



biosolids

management

Carollo has provided planning and/or design for facilities to accommodate more than 750,000 tons of biosolids per year.

Today many clients are facing critical decisions about key components of their wastewater treatment and disposal practices due to rapid growth and emerging technologies. Carollo's knowledge of local conditions and political and regulatory climates, as well as our strong background in biosolids thickening, dewatering, disposal, and beneficial reuse, make us a leader in biosolids management. We have developed numerous biosolids management plans and have designed, constructed, and implemented biosolids management projects which have helped our clients

beneficially reuse in excess of one million cubic yards of biosolids within the last five years. We have designed nearly 100 digesters and over 50 biosolids dewatering units.

The matrices on the following pages summarize many of the biosolids planning and design projects completed by Carollo. Highlights of a few key projects are provided on the pages that follow.



Representative Projects - Biosolids Design

Client/Project	Project Elements					
	Sludge Thickening	Anaerobic Digestion	Biosolids Dewatering	Solids Storage	Polymer Systems	Composting
City of Phoenix, Arizona - 91st Avenue Wastewater Treatment Expansion	●	●				●
Central Contra Costa Sanitary District, California - Centrifuge Facility Design	●		●		●	
Inland Empire Utilities Agency, California - RP-3 Design	●	●	●	●	●	
Fresno-Clovis Regional Wastewater Reclamation Facility, California - Facilities Master Plan	●	●	●	●	●	
Napa Sanitation District, California - Soscol Water Recycling Facility	●	●	●	●	●	●
Orange County Sanitation District, California - Plant No. 1 - Biosolids Handling Project	●	●	●	●	●	
Orange County Sanitation District, California - Plant No. 2 - Biosolids Handling Project	●	●	●	●	●	
City of Riverside, California - Wastewater Treatment Plant Upgrade	●	●	●		●	
San Bernardino Municipal Water Department, California - Wastewater Treatment Plant Expansion	●	●	●	●	●	
City of San Diego, California - Point Loma Wastewater Treatment Plant Improvements		●				
City of San José, California, San José/Santa Clara Water Pollution Control Plant - Long-Term Biosolids Project	●			●		
Metropolitan Wastewater Management Commission, Eugene/Springfield, Oregon - Biosolids Dewatering			●	●	●	
City of Provo, Utah - Biosolids Plan and Facility Upgrades	●	●	●	●	●	●

Representative Projects - Biosolids Planning

Client/Project	Project Elements					
	Capacity (mgd)	Biosolids Facility Planning	Land Application	Composting	Other Reuse/ Disposal Alternatives	Biosolids Regulations
City of San Diego, California - Point Loma Wastewater Treatment Plant Master Plan	240	●				
Orange County Sanitation District, California - Short-Term Biosolids Master Plan	230	●	●	●	●	●
Sacramento Regional County Sanitation District, California - 20-Year Master Plan	180	●	●	●	●	●
East Bay Municipal Utility District, California - Biosolids Management Plan	168	●	●	●	●	●
City of San José, California, San José/Santa Clara Water Pollution Control Plant - Long-Term Biosolids Management Plan	167	●	●		●	●
City of Phoenix, Arizona - 91st Avenue Wastewater Treatment Plant Master Plan and Two-Phased Digestion Projects	150	●	●		●	●
Clark County Sanitation District, Las Vegas, Nevada - Wastewater Treatment Plant Facilities Plan	130	●				●
City and County of San Francisco, California - Long-Term Biosolids Management Plan	106	●	●	●	●	●
Fresno-Clovis Regional Wastewater Reclamation Facility, California - Facilities Master Plan	80	●	●	●	●	●
San Bernardino Municipal Water Department, California - Focus Facilities Plan	60	●				
City of Stockton, California - Biosolids Management Plan	55	●	●	●	●	●
Eastern Municipal Water District, Perris, California - Biosolids Master Plan and Pasteurization Projects (with digesters) for Four Regional Plants	51	●	●		●	●
Metropolitan Wastewater Management Commission, Eugene/Springfield, Oregon - Biosolids Dewatering Facility	49	●				
City of Riverside, California - Facilities Plan	40	●				
Inland Empire Utilities Agency, California - RP-3 Master Plan	32	●	●	●	●	●
Delta Diablo Sanitation District, California - Biosolids Master Plan	24	●	●	●	●	●
City of Provo, Utah - Biosolids Management Master Plan and Facility Upgrades	21	●		●		●
Timpanogos Special Services District, Utah - Facilities Planning	20	●		●		●
City of Santa Barbara, California - Biosolids Alternatives Analysis	16	●	●	●	●	●
Napa Sanitation District, California - Biosolids Management Plan	8	●	●	●	●	●



ORANGE COUNTY SANITATION DISTRICT, FOUNTAIN VALLEY, CALIFORNIA

Solids Handling Facility

HIGHLIGHTS

Largest installation of its type in the U.S.

