



Record Keeping for Public Drinking Water Systems in Newfoundland and Labrador

Drinking Water Safety Workshop, Gander

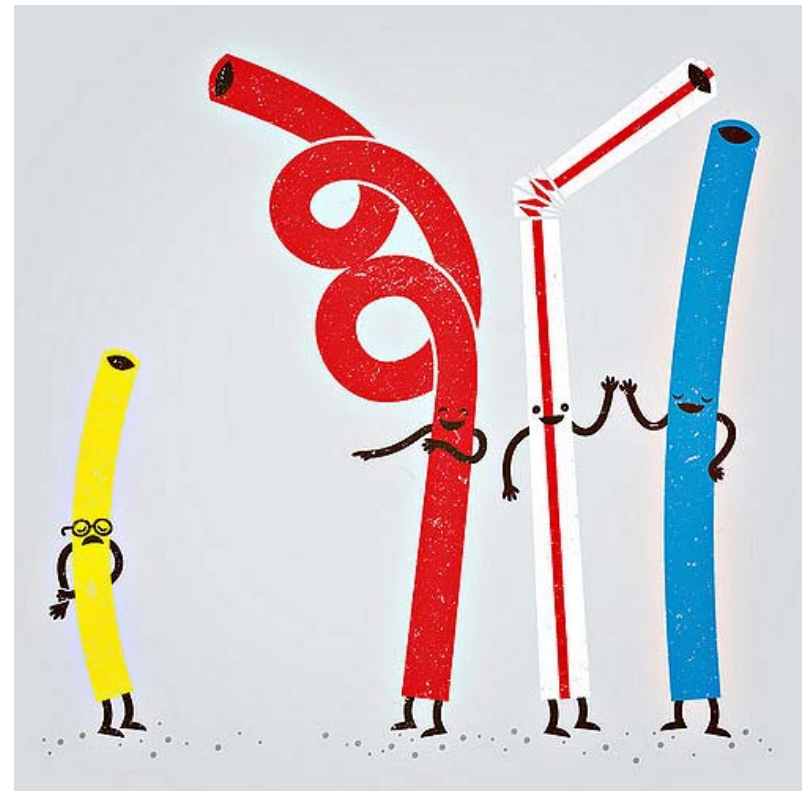
Paula Dawe, P.Eng

pauladawe@gov.nl.ca

March 27-29, 2018

What's She Talkin' About?

- Boring stuff
- Talking in Metaphors!
- Keeping records of what now?
- Oh, that's why keeping records is important!
- Storytelling...
- Evolution, Baby!
- Takeaways (not McDonalds)



Objectives of Presentation

- To get water system operators to record data and keep records accurately
- To understand why data collection and record keeping is important
- To understand how the data can be used



Let's Talk About Legislative and Regulatory Requirements

- Water Resources Act
- Permits to Operate



Water Resources Act

- Section 38
 - All waterworks in the province shall at all times be maintained, kept in repair and operated in a manner and with those facilities that the minister may direct



Permit to Operate

- Issued under Section 38 of the Water Resources Act
- Establishes minimum requirements for the O&M of drinking water systems
- Terms based on best management practices
- 323 PTOs for public drinking water systems have been issued

Newfoundland
Labrador

Government of Newfoundland and Labrador
Department of Municipal Affairs and Environment
Water Resources Management Division

PERMIT TO OPERATE

Pursuant to the *Water Resources Act*, SNL 2002 cW-4.01, specifically Section(s) 38

Date: **NOVEMBER 01, 2018** File No: **843.072-3**
Permit No: **OP-W-9996-2018**

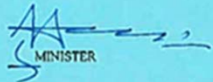
Permit Holder: **Town of Harbour Breton
PO Box 130
Harbour Breton NL A0H 1P0**

Attention: **Bernice Herritt**

Re: **Harbour Breton - Permit to Operate - Drinking Water System**

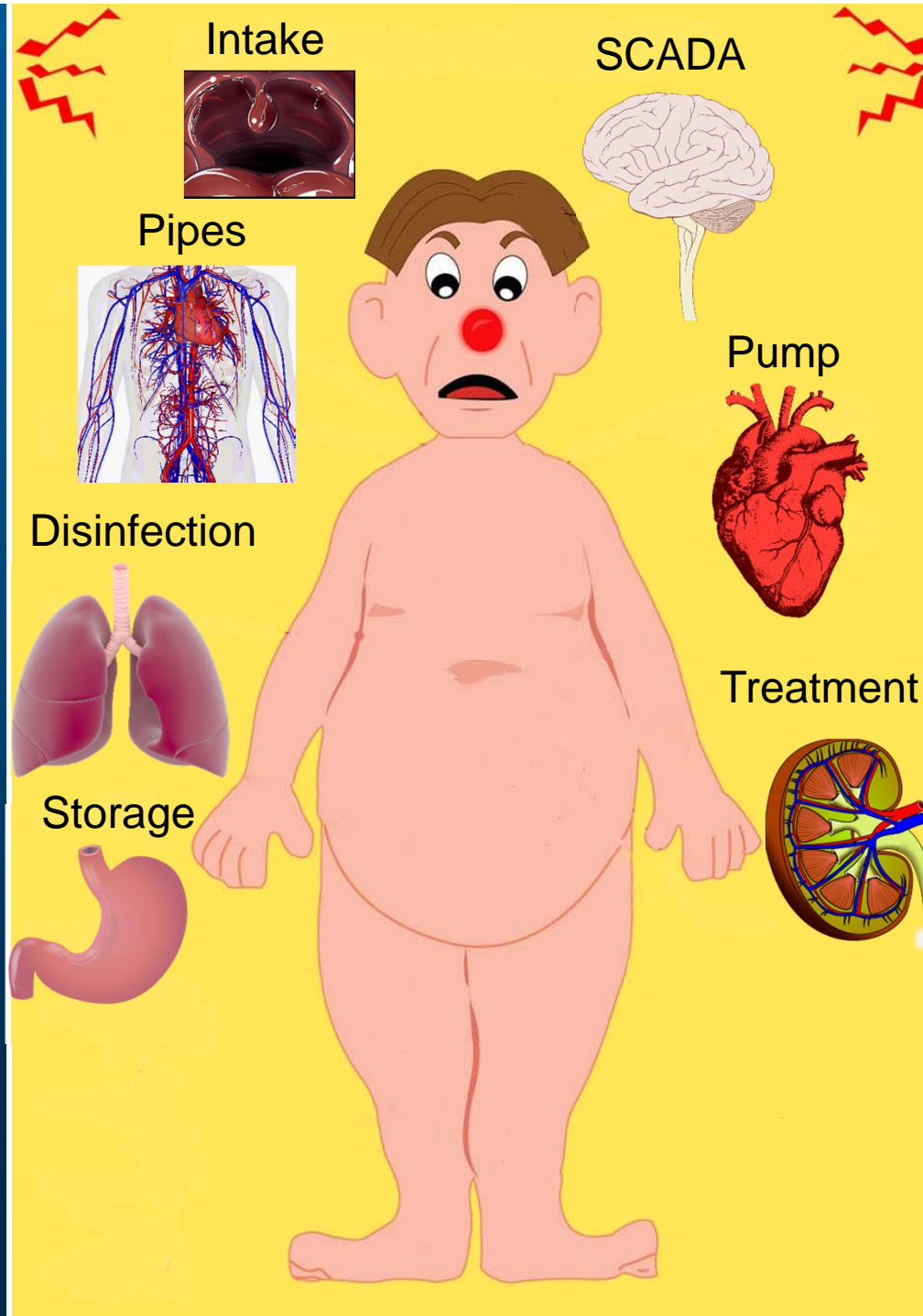
For the operation of a: **Class II Water Distribution**

