ONONDAGA COUNTY DEPARTMENT OF
WATER ENVIRONMENT PROTECTION

SCADA STANDARDS
FOR MONITORING AND CONTROL

REVISION 7.0

Version Date: December 17, 2014

This document was created to provide all interested parties a guide for use in the design and installations of Process Control Equipment and Supervisory Control and Data Acquisition (SCADA) integrations for Onondaga County, Department of Water Environment Protection (WEP or OCDWEP).

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Questions concerning information within these pages should be directed to WEP's Systems Programmer. Contact information is specified in Appendix H.

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SCADA Standards
For Monitoring and Control
Revision 7.0

1.0   Background

WEP's Supervisory Control and Data Acquisition (SCADA) System controls and monitors 6 wastewater treatment facilities, several Regional Treatment Facilities (RTF), Floatable Control Facilities (FCF), and Combined Sewer Overflow (CSO) facilities, over 150 pumping stations (PS), and the Henry Clay Maintenance Facility and Environmental Lab. The majority of the system is maintained by WEP I/E personnel.

The network is currently Ethernet based for real-time data connection. For those facilities not connected to WEP's High Speed Wide Area Network (small pump stations, etc.) a dedicated Cellular Network with status only communications is customarily provided.

This standard is a living document and will be updated as necessary during project design, implementation and integration phases. This document presents Onondaga County's standards and guidelines for SCADA monitoring and control. The standard is based on previous County projects using Allen-Bradley (AB) RSLogix software, EXOR HMI software, GE Proficy Cimplicity Plant Edition, Cogent OPC DATAHUB, Software Toolbox OPC Server (OLE for Process Control Server) and Allen-Bradley (AB) communication products. The primary purpose of this documentation is to allow the engineer a common look at the County's SCADA monitoring and Control Architecture.

For the purpose of this document, a distinction is made based on the capacity and purpose of the site to allow the engineer to specify the Programmable Logic Controller (PLC) hardware required for a specific facility. This distinction is as follows:

- ◆ <u>Large</u> - Includes all Wastewater Treatment Plants (WWTPs) as well as any collection facility (PS, RTF's, FCF's, CSO's) with a design capacity of 3 million gallons per day (MGD) and above.

- ◆ <u>Medium</u> - Collection facilities with a design capacity of 0.5 MGD to 2.9 MGD.

- ◆ <u>Small</u> - Collection facilities with a design capacity of 0.5 MGD and below.

Specific hardware may change to accommodate requirements at any site. Allow WEP to review prior to any final design.

This standard is divided into the following sections:

- ◆ **PLC** - WEP's preference on PLC packages and standardization on point/tag identification, and other information.

- ◆ **Graphics** - All graphic displays should share a common look throughout the SCADA system. Graphic displays titles should all appear in the same location. Background,

color schemes, font size and color should be the same, and dynamic linking of screens should be consistent.

   ◆ **Databases** - WEP has several SCADA projects for monitoring and control. These SCADA projects are located at: Baldwinsville (B'ville) Wastewater Treatment Plant (WWTP); Brewerton WWTP; Henry Clay Maintenance Facility (HCMF); Meadow-Brook/Limestone WWTP; Metropolitan (Metro) Syracuse WWTP; Oak Orchard WWTP; Wetzel Road WWTP; Clinton CSO Facility; and Lower Harbor Brook CSO Facility. All database records are kept in a single Microsoft SQL 2008R2 Server.

   Integrators and Engineers shall be aware that points added to one system (or SCADA Project) may need to be duplicated in one or more County SCADA Projects to maintain SCADA redundancy.

   Addition of Input/Output (I/O) to the County's Cimplicity system may require the addition of the same point to multiple County projects. All points (or tags) added to the system shall have the same name when added to multiple projects. The physical location of the I/O is used to determine the Cimplicity project or projects that will need the new point. If the physical I/O is located in a collection facility (PS, RTF, FCF, or CSO), then the primary project is determined by the plant that the collection facility feeds. **In addition, all PS, RTF, FCF and CSO points need to be added to the Ley Project**, located at HCMF.

   ◆ **Monitoring and Control Equipment** - WEP has specific equipment requirements for monitoring and control. This standard indicates the specific equipment and describes how the County prefers using the equipment to interface to SCADA system.

2.0   PLC

2.1   General

The PLC shall convert all raw data to appropriate engineering units, equipment runtime, totalized values, and real-time clock update. Equipment status and I/O monitoring is required. Depending on the specific site and application equipment may be controlled through the PLC.

2.2   I/O Point Configuration

Shall be consistent with existing SCADA I/O scheme and shall be used to identify all physical points within the PLC, using the following convention:

Point ID: *SQQLACCPP*

- ◆ *S = County Service Area*, i.e. - B = B'ville, C = Brewerton, L = Meadowbrook-Limestone, F = Oak Orchard, G = Wetzel Road, M = Metro, E = CSO, FCF, & RTF, H = HCMF

- ◆ *QQ = PLC number within the Rack*. The owner shall provide PLC number(s) to be assigned to prevent conflicts with owner's existing PLCs. The owner shall also provide the IP Configuration for network access.

- ◆ *L = Chassis or Communications Adapter*, i.e. 0-9 This ID is controlled or connected to the PLC QQ designated in the I/O Point Configuration.

- ◆ *A = Physical I/O Type*, i.e. I = Input, O = Output

- ◆ *CC = Slot/Module # within the Chassis*, i.e. 00-99

- ◆ *PP = Channel or I/O Point on the module*, i.e. 00-99

Example: M030I0503 would be a PLC I/O point at Metro in PLC #03 on a module in physical chassis 0, I/O Type (Input), Module # 05, third point (03) on module.

2.3   Virtual Points

2.3.1   Virtual points are internally (from PLC) derived points that collect data from pre-identified physical points or calculations that cannot physically be represented by field equipment. A point such as "pump overspeed", which is derived from PLC logic as defined by a pre-determined set-point, is considered a virtual point. On the other hand, a point indicating an "RPM" value (that refers back to physical I/O or a direct representation of that I/O) is considered to be a device point.

2.3.2   Virtual Points associated with the physical I/O shall be configured by additional descriptive tagging, not to exceed a total of eighteen (18) characters. e.g.: M072I0111_ASH. Virtual Points derived from non-physical I/O shall be configured using the PLC Device ID, followed by the ISA Standards for equipment identification. e.g.: M07_FIT101, M07_FAULT

2.3.3   Virtual Points derived from "DeviceNet, EtherNet/IP, ControlNet, or Fieldbus" linked to a PLC shall be configured using the PLC Device ID, followed by the Instrumentation Society of America (ISA) Standards for equipment identification. e.g.: M03_FIT130, M03_FIT130_ASL.

2.4   Data Exchange

2.4.1   A reserved tag database shall be used for all data exchange between the PLC and Local HMI. These tags shall be utilized in a contiguous structure in order to maintain data transfer efficiency.

2.4.2   A separate tag database shall be utilized for exchange of data from PLC to SCADA (Cimplicity) and for data from SCADA to PLC.

2.4.3   All tags communicating to SCADA shall be individual tags to OPC Server. No arrays allowed.

2.4.4   PLC Program design shall follow Rockwell Automation Guidelines as well as ISA standards utilized in the Wastewater Industry.

2.5   Software and Programming

2.5.1   All software & licenses provided under any project shall be registered and transferred to Onondaga County Department of Water Environment Protection, 650 Hiawatha Blvd. West, Syracuse, New York 13204.

2.5.2   PLC, HMI, Fieldbus, & communications source codes as well as copies of all programs in RSLogix, RSStudio, Exor Designer, Exor jmobile Studio, and associated programs with descriptors shall also be provided to OCDWEP anytime SCADA control and integration is required independent of Onondaga County.

2.5.3   Source code shall have descriptors or comments on each rung explaining what that rung logic will accomplish within the program.

2.5.4   To promote consistency and standardization of programming, sample programs are available from OCDWEP at the County's discretion.

2.6   Large Facility Hardware

2.6.1   **Networking:** Equipment at Large Facilities shall be networked together using the existing County Ethernet Network. It may be necessary to interconnect systems via fiber optic cables and media converters, bridges, Gateways, or switches, to allow connection to the existing Ethernet Network.
  - SCADA Connection shall be Ethernet via WEP's existing Wide Area Network (WAN)
  - WAN requires Time Warner Business Class or Verizon FIOS

2.6.2   **PLC Equipment:** Equipment preferred at large facilities is based around the AB 1756 ControlLogix System employing the following modules and equipment.

  - 1756 5570 Controller L7 Model

- ◆ 1756 Ethernet/IP Module
- ◆ 1756 ControlNet Redundant Module
- ◆ 1756 DHRIO Module
- ◆ 1756 DeviceNet Module
- ◆ 1788-EN2DNR Ethernet/IP to DeviceNet Linking Device
- ◆ 1788-EN2FFR Ethernet/IP to FF Linking Device
- ◆ 1788-CN2FFR Redundant ControlNet to FF Linking Device
- ◆ I/O necessary to support all points and spares
    - Minimum Spares: 4 analog isolated outputs, 4 analog isolated inputs, 16 digital isolated outputs, 16 isolated digital inputs
- ◆ Wiring arms on all I/O
- ◆ Slot fillers on all empty I/O slots

Additional equipment includes:

- ◆ Exor eTOP610 10.1" TFT Wide-Color HMI Display

- ◆ Consult WEP for hot-standby configuration if necessary, for system redundancy.

2.6.3 **Additional Requirements**:

- ◆ Development of AB software programs to integrate additional points into Cimplicity.
- ◆ Develop required Cimplicity points following WEP SCADA Standards.
- ◆ Develop OPC tags to communicate with OPC DataHub and PLC devices. Refer to Appendix A.
- ◆ Program OPC DataHub to communicate with Cimplicity SCADA and Software Toolbox OPC Server. Refer to Appendix A.
- ◆ Program OPC DataHub to communicate with existing WEP DataHubs.
- ◆ Develop **a minimum of 4 SCADA screens** at each site showing the status of the facilities I/O and alarms at the required County SCADA projects (minimum of three; located at HCMF, Oak Orchard WWTP and Metro WWTP). Consult WEP for additional sites.
- ◆ Provide one set of all documentation (including drawings and software).
- ◆ Provide startup services, including verification of programming additions and point to point testing, required for fully operational system.
- ◆ Sample SCADA & OPC programs are also available upon request.
- ◆ Sample SCADA screens have been provided in Appendix B, for reference.
- ◆ Develop **a minimum of 7 HMI screens**, showing the status of the station/plant inputs and alarms. A minimum of one history screen, one alarm screen, one data screen and four graphic screens are required. Provide one copy of PLC and HMI Source Code to OCDWEP on CD. Refer to Appendix F for reference.

