Implementing Reclaimed Water in Inverness: Big Steps for a Small Town

Katharine Cottrell

Katharine Cottrell is a project engineer in the Hernando office of the consulting engineering firm Hoyle, Tanner & Associates.

Utilizing reclaimed water—domestic wastewater that has been treated to a very high level of purity—is nothing new in Florida. Larger municipalities in the state have led the way in the last few decades, implementing water reuse successfully to irrigate crops and the landscaped areas of parks, golf courses, and residential subdivisions. Reclaimed water used to irrigate lawns or crops provides a many-faceted benefit to the community and the environment.

Fertilizer applications can be reduced where reclaimed water is used for irrigation, since levels of nitrogen and phosphorus remain elevated after the wastewater treatment process. Spraying treated wastewater where the nutrients will be consumed beneficially by the vegetation irrigated keeps the same nutrients out of our natural water bodies, where they become pollutants. Using reclaimed water for irrigation instead of pumping the same amount of water out of the aquifer for that purpose also extends existing water supplies and reduces stress on our aquifers.

Pumping large amounts of groundwater to support our ever-increasing, sprawling population has had visible effects on our natural water supplies. Besides wells that have run dry in some locations, large aquifers under high demand, such as the Floridan Aquifer, are depleted to the extent that water levels in lakes, streams, and wetlands have dropped substantially.

Lower water levels not only severely affect natural communities, they also can ruin our recreational areas and lower waterfront property values. By using water already withdrawn from the aquifer for an additional use before returning it to the ground, we can continue to enjoy our manmade landscaped areas while better matching our water consumption to the natural recharge rate of the aquifer.

Since the toll that our consumption places on groundwater supplies reaches farther than just urban communities, even rural Florida areas must begin to act with concern for our water supply. But what can a small community do to make an impact? How can a local government with limited resources afford to design and build a modern reclaimed water system?

This article tells the story of one small community with a vision to make a difference and the guts to put a plan into action. Through progressive leadership, this city pursued cooperative funding, county partnership, and community support in order to design a 1.5-million-gallons-per-day (MGD) modern treatment plant and reclaimed water system.

The Inverness Wastewater Treatment Plant Restricted Access Sprayfields— One goal of this project is to end the regular irrigation of these fields just to return the city's wastewater back into the aquifer.

The city of Inverness is a small community of 7,200 located in Citrus County—the heart of what is known as the Nature Coast. Our Gulf Coast environment is a far cry from white beaches packed with condominiums. Instead, we enjoy the seemingly endless channels of salt marsh along our coastline. There are no theme parks here, but we have seven spring-fed rivers, and beautiful natural lakes and wetland habitats. Residents of our community are fond of our natural bounty and generally committed to protecting the spectacular show that nature puts on daily.

The Inverness Wastewater Treatment Plant is sited near a chain of lakes more than 20 miles long. Lowered lake levels in recent years are a source of concern in this community. There is a strong desire to protect our water from what many fear is more than a natural fluctuation in lake levels.

The existing 1.5-MGD treatment plant uses an attached growth process consisting of rotating biological disks. It provides secondary treatment of wastewater and disinfection for disposal to a 150-acre restricted access sprayfield. Treatment objectives for the existing plant are 20 ppm Carbonaceous Biological Oxygen Demand (CBOD), 20 ppm total suspended solids (TSS), 6.00 – 8.50 pH, 200 CFU/100 ml fecal coliform, 0.5 mg/l residual chlorine, and <12 mg/l nitrate nitrogen.

In September of 2004, the Florida Department of Environmental Protection (FDEP) issued a consent order mandating that Inverness take certain steps to upgrade its wastewater treatment plant. The facility experienced more than 20 monthly, annual, and maximum limit violations of CBOD, TSS, and fecal coliform from October 2002 to June 2004.

Among the conditions of the consent order were the following mandates for the city:

- Retain the services of a professional engineer to evaluate the treatment facility and determine the cause or causes of the noncompliances.
- Design modifications to the facility to ensure consistent compliance with the treatment goals.
- Permit the modifications with the Florida Department of Environmental Protection (FDEP).
- Provide construction oversight.

