November 25th, 2022

Chief Wilbert Marshall, Chair

The regular meeting of the AFNWA Board will be held on Wednesday November 30, 2022 at 9:30AM via the Zoom virtual platform :
https://us06web.zoom.us/j/6852920354?pwd=K3ZOZnNzcFdDN05UWldMWFYxOVF4Zz09

Meeting ID: 685 292 0354
Passcode: 01650

AGENDA

In Camera Reports

1C Approval of Minutes of the In-Camera Meeting held on November 4, 2022

2C Business Arising from Minutes

(a) On-Boarding Update (CY)

3C Risk Register

Motion: That the AFNWA Board approve the recommendation as outlined in the confidential report dated November 25th, 2022

4C Insurance

Motion: That the AFNWA Board approve the recommendation as outlined in the confidential report dated November 25th, 2022

5C Budget Submission

Motion: That the AFNWA Board approve the recommendation as outlined in the confidential report dated September 23rd, 2022

Regular Reports

1. a) Ratification of In-Camera Motions
   b) Approval of the Order of Business and Approval of Additions and Deletions

2. Approval of Minutes of the Regular Meeting held on October 5th,2022

3. Business Arising from Minutes

   (a) Transition Implementation Plan (TIP) Update

4. Quarter 2 Financial Results

   Motion: That the AFNWA Board approve the Quarter 2 Financial Results in its substantive form, attached.

5. HR Policy Amendments

   Motion: That the AFNWA Board approve the HR Policy Amendments in its substantive form, attached.

6. Amendments to Financial Policy / Changes to Credit Card Holders

   Motion: That the AFNWA Board approve the amendments to the Financial Policy in its substantive form, attached.

7. Investment Policy

   Motion: That the AFNWA Board approve the Investment Policy in its substantive form, attached.

8. Water Quality Regulations

   Motion: That the AFNWA Board approve the Water Quality Regulations in its substantive form, attached.

Information Reports

1-I Transition Implementation Plan Update Nov2022

Original signed by

James MacKinnon
Board Secretary

Atlantic First Nations Water Authority
MINUTES

04 November 2022

PRESENT:

Chief Wilbert Marshall, Chair
Chief Ross Perley, Vice Chair
Chief Andrea Paul, Director
Chief Darlene Bernard, Director
Chief Terry Paul, Director
Chief Leroy Denny, Director
Regional Chief Paul Prosper, Director
Todd Hoskin, Director
Methilda Knockwood-Snache, Chair of Elders Advisory Lodge

REGRETS:

Chief Aaron Sock, Director
Shelley Denny, Director

STAFF:

Carl Yates, interim CEO
James MacKinnon, interim COO / Board Secretary
Chantal LeBlanc, Manager of Corporate Services/ CFO
Rayleen MacDonald, Administrative Assistant/ Recording Secretary

TABLE OF CONTENTS

CALL TO ORDER

Carl Yates, upon direction from the Chair, called the regular meeting to order at 8:40 AM via the Zoom virtual platform. Elder Methilda gave the opening prayer. The Board moved In Camera at 8:43 AM and the regular meeting reconvened at 9:45 AM

1.a) RATIFICATION OF IN-CAMERA MOTIONS

MOVED BY Chief Wilbert Marshall , SECONDED BY Todd Hoskin that the AFNWA Board ratify the In-Camera Motions from the 05 October meeting.

MOTION PUT AND PASSED.

1.b) APPROVAL OF THE ORDER OF BUSINESS AND APPROVAL OF ADDITIONS AND DELETIONS

MOVED BY Chief Terry Paul , SECONDED BY Chief Andrea Paul that the AFNWA Board approve the Order of Business ,in the Agenda as presented.

2. APPROVAL OF MINUTES – 05 October 2022

MOVED BY Regional Chief Paul Prosper , SECONDED BY Chief Darlene Bernard that the AFNWA Board approve the 05 October 2022 Regular Minutes.

MOTION PUT AND PASSED.

3. BUSINESS ARISING FROM MINUTES

N/A – will be discussed at next Regular Board meeting on November 30, 2022

4. NEXT MEETING DATE

The next Regular Board Meeting will be held on Wednesday November 30th 2022 @ 9:30AM via Zoom.

The meeting was adjourned at 9:47 AM

James MacKinnon
Board Secretary

Chief Wilbert Marshall
Chair

Item # 1-I
AFNWA Board
30 Nov 2022

TO: Chief Wilbert Marshall, Chair, and Members of the AFNWA Board

SUBMITTED BY: **original signed by**
James MacKinnon, MPA, interim COO

APPROVED: **original signed by**
Carl Yates, M.A.Sc., P.Eng., Interim CEO

DATE: 25 November 2022

SUBJECT: **22/23 TRANSITION IMPLEMENTATION PLAN**

INFORMATION REPORT

ORIGIN

2022-203 Transition Implementation Plan approved by the Board at the meeting held on April 13, 2022.

BACKGROUND

The 2022-2023 Transition Implementation Plan [TIP] provides a detailed overview of the AFNWA's internal developments as an organization, and external developments on projects and community outreach. The 2022-2023 TIP is a continuation of the TIP initially approved in June 2020 and will guide the final steps toward operationalization of the AFNWA.

DISCUSSION

Stage 1: Treasury Board Submission

- Stage one is considered complete

Stage 2: Agreement Ratification Process

- The Service Delivery Transfer Agreement (SDTA) was signed formally on November 8th and is now deemed complete.
- With the approval of the Community Agreement, Funding Agreement and Access Permit [Indian Act] at the September 7th, 2022 Special Board Meeting, these agreements are now deemed complete.
- The Access Permit for communities with a Custom Land Code was passed on September 29, and this agreement is now deemed complete
- The final stage of the agreement process is the passage of BCRs for communities to formally sign on to the above-mentioned agreements. As of the writing of this report, AFNWA has received 3 BCRs; Paqtnkek, Lennox Island and Neqotkuk [Tobique].

Stage 3: Capital Program Initiation

- SCADA Standards are complete. Pilots in Pictou Landing and Lennox Island First Nation are now underway.

Stage 4: Information Technology

- Service desk is now established.
- Operator hardware (Phones, Laptops and SCADA Desktop) have arrived, and staff are prepared to create user accounts and deploy.
- Step 4 is now considered complete

Stage 5: Finance/Corporate Services

- QuickBooks will be used exclusively by December 1st. Entire organizational history has been migrated to QuickBooks as well.
- Procurement processes are now formalized. Staff now becoming familiarized with new templates and processes.
- We have a procurement tab and a public notice tab on our website where contract awards are announced. Procurement portal will be completed during the 2023-2024 fiscal year.
- Vendor lists have been developed during our on-boarding process, and by using staff's professional experience.

Stage 6: Oversight and Compliance

- Work on AFNWA Drinking Water Regulatory Guidance and Compliance Standards Benchmark Regulations for Water Quality with Dalhousie University is complete. A sperate report has been written for formal approval.
- Monitoring and Sampling Plans are being developed by a dedicated AFNWA Compliance Committee. To become familiar with standard operating procedures, samples have been taken in the following communities:

- Glooscap
- Membertou
- Tobique
- Potlotek
- Paq'ntkek
- Elsipogtog
- Eskasoni

- The Lead Assessment project work is continuing. Samples have been taken in Eskasoni at multiple public locations
- Work continues with CBCL regarding the Private Well and Septic system database project.

Stage 7: Operational Initiation

- Staff are meeting with Band staff to complete the community onboarding checklist.to document contracts and agreements that may transfer to the AFNWA. The majority of the work in Stage 7 is dependent on the completion of the community onboarding checklist. That said, as of the AFNWA special board meeting on November 7, schedule 2.1(a) has been altered to recognize that formal inventories of movable assets would be developed post transfer.
- Training continues for AFNWA staff on the Incident Command System.
- Kildoon continues to work with AFNWA staff to have an Emergency Management Plan completed for December.

Report Prepared by: original signed by

James MacKinnon, MPA, interim COO, 9902-603-0312

2022-2023					
Stage 1: Treasury Board Submission					
Tasks		AFNWA Owner	Resources	Reviewer /Approver	Recommended Completion Date
1.0	Support ISC in development of Investment Analysis Report	CFO	SMT, CEO, COO	ISC	
1.1	Investment Analysis Report Approved	CFO	SMT, CEO, COO	ISC	April, 2022
2.0	Support ISC In development of TB Submission for ADM Approval	CFO	SMT, CEO, COO	ISC	May, 2022
3.0	Final Ministerial Signature	CFO	SMT	ISC	June, 2022

2022-2023					
Stage 2: Agreements Ratification Process					
Tasks		AFNWA Owner	Resources	Reviewer /Approver	Recommended Completion Date
1.0	Service Delivery Transfer Agreement				
1.1	Service Delivery Transfer Agreement Ratified by AFNWA Board of Directors	CEO	RB/COO	Board of Directors	April 13, 2022
1.2	Service Delivery Transfer Agreement sent to potential Member Communities	CEO	COO	Board of Directors	April 14, 2022
2.0	Funding Agreement Approved by Board of Directors	CEO	RB/COO	Board of Directors	April 13, 2022
2.1	Funding Agreement sent to prospective Member Communities	CEO	SMT	Chief &Council	April 14, 2022
3.0	Community Agreement (CA)	CEO	COO/RB/MC	Chief &Council	
3.1	CA Draft Approved for First Nations communities review	CEO	COO/RB/MC	Board of Directors	April 13, 2022
3.2	CA Sent to prospective Member First Nations for review	CEO	COO/RB/MC	C&C	April 14, 2022
3.3	Agreements Workshop	CEO	SMT/RB/MC	CEO	April 20, 2022
3.4	CA Review and Comment Period	CEO	SMT/RB/MC	CEO	June 30, 2022
3.5	CA Revision	RB	SMT/MC	CEO	July 22, 2022
3.6	Final CA Approved	CEO	SMT/MC/RB	Board of Directors	July 27, 2022

