

Implementing early warning of toxic chemical intrusion into a WWTP by using remote toxic chemical sensors communicating over cellular wireless telemetry into a central SCADA system with advanced alarming and voice notification.

Authors

Hiram Tanner, Muminu Badmus

District of Columbia Water & Sewer Authority

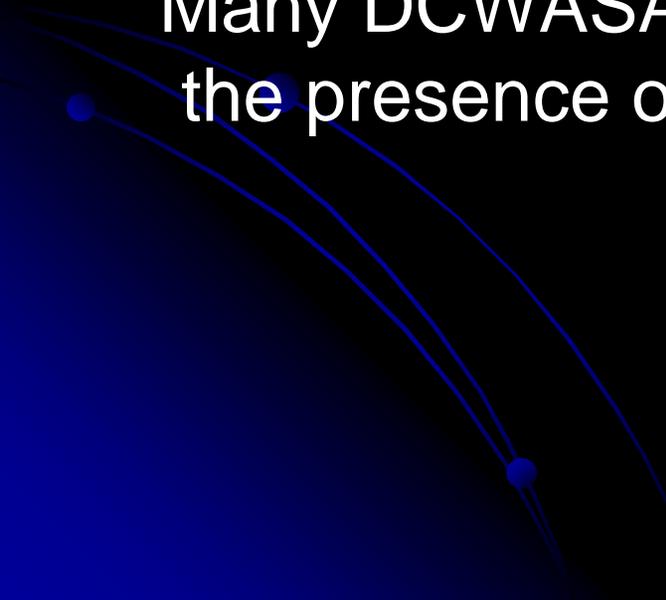
Bob Rutemiller

Automation Consulting & Education, Inc.

Problems:

The District of Columbia Water and Sewer Authority (DCWASA) has experienced sudden influx of high concentrations of organic chemicals into their main pumping station and the Blue Plains Wastewater Treatment Plant.

Many DCWASA staff members were affected by the presence of the toxic gas in the main pump station.





DCWASA Main Pumping Station

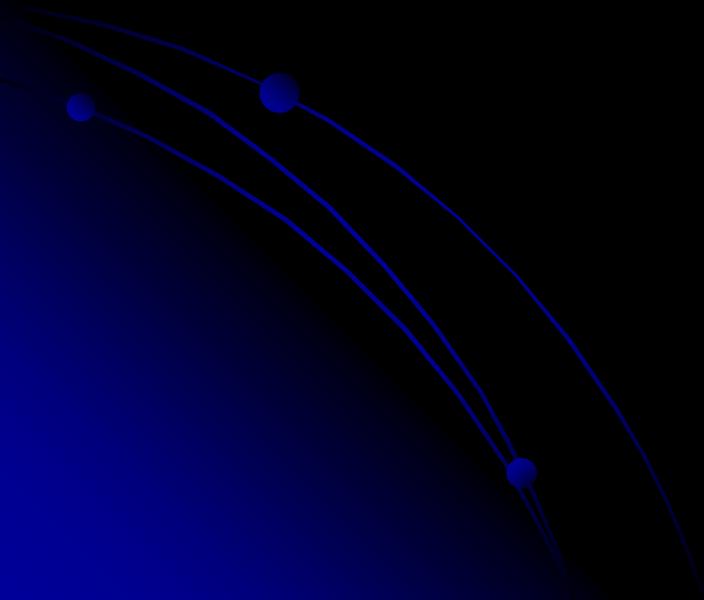


Flooding has impacted major local and regional communities.



Solutions

- Provide an early warning to the staff of the impending toxic chemical intrusion.
- Provide an early warning to alert the staff of sudden influx of flow & prevent flooding.



Installation Restrictions

The location of the toxic chemical sensor was in the main interceptor located in a very high use public park area and subject to the following restrictions:

- No telephone leased line
- No radio tower or mast
- Hidden antenna
- No radio repeater stations
- Sensor located underground
- Vandal proof installation
- Low maintenance
- Remote VPN access for programming and maintenance

Continuous VOC monitoring

- DCWASA has installed an MSA remote toxic chemical sensor upstream of the main pumping station to provide an early warning of the impending threat. It is currently monitoring volatile organic compounds (VOCs).



