that deterioration of existing sewers will occur. Therefore, based on the historical treatment plant peak flows; proposed City growth; the projected I&I reduction program; and existing sewers that will continue to deteriorate; it is estimated that PWWF at the treatment plant will begin to exceed 3.0 MGD regularly during extreme conditions over the next 10 to 20 years. It is anticipated that plant flows will be as high as 3.3 to 3.4 MGD by 2028. Therefore, some of the existing treatment plant processes may need

to be improved over the next 20 years in order to keep up with these anticipated peak flows.

Headworks: Based on the current effective capacity (i.e., two pumps operating at between 3.6 to 3.7 MGD) of the Linda Lane Lift Station, the City's operators have never reported a high water level alarm in the headworks during peak flow conditions (the high water alarm is set at 2 feet from the top of the headworks wall). Therefore, it appears that the existing treatment plant headworks has a current PWWF capacity of at least 3.6 MGD. Operators should continue to monitor the headworks during peak flow conditions in order to determine if there are any headworks capacity issues in the future.

Aeration Basins: As previously discussed, the aeration basin ABM slope protection appears to be failing in many locations due to wind and wave erosion of the earth from under the ABM.

In particular, the access ramps into the ponds have seen the worst damage to the ABM apron (see picture above). The continued degradation of the aeration basin slopes and ABM apron may compromise the existing earthen dikes and the City should implement a staged repair procedure within the next 10 years. It is proposed that in order to properly repair the aeration pond dikes, each aeration basin would be taken out of service temporarily over two summers, between June to September, in order to dry the pond slopes and install additional armament or slope

stabilization material. Pond 1 should be repaired first since it has a greater extent of dike area followed by pond 2. Repair of the slopes may involve replacing some of the severely damaged ABM, reinforcing the existing ABM with additional concrete footings, and installing additional ABM or possibly rock rip rap along the dike slopes, below the existing ABM apron, to protect the slopes from further erosion.

As a part of the ABM/slope repair, it is recommended that the City consider removing accumulated sludge and grit from the bottom of each pond. Although currently the ponds appear to be functioning properly, the addition of sludge over time will eventually reduce aeration basin capacity and have an effect on pond treatment efficiencies. It is estimated, based on recent pond bottom sounding measurements, that there could be as much as 12 to 24 inches of sludge at the bottom of each pond, currently.

The City will be required to perform a comprehensive analysis of the sludge prior to any disposal method. Laboratory analysis of the sludge would involve Title 22, California Code of Regulations, test requirements such as heavy metals, organic, and inorganic constituent testing. Furthermore, after the sludge analysis is performed, a comprehensive engineering report will need to be prepared in order to determine what alternatives are best suited for sludge disposal. Options could include drying the sludge at the treatment plant and land application onto City property or possibly disposing of the sludge at a land fill.

Effluent Pump Station: As discussed the effluent pumping station has an effective capacity of approximately 3.5 MGD and it appears to have sufficient capacity for the next 20 years based on estimated 2028 PWWF.

Chlorine Contact Pipeline: The chlorine contact pipeline was designed to provide a maximum 30 minute contact time for a peak wet weather flow of 3.0 MGD. Although these PWWF events have been isolated, it is expected that within the next twenty years peak flows above 3.0 MGD will start to become a more common occurrence, especially if I&I reduction within the collection system is not achieved. Therefore it is recommended that in order to optimize the current chlorine contact pipeline volume the pipeline be internally inspected and if needed, cleaned of

solids. Inspection and cleaning of this pipeline may involve draining the pipeline temporarily, inspecting the pipeline with either a CCTV robot or divers and cleaning with hydro-flusher equipment and pumps to remove accumulated sediment.

Furthermore, in order to maintain the minimum 30 minutes of detention time in the future, the City will need to consider adding additional volume to the chlorine pipeline to accommodate the estimated 3.3 to 3.4 MGD PWWF that is predicted by 2028. Additional chlorine contact capacity may be needed. The addition of a parallel 20-inch pipeline to the existing 650 foot 16-inch chlorine force main would add necessary volume to the existing contact chamber to achieve the recommended 30 minutes of contact time at 3.4 MGD PWWF.