2.6.3.1 <u>WAN Access:</u> Cisco device equivalent to the following:
- Cisco Model: ASA5505-sec-bun-K9

2.6.3.2 <u>Ethernet Switches</u>:
- Managed Ethernet switch shall be AB 1783 Stratix Series 8300
- Unmanaged Ethernet switch shall be AB 1783 Stratix Series 2000

2.6.3.3 <u>DeviceNet</u>: All DeviceNet shall be in accordance to the following:
- Allen-Bradley DeviceNet Cable System Planning and Installation Manual
- Allen-Bradley's DeviceNet Configuration Standard
- Tag Development shall follow WEP's SCADA Standards

2.6.3.4 <u>FieldBus</u>: All FieldBus wiring and programming shall be in accordance with the following:
- FieldBus Organization Wiring & Installation Guide 31.25 Kbs
- Relcomm Inc. Fieldbus Wiring Guide
- Allen-Bradley's 1756 Fieldbus Configuration Standard
- Tag Development shall follow WEP's SCADA Standards

2.6.3.5 <u>ControlNet</u>: All ControlNet shall be in accordance to the following:
- Allen-Bradley ControlNet Fiber Media Planning & Installation Planning Guide
- Allen-Bradley ControlNet Coax Media Planning & Installation Guide
- Allen-Bradley's Redundant ControlNet Configuration Standard

2.6.3.6 <u>EtherNet/IP</u>: All EtherNet/IP shall be in accordance with the following:
- ISA Standards for SCADA Security in the Wastewater Industry.
- Dedicated Ethernet communication between local control devices shall be on a dedicated hard-wired network.
- Dedicated Ethernet communication between remote control devices shall be on a dedicated VPN network.

2.7. Medium Facility Hardware

2.7.1 **Networking:** Equipment at Medium Facilities shall be connected to the County's WAN via routers and switches as noted in *Sections 2.7.3.1 and 2.7.3.2*. All data must be stored in the main SCADA Sequel (SQL) server located at the Metro WWTP. All data points shall be added to all appropriate Cimplicity Projects as described in *Section 4.1*. In addition, all appropriate projects shall share all information.

2.7.2 **PLC Equipment:** Equipment preferred at medium facilities is based around the AB CompactLogix 1769-L33ER, 1769 System employing the following modules and equipment.

- 1769-SDN, DeviceNet Module

- ◆ 1769 120VAC Power Supply Module
- ◆ I/O necessary to support all points and spares
  Minimum Spares: 4 analog isolated outputs, 4 analog isolated inputs,
  16 digital isolated outputs, 16 isolated digital inputs
- ◆ Wiring arms on all I/O
- ◆ Slot fillers on empty I/O slots

Additional equipment includes:

- ◆ Exor eTOP607M 7.0" TFT Wide-Color HMI Display

- ◆ SCADA Connection shall be Ethernet via WEP's Cellular WAN

2.7.3 **Additional Requirements:**

- ◆ Development of RSStudio software program to integrate additional points into Cimplicity.
- ◆ Develop required Cimplicity points following WEP SCADA Standards
- ◆ Develop OPC tags to communicate with OPC DataHub and PLC devices. Refer to Appendix A.
- ◆ Program OPC DataHub to communicate with Cimplicity SCADA and OPC Server. Refer to Appendix A.
- ◆ Program OPC DataHub to communicate with existing WEP DataHubs.
- ◆ Develop **a minimum of 2 SCADA screens** at each site showing the status of the station/plant inputs and alarms at the required County SCADA projects, s*ee Section 4.1.4*, (minimum of three sites; located at Henry Clay Maintenance Facility, Oak Orchard WWTP and Metro WWTP). Consult OCDWEP for additional sites.
- ◆ Provide one set of all documentation (including drawings and software).
- ◆ Provide startup services, including verification of programming additions and point to point testing, required for fully operational system.
- ◆ Sample SCADA & OPC programs are also available upon request.
- ◆ Sample SCADA screens have been provided in Appendix B, for reference.
- ◆ Develop **a minimum of 5 local HMI screens**, showing the status of the station/plant inputs and alarms. A minimum of one history screen, one alarm screen, one data screen and two graphic screens are required. Provide one copy of PLC and HMI Source Code to OCDWEP on CD. Refer to Appendix F for reference.

2.7.3.1 <u>WAN Access:</u> WEP's WAN Cellular Access device must be equivalent to the following device:

- ◆ Cisco Model C819G-4G-V-K9 Integrated Services Router

This device must be provided with the following accessories:

- Cisco ANT-4G-SR-OUT-TNC Low Profile Outdoor Saucer Antenna
- Cisco ACS-810-FWM
- Managed Ethernet Switch for Cisco Router
- WEP will provide Subscriber Identity Module (SIM) required for router and will configure hardware for WEP's WAN.

2.7.3.2 <u>Ethernet Switches</u>:
- Managed Ethernet switch shall be AB 1783 Stratix Series 8300
- Unmanaged Ethernet switch shall be AB 1783 Stratix Series 2000

2.8   Small Facility Hardware

2.8.1   **Networking:** Equipment at Small Facilities (control panels) shall communicate with either the Metro Project or the Oak Orchard Project via WEP's Cellular WAN as noted in *Sections 2.8.3.1 and 2.8.3.2*. All data must be stored in the main SCADA SQL server located at the Metro WWTP. All data points shall be added to all appropriate Cimplicity Projects as described in *Section 4.1*. In addition, all appropriate projects shall share all information.

2.8.2   **PLC Equipment:** At Small Facilities provide and install an AB MicroLogix 1400 PLC with Cisco Integrated Services Router for remote off-site monitoring by WEP at either Metro or Oak Orchard. The PLC shall be used for off-site monitoring only (no remote control from WEP Control Room). The PLC shall not be used for local control. PLC shall be provided and wired, including signal connections, managed switch, cellular router, mounting hardware and 120 volt power. Hardware shall include, but not be limited to, the following:

- MicroLogix Series 1400 PLC – AB 1766-L32AWAA
- EXOR eTOP605 – 5" TFT Wide Color HMI Display

2.8.3   **Additional Requirements**:

- Development of RSLogix 500 software program to integrate additional points into Cimplicity.
- Develop required Cimplicity points following WEP SCADA Standards
- Develop OPC tags to communicate with OPC DataHub and PLC devices. Refer to Appendix A.
- Program OPC DataHub to communicate with Cimplicity SCADA and OPC Server. Refer to Appendix A.
- Program OPC DataHub to communicate with existing WEP DataHubs.
- Develop a **minimum of 1 SCADA screen** at each site showing the status of the station/plant inputs and alarms at the required County SCADA projects, s*ee Section 4.1* (minimum of three sites; located at Henry Clay

Maintenance Facility, Oak Orchard WWTP and Metro WWTP). Consult OCDWEP for additional sites.

◆ Provide one set of all documentation (including drawings and software).
◆ Provide startup services, including verification of programming additions and point to point testing, required for fully operational system.
◆ Sample SCADA & OPC programs are also available upon request.
◆ Sample SCADA screens have been provided in Appendix B, for reference.
◆ Develop **a minimum of 4 HMI screens**, showing the status of the station/plant inputs and alarms. A minimum of one history screen, one alarm screen, one data screen and two graphic screens are required. Provide one copy of PLC and HMI Source Code to OCDWEP on CD. Refer to Appendix F for reference.

2.8.3.1 <u>WAN Access:</u> WEP's WAN Cellular Access device must be equivalent to   the following device

◆ Cisco Model C819G-4G-V-K9 Integrated Services Router

This device must be provided with the following accessories:

◆ Cisco ANT-4G-SR-OUT-TNC Low Profile Outdoor Saucer Antenna
◆ Cisco ACS-810-FWM
◆ Managed Ethernet Switch for Cisco Router
◆ WEP will provide Subscriber Identity Module required for router and will configure hardware for WEP's WAN.

2.8.3.2 <u>Ethernet Switches:</u>
◆ Managed Ethernet Switch shall be AB-1783 Stratix 6000 Series Ethernet Switch

2.9   Additional Requirements for all Panels:

◆ Panel must provide ample space for an Uninterruptible Power Supply (UPS) to be located without disturbing other connections. Do not install UPS sitting or resting on bottom of panel.
◆ UPS shall be provided for emergency power to PLC, Cisco router, and network devices.
◆ UPS is not to be used to power relays and other ancillary systems. UPS is to be used to power only the equipment listed above, for emergency monitoring & notification purposes.
◆ UPS shall be sized to provide backup power for a minimum duration of 30 minutes and not in excess of one hour.
◆ All hardware shall be securely attached & properly grounded per manufacturers specifications.
◆ There shall be no splices within wireways.
◆ Control wiring shall be separated from all higher voltage (voltage in excess of 120 volts) wiring, terminations, contacts, etc.
◆ Intrinsic safety relays shall be wired per NEC codes.

3.0   SCADA Screens (Graphics)

3.1   General

3.1.1   Contractor shall provide and install appropriate SCADA Screens for both "Exor Display" devices and the County's HMI software. HMI SCADA screens shall be developed using GE Cimplicity CIM Edit consistent with the version currently in use by the County. Where remote control is required, the contractor shall be responsible for developing appropriate SCADA screens for the "Exor Display" devices and the GE Cimplicity HMI.

3.1.2   SCADA screens shall be developed using standard GE Cimplicity Library elements and County developed library elements, in so far as possible.

3.1.3   Refer to Appendices B, C, D and E for samples on County's preferred color schemes, symbol library and alarm screens.