VOC Alarm Levels

The MSA ChemGard detector was setup to provide four levels of alarms:

- Trouble
- Caution - 400 ppm
- Warning - 600 ppm
- Severe - 800 ppm

Gases monitored are 1, 2 Dichloroethane, Toluene, Methane, Ethyl Benzene, Propane and other gasses that could cause burning, tearing and coughing.

Remote Station Hardware

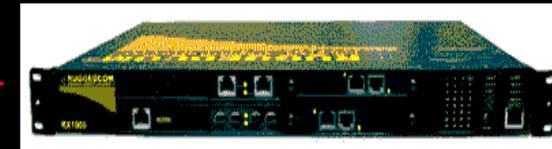
Remote Stations



VOC Gas Detector



Allen-Bradley
CompactLogix PLC



RuggedCom VPN Router



AirLink Cellular Radio

- PLC monitors VOC concentrations
- Router provides cyber intrusion protection (VPN)
- Cellular radio provides continuous communications

Wireless Connectivity

- Multiple technologies
 - CDMA / CDMA 2000
 - 1XRTT
 - EVDO Rev 0
 - EVDO Rev A
- Two types of connections
 - Serial RS232
 - Ethernet RJ45



Wireless Hardware Requirements

- Always-on, Always-aware intelligent connections
- EVDO Rev A with Automatic fallback feature
- Dual antenna inputs (800 MHz & 1900 MHz)
- 140 degree Fahrenheit temperature rating
- Hazardous location rating (Class 1 Division 2)
- Intrinsically safe
- Remote Configuration and Maintenance
- Low power consumption
- Ethernet connectivity



Raven X EVDO 3G



CDMA Raven II



Low profile antenna

Cellular Antenna: Low Profile, Vandal Proof



Rockwell SCADA System Display

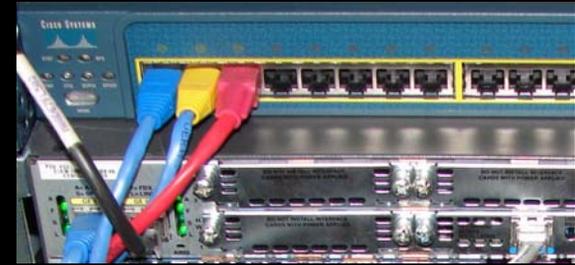


Allen-Bradley ControlLogix (Data Concentrator)



