

with its installed network included the necessary towers for LOS to enable the selected sites to poll concurrently from the Remotes: 70 Remotes for Wolfe Neck, 100 Remotes for South Coastal Regional Water Facility (SCRWF), 20 for Georgetown and another 100 for Inland Bay. SCRWF was designated as the backbone Master PLC to retrieve information from the three Sub-master PLCs. A high-speed T1 line connects the Sub-masters to the treatment plant network. The four main towers and their Remotes were installed one site at a time. The diagrams on the previous page represents the architecture of the Master PLC and the three Sub-masters.

The radios, housed in locked freestanding NEMA-4 type enclosures, sit above the well. The 12 inch, 3dBi gain, omni-directional antennas are an average 15 feet above ground. The 6dBi gain, YAGI directional antennas are used at a few sites where foliage obstructions exist. All of the four main plants use 9dBi gain, omni-directional antennas. Wolfe Neck has an antenna 100 feet above the plant, Inland Bay 320 feet, Georgetown 180 feet, and SCRWF 250 feet above.

The main plant, SCRWF, monitors all information from the other three Sub-master sites and

is the only plant that allows remote access to all sites. ProWORX NxT™, the PLC programming software, permits full network access to authorized technicians and managers who dial-in from any location for operational status, remote PLC program viewing, program changes and troubleshooting over the wireless network.

At each main tower there is one Modicon Quantum™ PLC. The SCRWF site has two HMI stations and each of the three other plants have one HMI station that runs through a router at Georgetown. Each pump station has a Modicon Momentum PLC. Using the SRM6200E network a Master PLC can update (read/write) a pump station in about two seconds. The VHF network requires 30 or 40 seconds per station. The diagram on the previous page gives an overview of the pump station to Sub-master PLC network architecture.

Since the original conversion, Sussex County has installed additional remote sites. Total SRM Ethernet modems utilize to date is in excess of 300. Sussex plans to continue expansion into the future utilizing their upgraded SCADA system architecture. Steve Hudson is very pleased with the system as it has met or exceeded all of Sussex County's expectations for performance and reliability.

cations. The Municipal Applications Group at United focuses on providing comprehensive power distribution, control, telemetry, data acquisition, and reporting solutions for municipal water and wastewater applications. United Electric Supply partners with municipalities, system integrators, and engineering firms to facilitate successful design, implementation, and maintenance of integrated systems founded on best in class products from a variety of manufacturers. For more information, visit [www.unitedelectric.com](http://www.unitedelectric.com) or call 302-324-3246.

#### About Data-Linc Group

Data-Linc Group modems are designed for highly reliable performance in challenging industrial environments. Data-Linc's communication solutions include license-free wireless Ethernet and serial radio, leased line, dial-up, dedicated wire, power line and fiber optic modems. Data-Linc has over 14 years industrial communications experience and provides no-charge consultation assistance during project design. All Data-Linc products promise field proven performance backed by industrial grade support from experts with hands-on knowledge of the major manufacturers' PLC and automation equipment. Contact Data-Linc for a no-obligation consultation regarding your industrial network needs

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## Case Study: Water/Wastewater

# SCADA System Modernization with a Foot in the Past and an Eye to the Future

## Sussex County, Delaware

Larry Terwisscha, DATA-LINC GROUP

**Abstract:** The evolution of Sussex County's water/wastewater SCADA system from a Motorola Infrac™ VHF communication network to a wireless Ethernet configuration is an ongoing project of significant proportions. Because the system was expanding so rapidly, an upgrade of the system was needed to modernize the pump station hardware and improve SCADA communications.

In early 2007, over 300 Data-Linc modems provided the communication link to monitor pump stations for over 1,000 square miles of Delaware territory. The network is comprised of a combination of T1 circuits, wireless Ethernet modems and VHF serial modems. Because Data-Linc Group ensures backward compatibility, the legacy SRM6200E radios from the initial installation remain able to communicate with the newer SRM6210E. The updated SCADA system architecture has improved efficiency and can easily accommodate future expansion.

### The Dilemma

Because Sussex County is one of only three counties in Delaware, it encompasses a substantial landmass of nearly 1,000 square miles. The map below shows the area.

In the late 1990s, the population expansion and the resulting increased water demands required an update to the existing system and a modernization plan. "When the project began, Sussex was

**It was tough deciding to use a non-licensed frequency where interference from other systems might be a problem...**

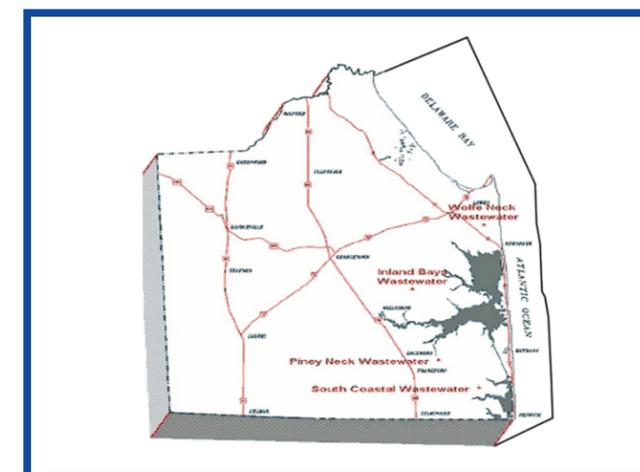
using a Motorola Infrac™ system for pump station and treatment plant alarming. This system provided alarms only, no control. The 150 remote pump sites operating at the time overwhelmed the