3.1.4   <u>Machinery Status Identification</u>: The following are color schemes that should be used in Cimplicity, to identify status of the machinery (i.e. pumps, motors, blowers etc.) These are minimum requirements OCDWEP uses in its SCADA system, and does not recommend contractor/engineers to supplement the above, unless requested and approved by OCDWEP.

- RED – pump/motor, blower, bar screen, gate "ON" (running), valve "OPEN"
- GREEN – pump/motor, blower, bar screen, gate "READY", valve "CLOSED"
- YELLOW – pump/motor "OFF", Warning Alarm
- GRAY – point not defined in system
- BLACK – point defined, but not active

3.1.5   <u>Value and Alarm Status Identification:</u> The following are color schemes that should be used in Cimplicity, to identify status of cells that show numeric values from field equipment,   values the system calculates and/or status points.

- YELLOW text on BLACK background – analog values
- WHITE text on GRAY background – calculated values
- BLACK text on GREEN background – status indication OK
- BLACK text on YELLOW background – status indication ALARM

3.2   Graphic Displays

3.2.1   All graphic displays shall share a common look. Graphic display titles should all appear in the same location, background color schemes, font size and color should be the same.   Each graphic screen shall have three regions; Title Bar, Main Graphic Area and Navigational Area. See Figure 1.

```
┌─────────────────────────────────┐
│  ┌───────────────────────────┐  │
│  │  Region 1                 │  │
│  └───────────────────────────┘  │
│  ┌───────────────────────────┐  │
│  │                           │  │
│  │  Region 2                 │  │
│  │                           │  │
│  │                           │  │
│  └───────────────────────────┘  │
│  ┌───────────────────────────┐  │
│  │  Region 3                 │  │
│  └───────────────────────────┘  │
└─────────────────────────────────┘
```
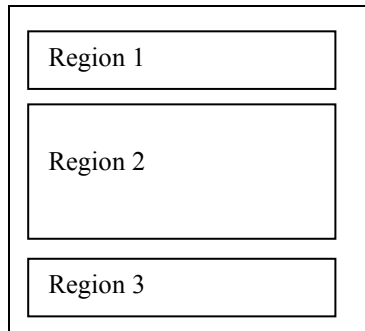
Figure 1: Graphic Display Layout

3.2.1.1 Region 1 –

Title Bar: The Title Bar, see Figure 2, should include the department's name, screen name, and description of screen fields centered on the top of the screen. Text shall be green, size 14 and Arial font style.

On the left side of screen, the date, user and role fields; and on the right side, the time and project fields are required. All text in these fields shall be black and Arial font style. Date and time fields shall use 12 pt. font size, the other fields shall use 10 pt. font size.

```
┌──────────────────────────────────────────────────────────────────────┐
│  DATE (12pt)          Department Name (14pt)          TIME (12pt)      │
│  USER (10pt)          Screen Name (14pt)              PROJECT (10pt)   │
│  ROLE (10pt)          Description (14pt)                               │
└──────────────────────────────────────────────────────────────────────┘
```
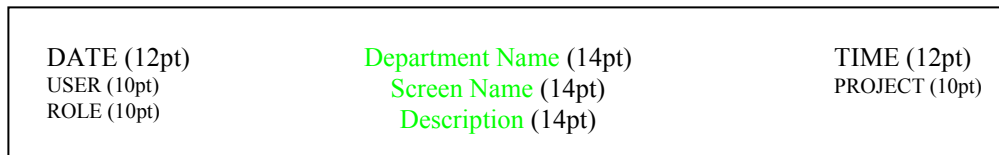
Figure 2: Region 1 - Title Bar

3.2.1.2 Region 2 –

Main Graphic Area: The main graphic area contains the primary screen information either in graphical format, tabular or both. Graphic images shall be arranged in a schematic format with the process flow moving from the left side of the screen towards the right side. Tabular data should be arranged in columns with no more than 6 columns per screen.

County color schemes, symbol libraries, alarm screens, graphic animations, etc. shall be used were applicable to maintain a uniformity throughout the projects. Refer to Appendices B, C, D & E.

3.2.1.3 Region 3 –

Navigational Area: The navigational area consists of global and local pushbuttons that allow the user to navigate through the system. Global buttons (i.e. Overview, Screen Menu, and Alarm Screen) shall allow the user to move about the system and access the alarm screen. These buttons shall

appear in all screens. Local buttons shall allow the user to access information about the current screen. These buttons shall be Previous, Point Access, Trend 1, Trend 2, Trend 3 and Trend 4. See Figure 3.

Overview	Screen Menu	Previous	Point Access	Trend 1	Trend 2	Trend 3	Trend 4	Alarm Screen

Figure 3: Region 3 - Navigational Area

3.3   Alarm Screen

3.3.1   The following is only a brief description of how OCDWEP uses the system. Contractor shall maintain consistency between all projects, as much as possible. If Contractor requires more information than is presented here, he/she shall contact the County as to depth of usage.

3.3.2   The alarm screen shall notify the user if any alarm occurs in the system. The alarm screen or the alarm banner should include project, alarm ID, date, time, acknowledge status, and any messages associated with it. Any new alarms coming in shall be red in color to alert users of its importance. Once the alarm has been acknowledged (but the point remains in alarm condition), the color shall change to green. If the alarm then goes to normal, it shall disappear from the screen and logged to the system. However, if the alarm goes normal before being acknowledged, the color shall change from red to blue. Refer to Appendix E.

4.0   Database

4.1   General

4.1.1   Onondaga County uses GE Fanuc's Cimplicity Plant edition as its standard SCADA HMI software. The County has ten (10) Cimplicity Projects for monitoring, control and logging in the SCADA system for Baldwinsville WWTP, Brewerton WWTP, Henry Clay Maintenance Facility, Meadowbrook/Limestone WWTP, Metropolitan WWTP, Oak Orchard WWTP, Wetzel WWTP, Clinton CSO, and Lower Harbor Brook CSO. A summary of the systems follows:

Brew Project: The Brewerton Cimplicity project monitors and controls the Brewerton WWTP as well as the pump stations that feed the Brewerton plant. This project is responsible for logging data values for this plant and associated pump stations.

Bville Project: The Baldwinsville Cimplicity project monitors and controls the Baldwinsville WWTP as well as the pump stations that feed the Baldwinsville plant. This project is responsible for logging data values for this plant and associated pump stations.

Wetzel Project: The Wetzel road Cimplicity project monitors and controls the Wetzel Road WWTP as well as the pump stations that feed the Wetzel road plant. This project is responsible for logging data values for this plant and associated pump stations.

Meadow Project: The Meadowbrook/Limestone project monitors and controls the Meadowbrook/Limestone WWTP as well as the pump stations that feed this plant. This project is responsible for logging data values for this plant and associated pump stations.

Ley (HCMF) Project: The Ley Creek project serves the county's Flow Control group. This project provides all data available for pump stations, RTF's, FCF's and CSO's in the county. This project does not do any historical data logging only alarm and event logging; all Flow facilities are logged at the associated treatment plant Cimplicity project.

Oak Project: The Oak Orchard project monitors and controls the Brewerton WWTP, Baldwinsville WWTP, Wetzel Road WWTP and Oak Orchard WWTP as well as all pump stations that feed any of these WWTP's. The Oak project offers backup data logging for the Brew, Bville and Wetzel Cimplicity projects. The Oak project is directly responsible for logging data values for the Oak Orchard WWTP and pump stations that feed Oak Orchard.

Metro Project: The Metro project monitors and controls the Meadowbrook / Limestone WWTP and the Metro WWTP as well as all pump stations that feed any of these WWTP's. The Metro project offers backup data logging for the Meadow Cimplicity project. The Metro project is directly responsible for logging data values for the Metro WWTP and pump stations, RTF's and CSO's that feed Metro.

BAF Project: The BAF Cimplicity project monitors and controls the BAF and HRFS treatment systems located on the Metro WWTP. This project operates as a stand-alone system - real-time requirements for automatic operation precludes this being part of the main system. Currently only some alarms and status are available in the main Metro project.

Clinton Project: The Clinton Project monitors and controls the Clinton CSO Facility.

LHB Project: The LHB Project monitors and controls the Lower Harbor Brook CSO Facility.

4.1.2 In the County's configuration, the Metro Project acts as the parent project for the south County projects (Meadowbrook, Ley [HCMF], Clinton CSO, and Lower Harbor Brook CSO) and the Oak Orchard Project acts as the parent project for the north County projects (Baldwinsville, Brewerton and Wetzel). The Oak Orchard and Metro sites are both manned 24 hrs/day. If the parent project at either site should fail, operators can start a backup project to assume control of that project.

4.1.3 Cimplicity logs historical trending and process analysis to a Microsoft SQL Database Server, located at the Metro WWTP.

4.1.4 Addition of I/O to the County's Cimplicity system may require the addition of the same point to multiple County projects. All points (or tags) added to the system shall have the same name when added to multiple projects. The physical location of the I/O is used to determine the Cimplicity project or projects that will need the new point. If the physical I/O is located in a Pump Station (PS), Regional Treatment Facility (RTF), Floatable Control Facility (FCF) or Combined Sewer Overflow (CSO) then the primary project is determined by the plant that the PS, RTF, FCF or CSO feeds. **In addition all PS, RTF, FCF and CSO points need to be added to the Ley Creek/Henry Clay Project**.

Location of Physical I/O or Plant Fed by PS, RTF, FCF, CSO	Primary Cimplicity Project[1]	24hr Monitoring and Backup Historical Data Logging[2]
Baldwinsville WWTP	BVILLE	OAK
Brewerton WWTP	BREW	OAK
Clinton CSO Facility	CLINTON	METRO
Lower HarborBrook CSO Facility	LHB	METRO
Henry Clay Maintenance Facility	LEY	N/A
Meadowbrook/Limestone WWTP	MEADOW	METRO
Metro WWTP [3]	METRO	N/A
Metro WWTP	BAF	N/A
Oak Orchard WWTP	OAK	N/A
Wetzel Road WWTP	WETZEL	OAK

1. The "Primary Cimplicity Project" will do all historical data logging.
2. The "24hr monitoring..." site will contain duplicates of all points added to the "Primary" project. This project will take over historical data logging on failure of the "primary" project.
3. The addition of physical I/O on the Metro WWTP site may not need to be included in the METRO Cimplicity project. If the point is part of the BAF, then the point will be added only to that respective project.

