ONONDAGA COUNTY DEPARTMENT OF
WATER ENVIRONMENT PROTECTION

PLC AND SCADA ARCHITECTURE, HARDWARE AND SOFTWARE STANDARDS FOR MONITORING AND CONTROL

REVISION 8.3

Version Date: February 2018

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

This document is a living manuscript, and information contained within can be edited at any time. As such, the reader should confirm with WEP's Systems Programmer that the specifications herein are those to be followed. The use of manufacturer and/or vendor names herein does not represent an endorsement and/or bias by WEP; rather, they simply serve to illustrate existing equipment. Information contained herein is believed to be correct, but WEP makes no warranties respecting it and disclaims any responsibility or liability of any kind for any loss or damage as a direct or indirect consequence of anyone's reliance upon such information.

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

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SCADA Standards
For Monitoring and Control
Revision 8.3

1.0 Background

WEP's Supervisory Control and Data Acquisition (SCADA) system controls and monitors six 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 Instrumentation/Electrical (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 for Programmable Logic Controller (PLC) programming; Allen-Bradley FactoryTalk View Studio software for HMI terminals; CIMPLICITY from GE Digital for SCADA; and Cogent OPC DataHub, Software Toolbox OPC Server (OLE for Process Control Server) and Allen-Bradley RSLinx for communications. The purpose of this document is to allow the engineer to understand the goals and expectations for automation design projects. One of the primary goals is to provide a uniform look and feel for Operations and Maintenance personnel throughout the County HMI and 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 main PLC hardware required for a specific facility. This distinction is as follows:

- Large - Includes all Wastewater Treatment Plants (WWTPs) as well as any collection facility (PS, RTFs, FCFs, CSOs) with a design capacity of 3 million gallons per day (MGD) and above.
- Medium - Collection facilities with a design capacity between 0.5 MGD and 3 MGD.
- Small - Collection facilities with a design capacity of 0.5 MGD and below.

Specific hardware may change to accommodate requirements at any site. Always allow WEP to review equipment selections 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 HMI and SCADA systems. 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.

- **Database** - WEP has several CIMPLICITY SCADA projects for monitoring and control. These SCADA projects are located at: Baldwinsville (B'ville) WWTP; Brewerton WWTP; Henry Clay Maintenance Facility (HCMF); Meadowbrook/ Limestone (MBLS) WWTP; Metropolitan (Metro) Syracuse WWTP (Metro, Flow, and Remote); Oak Orchard WWTP; Wetzel Road WWTP; Clinton CSO Facility; Midland RTF, and Lower Harbor Brook (LHB) CSO Facility. All records are kept in a single Microsoft SQL 2008 R2 Server database.

  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.

- **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 with the SCADA system.

2.0 PLC (Programmable Logic Controller)

2.1 General

The PLC shall convert all raw data to appropriate engineering units, calculate equipment runtime totalized values, and provide real-time clock updates. Equipment status and I/O monitoring is required. Depending on the specific site and application, equipment may also 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 and consists of one of the following*
  B = B'ville
  C = Brewerton
  L = Meadowbrook-Limestone
  F = Oak Orchard
  G = Wetzel Road
  M,N = Metro
  E = CSO, FCF, & RTF
  H = HCMF

- *QQ = 2-digit PLC number within the Service Area*. The Owner shall assign and provide PLC number(s) to prevent conflicts with Owner's existing PLCs.

- *L = Chassis or Communications Adapter*, i.e. 0-9. The ID value of an additional rack controlled by or connected to the PLC designated as QQ. The main PLC processor rack would have a value of zero here. Any remote I/O racks present would cause this value to be incremented.

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

- *CC = Slot/Module # within the Chassis*, i.e. 00-16.

- *PP = Channel or I/O Point on the module*, i.e. 00-15.

Example: M030I0503 would be an I/O point at Metro, in PLC 03, on a module in physical chassis 0, I/O type "Input", in module 05, fourth point (03) on the module.

The intent is for the software configuration of the I/O to match the physical location. Be aware of the use of slot 0 and channel 0 when allocating I/O points. (e.g. the fourth slot may actually be slot 03 when the first slot is 00)

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 setpoint, 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, not a virtual 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 Instrumentation Society of America (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 through communication adapters shall be configured using the PLC Device ID, followed by the ISA standards for equipment identification, e.g.: M03_FIT130, M03_FIT130_ASL.

2.4 Data Exchange/Communications

2.4.1 When required, a separate software routine shall be used for all data exchange between the PLC and any auxiliary devices (HMI, SCADA, other PLCs, variable speed drives, etc.).

2.4.2 All tags communicating to SCADA shall be individual tags to OPC Server. No arrays shall be permitted.

2.4.3 PLC program design shall follow Rockwell Automation guidelines as well as the 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, FactoryTalk View Studio, and associated programs – with descriptors – shall also be provided to OCDWEP anytime PLC and/or HMI/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. All delivered software, including OEM equipment, shall be delivered fully unlocked with no password protection. See S*ection 6.1* for further information regarding OEM equipment.

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

2.5.5 All custom software (PLC programs, HMI screens, SCADA graphics, SCADA database) shall be subject to 50% and 90% reviews by OCWEP.

2.5.6 No software should be generated until the control system narrative (by integrator) is reviewed and accepted by OCDWEP.

2.5.7 The revision number to be used for all PLC and HMI programming shall be reviewed and approved by OCDWEP prior to the start of automation software development.

2.6 Ethernet Hardware and Configuration

2.6.1 The Owner shall provide the IP addresses, gateways, and masks as required for network integration. All equipment configuration and proof of communications shall be by the Engineer/Integrator.

2.6.2 All PLC control panel designs shall include a Stratix managed Ethernet switch with full software, copper, and fiber connections (where required). All Ethernet switches shall have at least 1 spare copper connection.

2.6.3 The standard for fiber connections is to use 'LC' type connectors. All fiber shall be multi-mode, loose tube. Include minimum 50% spare tubes in all fiber designs. Sheathings and coverings shall be as needed for the environment.

2.6.4 Include a programming port and a 120 VAC outlet accessible from the panel interior in all control panel designs.

2.7 Large Facility Hardware

2.7.1 **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 Spectrum Business Class or equivalent.

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

- AB ControlLogix 5570 1756-L7x controller.

- 1756-EN2T Ethernet/IP Module.
- I/O necessary to support all points.
- Minimum spares: 4 analog isolated outputs, 4 analog isolated inputs, 16 digital isolated outputs, 16 isolated digital inputs
- I/O limited to a maximum of 16 points per module.
- 120 volt AC digital I/O is preferred.
- Electrical current-based (4-20 mA) analog I/O is preferred.
- Wiring arms, pre-manufactured cables, and terminal block assemblies (AB Bulletin 1492 IFM) shall be supplied on all I/O modules. Blown fuse indication should be included on all terminal blocks where applicable.
- Slot fillers shall be supplied on all empty rack slots.

Modules requiring OCDWEP permission to use include:

- 1756 ControlNet Redundant Module and 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.

Ethernet is the preferred I/O bus. The use of ControlNet, DeviceNet, and/or FOUNDATION Fieldbus shall be only by the approval of OCDWEP.

Additional equipment includes:

- Allen-Bradley PanelView Plus 7 Performance Terminal HMI (touchscreen, TFT color, Ethernet communications), 10" minimum.
- Consult WEP for preferred hot-standby configurations, if necessary, for system redundancy.

2.7.3 **Additional Requirements and Deliverables of Engineer/Integrator**:

- Development of necessary PLC logic to integrate required process monitoring and control points into CIMPLICITY.
- Develop required CIMPLICITY points following WEP's 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 applicable site showing the status of the facility's I/O and alarms at the required County SCADA projects. Refer to the background information presented in *Sections 1.0* and *4.1* to help determine the appropriate 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 a 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.

2.7.3.1 WAN Access: Cisco device equivalent to the following:
- Cisco Model: ASA5506-SEC-BUN-K9.

2.7.3.2 Ethernet Switches:
- Managed Ethernet switch shall be from AB 1783 Stratix 5410 Series or 8300 Series.
- The use of unmanaged switches is not permitted.

2.7.3.3 DeviceNet: DeviceNet shall only be allowed under permission or by request of OCDWEP. When included, it shall be in accordance with 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.

2.7.3.4 Fieldbus: Fieldbus wiring and programming shall only be allowed under permission or by request of OCDWEP. When included, it shall be in accordance with the following:
- Fieldbus Organization Wiring & Installation Guide 31.25 Kbps.
- Relcom Inc. Fieldbus Wiring Guide.
- Allen-Bradley's 1756 Fieldbus Configuration Standard.
- Tag development shall follow WEP's SCADA Standards.

2.7.3.5 ControlNet: ControlNet shall only be allowed under permission or by request of OCDWEP. When included, it shall be in accordance with 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.

2.7.3.6 EtherNet/IP: EtherNet/IP is the I/O communication platform preferred by OCDWEP. 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.
- Allen-Bradley Ethernet Design Considerations Reference Manual.
- Allen-Bradley Redundant Ethernet Configuration Standard.
- Allen-Bradley Fiber Optic Infrastructure Application guide.

2.8 Medium Facility Hardware

2.8.1 **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 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:** Equipment preferred at medium facilities is based around the AB CompactLogix 5370 1769-L33ER system employing the following modules and equipment:

- 1769-SDN, DeviceNet scanner module, shall only be allowed under permission or by request of OCDWEP. When included, it shall be in accordance with 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.
- 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
- I/O limited to a maximum of 16 points per module.
- 120 volt AC digital I/O is preferred.
- Electrical current-based (4-20 mA) analog I/O is preferred.

- EtherNet/IP: EtherNet/IP is the I/O communication platform preferred by OCDWEP. 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.
  - Allen-Bradley Ethernet Design Considerations Reference Manual.
  - Allen-Bradley Redundant Ethernet Configuration Standard.
  - Allen-Bradley Fiber Optic Infrastructure Application guide.

Additional equipment includes:

- Allen-Bradley PanelView Plus 7 Performance Terminal HMI (touchscreen, TFT color, Ethernet communications), 7" minimum.
- SCADA connection shall be Ethernet via WEP's cellular WAN.

2.8.3 **Additional Requirements and Deliverables of the Integrator:**

- Development of necessary PLC logic to integrate required process monitoring and control points into CIMPLICITY.
- Develop required CIMPLICITY points following WEP's 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. Refer to the background information presented in *Section 1.0* and *4.1* to help determine the appropriate 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 a 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.

2.8.3.1 WAN Access: WEP's cellular WAN access device must be equivalent to the following device:

- Cisco Model C819HG-LTE-MNA-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 mount kit.
- Managed Ethernet switch for Cisco router.
- WEP will provide Subscriber Identity Module (SIM) required for router and will configure hardware for WEP's WAN.

2.8.3.2 Ethernet Switches:

- Managed Ethernet switch shall be from AB 1783 Stratix 8300 Series or 5700 Series.
- The use of unmanaged switches is not permitted.

2.9 Small Facility Hardware

2.9.1 **Networking:** Equipment at Small Facilities (control panels) shall communicate with SCADA project located at the Metro WWTP 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.

2.9.2 **PLC Equipment:** At Small Facilities provide and install an AB CompactLogix L2 PLC with Cisco Integrated Services Router for remote off-site monitoring by WEP at Metro. 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:

- AB CompactLogix 5370 1769-L2 PLC.
- Allen-Bradley PanelView Plus 7 Performance Terminal HMI (touchscreen, TFT color, Ethernet communications), 7".
- I/O limited to a maximum of 16 points per module.
- 120 volt AC digital I/O is preferred.
- Electrical current-based (4-20 mA) analog I/O is preferred.