The leaders of Inverness, after considering their options, made a commitment to exceed the goals specified in the consent order: to design and build a wastewater treatment system that went beyond the requirements of the FDEP. Inverness wanted to implement the best technology available to design a plant that would serve the community for the foreseeable future.

It was also important to the city that this new plant make the largest positive environmental impact possible, contributing to the conservation of our valuable water resources and the protection of local natural water bodies by producing reclaimed quality water that could be sprayed on local parks and golf courses—areas of public access that are currently irrigated with potable well water and contributing to aquifer depletion.

The Inverness City Council, under the guidance of City Manager Frank DiGiovanni, has been committed to this project from the beginning. The council members determined to proceed with their vision of a modern, environmentally friendly treatment plant, despite the lack of a clear picture of where the design and permitting path would take them and how the design and construction of their project would be funded.

Frank DiGiovanni has a gutsy, "think big" approach to making city improvements. He believes strongly in making city enhancements that will stand the test of time: planning and building for the long term. He and the city council wanted to focus on designing a project that makes sense for the community, one that fits the needs of the community, and as much as possible in the beginning, to avoid focusing on the money.

The city manager has long understood that, especially for a small community, it is nearly impossible to first find money and then commence project planning. It is crucial to first commit to a meaningful project and proceed with the planning and design. Funding will be much more readily available for a worthwhile project that is understood and under way than for one that is still just a pipe dream.

So, with a firm determination to proceed with the construction of its new treatment plant and reclaimed water system, Inverness began the planning and design process, as well as the accumulation of the collection of agreements, grants, and trades needed to build and fund the upgrades. The process went something like this…

The Inverness Golf and Country Club—By piping the plant effluent to the golf course, the city's wastewater may be used one last time for irrigation on its way back into the water cycle.

As far back as 2002, before thoughts of a new wastewater treatment plant were ever considered and well before the FDEP consent order was issued, informal planning meetings between city of Inverness and Citrus County staff members took place, discussing ways to boost the local economy. Citrus County staff expressed a desire to obtain Inverness Wastewater Treatment Plant sprayfield property. The county had plans to build an airport business park and was pursuing Florida Department of Transportation (FDOT) grant money to help fund the project. Part of the sprayfield properties next to the county airport would be needed to make the business park and associated airport expansion feasible.

Many steps would have to be taken by the city in order to decrease the current sprayfield area. Wastewater processed by the plant would have to be piped to another location. A local golf course and park were possible future irrigation sites, but the existing plant does not produce public-access quality water.

The plan seemed like a good one, not only for all of the previously mentioned environmental reasons, but also in order to put some of that sprayfield land toward a good economic use for the community instead of just growing useless grass and weeds. The city, however, was unclear on the type of treatment system needed to accomplish this transition. Also, funding for all the changes needed would be substantial, and the upgrades seemed destined for a distant future.

Meanwhile, the consent order was issued against the city by the FDEP to upgrade the treatment plant. The decision was made to proceed in the direction of a plant capable of producing reclaim quality water. Citrus County purchased part of the sprayfield area from Inverness, with the treatment plant continuing to utilize the fields until FDEP permitting and construction of the new plant was completed. The FDOT grant awarded to the county also paid for the design of the new 18,000-foot reclaimed water (RCW) transmission line from the treatment plant to the Inverness Golf and Country Club and Citrus County's Holden Park.

The city then prepared to pursue funding the design, permitting, and construction of a totally redesigned wastewater treatment plant capable of producing the higher level of treated water required when spraying areas used by the public. Early estimates were approximately $2 million for the RCW transmission line and $4.5 million for the plant upgrades. As the design and bidding near completion and the ultimate project scope has been decided on, the total project cost for the design and construction of both the plant and the RCW line is estimated to be $17.4 million—approximately $3.1 million for the RCW system and $14.4 million for an almost entirely new treatment plant. A more detailed cost breakdown is shown in the table on the following page.

