Wayne County Department of Public Services

Downriver Wastewater Treatment Facility
SCADA Improvement Project
SRF Project No. 5217 - 05

SCADA
System Manual

Version: 1.0

June 2010

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Revision Control:

Version	Date	Author	QA/QC	Description of Revisions
1.0	June 2010	Kevin Donovan	Juan Stein	Submittal for Owner Review

GLOSSARY

Terms and abbreviations used in this Manual are shown and defined below:

AC	**Alternating Current**
A/C	**Air Conditioning**
Ack	**Acknowledge***
ADA	**Americans with Disabilities Act**
ADMIN	**Administration**
AGF	**Aerated Grit Channel***
AGFCP	**Aerated Grit Facility Control Panel***
AI	**Analog Input**
ANSI	**American National Standards Institute**
AO	**Analog Output**
ASHRAE	**American Society of Heating, Refrigerating and Air Conditioning Engineers**
ASME	**American Society of Mechanical Engineers**
Ass.	**Assembly***
ASTM	**American Society for Testing and Materials**
AUTO	**Automatic**
AUX	**Auxiliary**
A/V	**Audiovisual**
AWG	**American Wire Gauge**
AWS	**American Welding Society**
AWWA	**American Water Works Association**
BDG	**Building**
BOD	**Biological Oxygen Demand**
BRG	**Bearing**
BTR	**Block Transfer Read**

BTW	**Block Transfer Write**
C	**Celsius**
CAT5e	**Category 5 Enhanced Cable**
CAT6	**Category 6 UTP Cable**
CBOD	**Carbonaceous Biological Oxygen Demand**
CCITT	**Consultative Committee on International Telegraphy and Telephony**
CCTV	**Closed Circuit Television**
CD	**Compact Disc**
CEPT	**Chemically Enhanced Primary Treatment**
CFH	**Cubic Feet per Hour**
CFM	**Cubic Feet per Minute**
Chem.	**Chemistry**
CLAR	**Clarifier***
CLI	**Command Line Interface**
CMMS	**Computer Maintenance Management System**
CNHDC	**Communication Network Hybrid Distribution Cabinet***
COLL	**Collector***
Conf.	**Conference**
CPU	**Central Processing Unit**
CS	**Control System**
CSMA/CD	**Carrier Sense Multiple Access with Collision Detection**
CSO	**Combined Sewer Overflow**
CVT	**Constant Voltage Transformer**
DAF	**Dissolved Air Flotation**
dB	**Decibel**
DC	**Direct Current**
DCDPCP	**Disinfection Channel Drainage Pump Control Panel***

DDA	**Discharge and Disinfection Area***
DDACP	**Discharge and Disinfection Area Control Panel***
DDE	**Dynamic Data Exchange**
DHCP	**Dynamic Host Configuration Protocol**
DI	**Digital Input; Discrete Input**
DIN	**Deutsches Institute für Normung**
DISINF.	**Disinfection***
DMZ	**Demilitarized Zone**
DO	**Dissolved Oxygen; Digital Output; Discrete Output**
DoS	**Denial of Service**
DRAM	**Dynamic Random Access Memory**
DSL	**Digital Subscriber Line**
DWACP	**Dewatering Area Control Panel***
DWACR	**Dewatering Area Control Room***
DWTF	**Downriver Wastewater Treatment Facility***
ECPAD	**Ecorse Creek Pollution Abatement Drain***
EIA/TIA	**Electronic Industries Alliance/Telecommunication Industries Association**
Elec.	**Electrical**
EMI	**Electromagnetic Interference**
EOBGCRP	**Emergency Outfall Bypass Gates Control Relay Panel***
ESB	**Employee Service Building***
F	**Fahrenheit**
FAT	**Factory Acceptance Test**
FCC	**Federal Communications Commission**
FCPCP	**Ferric Chloride Process Control Panel***
FECP	**Ferric Chloride Control Panel***
FESS	**Final Effluent Suspended Solids***