2.9.3 **Additional Requirements**:

- Development of necessary PLC logic to integrate required process monitoring and control points into CIMPLICITY.
- Develop required CIMPLICITY points following WEP's 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. Refer to the background information presented in *Section 1.0* and *4.1* to help determine the appropriate 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 a 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.

2.9.3.1 WAN Access: WEP's cellular WAN access device must be equivalent to the following device:

- Cisco Model C819HG-LTE-MNA-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 mount kit.
- Managed Ethernet switch for Cisco router.
- WEP will provide Subscriber Identity Module (SIM) required for router and will configure hardware for WEP's WAN.

2.9.3.2 Ethernet Switches:

- Managed Ethernet switch shall be from AB 1783 Stratix 8300 Series, 5700 Series, 6000 Series, or 2500 Series.
- The use of unmanaged switches is not permitted.

2.10 Additional Requirements for all Panels:

- 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 HMI/SCADA Screens (Graphics)

3.1 General

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

3.1.2 SCADA screens shall be developed using standard GE CIMPLICITY CimEdit Library elements and County-developed library elements, insofar as is 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 Machinery Status Identification: The following are color schemes that should be used in the HMI and 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 Value and Alarm Status Identification: The following are color schemes that should be used in the HMI and 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.
- RED text on YELLOW background – status indication ALARM.

3.1.6 All delivered HMI systems should include a 'Configuration Mode' option button on a graphic that is only available upon power up of the unit. This will allow the user to exit the customized application and perform HMI configuration activities. Otherwise, they proceed to an Overview screen pertinent to the monitored process. Once exited, this startup screen cannot be accessed again without rebooting the HMI.

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*.

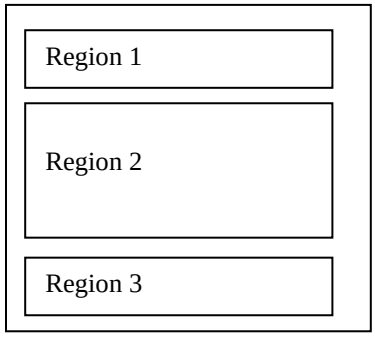


Figure 1: Graphic Display Layout

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.

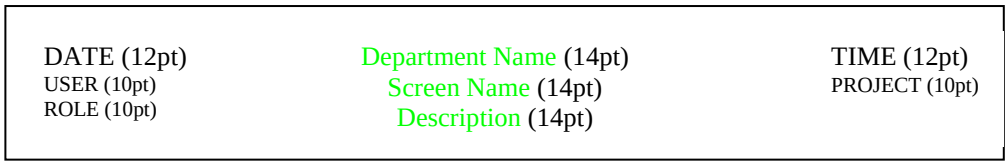


Figure 2: Region 1 - Title Bar

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*, and *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*.

3.3.3 All alarm descriptions as presented to the Operator need to contain information as to the geographic location of the origination of the alarm point. Minimally, abbreviations for the SCADA project name and the facility in alarm need to be included. Submit a list of all new alarms and the associated alarm text to OCWEP for approval before integration/startup. Refer to *Appendix E*.

4.0 Database

4.1 General

4.1.1 Onondaga County uses GE Digital's CIMPLICITY as its standard SCADA HMI software. The County has eleven (11) CIMPLICITY projects for monitoring, control and logging in the SCADA system for Baldwinsville WWTP, Brewerton WWTP, Meadowbrook/Limestone WWTP, Metropolitan WWTP, Oak Orchard WWTP, Wetzel WWTP, Clinton CSO, and Lower Harbor Brook CSO, Midland RTF, Remote, and Flow. 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.

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.

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.

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.

Oak Project: The Oak Orchard CIMPLICITY project monitors and controls the Oak Orchard WWTP as well as the pump stations that feed the Oak Orchard plant. This project is responsible for logging data values for this plant.

Metro Project: The Metro project monitors and controls the Metro WWTP including all BAF and HRFS monitoring and control. This project is responsible for logging data values for this plant.

Clinton Project: The Clinton project monitors and controls the Clinton CSO Facility. This project is responsible for logging data values for this site.

LHB Project: The LHB project monitors and controls the Lower Harbor Brook CSO Facility. This project is responsible for logging data values for this site.

Midland RTF: The Midland RTF project monitors and controls the Midland Regional Treatment Facility. This project is responsible for logging data values for this site.

Remote Project: The Remote project resides at Metro and monitors and controls the remote waste water treatment plants

Flow Project: The Flow project resides at Metro and monitors and controls all pump stations within the jurisdiction of OCDWEP. This project is responsible for logging data values for all pump stations.

4.1.2 In the County's configuration, the Metro, Flow, and Remote projects act as the parent projects for all south County projects (Meadowbrook, Clinton CSO, and Lower Harbor Brook CSO) along with all of the north County projects (Baldwinsville, Brewerton, Oak Orchard, and Wetzel). The Metro site is manned 24 hrs/day. If the project at Metro should fail, operators can start a backup project to assume control of the local project at each one of the remote facilities.

4.1.3 CIMPLICITY logs historical trending and process analysis to a Microsoft SQL Server database, 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 Facility (CSO) then the primary project is determined by the plant that the PS, RTF, FCF or CSO feeds.

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	FLOW
Brewerton WWTP	BREW	FLOW
Clinton CSO Facility	CLINTON	METRO
Lower Harbor Brook CSO Facility	LHB	METRO
Meadowbrook/Limestone WWTP	MEADOW	METRO
Midland RTF	MIDLAND	METRO
Remote	REMOTE	N/A
Flow	FLOW	N/A
Metro WWTP	METRO	N/A
Oak Orchard WWTP	OAK	FLOW
Wetzel Road WWTP	WETZEL	FLOW

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.

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 the Flow project, since this is where the PS feeds its effluent.
- Since the PS is normally unmanned, the Flow project will monitor the station on a 24hr basis. Logging is accomplished through the Flow project (Metro).

4.1.6 Example #2 provided:

A new Pump Station in Brewerton, Shepard Point, will feed 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 is a pump station, the Flow project will also monitor this pump station.
- Since the PS is normally unmanned, the Flow project will monitor the station on a 24hr basis. No logging is done by Brewerton. Logging is accomplished through the parent project (i.e. Flow).

- Upon BREW project failure, Flow project will continue to log the pump station points and to write to SQL Server. Flow project will start monitoring.

Note 1: In some cases, all points for a new pump station may need to be added to two 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. Alarms are logged to the EVENT_LOG table.

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. The clock master is synchronized from the OCDWEP time server down to each PLC.
- 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 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

Reference *Appendix H* for a listing of minimum standard I/O points expected with various process equipment classifications installed in OCDWEP facilities.

6.1.1 All OEM equipment I/O requirements shall be reviewed with OCDWEP, but shall always minimally comply with *Appendix H*. OEM software shall allow all system hardwired I/O points, alarms, and critical setpoints to be exposed to the SCADA system and/or OCDWEP PLC for monitoring and control as desired by OCDWEP.

6.1.2 All third party software shall be delivered unprotected without passwords, data locks, or encryption. See *Section 2.5* for other software and programming guidance.

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 Mean 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 is running.

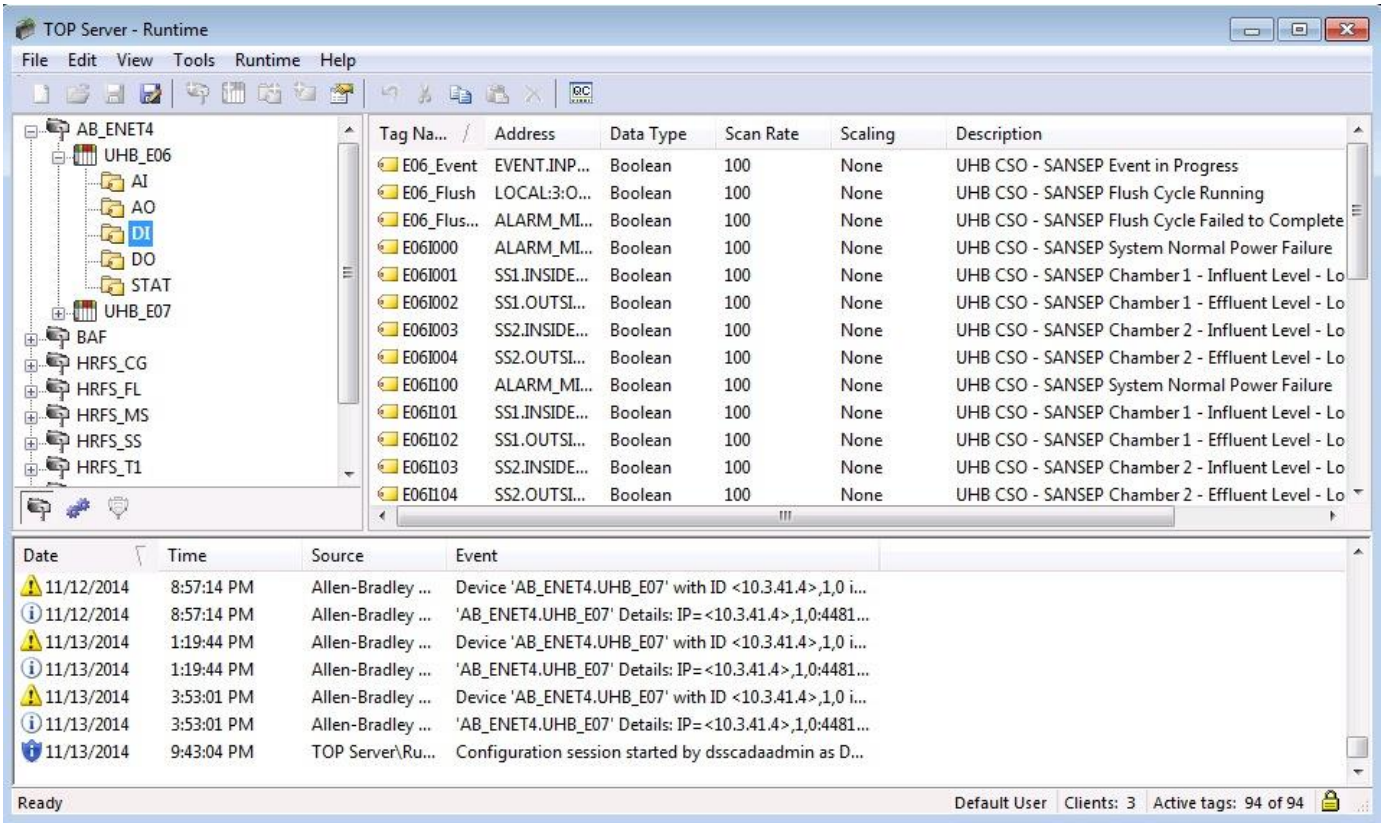
7.1.6 Panel must provide ample space for an Uninterruptible Power Supply (UPS) to be located without disturbing other connections. Do not install UPS sitting or resting on bottom of panel.