Successfully addressed odor control, site restriction, reliability, and ease-of-operation issues.

Nine 125-hp, 500-psi hydraulically-driven reciprocating piston pumps.

Fully automated system.

Winner of the California Water Environment Association's 1992 Engineering Achievement Award.

This unique 108-mgd biosolids handling facility combines state-of-the-art pumping, storage, and loading technology with computer automation in a system capable of transporting nearly 600 cubic yards of biosolids cake daily. This solids storage and truck loading facility at Plant No. 1 is one of the largest installations of its type in the United States. The project, which received the California Water Environment Association's Engineering Achievement Award in 1992, efficiently transports dewatered biosolids to storage and truck loading facilities. Issues successfully addressed in the design development stage include odor control, site restrictions, reliability, and ease of operation.

The facility includes nine 125-horsepower, 500-psi, hydraulically-driven reciprocating piston pumps (HDRPPs)—five for cake transfer and four for cake loading. A large-scale application of concrete pumping technology, each HDRPP has a rated capacity of 25 cy per hour.

Dewatered biosolids from belt filter presses are pumped to four 450-cy storage bins capable of holding 1,800 tons of biosolids for up to five days. Should there be an interruption in hauling, this reserve capacity allows the system to stay continuously on line. Each storage bin has a live bottom which discharges to a dedicated cake loading HDRPP. These pumps transport the biosolids cake to a truck loading hopper, where trucks parked on an active scale are loaded with up to 25 tons of cake at two separate points in the truck bed.



Orange County's biosolids handling facility combines state-of-the-art pumping, storage, and loading technology with computer automation in a system capable of transporting nearly 600 cy of biosolids cake daily.

The solids storage and loading facility is fully automated and controlled with PLCs. The PLC monitors and automatically adjusts many operational variables. A graphic control panel displays biosolids level and alarm status. The PLC automatically adjusts pump speeds and signals shut-off when biosolids reach the desired level. To facilitate efficient truck loading, a weighing scale microprocessor records and updates information about truck weight, volume, etc. The PLC uses this data to open the loading hopper and signal shut-off when the truck is nearly full.

Residuals Management

Carollo has been providing engineering services to the Phoenix Metropolitan area since the early 1950s. Our work for the City of Phoenix includes the development and successful implementation of a Residuals Management Facilities Plan, a test biosolids lagoon program, design of biosolids lagoons, and the development of biosolids lagoon operation and maintenance procedures.

The Residuals Management Facilities Plan, prepared by Carollo in association with others for both the 91st and 23rd Avenue wastewater treatment plants, was based on a combined wastewater flow of 157 mgd through the year 2000. The plan evaluated mechanical dewatering alternatives such as a belt presses, solid bowl centrifuges, and vacuum filters; solar dewatering methods such as biosolids lagoons and sand beds; and thermal drying methods such as flash drying with and without heat recovery.

The project team also performed an extensive evaluation of ultimate biosolids disposal/reuse alternatives including:

- ▶ Thermal reduction methods such as rotary kiln incineration, multiple-hearth incineration, fluidized-bed incineration, and pyrolysis.
- ▶ Windrow, aerated pile, and mechanical composting.
- ▶ Land disposal/reuse options such as landfilling and land application.

Carollo evaluated biosolids dewatering and reuse/disposal alternatives based on technical, physical, biological, socioeconomic, and cultural factors. As a result of this analysis, Carollo implemented recommendations which specifically addressed biosolids dewatering and disposal requirements for 100,000 tons of stockpiled biosolids as well as daily biosolids

production at the 150-mgd 91st Avenue Wastewater Treatment Plant.