4.0	Land Access Permits Sent for Review	COO	RB/MC	CEO	April 20, 2022
4.1	Comments Received on Land Access Permits	COO	RB/MC	CEO	June 30, 2020
4.2	Permit Revision	COO	RB/MC	CEO	July 22, 2022
4.3	Final Permits Complete	COO	RB/MC	Board of Directors	July 27, 2022
5.0	Final BCR	CEO	COO	Chief &Council	
5.1	Membership Presentation(s) to Chief and Council	CEO	SMT	CEO	Summer/Fall, 2022
5.2	Membership BCR Approved [Effective Dates]	CEO	SMT	Chief &Council	December 1, 2022 and April 1, 2023
6.0	Implementation Committee Established	Mgr CS/Mgr Eng	SMT	CEO	December 1, 2022

2022-2023					
Stage 3: Capital Program Initiation					
Tasks		AFNWA Owner	Resources	Reviewer /Approver	Recommended Completion Date
1.0	Predesign for HQ	Mgr Eng	Project Eng, Consultant	CEO	March 31, 2023
2.0	SCADA Masterplan				
2.1	SCADA Standards Development	Mgr Eng	Eramosa Engineering, Supt. Tech. Services	CEO	Oct 1, 2022
2.2	SCADA Pilot	Mgr Eng	Eramosa Engineering Project Eng. Supt. Tech Services	CEO	March 31, 2023

2022-2023
Stage 4: Information Technology

Tasks		AFNWA Owner	Resources	Reviewer /Approver	Recommended Completion Date
1.0	Servers Established	Mgr CS	IT Coord.	CEO	
1.1	Azure Services Acquired	Mgr CS		CEO	June 30 2022
2.0	One Drive Migration	Mgr CS	IT Coord.	CEO	September 30, 2022
3.0	Service Desk Establishment	Mgr CS	IT Coord.	CEO	September 30, 2022
4.0	Operator Computer/Cell Phone Roll Out – Hardware & Software deployment	Mgr CS	IT Coord.	CEO	November 30, 2022

2022-2023					
Stage 5: Finance/ Corporate Services					
Tasks		AFNWA Owner	Resources	Reviewer /Approver	Recommended Completion Date
1.0	Utility Accounting Framework	Mgr CS	Controller/IT	CEO	June 1, 2022
1.1	Implementation of New Accounting Software	Mgr CS	Controller/IT	CEO	September , 2022
2.0	Federal Budget Announcement				
2.1	Community Capital/ O&M Cash Flow Confirmation	Mgr CS	Mgr Eng/Mgr Ops	CEO	April 30, 2022
2.2	Support for Treasury Board Submission	Mgr CS	Mgr Eng/Mgr Ops	CEO	May 30, 2022
3.0	Procurement				
3.1	Recruit Procurement Coordinator	Mgr CS	HR/COO	CEO	June 30, 2022
3.2	Formalize New Procurement Processes	Mgr CS	PC	CEO	As required
3.2	Develop Procurement Portal on Website	Mgr CS	PC	CEO	March 31, 2023
3.3	Develop Vendor Lists – Parts suppliers, heavy equipment, consultants, etc.	Mgr Eng/Mgr Ops	Procurement Coordinator, Project Engineer, Supt. Operations	CEO	July 29, 2022
3.4	Develop Standard Construction Specifications and Drawings; GIS Standards	Mgr Eng	Project Engineer, AM Tech, Mgr Ops, Supt Ops, Ops Eng	CEO	July 29, 2022
4.0	Banking Services	Mgr CS	CEO/COO	CEO	
4.1	Complete RFP	Mgr CS	CEO	CEO	April 15, 2022

4.2	Develop Investment Policy	Mgr CS	CEO/COO	CEO	May 2022
4.3	Award Banking Services RFP	Mgr CS	CEO/COO	CEO	June 1, 2022
5.0	Interprovincial Payroll Planning	Mgr CS	CEO/COO	CEO	
5.1	WCB Registration	Mgr CS	HR	CEO	August 31, 2022
5.2	Pension Registration	Mgr CS	HR	CEO	August 31, 2022

2022-2023					
Stage 6: Oversight and Compliance					
Tasks		AFNWA Owner	Resources	Reviewer /Approver	Recommended Completion Date
1.0	AFNWA Benchmark Regulations	Mgr. Ops	CWRS, Compliance Coord/Supt. of Ops/ Ops Eng/Mgr. Eng.	CEO	Dec 31, 2022
1.1	Materials Produced to Articulate Compliance Standards	Mgr. Ops	CWRS, Compliance Coord/Supt. of Ops/Ops Eng/Mgr. Eng.	CEO	Aug 2022
1.2	Develop Guidance Documents for Each System	Mgr. Ops	CWRS, Compliance Coordinator/Supt. of Ops/Ops Eng/Mgr. Eng.	CEO	Dec 2022
1.3	Development of Monitoring and Sampling Plans	Mgr. Ops	Compliance Coordinator/Supt. of Ops/Ops Eng/Mgr. Eng.	CEO	Sept 2022
1.4	Benchmark Regulations Complete	Mgr. Ops	Compliance Coordinator/Supt. of Ops/Ops Eng/Mgr. Eng.	CEO	December 1, 2022
2.0	Establishment of Interim Water Quality Oversight Agency				
3.0	Establishment of AFNWA Compliance Committee	Mgr. Ops	Mgr Eng/ Compliance	CEO	April 1, 2022

			Coordinator/Supt. of Operations/Ops Eng.		
3.1	Establishment of FNIHB Water Quality Oversight Committee	Mgr. Ops	Mgr Eng/Compliance Coordinator/Supt. of Ops/Ops Engineer	CEO	June 1, 2022
3.2	Community Sampling Plan & Schedule Established	Mgr. Ops	Mgr Eng/Compliance Coord./Supt. of Ops/Ops Eng./CWRS	CEO	July 1, 2022
3.3	WSER Reporting Plan Established	Mgr. Ops	Mgr Eng/Compliance Coord./Supt. of Ops/Ops Eng./ECCC	CEO	July 1, 2022
4.0	Lead Assessment Pilot	Mgr. Eng.	Ops Eng./Project Engineer/Compliance Coord./Mgr Ops, CWRS	CEO	
4.1	Water Quality Assessment and Random Daytime Sampling	Mgr. Eng	CWRS/CC/Ops Eng/Supt. of Ops/Mgr. of Ops	CEO	July 2022
4.2	Follow-up Profile Sampling and Colloidal Characterization	Mgr. Eng	CWRS/CC/Ops Eng/Supt.of Ops/Mgr. Ops	CEO	Oct 2022
4.3	Laboratory Testing of Corrosion Control Treatment Strategies	Mgr. Eng	CWRS/CC/Ops Eng/Supt. of Ops/Mgr. Ops	CEO	Nov 2022
4.4	Recommendations and Guidance	Mgr. Eng	CWRS/CC/Ops Eng/Supt. of Ops/Mgr. Ops	CEO	Dec 2022
4.5	Final Report	Mgr. Eng	CWRS/CC/Ops Eng./Supt. of Ops/Mgr. Ops	CEO	Jan 2023
5.0	Private Well and Septic System Assessment	Mgr Eng	Consultant/CC/Ops Eng/Supt. of Ops/Mgr. Ops/Project Engineer	CEO	

5.1	Complete RFP	Mgr Eng	Consultant/CC/Ops Eng./Supt. of Ops/Mgr. Ops/Project Engineer	CEO	April 22, 2022
5.2	Award Consultant Contract	Mgr Eng	Consultant/CC/Ops Eng/Supt. of Ops/Project Engineer	CEO	May 25, 2022
5.3	Final Report	Mgr Eng	Consultant/CC/Ops Eng/Project Engineer/Mgr. Ops	CEO	December 1, 2022
6.0	Establish Economic Oversight				
6.1	Support Framework Development	Mgr CS	CEO/COO/RB	FMB	March 31, 2023
7.0	Participation in AFN Joint Working Group on SDWFNA	COO	SMT	CEO	

2022-2023					
Stage 7: Operational Initiation					
Tasks		AFNWA Owner	Resources	Reviewer /Approver	Recommended Completion Date
1.0	License & Service Transfer				
1.1	CCTV & Alarm Monitoring	Mgr Ops	Supt. TS/ Supt. Ops	CEO	As per SCADA plan
1.2	SCADA	Mgr Ops	Supt. TS/ Supt. Ops	CEO	As per SCADA plan
1.3	Utilities [Power, Water & Wastewater]	Mgr Ops	Supt TS/ Supt. Ops	CEO	As communities onboard
1.4	Internet	Mgr Ops	Supt. TS/ Supt. Ops	CEO	As communities onboard
1.5	Radio [UHF, VHF]	Mgr. Ops	Supt. TS		As communities onboard
2.0	Hardware Purchase/ Transfer				
2.1	Hardware Survey (What belongs to water and wastewater operations and comes to the AFNWA)	Mgr Ops	Supt. Ts/ SSupt. Ops	CEO	Sept 2022
2.2	Tool Purchase	Mgr Ops	S TC/ SI Ops	CEO	ongoing

2.3	Fleet Purchase	Mgr. Ops	Mgr CS/PC/Supt. Ops	CEO/Board of Directors	November 2022 and as communities onboard
2.4	Laptop Purchase	Mgr CS	IT/Mgr Ops	CEO	October 31 2022
2.5	Safety Equipment Purchase (PPE, Trench Box, Tripod w Harness)	Mgr Ops	Supt. TS/ Supt. Ops/Safety Co-ord	CEO	Ongoing
2.6	Emergency Power Source Purchase (Generator w trailer)	Mgr Ops	Supt. TS/ Supt. Ops	CEO	Sept 2022
3.0	Contract Initiation			CEO	
3.1	Snow Removal	Mgr Ops	Mgr CS	CEO	To be negotiated as members onboard
3.2	Landscaping	Mgr Ops	Mgr Cs	CEO	To be negotiated as members onboard
3.3	Hub Office Lease	Mgr Ops	Mgr CS	CEO	Ongoing
3.4	Chemicals Supplier	Mgr Ops	Mgr CS	CEO	Ongoing
3.5	Biosolids Removal	Mgr Ops	Mgr CS	CEO	Ongoing
3.6	Insurance – CGL, Environmental, Fleet, etc.	Mgr CS	Mgr Ops	CEO	Ongoing
3.7	Water Quality Testing	Mgr Ops	Mgr CS	CEO	Ongoing
4.0	O&M Program Initiation				
4.1	Water Loss Control Program Development	Mgr Ops	Supt. TC/ Supt. Ops/Consultant	CEO	Ongoing
4.2	Inflow and Infiltration Program Development	Mgr Ops	Supt. TC/ Supt. Ops/Consultant	CEO	Ongoing
4.3	Emergency Response Plan Development	Mgr Ops	EC/ Supt. TC/ Supt. Ops/S&S Coord.	CEO	Sept 2022
4.4	Incident Command System Training	Mgr Ops	EC/ Supt. TC/ Supt. Ops	CEO	Sept 2022
5.0	Operator Training and Development				
5.1	Development of Individual Training Plans	Mgr Ops	Supt. Ops/HR	CEO	Ongoing with all willing operators
5.2	Operator Employment Offers Sent	Mgr. Ops	/Supt. Ops/HR	CEO	As Req'd

6.0	Supervisor Recruitment	Mgr Ops	Supt. Ops/HR	CEO	Dec 31, 2022

Item #4
AFNWA Board
November 30, 2022

TO: Chief Wilbert Marshall, Chair and Members of the AFNWA Board

SUBMITTED BY: **Original Signed by**
Chantal LeBlanc, Manager of Corporate Services & CFO

APPROVED: **Original Signed by**
Carl Yates, interim CEO

DATE: **November 25, 2022**

SUBJECT: **Second Quarter Results**

ORIGIN

Governance Manual approved November 6, 2020. Approval of the 2022-2023 AFNWA Budget on February 10, 2022 and updated March 30, 2022.

