REQUEST FOR PROPOSAL
BID NO. 2015-22

WASTEWATER
COLLECTION AND TREATMENT
SCADA SYSTEM
DESIGN AND INSTALLATION

Non-mandatory Tour of Existing Installations: June 17, 2015
9:00 a.m. at Elk River Wastewater Treatment Plant
4301 Hilfiker Lane, Eureka, CA 95501

Submission Deadline: 5:00 p.m., July 3, 2015
No postmarks will be accepted.
The City of Eureka is soliciting Proposals from qualified consulting firms to design and install new Supervisory Control and Data Acquisition (SCADA) systems for the Wastewater Collection and Wastewater Treatment Divisions of the Public Works/Engineering Department.

Qualified firms will have broad expertise in the design, integration, and installation of SCADA system-related equipment, including power and signal wiring, control panels, computer software and hardware, radio and PLC programming, and screen configuration, and shall have a demonstrated capacity to implement replacement SCADA systems in the municipal wastewater collection and treatment industries.

Prospective consultants are encouraged to carefully read the Request for Proposal in its entirety, including the Terms and Conditions for Professional Consulting Services Agreements.

Attached are the Project Description, Scope of Work, Overall Project Schedule, Project Phasing and Payment, Proposal Submission Requirements, Acceptance Criteria and Legal Obligations, Selection Process, Terms and Conditions, and Appendix.

The proposal must be submitted in two parts. The first portion shall address the consulting firm’s project approach, applicable experience, and project team expertise. The second portion shall state the amount of compensation to review the existing installations and documentation and develop a detailed scope of work for implementing SCADA system replacements, i.e. Phase I as identified in the Scope of Work.

Inquiries regarding this Request for Proposal shall be directed to:
Angi Sorensen, Associate Civil Engineer
asorensen@ci.eureka.ca.gov; (707) 268-1970

Consultants responding to this solicitation shall submit six (6) copies of their Proposals and one sealed copy of their Statements of Compensation to:
Charles Roecklein, City Engineer
City of Eureka – Public Works/Engineering Department
531 K Street, Eureka, CA  95501-1165

Proposals must be received at the office listed above by:
5:00 p.m. on July 3, 2015
PROJECT DESCRIPTION

The City of Eureka wishes to upgrade the Supervisory Control and Data Acquisition (SCADA) systems used to control and monitor operations and archive data for its wastewater pumping stations and treatment plant. The existing SCADA systems have evolved from relay-based alarm panels communicating over leased telephone lines to a network of programmable logic controllers transmitting operational data and alarm conditions via dedicated 450MHz radio frequencies.

Water treatment and storage, wastewater collection, and wastewater treatment are separate operational divisions within the City’s Public Works/Engineering Department; therefore, three distinct SCADA systems were installed to monitor the following facilities:

1. Water Treatment and Storage – water treatment plant and 20MG reservoir, booster pump station, elevated storage tank, and two at-grade storage tanks
2. Wastewater Collection – thirteen wastewater lift stations
3. Wastewater Treatment – 5MGD (ADWF) wastewater treatment plant, four pump stations, one lift station, and seven (7) revenue-grade flow metering manholes

The City recently deployed centralized, redundant servers operating on a ClearSCADA platform to serve all three operational divisions. As the smallest and least complex of the three SCADA systems, the Water Treatment Division was selected as the first enterprise to be integrated into this new architecture. In addition to new PLC’s and control programs, the new SCADA system includes an operator work station and human-machine interface (HMI), 900MHz Ethernet radios, and local radio and control panels.

The Wastewater Collection Division’s SCADA system monitors operational data and transmits alarm conditions to a third party dispatcher. A master PLC polls the remote sites, and operational data is displayed on screens programmed in an outdated version of Lookout. Desired improvements for the thirteen lift stations maintained by this Division include the following:

1. Standardization of local control hardware and programming
2. Installation of redundant, hard-wired backup controls
3. Migration to ClearSCADA server
4. Configuration of new operator displays in ClearSCADA
5. Configuration of alarms in WIN911

The Wastewater Treatment Division’s SCADA system is also programmed in Lookout, with a point count of approximately 600 at the Elk River Wastewater Treatment Plant (WWTP). Desired improvements for the Wastewater Treatment Division’s SCADA system include the following:

1. Migration to ClearSCADA server
2. Configuration of new operator displays in ClearSCADA
3. Configuration of alarms in WIN911
4. Coordination with electrical engineer regarding planned pump station upgrades
Information regarding the locations of the WWTP and remote pump stations and lift stations is available on the City’s website (http://www.ci.eureka.ca.gov/depts/engineering/gis.asp), and pertinent sections from the SCADA System Needs Assessment are included as an Appendix to this solicitation. The City will host a tour of select facilities on Wednesday, June 17, 2015, to allow interested consultants to familiarize themselves with the existing SCADA installations. The tentative schedule for site visits is as follows:

<table>
<thead>
<tr>
<th>Time</th>
<th>Facility</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Elk River Wastewater Treatment Plant</td>
<td>4301 Hilfiker Lane</td>
</tr>
<tr>
<td>10:30</td>
<td>McCullens Avenue Pump Station</td>
<td>near Shamus T Bones Restaurant at 1911 Trusdale St.</td>
</tr>
<tr>
<td>11:30</td>
<td>Wastewater Collection Division Office</td>
<td>945 W. 14th Street</td>
</tr>
<tr>
<td>noon</td>
<td>Lunch Break</td>
<td></td>
</tr>
<tr>
<td>13:30</td>
<td>3rd &amp; Y Lift Station</td>
<td>near Gonsea Restaurant at 2345 4th St.</td>
</tr>
<tr>
<td>14:30</td>
<td>Del Norte (Stadium) Lift Station</td>
<td>1211 Del Norte Street</td>
</tr>
<tr>
<td>15:30</td>
<td>Martin Slough Pump Station</td>
<td>4747 Fairway Drive</td>
</tr>
</tbody>
</table>

If necessary, an Addendum will be posted on the City’s website no later than 5:00 p.m. on Friday, June 26, 2015, to answer questions submitted to the City and at the site visit. Questions shall be submitted no later than 5:00 p.m. on Wednesday, June 24, 2015. Prospective bidders who wish to receive a copy of the Addendum directly may submit their contact information to Associate Civil Engineer Angi Sorensen at asorensen@ci.eureka.ca.gov.

**SCOPE OF WORK**

The City intends to hire a qualified consulting firm to design and install new SCADA systems for the Wastewater Collection and Wastewater Treatment Divisions of the Public Works/Engineering Department. This work will be performed in two phases and is expected to include the following tasks:

**Phase I**
- Task 1  Review Existing SCADA Installations and Documentation
- Task 2  Prepare a detailed Scope of Work and Fee Estimate for SCADA upgrades

**Phase II**
- Task 1  Develop Preliminary Design Package
- Task 2  Finalize Design Package
- Task 3  Procure, Program, and Configure New Equipment
- Task 4  Install and Start-up New Equipment
- Task 5  Train City Staff to operate and maintain new SCADA system
- Task 6  Deliver O&M Manuals, Warranties, and Record Drawings to City
OVERALL PROJECT SCHEDULE

The City has set a completion date of March 31, 2016, for Phase I, with the intention of completing the overall project by June 30, 2017. If these deadlines do not present a reasonable timeframe for completion of the project, the Proposal shall include an alternate timeline. The anticipated schedule for the consultant selection process and contract award is as follows:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release of RFP</td>
<td>Friday, May 29, 2015</td>
</tr>
<tr>
<td>Tour of select SCADA installations</td>
<td>Wednesday, June 17, 2015</td>
</tr>
<tr>
<td>Deadline for submitting questions to City</td>
<td>Wednesday, June 24, 2015</td>
</tr>
<tr>
<td>Release of Addendum (if necessary)</td>
<td>Friday, June 26, 2015</td>
</tr>
<tr>
<td>Deadline for submitting Proposals to City</td>
<td>Friday, July 3, 2015</td>
</tr>
<tr>
<td>Ranking of Proposals by Selection Committee</td>
<td>Friday, July 10, 2015</td>
</tr>
<tr>
<td>Interviews (if further evaluation is necessary)</td>
<td>Tuesday, July 21, 2015</td>
</tr>
<tr>
<td>Negotiation with selected firm</td>
<td>Tuesday, July 28, 2015</td>
</tr>
<tr>
<td>Award of contract by City Council</td>
<td>Tuesday, August 4, 2015</td>
</tr>
</tbody>
</table>

PROJECT PHASING AND PAYMENT

The work for Phase I will be accomplished prior to the initiation of the work for Phase II. The City intends to contract with a consultant for accomplishing both phases of the project. Only after the City reviews the results and recommendations of Phase I will the City enter into negotiations with the consultant for Phase II services. The City reserves the right to negotiate with other consultant(s) or issue a separate Request for Proposal for Phase II services. The City reserves the right to not proceed with Phase II, if deemed in the best interest of the City.

The Phase I contract will be paid on a lump sum basis. Subsequent work may be paid on a Standard Hourly Rates and Charges Basis, with a not-to-exceed cost, depending on factors to be determined by the City.

Each Task shall have a complete cost breakdown. Progress payments shall be made in accordance with the cost associated with each Task and only for work completed.
PROPOSAL SUBMISSION REQUIREMENTS

Proposals should be as concise as possible and shall contain, at a minimum, the information requested below. Proposals shall not exceed fifteen (15) pages in length, printed on one side of the sheet. Additional materials, including detailed resumes and brochures, may be submitted as an attached appendix to the Proposal. Brochures and marketing materials not directly related to specific experience with the proposed Scope of Work shall not be submitted. Any exceptions to the requirements stated herein shall be clearly explained.

Proposals shall include the following:

1. An introductory letter, addressed to the City Engineer, containing the firm’s mailing address, telephone number, fax number, email address, type of ownership, and the name of the person to contact regarding the Proposal. This letter shall be signed by an official authorized to bind the firm, shall express the consultant’s interest in the work, and shall contain a statement to the effect that the Proposal is valid for at least sixty (60) days.

2. Consultant’s experience in SCADA system design, installation, and user training during the previous five years. If subconsultant(s) will participate in the project, specifically identify the nature and extent of each subconsultant’s experience and participation.

3. Identification and role of key personnel to be assigned to all phases of the project, including each individual’s background and experience. The Proposal shall include a project team organization chart and shall be very specific in identifying the nature and extent of each person’s participation.

4. A detailed description of the consultant’s approach to the project. The description shall convey the consultant’s basic understanding of the work to be accomplished.

5. A statement of the consultant’s ability to perform services within the required time of completion, including an estimated time schedule.

6. A minimum of three references for whom the consultant has provided similar work during the previous five years. If the project team includes subconsultants, clearly state which firm was responsible for each specific project reference, and identify any previous projects that were jointly completed.