Chlorination Facilities: Chlorine gas is one of the cheapest sources of chlorine that can be purchased today. Unfortunately, chlorine gas also has its safety issues when it comes to handling and storing the gas. Recently, the Lake County Environmental Health Department has requested that the City prepare a Risk Management Plan for all City facilities that use chlorine gas for disinfection. This Risk Management Plan is a part of the new regulations for the California Accidental Release Prevention Program (CALARP). The CALARP Program was established in California to prevent accidental releases of those substances determined to potentially pose the greatest risk of immediate harm to the public and the environment. Although the City has had an excellent safety record in handling chlorine gas at their treatment plant, it is evident that the use of large quantities of chlorine gas near residential developments is coming under closer scrutiny at the County, State, and Federal level. Given this increased level of County involvement and the safety of City workers and the public, Lake County Environmental Health Department has requested that the City evaluate its chlorine handling processes at the treatment plant and consider replacing the gas disinfection processes in the near future with a safer method of disinfection (e.g., sodium hypochlorite).

Although there are several disinfection alternatives (calcium hypochlorite powder and tablets, sodium hypochlorite solution, etc.), it appears that the City should consider switching from gaseous chlorine to a sodium hypochlorite dosing system within the next five years. A typical hypochlorite system would include installing bulk hypochlorite storage tanks within a

containment building, chemical feed pumps, and appurtenances. It is proposed that the supply of hypochlorite solution would be trucked to the treatment site regularly from sources in Santa Rosa or Sacramento. Labor costs for operating a sodium hypochlorite system would be similar to use of the current gas system, however material costs would probably be twice as much as using gas. Currently, the maximum that the existing effluent chlorinators can deliver is about 400 pounds per day (ppd). At 3.0 MGD this equates to dosage rate of about 16 mg/l. In order to maintain this dosage rate for future 20-year peak flows (i.e., approximately 3.4 MGD), it is estimated that the chlorinators would need to deliver approximately 470 ppd. It is recommended that as a part of switching from chlorine gas to sodium hypochlorite, the new system incorporate effluent chlorinators that can deliver 500 ppd.

Effluent Reservoir and Disposal: The water balance that was created for this Master Plan (see Table 2) suggests that the current effluent reservoir and irrigation deposal system at the treatment plant has an effective capacity to treat a 0.51 MGD ADWF during a 100-year annual rain event. Based on this, and the City's continued I&I reduction efforts and a 1.1 percent growth rate, it appears the effluent reservoir and disposal facilities at the treatment plant have capacity for at least the next 20 years.

In order to investigate sources for future effluent disposal, the City of Lakeport recently received a Water Recycling Facilities Planning grant from the State Water Resources Control Board. This grant will be used to perform a study to investigate the feasibility of providing recycled water, which has been recognized as a valuable source of water in the State of California, from the City's treatment plant to other water users. As a part of this study it is anticipated that other disposal sources will be established, including the prospect of finding users that could utilize the City's treated effluent all year around, without any restrictions due to rainfall (e.g., the Geysers). It is anticipated that this Water Recycling Facilities study will be completed by November 2008.

Recycle Pump Station No. 1: Currently all recycle water run-off is collected in recycle reservoir No. 1 and pumped back to the overland system via Recycle Pump Station No. 1. This operation is controlled by level switches that activate the pumps based on pond level. Currently, pump operation can occur during any part of the day including the peak energy periods of

between 12:00 p.m. and 6:00 p.m. Given that there appears to be significant excess volume within Recycle Reservoir No. 1 during the summer months, the City should pursue the idea with PG&E to convert Pump Station No. 1's operation to a time-of-use operation to save energy costs. By operating the pump station during Partial-Peak (8:30 a.m. to 12:00 p.m. and 6:00 p.m. to 9:30 p.m.) and Off-Peak hours (9:30 p.m. to 8:30 a.m.) during the summer, significant energy costs could be achieved. Conversion of this pump station to time-of-use operation would simply require that station controls be modified to include timer controls and a pond level system that would override the timer operation and turn the pumps on when the pond exceeds a certain level.