RECOMMENDATION

It is recommended that the AFNWA Board approve second quarter results, in its substantive form attached.

BACKGROUND

The governance manual specifies that the responsibility for review and recommendation of the quarterly financial statements is delegated to the Audit and Finance Committee, with final approval from the Board.

DISCUSSION

The above recommendation was discussed by two members of the Audit and Finance committee on November 22, 2022 , however due to lack of quorum , the recommendation is being made directly by staff.

Management has updated Q1 results to reflect a material item, that is an invoice received after the Q1 results were presented. This invoice for $75k is reflected in the updated numbers attached.

AFNWA has completed Q2 (6 months ending September 30, 2022) under budget by approximately $960k. The material differences are summarized as follows:

- Payroll, under budget by approx. $135k which is due mainly to 3 staff vacancies which were filled in August.
- Contracts under budget by approx. $175k, a reflection of ongoing legal contracts for discussions, feedback, and revisions as submitted by communities. Several other contracts have been initiated which will assist our work with developing emergency management plans, safety program and procedures, key performance indicators, as well as managing the overall transition.
- General and Administrative Expenses under budget by approximately $50,000, mainly due to underbudget items such as technology services and professional development.
- Office expenses underbudget by approximately $61,000 which is due mainly to timing given that our SCADA license has not yet been purchased (total estimated cost of $100,000).
- The most material contributor, underbudget by nearly $475,000, is our capital purchases. This is merely a timing difference in that the equipment is being ordered but had not yet arrived by the end of September. IE: technical equipment, laptops, and SCADA pilot work.

As noted in our first quarter results report, we anticipate being under budget throughout most of this 8-month transitional period. This is primarily due to the inclusion of funds required to onboard communities in anticipation of a possible delay of funds associated with the long-term funding agreement. We have confirmation that these funds can continue to be spent to assist AFNWA with transition and no carry-forward request is necessary to continue accessing these funds for the entirety of this Fiscal Year.

BUDGET AND FINANCIAL IMPLICATIONS

The budget for these expenditures reflects the first 8 months of the fiscal 2022-2023 year. When AFNWA has 8 confirmed communities, through the receipt of Band Council Resolutions, the Service Delivery Transfer Agreement and associated Funding Agreement will go into effect. The Ten-Year funding agreement and the existing Funding Agreement are not a duplication and AFNWA can continue to receive funding through both Agreements. As such, AFNWA will continue to use transition funds to assist with contracts and equipment purchases while also accessing Ten-Year agreement funds to begin work in communities that have transferred responsibility to AFNWA.

ALTERNATIVES

None to be discussed.

ATTACHMENT

Second Quarter Results, as compared to 8-month Transitional Budget, attached.

Report Prepared By	Original Signed By Chantal LeBlanc, Manager of Corporate Services & CFO, (902) 877-3813
Financial Reviewed By:	Original Signed By Carl Yates, M.A.Sc., P.Eng., interim CEO, (782) 414-6628

	UPDATED Q1	BUDGET Q1	ACTUAL Q2 YTD	BUDGET Q2 YTD	BUDGET Oct-Nov	BUDGET 8M
Payroll	520,356	550,000	1,015,097	1,150,000	814,975	1,964,975
Contracts	234,759	200,000	492,782	669,992	583,320	1,253,312
Meeting & Travel Expense	59,143	60,000	112,085	142,662	77,769	220,431
Board Compensation	29,250	30,000	49,500	86,250	63,750	150,000
General & Administrative Expenses						
Accounting & Legal	7,638	2,000	14,270	11,375	13,625	25,000
Advertising & Promotions	41,976	20,000	67,033	60,320	47,201	107,521
Amortization Expense	10,500	-	21,000	-	-	-
Bank and services charges	955	1,500	6,637	3,000	1,000	4,000
Chemicals	-	-	-	2,609	4,349	6,958
Insurance	8,870	15,000	22,633	38,102	23,503	61,605
Professional Development	10,774	15,000	30,826	60,200	60,333	120,532
Rent	46,333	46,335	92,666	92,670	30,890	123,560
Safety & PPE Supplies	5,636	3,929	8,832	7,858	2,619	10,477
Technology Services / Software	14,235	15,000	25,058	36,763	21,271	58,034
Telephone & communications	5,471	9,889	11,232	19,778	6,593	26,370
Utilities	7,881	10,000	10,955	26,925	18,208	45,132
Total General & Admin	**160,269**	**138,653**	**311,142**	**359,599**	**229,591**	**589,189**
Office Expenses						
Business Fees & Licenses	4,853	5,000	5,561	55,000	162,500	217,500
Repair & Maintenance	9,871	10,000	24,308	35,000	27,500	62,500
Office Supplies/Expense	7,835	8,875	16,535	17,750	5,917	23,667
Total Office Expenses	**22,559**	**23,875**	**46,404**	**107,750**	**195,917**	**303,667**
TOTAL EXPENSE	**1,026,336**	**1,002,528**	**2,027,010**	**2,516,252**	**1,965,322**	**4,481,574**
Fixed Asset Purchases						
Office Equipment & Furniture	729	100,000	20,394	200,000	142,420	342,420
Capital Projects	-	65,000	-	265,000	246,000	511,000
Land Lease		-		-	16,667	16,667
Fleet Payments		-	11,964	40,000	54,333	94,333
Total Fixed Asset Purchases	**729**	**165,000**	**32,358**	**505,000**	**459,420**	**964,420**
TOTAL FUNDING USED	**1,027,065**	**1,167,528**	**2,059,368**	**3,021,252**	**2,424,742**	**5,445,994**

Item # 5
AFNWA Board
November 30, 2022

TO: Chief Wilbert Marshall , Chair and Members of the AFNWA Board

SUBMITTED BY: **Original Signed by**
Chantal LeBlanc, Manager of Corporate Services & CFO

APPROVED: **Original Signed by**
Carl Yates, interim CEO

DATE: **November 25, 2022**

SUBJECT: **Amendments to HR Policy**

ORIGIN

Governance Manual approved November 6, 2020. AFNWA Human Resources Policy approved June 24, 2020.

RECOMMENDATION

It is recommended that the AFNWA Board approve the amendments to the HR Policy, in its substantive form attached.

BACKGROUND

On December 1, 2022, AFNWA will be operational for the first time. As the AFNWA team grows, and our responsibilities increase, it is necessary to adjust the HR policy to suit.

It is typical of most utilities to have a named person responsible for responding to any emergency calls. This person must remain sober and in range, ready to respond to any emergencies in a timely manner.

The Governance Manual stipulates that any changes to compensation are addressed by the Audit & Finance Committee before being sent to the Board.

DISCUSSION

The above recommendation was discussed by two members of the Audit and Finance committee on November 22, 2022 , however , due to lack of quorum the recommendation is being made directly by staff.

A number of amendments are presented to the Committee, for your consideration:

- Standby Pay. This compensation is tied directly to the inconvenience of being available 24 hours a day during a Standby rotation. Operations staff would be eligible for this compensation if they sign an agreement to remain sober and available for the duration of their rotation.
- Benefits Eligibility. It was brought to our attention that there was no provision for retired employees. AFNWA will agree to provide up to 3 months of coverage beyond the retirement date. At which time, they will be removed from the group plan.
- Non-Political Associations. Previously the policy stated that no employee shall be an elected member of a Band Council or an elected member of government. Add: “Exceptions can be made on a case-by-case basis, as determined by the CEO and Manager of Corporate Services”.

BUDGET IMPLICATIONS

Budget implications for all items listed above have been considered in the AFNWA annual operating budget.

ALTERNATIVES

None to be discussed.

ATTACHMENT

Draft HR Policy- Track Changes Word version

Report Prepared by: original signed by

Chantal LeBlanc, Manager of Corporate Services & CFO
(902) 603-0312

Financial Reviewed by: original signed by

Carl Yates, M.A.Sc., P.Eng., interim CEO, (902) 603-0312

Item # 6
AFNWA Board
November 30, 2022

TO: Chief Wilbert Marshall, Chair and Members of the AFNWA Board

SUBMITTED BY: **Original Signed by**
Chantal LeBlanc, CPA, CMA, MBA, Manager of Corporate Services & CFO

APPROVED: **Original Signed by**
Carl Yates, M.A.Sc., P.Eng., interim Chief Executive Officer

DATE: **November 25, 2022**

SUBJECT: **Amendments to Financial Policy**

ORIGIN

Approval of the Financial Policy in Board meeting held July 29, 2020, revised October 7, 2021, revised July 29, 2022.

RECOMMENDATION

It is recommended that the AFNWA Board approve the clarification on the Financial Policy, in its substantive form attached.

BACKGROUND

Amendments to the Financial Policy were approved in July 2022, including an amendment to the process for issuing credit cards to staff members.

