GUIDANCE DOCUMENT FOR PREPARING AN OPERATIONS PROGRAM

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Regional Services
Central Region – Red Deer

Foreword:

This document is intended to be used by operators of high quality groundwater facilities and systems consisting solely of a water distribution system to:

1. Initiate the development of an operations program including standard operating procedures (SOPs) and emergency response plans (ERPs); and

2. To help ensure the operations program has a maximum benefit to the waterworks systems.

Schedule 1 in the *Code of Practice for Waterworks Using High Quality Groundwater* and the *Code of Practice for a Waterworks System Consisting Solely of A Water Distribution System* (the codes) includes a list of the required content for a Waterworks System Operations Program.

That Schedule describes the minimum content for each of these three sections:

1. Routine Operational Procedures
2. Routine Operational Procedures for Monitoring and Analysis
3. Emergency Response Plan

This guidance document discusses the requirements specified by the code and provides a list of suggested SOPs and ERPs for consideration by the operators.

As each facility will have unique needs that may require additional or different SOPs and ERPs, this document is meant to provide a starting point and is not intended to be all-inclusive.

Operators should not use this document to assess the acceptability or completeness of their SOP's and ERPs.

Rationale for the Operations Program:

The Operations Program is intended to document various aspects of the waterworks system's operation. Should an operator be unavailable or leave the facility, another knowledgeable waterworks operator could use the operations program to understand the waterworks system and commence operating with the least amount of disruption.

The Operations Program should be a good starting place to be able to understand the waterworks system's configuration and operational nuances.

As such, the more comprehensive the plan, the more useful and valuable a tool it will be. As with all such undertakings, the more effort put into building the plan, the more benefit it will be when needed.

The Operators of a waterworks system typically have an intimate knowledge of their system and should be the key authors of the Operations Program. Local managers and administrators should also be involved to ensure the program meets the needs of the system owners as well as the regulatory requirements.

Introduction:

Safe operation of a waterworks system requires that operators base their decisions on knowledge, experience and use of best practices. An SOP is a set of written instructions that clearly documents the way activities are to be performed. Excellence in operations is best illustrated by:

- Implementing SOPs to ensure the plant is optimized when operating in normal operational mode; and
- Ensuring operators are prepared to handle disruptions or normal operations by following ERPs in place for emergency situations.

The contents of the Operations Program should be reviewed on a regular basis and updated as needed to ensure operators are accessing current and best operating practices. The operations program should indicate the dates when SOPs were created and revised. In addition, the person responsible for creating or revising the documents should be identified.

SOPs and ERPs should be consistent, clear, and concise. Development of a template will provide operators with a starting point to meeting this objective. There are many other sources of information available on developing SOPs and ERPs. A search of the Internet can yield many examples of SOPs and ERPs. Some of these references have been included in **Appendix 1.**

It is suggested that contents of the operations program be well organized. The use of a Table of Contents and tabbed separation of the different sections of the operations program is encouraged.

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Operations Program Contents

Effective operations programs will assist operators with meeting their regulatory requirements. The Waterworks Codes of Practice specifies that the Operations Program include the contents in Schedule 1. The requirements include:

1. Routine Operating Procedures

(a) Contact Names and Telephone Numbers for the following:

CONTACT	PHONE NUMBER	CELL NUMBER
Waterworks Personnel		
System Owner		
Administrator		
Mayor		
System Operators		
Engineering Consultants		
Government Agencies		
Alberta Environment		
Health Region		
Emergency Contacts		
Fire		
Ambulance		
Police		
Poison Control		
Priority Contacts		
Hospitals		
Schools		
Businesses		
Utility Contacts		
Power		
Telephone		
Energy		
Gas		
Equipment Suppliers		
Chemical Suppliers		
Maintenance Contractors		
Other Contacts		
Provincial Water Lab		
Edmonton		
Calgary		

NOTE: This list is not all-inclusive and should be modified to meet your needs.

(b) Operating Instructions

(i) General description of the water treatment process and operating procedures

- Specific details on the individual components of the water treatment process
- A description of the waterworks facility should include some basic detail, such as:
  - Facility location
  - Distribution system (e.g., location, expanse)
  - Well information (i.e., depths, production, location(s), Water Act Licence Diversion limits)
  - Process flow diagram
  - Potable water storage (i.e., Size and/or capacity)
  - Design and operation capacity
  - Acceptable ranges for treatment (e.g., backwash cycles)
  - Pressure/pump system
  - Chlorination system
  - Start and stop (e.g., based on clearwell level)

Note: This is not a comprehensive list and operators should include all relevant descriptions of their system.

