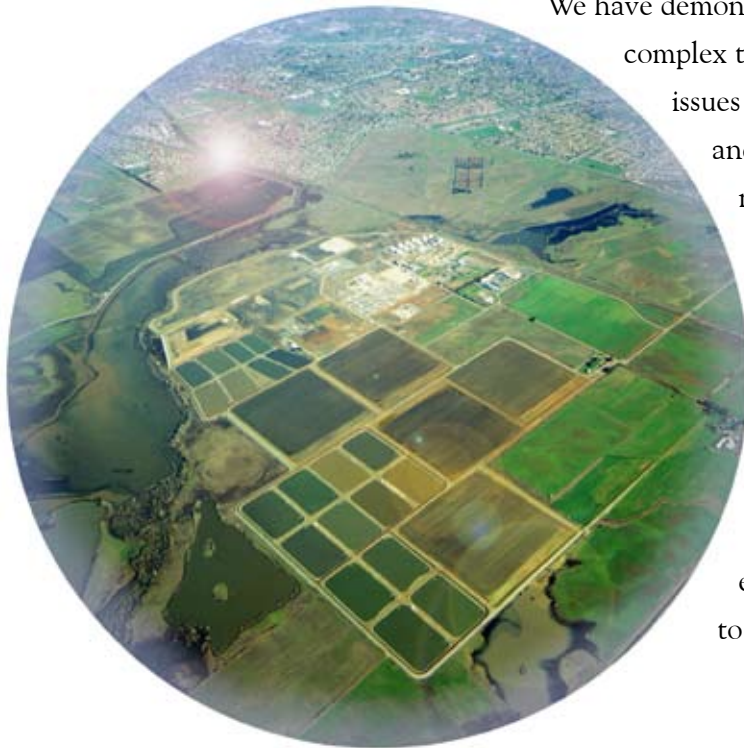




wastewater planning

In the last 10 years, Carollo has completed master plans for \$8.2 billion in wastewater facilities.

Carollo has been a leader in the development of award-winning, comprehensive master plans for wastewater agencies facing a variety of complex issues. Within the past 15 years, Carollo has prepared wastewater master plans or facility plans for more than 50 wastewater treatment facilities. We have also completed collection system planning for over 70 agencies.



We have demonstrated our ability to successfully simplify complex technical, legal, regulatory, and institutional issues to produce clear, concise, cost-effective, and implementable recommendations. Projects range from small planning studies to comprehensive regional master plans. These plans have addressed process and collection system reliability, flexibility, and operational issues. Our professionals provide cost-effective solutions which utilize existing facilities to the greatest extent possible and limit treatment alternatives and capital expenditures to the most reliable and easy-to-implement options.

Representative Projects - Wastewater Master Planning

Agency/Project	Project Elements												
	Capacity (mgd)	Environmental Enhancement/Wetlands	Collection System Planning/I/I Reduction Program	Public Involvement	Odors/Air Emissions	Discharge Permitting	Plant Hydraulics	Solids Handling	Disinfection	Filtration Enhanced Treatment	Regulatory Compliance	Multi-agency Coordination	Reuse/Recycling
City of Phoenix, Arizona - Three Major Facility/Master Plans	150				●	●	●	●			●	●	
City of Benicia, California - Wastewater System Improvement Project	4.5	●	●	●	●	●	●	●	●		●	●	●
Fresno/Clovis Wastewater Reclamation Facility, California - Facilities Master Plan	160	●	●	●		●	●	●			●		●
Orange County Sanitation District, California - Master Plans	276		●	●	●	●	●				●	●	
City of Riverside, California - Master Plan	47				●	●	●	●	●	●	●		●
Sacramento Regional County Sanitation District, California - 2020 Master Plan	181	●		●		●	●		●	●	●	●	●
Sacramento Regional County Sanitation District, California - 20-Year Master Plan	181	●		●	●	●	●	●	●	●	●	●	●
City of San Bernardino, California - 20-Year Master Plan	30				●	●	●	●	●	●	●		
Lower South Platte Regional Group, Denver, Colorado - Wastewater Utility Plan	70			●		●		●			●	●	
Metro Wastewater Reclamation District, Denver, Colorado - Service Area Utility Plan	80		●								●	●	
Carson City, Nevada - 20-Year Master Plan	6.5	●	●	●		●	●	●	●	●	●		
Cities of Reno and Sparks, and Washoe County, Nevada - 20-Year Master Plan	40			●	●	●	●	●		●	●	●	●
Cities of Reno and Sparks, and Washoe County, Nevada - Regional Wastewater Reclamation Facilities Design Phase I, II and III	40	●	●	●		●					●	●	●
Clark County Water Reclamation District, Las Vegas, Nevada - Wastewater Treatment Plant Facilities Master Plan	130				●		●	●		●	●		
City of Davis, California - Strategic Master Plan	7.5	●				●	●	●	●	●	●		
City of Petaluma, California - Water Recycling Facilities Planning	8	●		●		●	●	●	●	●	●	●	●
City of Stockton, California - Master Plan	48	●		●	●	●	●	●	●	●	●		●
City & County of San Francisco, California - Master Plan	84	●	●	●	●	●	●	●	●	●	●		●