Infrac equipment," stated Steve Hudson, Director of Maintenance for the Sussex County Engineering Department. Hudson concluded that it was time to update to a fully developed SCADA system. Sussex

County enlisted the Engineering firm of Whitman, Requardt and Associates, LLP to assist in finding a solution. After researching microprocessor based proprietary systems and considering several PLC architectures, the advantages of Ethernet became clear.

### The Ethernet Advantage

Ethernet communications would support much faster data rates for dramatically improved scan times, real time diagnostics and online PLC programming. Additionally, the open architecture would allow flexible system configurations, and compatibility with wireless and high-speed leased line telephone services. By installing Ethernet PLCs at every site, they could create an Ethernet wide area network (WAN). Wireless Ethernet mo-



Sussex County covers an area of nearly 1,000 square miles.

demands would be needed to interface with Schneider Electric's Modicon technology. Spread spectrum technology would permit wireless Ethernet transmission to the pump stations without LOS (line-of-sight)— a critical component to ensure communication. For locations with LOS, they would continue to use the existing VHF serial radios.

### The Approach to System Integration

Trijay Systems, Inc., an instrumentation systems integrator, began working with Sussex County in 1998 converting the Motorola Intrac VHF system. Trijay handled the PLC programming, HMI development and communications design. United Electric Supply, a full-line electrical distributor, and Trijay helped integrate the Modicon technology with wireless Ethernet connectivity. It was a difficult decision to bring in a non-licensed frequency where interference from other systems could pose a problem, but Sussex County believed that license-free technologies offered performance advantages and would eliminate the expensive,

recurring licensing fees. In Phase I they brought over 20 of the existing 150 stations with an architecture that integrated Modicon PLCs with a VHF system on the 154 MHz band, good for long distances but with the major disadvantage of a very slow data transfer rate. Phase II would introduce the wireless spread spectrum technology.

**Group demonstrated how wireless Ethernet technology could enhance the system architecture and... allow system diagnostics and HMI (human machine interface) access from any location.**

### Wireless Ethernet Technology for SCADA

The wireless system needed to be fast enough to support Ethernet packets, while facilitating long-range communications to the remote pump stations in a point-to-multipoint topology. Additionally, the modems needed to be very reliable, secure, immune to interference and able to operate in extreme temperatures. Because of Data-Linc's broad line of wire and wireless products, reputation for quality and industry renown customer service, Ken Radley of Trijay Systems contacted Data-Linc Group for no-cost project assistance.

Data-Linc demonstrated how wireless Ethernet technology could enhance the system architecture and would allow them to run system diagnostics and HMI (human machine interface) access from any location. As a result, Ken proposed to use frequency hopping, 902-928 MHz wireless Ethernet modems with high receiver sensitivity to meet project requirements. This technology supports data throughput rates of 100 Kbps, substantially higher than the 1200 bps VHF system. When Sussex installed Data-Linc's SRM wireless Ethernet modems, they were extremely pleased with a polling rate 15 to 20 times faster than the VHF radio network.

Line Of Sight (LOS) is a requirement for effective ISM band spread spectrum communication. Trijay and United Electric worked with Sussex County to identify potential LOS issues with the terrain, such as sites in wooded areas where foliage might cause RF attenuation, hills or other LOS obstructions. The topography of Sussex County

