

Operation and Maintenance of Potable Water Dispensing Units (PWDUs)

Small Town Perspectives
from NL

Introduction to PWDUs

What is a PWDU?

- Potable Water Dispensing Unit = PWDU
 - small scale water treatment systems
 - treat only a fraction of total water demand
 - combination of different water treatment processes
- Use some of the treatment processes found in large scale water treatment plants

Introduction to PWDUs

What is a PWDU?

- Intended to treat only drinking water portion
- Demand ~ 5 Liters/person/day
- Water stored on-site at a centralized location
- Manual collection by users
- Could be delivered to consumers in water coolers

Introduction to PWDUs

Common reasons for installing a PWDU

- Drinking water quality issues:
 - BWAs, pathogens, turbidity, THMs, HAAs, colour, pH, iron, manganese
- Other treatment systems are not economical or practical
- Advanced treatment technology on a scale affordable to small rural communities

Introduction to PWDUs

Advantages of a PWDU

- Safe source of potable drinking water
- Successfully piloted in 5 communities in NL
- Easy access
- Non-consumptive uses still met by tap water (wash cars, water lawns, fight fires, flush toilets)

Introduction to PWDUs

Common treatment components

- Multi-media filtration
- Activated carbon filtration
- Cartridge filtration
- Reverse osmosis
- Ozone disinfection
- UV disinfection
- Chlorine disinfection

Introduction of Community Presenters

- Town of St. Lawrence
 - Patrick Miller
- LSD of Black Tickle-Domino
 - Felix Keefe
- Town of Burnt Islands
 - Albert Kendall
- Town of Howley
 - Terry Stead
- Town of Buchans
 - Brian Caines
 - Rob Lane

Town of St. Lawrence

Pat Miller

Introduction to St. Lawrence

- Located on the Burin Peninsula approximately 343 km from St. John's
- Population – 1349 (Census 2006)
- Water supplied by the St. Lawrence River
- Disinfection achieved by chlorine gas
- 2 Full-Time water distribution operators
- PWDU System installed in the fall of 2006

St. Lawrence

Photo: Town of St. Lawrence



Photo Credit: Town of St. Lawrence

St. Lawrence

Reasons for Installing a PWDU

- PWDU selected after other filtration systems studied and deemed not economical or practical
- Fish plant
- Public water quality issues
 - Colour
 - Turbidity
 - Iron

St. Lawrence St. Lawrence PWDU



Photo Credits: OETC

St. Lawrence PWDU Design Specifications

- PWDU system consists of
 - Pre - Carbon Filters for Sediment, Mineral & CDBP precursors
 - Ozone Generation (Photo: Ozone Generating Cabinet & Power Supply)



Photo Credits: OETC

St. Lawrence PWDU Design Specifications

- PWDU system Cont'd
 - Post Carbon Filters for Precipitated Metals and Ozone Removal
 - Two Cartridge Filters
 - UV System



St. Lawrence Operation Processes

- Water supplied to the 1000 liter storage tank via the carbon filter
- Ozone then added
- When NO “Ozone Demand”, ozonated water is re-circulated to maintain bacteria free storage
- Post Treatment:
 - Carbon Filter, Cartridge Filtration, UV Disinfection
- Distribution of treated water after 7 point check.

St. Lawrence

Operation and Maintenance Highlights

- Daily
 - Drive-by to ensure PWDU is operational
- Weekly
 - Disinfect dispensing units
 - Clean facility
 - Inspect gauges and water quality
- Monthly
 - General inspection of Ozonator
- Quarterly
 - Clean ozone generator lamps

St. Lawrence

Operation and Maintenance Highlights

- Semi – Annually
 - Replace ozone generator filter
- Annually
 - Replace UV lamp and carbon (in the filters)
 - Remove any sediment build-up in the holding tank and rinse properly
 - Check Inlet Tubing on ozone system
 - Check ozone system electrical components, flow meters, air filters & main chassis
- Long term
 - The oxygen generating system air compressor should be replaced in 5 – 6 Years

St. Lawrence Operation and Maintenance Highlights

■ Highlights

- 2 Full-Time operators
- 4-5 hours per week maintaining system
- System automatically backwashes nightly
- Backwashing process uses 200L – 250L of water
- PWDUs under warranty for 1 year

■ Issues

- Increased water colour may trip alarm for Low UV transmittance
- Currently being rectified with upgrade in system.