4.1.5 Example #1 provided:

A new Pump Station in Camillus, First Street, will feed Metro WWTP.

- ♦ The I/O points for the PS will be monitored through Metro's project, since this is where the PS feeds its effluent.
- ♦ Since it's a pump station the Ley (HCMF) Project will also monitor this pump station. However, Metro is the PS's primary project.
- ♦ Since the PS is normally unmanned, the Syracuse Metro Project will monitor the station on a 24hr basis. Logging is accomplished through the Primary Project (Metro).

4.1.6   Example #2 provided:

A new Pump Station in Brewerton, Shepard Point, will feed to Brewerton WWTP.

- ♦ The I/O points for the PS will be monitored through Brewerton project, since this is where the PS feeds its effluent.
- ♦ Since it's a pump station the Ley (HCMF) Project will also monitor this pump station. However, Oak is the PS's parent project.
- ♦ Since the PS is normally unmanned, the Oak Project will monitor the station on a 24hr basis. No logging is done by Brewerton. Logging is accomplished through the Parent Project (Oak).
- ♦ Upon BREW Project failure, Oak Project will continue to log the pump station points and to write to the sequel server. Oak Project will start monitoring.

Note 1: In some cases all points for a new pump station will need to be added to three Cimplicity Projects.

4.2   Logging

4.2.1   County projects log three categories of data: alarm, event and group. Each record includes specific parameters for alarm or event conditions, logging attributes, maintenance actions, and events and logging properties.

4.2.1.1 Alarm Data

Alarms occur anytime the system detects any data that is outside the normal limits, operating ranges, equipment failure, or other operating details that do not meet pre-established parameters.

Each project logs alarms from their physical site, and parent projects log alarms for any child project or remote treatment plant associated with it. Each alarm shall include time alarm occurred, acknowledgement, resets, deletes and comments. Alarms are logged to the ALARM_LOG table in Cimplicity.

4.2.1.2 Event Data

Events occur whenever a user performs identified actions or makes changes to the database such as:

- ◆ Logging in/out of Cimplicity
- ◆ Disabling/enabling/modifying/restoring/deleting alarms
- ◆ Updating/enabling/disabling digital inputs, updating/enabling/resetting of runtimes or updating/enabling/resetting flow totals.

Non-alarmed digital inputs such as equipment change of state "run/stop" are also logged as events.

As with the alarm data, each project logs alarms from their local treatment plants, and parent projects log alarms for any child project or remote facility associated with it.

4.2.1.3 Group Data

The Cimplicity system allows the County to log group data as follows:

- ◆ Analog Input Values – system updates input values every minute to SQL Server.
- ◆ Running Volume Pumped Totals – system updates running volume (cumulative minute values) pumped data every minute to SQL Server.
- ◆ Daily Volume Pumped Totals – system updates daily volume (running volume total for the day) pumped one occurrence after midnight to SQL Server. Data is sent via trigger logic residing in the PLC. Trigger logic is based on the PLC Real Time Clock.
- ◆ Runtimes – system updates runtime data values every minute to SQL Server.

4.3   Cimplicity Workbench - This is where the project is developed and changes are implemented.

4.3.1   Point development – each point shall be derived using a single tag from the server's OPC DataHub, developed in Software Toolbox OPC Server using the tag address from the PLC's tag database. Refer to Appendix A.

4.3.2   All I/O tags for physical points shall utilize the same ID from the Software Toolbox OPC Server I/O to OPC DataHub to Cimplicity database.

4.3.3   Point and program design in workbench shall follow the current standard employed by the County. Refer to Appendix G.

5.0   Control Loops

5.1   General

5.1.1   All control algorithms needed for local equipment control and monitoring shall reside in the PLC.

5.1.2   Large Facilities shall be provided with local and remote control logic. Local control shall be via HMI device, touch screen color panel, with appropriate security features. Remote function is by Plant Control Board, via SCADA.

5.1.3   Medium Facilities shall be provided with local and remote control logic. County requires automatic local control via the PLC in conjunction with an "Exor Display" (HMI) device. Additional local switches and indicators shall be provided for testing and indication of critical facility functions.

5.1.4   Small Facilities have no control in the PLC or through Cimplicity. The PLC and SCADA are strictly for monitoring status and alarms.

6.0   SCADA I/O

6.1   I/O Functions and Alarms

The following monitoring and control I/O points shall be incorporated into the facility design as applicable. This list is not intended to be all inclusive but is provided as a guide to the designer and contractor for their work.

6.1.1   Analog Inputs

  ◆ Wet Well Level
  ◆ Wastewater Pump Speed (where applicable)
  ◆ Facility Room (Control Cabinet) Temperature
  ◆ Chemical Pump Speed (where applicable)
  ◆ Sewage Flow (WWTPs and Large/Medium PS only)
  ◆ Chemical Feed Flow (where applicable)
  ◆ Chemical Tank Level (where applicable)
  ◆ Power Usage/Power Quality Monitoring (WWTPs and Large/Medium PS only)

6.1.2   Analog Output – 4-20 mA DC

  ◆ Pump Speed Control Reference
  ◆ Chemical Feed Dosage Control
  ◆ Chemical Tank Volumes (where applicable)
  ◆ Total Flow (where applicable)
  ◆ Wet Well Level

6.1.3   Digital Inputs

  ◆ Pump Running
  ◆ Pump Fault (i.e. Over Temperature, Moisture Alarm, Overspeed, Overload, Failed to Start)
  ◆ High-High Wet Well
  ◆ Low Wet Well
  ◆ UPS Failed

- Emergency Power ON
- Emergency Power OFF
- Normal Power OFF
- Dry Well Flooding
- Generator (i.e. Running, Failure, Fuel leak)
- Chemical Feed System (i.e. Running, Failure, Over Temperature, Chemical leak)
- Chemical Feed System (i.e. Failed to Start, Chemical leak, Fill Port in Use)
- Chemical Feed System (i.e. Tank High Level, Tank Low Level, Eye Wash Station in Use)
- Variable Speed Drive (VFD) Fault

6.1.4   Digital Outputs

- Sewage Pump Start/Stops
- Chemical Pump Start/Stops
- Generator Start/Test (for diagnostics or load shedding)
- Pump Reset (Not on motor overload – for diagnostic purposes)

7.0   Uninterruptible Power Supply (UPS)

7.1.1   Contractor shall provide an adequately sized Uninterruptable Power Supply (UPS) to maintain power to all PLC units, modems and network interface equipment so as to maintain remote monitoring of facility for a minimum of 30 minutes. Provide remote monitoring of UPS functions as applicable and practical.

7.1.2   If normal AC power deviates by plus or minus 10% from nominal voltage, or plus or minus 5% from nominal frequency, the UPS shall supply energy to maintain constant, regulated inverter AC power output to the load without switching or disturbance.

7.1.3   Maximum harmonic content of output voltage waveform shall be 5% Root Means Squared (RMS) total and 3% RMS for any single harmonic for rated full load with Total Harmonic Distortion (THD) of up to 50%, with a load crest factor of 3.0.

7.1.4   The UPS shall have an integral surge suppression to protect internal components from surges that enter at each AC power input connection including main disconnect. The UPS shall have a true sine wave output.

7.1.5   The UPS selected shall be capable of operating normally while a standby generator running.

APPENDIX A.1 – SAMPLE SOFTWARE TOOLBOX OPC SERVER CONFIGURATION SCREEN (FOR REFERENCE ONLY)

APPENDIX A.2 – SAMPLE OPC DATAHUB CONFIGURATION SCREEN
(FOR REFERENCE ONLY)
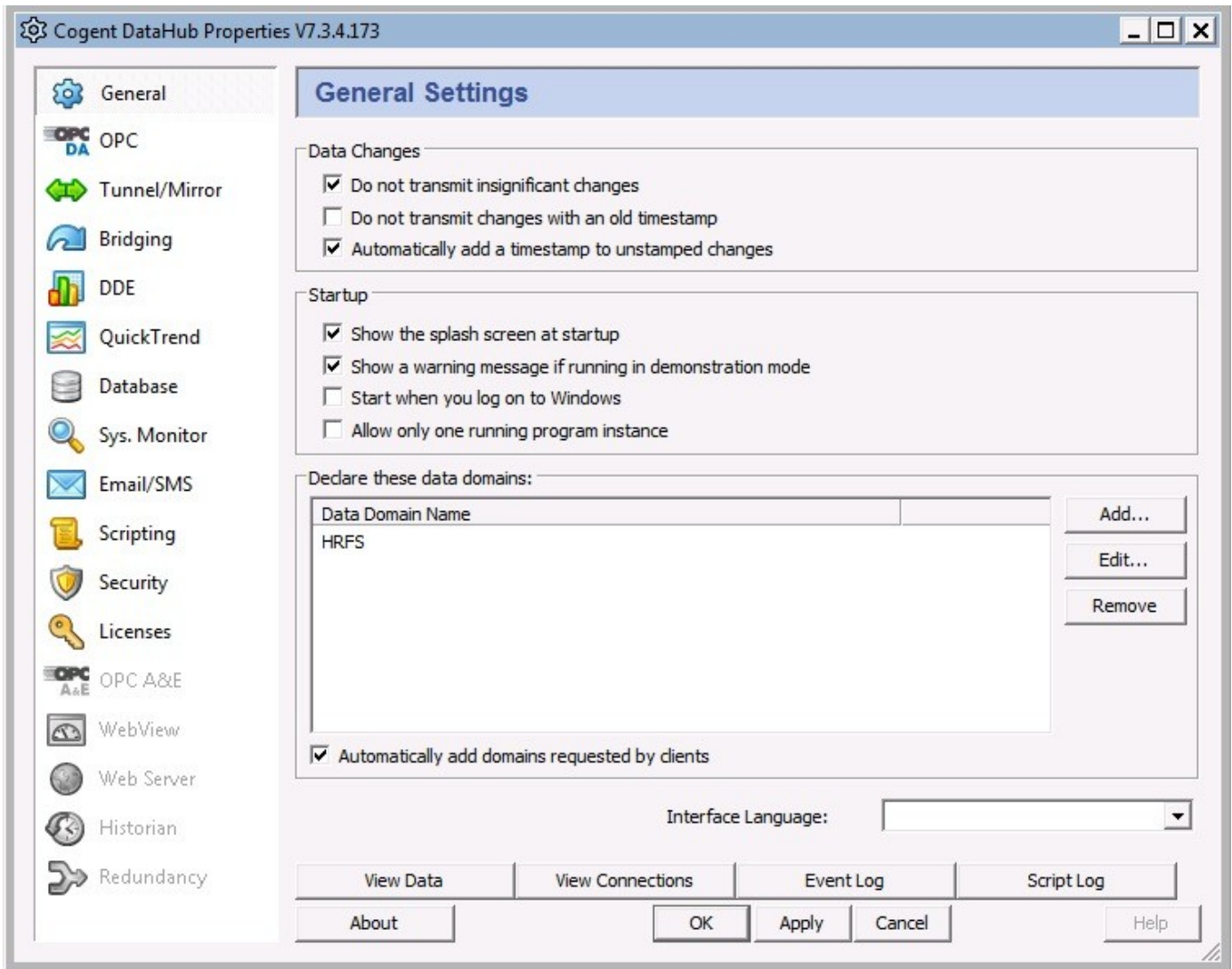
APPENDIX A.3 – SAMPLE OPC DATAHUB MONITORING SCREEN
(FOR REFERENCE ONLY)