Carollo designed 100 acres of special biosolids lagoons to compliment the already existing 110 acres of drying beds. Carollo also conducted an evaluation of compost-drying techniques. Phoenix contracted with a private firm to buy all biosolids produced.



Sludge dewatering options investigated as part the Phoenix Residuals Management Facilities Plan included mechanical methods, solar dewatering, thermal drying and composting.

HIGHLIGHTS

Residuals Management Facilities Plan.

Design of 100 acres of biosolids lagoons.

Addressed dewatering and disposal requirements for 100,000 tons of stockpiled biosolids as well as daily biosolids production.

Biosolids Management Master Plan and Facility Upgrades

Provo City selected Carollo to complete a biosolids master plan with beneficial reuse options focusing on full use of Provo's biosolids in a composting program. The master plan study included evaluating digester-mixing improvements and biosolids dewatering alternatives.

Composting alternatives included developing physical siting and layout of the composting facility and determining the quantity of bulking agent required to fully utilize Provo's biosolids. The study team projected revenues from the composting operation and determined capital and operations and maintenance (O&M) costs.

Digester mixing alternatives included pump mixing, mechanical draft tubes, and various gas mixing options. The team prepared capital and O&M cost estimates for each alternative. Rehabilitating the existing gas-mixing system provided the least expensive alternative. Rehabilitation included replacing the existing reciprocating compressors with stainless steel liquid ring compressors and providing stainless steel gas piping.

Following an evaluation of biosolids dewatering options, the team selected centrifuges based on project capital and O&M costs and other non-economic considerations. Carollo provided design and construction management services for the new dewatering facility and digester mixing improvements. Carollo prepared a prepurchase specification with an evaluated bid for competitive procurement of the centrifuge. Carollo also

designed a new dewatering building which included an elevated centrifuge platform, polymer feed facilities, shaftless screw conveyors for dewatered cake transport, and an enclosed truck loading bay with a cake storage hopper.

HIGHLIGHTS

Beneficial reuse options focusing on full use of Provo's biosolids in a composting program.

Digester-mixing improvements.

Design of a centrifuge dewatering facility.



Carollo has completed a biosolids master plan and recommended equipment for expansion of Provo's compost facility.

Residual Sludge Management Program

HIGHLIGHTS

On-going biosolids management assistance for San José since 1982.

One of the most cost-effective biosolids programs in the country.

A biosolids management program which will beneficially reuse over 1 million cubic yards of dried material over a five-year period.

Currently producing a dried Class A biosolids product.

The San José/Santa Clara Water Pollution Control Plant processes 110 million gallons of wastewater daily. This processing creates 1 million gallons of liquid sludge daily. After digestion, approximately 150 tons of solid matter remains and requires drying for ultimate disposal.

San José pumps the sludge from the digesters into existing storage lagoons. These lagoons are used exclusively to concentrate and store digested sludge. Recognizing that the existing sludge lagoons would soon be filled, San José retained Carollo to develop a program to manage the residual sludge and to extend the useful capacity of the lagoons. The selected program includes establishing an on-going unit process of lagoon use, on-site solar drying, and on-site stockpiling of dried sludge. Carollo developed the program based on the best technology successfully being used by other agencies similar in size or climatic conditions to San José.

Tasks required for the implementation of this program include major earthwork to construct 20 drying beds of varying sizes totaling 250 acres and extensive piping networks to transport dredged sludge from the storage lagoons to the drying beds. The project also included a number of support facilities, including road improvements, a dried sludge storage area, runoff control facilities, and facilities for equipment and employees.

Carollo also prepared the contract documents to purchase specialized equipment such as floating dredges with submersible sludge pumps, large earth moving and hauling equipment, sludge booster pumps, and other related equipment.

Carollo's biosolids management work for the City of San José, California has received national attention.



San José currently has one of the most cost-effective biosolids programs in the country. The plant produces a dried Class A biosolids product. The biosolids are reused as alternate daily cover material at a cost of \$7.00 per cubic yard. The cost for biosolids disposal at the plant (downstream of digestion) is \$28.70 per dry ton.