- This Permit is valid until there is a change in the classification of the water treatment or water distribution system as applicable, or as may be determined by this Department.
- This Permit does not release the Permit Holder from the obligation to obtain appropriate approvals from other concerned municipal, provincial and federal agencies.
- This Permit is subject to the terms and conditions indicated in Appendices A and B (attached).


MINISTER

Record Keeping: PTO Terms & Conditions

- Operator's daily log
- Chlorine residual testing
- Flow and pressure monitoring
- Complaints
- Emergency warning device testing
- Finished water quality from WTPs
- Tank O&M
- Records provided to MAE upon request
- Maintain records for at least 5 years
- As-built drawings
- Annual summary report to MAE



Lets Talk in Metaphors!

- Water system operators are like doctors
- The patient is your drinking water system

Drinking Water System

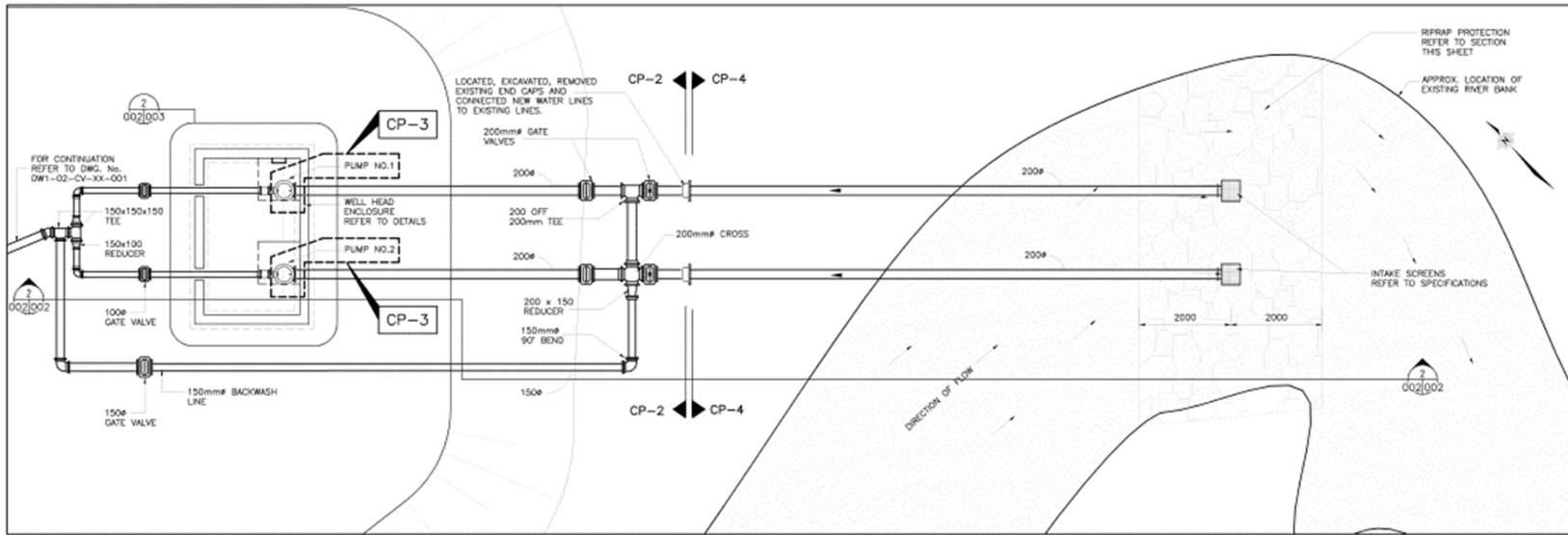


Monitoring Your Drinking Water System

- What should I be monitoring?
- What records should I be keeping?
- How can I monitor it?
- Why am I monitoring it?