Point Name	Time Stamp	Quality	Type	Value
E07_FT105	Nov 12 20:57:40.933	Good	R4	0
E07_FT107	Nov 13 21:39:34.559	Good	R4	0.024
E07_LT101	Nov 13 21:48:04.878	Good	R4	397.6074
E07_LT102	Nov 12 20:57:40.933	Good	R4	393.5

APPENDIX B.1 – SAMPLE PUMP STATION SCADA SCREEN
(FOR REFERENCE ONLY)
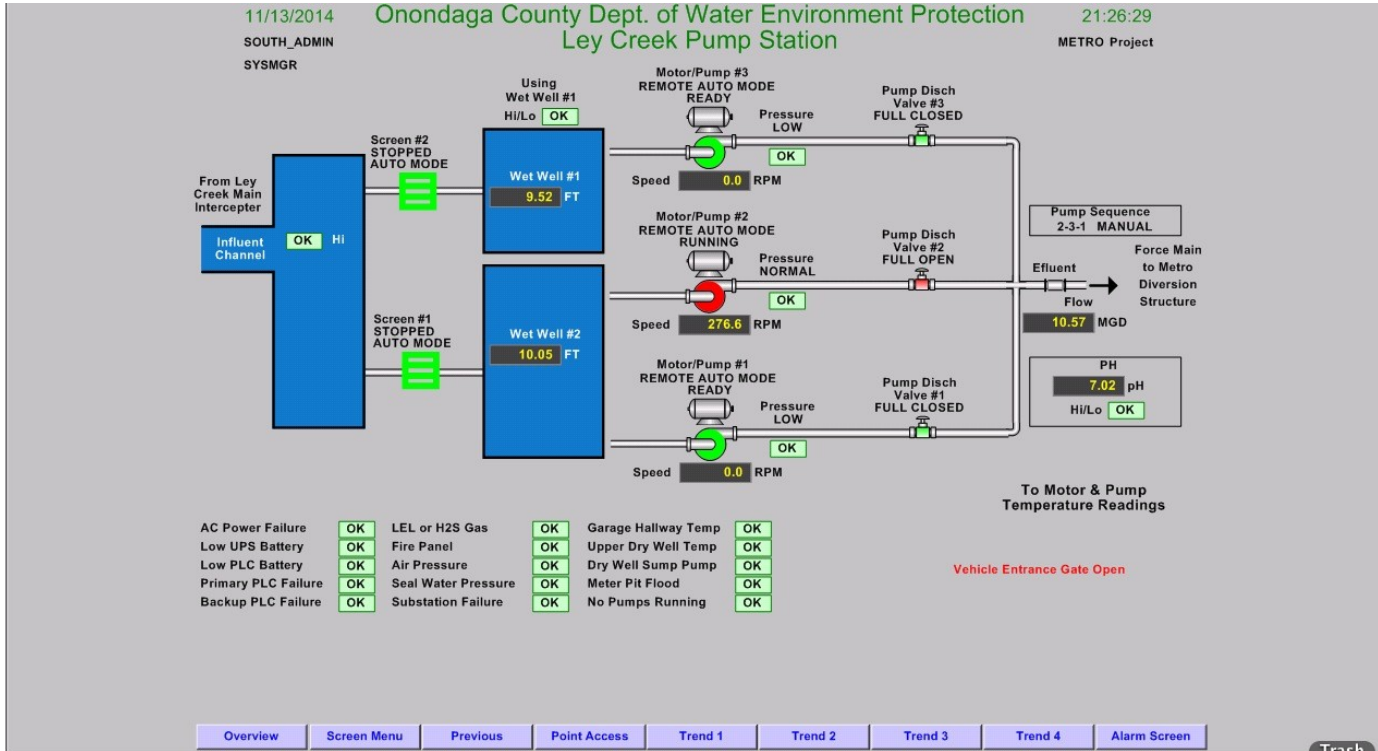
APPENDIX B.2 – SAMPLE ODOR CONTROL SCADA SCREEN
(FOR REFERENCE ONLY)
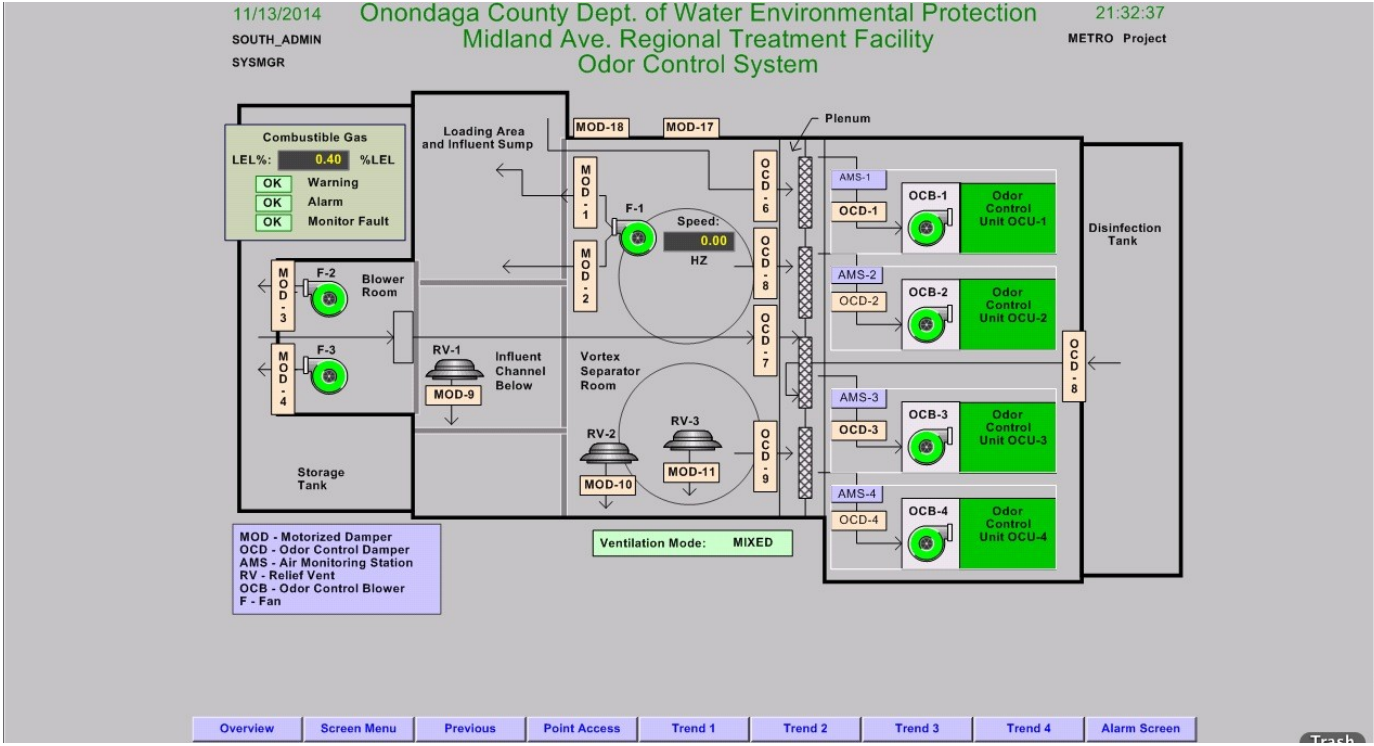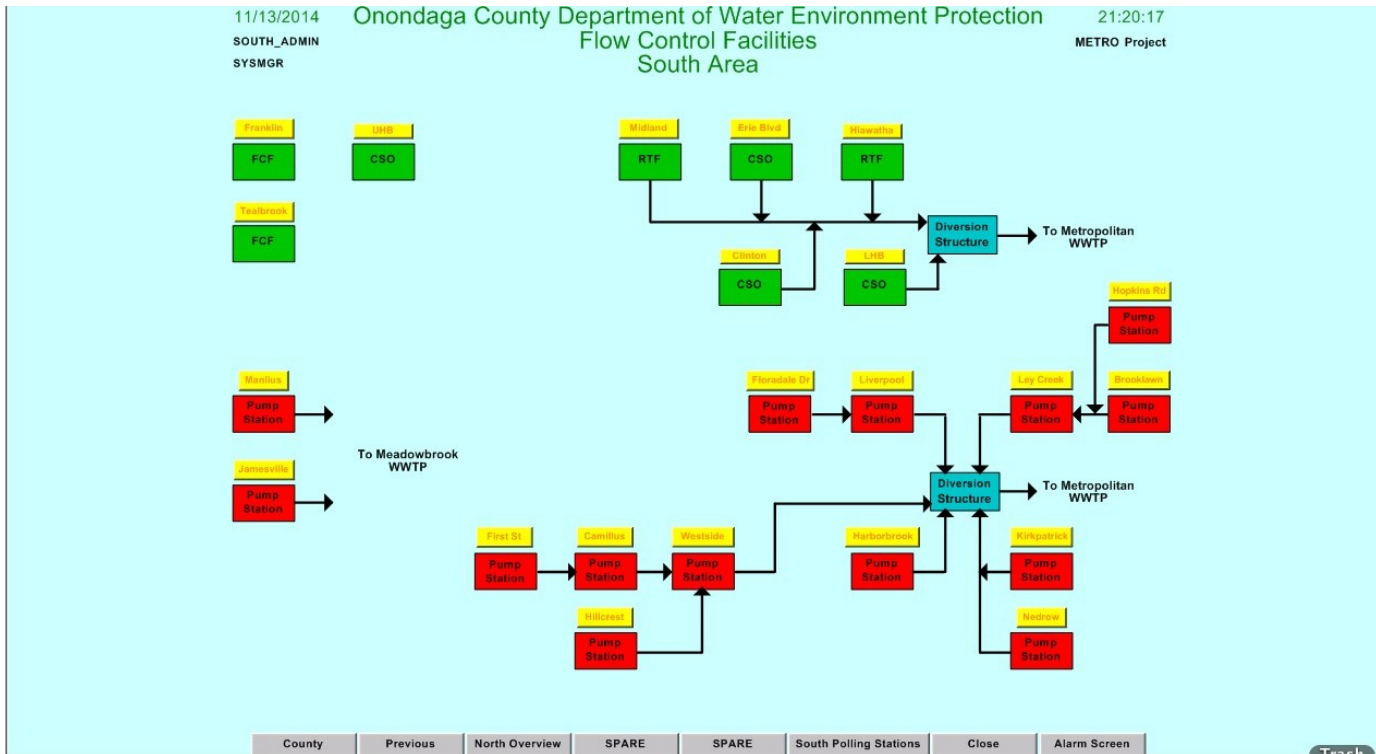
APPENDIX B.4 – SAMPLE PROCESS FLOW
SCADA SCREEN
(FOR REFERENCE ONLY)
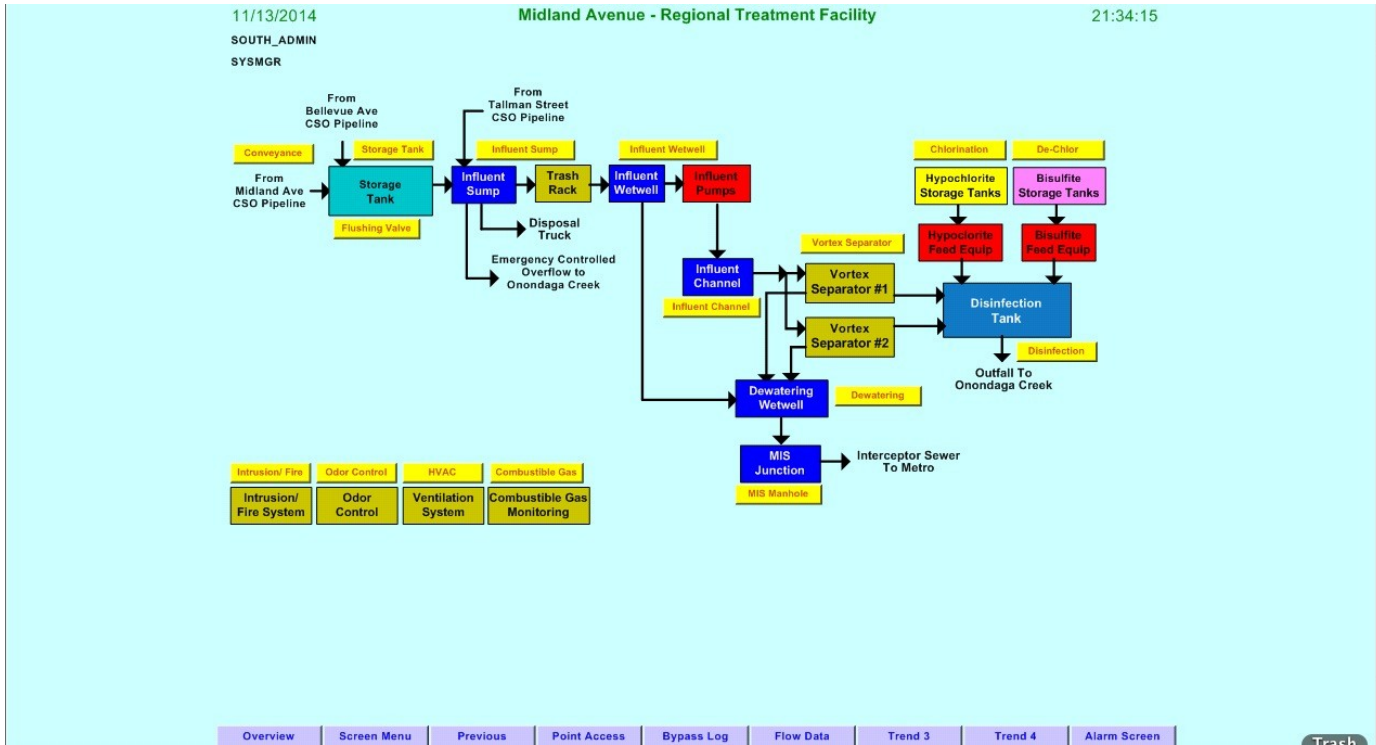
APPENDIX C – SAMPLE COLOR SCHEME
(FOR REFERENCE ONLY)