Central Control Room

Cisco Router & Switch



Wireless Cellular Communications

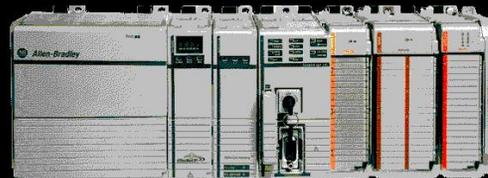
Cellular Wireless Private Network



Remote Stations



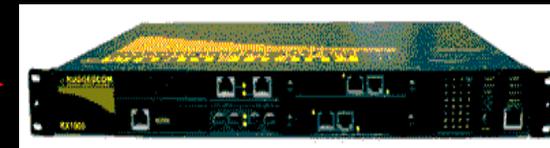
VOC Gas Detector



Allen-Bradley CompactLogix PLC

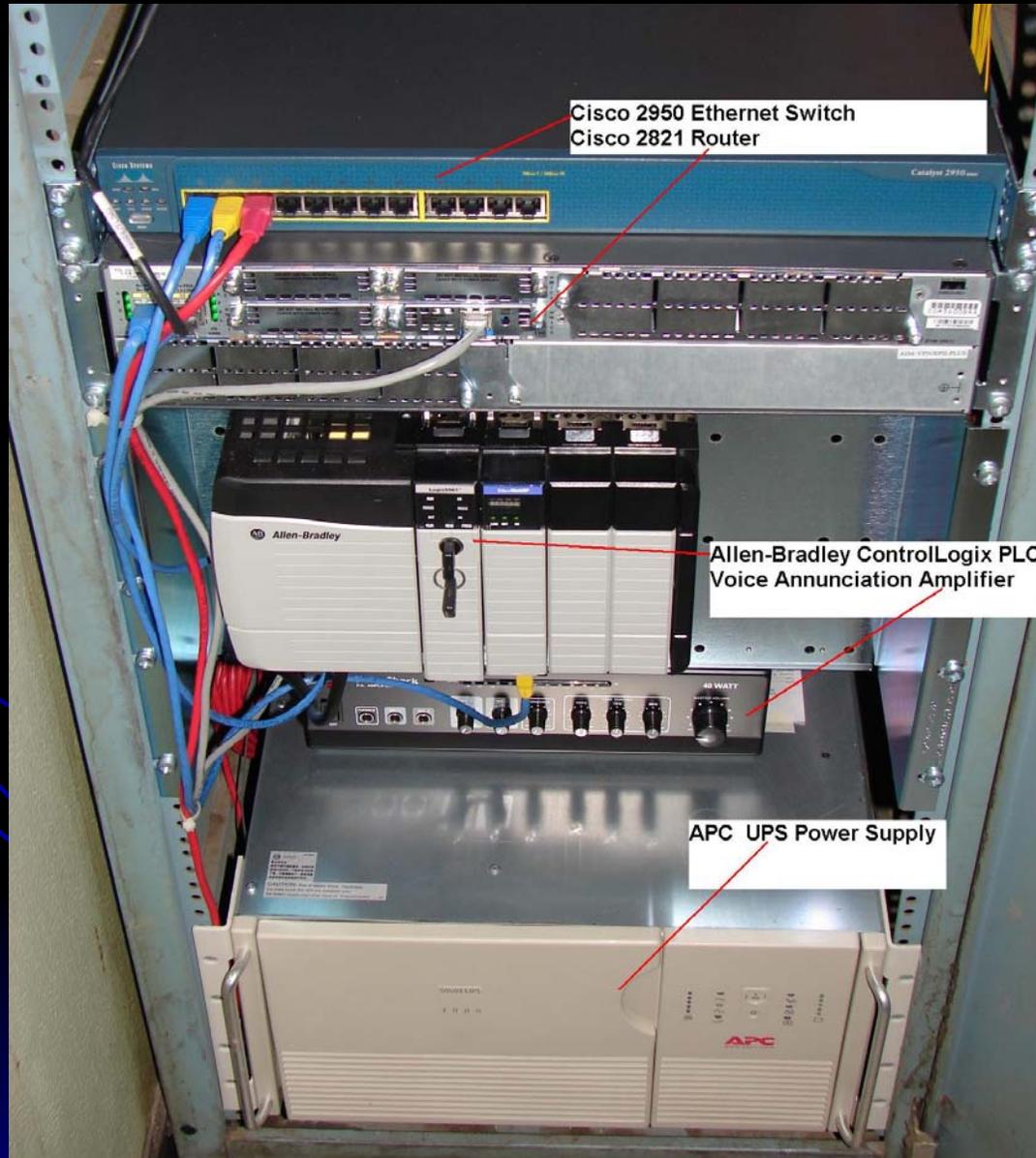


AirLink Cellular Radio



RuggedCom VPN Router

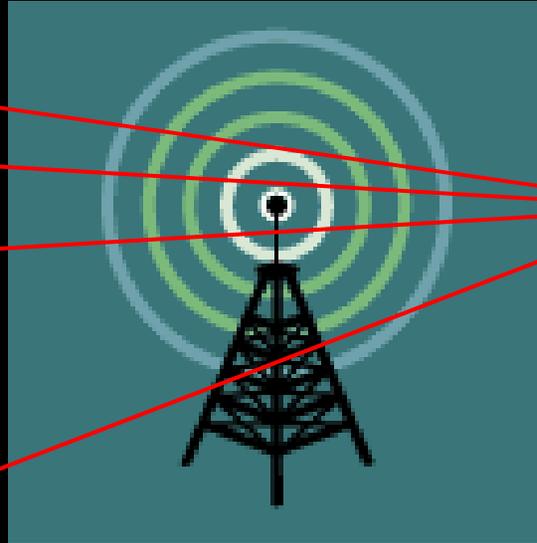