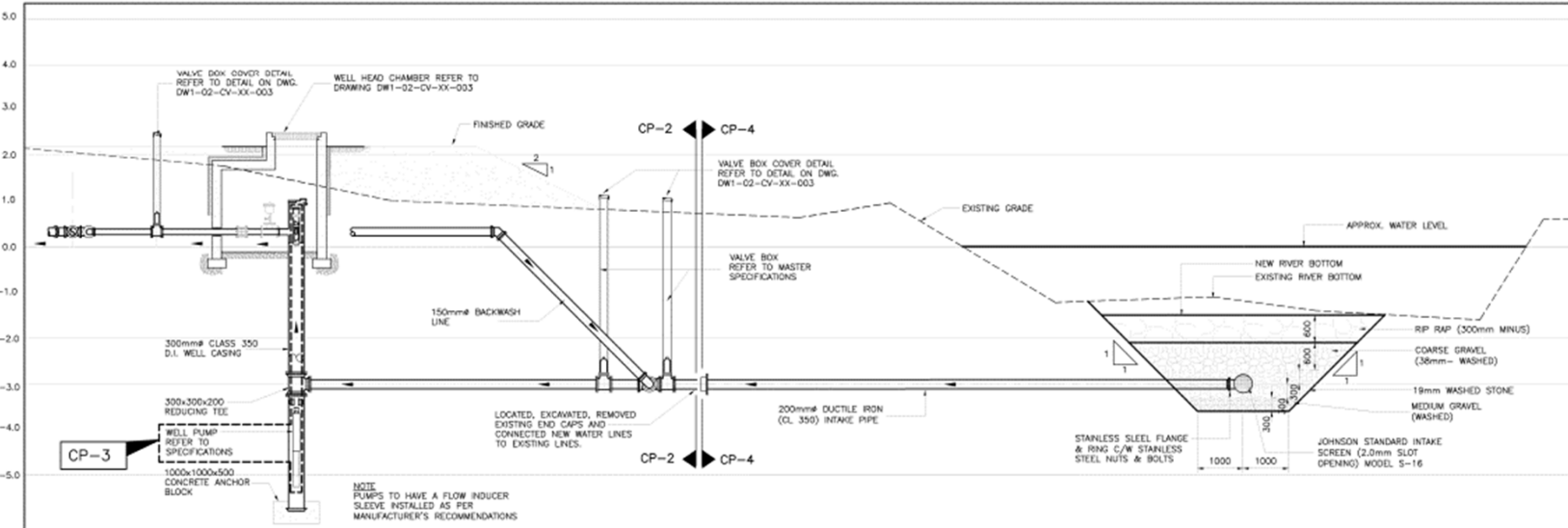
Engineering Drawings



PLAN AT INTAKE



1
001|002



SECTION



2
002|002

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND CONDITIONS ON SITE BEFORE PROCEEDING WITH ANY PORTION OF THIS WORK. REPRODUCTIONS OF THIS DRAWING MAY HAVE BEEN REDUCED OR ENLARGED. REFER TO GRAPHIC SCALE. DO NOT SCALE DRAWINGS FOR CONSTRUCTION.

LEGEND

INDICATES WORK TO BE DONE UNDER THIS CONTRACT (CP-3).

AS BUILT

2	ISSUED FOR AS-BUILT	W.C.M.	06/10/08	06/10/08
1	ISSUED FOR CONSTRUCTION	W.C.M.	06/10/08	06/10/08
0	ISSUED FOR TENDER	W.C.M.	06/10/08	06/10/08
REV.	REVISIONS	DATE	BY	DATE

ABC Engineering

PROFESSIONAL STAMP

J. Smith

06/10/08

PROVINCE OF NEWFOUNDLAND PERMIT HOLDER CLASS "A" This Permit Allows

BAE • NEWPLAN GROUP LIMITED

To practice Professional Engineering in Newfoundland and Labrador. Permit No. as issued by APPROX. 60001 which is valid for the year 2002.

