

Optimizing Existing Facilities to Provide Additional Capacity at Low Cost

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The Peace River Manasota Regional Water Supply Authority (Authority) owns and operates a regional surface water treatment facility located in DeSoto County and adjacent to the Peace River. The Peace River Regional Water Treatment Plant (facility) provides an alternative to brackish groundwater in southwest Florida and allows for the regional transfer of potable water derived from the Peace River among Charlotte, DeSoto, Manatee, and Sarasota counties, as well as the city of North Port. The entire facility was permitted for a production of potable water at a rate equivalent to 48 mil gal per day (mgd). This capacity has subsequently been increased and is now permitted for 51 mgd, an increase of 3 mgd. This new capacity was achieved for a low capital cost through mining the existing facilities for opportunities to rerate unit processes at higher flows. This was accomplished by analyzing existing systems for process capacity opportunities and elimination of hydraulic restrictions.

The facility was constructed in stages and consists of Unit 1 rated for 12 mgd (built by General Development Utilities Inc., or GDU, in the late 1970s), Unit 2 rated for 12 mgd (built by the Authority as the Peace River Option in 2001) and Units 3 and 4 rated for 24 mgd (also built by the Authority as the Regional Expansion Pro-

gram in 2009). Unit 1 was being renovated (1991 Peace River Facility Rebuild Project).

The facility had a total permitted capacity equivalent to 48 mgd of treated water production and has an excellent track record for production of high-quality potable water. The Florida Department of Environmental Protection (FDEP) participated in an areawide optimization program (AWOP) that benchmarked the performance of surface water treatment facilities in the state and identified the Peace River facility as one of the top performing surface water treatment plants in Florida, achieving a filtered water turbidity goal of <0.1 nephelometric turbidity units (NTU) 95 percent of the time and a maximum filtered water turbidity of less than 0.3 NTU. This is approximately three times better than the current regulatory requirements for filtered water turbidity of <0.3 NTU 95 percent of the time and a maximum filtered water turbidity of 1 NTU.

The facility is also designed for optimized powdered activated carbon contact for taste and odor control and has won the regional American Water Works Association Annual Taste Test competition on multiple occasions. The primary surface water treatment process used at the facility is enhanced coagulation with alum (aluminum sulfate), followed by dual-media gravity filtration.

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It was observed by the project team (Authority and TKW Consulting Engineers Inc.) that a careful analysis of the various process units might reveal units with inherent excess capacity, and that, with some modifications, the capacity of the facility might be increased while not only meeting all requirements for drinking water standards, but without degrading the history of excellent water quality that has historically substantially exceeded regulated standards. The project team believed that it could be demonstrated, with some modifications to be determined by analysis, that the treatment plant designated as Unit No. 1 (incorporating Treatment Trains No. 1 and No. 2, the oldest part of the facility), could effectively treat additional raw water at a rate equivalent to a production of 15 mgd, an increase of 3 mgd from the current permitted production capacity of



New 316 stainless steel effluent launders installed in Unit 1, Process Train 2 increasing hydraulic capacity of the Train 2 solids contact unit (SCU) from 6 mgd to up to 8 mgd. Note the pentagon structure on the left side. (photo: Kevin Morris, PRMRWSA)

12 mgd for Unit No. 1. This unit consists of the original treatment facilities acquired in 1991 by the newly formed Authority from GDU, a private utility serving communities originally developed by the General Development Corporation.

Florida Department of Environmental Protection Rerating Requirements

In order to apply for a rerating of capacity, FDEP requires an analysis and report complying with the requirements of FAC 62-555.528. The analysis and engineering report addressing the capacity of Unit 1 included the following sections:

1. Information about the facility; general description; raw source, including discussion and evaluation of the reservoir pumping capacity to supply raw water to the facility; and discussion of the proposed new design capacity and general statement of the objective of the rerate study.
2. Discussion of raw water quality inclusive of seasonal variations and water quality data.
3. Discussion of applicable primary and secondary drinking water standards, including

discussion of disinfection criteria and management of disinfection byproducts.

4. A flow diagram depicting all unit processes (mixing, solids contact, disinfection and chemical conditioning, and filtration), including recycle flows and backwash, residuals management (sludge blowdown, thickening, and dewatering) transfer pumping and storage, and high-service pumping.
5. An evaluation of the hydraulic capacity of the unit processes, interconnecting piping, and pumping systems. The evaluation is to be performed for the flow rates at the proposed new design capacity and is to include a preparation of a hydraulic profile at the proposed new design capacity.
6. An evaluation of the quantity of residuals and the capacity to manage and dewater the higher volume of residuals to be performed.
7. An evaluation of all water treatment facilities and unit processes, including chemical feed and storage systems, residuals management facilities, water pumping facilities, disinfection systems, and ancillary equipment, to be performed to confirm that the facilities and equipment will meet pertinent design requirements listed in Rule 62-555.320 FAC when operating at the proposed new design capacity.

8. For surface water treatment plants, a confirming contact time (CT) analysis at the proposed new design capacity, confirming that disinfection criteria are met at the higher flows and identifying any facility improvements that may be needed to meet CT criteria.

Depending on the results of the analysis, FDEP may require preparation of a demonstration plan for approval and the subsequent performance of a full-scale performance demonstration before granting a permit for the increased capacity. In this case, the results of the analysis were sufficiently compelling that, combined with the years of exceptional operating data, FDEP waived the requirement for a full-scale demonstration.