7.1.7 UPS shall be provided for emergency power to PLC, Cisco router, and network devices.

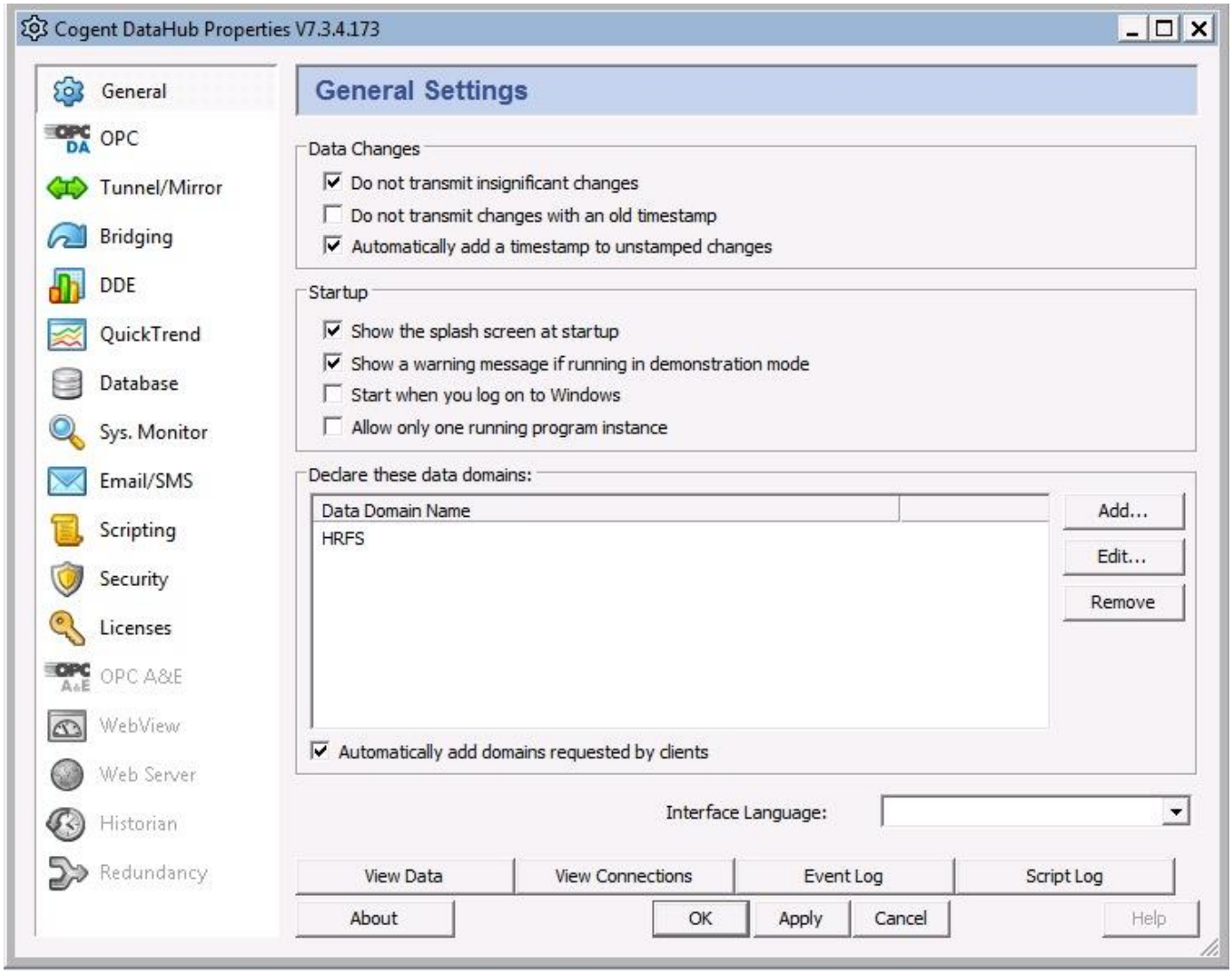
7.1.8 UPS is not to be used to power relays and other ancillary systems. UPS is to be used to power only the equipment listed above, for emergency monitoring & notification purposes.

7.1.9 UPS Bypass switch shall be included to allow for maintenance of the UPS without shutting down power to the systems

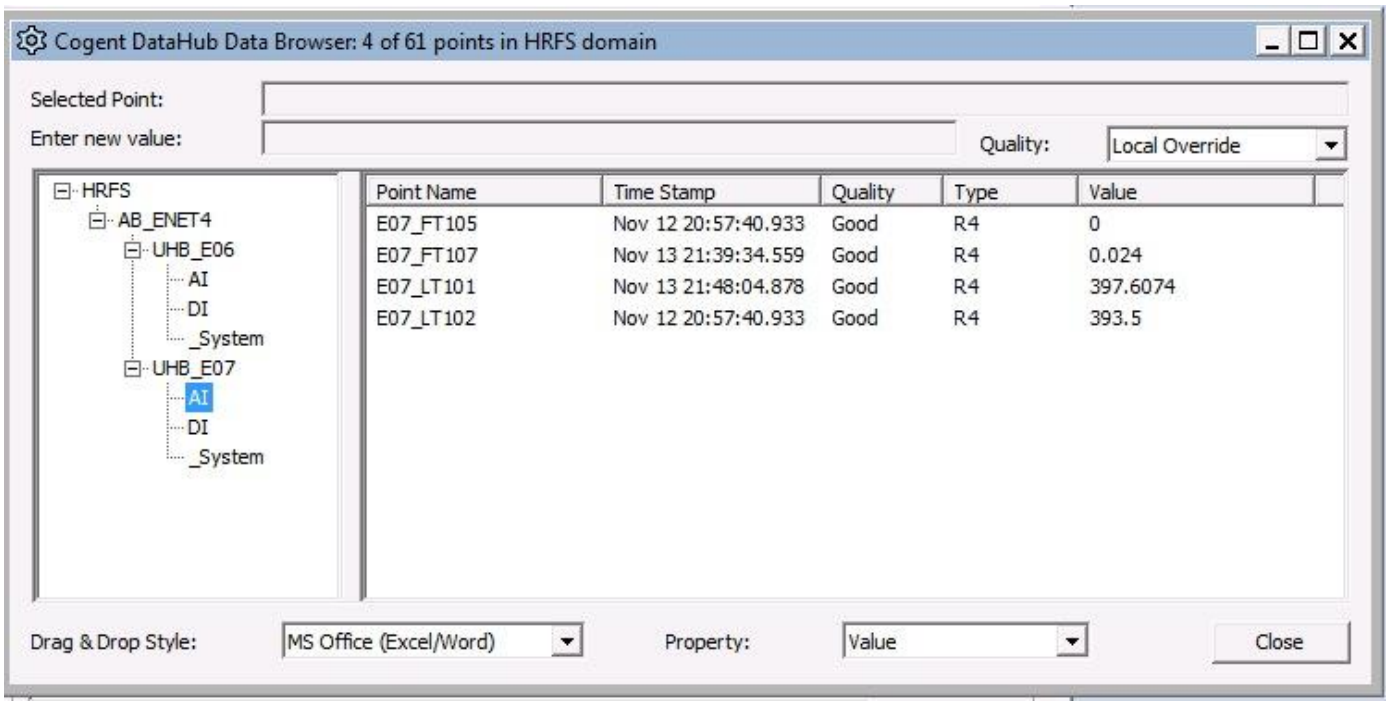
APPENDIX A.1 – SAMPLE SOFTWARE TOOLBOX OPC SERVER CONFIGURATION SCREEN (FOR REFERENCE ONLY)



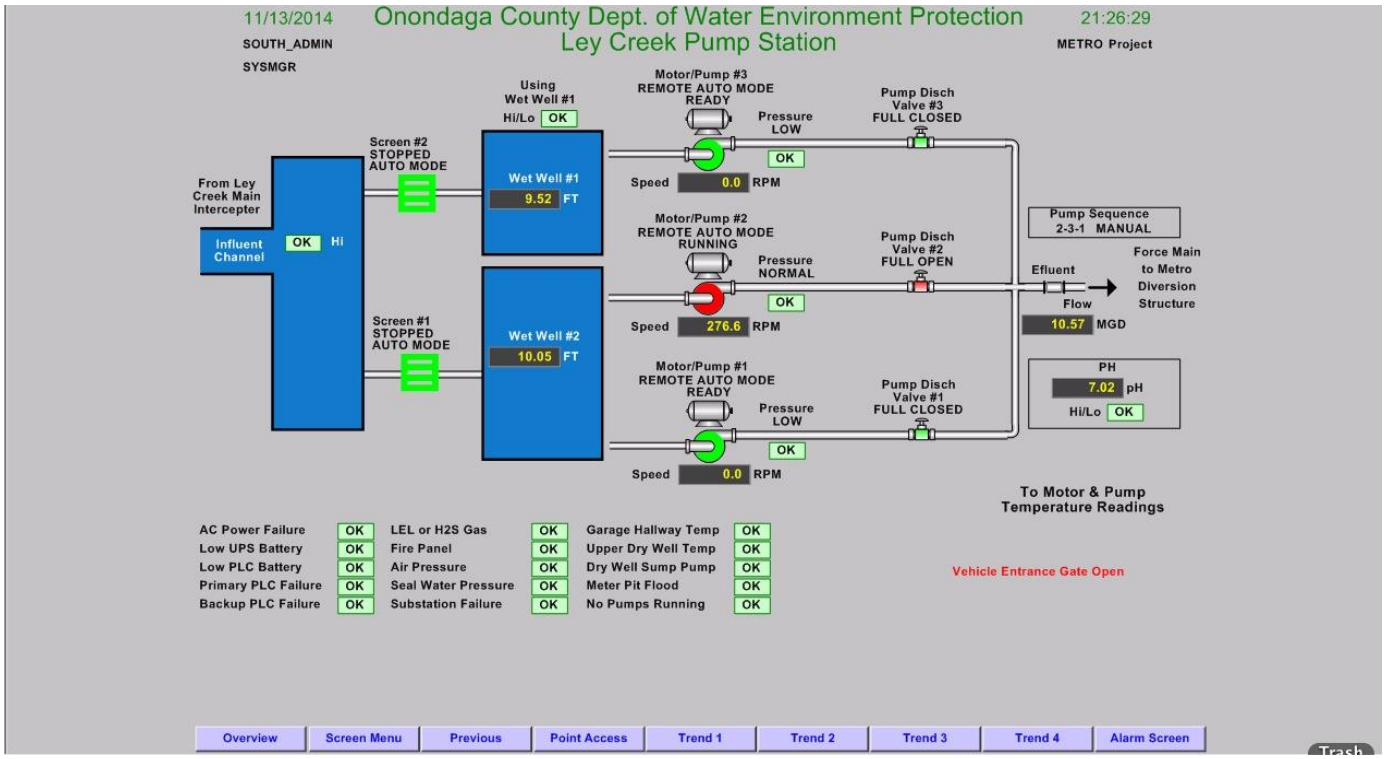
APPENDIX A.2 – SAMPLE OPC DATAHUB CONFIGURATION SCREEN
(FOR REFERENCE ONLY)