DISCUSSION

The above recommendation was discussed by two members of the Audit and Finance Committee on November 22, 2022 , however , due to lack of quorum, the recommendation

The request included in the July 2022 report was as follows:

- Request to expand the use of authorized Credit Cards in recognition that we now have a fleet of pick-up trucks and a number of staff that are

required to make purchases for travel accommodations, office supplies, fuel or small tools, etc. Previous list of authorized cardholders was restricted to Senior Management Staff with no reference to limits. We note that while Spending Authority is within the CEO's right to delegate, that the delegation of Payment Authority is a Board matter. The use of a Credit Card is essentially exercising both Spending and Payment authority simultaneously. The protection for this comes from the Scotia Visas which protect the organization from Employee Fraud and allows AFNWA to chargeback purchases that were unauthorized. The proposed list of staff for Visas are as follows, subject to change within reason at the discretion of the CEO:

Position Title	Maximum Limit
CEO	10,000
COO	10,000
CFO	10,000
Manager, Operations	10,000
Manager, Engineering	10,000
Manager, Communications	5,000
Superintendent, Operations	5,000
Superintendent, Technical Services	5,000
Controller	5,000
Supervisor & Utility Techs	2,000
Operators	1,000
Admin. Assistants	500

After presentation to the Board, it was discovered that the policy itself was not updated to state that credit cards could be issued, and limits adjusted, within the CEO's discretion. The Financial Policy currently requires an approval from the Audit and Finance Committee for any changes to credit cards.

At this time, we are asking for your explicit approval for the CEO to use their discretion for adjusting eligible cardholders and associated limits. We note that while this essentially gives payment authority to all cardholders, AFNWA feels confident in recourse through insurance against fraudulent purchases by employees.

BUDGET AND FINANCIAL IMPLICATIONS

None to be discussed.

ALTERNATIVES

CEO could continue seeking approval from Audit & Finance Committee members for the issuance of credit cards and adjustment of limits. This is not recommended given that we will have in excess of 30 cards issued to employees in the near future and the ongoing approval of cards would be cumbersome with very little added benefit through risk mitigation.

ATTACHMENT

Draft Financial Policy, revised July 2022, revised November 2022.
Approved Financial Policy July 2020

Report Prepared by: original signed by
Chantal LeBlanc, Manager of Corporate Services & CFO
(902) 877-3813

Financial Reviewed by: original signed by
Carl Yates, M.A.Sc., P.Eng., interim CEO, (782) 414-6628

Financial Policy and Procedures Manual

DRAFT for AFNWA Board Approval
July 29, 2022

Contents

MISSION STATEMENT

To provide safe, clean water and wastewater
in all participating First Nations communities in Atlantic Canada,
delivered by a regional water authority owned and operated by First Nations.

AMENDMENTS

These guidelines may be amended from time to time as required by the AFNWA management and the Audit & Finance Committee to evaluate the need for additional changes as issues arise or circumstances suggest better practices. Any proposed changes must be presented to the Audit & Finance Committee for approval. The policy is then sent to the AFNWA Board for final approval.

1.0 Financial Management Policy

1.1 Objectives

(a) The Atlantic First Nations Water Authority (AFNWA) was incorporated on July 18, 2018 as a non-profit organization under the Canada Not-for-profit Corporations Act.

(b) The AFNWA shall pursue its objectives, as described in the Corporate By-laws and within the AFNWA funding agreements.

(c) All Financial Records and financial and management control shall be established and maintained in such a manner as to provide reasonable assurance that:

- Assets are safeguarded, accounted for and controlled;
- The transactions of the AFNWA are in accordance with the Bylaws and Governance Manual; and,
- The financial, human and physical resources of the AFNWA are managed economically and efficiently, and the operations of the AFNWA are carried out effectively.

(d) The AFNWA financial policy provides the framework within which the AFNWAs financial guidelines and procedures are established. The policies set out the parameters within which business transactions in the AFNWA are made.

1.2 Roles and Responsibilities

(a) The AFNWA Board, in its responsibility for the delivery of the utility's mandate, is accountable for all of the AFNWA financial obligations.

(b) The Audit and Finance Committee shall be accountable to the AFNWA on all financial matters to ensure that activities carried out are consistent with the financial and accounting policies, authorities and guidelines as established by the AFNWA Board. (see Annex A)

(c) The Treasurer of the AFNWA shall carry out the duties as outlined in the AFNWA Bylaws and Terms of Reference. The Chief Executive Officer shall be responsible for the day-to- day implementation of the AFNWA Finance Policy and shall be an Ex-Officio member of the Audit and Finance Committee.

(d) The Manager of Corporate Services shall be an Ex-Officio member of the Audit and Finance Committee. The Manager of Corporate Services shall be responsible and accountable to the CEO for ensuring that activities carried out are consistent with the financial and accounting policies, authorities, guidelines, practices and procedures as established by the Audit and Finance Committee.

(e) Annual budgets submitted to the AFNWA Board shall be reviewed by the Manager of Corporate Services and the CEO and approved by the Audit and Finance Committee before submission.

1.3 Legal and Financial Framework

(a) The Legal and Financial Framework shall comprise the financial structure of AFNWA, its legal authorities as provided by law, and financial authorities.

(b) The financial activities of the AFNWA shall be grouped into operations and capital accounts based on generally accepted accounting principles and utility best practices, and in accordance with Canadian Not for Profit Accounting Standards.

(c) Legal Authorities shall primarily comprise the Canada Not-for-Profit Corporations Act, articles of incorporation and Bylaws.

(d) The financial authorities shall comprise the Canada Not-for-Profit Corporations Act and the approved AFNWA annual budget and business plans.

1.4 Managerial Authorities

(a) The Financial Policy and Procedures Manual provides the framework within which the AFNWA financial guidelines and processes are established. The policy sets out the parameters within which business transactions in the AFNWA are made.

(b) Cheque signing, banking and document resolutions shall represent those authorities delegated by the AFNWA Board to Officers and Employees of the AFNWA to carry out and execute business transactions.

(c) The Financial Procedures that follow shall set out the various guidelines and processes in the area of financial management and administration and shall be consistent with financial policy and directives.

1.5 Financial Year

The AFNWA fiscal year-end shall be the 12 months ending March 31st.

1.6 Business Plans and Budgets

(a) The AFNWA shall prepare business plans and budgets in accordance with the framework established.

(b) The AFNWA shall prepare annually the following documents on a corporate-wide basis:

- AFNWA Business Plan,
- Operating Budget; and,
- Capital Budget

(c) All business plans and budgets shall display activities in accordance with the AFNWA Legal and Financial Framework.

(d) The AFNWA shall establish and maintain a process to ensure that business plans and budgets are:

- Prepared in accordance with the AFNWA planning and resource allocation process;

- Consistent with the AFNWA Governance Manual and Bylaws;
- Consistent with the AFNWA classification of accounts;
- Consistent with financial policy and procedures manual;
- Prepared on the basis of approved performance standards;
- Based on plausible assumptions;
- Internally consistent;
- Prepared in accordance with generally accepted accounting principles; and,
- Clearly assigned for preparation and approval.

1.7 Budget Administration

(a) No commitment shall be made until annual budgets are approved by the AFNWA Board.

(b) The Manager of Corporate Services shall maintain records to ensure that approved budget limits are not exceeded without a documented explanation and approval.

(c) The Manager of each Department shall review actual expenditures against budget and shall analyze variances per process as outlined in Sections 6 and 7 below, and the CEO shall take appropriate remedial action, where required.

1.8 Classification of Transactions

The Manager of Corporate Services shall identify transactions to facilitate the display of aggregate financial data:

- On the basis of the AFNWA financial department codes or cost centers; and,
- According to the AFNWA accounting structure funding/account classification.

1.9 Banking and Cash Management

(a) The AFNWA Board, based on a recommendation from the Audit and Finance Committee, shall determine the specific provisions respecting the AFNWA banking arrangements.

(b) The Audit and Finance Committee shall assess the cost and quality of its banking services relative to other banks, periodically at the Committee's discretion.

(c) The CEO and the Manager of Corporate Services shall manage its cash economically and efficiently and shall seek to maximize the return on its temporary surplus funds, while also using best efforts to minimize transactional fees.

1.10 Signing Authorities

(a) The financial authorities assigned to the AFNWA Officers are approved by the AFNWA Board.

(b) The Manager of Corporate Services shall maintain a list of Signing Authorities on behalf of the CEO, as approved by the Audit and Finance Committee, on behalf of the AFNWA Board.

(c) Signing authorities shall be exercised only:

- Within the area of delegated authority;
- In accordance with the AFNWA financial policies and guidelines; and,
- To the extent that budget funds are available.

(d) Financial obligations on behalf of the AFNWA shall not be entered into unless there is authority to do so.

(e) Proposed commitments shall not be purposely parceled or divided in order that the authorized level of consideration is not exceeded.

(f) Financial Signing Authorities shall be delegated in such a way as to ensure an appropriate division of responsibility in the disbursement process.

1.11 Execution of Instrument

(a) The AFNWA Board may establish alternative signing authorities, if necessary, for corporate documents provided it is authorized by resolution as stipulated in the Governance Manual or Bylaws.

(b) The seal of AFNWA, where required to be applied to any instrument in writing, shall be affixed by or on behalf of AFNWA, as contained in the Bylaws.

1.12 Financial Management Control Systems

The financial information systems of AFNWA shall support financial reporting requirements and will include controls to ensure that the information is complete, accurate, and properly authorized.

1.13 General Accounting Policies

For the purposes of its annual audited financial statements (year end March 31st), AFNWA shall establish accounting policies consistent with Generally Accepted Accounting Principles (GAAP) for control of revenues and expenses.

The AFNWA shall follow GAAP or, in certain cases, accounting policies appropriate to the AFNWA activities and in accordance with the Canadian Not for Profit Accounting Standards.

The external auditors shall be confirmed by the Audit and Finance Committee, on the behalf of the AFNWA Board, annually at the time of approval of the audited financial statements. The Audit and Finance Committee will also provide an adequate venue for addressing auditing issues as reported through the annual audit exercise.

1.14 Accounting and Control of Expenditures

AFNWA shall establish and maintain adequate controls to ensure that expenditures are made in settlement of authorized commitments.

AFNWA shall establish and maintain a system of recording expenditures in a timely and accurate fashion.

In accounting for expenditures, AFNWA shall ensure that rules are established to ensure full disclosure.

1.15 Accounting and Control of Revenues and Accounts Receivables

AFNWA shall establish and maintain adequate controls to ensure that the revenue due to the AFNWA is recorded and collected on a timely basis.