Overall project management for 30-year wastewater master plan.

1,000 mile-long combined sewer system.

Condition assessments of existing wastewater treatment facilities and major pump stations.

Public outreach and involvement program.

Sewer Master Plan

San Francisco is the only coastal city in California with a combined sewer system. This system is made up of a 1,000-mile-long collection system and three treatment facilities that discharge to San Francisco Bay or the Pacific Ocean.

This 30-year master plan is a joint venture of three firms addressing citywide wastewater collection and treatment. Carollo is providing the overall direction of work, coordinating the other joint venture members and subconsultants, preparing materials for presentations to the Public Utilities Commission and stakeholder groups, facilitating team brainstorming workshops, and developing evaluation criteria to screen and compare alternatives. Carollo is also taking the lead on determining existing and future regulatory requirements and compliance, evaluating storm water and receiving water quality, and identifying green technology, including low impact development (LID) options for reducing storm water flow and desynchronizing peak flows. Work also includes an analysis of sea level rise in order to evaluate the potential impacts to the city's combined sewer system.

Key tasks include:

- ▶ Evaluating satellite treatment.
- ▶ Evaluating the condition of the three treatment facilities.
- ▶ Reviewing current and future regulations for effluent discharge, reuse, and biosolids.
- ▶ Identifying the future location, size, level, and type of treatment facilities.
- ▶ Identifying the future location and size of effluent outfalls.
- ▶ Integrating with the Water Reuse Master Plan.
- ▶ Developing costs, a CIP, and user rates and fees.
- ▶ Collaborating with an open public discourse involving various groups.
- ▶ Considering upgrading existing facilities and/or relocating treatment facilities at new sites.
- ▶ Modeling and planning for LID integration.
- ▶ Evaluating sustainability criteria.



San Francisco's Sewer Master Plan involves an analysis of sea level rise in order to evaluate the potential impacts to the city's combined sewer system.

FRESNO-CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY, CALIFORNIA

Facilities Master Plan

Carollo completed a 25-year wastewater master plan for the Fresno-Clovis Regional Wastewater Reclamation Facility. The master plan addresses the wastewater management needs for the projected population of approximately one million people in the year 2020, or 160 mgd, which is more than double the current flow and load to the plant. Key issues include the evaluation of new satellite wastewater treatment plants for developing outlying service areas, and increased levels of treatment for discharge to the San Joaquin River. The master plan also evaluated the potential impacts of on-site effluent percolation basins on groundwater quality and water reuse for agriculture and community-based uses.

The master plan also included the development of a recommended capital improvement program (CIP) including a financial analysis of the impact on sewer service rates and charges. A flow-and-load-triggered implementation strategy allows flow and load levels rather than a strict timetable to trigger expansion projects.

Environmental acceptance of the project was a key concern. The project included an assessment of the potential environmental impacts of the master plan recommendations in parallel with the master plan to ensure timely environmental compliance. Public acceptance of the master plan is also critical to implementation. The project included a comprehensive public participation program that involved identifying important interest groups and conducting focus groups, media outreach programs, and public meetings.