FLW	**Flow***
FM	**Factory Mutual**
FS	**Federal Specification**
FST	**Final Settling Tank**
FST1	**Final Settling Tank No. 1 Control Panel***
FST2	**Final Settling Tank No. 2 Control Panel***
FST3	**Final Settling Tank No. 3 Control Panel***
FST4	**Final Settling Tank No. 4 Control Panel***
FST5	**Final Settling Tank No. 5 Control Panel***
FST6	**Final Settling Tank No. 6 Control Panel***
GAC	**Granular Activated Carbon**
Gbps	**Gigabits per second**
GFI	**Ground Fault Interrupter**
GIS	**Geographic Information System**
GPD	**Gallons Per Day**
GPM	**Gallons Per Minute**
H2S	**Hydrogen Sulfide**
HC	**Hydrocarbon**
HDSL	**High-Speed Digital Subscriber Line**
HMI	**Human-Machine Interface**
HOA	**Hand-Off-Automatic (switch)**
HP	**Horsepower**
HVAC	**Heating, Ventilation, and Air Conditioning**
Hz	**Hertz**
I&C	**Instrumentation and Control**
IACP	**Influent Area Control Panel***
ICEA	**Insulated Cable Engineers Association**

ID	**Identification; Identifier**
IEC	**International Electrotechnical Commission**
IEEE	**Institute of Electrical and Electronics Engineers**
IJC	**Influent Junction Chamber***
INF	**Influent**
I/O	**Input/Output**
IP	**Internet Protocol**
IPS	**Influent Pumping Station***
ISA	**International Society of Automation; Instrument Society of America; Instrumentation, Systems, and Automation Society**
ISO	**International Organization for Standardization**
IT	**Information Technology**
ITA	**Instrument Testing Association**
JIC	**Joint Industrial Council**
KM	**Kilometer**
KPI	**Key Performance Indicator**
KV	**Kilovolt**
KVA	**Kilovolt-Ampere**
KVM	**Keyboard-Video-Mouse**
LAN	**Local Area Network**
LCD	**Liquid Crystal Display**
LCP	**Local Control Panel**
LED	**Light-Emitting Diode**
LEL	**Lower Explosive Limit**
LIMS	**Laboratory Information Management System**
LL	**Low Lift*; Ladder Logic**
LLPPCP	**Low Lift Pump Process Control Panel***
LLPS	**Low Lift Pump Station***

LLPSCP	**Low Lift Pump Station Control Panel***
LOR	**Local-Off-Remote (switch)**
LP	**Lighting Panel**
mA	**Milliampere**
Mach.	**Machine**
MAX	**Maximum**
Mb	**Megabit**
MBDS	**Maintenance Building Distribution Switch***
Mbps	**Megabits per second**
MCC	**Motor Control Center**
MCRT	**Mean Cell Retention Time**
MG	**Million Gallons**
MGD	**Millions of Gallons per Day**
MG/ft	**Million Gallons per Foot**
mg/L	**milligrams per liter**
MIN	**Minimum**
MLSS	**Mixed Liquor Suspended Solids**
MM	**Millimeter; Multimode**
MNT	**Maintenance***
MNTBDG	**Maintenance Building***
MOR	**Monthly Operating Report**
MSG	**Message**
MTBF	**Mean Time Between Failure**
MTTR	**Mean Time To Recovery; Mean Time To Repair**
MTW	**Machine Tool Wire (insulation type)**
NACP	**Sodium Hydroxide Control Panel***
NEC	**National Electrical Code**

NECA	**National Electrical Contractors Association**
NEMA	**National Electrical Manufacturers Association**
NESC	**National Electrical Safety Code**
NET	**Network Management***
NFBU	**National Board of Fire Underwriters**
NFPA	**National Fire Protection Association**
NIC	**Network Interface Card**
NIST	**National Institute of Standards and Technology**
NM	**Nanometer**
NPDES	**National Pollutant Discharge Elimination System**
NTU	**Nephelometric Turbidity Unit**
O&M	**Operations and Maintenance**
O2	**Oxygen**
OCM	**Optical Communication Module**
ODBC	**Open Database Connectivity**
OIT	**Operator Interface Terminal**
OPC	**OLE for Process Control (OLE = Object Linking and Embedding)**
ORH	**Out of Range High**
ORL	**Out of Range Low**
OSHA	**Occupational Safety and Health Administration**
P&ID	**Process and Instrumentation Diagram**
PB	**Pushbutton**
PC	**Personal Computer**
PCN	**Process Control Narrative**
PDC	**Power Distribution Center**
pF	**Picofarad**
PFD	**Process Flow Diagram**