CLIENT

TOWN OF LOURDES
NEWFOUNDLAND & LABRADOR

PROJECT

2002 WATER SUPPLY IMPROVEMENTS - CP3
WATER TREATMENT, PUMPING AND CONTROLS

TITLE

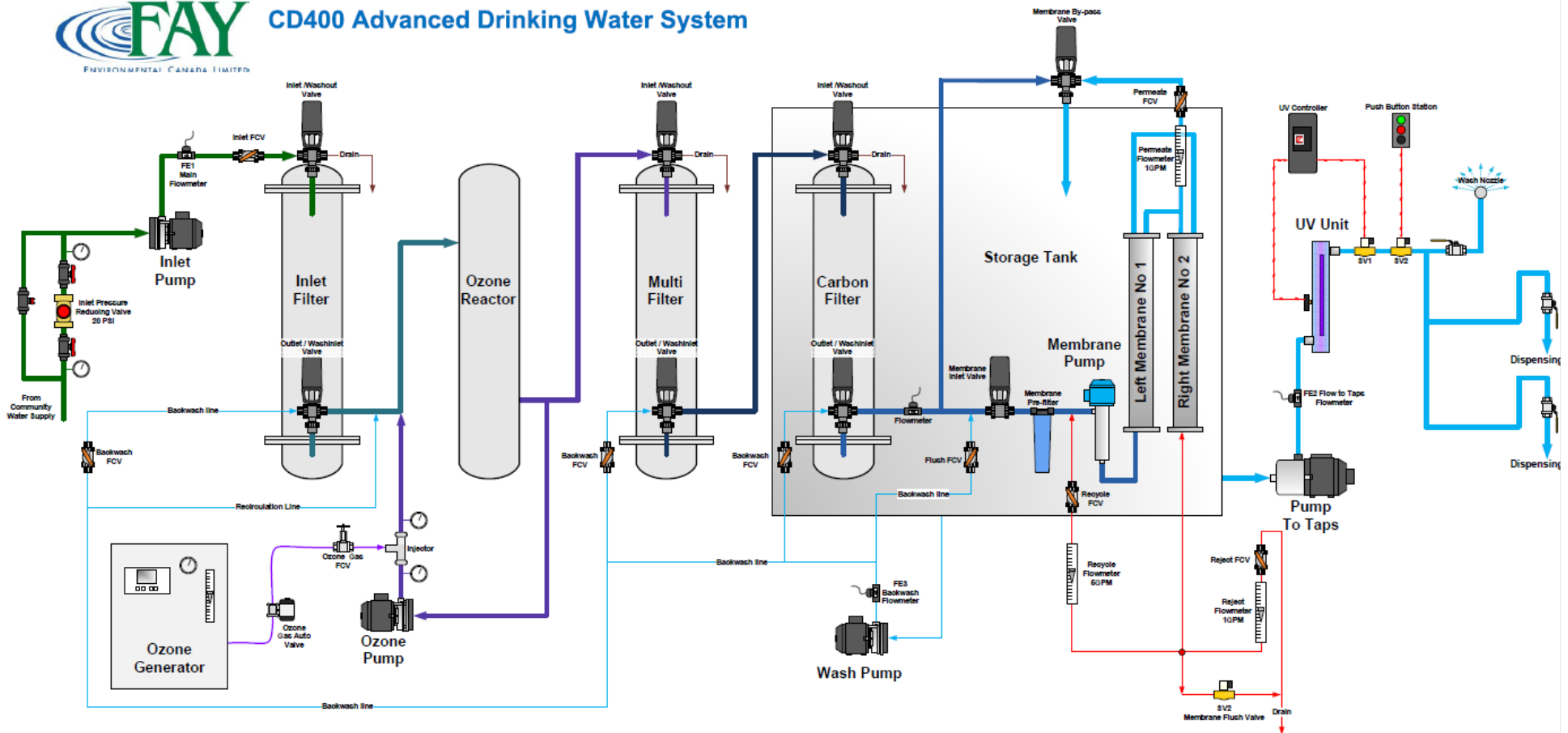
PLAN AT INTAKE AND SECTION

DESIGNED BY	D.L.	DATE	07/03/03	CHECKED BY	W.C.M.	DATE	03/06/03
DRAWN BY	C.L. & J.B.	DATE	07/03/03	APPROVED BY	W.C.M.	DATE	03/06/03
SCALE	AS NOTED	PROJECT NO.	2001128	PROJECT NO.	2001128		
DWG. NO.	72199B0W103CVXX002	PROJECT NO.	72199B	PROJECT NO.	72199B		
DRAWING NO.	DW1 - 03 - CV - XX - 002	REV.	2				

Process Flow Diagrams (PFD)



CD400 Advanced Drinking Water System



- Shows the flow of chemicals and the equipment involved in the drinking water treatment process
- Helps operator understand and troubleshoot system

Source Water Level

- Surface Water
 - Staff gauge



- Groundwater
 - Water level probe/tape



- Why monitor:
 - Is water supply sufficient to meet water demand?
 - Need for water conservation
 - Time to clean well to increase yield

Water Usage- Flow Meters

- YouTube video:
 - <https://www.youtube.com/watch?v=LFmY9dfbfVE>
- Required to monitor under Permit to Operate
- Why monitor:
 - How much water being used per person
 - Identify leaks
 - Needed for chemical dosing calculations
 - Daily water use patterns
 - Are peaks excessive?
 - Understand seasonal variation in water demand
 - Affects water age and water quality



Flow Monitoring and Recording

General Guidelines

- ❑ Identify the type of flowmeter (i.e. magnetic, turbine, ultrasonic, paddle wheel).
- ❑ Identify when the flow meter was installed.
- ❑ Identify if the flowmeter records instantaneous and total flow.
- ❑ Verify logging capability of meter; are flows recorded automatically.
- ❑ Ensure flowmeter is calibrated on an annual basis
- ❑ Ensure a by-pass is present to enable servicing and repair of meter.



Daily Tasks

- ❑ Ensure that screen displays the appropriate readings (totalizer or instantaneous flow).
- ❑ Ensure that the units are consistent (gpm, L/s, L/min etc.) with previous recordings.
- ❑ Record flows daily to aid in calculating the Average Daily Flow (see sample calculation below).
- ❑ Ensure totalizer is read and recorded at the same time each day

Sample Flow Meter Record and Calculations

Date	Time of Day	Totalizer Reading (Units)
January 1, 2019	9:00 AM	T1 - 205,050 L
January 2, 2019	9:00 AM	T2 - 218,020 L
January 3, 2019	9:00 AM	T3 - 230,500 L

Sample Calculation 1 - Daily Flow (DF1)

$$(T2) - (T1) = 218,020 \text{ L} - 205,050 \text{ L} = 12,970 \text{ L/day}$$

Sample Calculation 2 - Average Daily Flow (ADF1)

$$\frac{(T3) - (T1)}{\text{Number of days between readings}} = \frac{230,500 \text{ L} - 205,050 \text{ L}}{2 \text{ days}} = 12,725 \text{ L/day}$$

Identifying Distribution System Leaks

- ❑ Analyze average daily flow data for at least 30 days, and identify any anomalies.
- ❑ Identify if there is a consistent or significant increase in flow compared to previous months? This could indicate leaks in the distribution system.
- ❑ Observe instantaneous flow between 1:00 am and 3:00 am; a consistent demand during this time could indicate leaks in the distribution system.
- ❑ Follow leak detection procedures or hire specialized contractors to locate leaks.
- ❑ Check individual houses or properties for internal leaks or open taps.