AFNWA shall establish and maintain controls to ensure that no amounts receivable are removed from the records without the appropriate authority.

A reconciliation which compares Funding Agreements, Grants and all other funding sources to revenue received or receivable is to be provided as part of the quarterly reports.

1.16 Asset Administration and Insurance Policies

The CEO or delegate shall be responsible to maintain an updated list of 'portable' assets such as laptops, cell phones and ensure that these assets are returned, in good working condition, prior to an employee leaving AFNWA**.**

The CEO shall ensure AFNWA purchases adequate insurance coverage/policies for all its officers and assets and such policies are to be reviewed annually, prior to renewal.

1.16.1 Capitalization

AFNWA shall treat as capital assets any assets for which the AFNWA has title with an expected useful life beyond one (1) year; together with any expenditure relating to the alteration, modernization of such asset which appreciably prolongs that item's period of usefulness, increases its value, or improves its utility to the AFNWA. A capital asset, to be classified as such, must meet the following criteria:

- A useful life in excess of one (1) year, AND
- A per item cost in excess of $5,000.

1.16.2 Leases

The classification and accounting for leases shall reflect the economic substance of the lease transaction, in accordance with General Accepted Accounting Principles (GAAP):

- A lease that transfers substantially all of the benefits and risks of ownership of the leased property to AFNWA shall be accounted for as a capital lease; and,
- A lease where the benefits and risks of ownership of the leased property are substantially retained by the Leaser shall be accounted for as an operating lease.

1.16.3 Amortization of Capital Assets

AFNWA shall provide for amortization as follows:

- All assets shall be depreciated in accordance with Canadian Not for Profit standards.
- All assets directly associated with water and wastewater infrastructure to be depreciated in accordance with the Asset Management Framework, as amended from

time to time.

1.16.4 Write-offs

Where assets become obsolete or worthless, or are lost to AFNWA, they shall be written-off in accordance with approved processes and authorities.

1.16.5 Disposal

AFNWA shall dispose of assets, in accordance with AFNWA Procurement Policy, as amended from time to time.

1.16.6 Accountability

The security and safekeeping of AFNWA assets, utilized in carrying out the business operations of AFNWA, is the responsibility of the Employee so charged, for those particular assets. Each Employee is fully accountable to secure against risk or damage specifically to those assets under their control, and more broadly to all organizational assets.

1.17 Internal Management Reports

(a) The Manager of Corporate Services shall maintain internal management reporting systems that provide Management with the financial reports that are relevant, simple, timely, accurate, current and consistent.

(b) AFNWA internal reports shall provide AFNWA Management with a full range of information to provide a basis for decision making in respect to promote business-like operations and productivity.

(c) Internal financial reports will show expenses compared to budgets in order to provide management with information which will assist in the assessment of performance standards and the attainment of goals.

1.18 External Financial Reporting

(a) External financial reporting is prepared by AFNWA in a format that shall portray its financial activities in a clear and comprehensive manner consistent with funding agreement requirements.

(b) The principal external reports are the annual financial statements and summaries.

(c) In its annual report, AFNWA shall acknowledge its responsibility for establishing and maintaining a system of records, internal controls and management practices to provide assurance that reliable financial information is produced and that assets are safeguarded and controlled.

(d) The Audit and Finance Committee shall recommend to the AFNWA Board the appointment of the external auditor in conjunction with the approval of the annual financial statements.

(e) The Audit and Finance Committee shall oversee the Audit process:

- Communicate and meet with the external auditor;
- Assess the AFNWA accounting policies and ensure that the policies are consistent in letter and spirit;
- Review the financial statements and submit a report that will assist the AFNWA in the approval of the financial statements; and
- The Manager of Corporate Services will present the financial statements at the Annual General Meeting.

1.19 External Performance Reporting

AFNWA shall incorporate key financial indicators of performance and report these in its Annual Report.

2.0 Instrument of Financial Signing Authorities Policies

2.1 Objectives

(a) To prescribe policies and guidelines governing the exercise of Financial Signing Authority by the AFNWA Board and Employees.

(b) To set out the authorities and processes underlying the delegation, approval, recommendation and control of activities involved in the exercising of Financial Signing Authorities.

2.2 Policies

(a) The AFNWA Board shall formally identify all positions to which delegations of authority are made and the limitations imposed on the exercise of these for all financial activities of AFNWA.

(b) There shall be three levels of Financial Signing Authority: approval, authorization, and recommendation authority.

(c) The Audit and Finance Committee shall recommend the authorities to the AFNWA Board.

(d) The Manager of Corporate Services shall maintain the delegation of authority, on behalf of the CEO.

(e) Authorities approved by the AFNWA Board shall not be re-delegated. If re-delegation is required, new signing authorities shall be put in place.

(f) Designated AFNWA employees shall discharge all assigned functions in accordance with the financial authorities formally assigned to them as reflected in the documents for signing authority.

(g) The authorities delegated by the AFNWA shall only be exercised in accordance with the following principles:

- Within the area of responsibility of the delegated position;
- Within the AFNWA financial policies and guidelines; and,
- To the extent that budget funds are available.

(h) Financial obligations on behalf of AFNWA that extend beyond a 12-month period or that represent a material future commitment (IE: greater than $50,000 in most cases) shall not be entered into unless the authority to do so is expressly approved by the CEO.

(i) Proposed commitments shall not be purposely parceled or divided in order that the authorized level of consideration is not exceeded.

2.3 Amendments and Signing Authority

(a) Amendments to Signing Authorities shall be made by a motion of the Audit and Finance Committee.

(b) The Signing Authority Card is required to validate Financial Signing Authorities to incumbents of all positions to which Financial Signing Authorities have been delegated, as documented by the validation of signing authority. This document is acquired from AFNWA's Banking Institution.

(c) The Manager of Corporate Services, or other such delegate from the Finance Office, shall verify adequacy of Spending Authority and authenticate signatures prior to recommending for Payment Authority.

2.4 Acting Grants of Financial Signing Authority

Acting Grants of Financial Signing Authority shall be made in the following special circumstances only such as absences due to illness, travel or vacation. Acting Grants must be initialized in writing and contain an expiry date. Acting Grants must be copied to the Finance Office.

Finance Office to provide all documents signed using an Acting Grant to the regular Signing Authorities for review upon return.

2.5 Restrictions on Financial Signing

(a) No person shall be permitted to exercise the authority granted to a position on an acting basis, unless designated to act by virtue of an Acting Grant of Financial Signing Authority.

(b) Signing Authority can be revoked at any time, upon written direction from the CEO to the Finance Office.

(c) No AFNWA Employee or Board member shall exercise any element of Financial Signing Authority in connection with any payment from which they can personally benefit or in respect of which he is in conflict of interest. AFNWA has established a Code of Conduct and Conflict of Interest Policy for its employees and Board members, copies of this policy are available from the Manager of Corporate Services. All Employees and Board members shall agree to abide by this policy.

2.6 Internal Control

(a) Financial Signing Authorities shall be delegated in accordance with an appropriate division of duties and responsibilities commensurate with good internal financial control.

(b) Spending Authority and Payment Authority shall not be exercised by the same person in respect of a particular payment.

(c) The Commitment stage of spending authority is the stage at which authority to incur financial obligations on behalf of AFNWA is exercised. In exercising this authority, the Manager of Corporate Services shall ensure that commitments are made only within approved budget and for amounts earmarked.

(d) The Approval for Payment stage of spending authority which entails approving the charge for payment once the initial commitment has been made and the goods received or services performed, shall only be exercised upon establishing that the transaction represents a valid and proper claim on AFNWA funds, and the claim is in accordance with the terms and conditions of the contract and the funding agreement (where applicable).

(e) Payment Authority is the authority to requisition payments after reviewing their legality and exercising all appropriate financial controls. Responsibility for the adherence and the enforcement of the financial controls rests with the Manager of Corporate Services, but primary responsibility for the verification of individual accounts rests with those who are delegated Spending Authority.

(f) Payment Authority shall be delegated to the Manager of Corporate Services.

2.7 Authorities

(a) The AFNWA Board approves the Signing Authorities and Amendments, as recommended by the Audit and Finance Committee.

(b) The Manager of Corporate Services:

- Distributes copies of the approved amendments and validations of Delegation to the impacted parties or other designated staff.
- Updates the signing authorities for all approved amendments and additions.
- Obtains all necessary documentation to coordinate with all relevant Financial Institutions for the addition or deletion of Signing Authorities.
- Maintains, and regularly reviews, list of all Signing Authorities with all relevant financial institutions.

3.0 Financial Authorization Policy

3.1 Objectives

(a) To set out objectives, policies, authorities and processes for ensuring systematic, efficient, timely and quality provision of Financial Authorization to documents prior to submission to the AFNWA Board.

(b) To provide policies for assessing documents requiring Financial Authorization to ensure conformity with AFNWA approved legal and financial framework, Financial Management Policies, Instrument of Delegation of Financial Signing Policies, and General Accounting Policies and Authorities.

3.2 Policies

(a) The following represent the general criteria which apply to all documents subject to review for Financial Authorization:

- Adherence to AFNWA Bylaws and Corporate Governance Manual;
- Conformity with the Legal and Financial Framework;
- Conformity with established corporate financial policy;
- Adherence to generally accepted accounting principles as applicable; and,
- Adherence to principles of sound financial management.

(b) Financial Authorization shall principally relate to the accuracy and completeness of financial management information.

(c) The following are submissions that require Financial Authorization:

- Commitments or initiatives that exceed incumbent financial authorities as contained in the Instrument of Financial Signing Authorities;
- Changes to Compensation Policy
- Changes to Human Resources policies;
- Business Plans;
- Capital expenditure proposals greater than $100,000;
- Changes to AFNWA Travel Expense Policy and Rates;
- Changes to risk management policies; and
- Borrowing initiatives.

(d) The required contents of “Budget and Financial Implications” section or module regarding submissions are as follows:

- Financial information and data provisions;
- Documentation/calculations to support financial information and data;
- Consideration of adherence to funding or regulatory constraints of a financial nature;
- The adequacy of authorized budgets, including staff requirements; and
- Forecast of future financial commitments implied by proposals of an ongoing nature.

(e) Documents submitted for Financial Authorization shall be reviewed using the following specific criteria in addition to the general criteria in order to ensure consistency throughout AFNWA:

- Adherence to the financial planning and budgeting process;
- Adequacy of authorized budgets; and
- Full exploration of cash flow implications related to new activities.