HIGHLIGHTS	Evaluation of satellite plants.
	Increased levels of treatment.
	Flow and load triggered implementation strategy.
	Environmental impact assessment.
	Financial analysis and CIP.



The Fresno-Clovis Regional Wastewater Reclamation Facilities Master Plan addressed wastewater management needs through a 25-year planning period which will more than double the current flow and load to the treatment facilities.

Master Plans

Carollo's master planning effort for the Orange County Sanitation District (OCSD), completed in April 1989, was the largest planning project ever undertaken by OCSD. The Master Plan contained eight separate volumes and over 3,500 pages. It identified facility needs for a 30-year planning period to the year 2020. By 2020, flows are expected to increase from the existing 260 mgd to 400 mgd.

For the treatment and disposal facilities, both Reclamation Plant No. 1 in Fountain Valley and Treatment Plant No. 2 in Huntington Beach were master planned to provide up to 240 mgd of primary and secondary treatment each. The Carollo team performed detailed evaluations to compare the applicability and cost-effectiveness of various treatment processes. Treatment processes selected include: chemically-enhanced primary treatment with ferric chloride and polymer, activated sludge secondary treatment, anaerobic sludge digestion, and belt filter press sludge dewatering. A detailed evaluation of biosolids management alternatives resulted in the recommendation that OCSD continue to engage in privatization contracts. The plan also added reclamation potential and a disaster preparedness plan, including acts of organized vandalism.

The 1989 Master Plan included a major financial analysis to determine cash flow needs for the identified projects, which totaled \$3.4 billion for the 30-year planning period (including O&M and cost of debt).

The project included an extensive public involvement program which was successful in building consent with the identified stakeholders.

- Largest planning project ever undertaken by OCSD.
- Evaluation of alternatives for full secondary treatment at each of OCSD's two main treatment facilities.
- Detailed evaluation of biosolids management alternatives.
- Major financial analysis.
- Extensive public involvement program.

“The 1989 OCSD Master Plan is an award-winning document of the highest caliber that has served well. Their attention to concerns of Directors, staff, public, regulatory agencies and other stakeholders insures success. They have established a record of completing work on time and on budget. I recommend Carollo Engineers without reservation.”

*—Tom Dawes, Former Director of Engineering,
Orange County Sanitation District*



Carollo has planned and designed all of the major joint works treatment plant expansions, interplant interceptors, and ocean outfall systems for OCSD since its inception in 1953. Wastewater conveyance, treatment, and disposal facilities include over 100 projects totaling \$3.4 billion.

2020 Master Plan

HIGHLIGHTS	Detailed treatment plant flow projections.
	Competitiveness guidance document.
	Proactive stakeholder outreach program.
	Interactive Master Plan Model to evaluate “what if” scenarios.
	Detailed financial analysis/revenue program.
Reuse/recycling evaluation and Bufferlands Master Plan.	

The Sacramento Regional County Sanitation District (SRCSD) retained Carollo to prepare a comprehensive 2020 Wastewater Master Plan for the Sacramento Regional Wastewater Treatment Plant (SRWTP). This 181-mgd pure oxygen activated sludge treatment plant serves the metropolitan Sacramento area with a population of over 1 million people and is the largest river discharging plant in California (discharging to the Sacramento River). Carollo also completed an award-winning Master Plan for the SRWTP in 1992. The 1992 planning effort successfully addressed a number of complex issues and outlined a program for planned expansion of up to 350 mgd at ultimate build out. Carollo updated the Master Plan in 1994 to reflect changes in Sacramento County’s General Plan.

The 2020 Master Plan not only provides SRCSD with a 20-year blue print for facility expansion, it also gives SRCSD staff valuable tools and guidelines to evaluate and assess changing conditions and requirements. Major components of the 2020 Master Plan include:

- ▶ A “Competitiveness Guidance Document” to assist SRCSD staff with planning and design decisions related to privatization, process optimization, and management/financing programs.
- ▶ An extensive stakeholder participation program to encourage input from regulators, water purveyors, agriculture, industry, environmental groups, and rate payers on future Master Plan alternatives/scenarios.
- ▶ Structural and non-structural alternatives to address future treatment requirements. Non-structural alternatives included source control, water conservation, and watershed offset programs.