Pressure

- Pressure gauge
- Required to monitor under Permit to Operate
- Measure at critical points in distribution system:
 - High point
 - Low point
- Why monitor:
 - Have to maintain a working pressure range of 40-80 psi
 - High pressure:
 - Cause leaks
 - More wear on valves on fittings
 - Low pressure:
 - Potential for contaminant intrusion
 - Inadequate fire flow
 - Indicate leaks
 - Pressure surges:
 - Can indicate problems with components of system-pumps, valves, tanks
 - Biofilm detachment
 - Equipment failure
 - Pipe rupture



Chemical Usage

- Common chemicals used:
 - Sodium hypochlorite
 - Volume of hypo used (L)
 - Volume of water used (L)
 - Frequency solution tank is filled
 - Chlorine gas
 - Weight of gas used- (lbs)
 - Soda ash
 - Mass of soda ash used (kg)
 - Volume of water used (L)
 - Frequency solution tank is filled
- Required to monitor under Permit to Operate
- Why monitor:
 - Operational cost
 - Optimize treatment



Chlorine Residuals

- YouTube video:
 - <https://www.youtube.com/watch?v=FdRXFFqhuIM&t=306s>
- Chlorine Colorimeter
- Required to monitor under Permit to Operate
- Why monitor:
 - Ensures protection against pathogenic regrowth in the distribution system
 - Ensures public health against waterborne disease outbreaks



Water Quality


- Parameters:
 - Water temperature
 - pH
 - Turbidity
 - Conductivity
 - Aluminium residual
 - UVA/UVT
 - TOC/DOC
- May be required to monitor under Permit to Operate if you have a Water Treatment Plant
- Why monitor:
 - Optimize treatment



The Importance of Units!

- Two systems of units:
 - Metric (SI)
 - English
- Common units used by operators:
 - Length
 - meters (m)
 - feet (ft)
 - Area
 - square meters (m²)
 - Mass
 - grams (g)
 - Liquid volume
 - Liters (L)
 - cubic meters (m³)
 - gallons (Gal)
 - Time
 - seconds (s)
 - Volumetric flow
 - m³/s
 - L/s
 - Gal/s
 - Concentration
 - g/L
 - mg/L
- Need to be able to convert units
- You must record your units



▪ 455  L/person/day



Prefix	Symbol	Factor Number	Factor Word
Kilo-	k	1000	Thousand
Hecto-	h	100	Hundred
Deca-	da or dk	10	Ten
Unit	m, l, or g	1	One
Deci-	d	.1	Tenth
Centi-	c	.01	Hundredth
Milli-	m	.001	thousandth

Maintenance & Inspection Records

Maintenance

- Record of what maintenance work has been done on drinking water system infrastructure:
 - Flushing program
 - Valve maintenance
 - Pumps and motors
 - Leak detection and repair
 - Inventory
- Prevent small issues from becoming bigger problems
- Maintenance Assurance Manual forms:
 - <https://www.mae.gov.nl.ca/for/mam.html>

Inspection

- Assessing the condition of something
- What to inspect:
 - Water supply area
 - Water system infrastructure
 - Intake
 - Screens
 - Wells
 - Dam
 - Tanks
 - Treatment systems
 - Pumps
 - Hydrants
 - Valves

Complaints

- Water user complaints can indicate issues
- Main type of drinking water system complaints
 - Low pressure
 - Taste & Odour
 - Coloured water
- Complaints should trigger some kind of action by town



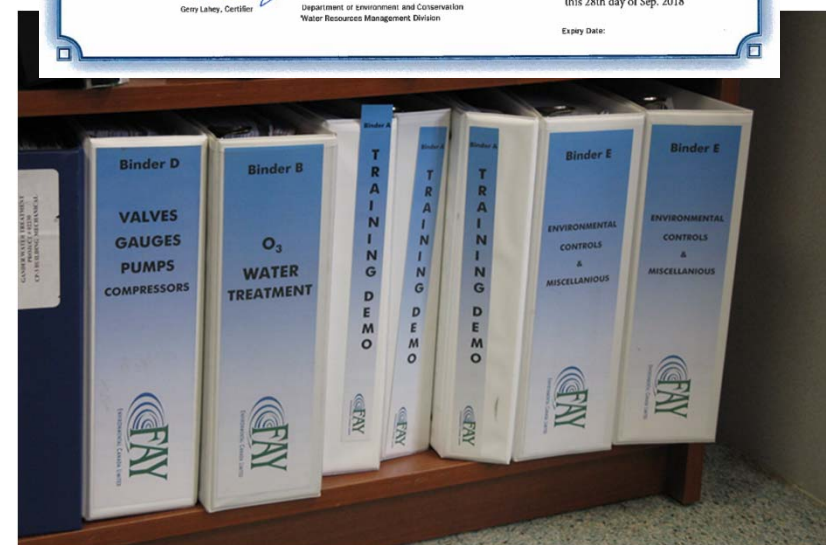
Financial Records

- Personnel costs
 - Wages and benefits
- O&M costs
 - Chemical usage
 - Electricity
 - Fuel
- Materials and supplies
 - Tools
 - Inventory of equipment
- Professional services
 - Engineering
 - Legal
 - Accounting
- Water testing
- Vehicle expenses
- Communication
 - Cell phones
 - Land lines
 - Telemetry
 - Postage
- Insurance



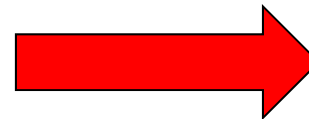
Miscellaneous Records

- Manuals
- Contacts
 - Equipment Suppliers
 - Chemical Suppliers
 - Electricians
 - Emergency contacts
- Operator training and certification records
- OHS records
- Emergency Plans



ABCs of Record Keeping

- Record keeping does not mean keeping every scrap of paper
 - The operator and manager of each system can determine which records are useful
- If information is important to the system – WRITE IT DOWN and FILE IT
- Photos are records
- Records must be accessible and maintained in an orderly manner to be useful
 - Chronological order
- Keep archived records in town hall
 - Available to all
 - Let town clerk know what is being stored where (communicate!)