7. A statement that all consultants involved have or will have the necessary insurance coverage noted in the Terms and Conditions for Professional Consulting Services Agreements (Attachment). The consultant should also address the acceptability of these Terms and Conditions. Any deviations or modifications to the Terms and Conditions should be noted and explained.

8. Six (6) copies of the Proposal shall be provided in the manner prescribed herein.
Statements of Compensation shall include the following:

1. A proposed fee itemized by task as identified in the Scope of Work for Phase I, Tasks 1 and 2. Costs and time requirements by project personnel and a statement of a lump sum cost shall be provided with the itemized budget. The itemized budget shall be valid for sixty (60) days from the proposal due date. Note the requirement (No. 3, below) to submit this information separately from the Proposal.

2. A statement of hourly billing rates for each classification of personnel to be assigned to the project, plus any related direct project expenses, including photocopies, long distance telephone, travel, etc.

3. One (1) sealed copy of the Statement of Compensation shall be provided in the manner prescribed herein.

Additional Efforts

If, in the professional judgment of the proposing firm, additional work over and above that requested for the Phase I services is necessary, this additional work shall be described in a separate section of the Proposal. Provide a corresponding schedule and estimate of work and deliverables with justification in the Proposal and Statement of Compensation, as applicable.

ACCEPTANCE CRITERIA AND LEGAL OBLIGATIONS

Submittals that do not contain the requisite number of copies and all information requested may be considered non-responsive and rejected without evaluation. Submittals received after the deadline or at an incorrect location will be considered non-responsive and rejected. Faxed or emailed copies will not be accepted. However, the City reserves the right to waive minor irregularities in a firm’s proposal if deemed in the best interest of the City. The City reserves the right to reject any or all proposals if they are deemed inappropriate or inadequate.

Final selection is subject to review and approval by the City Council and is contingent upon negotiating a satisfactory Agreement for Professional Consulting Services.

The City will not pay for any costs incurred by any firm or persons submitting a proposal in response to this solicitation. The City reserves the right to reject, modify, or cancel, in part or in its entirety, this Request for Proposal at any time. All data, documents, and other products used during completion of this project shall remain in the public domain. Similarly, all responses to this Request for Proposal shall become the property of the City and will be retained or disposed of accordingly.

By submitting a response to this solicitation, the consulting firm waives all rights to seek any legal remedies, whatsoever, regarding any aspect of this Request for Proposal, the selection by the City of a consulting firm, and the rejection by the City of any and all Proposals. The City also reserves the right to negotiate any price or provision and accept any part or all parts of any or all submittals, whichever is in the best interest of the City and the public.
SELECTION PROCESS

The Selection Committee will evaluate and rank all complete proposals based upon the following criteria:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience of firm(s) on similar projects</td>
<td>20</td>
</tr>
<tr>
<td>Experience and competence of key individuals with similar projects</td>
<td>25</td>
</tr>
<tr>
<td>General understanding of the work to be accomplished and overall approach to the services requested</td>
<td>25</td>
</tr>
<tr>
<td>Responsiveness to proposal requirements and overall written proposal</td>
<td>15</td>
</tr>
<tr>
<td>Ability of the firm to perform the work within the time limitations</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total Points:</strong></td>
<td>100</td>
</tr>
</tbody>
</table>

Responsive, qualified firms that have provided submittals that are easy to understand, brief, and specific as to the services to be provided will receive high rankings. Interviews may be scheduled with up to four of the highest scoring firms, and information derived therefrom shall be treated on a confidential basis.

The selected consulting firm will be notified and may be asked to enter into negotiations to finalize the work scope, schedule, and final compensation. A contract will be considered in effect only after approval by the City Council and execution by both parties.
Attachment

Terms and Conditions

for

Professional Consulting

Services Agreements
TERMS AND CONDITIONS FOR
PROFESSIONAL CONSULTING SERVICES AGREEMENTS

1. DEFINITIONS: "Consultant" shall mean the Professional Consultant which has entered into the Agreement which by reference is subject to the Terms and Conditions hereinafter set forth. "City" shall mean the City of Eureka, a municipal corporation "Agreement" shall mean the purchase order, contract, or other written instrument constituting the Agreement between the Consultant and the City.

2. CONTRACT TERMS TO BE EXCLUSIVE: This document is the entire AGREEMENT between the parties, and it incorporates or supersedes all previous agreements describing the terms and provisions of the Agreement for Consulting Services.

3. AMENDMENT OF SCOPE OF WORK: City shall have the right to amend the Scope of Work within the Agreement by written notification to the Consultant. In such event, the compensation and time of performance shall be subject to renegotiation upon written demand of either party to the Agreement.

4. CITY'S RIGHT TO TERMINATE/SUSPEND CONTRACT: At any time and for any reason, City shall have the right to terminate or cancel the agreement upon ten (10) days’ written notice; take possession of the Consultant's studies, preliminary drawings, computations and specifications, insofar as they are complete and acceptable to the City; and pay the Consultant such equitable proportion of the total remuneration as the work actually done by the Consultant at the time of such discontinuance bears to the whole of the work required to be done by the Consultant under the terms of this agreement. If the agreement is suspended for one year or more and then restarted, City and Consultant agree to act reasonably and in good faith to renegotiate Consultant’s compensation. Any compensation to Consultant for expenses resulting from the suspension and remobilizing the project shall be limited to twenty (20) hours and reasonable expenses incurred by Consultant in remobilizing the project.

City, at its sole discretion, may suspend indefinitely or abandon the completion of the project, or any part thereof and may require the Consultant to suspend the performance of its services. Said right to suspend or abandon shall be without limit or restriction.

If the City thereafter should determine to complete the project, the City shall have the privilege of requiring completion of the drawings, specifications, and other documents upon compensation to the Consultant.
5. **MEDIATION:** Any dispute, controversy, or claim arising out of or in connection with the interpretation or performance of any term or condition of this Agreement or any breach or alleged breach of this Agreement, shall be submitted to non-binding mediation by a neutral and independent mediator, who shall be selected by the parties by mutual agreement or, if the parties are unable to agree upon the selection of a mediator, then in accordance with the rules of the American Arbitration Association. The cost of the mediator and any other mediation costs shall be borne equally by the parties. The mediation process and the outcome of the mediation shall remain confidential. Notwithstanding the foregoing terms, the parties shall make every reasonable effort to resolve disputes, controversies or claims between themselves in a cooperative fashion prior to submitting a dispute to mediation. Unless otherwise mutually agreed in writing by the parties, neither party may commence any action at law or equity until the mediation provided herein has been concluded.

6. **EMPLOYMENT PRACTICES:** Consultant shall not discriminate in his performance under the Agreement either directly or indirectly on the grounds of race, color, religion, sex, age, or national origin in his employment practices, and shall take affirmative steps to ensure that applicants are employed and employees are treated during employment without regard to race, color, religion, sex, age, or national origin. The Consultant will comply with the regulations of the Department of Transportation relative to nondiscrimination in federally assisted programs of the Department of Transportation (Title 49, Code of Federal Regulations, Part 21).

7. **TITLE TO DOCUMENTS:** Title to all plans, specifications, maps, estimates, reports, manuscripts, drawings, descriptions and other final work products compiled by the Consultant under the Agreement shall be vested in the City, none of which shall be used in any manner whatsoever, by any person, firm, corporation, or agency without the expressed written consent of the City. Basic survey notes and sketches, charts, computations, and other data prepared or obtained under the Agreement shall be made available, upon request, to the City without restriction or limitation on their use.

8. **RECORDS OF PERFORMANCE:** Consultant shall maintain adequate records of contract performance and make these records available for inspection, audit, and copying by the City during the Contract period and for a period of three (3) years from the date of final payment.

9. **ASSIGNMENT:** The Agreement shall not be assigned by the Consultant in whole or in part, without the written consent of the City.

10. **PAYMENT:** Consultant shall submit itemized monthly statements/invoices for work performed. Payment shall be made based upon approval of the statement/invoice. City shall make payment to the consultant within thirty (30) days after receipt and approval of such statement/invoice.
11. **FEDERAL AND STATE RULES AND REGULATIONS:** In the event the Request for Proposal to Provide Professional Consulting Services cites any federal or state financial assistance involved in the project for which professional services are provided, the Consultant shall have the duty of performing under the Agreement in accordance with applicable federal and state laws, rules and regulations.

12. **CORRECTION OF WORK:** The performance of services or acceptance of information furnished by Consultant shall not relieve the Consultant from obligation to correct any defective work subsequently discovered and all incomplete, inaccurate or defective work shall be remedied by the Consultant on demand without cost to the City.

13. **INSURANCE REQUIREMENTS** - Consultant shall procure and maintain for the duration of the contract insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by the Consultant, his agents, representatives, or employees.

**Minimum Scope of Insurance**
Coverage shall be at least as broad as:

A. Insurance Services Office Commercial General Liability coverage (occurrence form CG 0001).
B. Insurance Services Office form number CA 0001 (Ed 1/87) covering Automobile Liability, code 1 (any auto).
C. Workers' Compensation insurance as required by the State of California and Employer's Liability Insurance.
D. Errors and Omissions liability insurance appropriate to the consultant's profession. Architects' and engineers' coverage is to be endorsed to include contractual liability.

**Minimum Limits of Insurance**
Consultant shall maintain limits no less than:

A. General Liability: $2,000,000 per occurrence for bodily injury, personal injury and property damage. If Commercial General Liability Insurance or other form with a general aggregate limit is used, either the general aggregate limit shall apply separately to this project/location or the general aggregate limit shall be twice the required occurrence limit.
B. Automobile Liability: $2,000,000 per accident for bodily injury and property damage.
C. Employer's Liability: $2,000,000 per accident for bodily injury or disease.
D. Errors and Omissions Liability: $2,000,000 per occurrence for Design or Construction and $250,000 for Non-Design or Construction.
E. I certify that in the performance of the scope of work outlined in this agreement, I shall not employ any person in any manner so as to become subject to the Workers Compensation laws of California. (Consultant to initial, if applicable)
Deductibles and Self-Insured Retentions
Any deductibles or self-insured retentions must be declared and approved by the City. At the option of the City, either: the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the City, its officers, officials, employees and volunteers; or the Consultant shall provide a financial guarantee satisfactory to the City guaranteeing payment of losses and related investigations, claim administration and defense expenses.