In addition to the FDOT funds, the city pursued and received a $10 million grant through the FDEP and State Revolving Fund (SRF) loans to make up the difference. Frank DiGiovanni advises a practical, transparent

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	Reclaimed Water Pipeline	*Inverness Wastewater Treatment Plant Upgrades*
Design Cost	$150,000	$1,356,000
Construction Cost	$2,920,000	$13,000,000 (engineer's estimate)
Total Cost	$3,070,000	$14,356,000

Project Cost Breakdown

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approach to relating to the various permitting and grant-bestowing government agencies. Especially when consent orders are coming from the same agency that has the authority to grant a community project money, it is important to commit to doing the right thing as a community from the very beginning. A combative relationship with the regulatory agencies will never pay off. Instead, make them a partner. They are there to help and they are willing to help.

The city sees a large project as an expense, a design, a long-term project, and finally a community asset. The regulatory agencies see the same project as a set of rules, a system that must be followed, and a process. The city doesn't necessarily understand the process that must be completed to end up with a finished project, and that is where a partnership with the state agencies pays off. With the right attitude on the part of the municipality, the state employees are there to help guide the project through the system.

Other political and community challenges arose during this project. The FDEP required that binding agreements be signed between the city and the recipients of the reclaimed water. Some negotiation was required in order to make the agreements palatable for both parties.

The city also held a community information session to explain the reclaimed water project, the environmental benefits, the safety of such a system, and the need for some residents to connect to city water, since their wells were within the setback distance from the golf and country club irrigated area. Representatives from Inverness, the design engineering firm (Hoyle Tanner), and the Southwest Florida Water Management District were all on hand to present information and answer questions.

An extensive amount of design work went into both the reclaimed water line and the Inverness Wastewater Treatment Plant upgrades, which were completed and bid as two separate projects. The pipeline design was completed and bid out, and construction on the upgrades began in February 2008, just as the plant upgrades came out for bid.

The RCW pipeline will stretch over three miles. Parts of the line installation will be open cut and parts are to be installed by directional drilling. Easements, where the pipeline crosses country club property before it ties into the golf course irrigation system, had to be defined by survey and signed into agreement.

Directional drilling along the newly completed State Highway 41 required that an FDOT Right of Way (ROW) permit be obtained. The remainder of the installation was inside county road ROWs and required permitting through Citrus County. Certain residential properties that utilized wells for potable water within the area to be irrigated by reclaimed water were connected to city water.

The design and construction of the extension of the city water lines and connection of the affected residences became a third design/build project to be completed by Inverness. Permitting of the RCW sites and system through the FDEP was included in the new treatment plant operating permit applied for during the design phase of that project.

An operating protocol was developed to define how the reclaimed water system would interface between the treatment plant and the country club's irrigation system. The pipeline is designed to stay under constant pressure. When the irrigation system turns on, the pressure drop will signal the main service pumps at the plant to deliver reclaimed water from the facility's storage pond.

If the plant experiences an upset in water quality and public-access quality water is not being produced, the water will be diverted temporarily to the reject pond or the remaining restricted-access sprayfields. If sufficient water is not available from the plant for its irrigation needs, the club can still draw water from its two wells. Jockey pumps at the plant and at the club will maintain pressure in the line without using the main service pumps if minor losses are experienced due to leaks in the club's irrigation system.

Many design elements were addressed in order to bring the Inverness treatment facility up to modern standards and transform it into a plant capable of producing reclaimed water. Tasks included updating the headworks equipment, replacing the outdated rotating biological contactor units with carrousel style anoxic/oxic aerobic reactors, designing two additional final clarifiers, adding additional treatment through effluent filtration, expanding the existing chlorine contact chambers to provide high-level disinfection, and designing a sludge treatment facility in order to end the practice of applying sludge to the spray fields.