SDA Treatment Plant Requirements: The Southern Development Area (SDA) previously discussed would include approximately 1,500 RUEs developed over an area of roughly 900 acres. This size development would equate to roughly 0.3 MGD ADWF and an estimated PWWF of around 2.0 MGD. Furthermore, the SDA developers propose that a large portion of the City's existing treatment plant effluent irrigation area be converted to a golf course, which would use the effluent for irrigation. In order to utilize the City's effluent for application onto a golf course, additional treatment of the effluent would be required, most likely tertiary treatment standards would be compulsory for the purpose of public health protection. Modification of the existing treatment plant to improve effluent quality to accommodate golf course irrigation needs may include the following options:

- Storage Reservoir Effluent Treatment:
    - Flotation Thickening and Filtration
    - Roughing Filter followed by Membrane Filtration
    - Roughing Filter followed by Upflow Clarification and Filtration (similar to existing water treatment plant)
- Replacing the Existing Oxidation Pond System for Unrestricted Reuse:
    - Conventional Activated Sludge with Effluent Coagulant Filtration
    - Activated Sludge with Membrane Filtration

Due to the speculative nature of the SDA at this juncture and the extent of the changes proposed to take place at the existing Lakeport treatment plant to accommodate a golf course, a comprehensive review of a practical treatment plant alternative for addressing the SDA development is beyond the scope of this Master Plan. It is anticipated that future tertiary treatment plant improvements will be evaluated as a part of the water recycling facilities study in order to determine which process will be the most cost effective in treating the existing effluent for recycle use.

ESTIMATES OF COST

BASIS OF COST ESTIMATES

Gravity sewer, force main, and other facility costs have been prepared using information from comparable projects in the area where construction contracts were competitively bid. Gravity sewer construction costs from these previous projects, projected to June 2008 costs, and an Engineering News Record Index (ENR) of 8185 are illustrated on the curves on Figure 6. The figure accounts for varying depths and types of backfill required. Values from these curves and recent projects were used as a guide in preparing the estimate of pipeline costs herein.

Note that these estimates are based, in many instances, on preliminary information. An example of this is the cost of proposed trunk sewers to serve areas that are currently undeveloped. Even in the developed areas, at the report stage, it is often difficult to determine the underground conditions relative to the amount of groundwater, rock excavation, and conflicts with existing utilities that would be encountered. These cost elements 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 Master Plan costs should be reasonably close and satisfactory for the basis of planning a financial program.

To obtain total project costs, construction contingencies and indirect costs were added to the construction costs. Construction contingencies are assumed to be 15 percent of the construction costs. Indirect costs include engineering, administration, and legal costs and amounts to about 25 percent. The total of the above two categories was taken at 40 percent for the treatment plant improvements and sewer improvements. This figure may vary considerably depending upon the complexity of the work.

All costs indicated in this report are based upon June 2008 dollars. For future or delayed work, an allowance for construction cost increases must be considered. During the last ten years,

general construction costs have increased at an average rate of about 3.2 percent per year. Similarly, the average rate of increase for the last four years has been about 5 percent per year. In projecting future costs, one should consider both short-term and long-term inflationary trends.

Note that costs presented in this report are capital improvement costs only and do not include any operation or maintenance costs of the sewer system. The total capital improvement costs include the estimated costs for correcting those high I&I areas that were identified for this study (see Plates 1 and 2, and Table 13). The projected capital costs do not include the annual cost for an I&I correction program outside these high I&I areas.

The need for sewer improvements has been determined using the best available information regarding the existing design capacity and flow conditions. However, the flow conditions are based on a small set of wet weather flow measurements and the future flow estimates are based on assumed growth rates. Because of the approximate nature of the flows, the improvements identified in this study are preliminary. Prior to expending any funds for improvements, a detailed analysis of each problem area should be undertaken by video inspecting and smoke testing those areas.

Time Periods

Near Term (2008 to 2013): Improvements where existing capacity is clearly less than the calculated theoretical and are thus needed as soon as possible or are needed to improve safety or performance of the existing facilities (probably within the next five years).

Intermediate Term (2013 to 2018): Other improvements that are marginal in capacity, or will be over the theoretical capacity in the next five to ten years, or are needed to improve performance or efficiency.

Long Term (2018 to 2028): The remaining improvements that are theoretically needed to have adequate capacity to meet 20-year development. Scheduling of these sewer facilities will be more definite in future Master Plan updates.