IITS *Interior Instrument Tech Services Ltd*

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July 26, 2005

Black Mountain Irrigation District
285 Gray Road
Kelowna, BC, V1X 1W8

Attention: **Bob Hrasko, P.Eng.**

Reference: **Existing Instrumentation and Controls Infrastructure Evaluation Report.**

The purpose of this report is to evaluate Black Mountain Irrigation District's Existing Instrumentation and Controls (I&C) Infrastructure and make recommendations on system upgrades. The report covers the following items and contains budget cost estimates for these recommendations:

1. Water Shed Monitoring and Control.
2. Water Treatment Plant I&C Infrastructure.
3. Water Reservoirs, Pump, PRV and Water Quality Monitoring Stations I&C Infrastructure.
4. Supervisor Control and Data Acquisition (SCADA) System.
5. Office, Works Yards and Water Treatment Plant Computer's Wide Area Network (WAN).

There is a summary in the back of the report that contains each recommendation, its cost estimate and the priority rank of each of the recommendations. The costs in the report are based on 2005 dollars and they include all taxes. A 15% contingency and engineering budget has been included at the end of the cost summary.

We thank you for your interest in Interior Instrument Tech and we look forward to working closely with you on this and future projects. If you have any questions concerning the above, please feel free to call our office at anytime.

Yours truly;
Interior Instrument Tech Services Ltd.

K. R. Hansen

Ken R. Hansen, A.Sc.T.
KH/aa.

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Instrumentation and Controls Evaluation Report

1. Water Shed Monitoring and Controls.

1. The District's Water Shed consists of a series of lakes to the northeast of Kelowna. The two main lakes are Belgo and Greystoke. The current control for the flow out of these lakes is a manually adjusted slide gate.

2. The monitoring and control of these remote sites will require a complete infrastructure to be put in place to support it. The following is a list of the items that will be needed for the project:

    1. Site Power Generation.
        1. It is recommended that the site power system have some redundancy and could consist of Hydro Electric Generation and Solar Power. This would be the most cost effective to operate and maintain.
        2. Budget Cost: $15,000.00 per site.
    2. Gate Control System.
        1. The automation of the existing slide gate would require a 48Vdc electric actuator. The actuator would either have to fitted to the gate on site or a new gate be installed complete with an actuator. The site retrofitting would be the most cost effective of the two options, but both should be evaluated during the design phase of the project:
        2. Budget Cost: $25,000.00 per site.
    3. Lake Level and Discharge Flow Monitoring and Control System.
        1. The best solution to monitoring the Lake Level and Discharge Flow is to use a software configurable, submersible type of level transmitter. This Lake Level unit would be installed in a conduit located on the bottom of the lake. The Discharge Flow unit would be installed in a conduit and be used to measure the level over the top of a weir. The level would be converted to flow in the Gate Flow Control System.
        2. The Gate Flow Control System would contain spare inputs for monitoring items like rain fall, snow pack and site security. The control system could be programmed to accept remote setpoints from the District's SCADA System.
        3. Cost: $25,000.00 per site.
    4. Remote Communications System.
        1. Due to the topography of the area around the lake sites, the only viable communications system that could be used to monitor and remote control these sites would be VHF Radio type modems. Both lakes are in the low lying areas of the water shed and to get the radio signals out would require a repeater site of some sort. Jubilee Mountain appears to be the best location, but path testing should be done to determine best signal paths to each site.
        2. Path Study Cost: $5,000.00
        3. Lake Site Cost: $8,000.00 per site.
        4. Repeater Site Cost: $16,000.00
        5. Office Radio Cost: $8,000.00
    5. Site Building.
        1. A 3-meter by 3-meter building will be required to house and protect the above equipment from the elements and vandalism.
        2. Cost: $20,000.00 per site.

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Instrumentation and Controls Evaluation Report

2. Water Treatment Plant I&C Infrastructure.

1. Instrumentation Equipment.

    1. The Water Treatment Plant was constructed in 1999 and most of its instrumentation equipment is in good working order. Some additions have been made since the plant was constructed and all of this new equipment is operating properly. The only two items that have caused any problems are the instrument air system and the water pH instruments. For the first few years of plant operations, water was getting into the instrument air system. This problem has been rectified, but the gate position controllers suffered some freezing damage and need to be repaired. The water pH instruments have become a high maintenance item and the probes need to be replaced on an annual basis.