(f) All Submissions shall include a section entitled "Budget and Financial Implications".

(g) The Manager of Corporate Services shall review and approve them for adherence to required contents of the "Budget and Financial Implications" section or module.

(h) Where the Manager of Corporate Services determines that there are no financial or budgetary implications requiring Financial Authorization, a statement to that effect shall be included in the "Budget and Financial Implications" section or module of the submission.

(i) Financial Authorization shall be provided by the AFNWA Board, following review by the CEO for all AFNWA Contracts over $100,000.00.

(j) Submissions requesting additional resources greater than 10% of the approved budget, and not less than $50,000, shall be submitted to the AFNWA Board for approval.

(k) For those submissions involving policy changes, the Financial Authorization provided by the CEO shall relate to the accuracy and completeness of the presentation and to any financial impact, current or foreseen, as contained in the submission as a whole.

4.0 General Accounting Policies & Authorities

4.1 Objective

(a) To prescribe the accounting policy covering AFNWA financial accounting activities.

(b) To prescribe policies and guidelines for the delegation and approval of cheque signing authorities. To set out the cheque signing authorities and processes in accordance with an appropriate division of duties and responsibilities commensurate with good internal financial control.

4.2 Financial Signing

(a) The Financial Signing Authorities, as assigned by the AFNWA Board to the CEO, are delegated as documented in the Instrument of Delegation of Financial Signing Authorities.

(b) Financial Signing Authorities shall be delegated in such a way as to ensure an appropriate segregation of responsibilities in the disbursements and collection of AFNWA funds.

(c) Cheque/Payment signing authorities assigned to Employees of the AFNWA shall not exceed their Financial Signing Authorities.

(d) For any payments or banking documents under $100,000, any two of the following shall have authority to sign for AFNWA:

- Chief Executive Officer;
- Manager of Corporate Services;
- Manager of Engineering;
- Manager of Operations;
- Chief Operating Officer
- Board Executive members.

(e) Payments and banking (borrowing) documents over $100,000 and any other legal documents, such as contracts with a value greater than $100,000, shall be executed by one Board Executive member (Chair or Vice-Chair) and either the Chief Executive Officer, Chief Operating Officer or Manager of Corporate Services.

(f) The Directors of the AFNWA are the Board members.

(g) The Officers of AFNWA are the Chair, Vice-Chair, Chief Executive Officer, Chief Financial Officer, Chief Operating Officer, Secretary and the Treasurer.

4.3 Cheque Signing Authorities Procedure

4.3.1 Policies

(a) The AFNWA Board, in accordance with the General Banking Resolution, may from time to time by resolution designate signing officers who shall be authorized to sign cheques/electronic payments drawn on AFNWA's bank accounts.

(b) The Manager of Corporate Services, with written permission of the CEO, may remove officers designated to sign cheques/electronic payments drawn on AFNWA bank accounts, immediately providing written notification to the Audit and Finance Committee advising rationale for the removal.

(c) All cheques, automatic debit authorizations, acceptances, drafts, orders including orders made electronically shall be signed, endorsed or otherwise made by any of the two persons noted in Section 4.2 (d).

(d) The signatories shall be knowledgeable of sound financial management and internal controls.

4.3.2 Internal Control

(a) Cheque signing and Payment Authorities may be exercised by the same person. However, cheque signing, and Spending Authorities may not be exercised by the same person, to ensure that an independent verification of the transaction is made.

(b) Cheque signatories shall be accountable for the disbursement of funds as a result of the issue of cheques under their signatures.

(c) Cheque signatories shall ensure that the responsibilities and processes associated with Spending and Payment Authorities have been duly carried out by authorized personnel.

4.4 Accounting and Financial Control

(a) All Spending Authority rests with, and at the discretion of the CEO;

(b) Any Delegation of the Spending Authority by the CEO shall be done in writing.

(c) AFNWA shall establish and maintain adequate controls and a system of recording expenditures to ensure they are for authorized purposes and processed in a timely and accurate fashion.

(d) AFNWA shall incur expenditures only when both legal and financial authorities have been obtained to do so.

(e) In cases where expenditures are incurred as a result of negligence, the CEO shall determine the method of recovery.

(f) All money disbursed by cheque/electronic payment is charged to a central bank account(s) as authorized.

(g) Under no circumstance will there be any "pre-signed" cheques or cheques signed with no payee listed and no supporting documentation.

(h) Blank cheques or manual cheques will only be used in emergency situations or for instances where there is no access to the accounting information system.

(i) Blank/manual cheques are kept under lock and key under the control of the Manager of Corporate Services.

(j) Adequate controls must be in place to ensure complete and accurate reporting of all disbursements made.

(k) All cheque disbursements are to be made on serially numbered cheques.

(l) Authorization for the addition of, or amendment to, banking information for vendors for the purpose of disbursing funds electronically is restricted to the Manager of Corporate Services or others delegated by the Manager of Corporate Services. The Finance Office should obtain regular statement of accounts from all regular or material vendors being paid by electronic funds.

(m) Each authorized cheque signing officer shall verify that review and approval has been given and is satisfied that the supporting documentation has been correctly prepared and approved at the time of affixing his/her signature.

(n) Financial control requires an appropriate division of responsibilities so that the work of one employee independently checks the work of another.

(o) Adequate procedures shall be established and maintained by the Manager of Corporate Services for the verification of accounts before payment is made. As a minimum these shall include:

- That the work has been performed, the goods supplied, or the service rendered, as the case may be, and that the price charged is according to contract, or if not specified by contract, is reasonable;
- That supplies and services are in accordance with contract specifications and that all the terms and conditions of the contract have been met;
- That, where a payment is to be made before the completion of the work, delivery of the goods or rendering of the service, as the case may be, such payment is specifically provided for in the contract;
- That applicable discounts have been deducted, that charges not payable have been eliminated and that the computation of the amount payable is correct;

- That the account has not previously been paid in whole or in part;
- That the proper expenditure coding is identified in the requisition; and,
- That any other procedures necessary in relation to the payment are carried out.

(p) Adequate controls shall be established and maintained to ensure that the revenue due to AFNWA is recorded and collected on a timely basis.

(q) Controls shall be established and maintained to ensure that no amounts receivable are removed from the records without the appropriate authority.

(r) Cheques for purpose of reimbursement of Travel to First Nations or Organizations' Employees shall be written out to the First Nation Community/Organization which the person(s) represent, exceptions require CEO written approval.

4.5 Banking Arrangements

(a) Funds received must be recorded daily and must be deposited to AFNWA bank account as soon as possible. Cash, cheques or deposits may be kept overnight in a locked fireproof safe or cabinet. Access to the safe is restricted to the CEO and Manager of Corporate Services, and others as delegated by the CEO in writing.

(b) Receipt of daily mail containing cheques and other negotiable instruments must be recorded immediately and distributed promptly to the Manager of Corporate Services so that deposits are completed on a weekly basis whenever possible.

(c) Complete detailed records must be maintained to ensure that receipts can be traced to provide adequate information and to ensure that all receipts are properly credited to the relevant accounts.

(d) The Manager of Corporate Services will prepare and record bank deposits, maintaining records of incoming funds and accompanying deposit receipts or payment notifications as in the case of electronic funds transfers.

4.6 Accounts Receivable

(a) The Manager of Corporate Services will ensure that all invoicing be done as soon as possible, after the project is completed or based on the funding agreement requirements.

(b) A reconciliation of Funding Agreements should be reviewed monthly by the Manager of Corporate Services and summarized in the quarterly reports delivered to the Audit and Finance Committee.

4.7 Year-End Accounting

(a) Every effort shall be made to obtain invoices, statements, contracts or other documents claiming payment, so that arrangements may be made for payment of all amounts owing by AFNWA at each quarter-end.

(b) All vendors shall be required to submit progress claims for all work performed to the last day of the quarter.

(c) Quarterly accrued liabilities shall be established for unpaid debts, only where, at quarter-end, the following are met, that:

- The work has been performed;
- The goods have been received;
- The services have been rendered; or
- The amount is owing in accordance with contractual arrangements entered into on or before the last day of the quarter;
- The debt represents a valid and proper claim on AFNWA funds, and is in accordance with the terms and conditions of the contract; and,
- The verification of accounts has been completed.
- Debts may be for a determinant amount, e.g. the document claiming payment has normally been received but has not yet been paid, or for an estimated amount.

(d) Estimated debts must meet the above, and in addition, shall only be charged when:

- The debt can be individually substantiated and valued;
- The debt can be individually identified with subsequent payments; and
- Accrual is required under Generally Accepted Accounting Principles (GAAP).

(e) Spending and Payment Authority shall be, in effect, exercised twice in respect of an accrual; once when the debt is recorded by AFNWA, and once when the debt is settled.

(f) Regular recurring services such as telephone paid for at monthly dates other than month-end shall not be accrued.

(g) No accruals are required for amounts less than $500.

(h) Accrued Liability accounts shall be reviewed and reconciled monthly.

4.8 Authorities

(a) The Manager of Corporate Services prepares and/or reviews all monthly, quarterly and annual reports for submission to the CEO.

(b) The CEO approves all quarterly and annual reports for submission to the Audit and Finance Committee and the Board.

5.0 Procedure for General Accounting

5.1 Objective

To prescribe the accounting procedures covering AFNWA financial accounting activities.

5.2 Accounting and Control of Disbursements

5.2.1 Payment of Accounts

(a) The Manager of Corporate Services and Finance Office will be responsible for ensuring that requests for payments are accompanied by supporting documentation and are in accordance with budget, financial signing authorities or other specific limitations.

(b) The Manager of Corporate Services and Finance Office will be responsible for establishing that all relevant information is provided to ensure that accurate posting of accounts will be maintained throughout the accounting system.

(c) The Manager of Corporate Services shall be responsible to provide monthly departmental budget updates. Each Department Manager shall be responsible for the adherence to the budget for the fiscal year and presenting any forecasted material deviations from budget to the Manager of Corporate Services and CEO for approval.

(d) The Manager of Corporate Services reviews and approves all expenditures for payment, unless otherwise delegated through an Acting Grant.

(e) Periodic reviews of material vendor accounts (including employee travel claims) must be completed and documented to ensure that accounts are current and that no duplicate requisitions/expense items exist.