“As Master Plan project manager, I would not hesitate to hire Carollo Engineers for future Master Plan related work. In my opinion, they are an exceptional firm.”

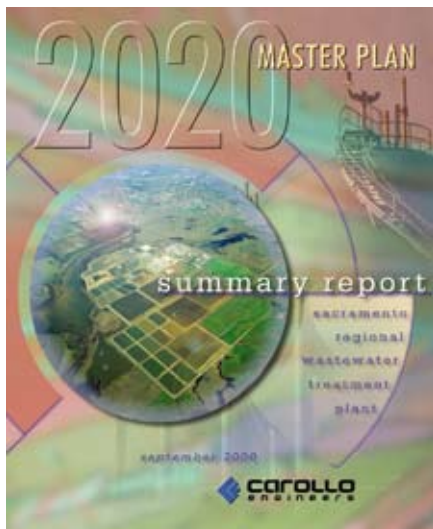
*—Mary James, Senior Civil Engineer,
Sacramento Regional County Sanitation District*

- ▶ An interactive Master Plan Model for evaluating future “what if” scenarios. The model combines all the basic Master Plan decisions into a user-friendly tool that generates process expansion information, capital and operations and maintenance (O&M) needs, and rate impacts.

- ▶ A Bufferlands Master Plan to provide guidance and direction for the 2,600 acres of mixed-use buffer area surrounding the plant.
- ▶ A reuse/recycling evaluation. The SRWTP now has a 5-mgd, California Title 22 water recycling facility on-site (expandable to 10 mgd).

The SRWTP currently treats about 155 mgd on an average annual basis. The 2020 Master Plan projects flows of 208 mgd by 2020, with peak wet weather flows of 434 mgd. The Master Plan estimates capital facilities to meet these projections at roughly \$700 million.

In addition to providing a 20-year blue print for facility expansion, the SRCSD 2020 Master Plan provides valuable tools to meet the challenges of changing conditions and requirements.



Wastewater Utility Plan

The development of the new Denver International Airport (DIA) has spurred significant growth in the northeast quadrant of the Denver metropolitan area. Because the majority of the wastewater generated from this area must be pumped upstream to the Metro Wastewater Reclamation District's central plant for treatment and disposal, three wastewater entities joined to fund the development of a new regional treatment facility. The Lower South Platte Regional Group, comprises the Metro Wastewater Reclamation District, South Adams County Water and Sanitation District, and the City of Brighton, retained Carollo to develop a wastewater utility plan for this facility. Preliminary service area and flow and load projections indicate the ultimate size of the facility could be 60 mgd, with an initial-phase capacity of at least 15 mgd.

Work includes a siting study to identify and acquire a 100+/- acre site downstream of Brighton; evaluating treatment process options; assessing biosolids treatment and disposal alternatives, identifying capital, operations, and maintenance requirements; siting and sizing service area transmission infrastructure; and permit acquisition.

Preliminary effluent limits indicate that, in addition to providing conventional treatment, the plant may have to meet ammonia effluent limits as low as 4 mg/L, possible future denitrification with a total inorganic nitrogen (TIN) limit, and a potential future phosphorus limit.

Odor control and "good neighbor" concerns are issues. The project will include a public education and involvement program and the team will consider minimizing negative public reaction and developing informed

consent for the new plant as part of the process selection process. It will also be necessary to evaluate biosolids treatment and disposal at the treatment plant site.



As part of a comprehensive planning study, Carollo evaluated potential sites for locating a new regional wastewater treatment facility northeast of Denver.

HIGHLIGHTS

New wastewater treatment facility.

70-mgd ultimate capacity;
15-mgd first-phase capacity.

Extensive permitting requirements.

Nutrient removal and effluent filtration.

"Good neighbor" design considerations.