False Records: BEWARE

- Permit to Operate audits
 - WRMD staff can tell if records look fishy
- MAE will send letters of warning concerning negligent operators to a community recommending:
 - Having operator comply with requirements
 - Having operator participate in OETC training
 - Getting a new operator
- Past allegations of an operator falsifying chlorine residual readings in NL
- Operator in Walkerton, ON falsified records
- ON publishes convictions under the Drinking Water Safety Act



Importance of Records

- Without maintaining adequate records, a water system cannot be operated efficiently
- Records assist with troubleshooting your system
- Records used to fulfill regulatory requirements
 - Annual Water System Report Form
- Records can serve as legal evidence
 - Document the actions taken to ensure the provision of safe, clean drinking water
- Records are used to understand your drinking water system
 - Distribution system modelling
- Data is incorporated into asset management
 - Long-term infrastructure replacement forecasting
 - Informs decisions to upgrade the drinking water system



Water Systems Report Form | 2018

BY FEBRUARY 28, 2019, COMPLETED FORM MUST BE SUBMITTED TO:

By Mail: Water Resources Management Division
Department of Municipal Affairs and Environment, 4th Floor, Confederation Bldg - West,
PO Box 8700, St. John's, NL, A1B 4J6

By Fax: 709-729-0320

By email: WaterAndSewer@gov.nl.ca

*A digital copy of this form can be found at: <https://www.mae.gov.nl.ca/waterrres/waste/index.html>

Community Name: _____ Population: _____

Drinking Water

1. What year did your community first start chlorinating its drinking water?
Year: _____

We do not chlorinate our drinking water We use an alternate disinfectant other than chlorine

2. What was the metered water usage for each drinking water system in your community during the past year?

Name of Drinking Water Source	Average Daily Water Use	Annual Maximum Day Demand*	Units (Example- m ³ /d, USGPM)

* The maximum amount of water supplied to the water distribution system on any given day within a calendar year.
Note: add information for additional drinking water sources as an addendum to the form

3. Have you experienced a water shortage during the past year? Yes No
Details: _____

4. How many complaints concerning drinking water did you receive from the public in 2018?
Number: _____
Type: Water Quality Water Pressure Other: _____

Wastewater

5. How many public wastewater system outfalls are there in your community (i.e., outfalls owned and maintained by the city, municipality or LSD that discharge sewage into the environment)?
Number: _____

6. How many wastewater lift stations are in your community? Number: _____

7. How many kilometers of sewer force main are in your community? km: _____

8. Were there any overflow events at your lift stations over the past year?
 No Yes- Frequency (i.e. Number per year): _____

Department of Municipal Affairs and Environment, Water Resources Management Division
PO Box 8700, St. John's, NL, Canada, A1B 4J6
Need assistance filling out the form? Labrador and Western call: 709-637-2034, Central and Eastern call: 709-729-2558

Data = Money

- Metrics can help justify budget requests to town council
- Spending \$100 annually on O&M can save your town \$100,000 in capital costs to replace equipment



Data = Money

- In 2017-2018, MAE received 494 application for capital works funding worth \$638.6 million
- 109 projects worth \$58.6 million were funded
 - 22% success rate

Project A- Water System Upgrades

- Need to replace the existing watermains that are either undersized or leaking

Project B- Water System Upgrades

- Breaks in 700 m section of old 1950s era 8 inch cast iron watermain are resulting in unnecessary water consumption through leaks
- Water usage is 100 Gal/min during the day and 50 Gal/min in the middle of the night
- Leaks account for 50% of water use

Data = Money

- In 2017-2018, MAE received 494 application for capital works funding worth \$638.6 million
- 109 projects worth \$58.6 million were funded
 - 22% success rate

Project A- Water System Upgrades

- Need to replace the existing watermains that are either undersized or leaking

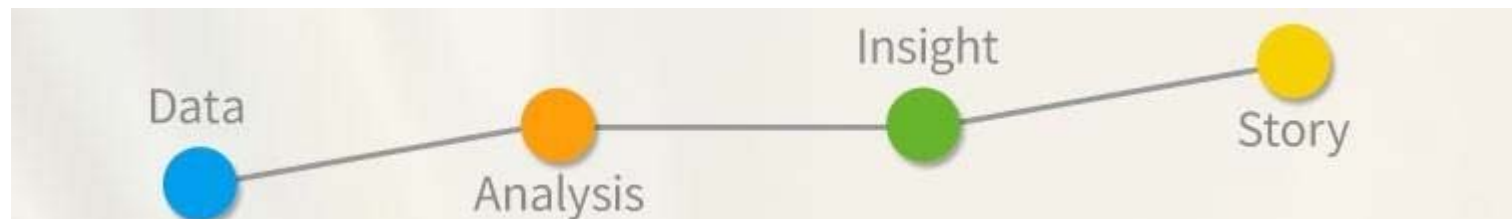
DENIED

Project B- Water System Upgrades

- Breaks in 700 m section of old 1950s era 8 inch cast iron watermain are resulting in unnecessary water consumption through leaks
- Water usage is 100 Gall/min during day and 50 Gall/min in middle of night
- Leaks account for 50% of water use

Listen to Your Data- It's Telling You a Story

- About the past
- About the present
- About the future



The Story of a Blowout

Relevant Records	Causes	Type of Issue
<ul style="list-style-type: none"> • Pipe material and age • Pressure • pH 	<ul style="list-style-type: none"> • Corrosion • Overpressure 	Pipe Blowout