- Operational instructions for the treatment process.
  - SOPs should be prioritized (i.e., routine vs. non-routine)
  - SOPs should provide guidance based on best practices
  - SOPs should be simple and straightforward
  - Detail in the SOP should reduce the opportunity for facility and/or treatment disruptions
  - Detailed manufacturer information should be referenced as an appendix or as a specific resource
  - Keep the operation program current. Allow for additions, revisions and deletions if required.
  - Consider following a 'source to tap' approach when developing a list of SOPs you will require
  - See **Appendix 2** for an example of a typical list of SOPs
  - **Appendix 3 has an example of an SOP template and an example SOP from an EPCOR waterworks facility.**

(ii) Performance Requirements

- Summary of AENV requirements (i.e., *Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems* or *Code of Practice for Waterworks Using High Quality Groundwater* and the *Code of Practice for a Waterworks System Consisting Solely of A Water Distribution System)*
  - Chlorine residuals
  - Chlorine contact times; log reduction
  - Bacteriological sampling requirements

- Operational targets and triggers for process adjustment
  - Chlorine concentration
  - Iron and Manganese concentrations
  - Dosages
  - Pressures
  - Performance goal (i.e., 24 hours/day)

- Summary of potential actions and reactions if trigger points are reached

(iii) Location of equipment major controls including:

- A description of the components
  - Their function
  - How they are activated, and

Examples:
  - Flow set points
  - Chemical adjustment locations
  - Distribution pump control
  - Chlorine pump set-up
  - Back wash set-up
  - SCADA controls (i.e., control panel)
  - Pressure control device(s)
  - Pump selector(s)

- Plans of the water distribution system including:
  - Locations of mains, hydrants, and valves
  - Location and details of any water storage facilities
  - Details on pressure zones

(c) Maintenance Schedule

- Review all components of the waterworks system and include all maintenance items in this schedule.
- Include monitoring and testing equipment calibrations.
- Consider recording who completes the calibrations (i.e., onsite operators or representative authorized by the supplier).
- DO what you say and say what you DO
- Consider organizing based on frequency (i.e., daily, monthly, annually).
- See **Appendix 4** for an Example of a Maintenance Schedule

(d) General Maintenance Instructions for:

(i) Treatment/process equipment
(ii) Monitoring equipment
- See **Appendix 5** for an example

(iii) Pumping equipment
- See **Appendix 5** for an example

- A troubleshooting section should be considered for (i) to (iii). See **Appendix 6** for an example.

(e) The schedule and procedures for cleaning and flushing the entire water distribution system, including the potable water storage reservoirs.

- The location and sequence of valve closures and openings to route the water through the targeted sequence of mains (map of normal valve position)
- Hydrant flushing operations, including water de-chlorination if warranted
- Determine the flushing objectives
    - Maintain/improve water quality
    - Scour pipes/remove sediments
    - Improve hydraulics
    - Conduct preventative maintenance
        - Valve operation checking
        - Hydrant checking as per National fire codes
    - Clean and disinfect
        - Newly installed or repaired mains
    - Minimize customer complaints
- Obtain maps and review hydraulic model
- Develop list of stakeholders (i.e., contacts for large user groups supplied by the system)
- Combine flushing program with other preventative maintenance programs
- Notify and educate the public

2. Routine Operational Procedures for Monitoring and Analysis

(a) Operational and Compliance Tests to be performed, including:

- A summary of all required monitoring in the EPEA codes
    - Frequency of testing
    - Location of testing
    - Will include the annual parameters outlined in the compliance monitoring section of the Standards and Guidelines, and quarterly monitoring (e.g., Trihalomethanes (THM's) and Bromodichlormethane (BDCM))
    - List of critical steps

- A summary of all operations monitoring conducted, including
    - Frequency of monitoring
    - Location of monitoring
    - Health and Safety warnings
    - Cautions for preventing the creation of invalid results
    - List of critical steps

    Examples:
        - Raw water checks (i.e., meter readings, source(s))
        - Treated water checks (i.e., meter reading, reservoir level)
        - Chlorine amount (i.e., Record Barrel levels)
        - Pump hours
        - Building checks (i.e., temperature, security)
        - Check Fire Pump

- A summary of any additional testing/monitoring that is relevant
    - Quality Assurance/Quality Compliance (QA/QC) of monitoring equipment
        - Procedures (i.e., self checks, calibrations)
        - Materials (i.e., blanks, spikes)
        - Frequency of checks, calibrations
        - Criteria for acceptable results
        - Actions required when QC criteria is exceeded
        - See **Appendix 7** for an example

(b) Methods used for monitoring and analysis

- Include all monitoring and analysis performed
- Standard operating procedures for each analysis performed. See **Appendix 8** for an example (NAIT's 'Laboratory Data Quality Assurance Program for Small Municipalities')
- Methods used for calibrating monitoring and analysis equipment
- Sample collection, handling, preservation

(c) Location of Monitoring Points

- Include all monitoring performed, both within the water treatment plant and the water distribution system. Consider using a diagram.