Other Insurance Provisions
The commercial general liability and automobile liability policies are to contain, or be endorsed to contain, the following provisions:

A. The City, its officers, officials, employees are to be covered as insured as respects: liability to the extent caused by the negligent operations performed by or on behalf of the Consultant; or automobiles owned, leased, hired or borrowed by the Consultant.
B. For any claims related to this project, the Consultant's insurance coverage shall be primary insurance as respects the City, its officers, officials, employees and volunteers. Any insurance or self-insurance maintained by the City, its officers, officials, employees or volunteers shall be excess of the Consultant's insurance and shall not contribute with it.
C. Each insurance policy required by this clause shall be endorsed to state that coverage shall not be canceled by either party, except after thirty (30) days' prior written notice by certified mail, return receipt requested, has been given to the City.

Acceptability of Insurers
Insurance is to be placed with insurers with a current A.M. Best's rating of no less than A:VII, unless otherwise acceptable to the city.

Verification of Coverage
Consultant shall furnish the City with original certificates and amendatory endorsements effecting coverage required by this clause. The endorsements should be on forms provided by the City or on other than the City's forms provided those endorsements conform to City's requirements. All certificates and endorsements are to be received and approved by the City before work commences. The City reserves the right to require complete, certified copies of all required insurance policies, including endorsements effecting the coverage required by these specifications at any time.

Worker’s Compensation Insurance
Worker’s Compensation Insurance as required by the State of California and Employer’s Liability Insurance of $2,000,000 per accident for bodily injury or disease.

The insurance company agrees to waive all rights of subrogation against the City of Eureka, its officers, officials, employees, and volunteers for losses paid under the terms of this policy which arise from the work performed by the named insured.
14. **SUBCONTRACTING:** None of the services covered by this contract shall be subcontracted without the prior written consent of the City. Execution of this AGREEMENT shall constitute consent by the City for Consultant to subcontract portions of the work covered by this AGREEMENT to the firms identified in the Scope of Work (Exhibit A). Services of this AGREEMENT shall be performed for City in fulfillment of the obligation of City. It is understood that Consultant's responsibility will be to City. Accordingly, Consultant shall provide services so as to be as accurate and objective as possible. It is further agreed that in all matters pertinent to this AGREEMENT Consultant shall act as Consultant only to City and shall not act in any capacity as Consultant to any other individuals or entities affected by the plan prepared under this AGREEMENT in any manner that would conflict with Consultant's responsibility to City during the course of the plan's preparation.

15. **COVENANT AGAINST CONTINGENT FEES:** The Consultant warrants that he has not employed or retained any company or person, other than a bona fide employee working for the Consultant, to solicit or secure this Agreement, and that he has not paid or agreed to pay any company or person, other than a bona fide employee, any fee, commission, percentage, brokerage fee, gift, or any other consideration, contingent upon or resulting from the award or making this Agreement. For breach or violation of this warranty, the City shall have the right to annul this Agreement without liability, or, in its discretion to deduct from the Agreement price or consideration, or otherwise recover, the full amount of such fee, commission, percentage, brokerage fee, gift, or contingent fee.

16. **DELAYS AND EXTENSIONS:** The Consultant will be granted time extensions for delays beyond Consultant's control. Extensions will be equal to the length of the delay or as agreed by the City and Consultant. In such event, compensation as set forth in the scope of services shall be subject to renegotiation upon written demand of either party to the agreement.

17. **WAIVER OR MODIFICATION INEFFECTIVE UNLESS IN WRITING:** No waiver modification of this AGREEMENT, or any covenant, condition, or limitation herein contained, shall be valid unless in writing and duly executed by the parties to be charged therewith. Modifications to the Scope of Work may be made administratively if set forth in writing and signed by each party's duly authorized representative; provided, however, that any modification which either increases the cost to City of Consultant's performance under this AGREEMENT or alters the basic purpose of the AGREEMENT may be made only with a prior written approval of City Council and a principal of Consultant. Furthermore, no evidence in any proceeding, arbitration, or litigation between the parties arising out of or affecting this AGREEMENT, or the rights or obligations of any party hereunder, unless such waiver modification is in writing, duly executed as aforesaid. Provisions of this paragraph may not be waived except as herein set forth.

18. **CONTRACT GOVERNED BY STATE LAWS OF CALIFORNIA:** This AGREEMENT and performance hereunder, and suits and special proceedings hereunder, shall be construed in accordance with the laws of the State of California. In any action, special proceeding, or other proceeding that may be brought arising out of, or in connection with, or by reason of this AGREEMENT, the laws of the State of California shall be applicable and shall govern to the exclusion of the law of any other forum, without regard to the jurisdiction in which the action or special proceeding may be instituted.
19. **BINDING EFFECT OF AGREEMENT:** This AGREEMENT shall be binding on and enure to the benefit of the respective parties and their respective heirs, legal representatives, successors and assigns, except as provided above.

20. **CONSULTANT’S ENDORSEMENT:** The Consultant will endorse plans, specifications, reports and documents in accordance with applicable portions of the Business and Professions Code of the State of California.

21. **HOLD HARMLESS:** Consultant shall defend, indemnify and hold harmless City and its officers, officials, employees from and against all claims, damages, losses and expenses including attorney fees to the extent caused by the negligent performance of the work described herein, caused by any negligent act or omission of the Consultant, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

22. **RELATIONSHIP OF PARTIES:** The parties intend that Consultant, in performing services herein specified, shall act as an independent contractor and shall have control of his work and the manner in which it is performed. He shall be free to contract for similar services to be performed for others while he is under contract with the City. Consultant is not to be considered an agent or employee of City, and is not entitled to participate in any pension plans, worker's compensation insurance, or similar benefits that City provide for its employees.
CERTIFICATION OF CONSULTANT

I HEREBY CERTIFY that I am the duly authorized representative of the firm of __________________ whose address is ___________________________ , and that neither the above firm I here represent nor I have:

(a) employed or retained for a commission, percentage, brokerage, contingent fee, or other consideration, any firm or person (other than a bona fide employee working solely for me or the above consultant) to solicit or secure this Agreement;

(b) agreed, as an express or implied condition for obtaining this contract, to employ or retain the services of any firm or person in connection with carrying out the Agreement; or

(c) paid, or agreed to pay, to any firm, organization or person (other than a bona fide employee working solely for me or the above consultant) any fee, contribution, donation, or consideration of any kind for, or in connection with, procuring or carrying out the Agreement;

except as here expressly stated (if any):

I hereby certify that this certificate is subject to applicable State and Federal laws, both criminal and civil.

__________________________________  ______________________________
Date

Name: ___________________________

Title: ___________________________
Appendix

Excerpts from

SCADA System

Needs Assessment

May 2011
SCADA System Needs Assessment

Submitted to:
City of Eureka

Submitted by:
ArcSine engineering
950 Executive Way
Redding, CA 96002
Tel: 530.222.7204

City P.O. No. 2410033
ArcSine Job No. 0939

May 2011
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7 Computerized Maintenance Management (CMMS) .................................................................................................................. 20
8 Other Recommendations ........................................................................................................................................................... 21

Attachments:

Existing Sample Screens

TM-1 Wastewater Collection System Lift Station Evaluation
TM-2 Wastewater Treatment and Pumping Evaluation
TM-3 Water Treatment and Storage Evaluation
TM-CS1 SCADA Software Evaluations

Tagnaming Standards
Section 3 - Evaluation of Existing Systems

3.1 Scope of Evaluation

This SCADA Needs Assessment includes evaluation of Supervisory Control and Data Acquisition (SCADA) needs for the following facilities (refer also to accompanying Technical Memoranda):

Wastewater Collection

- 17 wastewater lift stations (refer to Technical Memorandum TM-1 for complete listing)

Wastewater Treatment (Refer to TM-2)

- Elk River Wastewater Treatment Plant
- Hill Street Pump Station
- McCullens Avenue Pump Station
- Pound Road Lift Station
- Washington Street Pump Station

Water Treatment and Storage (Refer to TM-3)

- Water Treatment Plant
- Harris & K Street (High Tank Repeater Site)
- Lundbar Hills Pump Station (and Reservoir)
- Ryan Slough Pump Station

Field investigations were undertaken for each site, as well as interviews of City personnel. Many of the existing control installations were overseen or personally executed by the former Utility Maintenance Supervisor, and his insight was particularly helpful throughout the process. In many cases, controls upgrades were undertaken on an emergency basis and were limited to replacing then-existing functionality. The City advocates expanding the signals connected to SCADA and training additional City staff to respond to instrumentation, control, PLC, and SCADA issues. With the retirement of the Utility Maintenance Supervisor in May 2010, staff in each division will need to become proficient with routine SCADA system operation and maintenance procedures to ensure reliable operations.

The scope of this Needs Assessment was to include signal and controls propagation down to the programmable logic controller (PLC) level. Thus, investigations were not intended to investigate primary instruments, redundant instruments, hardwired controls, motor controls, or the extent and completeness of PLC inputs/outputs. However, ArcSine staff did make some observations in these areas, and selected ideas are presented in this Need's Assessment.

While much of the detail of the field investigations is not included in this Needs Assessment (nor is it suitable to do so in its present state), a logical modest follow-on effort would be to present the information. We suggest process and instrumentation diagrams, which provide a handy vehicle to depict existing arrangements, show recommended upgrades, and also provide the ultimate basis for graphical SCADA screens.
3.2 Supervisory Systems

Introduction

Supervisory systems consist of the central data infrastructure, data acquisition functionality, graphical operator interfaces, and related functions. For municipalities the size of Eureka, the typical architecture consists of programs (applications) running on PC/server machines, communicating with programmable logic controllers (or the like) distributed throughout the processes. The City’s existing supervisory systems are generally of this structure.

Supervisory applications are developed using one or more commercially available supervisory software packages consisting of the tools to build the project-specific items. The development process comprises a significant portion of the investment in SCADA. Thus, not only the choice of the tools, but the structure and discipline of development, have a significant bearing on the lifespan, maintainability, and expandability of the system.

Summary

As covered in the accompanying Technical Memoranda, the City now operates three stand-alone supervisory systems, as summarized below.

<table>
<thead>
<tr>
<th>System</th>
<th>Qty of PLCs/Sites</th>
<th>Location of Supervisory Computer</th>
<th>Supervisory Software</th>
<th>Supervisory Monitoring</th>
<th>Supervisory Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wastewater Collections</td>
<td>18/18</td>
<td>Corporation Yard</td>
<td>National Instruments Lookout</td>
<td>Yes</td>
<td>None</td>
</tr>
<tr>
<td>Wastewater Treatment and Pumping</td>
<td>9/5</td>
<td>Elk River WWTP</td>
<td>National Instruments Lookout</td>
<td>Yes</td>
<td>Limited</td>
</tr>
<tr>
<td>Water Treatment and Storage</td>
<td>4/4</td>
<td>Water Treatment Plant</td>
<td>National Instruments Lookout</td>
<td>Yes</td>
<td>Limited</td>
</tr>
</tbody>
</table>

Lookout Software

The Lookout supervisory software development package is offered and sold by National Instruments. Based on past experience, and recent inquiries, ArcSine is not recommending Lookout for new applications. Although Lookout could be a candidate for continued use and upgrade, the scope and scale of the City’s ultimate SCADA system are much larger than what is in place now. In our opinion, the benefit of continuing with the same is overshadowed by the following disadvantages:

- Lack of Product Development - Lookout has undergone very little in the way of fundamental improvements over the last several years.

