THE PACIFIC NORTHWEST IS FAMOUS FOR ITS RAINY CLIMATE AND VIBRANT, BUSTLING CITIES SITUATED ALONG LARGE RIVERS. Water is symbolic of the region, and it's an important element for both the urban and the outdoor lifestyles enjoyed by residents. Helping the two coexist harmoniously is a major part of the job at Clackamas County Water Environment Services (WES), south of Portland.

The department provides wastewater and surface water management services to six cities and several unincorporated areas of the county. It maintains more than 260 miles of sewer pipeline, operates 18 pump stations and runs five wastewater treatment plants. It also manages county programs for watershed protection and planning efforts to reduce urban storm runoff that could pollute the local rivers. The result is the return of purified water to the Willamette River and its tributaries so that the balance is maintained between people and nature.

Perhaps the most technically advanced wastewater treatment plant in the county's network is the Tri-City Water Pollution Control Plant in Oregon City. Since its opening in 1986, this plant has been continuously upgraded with automation systems built on several modules of FactorySuite® software from Wonderware, a business unit of Invensys Systems, Inc. These include InTouch® human-machine interface (HMI) software, the IndustrialSQL Server™ real-time plant historian, ActiveFactory™ trending and reporting tools and the SCADA alarm™ distributed alarm management system.

By 1987, the plant instrumentation and control systems at both the Tri-City and Kellogg Treatment Plants used programmable logic controllers (PLCs) that were not accessible via a PC, but rather through a proprietary industrial system that was extremely user-unfriendly. Users could access the system only to check status, and the programming was done in Basic on UV EEPROM chips, so that any small change required a complete erasure.

Keeping It Clean—and Efficient

Clackamas County, Ore., uses Wonderware's FactorySuite software to maintain a clean water supply, single-shift staffing and maximum facility capacity.
and reprogramming of that chip. After the PC-based program from Wonderware was installed, SCADA control became a very welcome reality.

Since installing Wonderware’s FactorySuite software, the wastewater population has grown from less than 70,000 people to greater than 150,000, and several major plant additions have been built and placed in service. Yet the Tri-City and Kellogg plants are still only staffed eight hours per day.

**Recycling Used Water**

**Wastewater is any used water** and, as it drains from sinks, bathtubs, washing machines and toilets, it travels the WES pipeline network to treatment plants like Tri-City. Here, it’s treated in an aerobic biological process that uses natural bacteria—microorganisms—usually referred to as “bugs” by the plant operators—to remove organic waste materials in a five-step process.

The wastewater arrives in the plant’s wet well, the lowest point in the plant. Five 100- to 200-horsepower pumps push the wastewater to a higher level in the plant, and then gravity drives it through the purification process. The water first passes through bar screens that remove large debris, such as sticks and plastics. It then moves through a grit removal area that takes out any sand and rocks, which are taken to local landfills. Last, the water goes through primary clarifiers, where solids sink to the bottom or are skimmed away.

The aeration basin process uses bacteria to process the wastewater and indicator organisms that tell operators the health of the bacteria population.

“This bugs are actually from the soil, a naturally occurring bacteria, and they do all the work in the aerated basins, breaking down the food and waste through absorption and adsorption,” explained Michael Trent, plant operator. “The aeration process is the heart and lungs of the treatment process. If anything goes wrong here, it messes up the rest of the treatment process.

“Our job is to give the bacteria enough time to do their work and also to supply them with their main requirement, which is air,” he added. “We feed them a lot of air, and that’s one of the biggest expenses in this plant. About 60 percent of our power bill is pumping air into the basins to maintain the aerobic process.”

The water then flows to secondary clarifiers, where remaining solids settle out or are skimmed off. At this point, some of the bacteria are pumped back into the aeration mix to replenish the bacteria population. Waste materials are carried off to digesters, where they’re heated at 100 degrees F for up to 30 days, then dechlorinated to produce biosolids. The clear water passes over a weir and flows into chlorine contact chambers where any remaining harmful bacteria are killed. After it’s dechlorinated, the pure water is then released into the Willamette River.

The dried biosolids from the digesters are loaded into trucks and taken to area hay fields, where they are used as high-quality fertilizer.

“The digesters are two-stage processes,” said Randy Conover, automation and instrumentation specialist. “We run the biosolids through primary and secondary digesters to get the proper detention time. The digesters are tested regularly for metals and nitrogen so that the end product is the proper composition for use as soil amendment. Farmers really like nitrogen because it helps the hay fields grow faster. At the same time, it saves us money because we don’t have to haul it long distances or put it in a landfill.”

**A Continuous Health Monitor**

The process is continuous, which is why all the new instrumentation is so important. It serves as a health monitor for the system.