St. Lawrence Financial Requirements

- Capital Cost
 - \$85,000 (Initial)
 - \$30,000 (Upgrade)
- Annual O&M Costs
 - \$5.00 per 250 Liters of water usage (\$0.02/L)
 - Daily usage = approximately 650 Liters
- Cost to Residents
 - 1-2% Yearly Increase in water tax rates for a duration of 2 Years

St. Lawrence Water Quality Comparisons

■ Colour

- Average source samples - 45 TCU
- Some samples > 100 TCU
- Average tap samples - 24 TCU
- PWDU samples - 0 TCU

■ Turbidity

- Average source samples – 0.85 NTU
- Average tap samples – 0.62 NTU
- PWDU samples – 0 NTU

St. Lawrence Water Quality Comparisons

■ Iron

- Average source samples – 0.41 mg/L
- Average tap samples – 0.22 mg/L
- PWDU samples – 0 mg/L

■ 2008 Average DBP Reduction

- THM tap samples – 46 micrograms per litre
- THM PWDU samples – 28 micrograms per litre
- HAA tap samples – 234 micrograms per litre
- HAA PWDU samples – 16 micrograms per litre

St. Lawrence Public Perception of PWDU

- Approximately 100 daily users
- Significant improvement in drinking water quality
- Positive feedback from residents

St. Lawrence

Lessons That Have Been Learned

■ Design changes

- To handle increased colour occurrences, ozone/oxygen generator is being re-sized
- To handle moisture problems an air dryer is being installed prior to the ozone/oxygen generator

■ Potential changes

- Existing building footprint can be reduced
- Install automatic fan/exhaust system
- Install outside visual alarm for ozone leak

LSD of Black Tickle/Domino

Felix Keefe

Introduction to Black Tickle-Domino

- Black Tickle-Domino is a small fishing community located on an island off the coast of Labrador
 - Southeast coast
 - 220 people
 - Surface water
 - One operator

Black Tickle-Domino

Reasons for Installing a PWDU

- Community had poor water quality and no distribution system making it easier to treat just the drinking water
 - Water quality issues
 - High Turbidity-Highest sample taken was 7.5 NTU
 - High Colour- Highest sample taken was 53 TCU
 - High Iron- Highest sample taken was 1.21 mg/L

Black Tickle-Domino

Reasons for Installing a PWDU

- Dispensing tap for general use water



Black Tickle-Domino PWDU Design Specifications

- System extracts raw pond water which is chlorinated and put through a multimedia filter



Black Tickle-Domino PWDU Design Specifications

- Chlorinated again and sent through a sand filter



Black Tickle-Domino Operation and Maintenance Highlights

- Chlorinated again before it goes through the reverse osmosis unit



Black Tickle-Domino PWDU Design Specifications



- From reverse osmosis it goes into holding tanks
- Put through Ultraviolet light before it is taken from the tap

Black Tickle-Domino Operation and Maintenance Highlights

- Regular Maintenance Activities
 - Daily-Visual check of property
 - Test chlorine residuals and pH
 - Change filters in the micron filter and activated carbon filter

Black Tickle-Domino Operation and Maintenance Highlights

- Regular Maintenance Activities
 - Annually-Replace the UV lamp bulb
 - Screens in the wet well are cleaned every four months
 - Raw water reservoir is cleaned in September and April each year

Black Tickle-Domino Operation and Maintenance Highlights

- Regular operation & maintenance information:
 - One operator involved
 - Spend four hours per day five days a week operating

Black Tickle-Domino Operation and Maintenance Highlights

- Most time is spent dispensing water



Black Tickle-Domino Financial Requirements

- The costs associated with installing and running the system are:
 - Capital Cost-\$73 000 (>\$100 000 with engineering)
 - Estimated operation and maintenance cost is upwards of \$25 000 a year due to the heating of three separate buildings

Black Tickle-Domino Financial Requirements

- Black-Tickle Domino is a very remote community and use diesel generated power
- Results in very high hydro costs

Black Tickle-Domino Water Quality Comparisons

- Average colour levels:
 - Source – 94 TCU
 - Utility tap - 29 TCU
 - PWDU - 0 TCU

Black Tickle-Domino Water Quality Comparisons

- Average turbidity levels:
 - Source - 19.3 NTU
 - Utility tap - 2.2 NTU
 - PWDU – 0 NTU