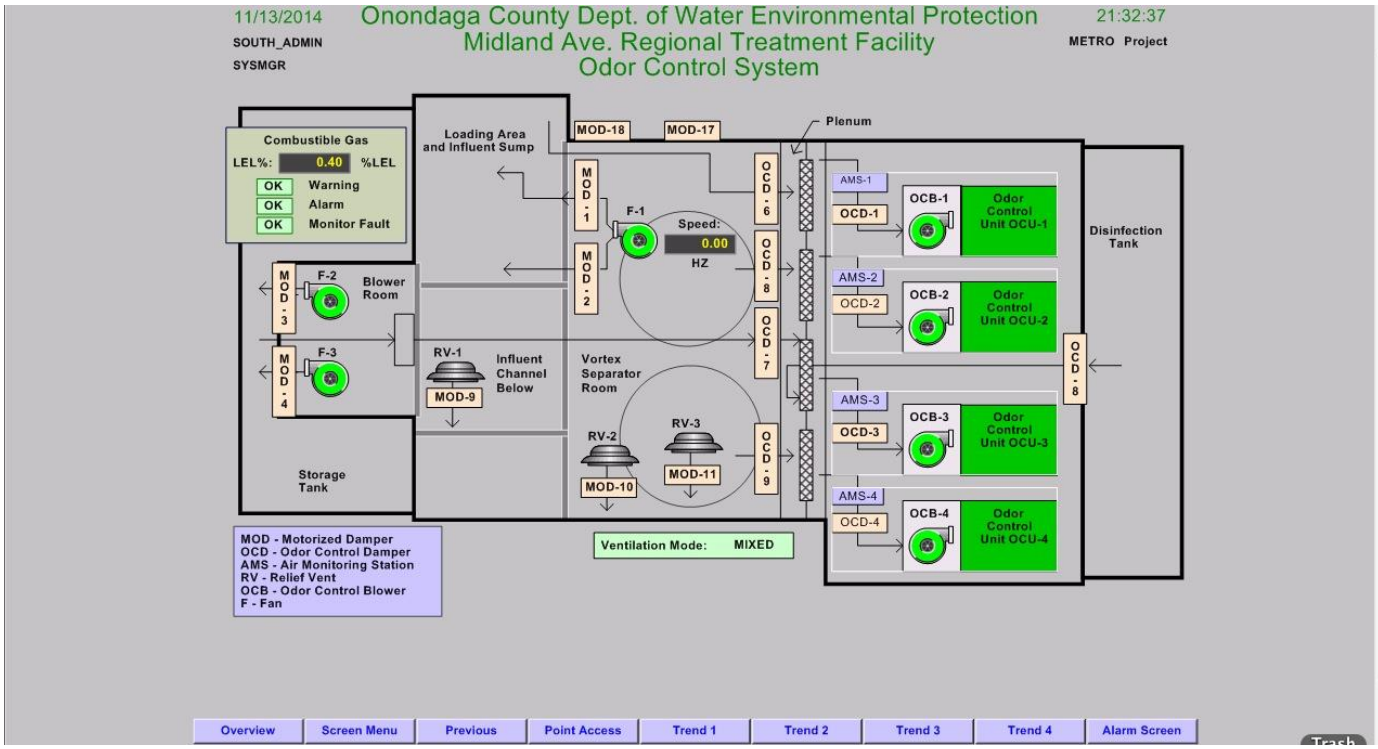
APPENDIX A.3 – SAMPLE OPC DATAHUB MONITORING SCREEN (FOR REFERENCE ONLY)



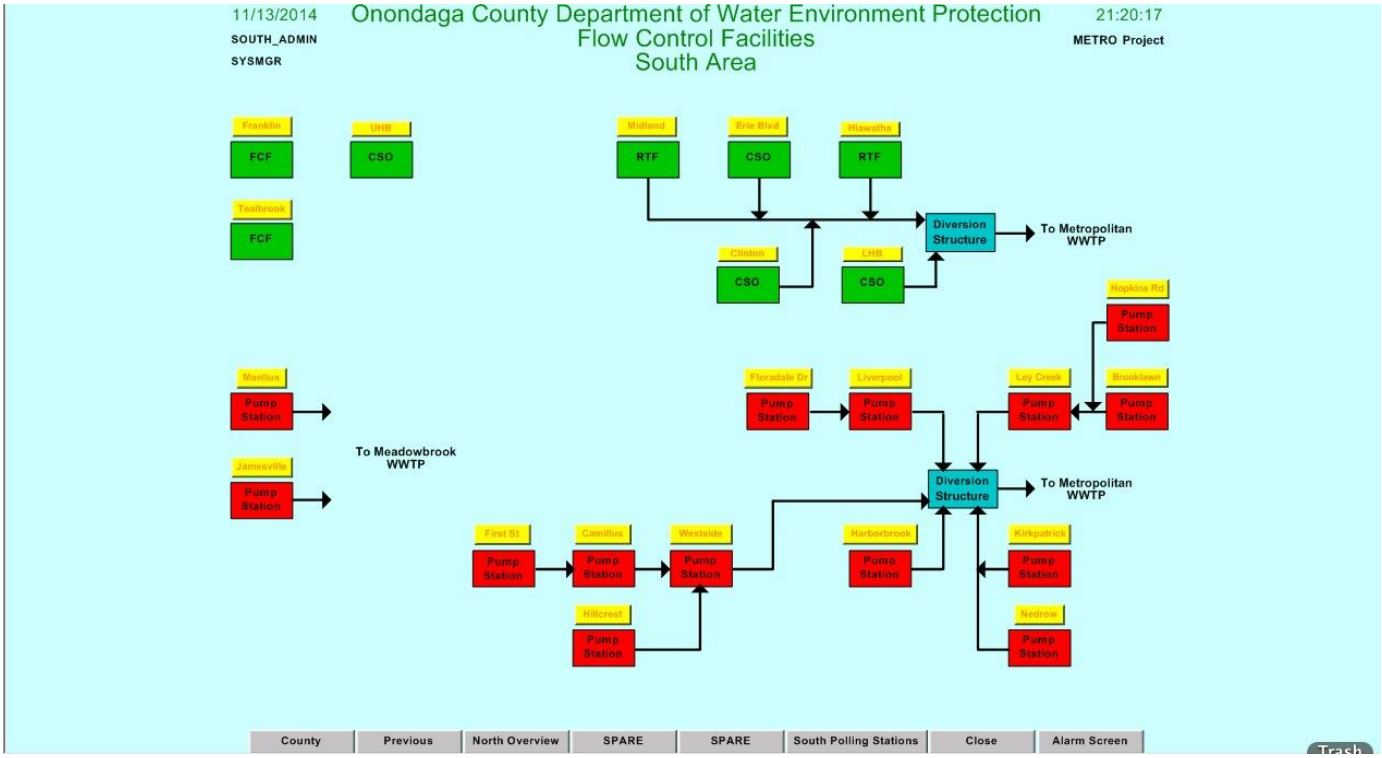
APPENDIX B.1 – SAMPLE PUMP STATION SCADA SCREEN (FOR REFERENCE ONLY)



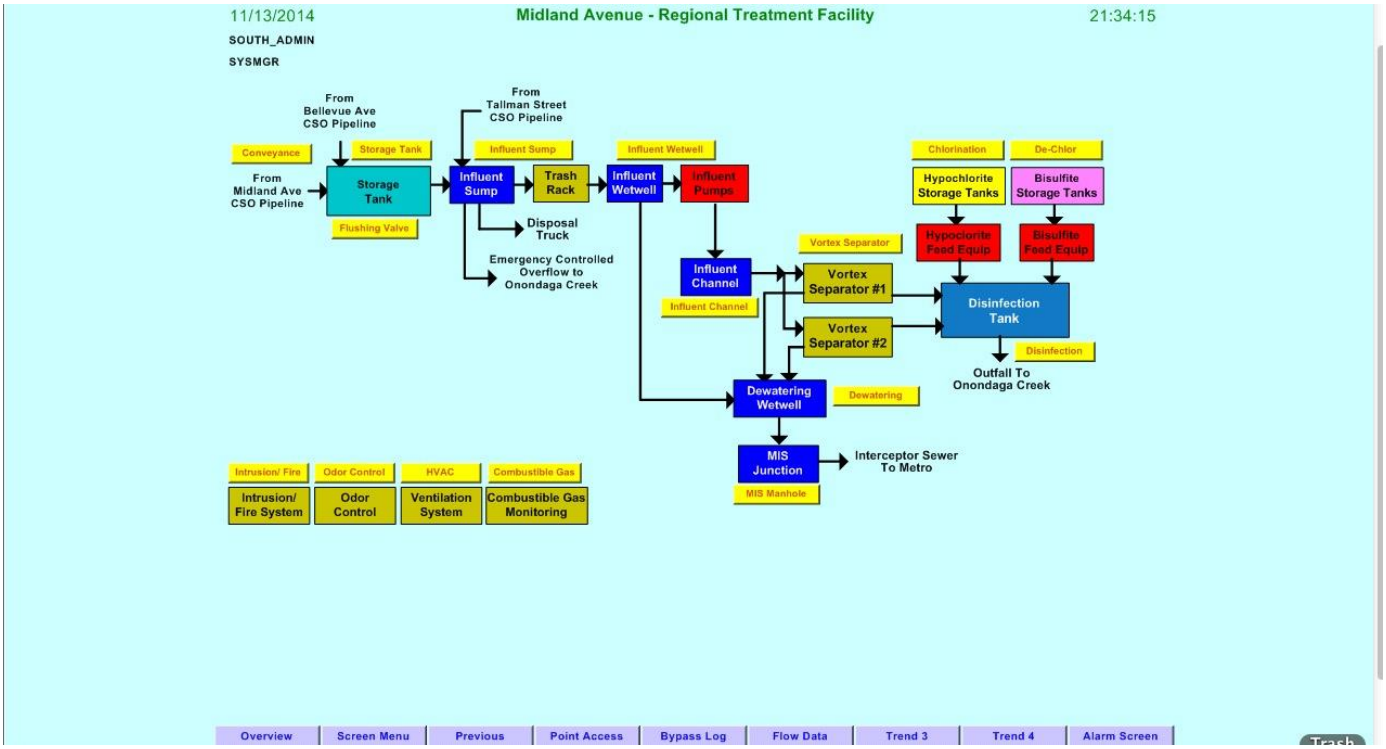
APPENDIX B.2 – SAMPLE ODOR CONTROL SCADA SCREEN (FOR REFERENCE ONLY)



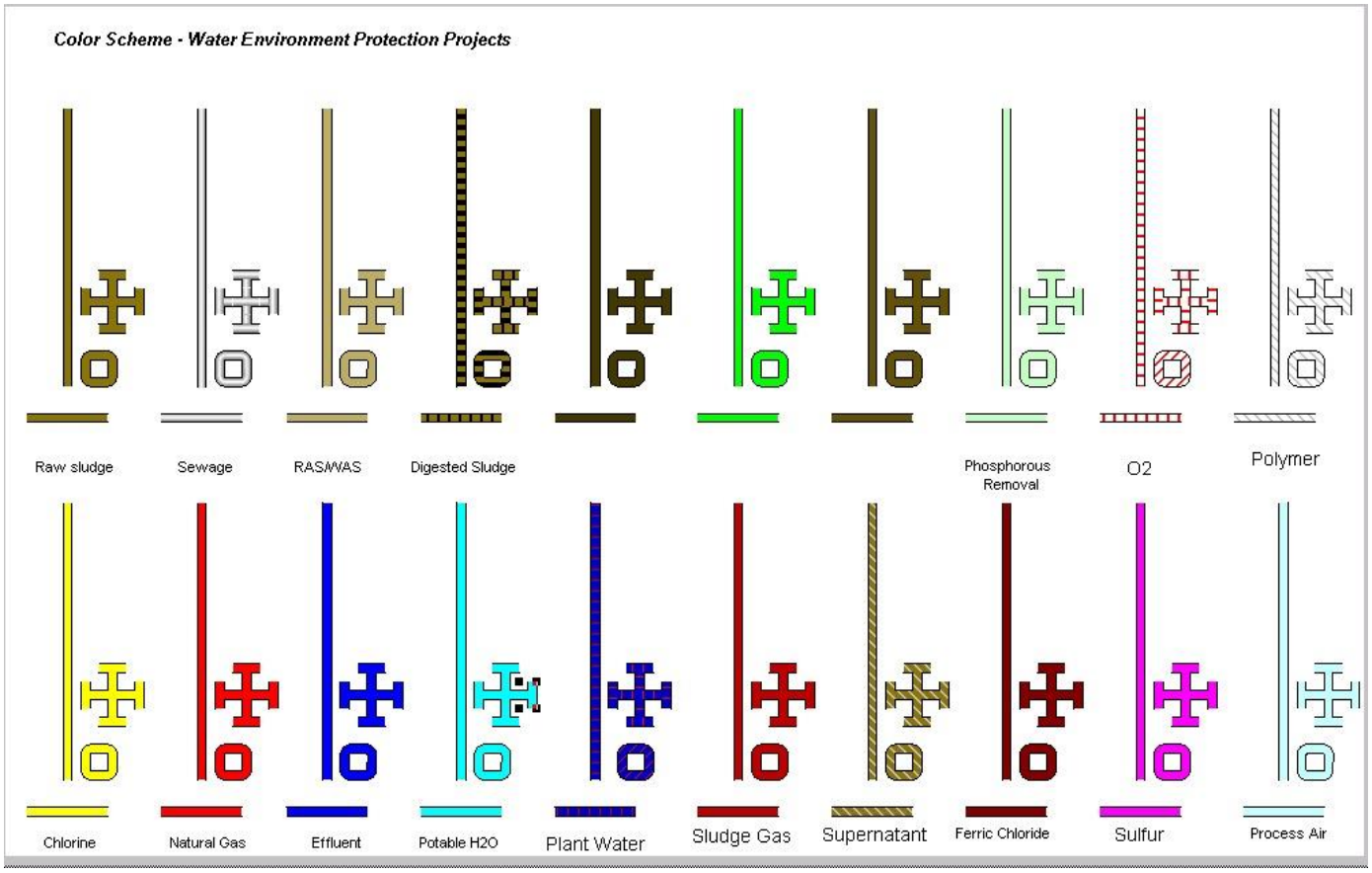
APPENDIX B.3 – SAMPLE FLOW CONTROL FACILITIES SCADA SCREEN (FOR REFERENCE ONLY)