Color Scheme - Water Environment Protection Projects

Raw sludge | Sewage | RAS/WAS | Digested Sludge | Phosphorous Removal | O2 | Polymer

Chlorine | Natural Gas | Effluent | Potable H2O | Plant Water | Sludge Gas | Supernatant | Ferric Chloride | Sulfur | Process Air
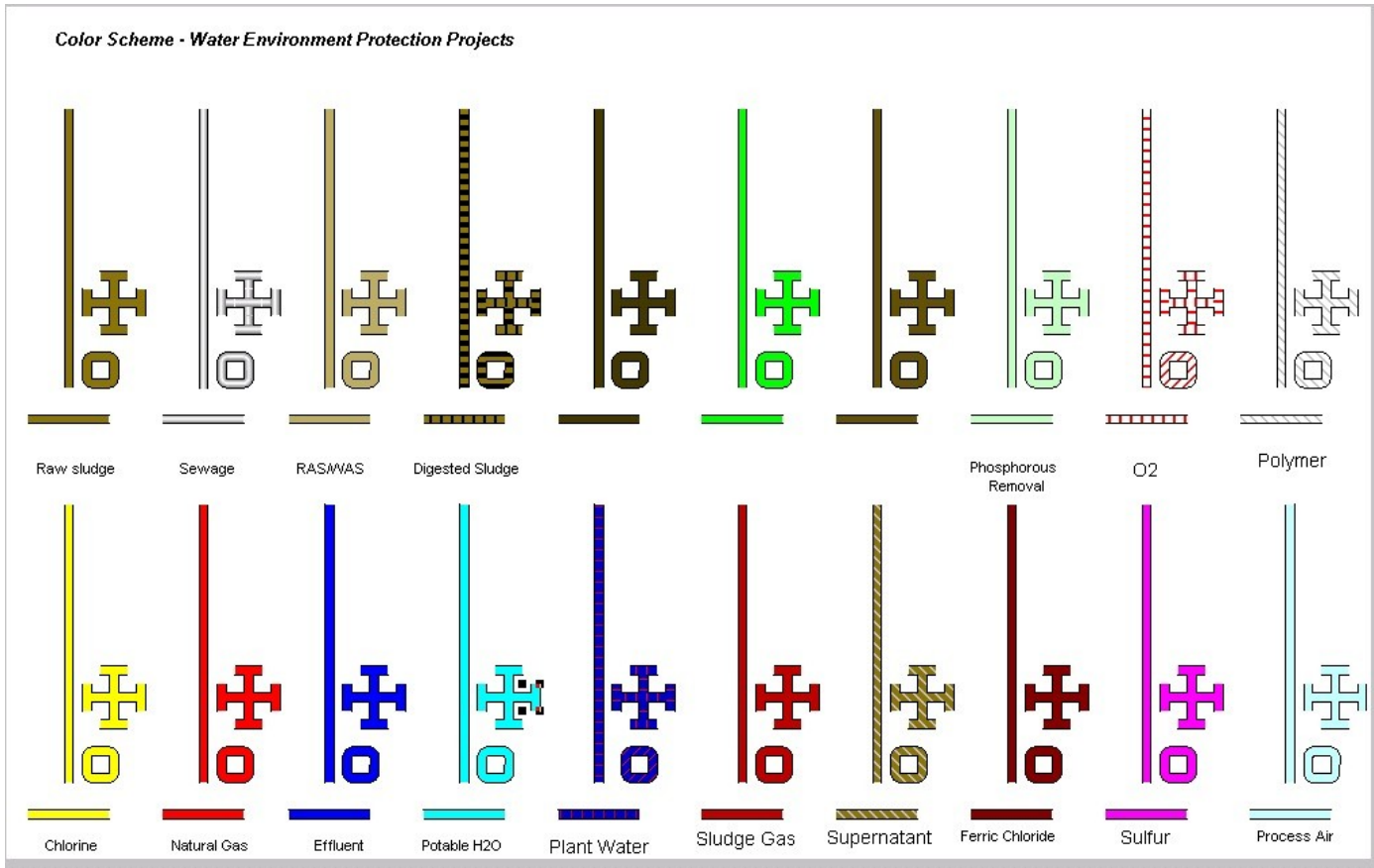
APPENDIX D – SAMPLE SYMBOL LIBRARY
(FOR REFERENCE ONLY)

APPENDIX E – SAMPLE ALARM SCADA SCREEN
(FOR REFERENCE ONLY)