3. Emergency Response Plan

The emergency response plan is intended to document the appropriate reactions required to address unplanned situations that may occur in the waterworks system. The ERP is similar to the SOP in that they provide the operator with a detailed list of procedures to follow and to put into action quickly, should an unplanned or emergency event happen. However, they should be visibly different that an SOP (e.g., use of different colours for heading backgrounds or the use of a header or footer on every page that clearly identifies SOP or ERP). **Appendix 9 has an example of an ERP template and a sample ERP.**

These situations could occur anywhere from the water source to the customer's tap. Operators and administrators must commit to preventing or minimizing losses during an emergency. Plans should address both regular hours and after hours situations (e.g., failed bacteriological re-sample) and identify who will be involved in the implementation of the ERPs.

The suggested methodology for developing the plan would be to list all components of the waterworks from source to tap, identifying the possible scenarios that could adversely affect the operation of those components and the specific details on how those problems would be both accommodated and corrected.

As indicated previously, because of their intimate knowledge of the system, the waterworks operators would typically have a key role in identifying potential challenging scenarios.

The Emergency Response Plan must also include, as a minimum, the steps that would be taken in the event of the following scenarios:

(a) bacteriological results exceed the prescribed limits
(b) low chlorine residual – at the plant or in the distribution system (see example in Appendix 9)
(c) equipment breakdown (raw water pump, chemical feed pump, distribution pump, distribution pressure loss, etc.)
(d) flood (wells, reservoir, pump houses, etc.)
(e) a water distribution system pipeline break and repair, including the return of the pipeline to service
(f) power failure; and
(g) the waterworks system becomes inoperable, including the steps that would be taken to provide an alternate potable water supply.

The Emergency Response Plan should also include section:

- That outlines the Occupational Health and Safety measures
- Equipment used in various emergency responses
- Vandalism and/or illegal activity
- Raw or treated water becomes contaminated
- Mechanical failure (i.e., Standby equipment or alternate routing)
- Fire/smoke within the water treatment plant
- Pump trip at the breaker
- Low reservoir level
- Certification requirement not met
- Include reporting where appropriate
    - Emergency Notifications (AENV, Health Authority, customers)
    - Notification procedures in each ERP scenario

4. Date of Last Update

- Suggested schedule for reviewing and updating Operations Programs
    - Update the plan every 3-5 years (or as needed)
    - Update contact list annually (or as needed)

- Operators should be testing and refining the Operations program to improve the plant operations, as
    - Problems (break downs) are solved
    - New technology is implemented, etc.

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Appendix 1 - Selection of Internet References

EPA Guidance for Preparing Standard Operating Procedures
http://www.epa.gov/quality/qs-docs/g6-final.pdf

AWWA - Water Supply Operations - Flushing and Cleaning
http://www.awwa.org/bookstore/product.cfm?id=65111

ERP for Small Waterworks Systems
http://www.healthservices.gov.bc.ca/protect/pdf/PHI061.PDF

Drinking Water System - Emergency Response Guidebook
http://www.drinkingwater.utah.gov/documents/compliance/emergency_response_guide.pdf

Effective Emergency Response Plans
http://www.nsc.org/issues/emerg/99esc.htm#SIDEBAR2

ERP for Small and Medium Community Water Systems
http://www.epa.gov/safewater/watersecurity/pubs/small_medium_ERP_guidance040704.pdf

ERP Guide for Public Water Systems
http://www.doh.wa.gov/ehp/dw/Security/331-211_5-13-03_Emergency_Response_Planning_Guide.pdf

Municipal Excellence Network
http://www.menet.ab.ca/bins/view_practice.asp?pid=611

SOP Working Example
http://www.biosci.ohio-state.edu/~jsmith/SOP/formsop.pdf

SK Guidelines for Waterworks Emergency Response Planning
http://www.se.gov.sk.ca/environment/protection/water/EPB%20240%20-%20Guidelines%20for%20Waterworks%20Emergency%20Response%20Pla.pdf

SK Water Quality Emergency Planning - An Overview
http://www.se.gov.sk.ca/environment/protection/water/epb%20241a%20-%20water%20quality%20emergency%20planning%20-%20an%20overview.pdf

Water Utility SOP and Contingency Plans Guidance
http://www.gov.ns.ca/enla/water/docs/WaterUtilitySOPContingency.pdf