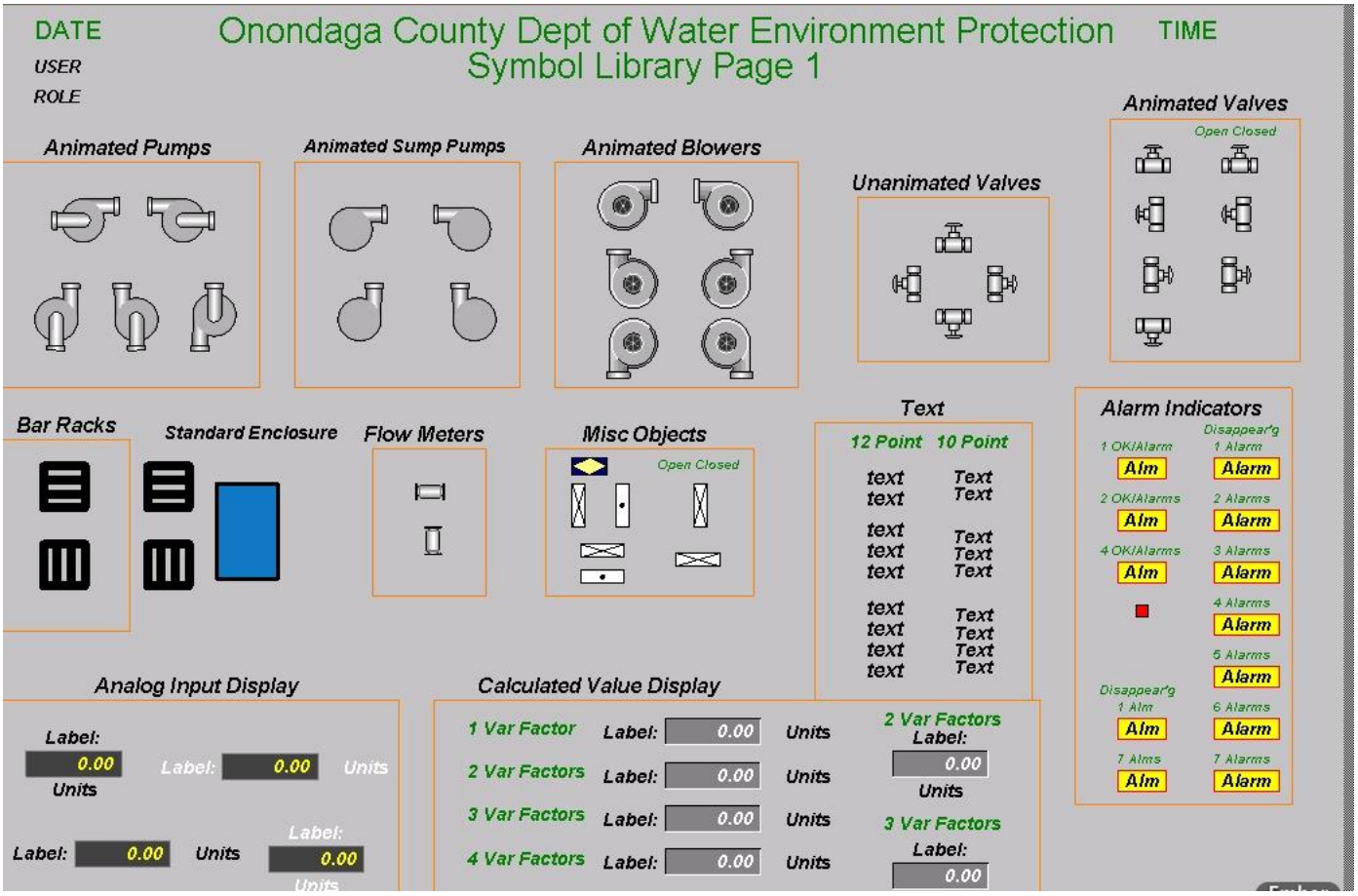
APPENDIX B.4 – SAMPLE PROCESS FLOW SCADA SCREEN (FOR REFERENCE ONLY)



APPENDIX C – SAMPLE COLOR SCHEME
(FOR REFERENCE ONLY)



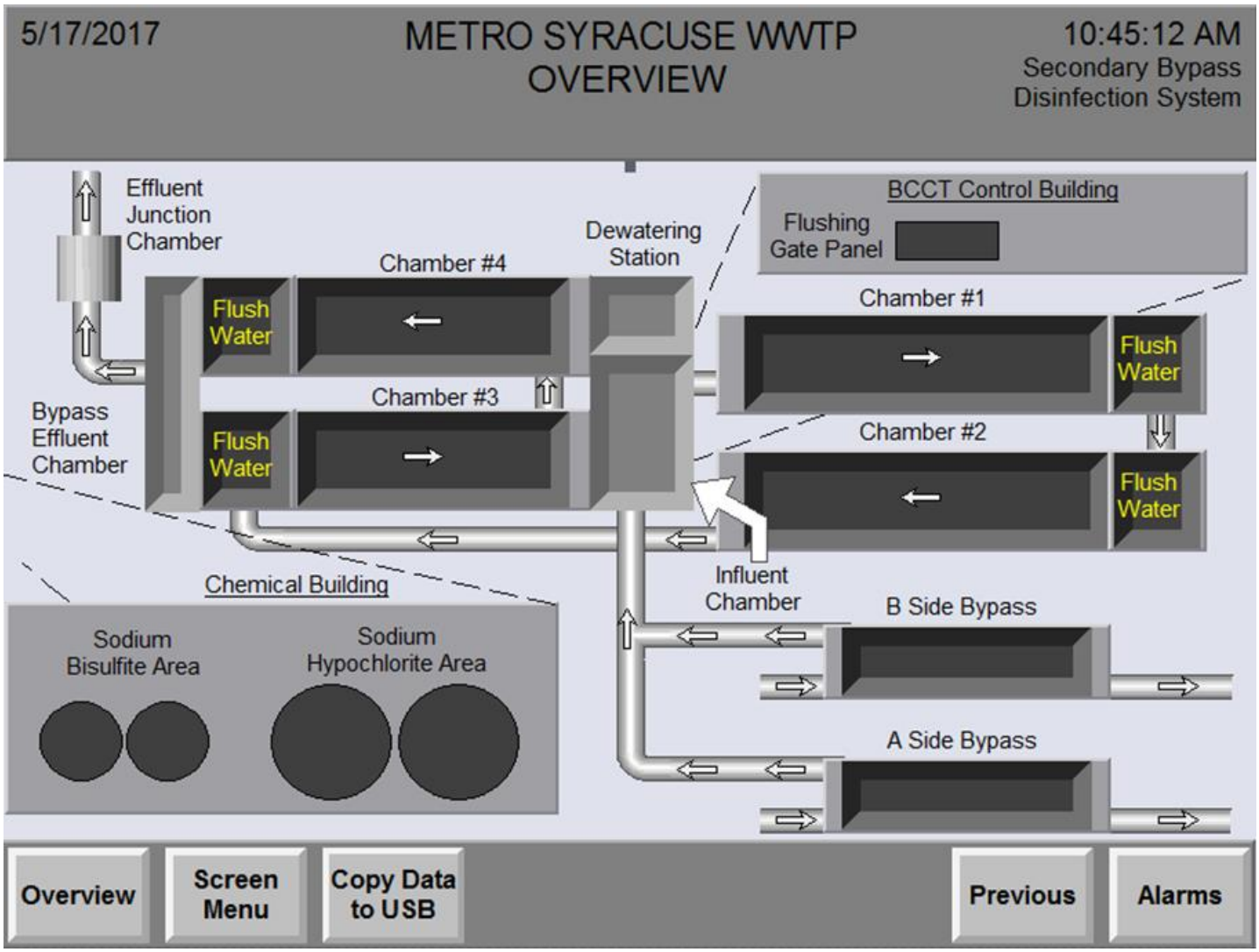
APPENDIX D – SAMPLE SYMBOL LIBRARY
(FOR REFERENCE ONLY)



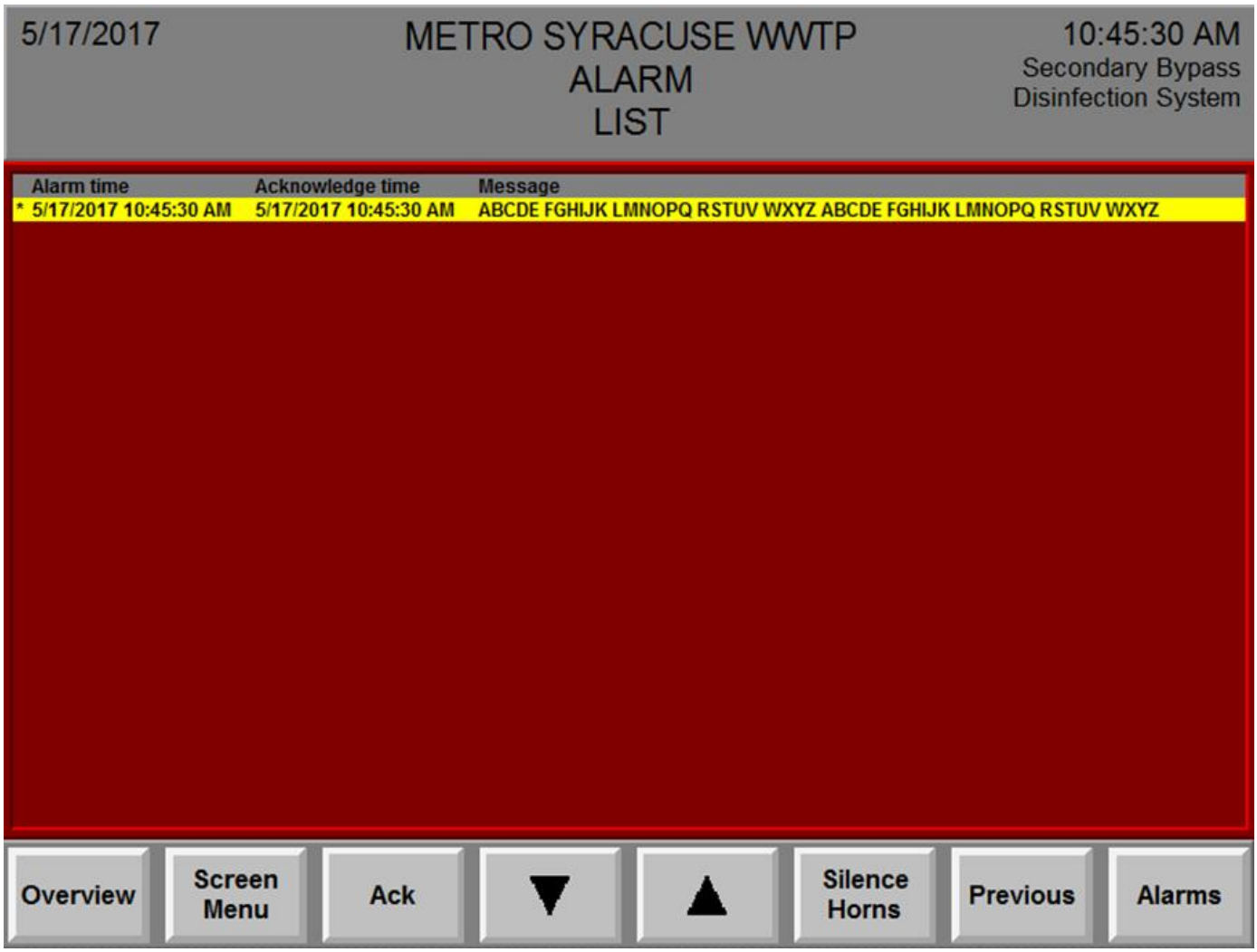
APPENDIX E – SAMPLE ALARM SCADA SCREEN
(FOR REFERENCE ONLY)