Results

Since rehabilitation work on the older facilities was already underway and those facilities were offline, the project team saw an opportunity to implement minor design changes without operational impacts. The team believed the treatment trains designated as Unit No. 1 could effectively treat additional raw water at a rate

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equivalent to a production of 15 mgd, an increase of 3 mgd from the current permitted production capacity of 12 mgd. This increase in treatment rate would be accomplished while maintaining the exceptional quality of finished water produced at the facility. The rationale for this was partially based on the observation that the original filters were oversized, likely designed for 15 mgd, as part of a former plan to expand the original GDU facility to 30 mgd by building a second filter structure and three more 6-mgd-capacity solids contact units (SCU) around a pentagon-shaped flow distribution structure, thereby increasing the original capacity from 12 to 30 mgd. The resulting filter rate, as measured by gpm/sq ft (sf) was conservative. With one filter out of service for backwashing, the filter rate for the Unit 1 filters at 12 mgd was 2.45 gpm/sf. Therefore, at the proposed higher water production rate, the filter rate would still be a conservative 3.06 gpm/sf. By comparison, the new filters constructed in the expansions of 2001 and 2009 have a design filter rate of 4.0 gpm/sf.

The conclusion of the analysis was that Unit 1, with some reasonable modifications, would be capable of reliably producing finished water at a process rate equivalent to 15 mgd. These improvements included:

- ◆ Replacing the effluent launders for both of the two SCUs in Unit 1, each rated originally for 6 mgd (Train 1 and Train 2) with new 316 stainless steel launders upsized for a hydraulic throughput of up to 8 mgd.
- ◆ Adjustments to lower the new weir elevations planned for the flow distribution structure, commonly referred to as the pentagon structure, to allow for higher flow rates.
- ◆ Replacement of the existing filter flow control orifices with slightly larger orifices. (All of the filters in the facility use the concept of interfilter backwash with gravity flow on the influent. To assure equal distribution of settled water to the filter cells, there are restrictions in the inlet piping sized to create a head condition that overrides any differences in friction losses in the gravity influent piping or influent channels.)

This analysis was submitted to FDEP for consideration, and following subsequent approval by the agency, these modifications were then incorporated into the ongoing rehabilitation project, which was then completed in 2015.

Other facility improvements implemented as part of this project included improved chemical storage/chemical feed, replacement of the filter media, a new supplemental filter backwash system, and two new high-service pumps. Unit 1 (the subject of the rerate analysis) and the fa-

cility overall are now permitted and capable of reliably producing high-quality finished water at an increased production rate equivalent to 15 mgd. This increases the total production rate of the facility to 51 mgd, a 3-mgd increase over the previously permitted 48 mgd. This increase in allowable production capacity will give the Authority greater operational flexibility when other process units are removed from service for maintenance.

The total cost of the rehabilitation project was approximately \$12 million, of which about \$3 million was associated with the cost of increasing the treatment capacity by 3 mgd. Therefore, conservatively, the capital cost associated with the new 3-mgd of capacity was about \$1 per gal.

For comparison, in a study conducted by the Authority on the feasibility of new brackish water treatment for supplementing the capacity of the facility (CH2M, 2013), the projected capital cost for developing 5 mgd of additional capacity collocated at the facility was \$34 million, or the equivalent of \$6.80 per gal. Additionally, the Authority recently completed the Integrated Water Supply Master Plan Update (2015). This study identified new potential sources of supply within the region for 11 alternative projects (not collocated at the facility) and capital investment cost in terms of dollars per gal ranged from \$8 to over \$27 per gal.

Conclusion

Effective Jan. 14, 2015, the Authority was permitted for an additional 3 mgd of treatment capacity based on the engineering analysis of the existing Unit 1 facility and implementation of hydraulic improvements incorporated in the rebuild project. Highlights of the permit language include the following:

- ◆ To construct rerating of the existing 12-mgd Peace River Facility 1991 (Unit 1) water treatment plant to a 15-mgd water treatment plant, for a total combine increase flow of 51 mgd at the existing Peace River Regional Water Treatment Plant.
- ◆ Proposed construction includes rerating of the existing 12-mgd water treatment plant at the Peace River Facility 1991 (Unit 1) to a 15-mgd water treatment plant for a rerated overall design permit capacity of 51 mgd at the existing Peace River Regional Water Treatment Plant.
- ◆ To construct in accordance with the TKW Consulting Engineers Inc. engineering report, dated Nov. 10, 2014, along with additional design information last received on Jan. 7, 2015. The engineering report was submitted in support of the construction application dated Nov. 6, 2014.

As shown, the incremental cost of capacity for the new water supply resulting from technical analysis, followed by reasonable hydraulic improvements, is an order of magnitude lower than the cost of new construction. This favorable “rate of return” was achieved by mining an existing facility for opportunities, followed by careful analysis of unit processes, removal of hydraulic restrictions, and subsequent repermitting for higher capacity.

This restoration project successfully restored a 40-year-old treatment facility and easily added another 20 years to its useful life. At the same time, the additional 3 mgd in treatment capacity was achieved in an extremely cost-effective manner by systematically looking for opportunities to not just restore facilities, but to generate additional value by increasing their capacity as well. The careful analysis of opportunities for increased process flow rates and elimination of hydraulic restrictions generated the new treatment capacity for a capital cost of about \$1 per gal versus alternative projects estimated to range from about \$7 to over \$27 per gal for capacity.

Utilities are stewards of the public trust and have an obligation to plan, manage, operate, and maintain infrastructure to provide essential services to society in a reliable, cost-effective manner. Consultants use their experience and expertise to help guide and advise utilities in making myriad decisions along the continuum from daily to long-term strategic decisions. Finally, the regulatory agencies ensure order, quality, and accountability in these processes. At its best, the collaboration of utility, consultant, and regulatory interests comprise to promote reliable, robust infrastructure systems to support public needs. This project represents such an ideal outcome.

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