Black Tickle-Domino Water Quality Comparisons

- Average iron levels:
 - Source - 0.62 mg/L
 - Utility tap - 0.56 mg/L
 - PWDU - 0 mg/L

Black Tickle-Domino

Public Perception of PWDU

- Community generally feel the PWDU is a success
 - Approximately 60% of residents use the system
 - Residents are happy with the water quality from the PWDU
 - Members of the community pay \$0.12 per litre of water used from unit

Black Tickle-Domino Lessons That Have Been Learned

- PWDU is two kilometres away
- Easier to have PWDU in community



Black Tickle-Domino Lessons That Have Been Learned

- The community has built a separate building to house the PWDU and the utility water dispensing tap



Town of Burnt Islands

Albert Kendall

Introduction to Burnt Islands

- Burnt Islands is a small coastal community on the southwest coast of Newfoundland.
 - Population is 703
 - Surface water comes from Long Lake
 - Water is disinfected with chlorine gas prior to entering the distribution system
 - One full time and two part time operators

Burnt Islands

Reasons for Installing a PWDU

- Source water samples had the following values:
 - Colour- 63 TCU
 - Turbidity- 1.3 NTU
 - Occasionally Disinfection By-Product levels were higher than the community wanted

Burnt Islands PWDU Design

- Originally two PWDUs were installed:
 - Town Office
 - Chlorination Building

Burnt Islands PWDU Design

- Multimedia & activated carbon filters which can filter 23 litres per minute
- Reverse osmosis (RO) unit which is capable of treating 2000 litres per day

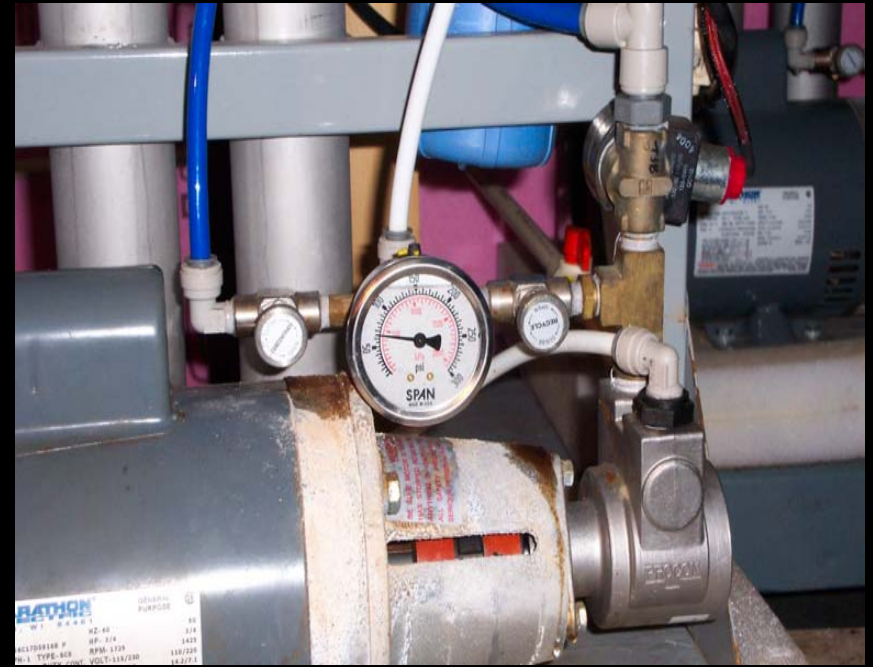
Burnt Islands PWDU Design

- Treated water is stored in two 500 litre water storage tanks
- Treated water is then run through an ultraviolet light before the tap



Burnt Islands Operation and Maintenance

- Flush the RO system every couple of days
- Turn both knobs and flush for five minutes



Burnt Islands Operation and Maintenance

- Change sediment filter on RO unit every two weeks
- Filters cost \$3.00 each



Burnt Islands Operation and Maintenance

- Multimedia and carbon filters sent to Dartmouth for regeneration last year
- Total cost \$650



Burnt Islands Operation and Maintenance

- Replaced membrane filters after three years
- Cost \$1200 for six membranes



Burnt Islands Operation and Maintenance

- UV lamps last 12 months
 - Alarm sounds
 - Cannot reuse bulbs



Burnt Islands

Operation and Maintenance

- There is only a small amount of time required to keep the system working
 - One operator could do it
 - Spend 1 to 1.5 hours a week
 - Call Atlantic Purification Systems for help to get through any problems