The existing headworks—the preliminary treatment processes that remove sand, rags, and other large materials at the treatment plant—consists of two static screens followed by two drag chain-type mechanical grit collection rakes. The headworks will be entirely demolished and replaced by a modern mechanical bar screen in parallel with a manual bar screen, followed by a vortex type grit separator, and finally a grit classifier and dewatering screw. Because the plant is next to the local fairgrounds, racetrack, and the Rails to Trails pathway, and occasional complaints about the offensive smell are received from these facilities, an odor control unit has been designed for the headworks.

Secondary treatment consists of biological processes used to stabilize organic matter in the wastewater by using a continuously cultivated population of microorganisms. The plant utilizes a fixed-film biological treatment process after the headworks. It consists of covered, air-driven, rotating biological contactors (RBCs) housed in two, 116,000-gallon, cast-in-place concrete tanks. The RBCs are particularly disliked by the FDEP for this site. They will be removed completely, leaving only the tanks for possible future use.

The two new 800,000 gallon anoxic/oxic aerobic reactors will be carrousel-type oxidation ditch units. A chemical feed system allows the option of adding sodium aluminate into the carrousel effluent distribution well to improve the coagulation of suspended solids and aid the settling process. This is a manual, back-up system intended for controlling high TSS levels.

Final clarification is used to remove the microorganisms from the previous step and other remaining solids. The two existing 40-foot, 94,000-gallon clarifier tanks will be retrofitted with new equipment, including skimmers, scum pumps, and scum wells. Two additional 40-foot clarifiers will also be constructed.

Six new return activated sludge (RAS)/waste activated sludge (WAS) pumps are included in the new design. RAS is pumped back to the carrousel. WAS is pumped to the digester—the beginning of the sludge processing system. The new chlorine feed system has the ability to pre-chlorinate in the clarifiers.

Filtration is used to produce very clear

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water with a low level of suspended solids. The existing plant does not include filtration of the effluent. The new design utilizes two eight-disk, vertically mounted, submerged, cloth-media, rotating disk filters with automatic backwash.

High-level disinfection using 12 percent liquid hypochlorite (chlorine) kills any remaining microorganisms that could be harmful if applied in public areas. The filter effluent enters a flow split box containing chlorine and TSS analyzers, which divides the flow between the existing chlorine contact tank and the two new chlorine contact tanks. The existing tank will be retrofitted with a tank drain, and the effluent will flow into the common well of the two new tanks.

The chlorine chemical feed system for final, high-level disinfection is also completely redesigned. An analyzer in the effluent well will monitor the chlorine residual continuously. Meters will also continuously monitor TSS, pH, and flow.

The two existing storage ponds will remain unchanged, with the larger 4.57-million-gallon pond storing public-access quality water to be pumped to the country club on demand. The 1.89-million-gallon pond will store reject water in the event that the plant effluent does not meet the required effluent limits.

The effluent is continuously monitored, and if a limit is exceeded, the system will automatically divert to the reject pond and notify an operator of the excursion, ensuring that only high-quality reclaimed water will reach areas of public access. The new reject pump may be used to retreat effluent in the reject pond by sending it to the process drain lift station (and then back to the carrousel) or to the disk filters. Alternatively, the reject water may be applied to the remaining 90 acres of restricted access sprayfield. The new effluent pump station (included in the RCW portion of the project) consists of three 950-GPM service pumps and one 350-GPM jockey pump.

Final processing consists of the treatment and disposal of the waste sludge produced by the plant. Residuals processing at the existing plant begins with a 163,000-gallon aerated aerobic digester that accepts WAS from the clarifier underflow system. Supernatant from the digester is returned to the headworks via the process drain lift station. Waste sludge is then further concentrated in the 27,000-gallon gravity thickener. Lime is added as a stabilizer, and the waste sludge is then land applied, by truck, to the restricted access sprayfields.

The process of land application of sludge is not favored by the FDEP and probably will be phased out; therefore, the new plant design includes an updated sludge handling process to further reduce the water volume in the sludge so the waste can be economically transported off site. A new sludge processing building will be constructed to house this process equipment.