Service Area Utility Plan

The Metro Wastewater Reclamation District (MWRD) retained Carollo to complete a Service Area Utility Plan. This plan addresses the current hydraulic capacity of the transmission system, including impacts of infiltration and inflow, and examines its ability to provide adequate service in the future. The work effort determines demographic trends within MWRD's service area so that wastewater flows conveyed to the MWRD's Central Treatment Plant can be estimated. Part of this process includes estimating and examining long-range population and land use trends.

MWRD's transmission system includes 43 gravity interceptor sewers, four lift stations, and four force mains. This system consists of approximately 236 miles of sewer pipe ranging in size from 8 inches to 90 inches in diameter, 65 primary metering facilities, 41 diversion structures, and approximately 3,750 manholes. Much of the transmission system was constructed within the last 15 to 20 years.

The project involves reviewing and recommending improvements to MWRD's Transmission Division's inspection and maintenance program. Work includes developing a comprehensive real-time InfoWorks model of the distribution system, maintainable by MWRD staff. Key features of this model are:

- ▶ A GIS-based land-use and population projection model.
- ▶ A flow-and-load-based model.
- ▶ A hydraulic model of the collection system.
- ▶ A predictive corrosion model.

The model's purpose is to evaluate the capacity and condition of the collection system to handle service area flows and loads. Project tasks have included the evaluation of several hydraulic models (with the final selection of InfoWorks) and development of a GIS-based data storage system using ArcView. Additional tasks include evaluating the current inspection models and conducting a condition assessment of the entire collection system as part of a sanitary sewer overflow (SSO) elimination program with the Colorado Department of Public Health and Environment (CDPHE).

The review of inspection and system condition will ultimately be guided by the capacity, management, operations, and management (cMOM) regulations. Final products will include the utility plan report, a capital improvements plan, a comprehensive service area model with the four model components listed, and an inspection and condition evaluation.

HIGHLIGHTS

- Evaluation of the capacity and condition of MWRD's collection system to handle service area flows and loads.
- Distribution system modeling.
- Improvement recommendations for MWRD's Transmission Division's inspection and maintenance program.
- Guided by the cMOM regulations.



The Service Area Utility Plan for the Metro Wastewater Reclamation District addresses 43 gravity interceptor sewers, four lift stations, four force mains, 65 primary metering facilities, 41 diversion structures, and approximately 3,750 manholes.

Engineer's Report for 1998 Wastewater Revenue Bonds

HIGHLIGHTS

Assessment of wastewater collection and treatment facilities for eight wastewater basins.

Detailed financial analysis.

Identification/evaluation of approximately \$2 billion in capital facilities.

Carollo completed an Engineer's Report for inclusion in the Official Statement relating to the issuance of revenue bonds in 1998 to finance capital improvement projects (CIP) for Honolulu's wastewater system. These bonds will be issued to finance a comprehensive 20-year CIP for the City and County of Honolulu. The Engineer's Report assesses the overall condition of the collection system and wastewater treatment facilities for eight separate wastewater basins on the island of Oahu. The treatment plants range in size from less than 1 mgd to greater than 80 mgd. The report addressed the need for the CIPs, the appropriateness of projected expenditures and project timing, and the adequacy of projected revenues.

The Engineer's Report includes a detailed financial analysis of projected operation and maintenance costs, capital costs, service charges, financing schedules, debt payments, reserve fund levels, and debt coverage ratios. The report identified and evaluated approximately \$2 billion in capital facilities as to project timing, impact on cash flow requirements, and regulatory requirements. Projects planned include collection system improvements/expansion, water reuse and distribution, headworks and primary treatment, secondary treatment, and solids handling and disposal.



Carollo prepared the Engineer's Report for the bond issue to finance a comprehensive 20-year CIP for Honolulu's wastewater facilities.

Regional Wastewater Reclamation Facilities Master Plan

HIGHLIGHTS	Phased program of structural and non-structural improvements.
	Sophisticated river modeling.
	Major reuse projects to reduce TDS loadings to the Truckee River.
	Integrated resources analysis.
	Financial analysis and public involvement program.