Burnt Islands

Operation and Maintenance

- PWDU at Town Office is open Monday to Friday from 8:00 AM till 5:00 PM
- PWDU at chlorination building was removed because of problems with users leaving the tap running

Burnt Islands Financial Requirements

- Capital cost of the system was \$26,000
- Annual cost in 2006 was just hydro costs

Burnt Islands Financial Requirements

- In 2007 system cost \$1300
 - Installation of three ground fault indicators (GFI)
 - Added UV intensity monitor and two rocker switches
- In 2008 system cost \$2500
 - Included \$650 for filter regeneration
 - Included \$1200 to replace all six membranes

Burnt Islands

Water Quality Comparisons

- Disinfection By-Product Reduction
 - HAA average from 2008 summer sampling was 84.3 micrograms per litre
 - HAA average from the PWDU was 0 micrograms per litre

Burnt Islands

Water Quality Comparisons

- Disinfection By-Product Reduction
 - THM average from 2008 summer sampling was 30 micrograms per litre
 - THM sample from the PWDU was 4.5 micrograms per litre

Burnt Islands Water Quality Comparisons

- Tap samples taken from the PWDU showed the following values:
 - Colour was reduced to zero from the average of 63 TCU
 - Turbidity was reduced to 0.20 from 1.3 NTU

Burnt Islands

Public Perception of PWDU

- The PWDU is considered to be a huge success
 - Residents of over 250 homes use it
 - Often there will be line ups on Fridays
 - A councilor approached maintenance personnel one day claiming the PWDU was not providing water fast enough

Burnt Islands

Lessons That Have Been Learned

- There have been a couple of changes we have made
 - Items left out of the original installation
 - GFI
 - UV Intensity monitor
 - Time restrictions for collecting water had to be imposed

Town of Howley

Terry Stead

Introduction to Howley

- Small community east of Deer Lake
 - Located on Grand Lake
 - Population approximately 289
 - Grand Lake is the surface water source, we use sodium hypochlorite as primary & secondary disinfectant
 - One part time operator

Howley

Reasons for Installing a PWDU

- Source water samples have averaged the following:
 - Colour- 47 TCU
 - Turbidity- 1.2 NTU
- Distribution system water samples have averaged the following:
 - THM Totals- 151 micrograms per litre

Howley PWDU Design Specifications

- Two multimedia filters
- Reverse Osmosis system
- Holding tank
- Small pressure tank
- Ultraviolet light

Howley Multimedia Filters

- Two multimedia filters back flush automatically every night



Howley Reverse Osmosis Unit



Howley Pressure tank

- Maintains pressure at dispensing tap



Howley UV lamp

- Lamp is cleaned every two weeks



Howley

Operation and Maintenance Highlights

- Regular maintenance is usually:
 - Visit building daily to check for visible problems and alarms checks
 - Clean UV lamp every two weeks
 - Once a month change the pre-filter in the RO unit
 - Replaced one UV lamp -\$142

Howley Operation and Maintenance Highlights

- Sediment Pre-Filter is changed every month
- Usually cost \$13



Howley Financial Requirements

- Cost of installing and running this system
 - Capital Cost – \$ 23 694
 - Annually- \$1250
 - Includes Hydro



Howley

Water Quality Comparisons

- Disinfection By-Product Reduction
 - THM average from 2008 summer sampling was 151 micrograms per litre
 - THM sample from the PWDU was 14 micrograms per litre

Howley Water Quality Comparisons

- Disinfection By-Product Reduction
 - HAA average from 2008 summer sampling was 158 micrograms per litre
 - HAA average from the PWDU was 0.0 micrograms per litre

Howley

Public Perception of PWDU

- Residents consider the PWDU to be a success and wish they could get that water quality from their taps

Howley

Lessons That Have Been Learned

- A few of the bumps in the road have been
 - Changing the insulated tank
 - UV lamp heats up when no water is running through it and alarms until the lamp cools back down
 - Need cross connection control at fill tap
 - Non-taxpayers have been using the water

Town of Buchans

Brian Caines

Introduction to Buchans

- Buchans is a small community situated on Buchans Lake in the interior of Central Newfoundland.

Located 72 km from the TCH at the terminus of route 370.