“We have tighter control now than we ever had before,” Trent noted. “When we do the nitrification and denitrification to break down ammonia, the monitoring process is critical. As the aeration process nears its end, it uses up a lot of oxygen, which means the blowers ramp up and down. That’s where automation can control that process really tightly and guarantee that control limits are enforced.”

“We get better water output, too,” he added. “Our expended solids consistently run below 10 milligrams per liter, which is well below government limits. That’s definitely due to tight control from the automation systems.”

The Tri-City plant’s processing operations run far more smoothly today than they did when the plant opened in 1986. Previously only the system supplier could update the SCADA system, and the supplier would burn EEPROM to change configurations. With this system, operators could monitor equipment, but they couldn’t control anything from the control room. The system had no reporting capabilities, so all information had to be collected and stored manually. Filling environmental reports was also a manual operation.

Tri-City still uses the same treatment processes, but every step is now controlled from a central Wonderware FactorySuite system, which uses the InTouch HMI as the process visualization tool. Each process step is run using Siemens Simatic T1505 and S7 PLCs, which are distributed around the facility. All S7 PLCs, sensors, actuators and a weather station are linked in an intelligent Proﬁbus network. All process data is collected in the IndustrialSQL Server database, from which trending and reporting can be done using the ActiveFactory mod-
The system essentially runs itself, and the plant’s three operators monitor and fine-tune processes during one daytime shift. All operations are unmanned from dusk to dawn. But if anything were to malfunction or go out of control limits, the system auto-dialer would trigger a phone call to operators so they could return to the plant to fix a problem.

“We have just one shift, eight hours a day, but if something were to break down, an alarm in the InTouch system would call out what’s wrong, and the system would phone the appropriate people to respond,” said Erin Duffy, microcomputer programmer/analyst. “We’re in the process of building our SCADAlarm application to streamline this further. It’s working for our Modbus project on the flow-monitoring stations we have out in the field, but we’ll soon have everything migrated to the SCADAlarm system.”

Easy, Continuous Upgrades

The FactorySuite system has been upgraded regularly because it’s so easy to expand. Tri-City operators are presently testing the use of a new wireless tablet PC, so that operators can walk their rounds in the plant and have mobile InTouch screens with them for continuous interaction with the control systems.

“Right now, we only have six Modbus stations online that use the radio links,” Duffy explained. “We wanted to test-run them for six months to make sure we’re getting data that’s valid and to ensure that our ROI supports implementing the additional stations. Thanks to the IndustrialSQL Server historian and ActiveFactory reporting capabilities, we were able to present valuable data, which was previously unavailable, to management. We just got the go-ahead to add three more stations this year, and we plan to add the other 18 wireless stations during the next budget year.”

The Tri-City plant will undergo its first major facilities expansion in the next year as well, when plans call for the addition of two new aeration basins and another secondary clarifier system. The InTouch system is so easy to use that plant staff has already done program development within the current control system, and as soon as the new equipment is installed, it only has to add data tags and equipment identifiers to bring them up and running.

“On the control screens, we already have references to ‘future aeration basins,’ but the basins aren’t visible yet,” Conover said. “The InTouch development has already been done for them, and all we have to do is make them visible and plug in the tags and numbers. I was in a meeting recently and was asked how long it would take to develop these new screens. My response was that they were actually already done. All we need to do is plug in the numbers and go. They couldn’t believe it.”

“We’ve also modified our aeration basin process,” Conover said. “In the past we had one airflow meter, one airflow control valve and one dissolved oxygen (DO) meter per basin to control the air to each basin. We’ve added three airflow meters, three DO meters and three air control valves to three zones in the aeration basin. We did that for tighter control and to conserve energy. We have four aeration basins, with a total of 32 instruments running on Profibus PA.”

The Water Environment Services staff has even built in long-term expansion capabilities by designing system architectures to take advantage of the new ArchestrA™ application development platform from Invensys. Some of the staff attended the Wonderware Showcase symposium in Las Vegas in 2001 and took classes in ArchestrA database design. WES has already begun using recommended naming conventions and incorporated them into its own standards. For example, WES uses development wizards to quickly expand control systems.

“We’ve predefined objects such as pumps and valves so that we can simply drop the wizard onto the InTouch screen, assign a tag and the programming is done,” Duffy added. “The system already knows the properties of the object, and its name conveys what the object is and where it’s located in the system.”

For the short term, the next upgrade to the Tri-City plant will be the installation of Wonderware’s SCADAlarm module to better manage notification and response to alarms. Plant management is also considering an Avantis® asset management system from Invensys to better manage facilities and equipment usage.

Clear, clean water is the lifeblood of any community, and thanks to Wonderware’s FactorySuite software, the residents of Clackamas County can look forward to a plentiful supply for years to come.

THE END