(f) All purchase orders, invoices, and payments stubs must be maintained in a shared database, with access restricted to relevant staff, with an identified data continuity strategy. The database must be organized in such a way that all relevant documents can be easily located.

5.2.2 Supporting Documentation

(a) The Manager of Corporate Services will be responsible for ensuring that all original invoices and associated Spending Authority payment form (IE: Purchase Order, Service Contract Payment Form, etc.) are accurate, complete, and stored in the AFNWA database.

(b) Aged Vendor listings must be reviewed weekly. At all times, payment information must be recorded and reviewed for accuracy within the accounts payable system.

(c) The Finance Office will examine all invoices or financial claims to ensure that all discounts have been claimed and that payments are scheduled to conform to the terms of payment as set out on the invoice or as previously agreed to with the supplier.

(d) Only AFNWA Employees with Spending Authority shall have the authority to request a Purchase Order from the Finance Office.

(e) The Finance Office will be responsible for ensuring that the Purchase Orders are attached to all invoices. Purchase Orders are required for all expenses, with the exception of those noted below:

- Recurring overhead expenses (e.g. Utilities, cellphone, internet, garbage/snow removal, security), in which case a detailed list of pre-approved vendors is to be maintained and reviewed quarterly.
- Contract payments – in which case, a detailed invoice and status report(s) are to be reviewed and approved by the CEO and Manager responsible for the project (if applicable) prior to payment issuance.
- Employee Travel Claims, in which case a travel claim form is to be signed by the employee and approved by a manager.
- Workshop Participant Travel Claim signed by the participant and approved by the hosting manager of the workshop.
- Items paid by Credit Card do not require a Purchase Order. Refer to Annex B for details regarding credit card payments.

(f) The Finance Office will be responsible for coding invoices that have no purchase orders and for following up with Departments on variances between purchase order and invoice amounts. For invoices that require detailed review and recommendation for payment by senior staff, proper documentation will be completed to ensure proper coding and an approval by the relevant Spending Authority.

(g) The Finance Office will be responsible for proper filing of support documentation and matching of Purchase Orders to invoices received. Purchase Orders will be held in a file until the approved invoice is received. It is then attached to the invoice as part of supporting documentation. Outstanding Purchase Orders with no associated invoice shall be reviewed monthly by the Finance Office.

5.2.3 Preparation of Cheque/Electronic Payment

The Finance Office will coordinate:

- Obtaining signatures by two authorized signing officers in accordance with the Financial Signing Authorities, on all cheques and electronic fund remittances.
- Mailing original Cheques to the payee, stubs shall be filed in sequential order.
- Emailing payment remittance notification to the payee, signed direct deposit logs shall be filed sequentially.

5.2.4 Cheque Cancellations/ Electronic Fund Transfer Recalls

(a) Where a cheque is cancelled before issuance, the Finance Office shall stamp the original and the copies Voided. The original and copies shall be filed sequentially in the system. Similarly, where an EFT is cancelled before it is uploaded to the Bank, the payment is to be reversed in the accounting system and an amended Direct Deposit Log is to be created.

(b) Where a cheque is cancelled or lost after issuance to the Payee, the Finance Office shall immediately issue a stop payment at the bank following the appropriate procedures as directed by the bank. Similarly where an EFT needs to be cancelled, the Finance Office shall

immediately recall the payment following the appropriate procedures as directed by the bank.

(c) The replacement payment shall not be issued until confirmation from the bank is received that the stop payment is in effect or the EFT has been successfully recalled, as applicable.

(d) The Manager of Corporate Services is to confirm that the payment cancellation is accurately recorded in the accounting system, with appropriately detailed notes, and arrangements for replacement payment is made, where necessary.

5.2.5 Outstanding and Stale Dated Cheques

The Manager of Corporate Services will review the monthly list of outstanding cheques. All cheques outstanding for more than six (6) months should be reversed. A replacement cheque or replacement payment will be reissued where it is deemed necessary.

5.3 Staff Travel

5.3.1 Purpose and scope

The purpose of this directive is to ensure fair treatment of all parties travelling on AFNWA business. The provisions contained in this directive are mandatory and provide for the reimbursement of reasonable expenses necessarily incurred while traveling on AFNWA business and to ensure individuals are not out-of-pocket. These provisions do not constitute income or other compensation that would open the way for personal gain.

This directive applies to all AFNWA employees, Board members or affiliates traveling on AFNWA business.

5.3.2 Administration

AFNWA has the responsibility to authorize and determine when business travel is necessary, and to ensure that all travel arrangements are consistent with the provisions of this Directive. Following consultation between AFNWA and the employee, Board member, or affiliate, the determination of travel arrangements shall best accommodate the individual's needs and interests, and AFNWA's operational requirements.

Business travel shall be authorized in advance in writing to ensure all travel arrangements are in compliance with the provisions of this directive. In special or emergency circumstances, travel shall be post authorized by AFNWA. Such situations shall be reviewed on a case by case basis.

Expenses resulting from misinterpretations or mistakes are not a basis for reimbursement or non-reimbursement. However, such situations shall be reviewed on a case by case basis.

5.3.2 Loyalty programs

Provided that there are no additional costs to AFNWA, employees and Board members traveling on business can join loyalty programs and retain benefits offered by the travel

industry for business or personal use.

5.3.3 Overpayments

Overpayments, namely amounts reimbursed or paid to travelers, which are not in accordance with the terms of this directive, shall be recovered from the traveler as a debt owing to AFNWA.

5.3.4 Receipts

Where the traveler certifies that the receipt was lost, accidentally destroyed or unobtainable, a personal declaration may replace the receipt.

5.3.5 Responsibilities

The Finance Office shall:

(a) establish the proper delegation framework to comply with this Directive;

(b) ensure that this directive is available at the employee's normal workplace during the employee's working hours;

(c) in consultation with the employee and responsible Manager,

i. determine whether travel is necessary;

ii. ensure that travel arrangements are consistent with the provisions of this directive; and

iii. ensure that accommodation of needs is provided to the point of undue hardship.

(d) authorize travel;

(e) verify and approve travel expense claims before reimbursement;

(f) The AFNWA Chair or Vice-Chair must approve and sign off on the Travel Claim for AFNWA Board members and the CEO for any payment being processed. The Chair and Vice-Chair will be looking to ensure that expenses are reasonable, all appropriate documentation is attached, the standard rates have been used and expenses are claimed within the required timeframe; and

The traveler shall:

(a) become familiar with the provisions of this directive;

(b) consult and obtain authorization to travel in accordance with the directive;

(c) complete and submit travel expense claims with necessary supporting documentation as soon as possible after the completion of the travel. In travel situations exceeding one month, the traveler may submit interim travel expense claims prior to the completion of the travel; and

(d) be responsible for canceling reservations as required, safeguarding travel advances and funds provided, and making outstanding remittances promptly.

5.3.6 Travel advances

Employees, Board members, and other affiliates on business travel for AFNWA shall be provided with a travel advance to cover travel expenses where services and products are not

prepaid or cannot be paid with an individual designated travel card or at the Manager of Corporate Services' discretion when travel is expected to be for an extended period.

(a) Travel advances for travel and other expenses incurred when conducting AFNWA business should be issued not more than one week before the trip or planned expenditure. Requests for advances must be approved by the CEO in the case of Department Managers, Department Manager in the case of employees and the Chair or Vice-Chair, in the case of Board members and CEO. Employee and Board member travel advances and expenses will be issued in accordance with Appendix A (Approved Travel Rates), and the amount of the travel advance shall not exceed 90% of the anticipated travel expenses.

(b) Travel advances for travel and other expenses incurred when conducting AFNWA business are intended to regulate and minimize the amount of transactions relating to advances. Employees shall obtain written permission from their Manager for a travel advance by acquiring Manager signature on a post-dated travel claim.

(c) Travel advances for travel and other expenses incurred when conducting AFNWA business may be granted for the following:

   i. Meals and incidentals;

   ii. Car rentals, taxis, accommodations and other AFNWA approved travel related expenses; and,

   iii. Out-of-town travel by car is allowed at (per kilometer) rates established by the AFNWA. In some circumstances, a rented car with unlimited kilometers may be more economical than use of a personal vehicle. In any case, the most economical method of transportation shall always be used.

(d) The Employee, Board member, or other affiliate must submit an expense claim by the end of each month. If the amount of the advance was higher than the actual expenditures, the Employee must attach a cheque for the full balance of the outstanding amount.

(e) Travel advances will be coded to the respective Employee accounts payable subledger account as "travel advance receivable" for each employee, or person who travel on the behalf of the AFNWA (if applicable).

(f) The expense claim form shall form the basis for the processing of a journal entry for reallocating the advance to the appropriate general ledger accounts.

(g) Excess funds are to be returned within one week (at the latest) following the completion of the trip.

(h) The Manager of Corporate Services will follow up on all outstanding employee advances on a monthly basis and report any outstanding amounts to the CEO for employees and the Chair and Vice-Chair for Board members for their information and appropriate action.

(i) The CEO shall confirm a repayment schedule for any outstanding charges for employees and the Chair or Vice-Chair for any Board members.

(j) The Manager of Corporate Services will process a request for a reimbursement with a cheque to the Employee or Board member, where the approved expenses exceed the travel advance.

5.3.7 Travel forms

AFNWA approved travel forms shall be used in seeking business travel authority and submitting travel claims with the supporting documentation where necessary.

The Employee must, at a minimum, submit their travel expense claim(s) by the end of each month.

Travel claim forms are available from the Finance Office.

5.3.8 Vehicle Insurance

Refer to the AFNWA Fleet Management Policy (available from the Finance Office) for vehicle insurance requirements for rented vehicles as well as the use of personal vehicles while traveling for AFNWA business.

5.3.9 Additional business expenses

As the business of AFNWA broadens so does the need to travel outside of Canada. Therefore, to ensure AFNWA employees, Board members, and other affiliates are properly compensated for travel; expenses for hotels, meals and taxis will be reimbursed using the relevant Exchange Rate for the date of purchase. Receipts for all such purchases, except for meals which will have the base rate of the AFNWA allowable meal rates; will be required. Regarding transportation, the same rules apply as for transportation mentioned in Section 5.3.10.