pH	**Potential of Hydrogen – negative 10-base log (power) of the positive hydrogen ion concentration; measure of acidity**
PID	**Proportional-Integral-Derivative (control algorithm)**
PLC	**Programmable Logic Controller**
PMP	**Pump**
POLYCP	**Polymer System Control Panel***
POLYCP03	**Polymer System Control Panel***
PPM	**Parts Per Million**
PREL	**Preliminary***
PRI	**Primary**
PS	**Pump Station**
PSI	**Pounds per Square Inch**
PSIG	**Pounds-per-Square-Inch Gauge**
PST	**Primary Settling Tank**
PSTCP	**Primary Settling Tank Control Panel***
PSTCP-A	**Primary Settling Tanks Nos. 1, 3, 5 Control Panel***
PSTCP-B	**Primary Settling Tanks Nos. 2, 4, 6 Control Panel***
PSTCP-C	**Primary Settling Tank No. 7 Control Panel***
PSTP	**Primary Solids Transfer Pump***
PSTPCP	**Primary Solids Transfer Pump Control Panel***
PWR	**Power**
QA	**Quality Assurance**
QC	**Quality Control**
QoS	**Quality of Service**
RADIUS	**Remote Authentication Dial-In User Service**
RAS	**Return Activated Sludge**
RASSS	**Return Activated Sludge Suspended Solids***
REC	**Receptacle**

RECT	**Rectangular**
RFC 1918	**Request For Comments 1918 (Industry best current practice that provides guidance for address allocation in LANs)**
RFI	**Radio Frequency Interference**
RH	**Relative Humidity**
RHW	**Rubber Insulated Moisture Resistant Wire good up to 75° C (insulation type)**
RJ	**Registered Jack**
RM	**Room**
RMBRTU	**Recycle Metering Building Remote Terminal Unit***
RMS	**Root Mean Square**
ROC	**Rate of Change**
ROM	**Read Only Memory**
RPM	**Revolutions Per Minute**
RTU	**Remote Terminal Unit**
SAD	**Site Availability Demonstration**
SAT	**Site Acceptance Test**
SCADA	**Supervisory Control and Data Acquisition**
SCCP	**Sludge Conveyance Control Panel***
SCFH	**Standard Cubic Feet per Hour**
SCR	**Silicon Controlled Rectifier**
SEL	**Select**
SFE	**Secondary Final Effluent***
SG	**Sluice Gate***
SHCP	**Solids Handling Control Panel***
SMACP	**Solids Management Area Control Panel***
SMGRI/O	**Solids Management Gallery Remote Input/Output***
SNMP	**Simple Network Management Protocol**
SP	**Setpoint**

SPG	**Single Point Ground**
SSID	**Service Set Identifier**
SST	**Solids Storage Tank***
ST	**Straight Tip**
STACP	**Secondary Treatment Area Control Panel***
Sup.	**Supervisor**
STR	**Strand**
SW	**Switch**
T1	**T-carrier 1**
TAS	**Technical Aid Series**
TBD	**To Be Determined**
TCP/IP	**Transmission Control Protocol/Internet Protocol**
TEMP	**Temperature**
TGD	**Tag Group Display**
THD	**Total Harmonic Distortion**
TPS	**Tunnel Pump Station***
TPSCP	**Tunnel Pump Station Control Panel***
TS	**Terminal Server***
TSS	**Total Suspended Solids**
TUNNL	**Tunnel***
TV	**Television**
UBC	**Uniform Building Code**
UL	**Underwriters Laboratories Inc.**
UPS	**Uninterruptible Power Supply**
USB	**Universal Serial Bus**
UTP	**Unshielded Twisted Pair**
UV	**Ultraviolet**

UVT	**Ultraviolet Transmission***
V	**Volt**
VAC	**Volts Alternating Current**
VBA	**Visual Basic for Applications**
VDC	**Volts Direct Current**
VFD	**Variable Frequency Drive**
VLAN	**Virtual Local Area Network**
VLV	**Valve**
VOC	**Volatile Organic Compound**
VPN	**Virtual Private Network**
WAN	**Wide Area Network**
WAP	**Wireless Access Point**
WAS	**Waste Activated Sludge**
WASSS	**Waste Activated Sludge Suspended Solids***
WCDOE	**Wayne County Department of Environment***
WCDPS	**Wayne County Department of Public Services***
WCSW	**Wayne County Switch***
WEP	**Wired Equivalent Protocol**
WTR	**Water**
XHHW	**Cross-Linked High Heat Water Resistant Insulated Wire (insulation type)**
XML	**Extensible Markup Language**