Project	Alarm ID	Date	Time	State		Ack	Message
WEP9252	M0102006	Nov 13	21:25	ALARM		N	Metro WWTP - Waste Dig Sludge Flow Alarm LOW at 0.00 GPM
WEP9252	E05011202_ASLL	Nov 13	21:24	NORMAL		N	Clinton CSO - Effluent Chamber Level A Low-Low
WEP9252	L53I006	Nov 13	21:23	NORMAL	C	N	Butternut #1 PS - Wetwell High
WEP9252	MIVU_FSU_ALM	Nov 13	21:19	ALARM		N	Metro WWTP - PMB - Four Seasons Unit Malfunction Alarm
WEP9252	L53I005	Nov 13	21:17	NORMAL		N	Butternut #1 PS - Power Failure
WEP9252	M32_FIT608	Nov 13	20:53	NORMAL		N	Metro WWTP - TSBB - Process Drain Flow NORMAL at 1292.48 GPM
WEP9252	M3205211	Nov 13	20:52	NORMAL		N	METRO-SDF-Process Drain Sump Low Low Level
WEP9252	M5200500	Nov 13	20:20	NORMAL		N	Hillcrest PS - Wet Well Level NORMAL at 4.90 Feet
WEP9252	M6100503	Nov 13	19:52	NORMAL		N	Westside PSTA Flow NORMAL at 3.28
WEP9252	M11_GGG_DO2	Nov 13	19:40	ALARM		N	METRO Tank GDO #2 Warning LOW
WEP9252	M0605117	Nov 13	14:53	ALARM	C	Y	Brookside PS Tone Loss
WEP9252	M0102313	Nov 13	13:58	ALARM		Y	Metro WWTP - Digester #3 Inlet Temperature Warning HIGH at 100.62 DEG F
WEP9252	M5200101	Nov 12	10:26	ALARM	C	Y	Hillcrest PS - Pump 1 Failure
WEP9252	M0100715	Nov 10	13:34	ALARM		Y	#1 SL Rec PP Seal Water Loss

14	Ack	Ack All	Delete	View Stack	Help	Comments	CimView Screen	Setup

Microsoft Remote

APPENDIX F.1 – SAMPLE GRAPHICS HMI SCREEN
(FOR REFERENCE ONLY)
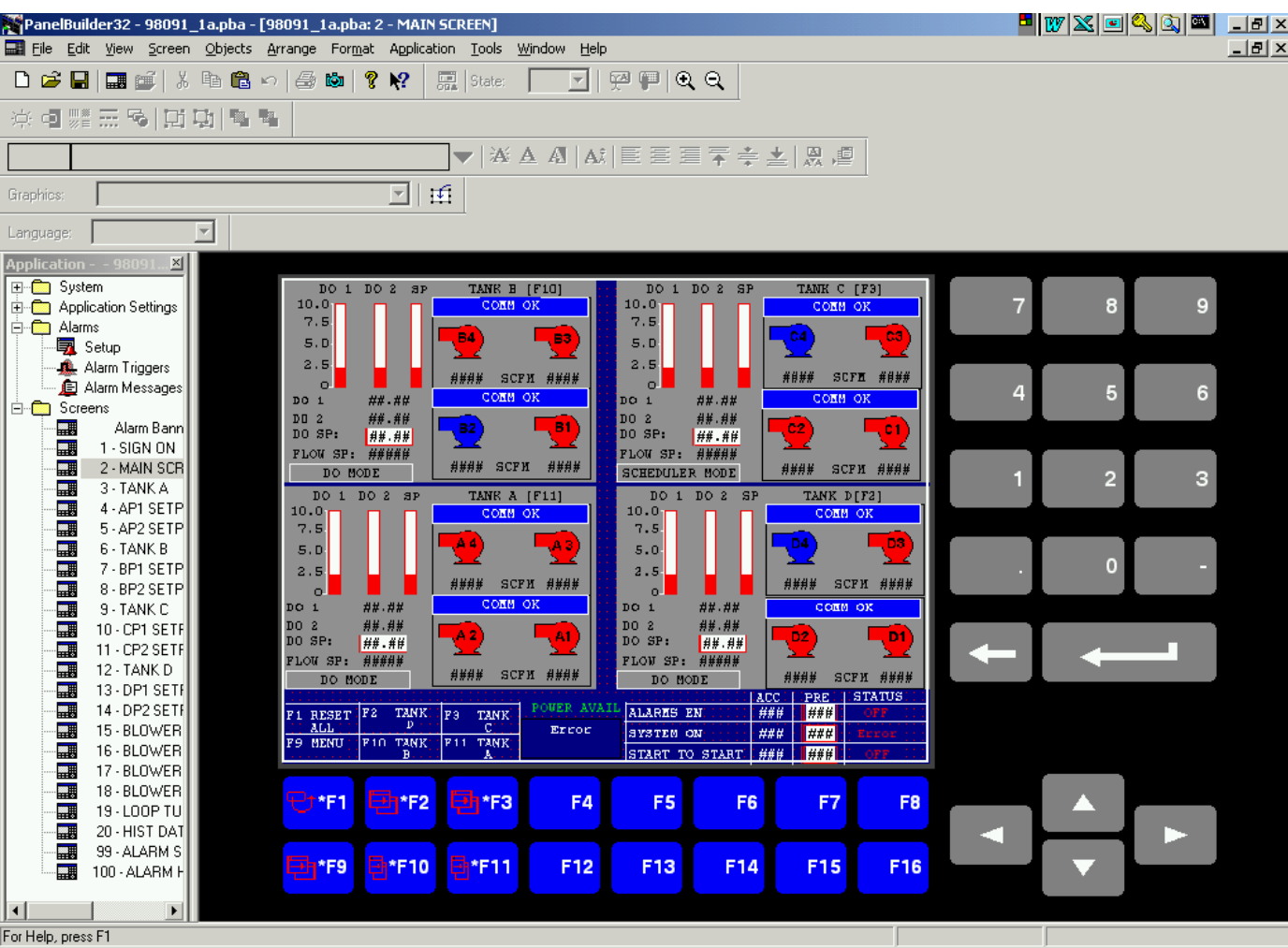
APPENDIX F.2 – SAMPLE ALARM SUMMARY HMI SCREEN
(FOR REFERENCE ONLY)
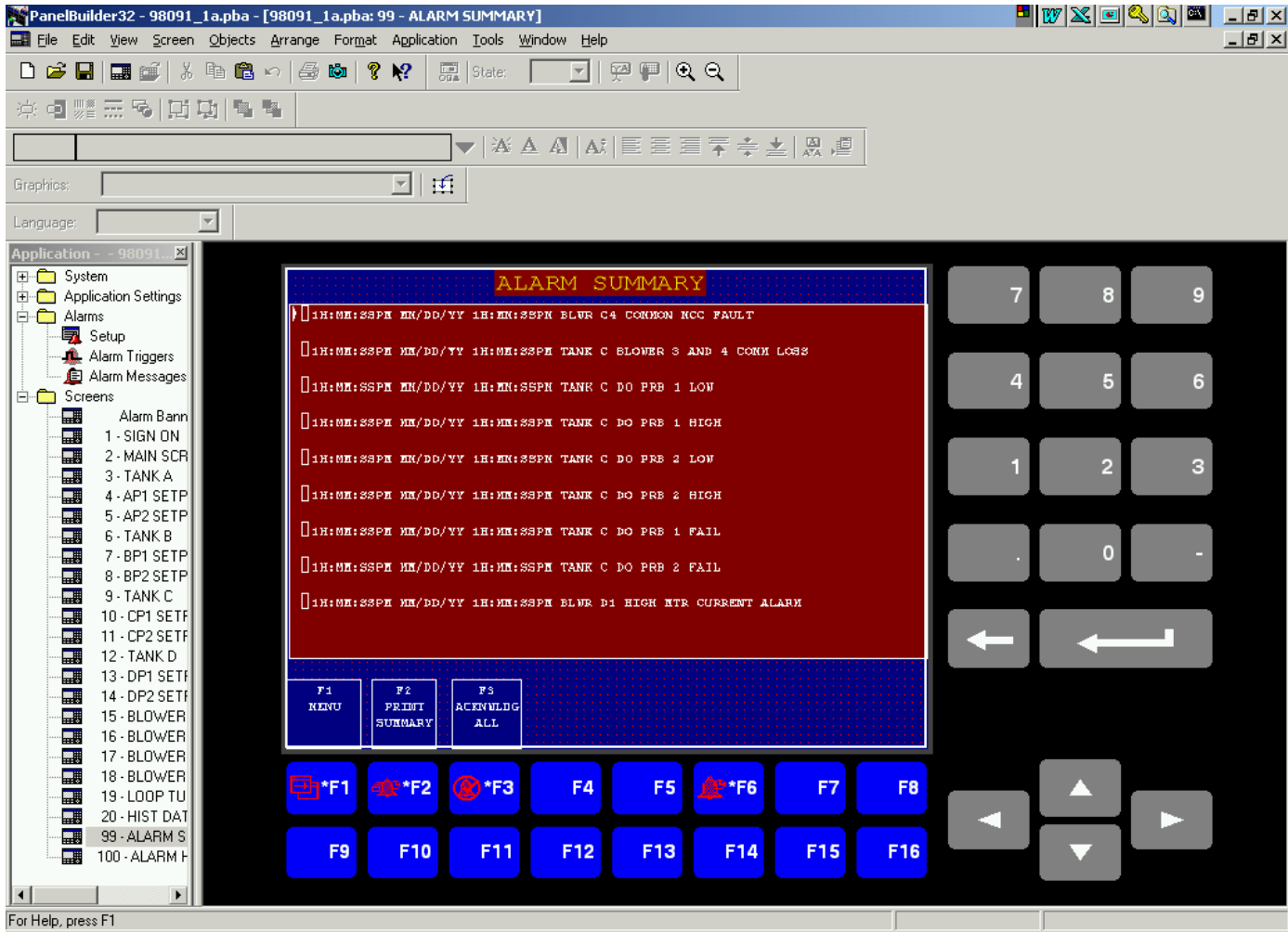
APPENDIX F.3 – SAMPLE DATA HMI SCREEN
(FOR REFERENCE ONLY)
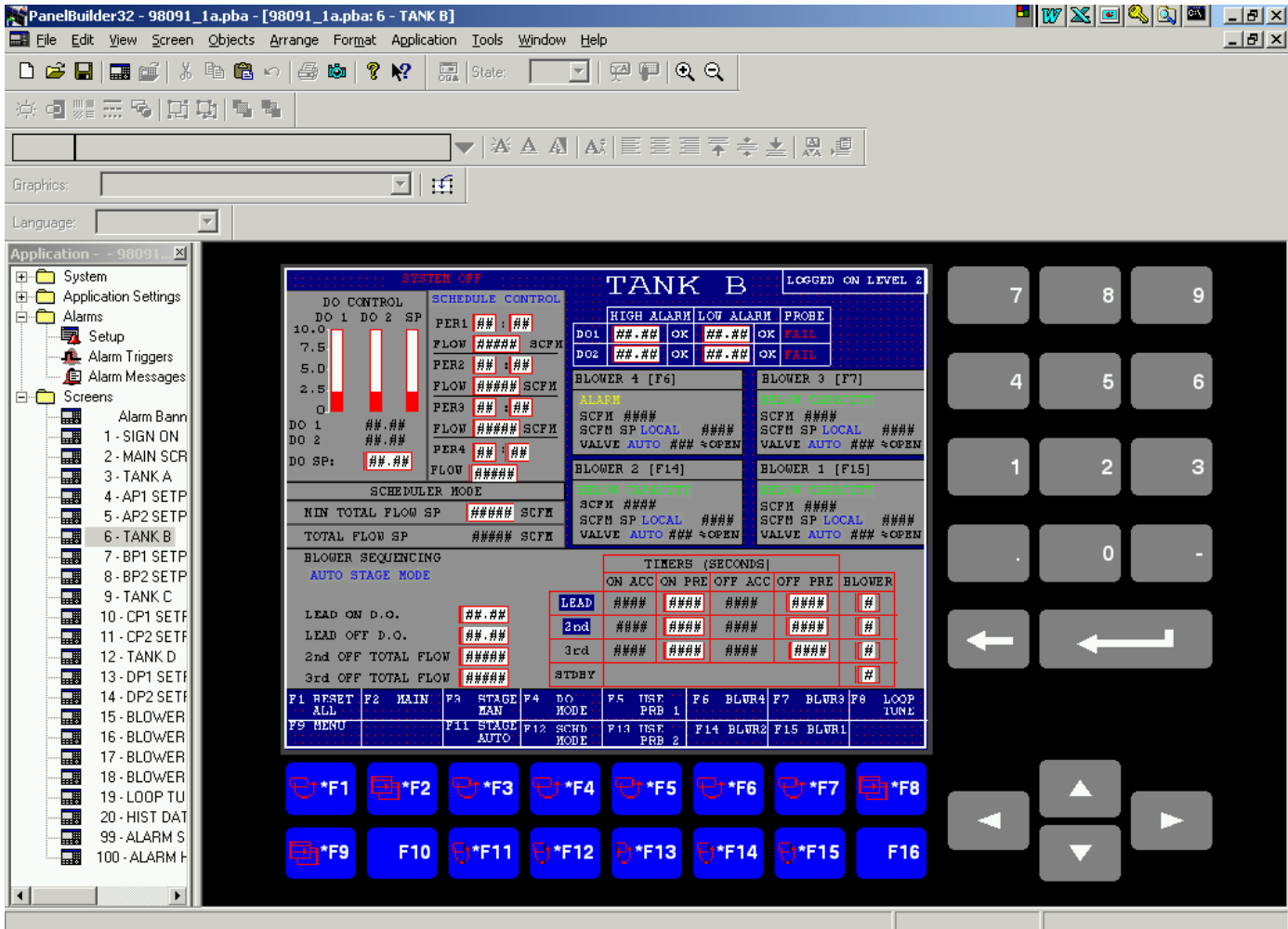
APPENDIX F.4 – SAMPLE HISTORICAL DATA
HMI SCREEN
(FOR REFERENCE ONLY)