Central Data Concentrator



Data Concentrator



Allen-Bradley
Logix PLC
(Remote sites)



Allen-Bradley
ControlLogix
(Data Concentrator)

➤ PLCs located at remote sites

- Remote PLCs report on exception
- Listen for acknowledgement
- Error timeout triggers a message retry.
- ControlLogix, CompactLogix or MicroLogix

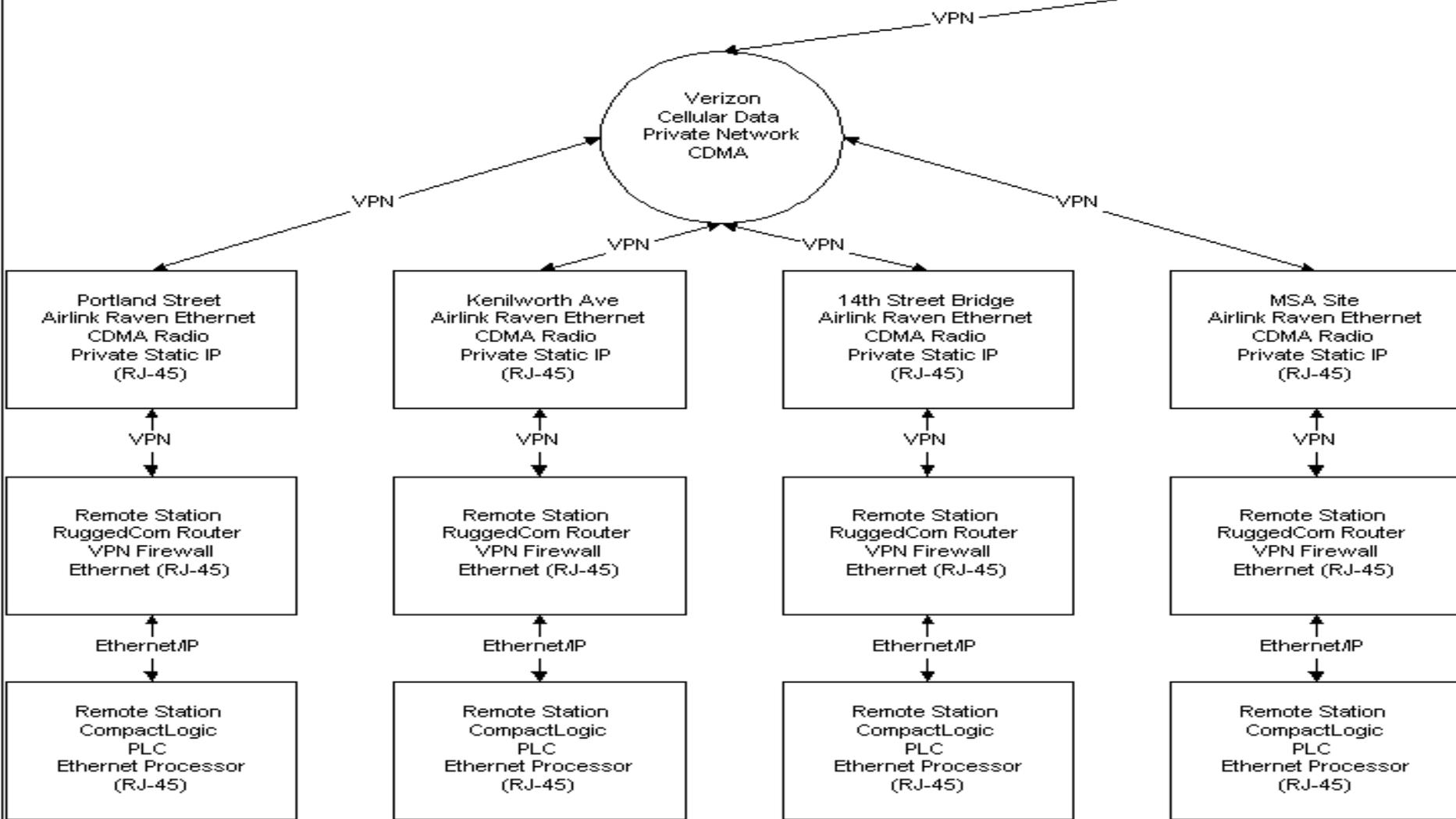
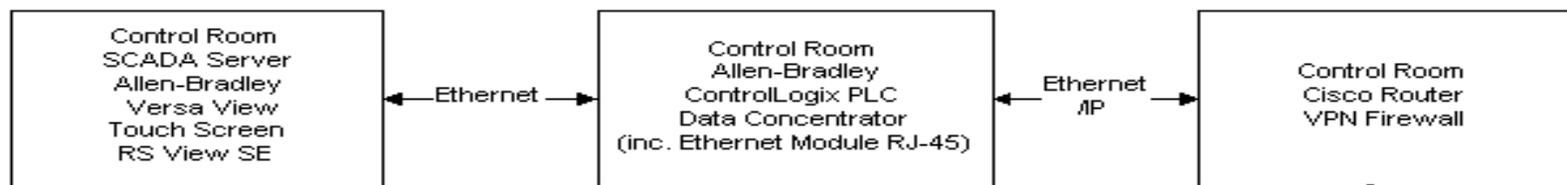
➤ Central Data Concentrator