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

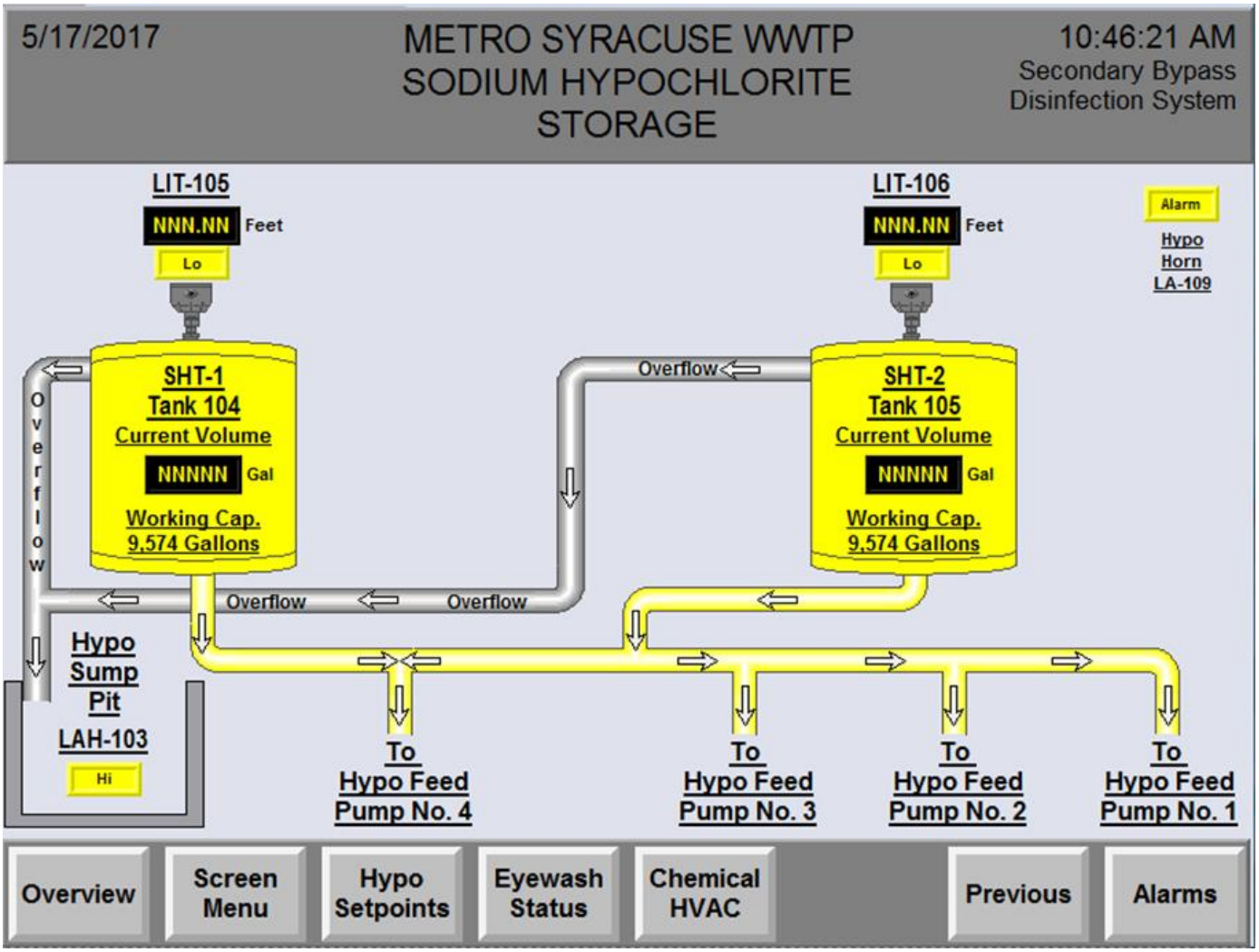
APPENDIX F.1 – SAMPLE GRAPHICS HMI SCREEN
(FOR REFERENCE ONLY)



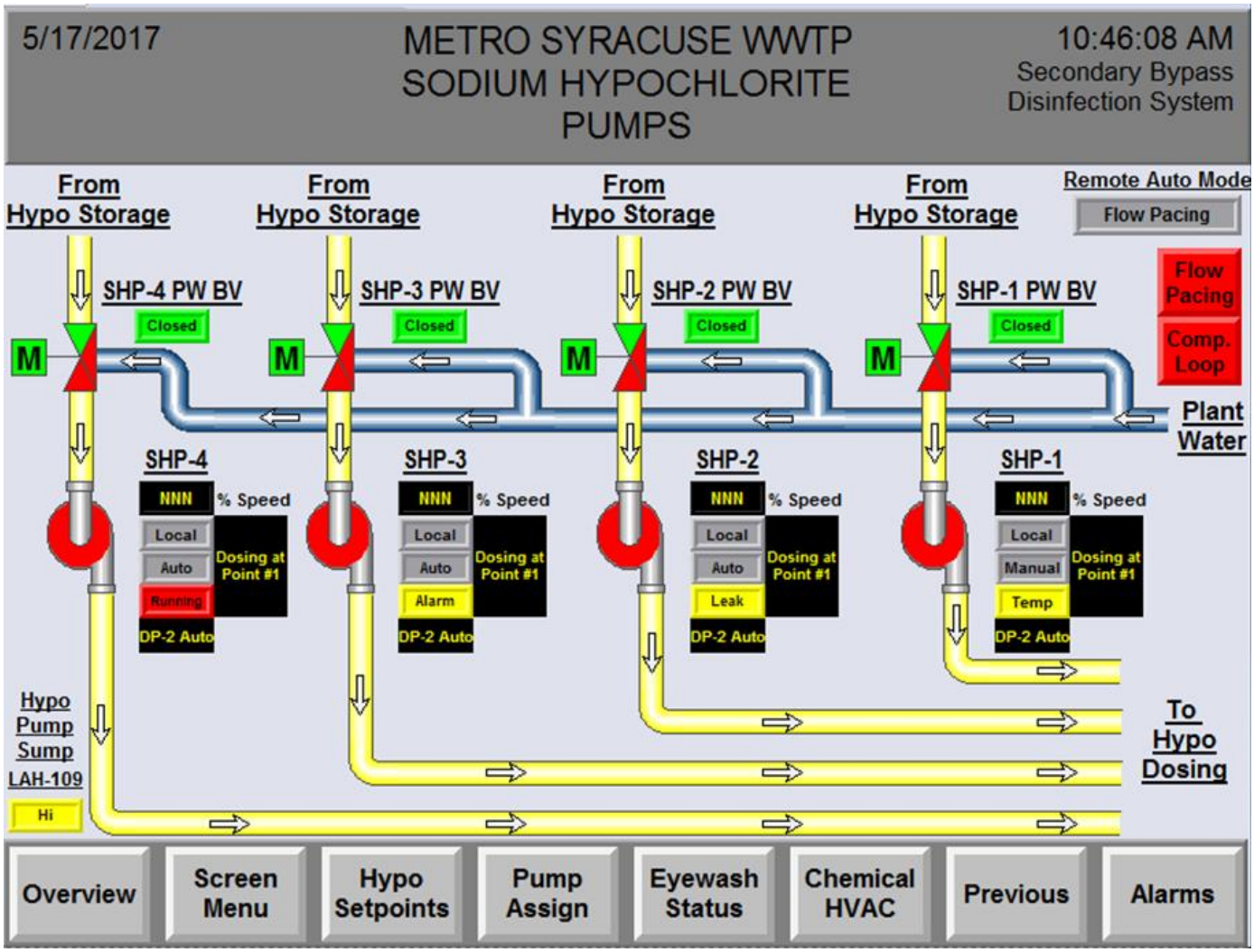
APPENDIX F.2 – SAMPLE ALARM SUMMARY HMI SCREEN (FOR REFERENCE ONLY)



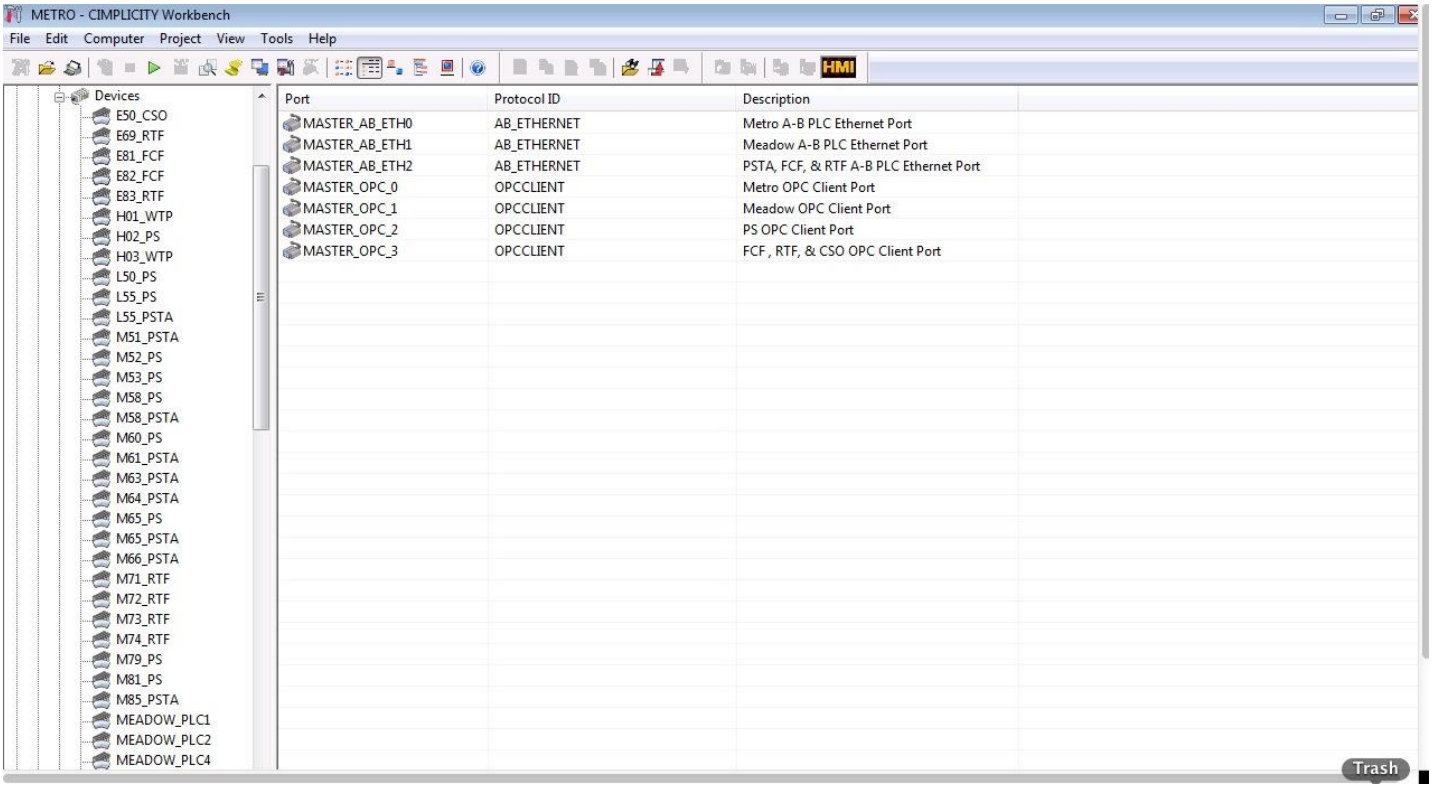
APPENDIX F.3 – SAMPLE TANK HMI SCREEN
(FOR REFERENCE ONLY)



