Bridging the Gap

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Welcome to the Spring/Summer 2013 issue of *Research Solutions*. This issue highlights how Carollo is working to bridge the gap between good ideas and practical solutions in master planning, water/energy life-cycle inventories, Engineered Biofiltration™, and automated meter reading. You'll also read about a recent publication on minimizing brominated DBPs, learn about a new PVC-based ultrafiltration membrane, and we'll introduce you to one of Carollo's R&D Practice engineers.

- **Plan to Prioritize.** Performing a comprehensive master plan can help an agency prioritize resource investment and allocation … a particularly valuable exercise during lean times. This work requires asset risk analyses, rigorous hydraulic modeling, and non-process facilities planning and results in an optimized long-term CIP.
- **Modeling the Green.** Carollo developed a framework for quantitatively assessing the life-cycle water and energy embedded in water infrastructure — resulting in an efficient, dynamic life-cycle inventory model, which can be used to improve system performance while minimizing environmental impact.
- **Passive No More.** Historically, the "bio" portion of biofilters hasn't received much attention, as particle/turbidity removal has ruled the day. This article discusses how Carollo is "engineering" biofiltration at full-scale facilities, giving both filtration and biological activity top billing to improve overall water treatment and hydraulic performance.
- **To Retrofit or Replace … That Is the Question.** Read about how Carollo's Business Solutions Group performed a life-cycle cost analysis for a planned meter replacement program. This work balanced revenue loss due to inaccurately metered water with the cost of replacing old meters.

I hope you find some useful information in these articles. Please let me or the primary authors know if you have any questions or comments.

COMMENTARY

Why Should Wastewater Agencies Consider an Integrated Master Planning Approach?

By Andre Gharagozian, P.E. (agharagozian@carollo.com), Katy Rogers, P.E., Tim Loper, P.E., Rebecca Overacre, P.E., and EJ Shalaby [West County Wastewater District, CA]

The West County Wastewater District (District) serves a population of 93,000. It owns, operates, and maintains a wastewater collection system with 249 miles of sewer, 17 lift stations, 6 miles of force mains, and a Water Pollution Control Plant (WPCP) with a capacity of 12.5-million gallons per day (mgd). Like many agencies in the San Francisco Bay Area, growth is limited, but aging infrastructure, wet weather capacity, and regulations must still be addressed into the future. The District has performed numerous studies on individual system components, including the trunk sewers, the WPCP, and some non-process facilities. However, these studies have been performed independent of each other, which has made prioritizing system needs challenging. Recognizing this limitation, the District hired Carollo to develop an integrated District-wide master plan (Master Plan) for all of the District's facilities, including the collection system, the WPCP, and the non-process functions such as the administration, laboratory, storage, and maintenance facilities.

System-Wide Prioritization of CIP Projects

The main benefit of preparing an integrated Master Plan is that the needs of the collection system, WPCP, and non-process facilities can be prioritized with each other. This is important. It gives the District some assurance that financial resources are being directed towards the highest needs. It also makes the District's capital improvement program (CIP) more legally defensible. Bay Area agencies are under intense scrutiny from environmental non-governmental organizations (NGOs) that bring lawsuits in the event of violations. The approach used to prioritize projects in the Master Plan focused, in part, on minimizing the chance that violations will occur; but should such an event happen, the District will have a strong legal position that they did everything within reason to avoid it.

To prioritize renewal projects (i.e., rehabilitation and replacement), Carollo calculated risk scores for each of the District's 12,000 assets, including individual pieces of equipment, pipes, and manholes (Figure 1). Risk is defined as the product of the asset's likelihood of failure (*i.e.*, vulnerability) and the consequence of its failure (*i.e.*, criticality). Carollo used several tools to identify vulnerabilities, including the asset's age, visual inspections of the lift stations and WPCP facilities, and defect ratings determined from the District's closed-circuit television (CCTV) inspections. Criticality was based primarily on an asset's proximity to environmentally sensitive areas and public facilities (*i.e.*, schools or hospitals), and the potential environmental and fiscal impacts of a failure. The higher the risk score, the higher the relative need to renew that asset. The same overall approach, evaluation criteria, and scoring system was used to calculate risk scores for both the collection system and other WPCP assets. As a result, the risk scores for all the assets were comparable, and provided a uniform basis for prioritizing renewal needs.

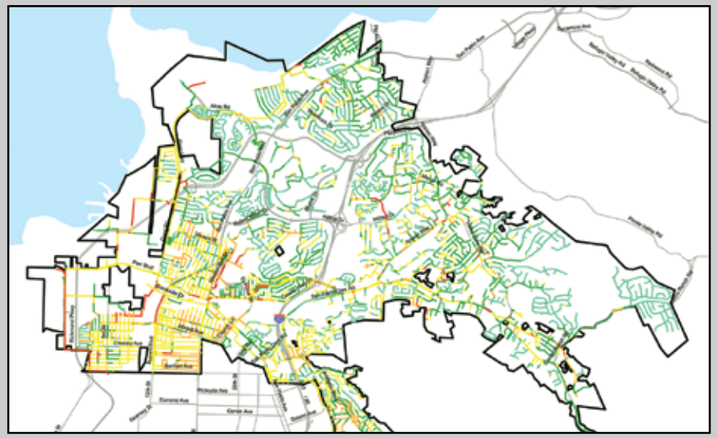

Figure 1. Collection system and WPCP rehabilitation projects were prioritized based on risk scores.