Writing Effective SOP and other Process Documents
http://www.cfpie.com/showitem.aspx?productid=083

BMP 5-Step Protocol - Steps to Creating SOP
http://www.gov.ns.ca/enla/water/docs/MaintainDistributionSystemWaterQuality.pdf

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Appendix 2 - Typical List of "SOURCE TO TAP" SOPs

LOCATION	Standard Operating Procedure	SOP Reference #
Groundwater Well	• Pump Operation • Superchlorination of well • water depth measurements • Site security and well-head protection • Source protection	
Treatment - Iron and Manganese	• Process operation (schematic) • Operation in automatic and manual control • Filter backwash in automatic and manual control • KMNO4 solution preparation and handling	
Disinfection	• Dosage control – automatic and manual addition • Chemical feed pump operation • Chlorine solution preparation and handling	
Reservoir and Pumping	• Operation and level control • Distribution pump operation/sequence • Fire pump operation • Cleaning procedures	
Distribution System	• Hydrant operation and testing • Hydrant winterization • Flushing procedures • Water line repairs	

NOTE: The purpose of this list is to provide typical examples of SOPs suggested for HQGW and sole distribution utilities. As each system is unique, this list is meant to provide a starting point for operators.

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Appendix 3 - SOP Template and Example

Standard Operating Procedure	**Municipality**	**SOP: ##** **Revision: ##** **Issue Date: dd/mm/yy**
Name of Treatment Facility		
SOP developed By:	**SOP Approved By:**	

NAME OF SOP (Bold and Underline)

Description of SOP (only if required)

Procedure:

1.
2.
3.....

Notes:

Appendix 3 - SOP Template and Example (cont)

Standard Operating Procedure	VILLAGE OF GOODWATER	SOP: 3 Revision: 1 Issue Date: dd/mm/yy
GOODWATER WATER TREATMENT PLANT		
SOP developed By: I.M. Leaking	**SOP Approved By:** Albert A. Waters	

3.0 Distribution Pump Operation

The Code of Practice requires the distribution system to maintain a constant pressure greater than 150 kPa. The WTP is designed to run on demand, operating automatically to maintain a constant pressure between 200 & 600 kPa. The control system designates one distribution pump to run constantly and activate the second distribution pump once the SMAR pressure control device detects the distribution pressure to be below 200 kPa. Once demand decreases and the pressure increases to 600 kPa, the SMAR pressure control device will inform the PLC to turn off the 2nd distribution pump. When one pump is operating and the pressure is greater than 600 kPa, the distribution system Pressure Relief Device (PRV) will activate and re-circulate the excess water back into the reservoir.

3.1 Distribution Pump Sequencing

A typical pump sequence is as follows:

1. Lead distribution pump **On**, maintains pressure between 200 & 600 kPa.
2. Distribution pressure decreases to 200 kPa.
3. Lag distribution pump turns **On**.
4. Pressure increases to 600 kPa.
5. Lag distribution pump **Off**.
6. Lead distribution pump **On**, maintains pressure between 200 & 600 kPa.

A lead/lag distribution pump selector switch is located on the main control panel, and is designated to be alternated weekly.

3.2 Fire Pump Operation

A natural gas fired generator operating a third distribution pump is available during power outages and high consumption periods. During power outages greater than 45 seconds, the generator will start which automatically runs the fire pump until normal power is restored. The distribution system pressure relief valve (PRV) doesn't operate on power and will activate on water pressure. A power failure doesn't affect operation of the PRV therefore the excess water will re-circulate back into the reservoir when the pressure is greater than 600 kPa.

Appendix 3 - SOP Template and Example (cont)

The control system will activate the fire pump once the SMAR pressure control device detects the distribution pressure is below 200 kPa with 2 distribution pumps running.

Once demand decreases and the pressure increases to 600 kPa the SMAR pressure control device will inform the PLC to turn off the fire pump based on pressure.

A typical fire pump sequence is as follows:

1. Lead Distribution pump **On**, maintains pressure between 200 & 600kPa.
2. Pressure decreases to 200kPa.
3. Lag distribution Pump turns **On.**
4. Pressure decreases to 200kPa.
5. Fire pump turns **On.**
6. Pressure increases to 600 kPa.
7. Fire pump turns **Off**.
8. Pressure increases to 600 kPa.
9. Lag distribution pump **Off**.

Lead distribution pump **On**, maintains pressure between 200 & 600kPa.