- Low Market Share - Users are migrating away from this already low-market-share product. For future SCADA, we recommend limiting the software selection to leading manufacturers (refer to Technical Memorandum TM-CS1).

- Lack of Support - National Instruments’ salespeople, as well as independent distributors, report that technical support is available only by e-mail, with one or more individuals in China. Any given question can take several day/night cycles to resolve.

- Weak on Redundancy - Dual-redundant server applications are feasible but somewhat cumbersome.
• Unpredictability - A number of years ago, complaints were common for crashes and subsequent database losses. The databases are not well suited for I/O point counts above 500, and the City has exceeded this threshold at the wastewater treatment plant.

• Lack of Manufacturer Knowledge - National Instruments’ employees are quick to admit that they don’t know the product well, and promote the firm’s successful LabView product. ArcSine uses LabView for research facilities, including NASA, but we do not believe it is a good fit for SCADA.

• Licensing - The City’s Lookout licensing is not in agreement with the quantity of machines and systems in use. This discrepancy should be rectified.

• Graphic Screens - Refer to the attachments for sample screens of the existing supervisory systems in the Water Division. Note that most are of a tabular nature; the process components are not graphically depicted. To date, the need (and benefit of) process graphical depictions has been limited due to the limited extent of PLC inputs/outputs. Future applications can and should be graphical in nature.

Based on the reasons cited above, ArcSine recommends migrating away from Lookout. A comparison of regional market leaders was undertaken on behalf of the City, and City staff reviewed qualified contenders listed in the accompanying TM-CS1-SCADA Software Evaluations. The City has selected a ClearSCADA supervisory software development package offered and sold by Control Microsystems.

### 3.3 Communications

**Introduction**

The City makes use of four communications media for existing SCADA system telemetry:

- Three separate, City-wide 450-MHz licensed radio networks; one for each utility division.
- Modbus Plus network over copper at the Elk River Wastewater Treatment Plant.
- Telephone leased lines for transmitting alarms from the large pump stations to Elk River Wastewater Treatment Plant.
- General (Centrex) telephone lines for connection with the City’s alarm monitoring service.

Refer to the existing block diagrams in the attached Technical Memoranda as follows: TM-1, Figure 5.1; TM-2, Figures 1 & 2; TM-3, Figure 3.
450-MHz Communications

Each of the three 450-MHz networks serves one of the three municipal utilities discussed in this Need's Assessment: Wastewater Collections; Wastewater Treatment and Pumping; and Water Treatment and Storage. The City pays a fee for each of the three Federal Communication Commission (FCC) licenses, which are typically valid for 10 years. (Note: Based on the 2004 origin of these radio systems, these licenses will require renewal on or about 2014.)

Below is a summary of frequency licensing:

<table>
<thead>
<tr>
<th>Licensed Frequency</th>
<th>Node Name</th>
<th>Node Number</th>
<th>Modem Address</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wastewater Collections</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>463.400</td>
<td>Station 01 - Jacobs (By WBCo)</td>
<td>iii</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Station 02 - Jacobs (@ John's Used Cars)</td>
<td>iii</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Station 03 - Hilfiker and Broadway</td>
<td>aa</td>
<td>01</td>
</tr>
<tr>
<td></td>
<td>Station 04 - 15th and M ( thru Gate)</td>
<td>iii</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Station 05 - Del Norte (across from Albee Stadium)</td>
<td>iii</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Station 06 - Waterfront (Second and K)</td>
<td>hh</td>
<td>08</td>
</tr>
<tr>
<td></td>
<td>Station 08 - Cal Street</td>
<td>bb</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>Station 09 - Charles Place (off Patricia)</td>
<td>ii</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Station 10 - Golf Course</td>
<td>dd</td>
<td>04</td>
</tr>
<tr>
<td></td>
<td>Station 11 - Commercial and First</td>
<td>ii</td>
<td>09</td>
</tr>
<tr>
<td></td>
<td>Station 12 - Lowell</td>
<td>cc</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>Station 13 - H Street</td>
<td>ee</td>
<td>05</td>
</tr>
<tr>
<td></td>
<td>Station 14 - 3rd and Y</td>
<td>iii</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Station 15 - O Street at Vista</td>
<td>ff</td>
<td>06</td>
</tr>
<tr>
<td></td>
<td>Station 16 - K St (foot of K down from Hodgson)</td>
<td>iii</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Station 17 - Del Norte and Broadway</td>
<td>ii</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Station 27 - Cooper Gulch</td>
<td>gg</td>
<td>07</td>
</tr>
<tr>
<td></td>
<td>Harris &amp; K Street (High Tank Repeater 130' above ground)</td>
<td></td>
<td>990</td>
</tr>
<tr>
<td></td>
<td>Short Street (Wastewater Collection Master)</td>
<td>zz</td>
<td>999</td>
</tr>
</tbody>
</table>

**Wastewater Treatment and Pumping**

| 451.300           | Hill Street Pump Station                      | aa          | aa            |
|                   | McQuilens Avenue Pump Station                | bb          | bb            |
|                   | Washington Street Pump Station (S/F repeater) | cc          | cc            |
|                   | Pound Road Lift Station                      | dd          | dd            |
|                   | Elk River Plant (Wastewater Treatment Master) | zz          | 999           |

**Martin Slough Pump Station**

**Water Treatment and Storage N/A**

| 451.400           | Harris & K Street (High Tank Repeater)       | aa          | 1             |
|                   | Lundbar Hills                                | bb          | 2             |
|                   | Ryan Slough                                  | cc          | 3             |
|                   | Water Plant ( Water Master)                  | zz          | 999           |
The 450-MHz fixed-frequency radios presently in use comprise a communications platform which has been an industry staple for decades. However, data transfer rates are low by today’s radio standards, and remote programming and diagnostic capabilities are not available with these radios.

The existing 450-MHz radios have provided reliable and functional communications for the existing SCADA system, with a couple of exceptions. One complaint, voiced by the operations supervisors, is relatively slow polling cycles. A second problem has been intermittent loss of communications with select remote sites, which have resulted in trouble calls.

A formal radio path study would be an appropriate tool to model existing paths, and verify new paths. Such a study is not included in this effort, but is recommended prior to making any radio changes.

**Telephone Leased Lines**

The City pays a fee for each of the telephone leased lines, which are presently used solely for alarm notification for the Wastewater Treatment Division (see Alarm Notification, below).

### 3.4 Security

The Lookout software used by each utility’s supervisory systems does NOT include security measures, other than the system log-on password required to change configurable setpoints or modify system programming. Each user, once logged on, has access to all components of the software. While this arrangement has not resulted in any serious mishaps to date, we encourage the City to adopt a structured security approach, whereby the level of access granted (privilege) is linked to each individual user’s password.

### 3.5 Alarm Notification

Alarm notification generally consists of station common alarms, conveyed via telephone to a monitoring service which then pages the applicable on-call City operator. Refer to Figures 3.6A, 3.6B, and 3.6C. The pages indicate the telephone number of the alarm service. The operator with the pager then calls the service, to be verbally told which site is in alarm.

As can be seen from the figures, the existing alarm notification system is somewhat complex, and relies on multiple communications links. The systems provide no alarm detail; thus, each alarm generally results in staff having to visit the site. In contrast, modern alarm notification systems provide more detailed information, to support prioritization of work, as well as go/no go decisionmaking on site visits.

It should be noted that off-hours call-outs result in a minimum number of booked hours, at premium rates; and sometimes multiple employees are required. Significant improvements in alarm notification efficiencies are available.

### 3.6 PLCs

The three existing SCADA systems presently utilize a variety of both Modicon and Control Microsystems PLCs, as shown in Table 3.7. Water and Wastewater Treatment uses various Modicon PLCs, while Wastewater Collections uses various Control Microsystems PLCs. Two exceptions are the Pound Road and Cooper Gulch lift stations, which utilize Tesco Liquitronics III PLCs for pump control. In addition to the Tesco PLC, the Cooper Gulch site also uses a Control Microsystems PLC as a remote terminal unit (RTU) for interface with the telemetry system radio.
<table>
<thead>
<tr>
<th>ALARM NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 2</td>
<td>Jacobs Avenue</td>
</tr>
<tr>
<td>3</td>
<td>Hilliker</td>
</tr>
<tr>
<td>4</td>
<td>15th &amp; M</td>
</tr>
<tr>
<td>5</td>
<td>Stadium Hill</td>
</tr>
<tr>
<td>6</td>
<td>Waterfront Drive</td>
</tr>
<tr>
<td>7</td>
<td>California</td>
</tr>
<tr>
<td>8</td>
<td>Charles Place</td>
</tr>
<tr>
<td>9</td>
<td>Golf Course</td>
</tr>
<tr>
<td>10</td>
<td>Commercial</td>
</tr>
<tr>
<td>11</td>
<td>Lowell</td>
</tr>
<tr>
<td>12</td>
<td>H Street</td>
</tr>
<tr>
<td>13</td>
<td>3rd &amp; Y</td>
</tr>
<tr>
<td>14</td>
<td>O Street</td>
</tr>
<tr>
<td>15</td>
<td>K Street</td>
</tr>
<tr>
<td>16</td>
<td>Del Norte &amp; Broadway</td>
</tr>
<tr>
<td>17</td>
<td>Cooper Gulch</td>
</tr>
</tbody>
</table>

WASTEWATER COLLECTION SYSTEM ALARMS

<table>
<thead>
<tr>
<th>ALARM PANEL</th>
<th>HARDWIRE SIGNALS, COMMON ALARM PER STATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CENTRAL COMPUTER</td>
<td>DATA CONCENTRATOR PLC</td>
</tr>
<tr>
<td>RADIO</td>
<td>CORPORATE HEADQUARTERS</td>
</tr>
</tbody>
</table>