Carollo prepared the wastewater element of the 1995-2015 Washoe County Regional Water Management Plan for the cities of Reno and Sparks and Washoe County. The wastewater plan provides a phased program of new facilities to accommodate growth and meet future discharge requirements and water quality objectives through the year 2015. The plan evaluated both non-structural and structural approaches to meet the stringent water quality objectives established by the Nevada Division of Environmental Protection for the Truckee River.

Non-structural alternatives developed to reduce nitrogen and total dissolved solids (TDS) loadings to the Truckee River include non-point source control, river restoration, and water conservation. Carollo used sophisticated river modeling to estimate the increased nitrogen loading capacity of the Truckee River due to the purchase of agricultural water rights along the river and restoring several sections of the river to a more natural configuration.

Structural alternatives evaluated for the 40-mgd Truckee Meadows Water Reclamation Facility and the 0.75-mgd South Truckee Meadows Wastewater Treatment Facility include expanding the regional treatment facilities versus building a second satellite plant. In addition, the plan developed major reuse projects to reduce TDS loadings to the Truckee

River and to provide a drought-proof supply for various water users.

Carollo performed an integrated resources analysis between the water supply and wastewater facilities. This analysis identified several linkages, including TDS and water conservation, that affect the overall capacity and operating costs of both water and wastewater systems. Alternatives were then developed integrating these linkages in order to determine the

optimum level of water conservation that should be practiced to reduce the TDS loading to the Truckee River.

Based on the results of the wastewater plan and the integrated resources analysis, Carollo prepared a detailed financial analysis of the recommended non-structural and structural facilities for the region. Carollo also coordinated and implemented an effective public involvement program to bring together the major stakeholders to obtain their consent.

“Throughout our wastewater master planning effort Carollo Engineers has exhibited the qualities I value in an engineering consultant, and which distinguish them above many other firms I have previously dealt with.”

—David R. Roundtree, Regional Water Manager, Washoe County



The Reno Master Plan provides a road map for improving performance of existing facilities at the Truckee Meadows Water Reclamation Facility and the South Truckee Meadows Wastewater Treatment Facility.

Wastewater Treatment Plant Facility Master Plan

The Clark County Water Reclamation District (CCWRD) selected Carollo to prepare its Wastewater Treatment Plant Facility Master Plan for plant expansion from 88 to 130 mgd. Completed in March of 1998, the purpose of the facilities plan was to evaluate the treatment capabilities of CCWRD's existing facilities, plan for the next reasonable increment of capacity to accommodate growth, and identify future treatment needs.

The facility plan identified treatment expansion requirements consisting of a total of \$640 million for new facilities to accommodate growth and replace aging facilities. Las Vegas is one of the fastest growing communities in the nation with an average growth rate of 7.2 percent per year. It is also one of the few communities in the western United States that discharges treated wastewater to a high-quality lake (Lake Mead) that is used as a drinking water supply. Treatment requirements are very stringent, requiring essentially complete phosphorus removal and nitrification. Future facilities include BPR and tertiary treatment consisting of ferric chloride addition and filtration. Carollo evaluated the existing treatment processes and developed a facility layout based on the most economical use of existing facilities combined with the best use of alternative wastewater treatment processes. Processes/facilities evaluated as part of the planning effort included influent flow metering and splitting, a new headworks, expanded primary sedimentation, biological nutrient removal (BNR)/activated sludge, solids handling, odor control, power distribution, plant utilities, advanced wastewater treatment, and support facilities. Proposed new facilities will increase capacity and meet regulatory guidelines in a manner that requires low maintenance, is energy efficient, highly reliable, flexible, and cost effective.

CCWRD now operates one of the largest BPR plants in the country.



Carollo has identified innovative approaches for the Clark County Sanitation District which will save over \$3.2 million per year in operating expenses.

HIGHLIGHTS

Facility layout based on most economical use of existing facilities and the best use of alternative wastewater treatment processes.

Proposed facilities that are flexible, reliable, energy efficient, easy to maintain, and cost effective.

Continued BPR removal to meet stringent discharge requirements.