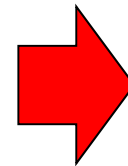
Cast iron pipe from 1960s



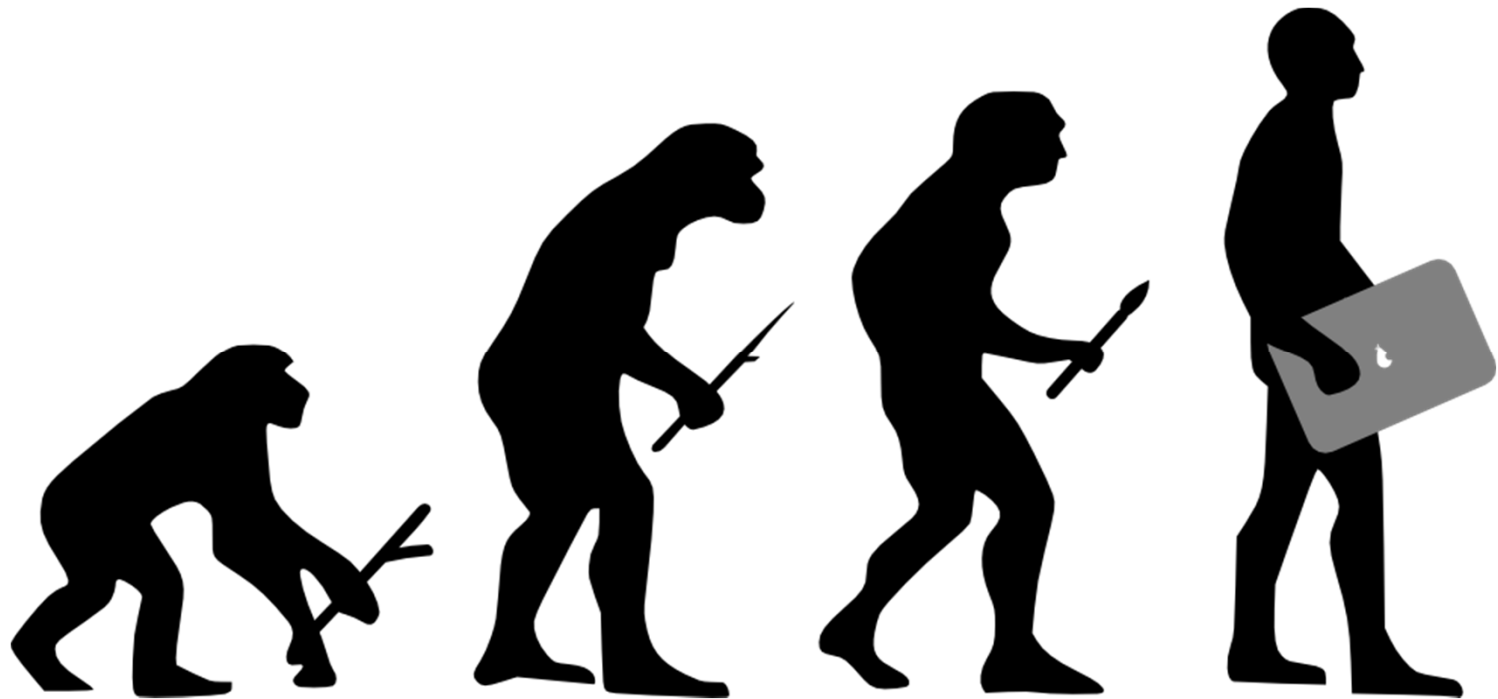
pH typically around 5.0



Pressure in lower end of system has been over 80 psi since fish plant shutdown



Lets Talk About Evolution!



Manual Record Keeping

- Paper and pen
- Record keeping templates available
 - Tailored log books coming Fall 2019- contact OETC trainer
- Keep your own operator log book
 - Permit to Operate requirement

US GALLONS

DAILY FLOWS

MONTH Aug 2012

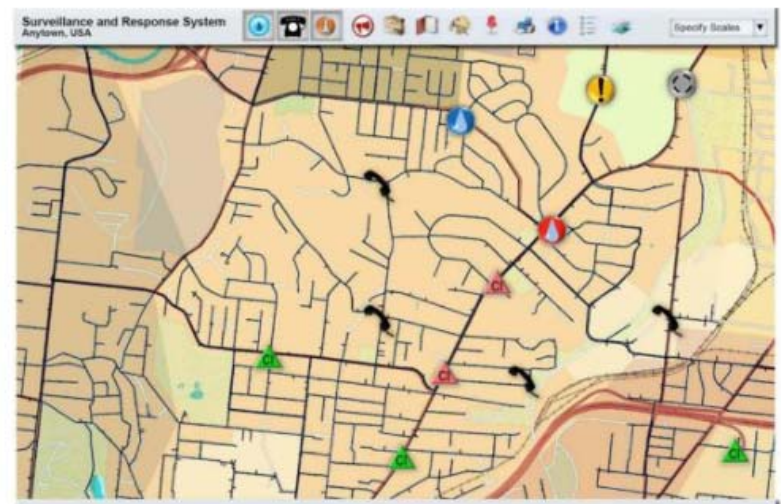
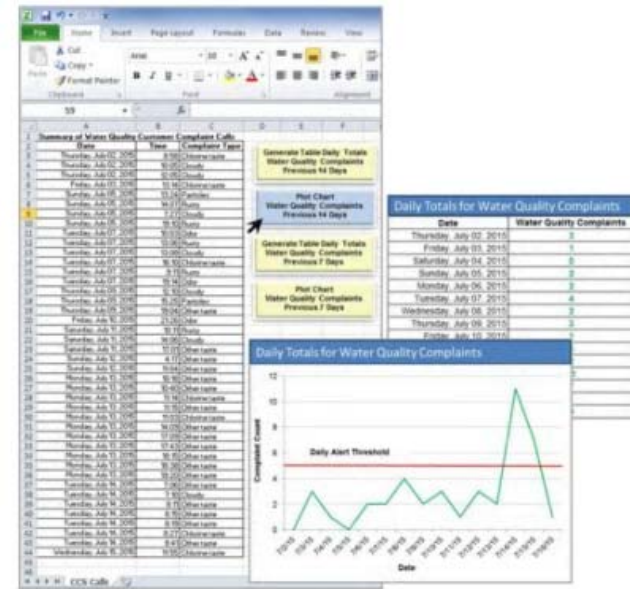
DATE	TIME	RAW WATER TOTAL	FINISHED WATER TOTAL	INTAKE LEVEL	R.W. TURBIDITY
1	0700	1292851	1117943	1.58	0.21
2	0700	1388555	1205480	1.57	0.29
3	0700	1454728	1214872	1.58	0.24
4	0700	1353239	1200371	1.60	0.33
5	0700	1347220	1178820	1.59	0.33
6	0700	1418939	1220102	1.58	0.26
7	0700	1409234	1300559	1.57	0.26
8	0700	1572270	1345068	1.57	0.26
9	0700	1511240	1321112	1.57	0.25
10	0700	1391784	1226870	1.56	0.25
11	0700	1396724	1291237	1.56	0.23
12	0700	1523932	1351376	1.57	0.22
13	0700	1678836	1452179	1.57	0.24
14	0700	1531598	1345823	1.62	0.52
15	0700	1613725	1418613	1.59	0.35
16	0700	1664070	1453189	1.59	0.28
17	0700	1545572	1360999	1.58	0.26
18	0700	1543699	1329999	1.60	0.26
19	0700	1467065	1298080	1.60	0.35
20	0700	1574900	1353173	1.59	0.33
21	0700	1541350	1350165	1.65	0.50
22	0700	1599016	1353617	1.62	0.43
23	0700	1600258	1410602	1.61	0.38
24	0700	1561607	1402307	1.60	0.35
25	0700	1448790	1252062	1.64	0.59
26	0700	1475103	1280811	1.62	0.41
27	0700	1575799	1392766	1.62	0.42
28	0700				
29	0700				
30	0700				
31	0700				
GRAND TOTALS					