    2. It is recommended that the gate position controllers be replaced and water pH probes be upgraded to a solid-state type of probe and electronics.
        1. Gate Position Controllers.
            1. Cost: $3,000.00 per gate.
        2. pH Probe Replacement.
            1. This type of pH probe has built-in diagnostics and will notify the operator when cleaning & calibration is required.
            2. Cost: $2,000.00 per probe.

2. Control Equipment.

    1. The plant control system consists of a main programmable logic controller (PLC) panel and a computer running Lookout 500 point SCADA software. The PLC used in the panel is a Control Micro Systems SCADAPack Plus and it has several expansion cards. There are still some spare inputs and outputs on the expansion cards for the future additions to the PLC system. The PLC is connected to the SCADA computer via two RS232C communication links. One is used for programming and the other for data access. The PLC also has a Modpac Radio Modem connected to it on its third RS232C port. The link is used to obtain data from the District's SCADA system for monitoring purposes.

    2. The system has worked fairly trouble free over the past six years, but there have been some communication issues with between the SCADA computer and the PLC system. Also there have been some problems with upgrading of the SCADA computer hardware. The following is our recommendations for system upgrade:
        1. SCADAPack Plus Upgrade.
            1. The new versions of the SCADAPack PLC are using a faster CPU processor and also have onboard Ethernet communications. To resolve the communications problems between the two devices, it is recommended the SCADAPack Plus be upgraded to a SCADAPack 32 PLC. Also an Ethernet link will have to be run between the control room and the main PLC panel. No hardware upgrade will be required for the SCADA computer, but the Lookout software database will have to be reconfigured to communicate on the Ethernet link.
            2. Cost: $6,000.00

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2. Lookout Software Upgrade.
    1. The existing Lookout software is 5 years old and there have been numerous upgrades to this product in that period. The existing software is not Windows XP compliant and is currently running on a new computer. That's not saying the existing software will not work on the new operation system, but may do strange things and the software manufacturer will not support troubleshooting or supporting it. It is recommended that the software be upgraded to the latest version and that Client Access be added to it. Client Access will allow other computers to obtain data from this computer for display and control purposes.
    2. Cost: $8,000.00

3. Water Reservoirs, Pump, PRV and Water Quality Monitoring Stations I&C Infrastructure.

1. Stevens Pond.

    1. WTP Bypass Gate.
        1. The existing WTP bypass gates on the inlet Stevens Pond are currently manually controlled by hand wheels. These gates are used as backup to the WTP during plant operations.
        2. Automate these two gates to allow for backup control for water into Stevens Pond.
        3. Cost: $20,000.00 per gate.

2. Hadden Pond.

    1. Remote Setpoint Control.
        1. An automated valve on its inlet currently controls the level in the pond. The setpoints are hard coded into the controller at the chlorination facility.
        2. It is recommended that these setpoints be made SCADA accessible on the WTP system.
        3. Cost: $2,000.00.

3. Chlorination Facility.

    1. Remote Setpoint Control.
        1. A separate controller mounted in the chlorinator cabinet does the chlorine residual control. The setpoints for this control can only be changed on the front of this controller, as the unit has no remote setpoint capabilities.
        2. It is recommended that this control function be moved over the facility's PLC and the setpoints be made available on the WTP & Office SCADA systems.
        3. Cost: $8,000.00.

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4. Screening Facility.

1. Controls Upgrade.
1. The existing controls for the rotary screen are relay based and approximately 25 year old. Some of the equipment is obsolete and replacement may be hard to come by.
2. It is recommended that the controls be abandoned and the control function be moved into the chlorine facilities PLC System. This will allow for more flexible control of the screens and the ability to add them to the District's SCADA system.
3. Cost: $12,000.00.