Linkages between Wastewater Collection and Treatment Systems Can Be Explored

The rate and quantity of wastewater a collection system conveys has a direct impact on the size and design of the treatment system. This is well understood in the industry. However, the opportunity to explore this relationship is limited if collection system and treatment plant master plans are performed independently. Conducting these master plans in concert allows the engineer to explore the most effective split between collection system and treatment plant improvements. For most treatment plant master plans, peak flow projections are developed based on historical peaking factors. While this is a reasonable method, the approach taken in collection system master plans is far more rigorous and can account for planned changes in land use, infiltration and inflow (I&I) reduction programs, or storm water projects that would affect wastewater flows. In addition, capacity constraints will dampen peak flow in the collection system and improvements to mitigate those constraints may actually increase the peak flows to the plant. Understanding that dynamic is important for planning the WPCP's ability to handle peak wet weather flows.

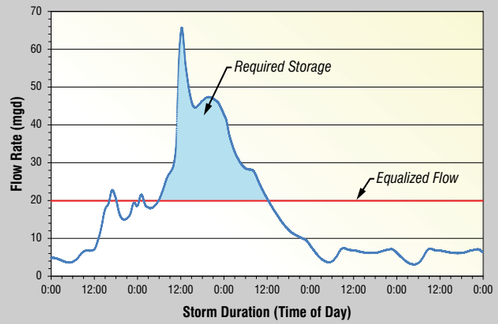

Figure 2. Collection system modeling helped establish wet weather storage needs at the WPCP.

For the District's Master Plan, an InfoSWMM hydraulic model was developed that included all sewer pipes 6 inches in diameter and larger. The model was calibrated using land use data from the GIS database and 2 months of wet weather flow monitoring. The calibrated model was then used to develop flow projections, identify capacity limitations and necessary improvements in the collection system, and calculate how much hydraulic capacity and wet weather storage volume is needed at the WPCP (Figure 2). Having an accurate and precise collection system hydraulic model was highly beneficial. It indicated that the needed size of the wet weather storage basins is driven by the volume of wastewater received at the WPCP, not the peak flow. In addition, the appropriate level of I&I reduction the District should target was identified.

Non-Process Facilities Should Be Included in the Plan

Space planning for non-process facilities is typically ignored in wastewater planning efforts. The District, however, wanted to include these facilities in the Master Plan because their existing non-process facilities are undersized and implementing a 20-year CIP will require increased staff. Furthermore, the District desires to improve overall staff efficiency, communication, and collaboration. The District ultimately decided to consolidate all of their facilities into one campus at the WPCP (Figure 3). Including this planning effort in the Master Plan allowed Carollo to coordinate the proposed one-campus concept with space needs for future process facilities.

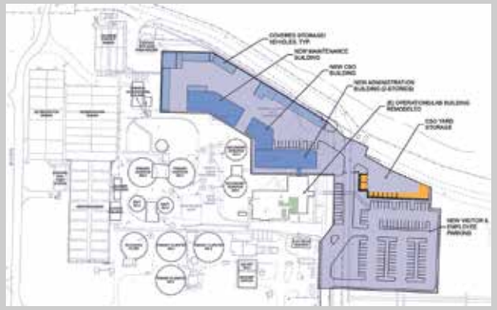

Figure 3. Consolidating all non-process facilities into one campus at the WPCP is expected to improve overall performance and efficiency.

Results

Once the entire system was assessed and future needs were identified, improvement alternatives were uniformly evaluated and prioritized in a 20-year CIP. Regulatory improvements are timed based on when regulations are anticipated to take effect, wet weather capacity projects are timed to address the greatest capacity issues first, and renewal projects are timed to address assets in order of failure risk. A governing philosophy to touch each area as few times as possible was applied to ensure renewal projects and other projects in the same area were coordinated. This approach will minimize impacts to service and make design and construction efforts more efficient. The focus of the CIP over the next 5 years will be to replace or rehabilitate the highest risk aging assets (Figure 4).

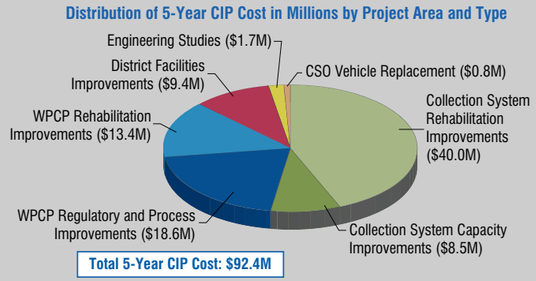

Figure 4. The focus of the next 5 years is on rehabilitating and replacing aging assets.