Appendix 3 - SOP Template and Example (cont)

Standard Operating Procedure	VILLAGE OF GOODWATER	SOP: 4 Revision: 1 Issue Date: dd/mm/yy
GOODWATER WATER TREATMENT PLANT		
SOP developed By: I.M. Leaking	**SOP Approved By:** Albert A. Waters	

4.0 Manual Distribution Pump Operation

Manual operation of the WTP may be required due to SCADA malfunction, station power loss, analyzer malfunction, equipment malfunction or troubleshooting activities. Additional sampling and manpower requirements will be required to operate the WTP manually.

4.1 Distribution Pump Operation

Manual activation of the distribution pumps would normally be required during a SCADA or pressure gauge malfunction. There is currently no manual pump activation during power outages and an alternative power source (Portable Generator) would be required during a prolonged outage.

To manually activate a well pump you will need to go to the pump control panel's HOA switch and put both distribution pumps into the **Off** position. Select one distribution pump and put into the **Hand** position. While performing this function you will need to monitor the distribution discharge pressure. If the discharge pressure drops below 250 kPa the second distribution pump will need to be manually activated using the same procedure as the first distribution pump. If the discharge pressure increases to 550 kPa and the excess flow is being diverted back to the reservoir through the PRV, one distribution pump will need to be taken off line and the pressure monitored. Continual monitoring (every hour) of the distribution system pressure will need to be conducted until automatic control is available.

To return the distribution pumps to automatic control put the distribution pump that is not running into the auto mode, wait 15 seconds then put the last pump into auto mode. If both pumps are running in manual mode, put the pump designated as lead first into auto mode, wait 15 seconds then put the last pump into auto mode.

4.2 Fire Pump Operation

The fire pump is automatically designated to operate during high demand periods or power outages. Manual activation of the fire pump may be required if a SCADA malfunction occurs, if the transfer switch does not activate or during monthly operational checks. To manually activate the fire pump go to the HOA selector switch on the generator control panel and put it in the **Hand** position. To turn off the generator go to the HOA selector switch on the generator control panel and put in the **Off** position, wait 15 seconds and put into the **Auto** position.

Appendix 3 - SOP Template and Example (cont)

Standard Operating Procedure	VILLAGE OF GOODWATER	SOP: 6 Revision: 1 Issue Date: dd/mm/yy 14/02/2006
GOODWATER WATER TREATMENT PLANT		
SOP developed By: I.M. Leaking	SOP Approved By: Albert A. Waters	

6.0 Bacteriological Sampling Procedures

6.1 When to Sample

1. Weekly Coliform Requirement. Bacteriological bench sheet with historical random sampling locations can be found in Table 1.
2. After any depressurizations in the distribution system.
3. Upon receipt of request for sample or re-sample by AENV.

6.2 Where to Sample

1. All samples are to be drawn from the internal plumbing system of residence or business.
2. Ideal sampling point is from a bathtub faucet or, alternately, a kitchen tap.

6.3 Where Not to Sample

1. From an outside hose bib
2. From a hydrant
3. From a hot water source
4. From visibly unsanitary sources
5. From a non potable water source

6.4 Most Common Mistakes

1. Improper sampling point
2. Poor handling of sample bottles
3. Failure to keep lids and bottles in sanitary condition
4. Breathing on sample.
5. Failure to wash hands or wear gloves
6. Incomplete Forms – Customer name, address and phone number are particularly important if the sample fails
7. Failure to use bleach to disinfect sampling tap
8. No identification number sticker attached to the bottle
9. Sample is not received in the standard microbiological bottle.
10. Sample is received more than 24 hours after collection
11. Sample is frozen upon receipt

Appendix 3 - SOP Template and Example (cont)

6.5 Bacteriological Sampling Procedures

Remove dirty work clothing and wash hands

1. Select residence/commercial property in affected area.
2. Identify self as a municipal employee.
3. Advise customer of intent and purpose of sampling and request permission to enter premises
4. Ensure no water softening devices or water filtration devices are present.
5. Select sample point (bathroom faucet or kitchen sink). If using kitchen sink remove aeration screen from tap. Wrap electrical tape around screen prior to removal so as not to damage.
6. Wash hands.
7. Spray inside and outside of faucet or tap with 100 ppm bleach solution using care not to over spray. Special care should be paid to curtains, towels, etc. so as to not bleach.
8. Wait two minutes.
9. Run hot water for 2 minutes at moderate flow.
10. Shut off hot water.
11. Place surgical gloves on hands.
12. Run cold water at a minimum of three minutes at moderate flow.
13. Remove lid from Bacteriological bottle.
    Note: Do not place on counter, retain in hand. Do not rinse the bottle or contact the inside of bottle or lid. Do not breathe, cough, etc. on bottle or lid.
14. Slowly fill bottle to fill line and do not interrupt or change flow rate.
15. Place lid tightly on bottles using care not to touch inside of lid.
16. Label bottle with address.
17. Replace aeration device and remove electrical tape.
18. Complete Laboratory Form in full. Include customer Name, Phone Number, Address and Time.
19. Place samples in a sterile location and keep cool.
20. Log in Bacteriological Benchsheet that can be found in Table 1.
21. Arrange for transportation to provincial lab.