5. Surge Tower.

1. Control Upgrade.
1. The existing electrical and controls at the surge tower have been modified numerous times and equipment added whereever there was space on the wall. Parts of these installations do not meet the Canadian Electrical Code (CEC) and there is exposed equipment mounted on the wall. The electrical equipment is mounted in the same room as the chlorine ejector booster pumps and if a water leak were to occur, major equipment damage could be caused.
2. It is recommended to mount this exposed equipment into a protective enclosure and upgrade the electrical installation to meet the CEC.
3. Cost: $17,000.00.

6. Booster No.1

1. 100Hp Fire Pump Automatic Controls.
1. During the last upgrade at the station, a 100Hp fire pump was added and the existing pressure reducing valve reused as the pump control valve. The valve piping is complete, but the pilot controls and piping is still not finished.
2. It is recommended that the pilot controls be added to the valve and the pump be properly commissioned. Due to a large amount of flow required to test the pump, the commissioning will have to occur in the summer peak demand period.
3. Cost: $5,000.00.

2. Rotork Electric Valve Actuator Controls.
1. The existing controls for the electric actuator were damaged several years ago and have never been repaired.
2. We recommend the controls been repaired and the electric actuator be connected to the District's SCADA System.
3. Cost: $3,000.00.

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Instrumentation and Controls Evaluation Report

3. Rotork Chamber Flood Alarm.
   1. The chamber contains a floor drain, but if it was to ever flood major damage could be caused to the electric valve actuator.
   2. We recommend a float switch be added to the chamber and connected to the District's SCADA System.
   3. Cost: $1,000.00.

7. Booster No.2

1. Automation Upgrade.
   1. The existing controls at the station will start the booster pump on low pressure. Once started the pump must be stopped manually. The electrical system for the station is located in a pre-engineered building above the booster pump chamber. The electrical service and the motor control center are 1970 vintage and are no longer available from the manufacturer. The building is not insulated and contains no ventilation equipment.
   2. For the station to operate reliably in the future we recommend a complete overhaul of the electrical and controls for the station. To control the station properly both pressure and flow should be used and it should be put on SCADA.
   3. Cost: $50,000.00.

2. Confine Space Entry.
   1. The pump station is an in ground type with access from the top. It has a ventilation fan that is manually controlled from the top of the access.
   2. The pump chamber ventilation fan and lights should be upgraded to automatically turn on when the access hatch has been opened. The fan should be interlocked to shutdown on low chamber temperature.
   3. Cost: $1,000.00.

3. Chamber Flood Alarm.
   1. The chamber contains a floor drain, but if it was to ever flood major damage could be caused to the pump.
   2. We recommend a float switch be added to the chamber and connected to the District's SCADA System.
   3. Cost: $1,000.00.

8. Pressure Reducing Station No.7

1. SCADA Controls Upgrade.
   1. The station contains two major pressure zones and an upgrade to add the station to the District's SCADA system was started last year. The SCADA equipment installed was reused from the Booster No.1 Station upgrade. The equipment has been mounted small enclosure with no room for expansion.
   2. The reused SCADA equipment is obsolete and is the only unit of this type the District will have in service. It is recommended that this equipment be upgrade to match the District's other SCADA equipment and install the new equipment in a larger enclosure.
   3. Cost: $10,000.00.

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Instrumentation and Controls Evaluation Report

2. Confine Space Entry.
- **1.** The station is an in ground type with access from the top. It has a ventilation fan that is manually controlled from the top of the access.
- **2.** The PRV chamber ventilation fan and lights should be upgraded to automatically turn on when the access hatch has been opened. The fan should be interlocked to shutdown on low chamber temperature.
- **3.** Cost: $1,000.00.

3. Chamber Flood Alarm.
- **1.** The chamber contains a floor drain, but if it was to ever flood major damage could be caused to the pump.
- **2.** We recommend a float switch be added to the chamber and connected to the District's SCADA System.
- **3.** Cost: $1,000.00.

9. Pressure Reducing Station No.1

1. SCADA Controls Upgrade.
- **1.** The station currently does not have any SCADA Controls. There is a booster pump that can be used to manually pump water into the upper pressure zone. The motor controls are 1970 vintage and are no longer available from the manufacturer. There is a chlorine residual analyzer in the station connected to a data logger. The data logger data is down loaded on a monthly basis.
- **2.** For the station to operate reliably in the future we recommend a complete overhaul of the electrical and controls for the station. To control the station properly both pressure and flow should be used and it should be put on SCADA. By adding the station to the SCADA system, the system's chlorine residual can be monitored and alarmed on a realtime basis, not the monthly basis the data logger is providing.
- **3.** Cost: $33,000.00.