- All data concentrated at one location
- Listens for incoming messages from each remote station
- Replies to messages from remote stations
- Alarms on communication error timeout
- Sends data to Rockwell Factory Talk Suite or other applications

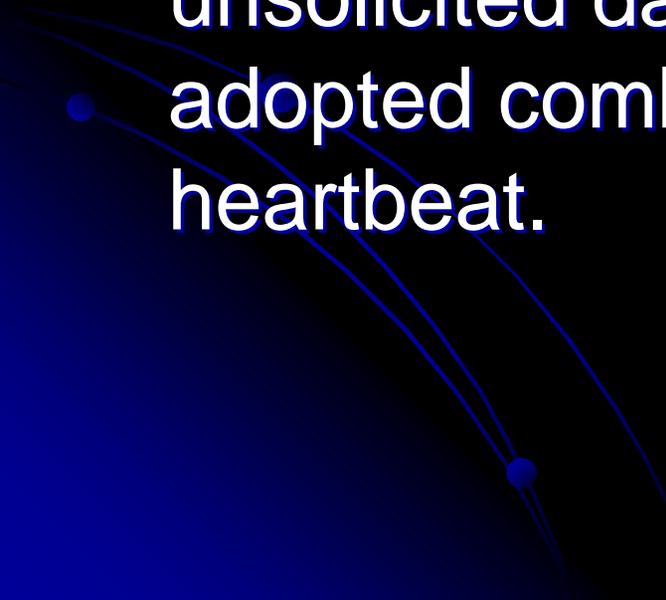
Hardware Summary

- MSA ChemGard Infrared Gas Monitor
- Allen-Bradley CompactLogix PLC – Remote stations
- Allen-Bradley ControlLogix PLC – Central Station
- Allen-Bradley VersaView Integrated Touch Screen
- AirLink Raven EVDO Cellular Radio
- RuggedCom RX 1000 Routers
- Cisco 2800 Router