Not Ideal Records, But Better Than Nothing



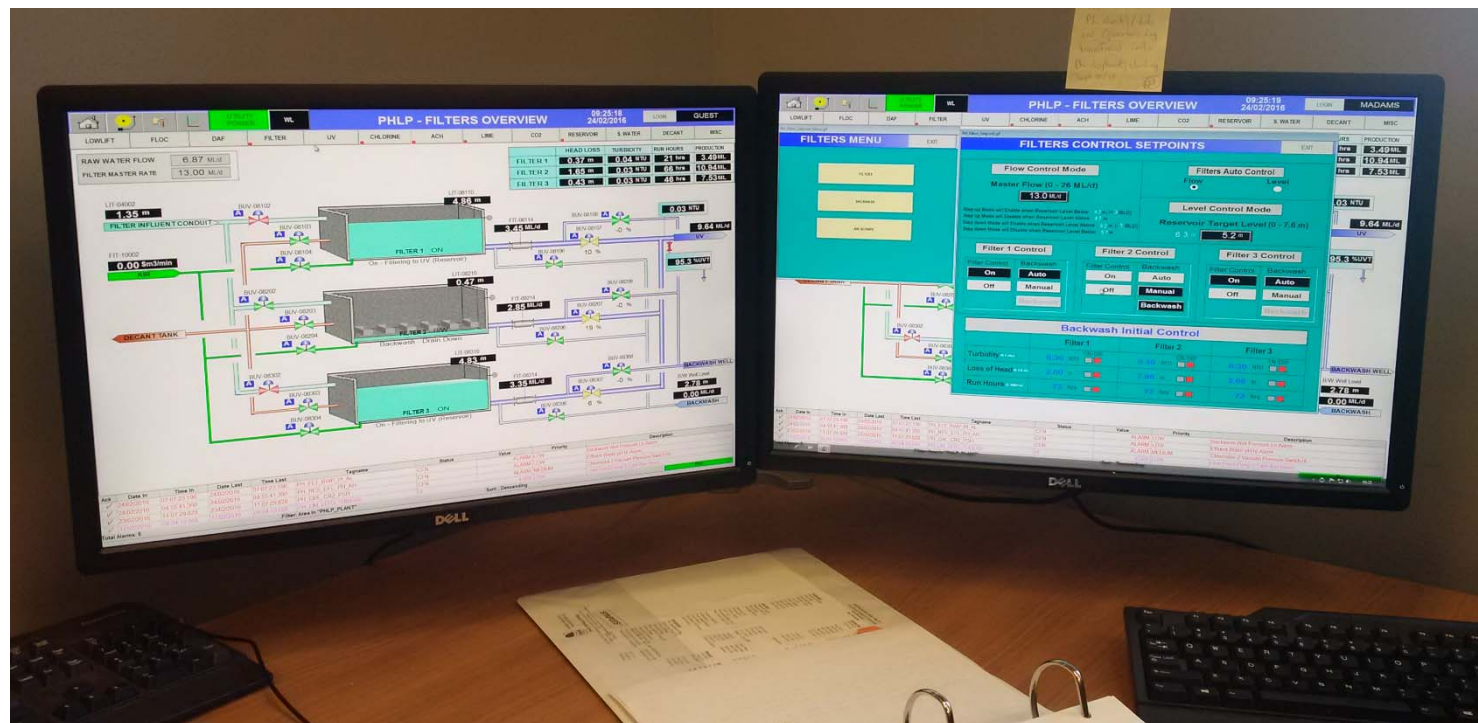
Digital Record Keeping

- Digitize manual records
- Use simple tools, program or apps
 - Excel table
 - Time series graphs
 - GIS
 - Multiple component data layers- pipes, hydrants, valves, etc.
 - Geospacial overview of the systems
 - Drill down capabilities



Supervisory Control & Data Acquisition (SCADA)

- Monitors and controls equipment and processes
- Records and stores system data
- Consists of:
 - Computer (centralized location)
 - Communication equipment
 - Sensors & other devices



Smart Water Systems

- Based on the Internet of Things (IoT)
- Integrated network of sensors and systems that allows remote and continuous monitoring to optimize all aspects of a drinking water system operation
 - Online water quality monitoring
 - Advanced metering



Takeaways

- Keep accurate records
- Record keeping is the 1st step in forming good habits in managing your drinking water system
 - Leads to improvements in all aspects of system management
 - More likely to know what is going wrong, to apply for capital works funding, and to get funding to fix the problem
 - Fewer public complaints
 - Infrastructure lasts longer
- Records improve an operator's ability to effectively manage drinking water system assets
- Data and records can help you justify funding requests
- Contact OETC staff to help tailor a log book for your specific drinking water system
 - Coming Fall 2019
- Records and data need to be managed
 - From field collection to storage

It's Over!