Appendix 3 - SOP Template and Example (cont)

Table 1
Bacteriological Bench Sheet
LOCATION WATER DISTRIBUTION SYSTEM BACTERIOLOGICAL TESTS MONTHLY REPORT - MONTH 2005

					Coliforms		Free Cl_2	Comments
Date	**Time**	**Operator**	**I.D. Number**	**Location**	**Total**	**E.coli**	**(mg/L)**	
Monitoring					----------Weekly*----------			
Operational							0.5-1.5	
Regulated				**Random**	**Not present in consecutive samples**	**Absent**	**≥ 0.1**	

*four grab samples per month at a random location in the water distribution system

Historical Sampling Locations:
123 10th Ave
555 7th Street
134 Yahoo Drive

Appendix 4 - Maintenance Schedule Example

MAINTENANCE CATEGORY	MAINTENANCE ITEM	FREQUENCY	Maintenance Instruction #
Monitoring Equipment	**HACH colorimeter**		
Cleaning the Colorimeter		With every use OR when spill occurs	1
Cleaning Sample Cells			3
Battery Replacement Instructions		When LOW BATTERY icon appears, typically every 6 months	4
Replace Spec Check Secondary Standards kit		Once a year (one year shelf life)	4
Pumping Equipment	**Diaphragm Dosing Pump 209-2,5D**		
Clean Diaphragm and Valves		At least every 12 months or after 8000 operating hours OR in the event of an error	**See ALLDOS Operations manual P. 87-88**
Opto-Sensor for Diaphragm Breakage Signal			
Cleaning Suction and Pressure Valves			**7**
Replacing the Diaphragm			

NOTE: See Appendix 5 for Maintenance Instruction Examples

Appendix 5 - Maintenance Instructions Examples

Example for Monitoring Equipment listed in Appendix 4
HACH DR 890. (as per manufactures specs)

1. **Cleaning the Colorimeter**
   Use a damp cloth to wipe the outside of the colorimeter enclosure. Wipe up spills promptly. Use cotton swabs to clean and dry the sample compartment if any spillage occurs.

2. **Cleaning the Data Transfer Adapter**
   Little cleaning is required of this adaptor. Clean the outside and inside carefully with a barely damp cloth. Wipe up spills promptly.

3. **Sample Cells**
   Clean sample cells with detergent, rinse several times with tap water and then rinse thoroughly with deionized water. Some cells may require acid washing or other special cleaning procedures. Refer to the Procedures manual for additional information. Rinse sample cells used with organic solvents (chloroform, benzene, toluene, etc.) with acetone before detergent washing and again as a final rinse before drying.

4. **Battery Replacement Instructions**
   To prevent static electricity damage to the instrument, always turn the instrument off before removing the batteries.

   When the LOW BATTERY icon appears in the display the batteries must be replaced or recharged as soon as possible to ensure proper instrument performance. Turn the instrument off before removing the battery compartment door.

   The correct date and time may need to be re-entered after battery replacement.

   Power is supplied by 4 AA-sized alkaline batteries. Typically, a set of batteries provides approximately 6 months of operation. Do not use rechargeable Nickel-Cadmium (NiCad) batteries. If rechargeable batteries are desired, available alkaline batteries are available from Hach.

Examples for Pumping Equipment listed in Appendix 4
DIAPHRAGM DOSING PUMP

7. Cleaning Suction and Pressure Valves

7.1 Switching Off the Pump

- Switch off pump and disconnect from the mains
- Depressurize the system
- Take suitable steps to ensure that the returning dosing medium is safely collected

7.2 Unscrewing the Pre-Lifting Chamber Valve

Unscrew the pre-lifting chamber valve as follows:

1. Remover cover from the pre-lifting chamber
2. Remove valve tube with the valve
3. Unscrew valve from the valve tube

See operating manual for instructions with diagram.

7.3 Unscrewing Suction and Pressure Valves/Cleaning Valves

1. Unscrew suction and pressure valves
2. Dismantle valve inner parts:
   (a) Carefully push out the inner valve using a thin wire nail or a paper clip in the direction of flow (see arrow on the valve body)
   (b) Dismantle inner part: Seat, O-ring, balls, ball cages
3. Clean all parts
   - If faulty parts are detected:
     Replace valve. For contents and order numbers of the spare parts sets, see "Spare Parts" Section of the operation manual
4. Re-assemble and remount the valve
5. Remove the deaeration cartridge under the pressure valve from the dosing head using a pair of tweezers
   - Dismantle and clean cartridge.
   - If faulty parts are detected:
   - Replace deaeration cartridge. For contents and order numbers of the spare parts sets, see "Spare Parts" Section of the operation manual.
   - Reassemble cartridge
6. Remount all parts.