APPENDIX G.1 – CIMPLICITY WORKBENCH PORT AND DEVICE ID SCREEN (FOR REFERENCE ONLY)

METRO - CIMPLICITY Workbench

File Edit Computer Project View Tools Help

Port	Protocol ID	Description
MASTER_AB_ETH0	AB_ETHERNET	Metro A-B PLC Ethernet Port
MASTER_AB_ETH1	AB_ETHERNET	Meadow A-B PLC Ethernet Port
MASTER_AB_ETH2	AB_ETHERNET	PSTA, FCF, & RTF A-B PLC Ethernet Port
MASTER_OPC_0	OPCCLIENT	Metro OPC Client Port
MASTER_OPC_1	OPCCLIENT	Meadow OPC Client Port
MASTER_OPC_2	OPCCLIENT	PS OPC Client Port
MASTER_OPC_3	OPCCLIENT	FCF , RTF, & CSO OPC Client Port

Devices:
- E50_CSO
- E69_RTF
- E81_FCF
- E82_FCF
- E83_RTF
- H01_WTP
- H02_PS
- H03_WTP
- L50_PS
- L55_PS
- L55_PSTA
- M51_PSTA
- M52_PS
- M53_PS
- M58_PS
- M58_PSTA
- M60_PS
- M61_PSTA
- M63_PSTA
- M64_PSTA
- M65_PS
- M65_PSTA
- M66_PSTA
- M71_RTF
- M72_RTF
- M73_RTF
- M74_RTF
- M79_PS
- M81_PS
- M85_PSTA
- MEADOW_PLC1
- MEADOW_PLC2
- MEADOW_PLC4

Trash

APPENDIX G.2 – CIMPLICITY WORKBENCH POINT ID SCREEN
(FOR REFERENCE ONLY)

Point ID	Device ID	Resource	Point Type	Description
L5000100	L50_PS	MET_PSTA_DIG	BOOL	Manlius PS Pump 1 Auto
L5000101	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS Pump 1 Failure
L5000102	L50_PS	MET_PSTA_DIG	BOOL	Manlius PS Pump 2 Auto
L5000103	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS Pump 2 Failure
L5000104	L50_PS	MET_PSTA_DIG	BOOL	Manlius PS Pump 3 Auto
L5000105	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS Pump 3 Failure
L5000107	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS High Water Drywell
L5000200	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS High Wet Well Alarm
L5000201	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS Low Wet Well Alarm
L5000202	L50_PS	MET_PSTA_DIG_RT	BOOL	Manlius PS Pump 1 Running
L5000202_RT_ENABLE	L50_PS	MET_PSTA_RT_ENB	BOOL	Manlius PS Pump #1 Runtime Enable
L5000202_RT_LSR	L50_PS	MET_PSTA_RT	REAL	Manlius PS Pump #1 Runtime - LSR
L5000202_RT_MSR	L50_PS	MET_PSTA_RT	REAL	Manlius PS Pump #1 Runtime - MSR
L5000202_RT_RESET	L50_PS	MET_PSTA_RT_RST	BOOL	Manlius PS Pump #1 Runtime Reset
L5000203	L50_PS	MET_PSTA_DIG_RT	BOOL	Manlius PS Pump 2 Running
L5000203_RT_ENABLE	L50_PS	MET_PSTA_RT_ENB	BOOL	Manlius PS Pump #2 Runtime Enable
L5000203_RT_LSR	L50_PS	MET_PSTA_RT	REAL	Manlius PS Pump #2 Runtime - LSR
L5000203_RT_MSR	L50_PS	MET_PSTA_RT	REAL	Manlius PS Pump #2 Runtime - MSR
L5000203_RT_RESET	L50_PS	MET_PSTA_RT_RST	BOOL	Manlius PS Pump #2 Runtime Reset
L5000204	L50_PS	MET_PSTA_DIG_RT	BOOL	Manlius PS Pump 3 Running
L5000204_RT_ENABLE	L50_PS	MET_PSTA_RT_ENB	BOOL	Manlius PS Pump #3 Runtime Enable
L5000204_RT_LSR	L50_PS	MET_PSTA_RT	REAL	Manlius PS Pump #3 Runtime - LSR
L5000204_RT_MSR	L50_PS	MET_PSTA_RT	REAL	Manlius PS Pump #3 Runtime - MSR
L5000204_RT_RESET	L50_PS	MET_PSTA_RT_RST	BOOL	Manlius PS Pump #3 Runtime Reset
L5000205	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS Bar Screen Failure
L5000205_RT_ENABLE	L50_PS	MET_PSTA_RT_ENB	BOOL	Manlius PS Bar Screen Runtime Enable
L5000205_RT_LSR	L50_PS	MET_PSTA_RT	REAL	Manlius PS Bar Screen Runtime - LSR
L5000205_RT_MSR	L50_PS	MET_PSTA_RT	REAL	Manlius PS Bar Screen Runtime - MSR
L5000205_RT_RESET	L50_PS	MET_PSTA_RT_RST	BOOL	Manlius PS Bar Screen Runtime Reset
L5000206	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS PLC Failure
L5000207	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS Normal Power Failure Alarm

APPENDIX G.3 – CIMPLICITY WORKBENCH POINT ID
CONFIGURATION SCREEN
(FOR REFERENCE ONLY)

Point Properties - L5000200

General | Device | Alarm | View | Conversion

Description: Manlius PS High Wet Well Alarm

Basic <<

Data type: BOOL   Elements: 1   ☑ Read only

☑ Enable point
☑ Enable alarm
☐ Enterprise point
☐ Log data

Resource ID: MET_PSTA_DIG_ALM   >

Trend history
☐ Max duration   0   Seconds
☐ Max samples   0

Change approval
○ Perform
○ Perform and verify
⦿ None
☐ Unsigned writes

Safety point: ___   >

Availability trigger: ___   >

☐ Invert

Attribute set: ___   >

Extra info: 0   Level: 0

OK   Cancel   Apply   Help

APPENDIX G.4 – CIMPLICITY WORKBENCH POINT ID CONFIGURATION SCREEN (FOR REFERENCE ONLY)

APPENDIX G.5 – CIMPLICITY WORKBENCH POINT ID CONFIGURATION SCREEN (FOR REFERENCE ONLY)

APPENDIX H – CONTACT INFORMATION
(FOR INFORMATION)

Please feel free to call to clarify any part of the above document.

Timothy Morse, Systems Programmer…………………………………………...435-2260