2. Confine Space Entry.
- **1.** The station is an in ground type with access from the top. It has a ventilation fan that is manually controlled from the top of the access.
- **2.** The PRV chamber ventilation fan and lights should be upgraded to automatically turn on when the access hatch has been opened. The fan should be interlocked to shutdown on low chamber temperature.
- **3.** Cost: $1,000.00.

3. Chamber Flood Alarm.
- **1.** The chamber contains a floor drain, but if it was to ever flood major damage could be caused to the pump.
- **2.** We recommend a float switch be added to the chamber and connected to the District's SCADA System.
- **3.** Cost: $1,000.00.

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Black Mountain Irrigation District
Instrumentation and Controls Evaluation Report

10. Pressure Reducing Station No.2

1. SCADA Controls Upgrade.
- **1.** The station currently does not have any SCADA Controls. There is a booster pump that can be used to manually pump water into the upper pressure zone. The motor controls are 1970 vintage and are no longer available from the manufacturer. There is a chlorine residual analyzer in the station connected to a data logger. The data logger data is down loaded on a monthly basis.
- **2.** For the station to operate reliably in the future we recommend a complete overhaul of the electrical and controls for the station. To control the station properly both pressure and flow should be used and it should be put on SCADA. By adding the station to the SCADA system, the system's chlorine residual can be monitored and alarmed on a realtime basis, not the monthly basis the data logger is providing.
- **3.** Cost: $33,000.00.

2. Confine Space Entry.
- **1.** The station is an in ground type with access from the top. It has a ventilation fan that is manually controlled from the top of the access.
- **2.** The PRV chamber ventilation fan and lights should be upgraded to automatically turn on when the access hatch has been opened. The fan should be interlocked to shutdown on low chamber temperature.
- **3.** Cost: $1,000.00.

3. Chamber Flood Alarm.
- **1.** The chamber contains a floor drain, but if it was to ever flood major damage could be caused to the pump.
- **2.** We recommend a float switch be added to the chamber and connected to the District's SCADA System.
- **3.** Cost: $1,000.00.

11. R&L Excavating Chlorine Monitoring Station.

1. SCADA Controls Upgrade.
- **1.** A chlorine residual monitoring station complete with a data logger is installed on the R&L Excavating property at the north end of the distribution system. Similar to PRV No.2, the data logger is downloaded on a monthly basis.
- **2.** We recommend the chlorine residual analyzer be added to the SCADA system. This will require the installation of SCADA equipment at the site. If that is not possible, it is recommended to install a monitoring system kiosk on BMID property and connect that to the SCADA system.
- **3.** Cost: $30,000.00.

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Instrumentation and Controls Evaluation Report

12. Pressure Reducing Station No.10.

1. SCADA Controls Upgrade.
- **1.** The station is currently on the District's SCADA system. The power service and SCADA equipment are mounted in a pole-mounted enclosure adjacent to the station.
- **2.** There is inadequate space in the enclosure to accommodate all the equipment and also there is exposed wiring due to the lack of space. It is recommended that the power service and SCADA equipment be relocated to a small monitoring kiosk located on the other side of the station.
- **3.** Cost: $33,000.00.

2. Confine Space Entry.
- **1.** The station is an in ground type with access from the top. It has a ventilation fan that is manually controlled from the top of the access.
- **2.** The PRV chamber ventilation fan and lights should be upgraded to automatically turn on when the access hatch has been opened. The fan should be interlocked to shutdown on low chamber temperature.
- **3.** Cost: $1,000.00.

3. Chamber Flood Alarm.
- **1.** The chamber contains a floor drain, but if it was to ever flood major damage could be caused to the pump.
- **2.** We recommend a float switch be added to the chamber and connected to the District's SCADA System.
- **3.** Cost: $1,000.00.