Caution - The o-rings must be correctly placed in the specified groove. Observe flow direction arrows! Only tighten the valve by hand. Risk of damage!

Warning - Do not open the pump! Authorized and qualified personnel must only carry out repairs. Switch off the pump and disconnect it from the main before carrying out maintenance work and repairs!
Warning - Risk of chemical burns! Wear appropriate PPE when working with dosing head, connections and lines!
Warning - Do not allow any chemicals to leak form pump. Collect and dispose of chemicals correctly.
Note - If possible, rinse the dosing head, e.g. by supplying it with water.
Note - For detailed instructions with diagrams refer to the operation manual for *Diaphragm Dosing Pump TrueDos* D

Appendix 6 - Trouble shooting example (Pumping Equipment)

PROBLEM DESCRIPTION	POSSIBLE CAUSE	REMEDY
Diaphragm Dosing Pump 209-2,5D		
Dosing Pump does not run	Not connected to power mains	Connect the power supply
	Incorrect power voltage	Switch off pump, check voltage and motor. If the motor is faulty return pump for repair
	Electrical failure	Return the pump for repair
Dosing pump does not suck in	Leaking suction line	Replace or seal the suction line
	Clogged suction line	Rinse or replace suction line
	Buckled suction line	Install the suction line correctly. Check for damage.
	Crystalline deposits in the valves	Clean the valves
	Diaphragm broken or tappet work out	Replace the diaphragm
Dosing pump does not dose	Air in the suction line and dosing head	Fill dosing head and suction line
	Viscosity or density of medium too high	Check installation
	Sealing elements not chemically resistant	Replace sealing elements
Dosing flow of the pump is inaccurate	Dosing head not fully aerated	Repeat de-aeration
	Incorrect dosing flow display	Recalibrate
	Variation of the dosing medium	Check the concentration, use an agitator if necessary
Loud Piercing Noises	At dosing capacity < 10% of the maximum dosing capacity of the pump, resonance noises may temporarily occur at the stepper motor	The resonance noise of the stepper motor does not indicate an error

Appendix 7 -QA/QC Example: Spec Check Secondary Standards for HACH DR80

1. On a instrument that has been calibrated with a laboratory control standard, perform steps 1 through 4 of the instructions for Quality Control Use.
2. Place a standard in the instrument with the alignment mark properly aligned. Record the instrument reading. The reading should be within the tolerance limits of the value specified on the Certificate of Analysis.
3. Record the actual obtained value on the Certificate of Analysis and on the standard in the area provided.
4. Repeat Steps 2 and 3 above for all standards

Caution - Use standards only with Hach Company Instruments. Store standards in set box at room temperature in an upright position.

Instructions for Quality Control Use:

1. Set wavelength as specified in instrument specific procedure for DPD Chlorine analysis.
2. Wipe tubes with a clean tissue before use.
3. Insert the blank into the instrument, properly aligned. See instrument manual for alignment. Do not use this blank to zero instrument for chlorine determinations. Use a water blank.
4. Zero the instrument

Place each colored standard in the instrument with the alignment mark properly aligned. Record the instrument reading. The readings should correspond within the stated tolerance limits to the initial value recorded for that instrument. Hach instruments are precalibrated during manufacture. If the instrument calibration changed during normal use, refer to the instrument manual or contact your Hach dealer.

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Appendix 8 - SOP For Analyses Performed

Chlorine

Purpose:
To maintain proper disinfection of the water, a free chlorine residual is maintained in domestic water supplies. Current guidelines require a specified minimum residual in the effluent leaving the plant and a specified minimal residual at the most remote point in the distribution system. (This will depend on the requirements outlined in the approvals.) The purpose of the chlorine test is to determine if the chlorine residual in the water is sufficient to ensure good disinfection in all parts of the distribution system. Chlorine can be measured as free chlorine, or as total chlorine (total of all free and combined forms) available for disinfection.

Objective:
To measure the free or total chlorine in the water in mg/L Cl_2 using the HACH 2000/2010, which uses a difference in colour to measure the chlorine residual.