COMMUNICATIONS WITH REMOTE SITES
<table>
<thead>
<tr>
<th>ALARM NO.</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HIGH TANK LOSS LEVEL SIGNAL</td>
</tr>
<tr>
<td>2</td>
<td>POWER OUT</td>
</tr>
<tr>
<td>3</td>
<td>HARRIS &amp; K TELEMETRY LOSS</td>
</tr>
<tr>
<td>4</td>
<td>HARRIS &amp; K POWER OUT</td>
</tr>
<tr>
<td>5</td>
<td>HARRIS &amp; K INTRUSION</td>
</tr>
<tr>
<td>6</td>
<td>LOW TANK LOW LEVEL</td>
</tr>
<tr>
<td>7</td>
<td>LOW TANK HIGH LEVEL</td>
</tr>
<tr>
<td>8</td>
<td>HIGH TANK LOW LEVEL</td>
</tr>
<tr>
<td>9</td>
<td>HIGH TANK HIGH LEVEL</td>
</tr>
<tr>
<td>10</td>
<td>PIT FLOOD (WTP)</td>
</tr>
<tr>
<td>11</td>
<td>CL2 LEAK (WTP)</td>
</tr>
<tr>
<td>12</td>
<td>LOW CL2 RESIDUAL (WTP)</td>
</tr>
<tr>
<td>13</td>
<td>CLEARWELL HIGH LEVEL (WTP)</td>
</tr>
<tr>
<td>14</td>
<td>CLEARWELL LOW LEVEL (WTP)</td>
</tr>
<tr>
<td>15</td>
<td>LUNDBAR HILLS ALARM</td>
</tr>
<tr>
<td>STATION NO.</td>
<td>NAME/LOCATION</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td></td>
<td>WASTEWATER COLLECTIONS</td>
</tr>
<tr>
<td>00</td>
<td>WASTE COLLECTION MASTER SHORT STREET</td>
</tr>
<tr>
<td>01</td>
<td>JACOBS BY WB (W)</td>
</tr>
<tr>
<td>02</td>
<td>JACOBS AT JOHN'S USED CARS</td>
</tr>
<tr>
<td>03</td>
<td>MILFIRER AND BROADWAY</td>
</tr>
<tr>
<td>04</td>
<td>5TH AND M (THRU GATE)</td>
</tr>
<tr>
<td>05</td>
<td>DEL NORTE ACROSS FROM ABBE STADIUM</td>
</tr>
<tr>
<td>06</td>
<td>WATERFORT (SECOND AND K)</td>
</tr>
<tr>
<td>08</td>
<td>CAL STREET</td>
</tr>
<tr>
<td>09</td>
<td>CHARLES PLACE (OFF PATRICIA)</td>
</tr>
<tr>
<td>10</td>
<td>GOLF COURSE</td>
</tr>
<tr>
<td>11</td>
<td>COMMERCIAL AND FIRST</td>
</tr>
<tr>
<td>12</td>
<td>LOWELL</td>
</tr>
<tr>
<td>13</td>
<td>H STREET</td>
</tr>
<tr>
<td>14</td>
<td>3RD AND Y</td>
</tr>
<tr>
<td>15</td>
<td>O STREET AT VISTA</td>
</tr>
<tr>
<td>16</td>
<td>K STREET (FOOT OF K DOWN FROM HODGDON)</td>
</tr>
<tr>
<td>17</td>
<td>DEL NORTE AND BROADWAY</td>
</tr>
<tr>
<td>27</td>
<td>COOPER GULCH</td>
</tr>
</tbody>
</table>

**WASTEWATER TREATMENT AND PUMPING**

<table>
<thead>
<tr>
<th>STATION NO.</th>
<th>NAME/LOCATION</th>
<th>PLC</th>
<th>PUMP CONTROLLER</th>
<th>OIP</th>
<th>RADIO</th>
<th>ANTENNA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ELK RIVER WTP CONTROL ROOM</td>
<td>MOD M3012</td>
<td>NA</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>ELK RIVER WTP CONTROL ROOM</td>
<td>MOD TSX COMPACT  (PLC 265)</td>
<td>NA</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>ELK RIVER WTP PRIMARY GALLERY</td>
<td>MOD TSX COMPACT  (PLC 7120)</td>
<td>NA</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>ELK RIVER WTP TREATMENT FILTER PUMP STATION</td>
<td>MOD TSX COMPACT  (PLC 3350)</td>
<td>NA</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>ELK RIVER WTP EFFLUENT/CHLORINATION</td>
<td>MOD TSX COMPACT  (PLC 5650)</td>
<td>NA</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>ELK RIVER WTP SHEDDER</td>
<td>MOD TSX COMPACT  (PLC 5650)</td>
<td>NA</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>ELK RIVER WTP COGENERATION PANEL</td>
<td>MOD TSX COMPACT  (PLC 2650)</td>
<td>NA</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>HILL STREET PUMP STATION</td>
<td>MOD 984 COMPACT</td>
<td>SEE PLC</td>
<td>MOD PANEL PLUS</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>YAGI</td>
</tr>
<tr>
<td></td>
<td>MCCULLIEN'S AVENUE PUMP STATION</td>
<td>MOD 984 COMPACT</td>
<td>SEE PLC</td>
<td>MOD PANEL PLUS</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>WASHINGTON PUMP STATION</td>
<td>MOD 984 COMPACT</td>
<td>SEE PLC</td>
<td>MOD PANEL PLUS</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>POUND ROAD LIFT STATION</td>
<td>TESCO LIQUETRONICS III</td>
<td>SEE PLC</td>
<td>MOD PANEL PLUS</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
</tbody>
</table>

**WATER TREATMENT AND STORAGE**

<table>
<thead>
<tr>
<th>STATION NO.</th>
<th>NAME/LOCATION</th>
<th>PLC</th>
<th>PUMP CONTROLLER</th>
<th>OIP</th>
<th>RADIO</th>
<th>ANTENNA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WATER TREATMENT PLANT</td>
<td>MOD TSX COMPACT</td>
<td>SEE PLC</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>HARRIS AND K - HIGH TANK</td>
<td>MOD TSX COMPACT</td>
<td>SEE PLC</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>OMNI</td>
</tr>
<tr>
<td></td>
<td>LUNDINAR HILLS PUMP STATION</td>
<td>MOD MICRO</td>
<td>SEE PLC</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>YAGI</td>
</tr>
<tr>
<td></td>
<td>RYAN SLough</td>
<td>MOD TSX COMPACT  (NONOPERATIONAL)</td>
<td>SEE PLC</td>
<td>NA</td>
<td>SATELLITE TELEDYNE S4800 SERIAL RADIO</td>
<td>YAGI</td>
</tr>
</tbody>
</table>
Control Microsystems PLC

The wastewater collections system uses both Control Microsystems TeleSAFE Micro 16 5203 and SCADAPack LP 5207 PLCs. These PLCs are used exclusively as an interface with the telemetry system radio, and perform no control functions at this time; pump controls for the wastewater collections system lift stations are provided by both hardwired instruments, combined with various MultiTrode level monitoring with integral pump controllers. This present configuration adds a level of operational and maintenance complexity, with little, if any, benefit.

Control Microsystems recently issued an “End of Life” notice for the TeleSAFE Micro 16 PLC, and expects to issue a similar edict for the SCADAPack LP PLCs in the near future. The impact this will have to the City is that these devices will no longer be supported by Control Microsystems (either for programming support or hardware replacement).

Replacing these PLCs will be necessary to assure long-term maintainability.

Modicon PLCs

Both the Water and Wastewater treatment utilities exclusively use Modicon PLCs, with the exception of two TESCO PLCs mentioned earlier. The Water utility uses both the Modicon TSX Compact and the Modicon Micro PLCs, while the Wastewater utility uses a single Modicon Momentum (presently serving as an unprogrammed spare Modbus Plus port at the WWTP), a single Modicon Quantum (the data concentrator for interface with other plant PLCs at the WWTP), six Modicon TSX Compacts (unit process controllers at the WWTP), and three Modicon 984 Compacts (controllers at each of the three large pump stations).

Standardization

The City is not unusual in its mix of PLCs. However, migrating towards standardized PLCs would offer the following benefits:

- Need for fewer shelf spares.
- Staff expertise on fewer products.
- Consistency in program architecture, structure, tagging, development platforms.
- Fewer PLC programming packages to have on hand.

PLC Conclusions

The PLCs in service can be made to work with modern Supervisory Control and Data Acquisition software and systems. The various PLCs can be made to coexist with one another, and provide high-functioning SCADA.

However, with explicit end-of-life declarations across the board from Control Microsystems, the City would be well advised to migrate towards products and models which are presently in production and offer the promise of future support.

3.7 Other

1. Documentation of existing instrumentation and controls is minimal, and/or not trusted by City staff. This poses a significant obstacle to maintenance and troubleshooting.

2. PLC input/output signals are generally minimal, and thus provide an incomplete remote view of the City’s systems.
3. Particularly for wastewater applications, ArcSine recommends redundant instruments to detect out-of-range excursions which can be caused by failed primary instruments. Redundant instruments today are minimal.

4. Particularly for wastewater pumping applications, ArcSine recommends rudimentary hardwired backup pumping controls which assert themselves on failure of the primary system. We see little to no evidence of such controls.

5. As described in the Technical Memoranda, opportunities exist within each utility to improve monitoring, control, and reliability.
Section 4 – Planned Projects

The City has identified the following firm and/or candidate improvement projects. The proposed SCADA architecture should cover existing facilities, as well as accommodate future integration of anticipated projects such as these:

**Wastewater Collections Lift Stations**

- Refurbish Lift Stations - The City began refurbishing wastewater collection lift stations in 2000, and the remaining three stations (Hilfiker Lane, Del Norte and Broadway, and Waterfront Drive) are expected to be rebuilt in the next 5-7 years.

- Decommission Lift Stations - Four wastewater lift stations (California Street, Golf Course, H, and O Streets) will be decommissioned when the Martin Slough interceptor, pump station, and force main become operational.

- Standardize lift station instrumentation and wiring – The City desires standardization of lift station sites. While not a formal project, per se, the proposed SCADA architecture will benefit from standardized controls and instrumentation.

**Wastewater Treatment Plant**

- Install variable-frequency drives at Hill Street, Washington Street, and McCullens Avenue Pump Stations.

- Install standby generator at Elk River WWTP.

- Construct Biosolids Dewatering Facility at Elk River WWTP.

- Construct Martin Slough Pump Station and force main.

- Receive HCSD flow data for Martin Slough Interceptor – when the Martin Slough Interceptor system becomes operational, the City will begin receiving data from a remote flowmeter at each of the various HCSD connections to the interceptor.

- Complete Wastewater Facilities Plan - Identification of additional projects is anticipated as the City progresses with the Wastewater Facilities Plan, implements a new rate structure, and prepares for NPDES permit renewal.

**Water Treatment and Storage**

- Construct New Harris & K Street Pump Station – The pump station at Harris & K Street (High Tank) should be replaced within the next 5-7 years.

- Recent WTP and Ryan Slough Upgrades – The City recently completed upgrades at Ryan Slough Pump Station and the Water Treatment Plant; installed new pumps, variable-frequency drives, and surveillance and security equipment at the plant; installed flow monitoring and surveillance equipment at the Lundbar Hills Pump Station; and constructed a secure building to house communications equipment at the Harris & K Street site.
Section 5 – Proposed Architecture

5.1 Introduction

This section describes the proposed overall SCADA architecture. This architecture is preliminary, and should be detailed and refined in the course of design and/or implementation.