13. Scotty Creek Intake.

1. SCADA Documentation.
- **1.** The station was upgraded to complete SCADA monitoring two years ago.
- **2.** The project wiring is complete, but not tagged and there are no drawings on the upgrade. It is recommended that drawings be generated for the station's control panel and associated equipment interconnection wiring. Also it is recommended to tag the panel and interconnection wiring with a permasleeve type of wire tag.
- **3.** Cost: $3,000.00.

2. Flowmeter Chamber Flood Alarm.
- **1.** The chamber contains a floor drain, but if it was to ever flood major damage could be caused to the system flowmeter.
- **2.** We recommend a float switch be added to the chamber and connected to the District's SCADA System.
- **3.** Cost: $1,000.00.

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14. Wells No.4.

1. Electrical Upgrade.
1. The station's electrical service is located on a pole above the pump chamber. The motor control center (MCC) and all other electrical equipment are located in the pump chamber. The MCC is 1970 vintage and is no longer available from the manufacturer.
2. It is recommended that the station's electrical be upgraded and the new equipment be installed in Well No.5 Station and it be connected to the SCADA system.
3. Cost: $31,000.00.

2. Chamber Flood Alarm.
1. The chamber contains a floor drain, but if it was to ever flood major damage could be caused to the pump.
2. We recommend a float switch be added to the chamber and connected to the District's SCADA System.
3. Cost: $1,000.00.

15. Wells No.5.

1. SCADA Documentation.
1. The station was upgraded to complete SCADA monitoring two years ago.
2. The project wiring is complete, but not tagged and there are no drawings on the upgrade. It is recommended that drawings be generated for the station's control panel and associated equipment interconnection wiring. Also it is recommended to tag the panel and interconnection wiring with a permasleeve type of wire tag.
3. Cost: $3,000.00.

4. Supervisor Control and Data Acquisition (SCADA) System.

1. SCADA Software.

1. The existing SCADA system consists of three separate computers running National Instruments Lookout software. The computers at the Office and the Works Yards are connected to the District's radio telemetry system via separate Modpac Radio Modems. The WTP's computer is connected to the plant's PLC system, which in turn is connected to the telemetry system via another Modpac Radio Modem. The computers at the three sites are of different vintages and the Lookout software is version 3.8.16. The Office and Works Yards Lookout packages are 200 points each and the WTP's package is a 500-point system. This version of Lookout software is Windows 2000 compliant, but not the current Windows operating system XP Pro. The software offers a graphical interface to the District's pump stations, PRVs, Reservoirs and WTP. The Office and Works Yards systems are configured to only display the data from the remote sites and have not remote control capabilities. The WTP system is configured for display and remote control.

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2. We recommend the Office and Works Yards SCADA Computers be replaced with new units running the Windows XP Pro operation system, the Lookout software be upgrade to the latest version and the Client Access option be added to each. The WTP system be upgraded to the latest version of Lookout and the Client Access option also added. The three computers be connected to the new Wide Area Network for software backup purposes. Remote control programming should be added to the Office and Works Yards system to allow better control of the overall water system.
3. Cost: $27,000.00

2. Historical and Reporting Data
1. All three systems gather data and store it for 200 days. Data can be retrieved and displayed in a trend format. No reports have been configured in the system. Circular chart recorders are used as backup records for the system's historical data records.
2. It is recommended that a 500-point Report Historian be installed on the office SCADA System and it be configured to log the data to the file server.
3. Cost: $12,000.00

5. Office, Works Yards and WTP Computer's Wide Area Network (WAN).

1. The District does not currently have a WAN for its computer systems. The Office, Works Yards and WTP have their own local area networks and data is transferred between the networks manually. A dialup connection is used to connect to the Office network for access to the District's mapping software. This connection is slow and cumbersome to use. The current SCADA system consists of three separate computers connected to the District's radio telemetry system gathering the same data for display at each site. Internet and e-mail access for the WTP is done through a slow dialup connection.

2. It is recommended that the District install a high-speed wireless WAN between the office, works yards and the water treatment plant. The connection to the WTP can be achieved by installing a repeater site at either the new Kirschner Mountain Pump Station or Reservoir. This new high-speed wireless system should be configured with restricted security access and use encryption for all its data transmissions. The office's local area network should be divided into two networks and the District's accounting computers isolated for the new WAN.