Apparatus: **HACH 2000/2010**
HACH 2000/2010 machine
2 – 25 ml sample cells

Reagents: **HACH 2000/2010**
Chlorine DPD powder pillows (1 per 25 ml sample)
Cell cleaning oil

Procedures: HACH 2000/2010

1. Using the HACH DR 2000 or HACH DR 2010 machine, find instructions for appropriate chlorine test using the Water Analysis Handbook.

2. Enter program number **80** and push **ENTER**. Rotate wavelength dial until display shows **530 nm**. Be sure to go above and below 530 nm. Push **ENTER**. Display will show **mg/L Cl_2**.

3. Fill two 25 ml cells with sample water. Mark one sample as a blank.

4. To the test sample, add 1 DPD Total Cl_2 pillow for Total Cl_2, or 1DPD Cl_2 pillow for Free Cl_2. Swirl sample for 20 seconds to mix.

5. Clean cells with a few drops of cleaning oil to ensure accurate results.

6. Press **SHIFT TIMER** to start the 3-minute reaction period for total Cl_2 test. For a free chlorine test, take reading immediately. (Care should be taken to make sure reading times are consistent.)

7. After timer beeps, place blank into cell holder. Close lid and press **ZERO**. Display will show **WAIT** and then **0.00 mg/L Cl_2**.

8. Place prepared sample into the cell holder, close lid and press **READ**. Display will show **WAIT** and then display the result in **mg/L Cl_2**.

9. **The sample for free Cl_2 will not require a reaction period and should be read immediately after mixing of sample and reagent.**

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Appendix 9 - ERP Template and Example

Emergency Response Plan	**Municipality**	**ERP: ##** **Revision: ##** **Issue Date: dd/mm/yy**
Name of Treatment Facility		
ERP developed By:	**ERP Approved By:**	

NAME OF ERP (Bold and Underline)

Description of ERP

Corrective Actions:

1.
2.
3.....

Notes:

Alberta Environment

Appendix 9 - ERP Template and Example

Emergency Response Plan	VILLAGE OF GOODWATER	ERP: #1 Revision: Issue Date: DD/MM/YY
GOODWATER WATER TREATMENT PLANT		
ERP developed By: Albert A Waters (Jr)		**ERP Approved By:** Albert A Waters (Sr)

Low Chlorine Residual Response

Description of ERP:
If the concentration of free chlorine residuals in the water **entering** the distribution system is less than <0.1 mg/L, the operator shall:

Corrective Actions:

1. Stop water production until the reason for the low chlorine is determined:
   a. Check chlorine solution tank level
   b. Check if chlorine pump is pumping
   c. Check chlorine tubing, fittings and foot valve for blockages/ air lock, etc.
   d. Check if proper chlorine solution was used: is it outdated, old, etc.
   e. Check if any raw water quality changes or treatment process problems occurred causing increased chlorine demand
   f. Check for any contaminant sources that may have entered the reservoir

2. Once the cause of low residuals is determined, start water production and increase chlorine dosage until a free chlorine residual of at least >0.1 mg/L is achieved.

3. Manual addition of 12% chlorine solution may have to be added directly to the reservoir. For example, each 1.0 Litre of 12% sodium hypochlorite added to a 250-m3 reservoir will equal a 0.5 mg/L chlorine dosage. However, the chlorine residual may not increase that much if the water contains material with a chlorine demand. (Chlorine Residual = Chlorine Dosage – Chlorine Demand)

4. Increase free chlorine residual monitoring frequency to once per hour until the concentration of free chlorine residual of at least 0.1 mg/L is achieved;

5. Undertake emergency reporting **(1-780-422-4505)** and the corrective action established in consultation with Alberta Environment as required in section 8.1.1 of the code of practice.

6. Collect a bacteriological sample and ship to the Provincial Lab for total coliform and E.Coli analysis.

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Low Chlorine Residual Response (con't)

Description of ERP:
If free chlorine residual in the water in the **water distribution system** is less than 0.1 mg/L, the approval holder shall:

Corrective Actions:

1. increase the chlorine feed rate, if required;

2. flush the line(s) until the free chlorine residuals, in the **water distribution system**, of at least 0.1 mg/L is achieved;

3. increase free chlorine residual monitoring frequency to a minimum of once (1) per hour until the concentration of free chlorine residual, in the **water distribution system**, of at least 0.1 mg/L is achieved.

4. undertake emergency reporting and the corrective action established in consultation with Alberta Environment as required in section 8.1.1 of the code.

5. If the loss of chlorine residual is evident in most of the system, than the local Public Health Authority and major water users should be advised and bacteriological samples should be collected from within the distribution system and sent to the Provincial Lab for total coliform and E.Coli analysis.

Notes:

A 7-day report is required to AENV as per section 8.1.3 and 8.1.4 of the Code.