***Nomenclature specific to DWTF**

Section 1 – General

Section 1 – General

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Table 1: Emergency Contact List 1-5

Revision Control:

Version	Date	Author	QA/QC	Description of Revisions
1.0	July 2010	Kevin Donovan	Juan Stein	Submittal for Owner Review

1.0 General

1.1 Document Overview

1.1.1 Document Objectives

The SCADA System Manual provides pertinent information about the DWTF SCADA System including Network, PLC, HMI and ancillary equipment. This manual is written for Operations, Maintenance and Administrative staff responsible for daily use and monitoring of the SCADA System. This Manual is written for personnel possessing a general understanding of SCADA Systems and have completed vendor sponsored training on PLC, HMI and Network components.

1.1.2 Document Organization

The Systems Manual is Volume 1 of the SCADA System Documentation and consists of 10 Sections. This Section (Section 1) provides an overview of the DWTF SCADA System. Sections 2 – 10 contain information on separate major SCADA System element. Volume 2 of the SCADA System Documentation contains the Process & Instrument Drawings and Volume 3 of the SCADA System Documentation contains the Control Panel Drawings.

Document Conventions

Throughout the document certain conventions are used to highlight important features. For example, the use of **bold** lettering indicates an important point and the word **WARNING** is used to alert the reader to instances where they must proceed with caution.

1.1.3 Reference Documents

The following reference documents are part of the overall SCADA System documentation and may be referenced for more information about manufacturer equipment produced by the SCADA System contractor, Motor City Electric and Technologies.

Equipment O&M Manuals Volumes 1 – 7

Check-Out Documentation (Instrument Calibration and Check-out)

1.2 SCADA System Overview

1.2.1 Project Description

The Downriver Wastewater Treatment Facility SCADA System consists of a redundant SCADA servers, redundant Terminal Servers, a historian server, SCADA HMI System, a main server room, seven (7) access level switch locations (CNHDCs and Administration Building Communication Closet), and

twenty-two (22) process control PLCs that monitor and control the wastewater treatment facility.

1. Process Data Network

   The SCADA network is a redundant, fiber-optic-based Ethernet network. The network reuses the existing fiber-optic cables in a hybrid spoke and hub configuration. A second fiber pair is now activated within the existing fiber bundle to provide redundant communication paths for greater immunity to loss of communications between the control locations and any portion of the DWTF. Network switches and network components were upgraded in each of the existing CNHDC panels to improve network reliability.

2. SCADA Control Processors (Programmable Logic Controllers)

   To the greatest practicable extent, the existing programmable logic controllers (PLCs) that execute the field-level process control logic and data acquisition were retained. Allen-Bradley PLC-5, SLC and MicroLogix 1500 are used in the SCADA System.

3. Human-Machine Interface Software and Computers

   The SCADA System is based on GE iFIX Proficy software for process visualization and operator interface. Dell workstations and PC are used as the hardware platform. Refer to the Software Section for a complete list of software products.

4. Security

   Multi-level security measures will protect the SCADA system from physical and software intrusion and illicit access. Cisco router and firewalls are implemented at the SCADA System top-end to control in-bound access. There is no physical connection between the SCADA System and the WCDPS business network.

5. Power Supply

   Uninterruptible power supplies are provided for all PLC, CNHDCs, Servers and HMI workstations, to provide steady, conditioned power through most power failures and disruptions.

6. Panels

   The existing SCADA system panels in the DWTF are in good condition and were reused under the SCADA System Improvement Project. Control panels were modified to provide additional control and monitoring functions through the SCADA System. Solids Area control panel was relocated for better protection from environmental damage and two panels, no longer used, were decommissioned and removed.

7. Instrumentation

   Additional instruments were added to the SCADA System. Backup level sensors, dissolved oxygen sensors, and flow sensors were added. Refer to the

Instrument Section for a complete list of new instruments. Existing instruments were retained and connected to the SCADA System.