Long-Term Biosolids Management Plan

HIGHLIGHTS

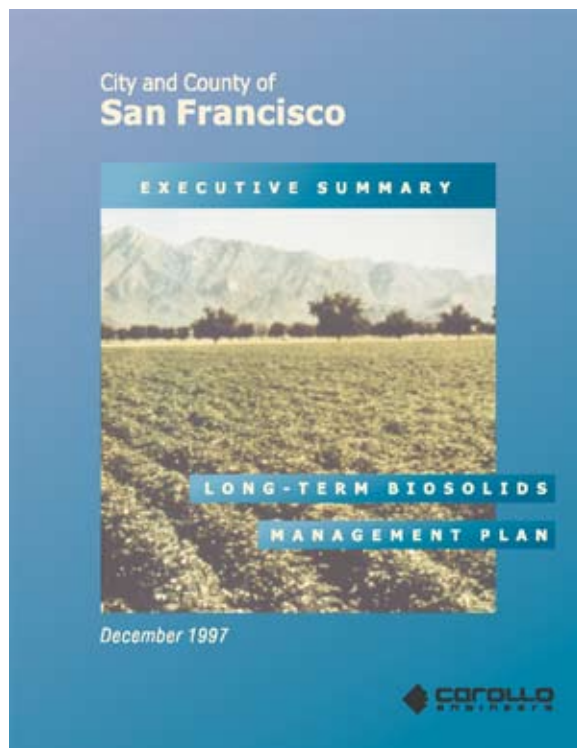
- Multi-faceted, mutually-beneficial, and cost-effective program.
- Innovative solutions involving co-management with residuals from other agencies.
- Market study to consider biosolids product demand and identify potential markets.
- Public participation program aimed at educating public on the benefits of biosolids reuse.

San Francisco currently generates approximately 80,000 tons per year of anaerobically-digested biosolids at its two secondary treatment facilities, the Southeast and Oceanside Water Pollution Control Plants. These biosolids are dewatered and hauled to a sanitary landfill for disposal. To improve the flexibility and reliability of its biosolids reuse/disposal program, Carollo assisted San Francisco in preparing a Long-Term Biosolids Management Plan. The goal of the plan is to maximize beneficial reuse while maintaining reliable capacity for 150 to 200 percent of San Francisco's total biosolids production.

In addition to studying conventional biosolids processing and reuse/disposal alternatives, the client/consultant team considered innovative solutions which involve co-management with residuals from other agencies. For example, the plan considered solids management for residuals generated by the San Francisco Water Department at its two water treatment plants.

Since beneficial reuse is a key consideration of San Francisco's planning effort, a significant portion of the project involved biosolids marketing and public participation. Carollo helped San Francisco conduct a market study to determine the critical factors which influence the demand for biosolids products, identify potential markets for biosolids products and the sources of competition, and estimate the demand for biosolids products and the potential market value. The project also involved a concurrent public participation program aimed at educating the public on the benefits of biosolids reuse and building consensus.

The goal of San Francisco's Long-Term Biosolids Management Plan is to maximize beneficial reuse while maintaining reliable capacity for 150 to 200 percent of San Francisco's total biosolids production.



The primary objective of this project was to develop a multi-faceted program with the flexibility to accommodate changes in biosolids characteristics, regulations, and public acceptability. By coordinating San Francisco's effort with other agencies facing similar situations, the project's goal was to help San Francisco achieve a mutually-beneficial, cost-effective program. This, coupled with a sound technical evaluation, careful market research, and earnest public participation, provided San Francisco with a biosolids planning approach attuned to the challenges of the twenty-first century.

METROPOLITAN WASTEWATER MANAGEMENT COMMISSION, EUGENE/SPRINGFIELD, OREGON

Biosolids Dewatering Facility

The Metropolitan Wastewater Management Commission selected Carollo to design a new mechanical dewatering facility to be installed at the Regional Biosolids Management Facility. The facility processes biosolids from the agency's 49-mgd regional wastewater treatment plant. The new system will supplement the existing air drying beds that are used in conjunction with facultative sludge lagoons.

When complete, the facility will pump biosolids from the existing lagoons into two 350,000-gallon mixed-feed tanks, each of which will hold one day's production. From there, they will be pumped through strainers to three 2.0-meter belt filter presses. A screw conveyor will then carry cake to a truck loading facility with a 200-cubic-yard mechanical hopper. A confined slab area will provide auxiliary storage.

The client will operate the facility about five months per year on a schedule of seven days per week and two shifts per day. It will have a capacity of 420 gpm at 3.5 percent solids. Pilot studies indicated a cake with about 18 percent solids.