- Population is 750



Introduction to Buchans cont'd

- Raw river water from wet well intake is pumped to the treatment building in town where it is separated into two streams:
 1. Chlorinated water distributed to residential and commercial customers.
 2. PDWU system

Introduction to Buchans cont'd



■ Intake Wet well



Water Treatment Bldg

Buchans

Reasons for Installing a PWDU

- Water distribution system provided safe drinking water but significantly exceeded aesthetic guidelines for colour
- Consultants recommended PWDU unit as a viable alternative to improve drinking water quality

Buchans

Reasons for Installing a PWDU

- Water quality issues
 - High Colour - up to 31 TCU significantly above guideline of 15 TCU
 - Dissolved Organic Carbon – DOC levels of >5.0 mg/L indicate significant source of colour
 - Residents complained of brown ice cubes

Buchans

Reasons for Installing a PWDU

- Other Contributing Factors
 - Full scale water treatment upgrade beyond the financial capability of the community
 - PWDU water compared to spring water for clarity
 - Availability of PWDU water to discourage use of spring water

Buchans

Initial Challenges

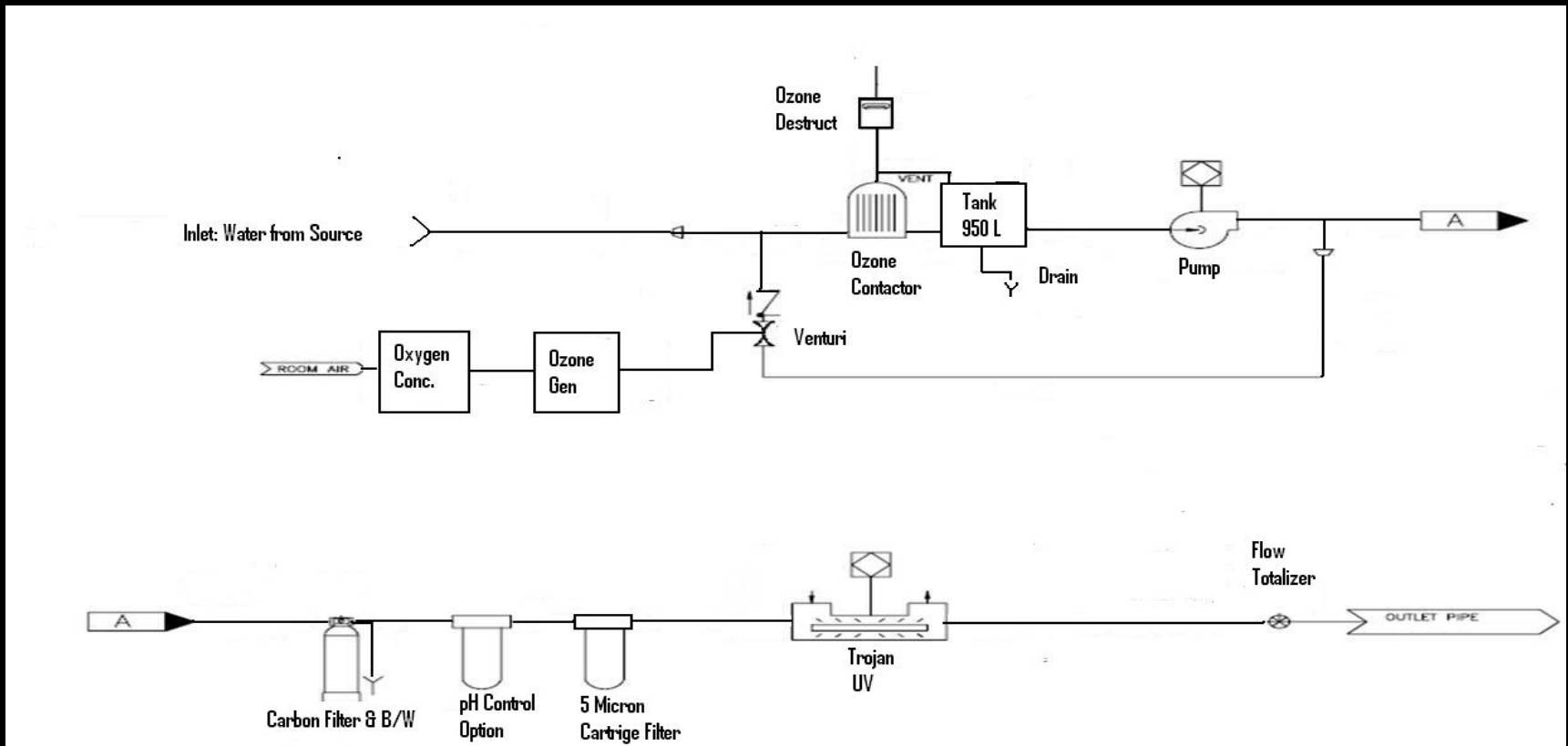
- Public perception
 - Smell of ozone occasionally causes complaints
 - Difficulty to accept UV disinfection
 - People still think water is chlorinated
 - People still think spring water is better
 - People blame normal discolouration of plastic jugs on PWDU water