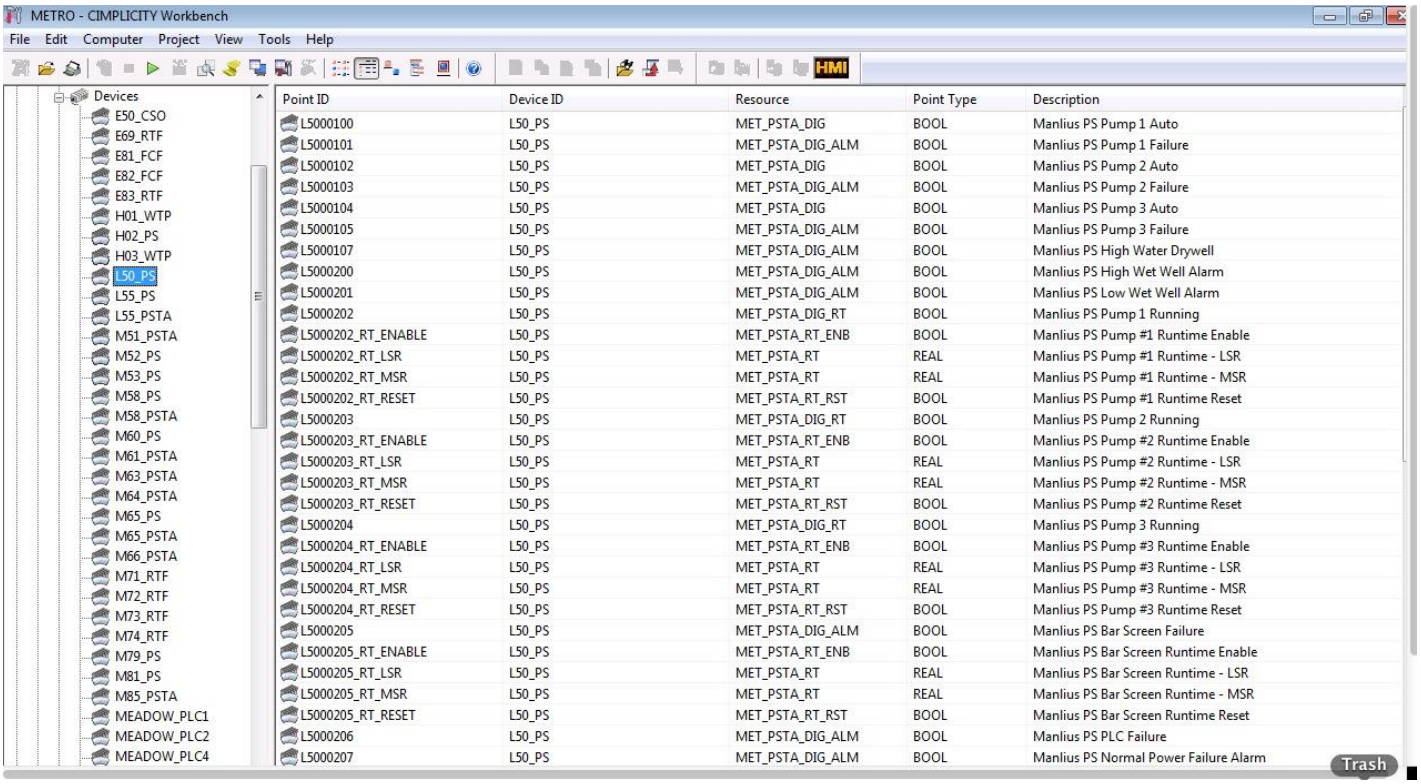
APPENDIX F.4 – SAMPLE PUMP HMI SCREEN
(FOR REFERENCE ONLY)



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

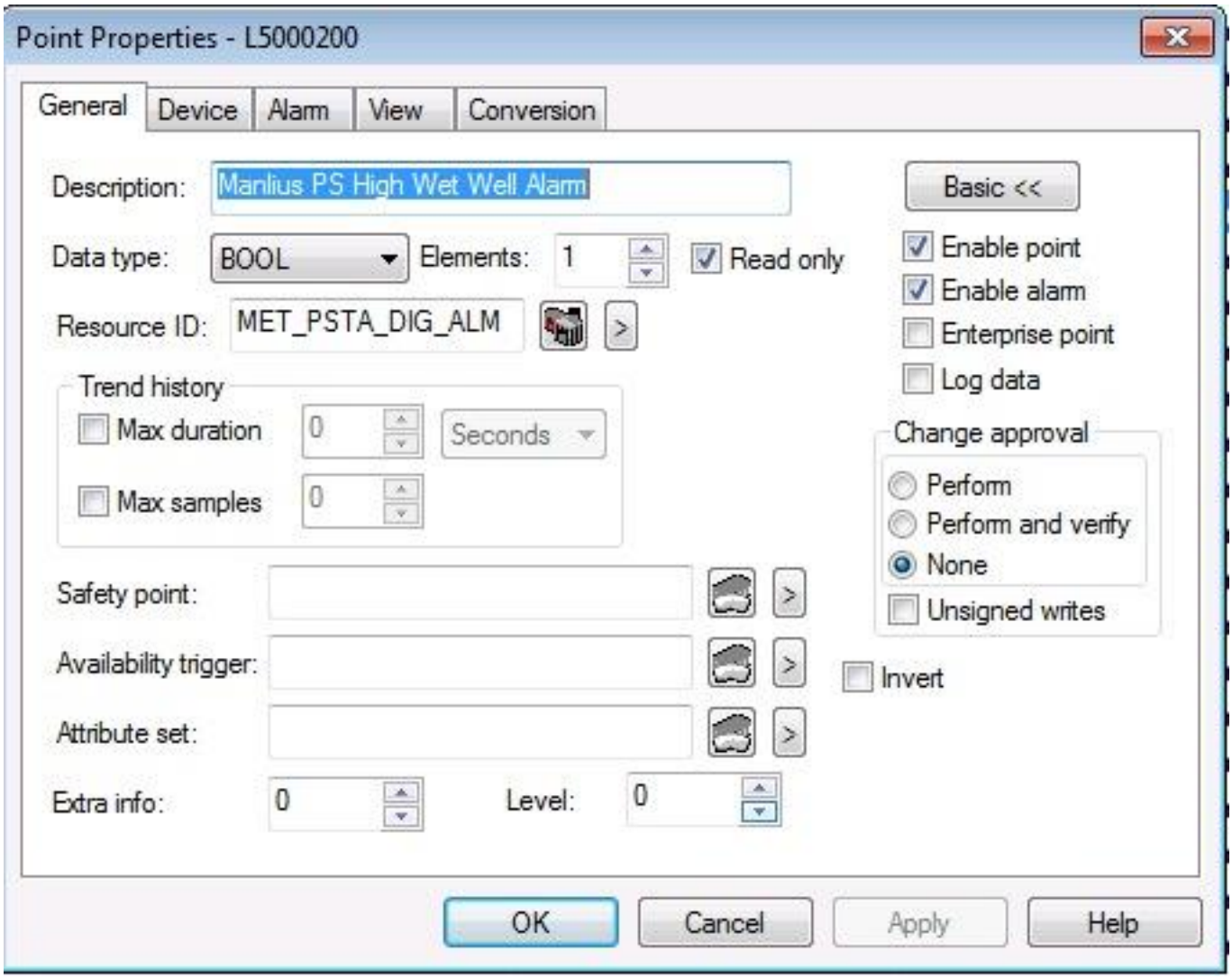


APPENDIX G.2 – CIMPLICITY WORKBENCH POINT ID SCREEN (FOR REFERENCE ONLY)

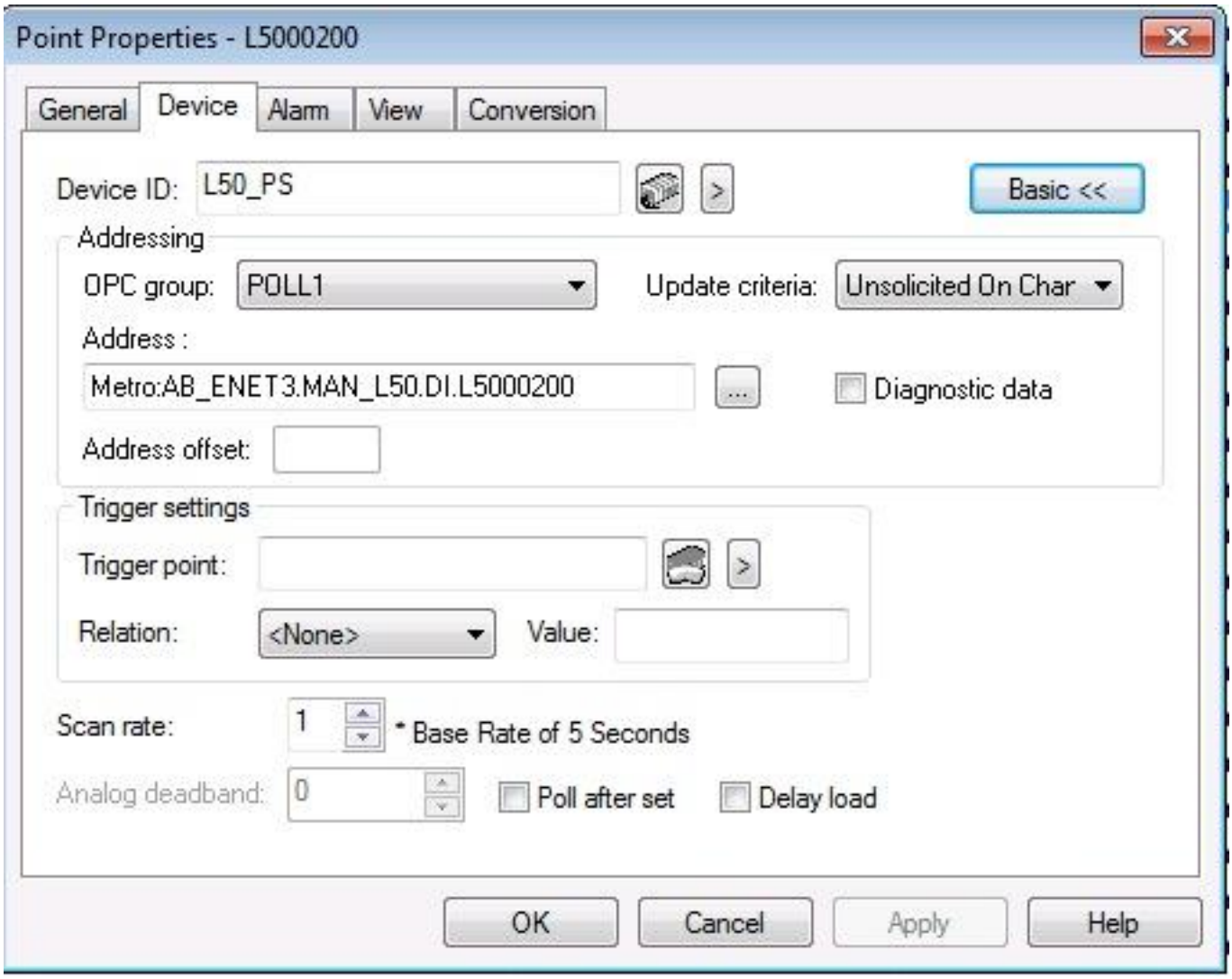


Point ID	Device ID	Resource	Point Type	Description
L5000100	L50_PS	MET_PSTA_DIG	BOOL	Manlius PS Pump 1 Auto
L5000101	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS Pump 1 Failure
L5000102	L50_PS	MET_PSTA_DIG	BOOL	Manlius PS Pump 2 Auto
L5000103	L50_PS	MET_PSTA_DIG_ALM	BOOL	Manlius PS Pump 2 Failure
L5000104	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