The existing 450-MHz radio telemetry system is proposed to be reused for initial SCADA implementation. This radio system has inherent limitations, described herein, which limit ultimate SCADA capabilities. The proposed architecture (preliminarily) assumes that any new radios utilize spread-spectrum Ethernet technology. Given present-day reliability complaints, we recommend additional evaluation of the radio system.

Note that this architecture represents a “final” arrangement; and at this planning level, intermediate arrangement(s) are not yet laid out. A number of functional migration paths are available, which could incrementally proceed towards the final arrangement in an efficient manner.

The following paragraphs, in conjunction with Figure 5.1, describe highlights of the proposed architecture.

5.2 Highlights of The Proposed Architecture

As shown on Figure 5.1, the proposed architecture has the following characteristics:

- Sharing of SCADA resources across City enterprises. Each enterprise will enjoy the redundancies.

- Appropriate redundancies.

- Central computing at both the Harris & K site and the Water Treatment Plant. Under emergency scenarios, these sites will have City-wide information (subject to communications).

- Uniformity, consistency.

- The ability to migrate to the architecture (need not be done all at once).

- Reuse of existing serial radio where appropriate. And the opportunity to migrate to higher-speed communications where desired.

- Use of high-speed Ethernet radios to support operator workstations remote from the two central sites.

- Remote roving access via cell modem for O&M staff.

- Support of any level of access desired for other City staff members, either at City offices, or elsewhere (subject to various security provisions).

- Ability to limit viewing, control, and/or setpoint access on a user-by-user basis.
• Logical control hierarchy, with local control at the site available, and control being “handed” up to SCADA.

The following paragraphs address selected aspects starting at the site and moving up to supervisory functions.

5.3 At the Site or Unit Process Level

5.3.1 This scope was not intended to go “below” the PLC level, and thus Figure 5.1 does not show any detail below the PLCs. Nonetheless, certain important features are described below as they impact the overall structure of the system.

5.3.2 Manual equipment operation is available at local motor starters, VFDs, valve operators, etc. This lowest form of control is generally available, even if all forms of automation fail.

These manual provisions exist today, and will generally be reused as-is.

In addition, any forms of critical equipment protections should be hardwired. Candidates include monitoring such as HIGH TEMPERATURE, HIGH VIBRATION, LOW LOW LEVEL, etc. On a case-by-case basis, the following questions should be answered:

• Does hardwired protection apply when operating locally, manually?

• If so, is an override needed? For example, to allow the operator to override a LOW LOW shutoff to pump down a wetwell.

• Does the condition latch at the site, such that a person needs to visit the site to clear the lockout? Or can it be remotely reset? Or will it self-reset? For example, motor high temperature usually applies in all forms of operation, and is a motor starter lockout which requires a local reset. This condition qualifies as a major threat to equipment, and calls for a personal visit to clear.

As part of design and/or implementation, these questions should be posed and answered on an item of equipment basis.

5.3.3 Process control is local to each site and/or unit process. That is, a PLC and/or hardwired logic use stored setpoints and act on monitored process conditions (levels, flows, pressures, etc.) to control equipment. With some exceptions, local process control can and should remain functional even on failure of communications or failure of the supervisory system.

PLC program response on loss of communications or loss of instrument signals is often left to accident, and instead needs to be programmed with deliberation. Achieving predictable site stand-alone functionality is a critical element of overall SCADA architecture.

Stand-alone operation eliminates the burden of communications redundancy. Combined with redundant hardwired automatic controls described below, these measures result in a high degree of fault tolerance.
5.3.4 At each site or process area, operator interfaces will consist of conventional switches, indicators, or lights; or in some cases, a SCADA workstation. Preliminary suggestions for SCADA workstations are shown on Figure 5.1. Combined with roving notebook PCs described later, City staff will have flexible access to process monitoring and control. Workstation locations can and should be critically reviewed and finalized as part of design and implementation.

5.4 Site Communications

As shown on Figure 5.1, the City’s existing 450-MHz licensed radio systems are largely reused. For remote sites shown now with operator (SCADA) workstations, additional unlicensed spread-spectrum Ethernet communications are also shown added. This approach will provide the necessary bandwidth to support the workstations, and could also be configured to provide some communications redundancy.

However, it is recommended that the City evaluate the feasibility of a wholesale upgrade from the existing fixed-frequency radios to a spread-spectrum Ethernet radio system. Spread-spectrum Ethernet radios provide higher data-transfer rates, provide capabilities for remote programming and diagnostics, and will increase the availability of later expanded functionality. For example, the increased bandwidth of spread-spectrum could support later installation of SCADA workstations at selected sites (not shown in proposed buildout).

5.5 Other Communications

Figure 5.1 shows roving notebook PCs as full operator (SCADA) workstations accessing the system through a cellular telephone interface. As described below, the distributed SCADA servers are interconnected with telephone data lines, as well as redundant unlicensed spread-spectrum Ethernet radios.

The leased telephone lines in use today ultimately would not be needed. Decommissioning them would provide some savings in ongoing charges.

5.6 SCADA-Shared Infrastructure

The overall architecture at the supervisory level consists of shared resources, with redundancies. The SCADA application programs can and should be configured to allow users access to their areas of interest, with appropriate privileges which are associated with the users’ log-in credentials.

This approach provides tremendous economies, which become most evident after commissioning the system, when operating and maintaining it. Standardization, a limited number of programs and licenses to maintain and update, and repetition across utilities make the system relatively easy to maintain. The extent to which City staff maintain the system will be at the City’s discretion; and we expect that with training, many of the recurring responsibilities could be readily undertaken by O&M staff.

5.7 Open Architecture

The SCADA architecture is based on commercially available server-grade personal computers, and SCADA screens and data structures developed using Control Microsystems’ ClearSCADA development packages. The system can evolve and grow, and be maintainable by City staff and/or qualified outside firms. The architecture allows for future connection and integration with other applications such as computerized maintenance management, laboratory software, electronic reporting now being adopted by some Regional Water Quality Control Boards, City GIS, and other enterprise software.
5.8 SCADA Servers Are Located In Safe Areas

The existing SCADA servers are presently located at each utility’s headquarters (e.g., Water Treatment Plant, Elk River Wastewater Treatment Plant, and Wastewater Collections Corporation Yard office). Two of these three sites (the Elk River WWTP and the Corporation Yard) are located in the State-designated Tsunami Zone, and thus are susceptible to damage in the event of a catastrophe. ArcSine’s proposed architecture (Figure 5.1) includes redundant SCADA master servers and workstations to be located at the Harris & K Street (High Tank Repeater) site and the Water Treatment Plant. This configuration will provide the City economical redundancy, while managing this risk.

Operator workstations for day-to-day SCADA interface, are logically located at each utility’s present headquarters.

5.9 SCADA Server Architecture Provides Fault Tolerance

A detailed description of failover schemes is outside of the scope of this document; but in summary, the redundant architecture provides the following:

- Continuously updated, redundant terminal servers
- Continuously updated, redundant data historians
- Capability of either SCADA Master to assume the role of primary data management, in the event the other fails

5.10 SCADA Is Not Merged With City Networks

The requirements for SCADA servers, networks, and workstations are very different from the requirements of business and administrative uses as deployed by Information Services (IS) staff. Volumes could be written on the requirements and differences. In our view, it makes sense for SCADA to be merged with and/or under the jurisdiction of City IS when the following are true:

- The user group does not want the responsibility of maintaining SCADA.
- The user group wants to avail itself of the computing expertise of IS, which is often significant.
- IS and the user group are both motivated and willing to make concessions, and adopt practices which are different for SCADA than apply to other City installations.
- IS is willing and able to provide around-the-clock emergency support, and they can and will elevate SCADA priorities above most others within the City.

A particularly difficult area is in operating system patches. Deploying patches, a routine exercise for IS, can cause significant problems within SCADA.

Based on our interviews of operating staff, we do not see a compelling reason to recommend that SCADA be under the jurisdiction of IS. Instead, it should be operated and maintained under the authority of the Public Works Department. However, for remote access, an important feature, we recommend connecting to City networks via a firewall, as summarized below.
5.11 Remote Access

Remote access will allow users to connect as a SCADA workstation via the Internet, and/or via cell phone-connected roving notebook PCs. The privilege of the given user will dictate the portions of the water/wastewater systems viewable, and the operations allowed. In addition to supporting daily operations, remote access is an exceptional tool for City staff and consultants to respond quickly to inquiries and problems. For example, upon being alerted to an alarm, the supporting party can connect and investigate circumstances virtually immediately.

As shown, remote access requires a connection to the Internet. The Internet connection can be a new connection for the sole benefit of the utility, or make use of City network(s). If City networks are used, the rules and requirements for the remote access connection should be negotiated with City IS. A network responsibilities document is a recommended end item of this collaboration, and would define the technical and administrative agreements associated with using and maintaining this connection. Whether this connection is the pathway for alarm notification remains to be decided, a detail which can and should be addressed at a later date.

5.12 Alarm Notification

Figure 5.1 shows redundant alarm notification resident on the terminal servers. The alarms will find their way to on-call operators via a dedicated telephone/Internet connection, and/or via City networks. The notification devices can be telephones, pagers, smart-telephone-type devices, or combinations; with voice and/or text messaging. Alarms will be delivered with detail on the location and origin of the alarm, essential information to assess urgency.

5.13 Data Logging (Data Historian)

The data logging and reporting tools will support system monitoring, evaluations, failure analyses, troubleshooting, and internal and regulatory reporting. Today’s tools are flexible and powerful, and offer a variety of database and interface options.

5.14 Can Be Phased

The architecture shown is the proposed final arrangement. Phasing could be accomplished in many ways, over years, either independently within each utility, or system-wide as a single comprehensive project. Once the overall approach is accepted, a logical follow-on effort would be a predesign of a phased approach meeting City priorities and budget limitations.
Technical Memorandum TM-1

City of Eureka

Subject: SCADA Needs Assessment – Wastewater Collections System
        Lift Station Evaluation

Prepared For: City of Eureka
Prepared By: Doug McHaney, ArcSine Engineering
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Date: May 7, 2010 (Draft)
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      Revised May 11, 2011 (Final SCADA Needs Assessment)

Project No.: 0939/T1

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1 Introduction

ArcSine Engineering is under contract with the City of Eureka for a Supervisory Control and Data Acquisition (SCADA) Needs Assessment. This assessment consists of a high-level review of the City’s needs for control, monitoring, data acquisition, and related functions for the City’s water and wastewater utilities.