Buchans PWDU Components

- Durpro system features:
- Ozone
- Storage Tank
- Charcoal Filter
- Cartridge Filter
- UV Disinfection



Buchans PWDU Operational Schematic

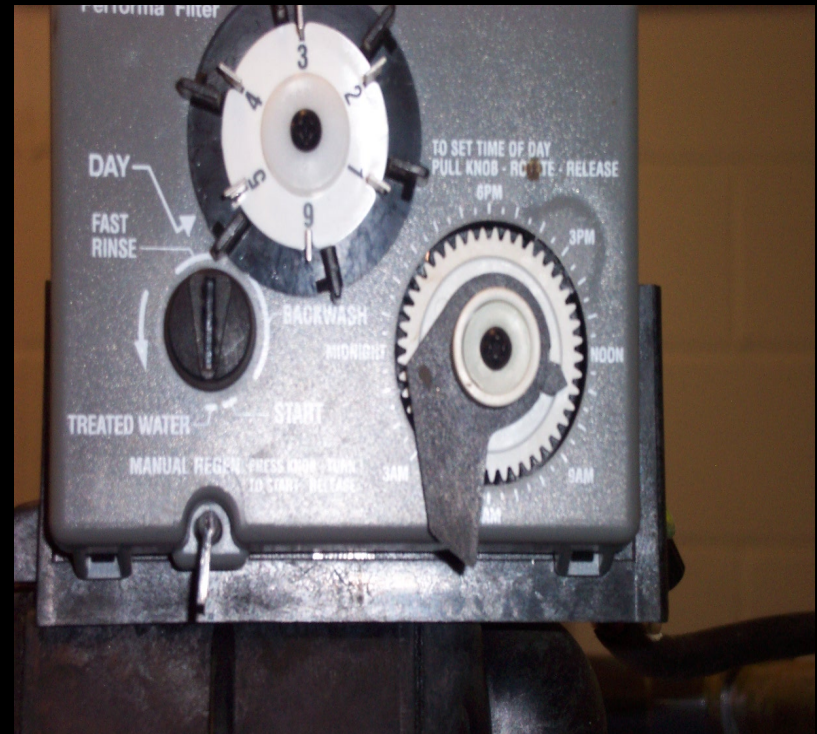


Buchans PWDU Process

- Water is first disinfected using ozone and delivered to storage tank
 - Iron, manganese and sulphur removed through oxidation and precipitation
 - Ozone provides primary disinfection
 - Removes or reduces taste and odour
 - Water re-circulated through the ozone contactor at one hour intervals

Buchans PWDU Process

- Activated carbon filtration
 - Adsorbs impurities
 - Removes colour, taste, odour and organic matter
 - Automatic backwash timer – every 6 days @ 2am



Buchans PWDU Process

- Filtration using cartridge filters
 - Removes suspended dirt and particles (1 micron)
 - Optional pH adjustment using a Corosex filter
 - Buchans just using one filter to avoid pressure problems



Buchans PWDU Process

- UV Disinfection
 - Final disinfection with UV light prior to dispensing
 - UV sensor deactivates system if UV light is dirty or failing



Buchans PWDU Process

- Flow Totalizer
 - Records daily useage
 - Provides maintenance indicators
- Ozone monitor
 - Indicates fire and explosion risk
 - Alarms if ozone is detected in the air



Buchans PWDU Process

- Nominal Capacity 3785 Liters/Day
 - Normal daily useage averages about 450-500 Liters/Day
- If alarm state occurs PWDU will shut down
 - Indicator light illuminates in the Water Service Room

Buchans PWDU Design Specifications

- The Durpro System was chosen for the following reasons
 - Can treat coloured water
 - Can produce water with low DBPs
 - Can provide effective treatment of bacteria and protozoa
 - Low capital cost (installation)
 - Operator friendly
 - Low operating cost