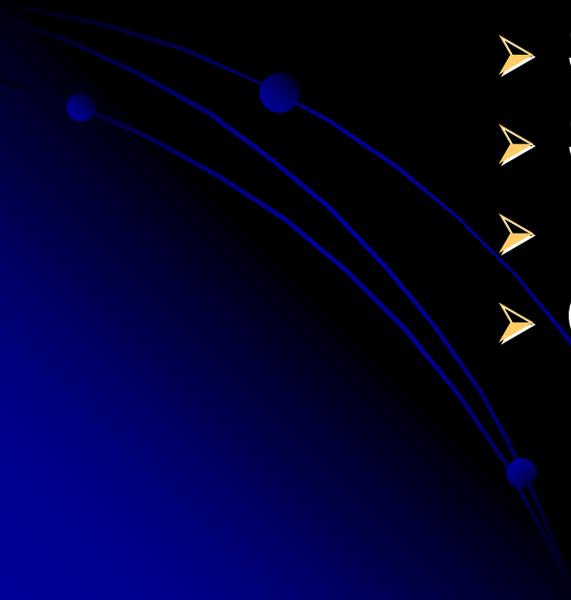
Communications Architecture Overview



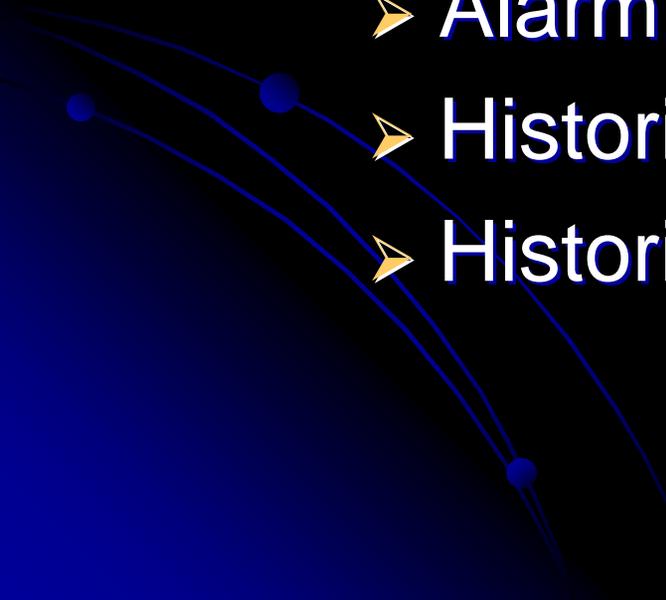
Minimal Data Transmission

- One of the main goals of this installation was to minimize the amount of data transmitted, resulting in a low monthly data use fee from the wireless cellular carrier - Verizon. In order to achieve this, an unsolicited data transmission scheme was adopted combined with a regular one-hour heartbeat.
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Types of Data Monitored

- VOC trouble
 - VOC alarm levels
 - Wet Well Level (feet)
 - High Wet Well Level Alarm
 - Pump 1, 2 or 3 Running
 - Power Failure Alarm
 - Station Flood Alarm
 - Station Door
 - Intrusion Alarm
 - Communication Error
- 

SCADA System Features

- Real-time process information
 - Graphical alarm display
 - Alarm logging
 - Alarm summary
 - Alarm Suppression
 - Historical Collection
 - Historical Display (charts)
- 

Overview



Alarm Summary

Alarm Log

2/7/2007 3:27:05 PM

1st & Canal Sewer Station Volatile Organic Compound Detector

Alarm_Settings_Canal - /Homeland//

Alarm Settings Close

VOC Detection Severe Sound Test	VOC Detection Severe Alarm Suppression
VOC Warning Sound Test	VOC Warning Alarm Suppression
VOC Detection Caution Sound Test	VOC Detection Caution Alarm Suppression
MSA Detector Trouble Sound Test	MSA Detector Trouble Alarm Suppression
Communication Sound Test	Communication Alarm Suppression