This Technical Memorandum presents results of investigations of the City of Eureka’s Wastewater Collections system lift stations. Refer to other Technical Memoranda for the City’s other utilities investigated. The overall Needs Assessment, to which this TM is attached, covers overall subjects including evaluation of communications, alarm notification, recommended SCADA system architecture, and costs.

2 Scope of the Evaluation

In an effort to narrow the focus of the assessment to system-wide issues, this Technical Memorandum does not comprise a detailed evaluation of lift station mechanical systems, electrical systems, instrumentation, or controls. The Scope covers investigation of each site’s programmable logic controller (PLC), overall control philosophy, communications, and the existing central monitoring system with which each station communicates.

However, in the course of investigations, ArcSine’s field team made certain observations outside of the scope above, and selected observations are briefly included herein in an effort to capture related, potentially important, issues.
3 Sites Included

The following City sites were investigated:

- 00 - Office at the City Corporation Yard (location of central computer)
- 01 - Jacobs (by WBCo)
- 02 - Jacobs (at John's Used Cars)
- 03 - Hilfiker and Broadway
- 04 - 15th and M
- 05 - Del Norte
- 06 - Waterfront
- 08 - California Street  Lift Station eliminated; Flow Meter installed
- 09 - Charles Place
- 10 - Golf Course  Lift Station eliminated
- 11 - Commercial and 1st
- 12 - Lowell
- 13 - H Street  Lift Station eliminated; Flow Meter installed
- 14 - 3rd and Y
- 15 - O Street and Vista  Lift Station eliminated; 3 Flow Meters installed
- 16 - K Street
- 17 - Del Norte and Broadway
- 27 - Cooper Gulch
4 Organization and Present Operations

The lift stations are operated and maintained by the Wastewater Collections Division of the Public Works Department, under the leadership of the Wastewater Collections Supervisor. Headquarters are at the City Corporation Yard (Short Street), also the location of the existing central monitoring computer, data concentrator PLC, and master radio. The Corporation Yard is in the State-designated Tsunami Zone; thus, it is not desirable to house essential infrastructure at that location.

Staffed Monday through Friday, 8:00 a.m. to 4:30 p.m., operators visit each remote wastewater collections system site twice weekly. During normal working hours, staff are alerted to alarm conditions either by virtue of seeing them on the central computer screen at the Corporation Yard, or by common alarm notification via the City’s alarm monitoring service and pager. Alarms result from selected monitored conditions at the sites, as well as site communications failures. Some sites are prone to frequent communications failures.

After hours, common alarms are provided via the City’s alarm monitoring service to the pager of the on-call operator. After-hours calls result in a telephone call to the alarm service to determine the site, a visit to the Corporation Yard to assess and clear the alarm, plus usually a trip to the site itself. The City’s policies result in a minimum of 3 hours of overtime for each after-hours callout.

The stations are maintained by the Wastewater Collections Division, with some assistance from the former Utilities Maintenance Supervisor for controls issues. Desired improvements in the Wastewater Collections SCADA system include improved communications, additional data to monitor performance and assess after-hours alarm conditions, and additional training to equip Wastewater Collections personnel to operate and maintain their SCADA system.

5 Existing SCADA

Overview

The wastewater lift stations are presently monitored at the Corporation Yard by a supervisory system. See Figure 1.

The supervisory system consists of an office-grade central personal computer with the Windows 2000 operating system, running a graphical user interface package developed using National Instruments Lookout software. This software package occupies a relatively small, and apparently diminishing, marketshare for municipal SCADA applications. The former Utility Maintenance Supervisor developed this and other City Lookout applications, and this individual continues to work with the City on a part-time basis to respond to inquiries from Wastewater Collections staff for service and modifications.

SCADA Screen
The central computer communicates with a central PLC (TeleSAFE Micro 16) at the Corporation Yard, which acts as a data concentrator in its role of acquiring data from each of 17 sites via a serial, licensed Teledesign 450-MHz radio system. The central PLC also outputs discrete alarm signals to a panel connected to the City’s alarm monitoring company. The alarm monitoring system overall provides a common alarm per site, and an alarm condition results in a page to the on-call operator, with a message containing only the number of the alarm service. The system does not allow operators to discern the nature or urgency of the alarm or to determine when an alarm condition has cleared.

**SCADA Observations**

1. The licensed serial radio system results in an overall polling cycle time of approximately 2 minutes. This is a fairly long interval given the limited quantity of data acquired, although the long interval may be explained at least in part by the communications characteristics of the Micro 16 data concentrator PLC.

2. The common alarm output (for each site) results in the need to reset the alarm both at the alarm service’s keypad, as well as issue a reset at the central computer, both at Corporation Yard offices.

3. Site communications failures happen frequently, result in alarm callouts, and represent about 90% of all alarms. Staff manage the likelihood of failures by selectively increasing the configurable time, within the central computer, for declaring a communication failure at any given site.

4. The central computer provides no access to control system setpoints at individual site PLCs. This characteristic is the result in part, of the fact that the PLCs perform no control. The data concentrator and master radio are not presently configured to write to the remote sites at all.

5. Pump runtime totalizing functions within the central computer reset daily, which is undesirable.

6. The pump runtime information is non-functional for MultiSmart sites. (Refer to Section 6 for identification of MultiSmart sites.)

7. The central computer screens do not include station graphical depictions. Screens are generally tabular, with much of the information displayed without units.

8. All sites monitor wetwell HIGH LEVEL and power status; 6 of the 17 sites acquire additional data which is depicted on associated screens.

9. Historical alarm and event logging are not configured in the Lookout application. When the computer or application is restarted, all alarm and event logging are lost.

10. Battery voltage and power information are available for all site PLCs, except for the master data concentrator PLC. For the master data concentrator PLC, upon a loss of power, a low-battery condition may result in a loss of data concentrator PLC program. Such a loss renders all data acquisition inoperative.
11. Within Lookout graphical trending, multiple trend lines appear on the same graph, scaled to only one of the variables, which causes confusion.

12. Wetwell level is displayed as a percent of height from the bottom of the probe, to the top of the liquid. The system does not convert this level to the actual wetwell depth. City staff refer to levels in terms of depth (from bottom of the wetwell), which is cause of some confusion.

6 Remote Sites

Overview

Each remote site communicates with the central computer via radio. The remote site control system architecture, including radio interface, falls into one of three general categories, as described below:

**Control Microsystems PLC**

Refer to Figure 2. The TeleSAFE Micro 16 only arrangement applies to the following sites:

- Site 03 - Hilfiker and Broadway
- Site 05 - Del Norte
- Site 16 - K Street
- Site 17 - Del Norte and Broadway
- Site 27 - Cooper Gulch

This arrangement consists of a TeleSAFE Micro 16 PLC acting as the radio interface, and forwarding two discrete signals (POWER FAIL and HIGH LEVEL) to the central computer. Pump control is by hardwired logic, or in the case of Cooper Gulch, an additional programmed pump controller.

**MultiTrode/Control Microsystems PLC**

Refer to Figure 3. The MultiTrode/Control Microsystems PLC arrangement applies to the following sites:

- Site 04 - 15th and M
- Site 06 - Waterfront
- Site 08 - California Street
- Site 09 - Charles Place
- Site 11 - Commercial and 1st
- Site 12 - Lowell
- Site 13 - H Street
- Site 14 - 3rd and Y
- Site 15 - O Street and Vista
Although wiring configuration varies among the sites, in general this arrangement consists of a Control Microsystems PLC as the radio interface, with hardwired connections to field devices and to a MultiTrode pump controller which provides pump control.

The model of the Control Microsystems PLC is either a Micro 16 or LP. (Refer to Figure 3, Note 1). The Micro16 PLC has three discrete inputs available, with two inputs used for 'Power Fail' and wetwell HIGH LEVEL. The LP is a larger PLC with a capacity of seven discrete inputs, although only two of the six sites that employ the LP’s, utilize the additional inputs for pump 'ON' statuses (3rd and Y and H Street wastewater collections sites).

The three pump controllers utilized are MultiTrode models MT DPC, MT 2PCL, and MT 3PC. Each pump controller contains an operator interface panel used to enter control setpoints. Currently, no setpoint or status data are communicated from the pump controller to the central computer.

At H Street wetwell level is communicated via the MultiTrode, although this signal is also available (but not used) at other sites.

**MultiTrode MultiSmart Pump Controller**

Refer to Figure 4. The MultiSmart arrangement applies to the following sites:

- Site 01 - Jacobs (by Webco)
- Site 02 - Jacobs (at John’s Used Cars)
- Site 10 - Golf Course

This arrangement consists of a MultiSmart pump controller, manufactured by MultiTrode which provides the Modbus radio interface plus performs pump control functions. The MultiSmart sites do not have PLCs. City staff report that the MultiTrode controllers have been unreliable and that assistance from MultiTrode technical support staff often includes a directive to upgrade the firmware. To this day, staff is skeptical about the device, and would prefer that it not be used. The City’s lift station operating profiles are very straightforward, and a preprogrammed combination pump controller and RTU may introduce unnecessary complexity.

Other complaints include the fact that pumps are not configured in a LEAD/LAG fashion. Thus, the controller does not call the LAG pump in the event of a LEAD pump failure, which resulted in an overflow at Golf Course. Also, data required for communication with the central computer are not easily accessible, requiring the master radio to execute several read cycles from the site to acquire data.
Remote Site Observations

1. The Control Microsystems (CM) PLCs are capable of performing control logic, but these capabilities are not presently utilized. Control is executed with hardwired or other controls.

2. The variations in control system architecture with the CM PLCs, MultiTrodes, and MultiSmarts are confusing to everyone. Variations in wiring and circuit arrangement complicate matters. The lack of as-built documentation further impedes the efforts of City staff to operate and maintain the lift stations.

3. The Control Microsystems Micro and LP PLCs are out of production as of the date of this Technical Memorandum.

4. O&M staff are not equipped to service the Control Microsystems PLCs.

5. Currently there are no file management or version control procedures in place for the lift station software. Copies of the PLC code were downloaded from each site onto the City’s programming laptop, at some point. In general, the same program is used for each site.

6. In general, ArcSine recommends that switches/transmitters used for control not also be the sole source of alarming. Additional, redundant switches for alarming provide a means to detect a failed control element, as such failures will often cause the control system to underpump or overpump with undetected (and undesirable) results.

   In most cases, a redundant HIGH LEVEL float switch appears to exist. No low switch redundancy exists. At two of the sites this HIGH LEVEL float switch is used to start and stop the LEAD pump; however, there is no control deadband implemented to prevent short cycling of pump starts/stops.

7. The quantity of data points acquired by the central computer is minimal. Minor field modifications in many cases would greatly expand site data acquisition and system capabilities.

8. Signal polarity varies among the sites due to the fact that the Micro16 PLCs use sourcing inputs, while the LP PLC uses sinking inputs. This difference and the lack of documentation has caused confusion in the field.