Buchans

Operation and Maintenance Highlights

■ Daily

- Inspections 0.5 hours/day, 7 days/week
 - Visual check of alarms
 - Check that storage tank is full
 - Check flow usage
 - Keep water service room clean

■ Weekly

- Check bleed water valve

Buchans

Operation and Maintenance Highlights

■ Monthly

- Change cartridge filters
- Clean UV light and sensor (less often winter months)



Buchans

Operation and Maintenance Highlights

■ Bi-monthly

- Clean 950L Storage tank (high pressure hose and javex)

■ Semi-annually

- Replace UV light

■ Annually

- Change out media in activated carbon filter

Buchans

Operation and Maintenance Highlights

- Other O&M activities
 - 2 operators operate and maintain water systems
 - Time spent maintaining the system
 - Varies with condition of source water
 - Buchans estimates 183 man hours per year

Buchans

Operation and Maintenance Highlights

- Challenges operators face in maintaining the system
 - Must be maintained 7 days/week
 - Cleaning water service room
 - Accessing parts for normal maintenance from a remote community

Buchans Financial Requirements

- Cost of installing and operating system
 - Capital cost - \$47,000 (with engineering >\$70,000)
 - Annual O&M Costs - \$4,650 per year
 - Operational costs for residents is absorbed in the town's annual water rates

Annual O & M Cost Breakdown

Component	Freq. of Replacement	Cost
Electricity (heating & unit operation)	N/A	Absorbed in treatment building
UV lamp	Every 6 months	\$162.00
Multi-media filters	12 times per year	\$160.00
Filter media (Activated Charcoal and stone)	Annually	\$120.00
Labour	Annually	\$4,197.50
Total Costs		\$4,639.50

Annual O & M Cost Breakdown

- One 4 year maintenance check was performed by the supplier at a cost of \$1700.00
- One service and upgrade was completed by the supplier to add a moisture bleed system between the Oxygen concentrator and the Ozone generator costing \$1400.00

Buchans

Water Quality Comparisons

Parameter	Raw	Treated	Guidelines
Colour (TCU)	31	5	15
pH	6.44	6.33	6.5-8.5
Turbidity (NTU)	0.6	0.3	1.0
DOC (mg/L)	5.6	1.1	none
Copper (mg/L)	0.347	0.002	1.0
Iron (mg/L)	0.03	0.13	0.3

Buchans

Public Perception of PWDU



- The people of Buchans consider the PWDU to be a success
 - An estimated 20-30% of the people use the PWDU
 - Usage low because the town delivers potable water to the households
 - People from the neighboring towns of Millertown and Buchans Junction also use the facility
 - Residents are very pleased with the system

Buchans Public Perception of PWDU

- Cabin owners also appreciate the water quality
- Kevin Slaney of Harbour Main fills buckets for his cabin on Red Indian Lake



Buchans

Lessons That Have Been Learned

- System design or O&M changes
 - Occasional high humidity in the ambient air created moisture problems in the oxygen concentrator
 - Ozone generator requires dry air to operate
 - A bleed valve was added between oxygen concentrator and ozone generator to remove water
 - New units now come with an air dryer system



Buchans

Lessons That Have Been Learned

■ Building changes

- An extra source tap was added to improve accessibility for residents collecting water
- Located in a remote area - centralized location would probably facilitate more usage

■ Disadvantages

- Second tap was not spring loaded so water run on is possible. System will shut down after 5 minutes

Path Forward for PWDUs in NL

Drinking Water Safety Initiative for
Small Systems

Current Status - PWDUs

- Interdepartmental Committee on Drinking Water Safety for Small Water Systems established
- Identified high priority communities for installation of PWDUs
- September 2008, communities with population less than 500 invited to submit requests for PWDUs
- 42 communities targeted for initial installation

Current Status - PWDUs

- Design, construction and operation guidelines for PWDUs developed and available on Water Resources web-site
- Drinking water quality monitoring of PWDUs began in Spring 2008
- Performance evaluation study of PWDUs initiated February 2009

Future Direction – PWDUs

- Hire staff and purchase vehicles to help implement program
- Install first PWDUs by end of 2008/09 fiscal year
 - Gaultois
- Develop permitting system for PWDUs

Future Direction – PWDUs

- Perform regulatory inspection of PWDUs
- Develop PWDU system operator education and training
- Annual reporting on the program
- Further target communities for installation of PWDUs

Thank-You