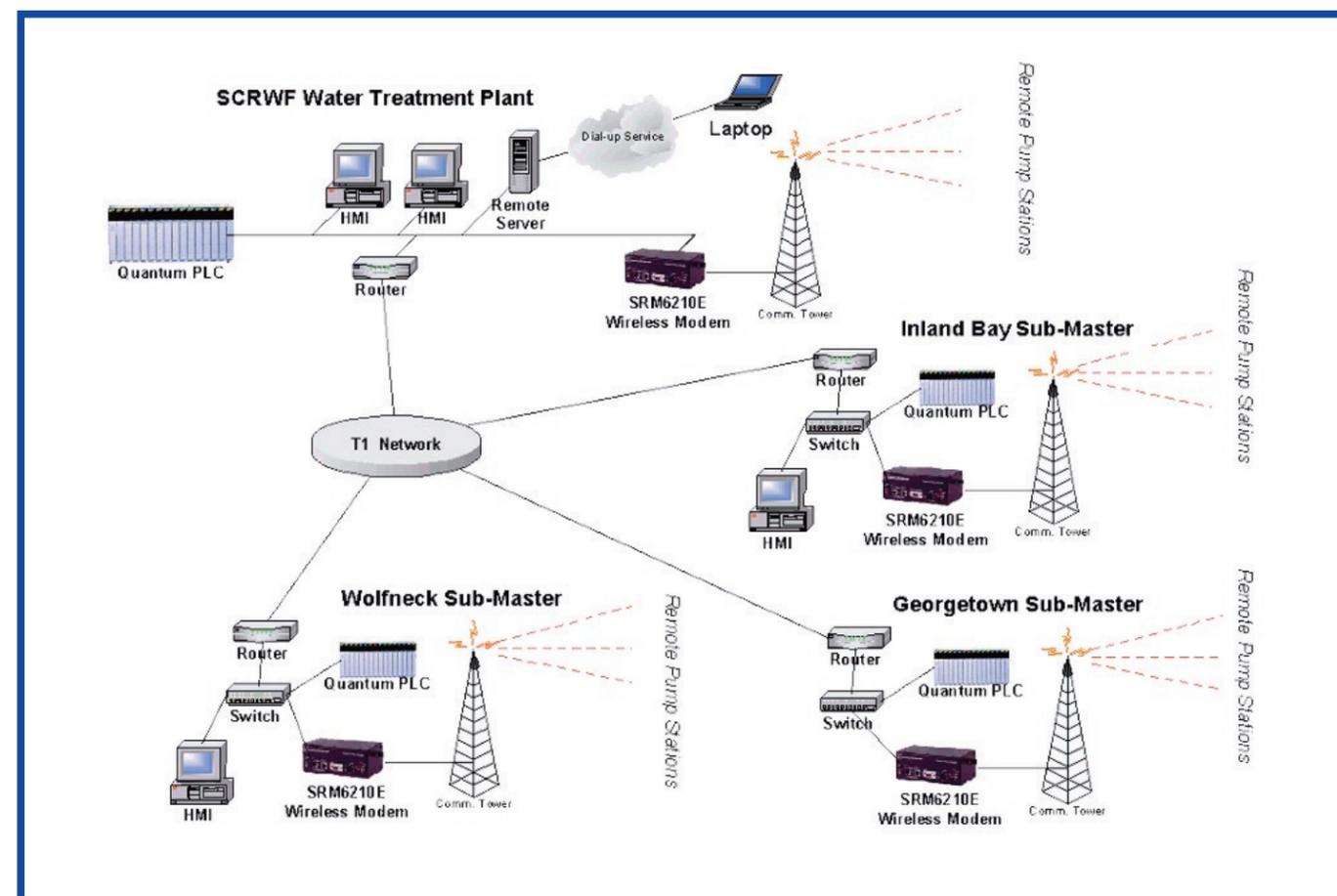
is primarily flat with the majority of sites along waterways or in housing developments that did not interfere with LOS, so concerns were minimal. In order to test an area to ensure good communication, a wireless radio was set up and communication attempt-

ed with the tower. If contact could not be established or weak, the solution was to redirect one wireless radio to another identical unit and use it as a repeater. This would pinpoint and eliminate problems where LOS might otherwise not occur. Where needed, Trijay utilized a unique feature of Data-Linc's radios, "store-and-forward," that allows a single radio to function as a Repeater/Remote to communicate around obstructions thus saving the expense of an additional modem to form a back-to-back Repeater.

### Building the System

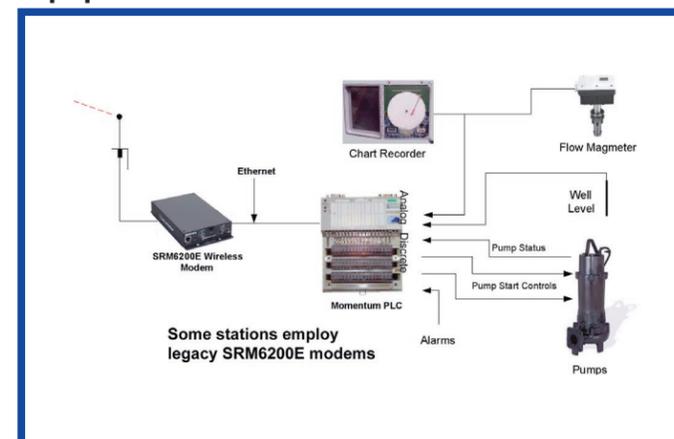
Sussex County was divided into four areas, each with a large water processing plant. Each area

### Master PLC and Sub-master Network Architecture



Remote access is used to connect to the SCRWF plant, which feeds information from all the major sites. The software permits authorized technicians and plant managers to dial in from any location and have full network access.

### Pump Station Equipment



The typical pump station has 3 analog inputs, 16 digital inputs and 8 digital outputs. Two pumps generally alternate control. The analog inputs are used to monitor wet well level and the flow back to the plant. The digital inputs provide the status of the equipment, alarm condition, and pump operation. During storm conditions, the digital outputs disable pumps or start them as required. They can also be used to enable local manual control.

### Pump Station to Sub-master PLC Network Architecture