1.2.2 Process Scope

All DWTF process areas have been impacted by the SCADA Improvements project. All control panels and SCADA communications equipment has been upgraded or modified to provide improved redundancy. A new SCADA Server room was constructed in the Administration Building along with a SCADA Lab and Maintenance Assembly Area in the Maintenance Building.

The SCADA System provides additional automatic process control functions thereby reducing labor-intensive operator control actions. The DWTF can be operated in SCADA/Auto mode with automatic pump operation (ramping, start/stop) and flow balancing within Secondary Treatment for improved efficiency. The reporting system has provided additional automation for the development of regulatory reports.

1.2.3 Project Participants

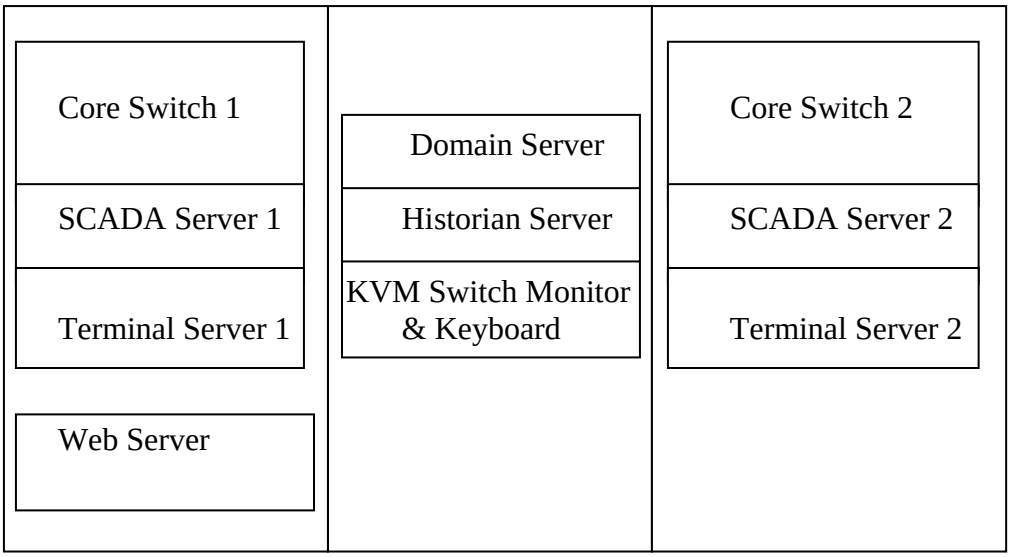
Contact information for individuals involved in the design and construction of the SCADA system is provided below.

Table 1: Emergency Contact List

Company Name	Contact Representative	Role of the Contact	Telephone Number	Fax Number	Email Address
Westin	Kevin Donovan	Project Manager	313.961.1100	313.961.1104	kevin.donovan@we-inc.com
Westin	Juan Stein	Construction Administrator	313.961.1100	313.961.1104	juan.stein@we-inc.com
MCET	Justin Fleming	Construction Manager	313.957.3440	313.957.3540	Jfleming@mce-tech.com
Rotor Electric	Darin Lemond	Electrical Foreman	313.891.0331		dlemond@rotor.com
Gray Matter	Mark Meisel	Sales Manager	248.259.9193	586.725.6320	mmeisel@graymattersystems.com

1.2.4 System Description

The SCADA System server equipment is located in the basement of the Administration Building. The server room is air conditioned to prevent equipment overheating. The servers are contained in three computer enclosures as depicted below.



SCADA Server Room Cabinets, Front View

1.2.4.1 SCADA Servers

The SCADA System is a distributed iFIX client server architecture with single redundant blind SCADA server pairs. The database files on the server pair are automatically synchronized through the iFIX software to ensure that the database configuration is identical and up-to-date on both servers. In the event that either SCADA server is taken off-line or fails, the other server continue to capture and forward real-time and historical data and execute other configured system functions.

The SCADA servers are dedicated exclusively to the process control system and are not loaded with or executing any non-essential software applications. The primary server is equipped with an iFIX development license to allow for maintenance and configuration changes to the SCADA system via these servers, including graphics development. The iFIX servers are lockable, through iFIX security, when not being used for system configuration. HMI graphics are created/modified at the server level and distributed to all view nodes from one central location via Proficy Change Management Software.