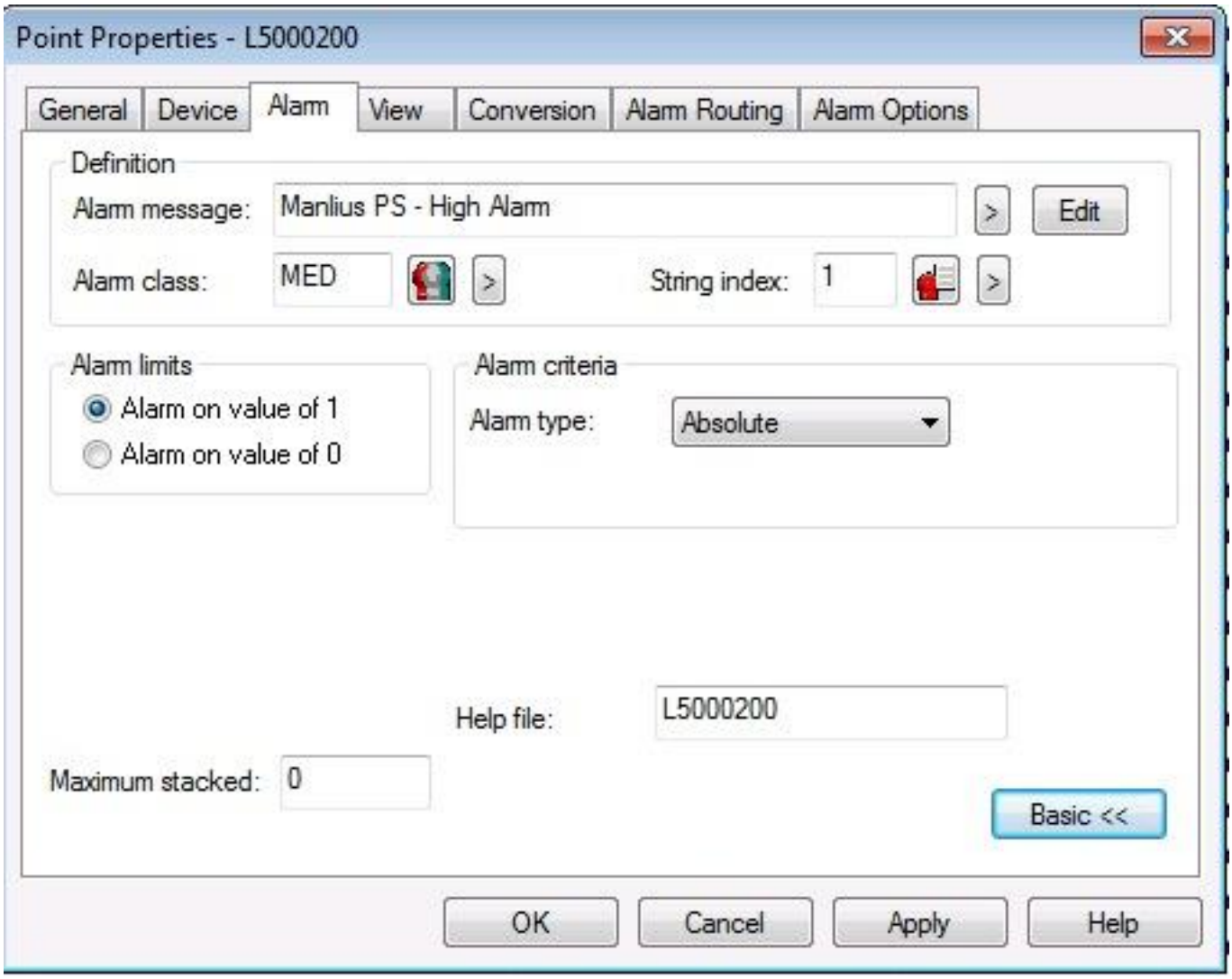
APPENDIX G.3 – CIMPLICITY WORKBENCH POINT ID CONFIGURATION SCREEN (FOR REFERENCE ONLY)



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 – TABLE OF EQUIPMENT AND I/O EXPECTATIONS (FOR REFERENCE ONLY)

PLC Point Type		DI	DI	DI	DI	DI	DI	DI	DI	DI			DO	DO	DO	DO		AI	AI	AI				AO	AO	AO					
Parent Classification	**Asset Classification**	Running	Auto - HOA Switch	Fault/Error	Opened	Closed	Motor Overload	Processs Fault (LOE, Empty Pipe)	Process Switch	Torque Overload	Fast/Slow Speed			Open/Start	Close/Stop	Enable	Fast/Slow Speed	Number of Process Values	Speed Indication	Position Feedback				Speed Setpoint	Position Setpoint	Flow Pace			Ethernet Comms			**Number of Points**
Actuator	Electric Valve Actuator		X	X	X	X	X							X	X																7
Actuator	Electric Valve Positioner		X	X			X													X					X						5
Actuator	Electric Valve Combined Act./Pos.		X	X	X	X	X							X	X					X					X						9
Actuator	Pneumatic Actuator		X	X	X	X								X	X																6
Actuator	Pneumatic Positioner		X	X																X					X						4
Actuator	Pneumatic Combined Act./Pos.		X	X	X	X								X	X					X					X						8
Actuator	Manual Actuator				X	X																										2
Aeration	Air Diffuser	X	X	X			X							X				2														7
Blowers	Centrifugal Multi-Stage Blower	X	X	X			X							X				2														7
Blowers	High-Speed Turbo	X	X	X			X							X				2														7
Blowers	Positive Displacement Blower	X	X	X			X		X					X				2														8
Blowers	Other Blower	X	X	X			X							X				2														7
Chemical System	Polymer Make-up Unit	X	X	X												X			X							X			X		7
Chemical System	Chemical Dosing Pump	X	X	X										X					X							X					6
Clarifiers	Circular Clarifier	X	X	X			X			X	X			X			X														8
Clarifiers	Collector	X	X	X			X			X	X			X			X														8
Clarifiers	Rectangular Clarifier	X	X	X			X			X	X			X			X														8
Compressor	Air Compressor	X		X												X															3
Compressor	General Compressor	X		X												X															3
Conveyor	Belt Conveyor	X	X	X										X																	4
Conveyor	Screw Conveyor	X	X	X										X																	4
Dewatering Equipment	Belt Filter Press	X		X												X													X		4
Dewatering Equipment	Centrifuge	X		X												X													X		4
Dewatering Equipment	Cyclone	X		X												X													X		4
Digester Gas Equipment	Burner	X		X												X													X		4
Digester Gas Equipment	Digester	X		X												X													X		4
Digester Gas Equipment	Gas Delivery System	X		X												X													X		4
Disinfection	Ultraviolet Disinfection Unit	X		X												X													X		4
Drive	Gearbox									X																					1
Drive	General Drive									X																					1
Filters and Strainers	Filter								X																						1
Filters and Strainers	Strainer								X																						1
Generator	Electric Generator	X		X												X															3
Generator	Engine	X		X												X															3
Generator	ATS				X	X																									2
HVAC	Air Conditioner	X		X																											2
HVAC	Air Dryer	X		X																											2
HVAC	Air Handling Unit	X		X																											2
HVAC	Boiler	X		X																											2
HVAC	Cooling Tower	X		X																											2
HVAC	Electric Unit Heater	X		X																											2
HVAC	Fan	X		X																											2
HVAC	Louver	X		X																											2
HVAC	MUAU	X		X																											2
HVAC	Steam (Hydronic) Unit Heater	X		X																											2
HVAC	Ventilator	X		X																											2
HVAC	Water cooler/chiller	X		X																											2

APPENDIX H – TABLE OF EQUIPMENT AND I/O EXPECTATIONS (FOR REFERENCE ONLY)

PLC Point Type		DI	DI	DI	DI	DI	DI	DI	DI	DI	DI			DO	DO	DO	DO		AI	AI	AI			AO	AO	AO				
Parent Classification	**Asset Classification**	Running	Auto - HOA Switch	Fault/Error	Opened	Closed	Motor Overload	Processs Fault (LOE, Empty Pipe)	Process Switch	Torque Overload	Fast/Slow Speed			Open/Start	Close/Stop	Enable	Fast/Slow Speed		Number of Process Values	Speed Indication	Position Feedback			Speed Setpoint	Position Setpoint	Flow Pace			Ethernet Comms		**Number of Points**
Instrumentation and Electrica	Battery			X															1											1
Instrumentation and Electrica	Communications Equipment			X																										1
Instrumentation and Electrica	Circuit Breaker														X															1
Instrumentation and Electrica	Motor Control Center																												X	1
Instrumentation and Electrica	PLC Fault			X																									X	2
Instrumentation and Electrica	Surge Supressor			X																										1
Instrumentation and Electrica	Variable Speed / Frequency Drive	X	X	X												X				X				X					X	7
Instrumentation and Electrica	UPS	X		X																										2
Meter	Conductivity Meter																		1											1
Meter	Dissolved Oxygen Meter																		1											1
Meter	Flow Meter							X	X										1											3
Meter	General Meter																		1											1
Meter	Hazardous Air Meter																		1											1
Meter	Level Meter							X	X										1											3
Meter	ORP Meter																		1											1
Meter	pH Meter																		1											1
Meter	Pressure Meter																		1											1
Meter	Temperature Meter																		1											1
Meter	Turbidity Meter																		1											1
Mixer	Mechanical	X	X				X			X				X																5
Mixer	Other (Submersible?)	X	X				X							X																4
Motor	Electric Motor	X	X			X					X			X			X													6
Odor Control	System	X	X	X											X														X	5
Oxygen Generation	System	X	X	X											X														X	5
Packaged Systems (OEM)	All	X	X	X											X														X	5
Pumps	All Styles/Types	X	X	X										X																4
Screen	Mechanical Bar Screen	X	X	X												X			1											5
Solids Thickening	Gravity Belt Thickener	X	X	X												X														4
Solids Thickening	Gravity Thickener	X	X	X										X																4
Solids Thickening	Rotary Drum Thickener	X	X	X												X														4
Tank	Chemical Tank							X	X										1											3
Tank	Open Tank																		1											1
Additional Equipment	Eyewash/shower								X																					1
Additional Equipment	High Level Float								X																					1
Additional Equipment	Low Level Float								X																					1
Additional Equipment	Leak Detection								X																					1

Table H - Page 2 of 2

APPENDIX I – CONTACT INFORMATION (FOR INFORMATION)

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

Bob Gunnip, Systems Programmer……...315-435-2260