9. The Golf Course site is the first site in the wastewater collections system to utilize a level transducer. In 2007, submersible pumps were installed to replace the two Yeomans 150-gallon “SDV” Shone ejectors, and the new control system includes variable-frequency drives and a MultiTrode MultiSmart controller. The controller is equipped with only one analog output; therefore, staff chose to loop the level signal to the VFD’s, utilizing the VFD PID control to modulate pumping speed and maintain an operator-configurable wetwell level.

10. No station-to-station interlocking exists. For example, an out-of-service downstream station will not cause an upstream station to alter its pumping. SCADA would provide the opportunity to implement selective interlocking.

11. Pump LEAD/LAG call rotation is inconsistent. At some sites this is manual; some automatic.
Technical Memorandum TM-2

City of Eureka

Subject: SCADA Needs Assessment – Wastewater Treatment and Pumping System Evaluation

Prepared For: City of Eureka

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Reviewed By: Doug McHaney, ArcSine Engineering

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2 Wastewater Pumping Stations Block Diagram
1 Introduction

ArcSine Engineering is under contract with the City of Eureka for a Supervisory Control and Data Acquisition (SCADA) Needs Assessment. This assessment consists of a high-level review of the City’s needs for control, monitoring, data acquisition, and related functions for the City’s water and wastewater utilities.

This Technical Memorandum presents results of investigations of the City of Eureka’s Wastewater Treatment and Pumping System. Refer to other Technical Memoranda for the City’s other utilities investigated. The overall Needs Assessment, to which this TM is attached, covers overall subjects including evaluation of communications, alarm notification, recommended SCADA system architecture, and budgetary costs.

2 Scope of Evaluation

In an effort to narrow the focus of the assessment to system-wide issues, this Technical Memorandum does not comprise a detailed evaluation of wastewater treatment or pumping mechanical systems, electrical systems, instrumentation, or controls. The Scope covers investigation of each site’s programmable logic controller (PLC), overall control philosophy, communications, and the existing central monitoring system with which each station or process area communicates.

However, in the course of investigations, ArcSine’s field team made certain observations outside of the scope above, and selected observations are briefly included herein in an effort to capture related, potentially important, issues.

3 Sites Included

The following City sites were investigated:

- Elk River Wastewater Treatment Plant (WWTP)
- Hill Street Pump Station
- McCullens Avenue Pump Station
- Pound Road Lift Station
- Washington Street Pump Station
4 Organization and Present Operations

The Elk River Wastewater Treatment Plant, three large pumping stations, and one small lift station are operated and maintained by the Utilities Operations and Maintenance staff, under the leadership of the Utilities Operations Manager, the Wastewater Utility Operations Supervisor, and the Utility Maintenance Supervisor. Headquarters are at the Elk River WWTP, also the location of the existing central monitoring computer, data concentrator PLC, and master radio. The Elk River WWTP is in the State-designated Tsunami Zone; thus, it is not desirable to house essential infrastructure at that location.

Staffed daily from 8:00 a.m. to 4:30 p.m., operators visit the pump stations daily. During normal working hours, staff are alerted to alarm conditions either by virtue of seeing them on the central computer screen or on the annunciator panel, both located at the Elk River WWTP, or by common alarm notification via the City’s alarm monitoring service and pager. Alarms result from selected monitored conditions at the sites, as well as site communications failures.

After hours, common alarms are provided via the City’s alarm monitoring service to the pager of the on-call operator. After-hours pages result in a telephone call by the on-call operator to the alarm service to determine the site in alarm, a visit to the Elk River WWTP to assess and clear the alarm, plus usually a trip to the site itself. The City’s policies result in a minimum of 3 hours of overtime for each after-hours callout.

5 Existing SCADA

Overview

The wastewater treatment system sites are presently monitored by a supervisory system at the Elk River WWTP. See Figures 1 and 2.

The supervisory system consists of three office-grade personal computers with the Windows 2000 operating system, running a graphical user interface package developed using National Instruments Lookout software. This software package occupies a relatively small, and apparently diminishing, marketshare for municipal SCADA applications. The former Utility Maintenance Supervisor developed this and other City Lookout applications, and this individual continues to work with the City on a part-time basis to respond to inquiries from WWTP staff for service and modifications.

For the purpose of this evaluation the wastewater supervisory system will be discussed under the following two subsystems: 1) the treatment plant, which consists of eight Modicon PLCs networked via two Modbus Plus loops (see Figure 1); and 2) the three large pumping stations, which consist of Modicon PLCs communicating with one of the treatment plant PLCs via a licensed serial 450-MHz radio system (see Figure 2).
NOTES:
1. UNLESS OTHERWISE NOTED, PLC’S SHOWN ARE MODICON TSX COMPACT.
2. THE INFORMATION DEPICTED WAS OBTAINED FROM CITY HAND-MARKED IESCO DRAWING (M3554) AND DAOATA SYSTEMS DRAWINGS OF JULY 2007.
3. PLC SERVES AS THE INTERFACE WITH WASTEWATER PUMP STATIONS. SEE FIGURE 2.
4. NOTED PLC CONTAINS NO I/O OR PROGRAMMING; PRESENT FUNCTION IS TO PROVIDE ADDITIONAL MODBUS PLUS PORT.
5. SPARE MODBUS PLUS TAP (MODICON MODEL 990 NAD 230 00) LOCATED IN PLC 1100 ENCLOSURE.
6. MB+ = MODBUS PLUS.
**SCADA Observations**

1. The outdated version of Lookout software is not in compliance with licensing agreements.

2. The wastewater treatment system has exceeded Lookout’s capacity of 500 I/O points, with no plans to purchase additional I/O point licensing. As additional points are required, they are combined with existing points, alarms, etc., at City staff’s discretion.

3. The existing supervisory system does not have the capability to provide remote access.

4. Regulatory reporting is not a function of the supervisory system; instead reports are presently generated manually by plant staff.

5. SCADA computers are of different make and vintage from one another. The computers suffer from periodic crashes.

6. The existing plant alarm annunciator is outdated and incurs periodic module failures. As modules fail, the associated alarms are combined into other modules, thereby reducing the ability to discern the alarm’s source.

7. The configuration of the alarm system requires an operator to first visit the WWTP to ascertain the origin of the alarm and to acknowledge/reset the alarm, regardless of whether the alarm is at the treatment plant or a remote pumping station.

8. The pump ‘running’ indications for the pumping stations is based on the control system’s “call” for a pump to operate; there does not exist feedback from the pump motor starter to indicate whether the called pump is indeed operating.

9. Site communications failures happen frequently, and result in alarm callouts. Staff manage the likelihood of failures by selectively increasing the configurable time, within the central computer, for declaring a communication failure at any given site.

10. The central computer provides no access to control system setpoints at individual site PLC’s. This characteristic is the result in part of the fact that the PLC’s perform limited control. The data concentrator and master radio are not presently configured to write to the remote sites at all.

11. Historical alarm and event logging are not configured in the Lookout application. When the computer or application is restarted, all alarm and event logging are lost.

12. Within Lookout graphical trending, multiple trend lines appear on the same graph, which scaled to only one of the variables, which causes confusion.
6 Elk River Wastewater Treatment Plant

Overview

The Elk River WWTP control system utilizes a “distributed controls” architecture consisting of nine PLCs, five of which control separate plant processes, networked to a central plant computer via a dual-ring Modbus Plus network. The PLCs are primarily Modicon TSX Compacts (seven) with a Modicon Momentum PLC used as a spare Modbus Plus port, and a Modicon Quantum PLC used as a plant data concentrator for communicating with other plant PLCs. While the majority of plant equipment is under PLC control, one exception is the odor control fan VFDs, which are operated by the supervisory system directly over the plant Modbus Plus network.

The hardwired Modbus Plus plant network provides a reliable, robust communications network with adequate redundancy and sufficient capacity for proposed SCADA system expansion. However, the Modicon PLCs in use are nearing the end of their useful lifetime, and the City should explore options for replacement controllers.

PLCs

Modicon TSX Compact PLC

Individual plant unit process control is performed by Modicon TSX Compact PLCs. The TSX was the immediate successor to the 984, and is identical to the 984 with the exception it was marketed by Telemechanique, the parent company of Modicon. Modicon stopped production of the TSX Compact 6 years ago, and while some replacement parts are still available, the supplier does not anticipate supporting the TSX platform beyond another few years (Modicon’s stated position is to provide an 8-year “end of support” notice from cessation of production).

Modicon Quantum

The Modicon Quantum is one of the ‘heavy lifters’ in Modicon’s PLC product line, is well-suited for the data concentrator/master PLC role it serves in the Treatment Plant control network, and is fully supported by Modicon (with factory support anticipated to continue into the foreseeable future).

Modicon Momentum PLC

The single Modicon Momentum PLC in use at Elk River WWTP provides no present control functioning. Instead, it serves simply as a spare Modbus Plus port.

Alarming

Plant alarms are generated within each unit process PLC, and read by the data concentrator PLC, which communicates alarms to the central annunciator panel in the plant control room and to the alarm monitoring company. Alarms are also displayed on plant SCADA screens (for informational purposes only), but must be acknowledged and reset at the annunciator. The annunciator generates a notification
over the plant public address (PA) system during business hours, and generates a call-out to the City's alarm company after hours.

7 Wastewater Pumping Stations

Overview

The three large wastewater pump stations each use a combination of PLC (Modicon 984s) and hardwired controls for pumping. These sites communicate to a central data concentrator PLC (Modicon TSX) at the wastewater treatment plant via licensed 450-MHz serial radios. The data concentrator PLC is networked to the wastewater treatment supervisory system via the plant's Modbus Plus network. Each site also contains an office-grade personal computer operating Lookout software and a Modicon Panelmate operator interface panel (OIP). The Lookout programs are stand-alone (unique for each individual pump station) and are not networked into the treatment plant SCADA system. The Panelmate OIPs are a discontinued product, no longer available from the supplier, and are not used at this time.

Modicon 984 Compact PLCs

The Modicon 984 PLCs have the capability to perform pump controls, but are presently used in a very limited role for this capacity (pump control is performed primarily by relay logic). Instead, these PLCs are used as an I/O interface for the 450-MHz radios.

The 984 Compact is no longer in production, and the manufacturer (Schneider Electric) anticipates a decreasing level of factory support over the next several years.

Alarming

Site alarms do not utilize the radio system to transmit to SCADA. Instead, a stand-alone FSK (frequency shift key) modem at each site transmits site alarms over a leased telephone line to a central FSK modem at the treatment plant. The central FSK modem then retransmits alarms to the main treatment plant annunciator panel for annunciation at the plant or, during after hours operations, retransmission to the City's alarm service for paging an on-call operator.