1.2.4.2 Domain Server

The Domain Server provides user account management. It contains the user accounts and security information for the resources in the domain. Each person using a work station on the SCADA Network domain receives his or her own unique account, or user

name/password. This account can then be assigned access to resources within the domain by a system administrator.

The domain controller (server) manages all security-related aspects between user and domain interactions, centralizing security and administration.

1.2.4.3 Historical Server

GE iHistorian software, with 5,000 tag capacity, is provided for the single Historian Server and is used as the SCADA reporting application tool. iFIX Data Capture Modules (collectors) are installed on the iFIX SCADA servers to process and forward data to the iHistorian server for archiving and retrieval as needed by the system users. A third-party reporting package, XL-Reporter, is used to configure and generate dashboard, ad-hoc, and regulatory reports.

1.2.4.4 Terminal Servers

The pair of redundant Terminal Servers uses the GE iFIX Terminal Server (TS) software. The Terminal Server authenticate every connecting device (TS Thin Client workstation running on a desktop PC, laptop PC, or panel-mounted device) to provide secure access through user name and passwords along with workstation IP Address verification. The servers utilize a Microsoft Server operating system with Microsoft's Terminal Server application. There are 25 terminal server licenses available for concurrent use between the two terminal servers.

1.2.4.5 Web Server

iFIX Real-Time Information Portal (Web Server) software provides secure remote access between the SCADA System and external networks. The Web Information portal is a Web-based, thin-client application written to the Sun Java J2SE specification. All client functions including screen development, display, administration and query development is performed using a Web browser and can be accessed from any location. The desktop is customizable on any the local users' workstation.

1.2.4.6 Operator Interface Terminals

The SCADA System is comprised of four Thick Clients (two are laptops) and 25 Thin Client OITs (three are laptops and five are GE QuickPanels). GE iFIX HMI software is provided for all HMIs: iClient Runtime workstations (thick clients) and iClient TS workstations (thin clients).

The Thin Client OITs upload graphic displays and process information as needed from the Terminal Servers. The laptop OITs are capable of connection to the SCADA System through a virtual private network (VPN) using authentication and encryption to ensure a secure connection.

1.2.4.7 Control Panel OIT Software – GE Quick Panel

The panel-mounted GE Quick Panels use Microsoft Windows CE.NET™ operating system. These OITs are full featured thin clients and access and utilize the SCADA system graphics through the Terminal Servers. The panel-mounted OITs are located in

four (4) existing PLC control panels: PSTCP-B, PSTCP-C, LLPSCP, and RAS Pump Station 5 & 6.

1.2.5 Third-Party Integrated Software

The SCADA System integrates third-party software with the iFIX SCADA System software to provide Network Management, Alarm Management, Report Management, and File Management capabilities.

1.2.5.1 Network Management Software

IntraVUE WNMS-064 Network Management software is used to monitor all major components attached to the SCADA network. The software is installed on the Domain Server located in the SCADA Server Room. The software runs in the as a background task of the iFIX HMI/SCADA software and can be accessed and viewed from the HMI display. This software monitors the network connection for all OITs, PLCs, Servers and network switches.

1.2.5.2 Alarm Management Software

The SCADA System uses WIN-911/TEP-BD Alarm Software for notification of critical alarms with telephony cards over telephone lines. The software is installed on both SCADA Servers and is configured to operate on the active server. The alarm management software monitors the active Server's database and will call out to WCDPS cell phones to alert operator of high priority alarms.

1.2.5.3 Report Management Software

SyTech's XLReporter software is installed on OITs in the DWTF Laboratory, the common reception area, and the DWTF plant superintendants office and is used for creation of Regulatory and Ad-Hoc reports. The software is integrated with the Historian server and data entered into the XLReporter spreadsheets is automatically uploaded to the Historian. In addition, data collected in the Historian is transferred automatically to the report spreadsheet eliminating the need for manual entry of process data such as daily flow totals.

1.2.5.4 File Management Software

GE Proficy Change Management is installed on the Back-up Server located in the SCADA Lab. This software manages the SCADA software graphics and requires users to check-out files from the software library and check-in new versions.