Tertiary treatment facility with cloth media disk filters, chlorine disinfection basins and recycled water storage tank.

Photos courtesy of Parsons/Rich La Salle

# Greener Plants

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*Bakersfield, California's eleventh-largest city, has a population of 338,952 and is located in Kern County. The city's generated wastewater is treated in two plants: Plant 2, which treats 25 million gal per day (mgd), and Plant 3, which treats 32 mgd. Before expansion, Plant 3's capacity was 16 mgd, and it was often in violation of its effluent discharge permit.*

## Innovative and sustainable upgrades to Bakersfield WWTP

The upgraded Bakersfield Wastewater Treatment Plant 3.

Covered aeration basins achieve the zero-odor plant goal.

In 2004, the city of Bakersfield decided to upgrade and expand Plant 3 to address its capacity needs and regulatory requirements, including nitrogen removal to 10 mg/L of total inorganic nitrogen for groundwater recharge. The city retained Parsons to plan for this upgrade (to an ultimate 64-mgd capacity) and to provide design and construction support services for Plant 3's 32-mgd capacity.

Before the upgrade and expansion, Plant 3 was a 16-mgd secondary treatment facility with 40/40 effluent quality requirements for irrigation and onsite percolation. The treatment train consisted of one headworks, four primary clarifiers, four trickling filters, four secondary clarifiers, four percolation ponds, six anaerobic digesters, 24 sludge-drying beds and one cogeneration facility. In addition, an 8-mile-long effluent pipeline conveys up to 14 mgd of secondary effluent to Los Angeles' Green Acres Farm.

### Capital Improvement

Plant 3's upgrade is the largest capital improvement project in Bakersfield's history. It increased the plant's reliable treatment capacity to 32 mgd with biochemical oxygen demand (BOD) and nitrogen removal. The city had two major goals for this project:

1. Address capacity and regulatory requirements; and
2. Consider state-of-the-art and cost-effective technologies for treatment processes, odor control, biosolids management, biomass energy recovery and recycled water production.

The city also wanted to incorporate innovative ideas and energy-saving features to maximize its benefits to the community.

This project required about 1.2 million man hours, 65,000 cu yd of concrete, 45,000 ft of aboveground pipeline and 90,000 ft of underground pipeline. The project construction was completed on time and with no recordable Occupational Safety & Health Administration accidents. Since startup, Plant 3 has outperformed all regulatory requirements.

### Expansion Features

Key features of the 32-mgd expansion project include:

- One 40-mgd McCutchen-Gosford lift station;
- One headworks, eight primary clarifiers (including four converted from existing secondary clarifiers), 10 new aeration tanks and four new secondary clarifiers;
- Two dissolved-air flotation thickeners to thicken activated sludge;
- Plantwide odor control system, including conversion of two decommissioned trickling filters into biofilters, plus one additional biofilter to treat odor from sludge-dewatering building;
- Septage- and grease-receiving stations;
- New 1.9-MW biomass energy recovery system using two 848-kW internal combustion (IC) engines and a state-of-the-art digester gas purification system to remove moisture, particulates, hydrogen sulfide and siloxane;
- A 1 MW-capacity, ground-mounted, single-axis-tracking solar photovoltaic (PV) system;
- Eight anaerobic digesters, including two new large digesters and sludge-dewatering facility with centrifuges;
- A 2 mgd-capacity tertiary treatment system with cloth media filters and sodium hypochlorite for disinfection;
- Five percolation ponds; and
- Leadership in Energy and Environmental Design (LEED)-type administration and control buildings.

### Technical Issues & Design Challenges

***Major change in design concept.*** The original design considered capacity expansion to 24 mgd for BOD removal only, but the city decided during predesign on a 32-mgd capacity to provide for BOD and nitrogen removal, an extensive odor control system and a 2-mgd tertiary treatment facility.

***"Zero-odor" plant.*** Because of the presence of residential housing and the development of Bakersfield Sports Village nearby, the city required the design of a

zero-odor plant.

***Innovative approach for use of existing facilities.*** Plant 3's design concept incorporated converting the decommissioned trickling filters to biofilters for odor control and modifying the four existing secondary clarifiers to become primary clarifiers for the 32-mgd expansion.

***Keeping existing plant in operation during construction***. Maintaining plant operations during construction required intricate coordination and sequencing between the trickling filter shutdown and the startup of the new activated sludge system, plus effective monitoring of plant hydraulics while the wastewater flow was transferred from the trickling filters to the aeration basins.

***Training plant staff for new processes.*** Parsons provided the city with intense onsite training and maintained its continuous assistance to the plant staff for several months after new Plant 3 startup because operation of the new treatment processes required a considerably higher skill level than did the former trickling filter system.

***Configuring percolation basins to avoid interference with high-pressure gas line.*** To avoid interference with a high-pressure gas transmission pipeline, Parsons worked with the utility company to place a berm between two percolation basins along the pipeline route with special provisions for protection and access to the pipeline.

***Interconnecting biomass energy recovery and solar PV systems via net metering.*** The solar PV system is eligible for net metering by Pacific Gas and Electric (PG&E), but IC engines are not. This interconnection of solar PV and biomass energy recovery posed a unique challenge to integrate the two sources of renewable power with PG&E's grid. To meet this challenge, unidirectional and bidirectional electrical meters were placed strategically within the electrical system to account for power generation accurately from each renewable source—as well as the net power export and import to/from the PG&E grid.

**Truck unloading at grease-receiving station. Grease is added to digesters to increase gas production.**

Close coordination between Parsons and the city at different decision-making levels enabled immediate modifications to address changing requirements. This proactive approach helped the partners address and resolve all issues and challenges while meeting the discharge permit deadline.

The facility's sustainable and innovative design concept features include:

- Significant greenhouse gas reduction by generating substantial onsite renewable power;
- LEED-type buildings;
- Use of surplus earth to build a berm around the plant and for drought-tolerant landscaping;
- Use of recycled water for landscaping; and
- Creative approach to convert old trickling filters to biofilters and old secondary clarifiers to primary clarifiers.

## Recognition

PG&E recognized the team's success in providing a sustainable design by granting a $368,997 rebate. PG&E estimates that these upgrades and efficiencies will translate into an annual operating cost savings of $556,319. Parsons' extensive support also helped the city obtain more than $3 million through the American Recovery and Reinvestment Act of 2009 to construct a PV solar energy system in order to help offset future electrical costs. WWD

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