3. Path Testing Cost: $2,000.00

4. System Installation Cost: $30,000.00.

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1. Upgrade Cost Estimate Summary

Item	Description	Priority	Unit Cost	Qty	Units	Total Cost
1	Water Shed Monitoring and Controls.	Low	$110,000.00	2	Site	$220,000.00
2	WTP Gate Position Controllers.	High	$3,000.00	4	Each	$12,000.00
3	WTP pH Probe Replacement.	Medium	$2,000.00	3	Each	$6,000.00
4	WTP SCADAPack Plus Upgrade.	High	$6,000.00	1	Each	$6,000.00
5	WTP Lookout Software Upgrade.	Medium	$8,000.00	1	Each	$8,000.00
6	Stevens Pond Inlet Gates Automation.	Low	$20,000.00	2	Each	$40,000.00
7	Haddon Pond Remote Setpoint Control.	Medium	$2,000.00	1	Each	$2,000.00
8	Chlorination Facility Remote Setpoint Control.	Medium	$8,000.00	1	Each	$8,000.00
9	Screening Facility Controls Upgrade.	Medium	$12,000.00	1	Each	$12,000.00
10	Surge Tower Controls Upgrade.	Medium	$17,000.00	1	Each	$17,000.00
11	Booster #1 100Hp Pump Automatic Controls.	High	$5,000.00	1	Each	$5,000.00
12	Booster #1 Rotork Electric Actuator Controls.	Medium	$3,000.00	1	Each	$3,000.00
13	Booster #1 Rotork Chamber Flood Alarm.	High	$1,000.00	1	Each	$1,000.00
14	Booster #2 Automation Upgrade.	Low	$50,000.00	1	Each	$50,000.00
15	Booster #2 Confine Space Entry Upgrade.	High	$1,000.00	1	Each	$1,000.00
16	Booster #2 Chamber Flood Alarm.	High	$1,000.00	1	Each	$1,000.00
17	PRV #7 SCADA Upgrade.	Medium	$10,000.00	1	Each	$10,000.00
18	PRV #7 Confine Space Entry Upgrade.	High	$1,000.00	1	Each	$1,000.00
19	PRV #7 Chamber Flood Alarm.	High	$1,000.00	1	Each	$1,000.00
20	PRV #1 SCADA Upgrade.	Low	$33,000.00	1	Each	$33,000.00
21	PRV #1 Confine Space Entry Upgrade.	High	$1,000.00	1	Each	$1,000.00
22	PRV #1 Chamber Flood Alarm.	High	$1,000.00	1	Each	$1,000.00
23	PRV #2 SCADA Upgrade.	Low	$33,000.00	1	Each	$33,000.00
24	PRV #2 Confine Space Entry Upgrade.	High	$1,000.00	1	Each	$1,000.00
25	PRV #2 Chamber Flood Alarm.	High	$1,000.00	1	Each	$1,000.00
26	R&L Excavating Monitoring Upgrade.	Low	$30,000.00	1	Each	$30,000.00
27	PRV #10 SCADA Upgrade.	Low	$33,000.00	1	Each	$33,000.00
28	PRV #10 Confine Space Entry Upgrade.	High	$1,000.00	1	Each	$1,000.00
29	PRV #10 Chamber Flood Alarm.	High	$1,000.00	1	Each	$1,000.00
30	Scotty Creek Intake SCADA Documentation.	High	$3,000.00	1	Each	$3,000.00
31	Scotty Creek Flowmeter Chamber Flood.	High	$1,000.00	1	Each	$1,000.00
32	Well #4 Electrical Upgrade.	Low	$40,000.00	1	Each	$40,000.00
33	Well #4 Chamber Flood Alarm.	High	$1,000.00	1	Each	$1,000.00
34	Well #5 SCADA Documentation.	High	$3,000.00	1	Each	$3,000.00
35	SCADA and Reporting System Upgrade.	Medium	$47,000.00	1	Each	$47,000.00
36	Computer WAN Wireless Upgrade.	Medium	$32,000.00	1	Each	$32,000.00
37	15% Contingency and Engineering					$99,900.00
					Total	$765,900.00