VOC Detection Severe
Normal

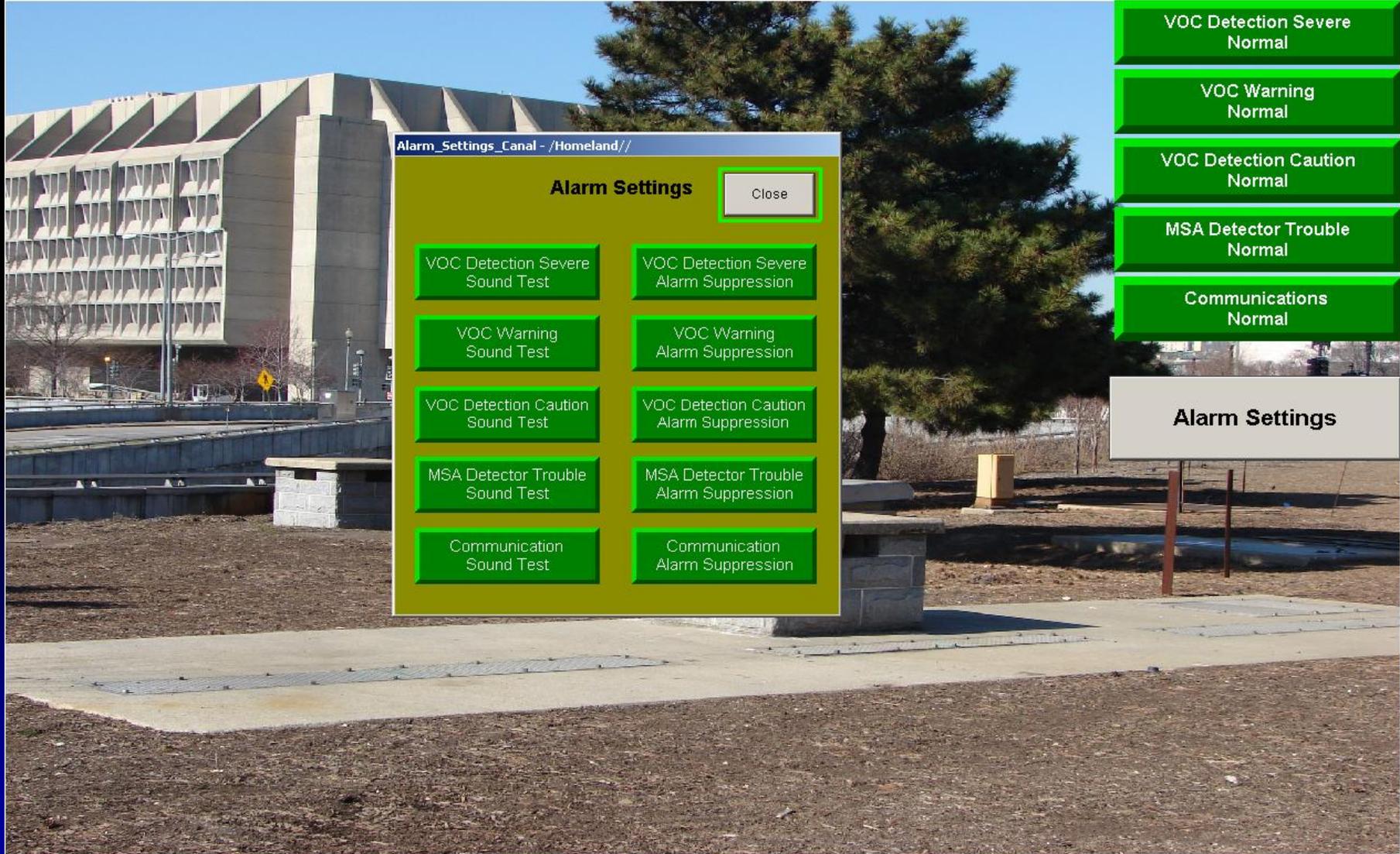
VOC Warning
Normal

VOC Detection Caution
Normal

MSA Detector Trouble
Normal

Communications
Normal

Alarm Settings



Overview



Alarm Summary

Alarm Log

2/7/2007 3:51:10 PM

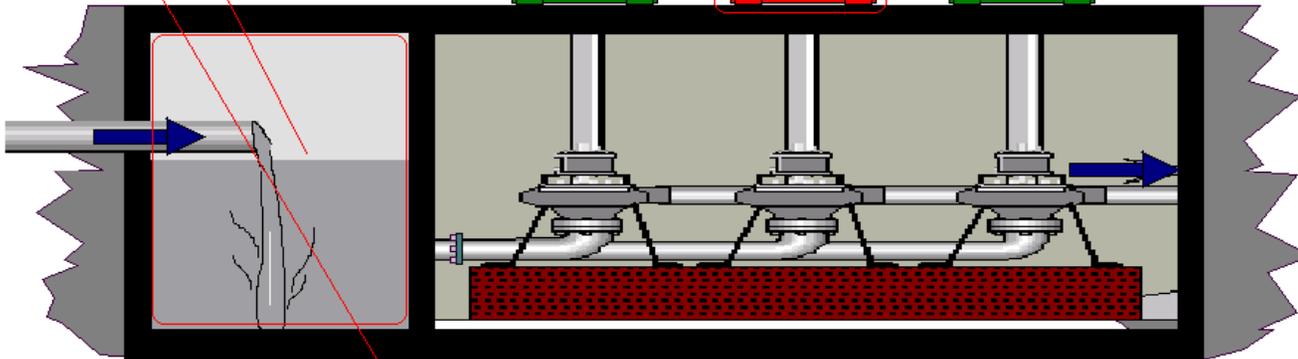
Trend

14th Street Bridge

Red indicates RUN
Pump Running

Wet Well Level Animations:
Level in Feet
Graphical Display
Chart

Wet Well Level: **5.74** Feet



Station Flood
Normal

High Wet Well
Normal

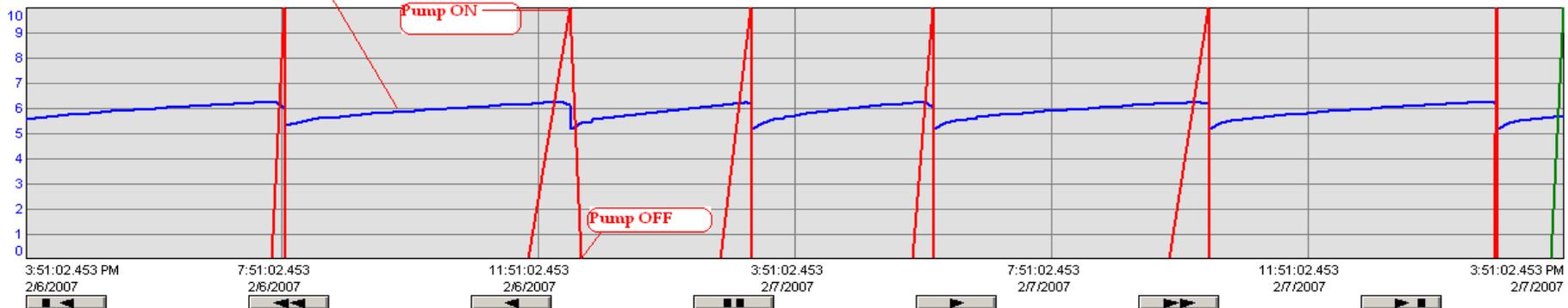
Power Failure
Normal

Intrusion
Normal

Communication
Normal

Station Door
Closed

Alarm Settings



Caption	Units
Wet Well Level	Feet
Pump 1 Run	Off / Run
Pump 2 Run	Off / Run
Pump 3 Run	Off / Run

Result

DC-WASA is currently operating a wireless cellular SCADA system that includes continuous monitoring for Volatile Organic Compounds. The rapid response time of all alarms will allow DC-WASA operators and staff to effectively respond to impending emergencies and provide additional life safety measures for protection of the general public.

Thank You!

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