The new concrete block dewatering building will include a number of windows and skylights to maximize natural light. It will house the three presses, three feed pumps, three strainers, a dry polymer storage and mix system, polymer feed pumps, a motor control center, a control room, and a solids process laboratory.

The dewatering system will be controlled with an advanced control system that automatically modulates polymer feed and other critical operating parameters based on the quality of the press filtrate. It is designed to reduce operating costs and the level of operator attention.

HIGHLIGHTS

- Mechanical dewatering facility with three belt filter presses.
- State-of-the-art cake hopper system with automatic loading controls.
- Sludge expert control system to automate operation, optimize cake quality, and minimize operations/labor costs.



Carollo's design of a new belt filter press dewatering facility will supplement the existing overloaded air drying beds at the Eugene-Springfield Regional Biosolids Management Facility.



WATER ENVIRONMENT RESEARCH FOUNDATION, ALEXANDRIA, VIRGINIA

HIGHLIGHTS

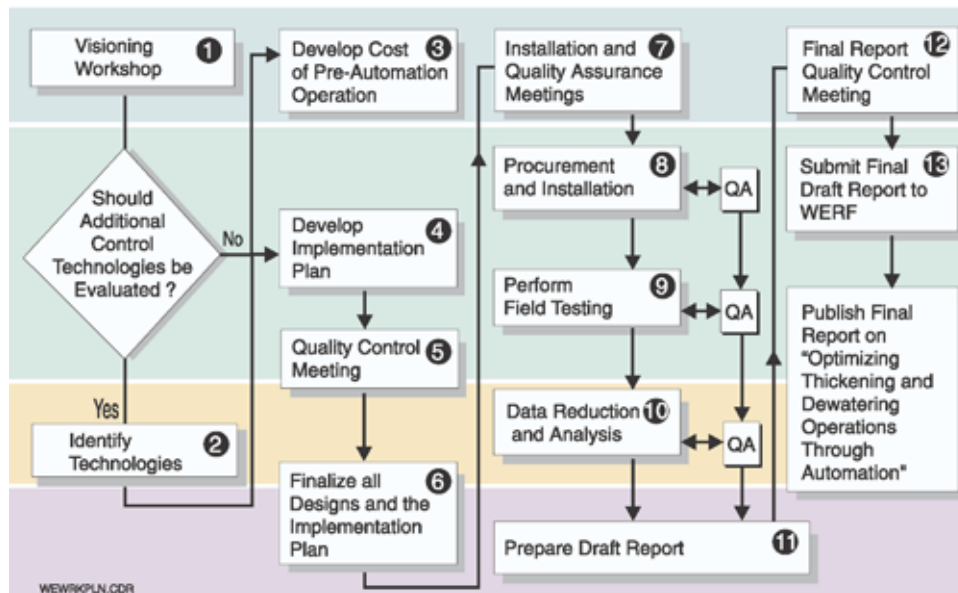
- Cutting-edge research project.
- Investigates biosolids automation as a method to reduce operating costs.
- Long-term operational tests on automation packages.

Automation of Thickening and Dewatering Operations

The Water Environment Research Foundation (WERF) Board of Directors selected Carollo's proposal on Optimizing Thickening and Dewatering Operations through Automation (RFP 98-REM-3) for funding in 1998. The premise of the project submitted by Carollo is that implementation of fully-automated biosolids processing can reduce operational costs. As agencies seek to do more with less, automation provides a potential opportunity to operate various processes with a smaller staff, while incorporating additional cost saving benefits.

Previous studies dedicated to the research and development of dewatering automation packages concentrated on the theory behind the monitoring device. Little objective research has been conducted to either quantify or qualify the applicability and overall value of automatic solids handling process control. Our study proposes to take the research on automated thickening and dewatering process control to the next level by performing long-term operational tests on automation packages that are likely to work. Automation for solids handling equipment allows the operator to direct the automation package to control for minimum polymer use, maximum cake solids, or maximum throughput. Implementation of an automation package increases the consistency of the cake solids which allows for better control of down stream solids handling processes.

Work Plan for WERF Thickening and Dewatering Automation Research Project



Carollo's cutting edge work on solids process control allows us to offer our clients first-hand knowledge of emerging automation technologies that are available for process optimization.