After passing through the existing aerobic digester, the waste sludge will be pumped to a rotating drum thickener, followed by a rotary press. Chemical delivery systems add polymer at both the thickener and the press to assist with flocculation and thickening of the sludge. The resulting thickened sludge will be hauled to the landfill by truck.

Other plant improvements include a supervisory control and data acquisition (SCADA) system; a complete remodeling and expansion of the administration building; remodeling of the chlorine storage and feed system building; a new process water system, including pumps, piping to the entire plant, and a hydrotank; and a new 460-kilowatt emergency generator.

The existing process drain lift station will also be retrofitted (including the addition of a mechanical grinder) to accommodate the new process equipment, and an additional process drain lift station is included in the plant design. Finally, the plant roadways will be repaired, resurfaced, and extended to include an adequate turn-around for fire equipment and chemical delivery trucks.

FDEP permitting tasks for the treatment plant upgrades required considerable time and effort. A capacity analysis report (CAR) was completed, showing that even with the most aggressive trending, the current capacity of 1.5 MGD will be adequate for this plant for the foreseeable future. The plant currently operates at approximately one-third of its capacity, and growth in the area, at about 1 to 2 percent per year, will not require additional treatment plant capacity until the year 2025.

The FDEP also required that Inverness adopt a cross connection and control policy to ensure that the reclaimed water, or water from other sources that may be contaminated, never enters the city water supply. An environmental resource permit was also obtained, addressing stormwater run-off created by the addition of new impervious areas caused by the treatment plant upgrades.

Hydrogeologic studies were completed to ensure that sufficient sprayfield area is available and wet-weather storage is accounted for. The first study completed at the country club provided application rates for that site. Nearby Holden Park, next to the treatment plant sprayfields, was permitted at the same application rate as the restricted-access sprayfields.

Another hydrogeologic study was later completed for the restricted-access sprayfields. Because the public-access sprayfields may not irrigate during periods of heavy rainfall or during periods when the plant exceeds its effluent limits, the restricted access sprayfields must still be able to provide full disposal capacity for these periods of time.

Because of the sale of sprayfield property to the county, the treatment plant now needed to re-rate the remaining sprayfields at a higher application rate for temporary usage. The original size of approximately 150 acres will decrease to about 90 acres, meaning the fields need to support an application rate of 4.45 inches per week. The loading rate permitted for the fields was 2.57 inches per week.

A loading test was performed on Sprayfield No. 1 for 54 days. The entire effluent volume during that time was diverted to Sprayfield No. 1, which experienced a loading rate of approximately 10 inches per week. Groundwater monitoring wells showed no discernable response to this loading rate, and no run-off or other adverse effects were noted. Based on the data from this test period, the FDEP approved the new loading rate of 4.45 inches per week, requiring only some rearrangement of the existing monitoring wells.

As of March 2008, the RCW pipeline project had been awarded and construction is just beginning. The treatment plant upgrade project had been released for bid, with a bid opening date of March 11, 2008. About 10 bids were expected.

Officials at the city of Inverness are excited about what the future holds for their new wastewater treatment plant. With an updated facility capable of meeting treatment goals, they hope to pursue additional sewage customers and service areas in the near future.

As construction funds and supply and demand allows, they plan to offer their reclaimed water product to local parks, the future airport business park, and new developments for their irrigation needs. The city will also review its development codes with an eye for environmental impact, requiring or offering incentives for community and subdivision planning that includes reclaimed water lines for irrigated areas.

We live in an era when big cities are funding big projects to protect the environment and ensure the continued availability of our public water supply. Here is an example of a small community that, through hard work and determination, is harnessing the best of today's technology to create an impact where it really counts—not in the concrete jungle, but in Florida's lesser-known wilds.

Inverness's story may inspire other cities of any size to dream big—to plan and build projects that are right for the future of their communities and protective of the beautiful environment that we enjoy here in Florida.