The Employee, Board member, or other affiliate shall also be reimbursed business expenses not otherwise covered. This includes things such as administrative services, internet connections, rental and transportation of necessary office equipment and transportation of required personal effects. If the travelling individual has an AFNWA issued cellphone, they shall contact the Finance Office in advance of their travel to arrange for international access to networks.

In order to be reimbursed for any of the above expenses, with the exception of meals as they are per the AFNWA rates; employees must have written approval from their Department Manager or CEO in the case of Department Managers, prior to the expense being incurred, except in the case of an emergency. This approval must be submitted along with any other necessary documentation in order for the employee to be reimbursed.

5.3.10 Transportation

The selection of the mode of transportation shall be based on cost, duration, convenience, safety and practicality. In addition to provisions outlined in this section under commercial travel, vehicles and other modes of transportation, expenses associated with the selected mode of transportation such as ferries, tolls, docking fees, shall be reimbursed. Should an employee or Board member decide to travel via land rather than Air; the lesser of the two travel amounts will be reimbursable.

(a) Commercial Travel:

i. Where commercial transportation is authorized and used, the employee or Board member shall be provided with the necessary prepaid tickets whenever possible.

ii. Taxis, shuttles and local transportation services are alternatives for short local trips. Actual expenses shall be reimbursed, based on receipts.

iii. The standard for air travel is economy class. Booking air travel shall be done in coordination with the Finance Office to ensure that the lowest available airfares

appropriate to particular itineraries shall be sought and bookings shall be made as far in advance as possible.

(b) Vehicles

i. The standard for rental vehicles is mid-size. Rental vehicles beyond the standard shall be authorized based upon factors such as but not limited to safety, the needs of the traveler and the bulk or weight of goods transported.

ii. The kilometric rates payable for the use of privately-owned vehicles driven on authorized business are prescribed in Appendix A. Travelers shall use the most direct, safe and practical road routes and shall claim only for distances necessarily driven on business travel.

iii. Parking charges are payable when an employee is authorized to use a private vehicle on business travel, the employee shall be reimbursed the actual costs of parking provided receipts are submitted for the expense.

5.3.11 Accommodation

The standard for accommodation is a single room, in a safe environment, conveniently located and comfortably equipped.

Total cost of Hotel/Motel accommodations not to exceed $200.00 per night taxes included within the Atlantic Provinces. Total cost of Hotel/Motel accommodation is not to exceed $250.00 per night taxes included if traveling domestically outside of Atlantic Canada or Internationally. Any exceptions to this amount require the approval of the CEO for employees and the Chair or Vice Chair for Board members and the CEO.

Private accommodations will be paid at a rate of $50.00 per night.

5.3.12 Incidental expense allowance

A traveler shall be paid an incidental expense allowance that covers a number of miscellaneous expenses not otherwise provided for in this directive for each overnight in travel status as per AFNWA approved travel rates (see Appendix A).

5.3.13 Home communication

Home communication is included in the incidental expense allowance.

5.3.14 Meals

A traveler shall be paid the applicable meal allowance for each breakfast, lunch and/or dinner (if not provided for otherwise) while on travel status (defined as 200kms from your office), or when overnight accommodation is required.

AFNWA employees, Board members or other affiliates can claim meals based on the following criteria:

(a) If they leave their residence before 6:30am they can claim breakfast;

(b) At the end of the trip, if they arrive home later than 6:30pm directly from the event they are attending then they can claim dinner;

(c) If the meeting or event organizer provides meals, then the AFNWA traveler cannot claim these meals on their travel claim form;

(d) If a hotel offers a hot breakfast with the cost of the room, then the AFNWA traveler cannot claim breakfast.

(e) Meal allowances shall be reimbursed in accordance with the AFNWA rates specified in Appendix A.

5.4 Travel Expenses – Participants of Meetings/Workshops

(a) Participants of Meetings/Workshops must submit their expense claim within 30 days of the event, along with applicable receipts using the AFNWA Travel Form.

(b) Travel expenses will be issued in accordance with the AFNWA Approved Rates (Appendix A)

(c) It is the responsibility of the Department to submit the travel claims for any participants to their events.

(d) Travel claims have to be signed off by both the participant and the Manager of the Department hosting the event.

(e) All travel claims must have all relevant information attached to them to be processed.

5.5 Bank Reconciliations

(a) A weekly summary of cash disbursements and receipts shall be prepared by the Finance Office and shall be reviewed and approved by the CEO on a weekly basis.

(b) The end of the month bank reconciliation shall be completed within AFNWA Accounting Software within 5 business days of the end of the month, to be reviewed/approved by the Manager of Corporate Services.

(c) Any imbalance in the bank reconciliation shall be reported to the CEO and followed up by the Manager of Corporate Services.

(d) The CEO will participate in a detailed bank reconciliation review on a random basis throughout the year. A detailed review will include reconciliation of outstanding cheques and deposits, review of bank statement transactions, and a review of cancelled cheques returned from the bank.

5.6 Credit Card Reconciliations

The following AFNWA employees are authorized to hold an AFNWA corporate credit card, ~~based on approval, via resolution, by the Audit and Finance Committee.~~subject to change, based on written direction from the CEO.

Position Title	Maximum Limit
CEO	10,000
COO	10,000
CFO	10,000
Manager, Operations	10,000
Manager, Engineering	10,000
Manager, Communications	5,000
Superintendent, Operations	5,000
Superintendent, Tech	5,000
Controller	5,000
Supervisor	2,000
Operators	1,000
Admin. Assistants	500

Any employee who is authorized to hold an AFNWA corporate credit card shall agree, in writing, to adhere to the AFNWA Corporate Credit Card Usage Policy by signing the AFNWA Credit Card Agreement (see Appendix B). Such employees must agree to the following:

(a) To adhere to the AFNWA Travel Directive and the AFNWA policies for continued use of the credit card privilege;

(b) The credit card is for approved specific AFNWA corporate/business related expenses only as per the policy directive. No personal charges whatsoever shall be charged on the credit card. There are no exceptions to this rule.

(c) Diligent protection of the number and expiry date is the AFNWA employee's responsibility.

(d) A copy of the statement will be obtained directly by the Finance Office and scrutinized by the Manager of Corporate Services for any misuse.

(e) The credit card reconciliation shall be completed within 5 business days of the statement date and shall comprise the following:

i. Matching of credit card charge with original receipt;

ii. Where original receipt is not applicable, verification of the expenditure;

iii. Employee signature representing agreement with the stated charges;

iv. Manager Signature representing Payment Authority for the purchases incurred during the respective month.

(f) Any inconsistencies or unidentifiable entries in the credit card statement shall be reported to the Manager of Corporate Services immediately. If fraud is suspected, the affected credit card shall be put on suspension immediately and the Manager of Corporate Services will conduct an investigation to identify how the card details were compromised.

6.0 Policy/Procedure for Operating Budgets

6.1 Objectives

To provide guidelines and procedures for the preparation, monitoring and control of the AFNWA's Operating Budget.

6.2 Financial Management

Managers at all levels are accountable for the planning of all activities (output) within their area of responsibility, identification of resource requirements (input) in relation to plans, and performance reporting.

6.2.1 Business Plan

AFNWA Business Plan is a document outlining the critical priorities of the AFNWA, including all major activities to be undertaken within the specified year. It provides the basis for preparation of annual operating and capital budgets.

6.2.2 Division or Department Work Plans

AFNWA division or department work plans shall be prepared for the upcoming year following issuance, by the CEO consistent with Corporate Strategic Plans. The CEO will establish a deadline for draft work plans for each division or Department which will outline the achievement of objectives and outputs, and for the identification of required resources, in terms of staff and budgets to produce stated outputs.

6.3 Operating Budget Preparation

6.3.1 General

(a) The Operating Budget is an expression of AFNWA's Business Plan in financial terms. The Operating Budget serves three main purposes for the AFNWA:

   i. To determine financial and other resources to carry out the Operating Plan;

   ii. To obtain AFNWA Board approval of the resources required to meet corporate objectives; and,

   iii. To provide a basis for financial monitoring and control.

(b) The Operating Budget shall be prepared by the Manager of Corporate Services, in consultation with Department Managers, and forwarded to the CEO for approval prior to submission to the Board.

(c) The Operating Budget shall provide the authority from the Board to the CEO to carry out operational activities in the upcoming year and to consume resources to achieve the objectives of AFNWA Business Plan.

(d) Operating Budgets shall be completed annually, presented in a format with departmental and elemental breakdown readily identifiable, broken down monthly, and submitted to the CEO no later than December 31st in order to achieve Board approval on or before January 31st.

(e) Departmental budget reports shall be available to the Department Managers monthly, within 8 business days of the month-end. Supplementary reports of material variances in budget shall be submitted to the respective manager as soon as the discrepancy is identified. Department managers shall submit, in writing to the Manager of Corporate Services, commentary on material variances, within 5 days of receiving departmental budget report.

(f) A Quarterly Management Discussion and Analysis on budget variance shall be submitted to the CEO within 15 business days of the quarter end for onward submission and approval by the Board. Material variances shall be identified and alternative funding sources or re-allocation of resources shall be discussed in this quarterly report.

7.0 Procedure for Capital Budgets

7.1 Objectives

To provide guidelines and procedures for development of the Capital Budget.

7.2 Capital Assets

In keeping with Generally Accepted Accounting Principles (GAAP) and the Accounting Standards for Not for Profit Organizations of materiality and consistency, the AFNWA shall treat as capital assets any items which meet the following criteria:

A useful life in excess of one year, and a per item cost of at least $5,000.

7.3 Budget Preparation and Approval

(a) The Manager of Engineering shall initiate and direct the preparation of the Capital Budget for submission to the CEO prior to December 31st each year.

(b) The Manager of Engineering shall work in coordination with the Manager of Corporate Services and seek input from Departments for the preparation of the Capital Budget. The Manager of Corporate Services shall remain principally responsible for the final presentation of the Capital Budget.

7.4 Monitoring, Reporting and Control

(a) The Manager of Engineering, in consultation with the Manager of Corporate Services, shall administer the Capital Budget during the fiscal operating year in accordance with the approved budget.

(b) The Department Managers shall be accountable for and administer their respective allocated Capital Budget for their Divisions or Departments, including the acquisition of furniture and equipment in accordance with the approved plan.

(c) Anticipated budget variances on capital projects are to be communicated in writing to the CEO as immediately as the overrun can reasonably be estimated, and summarized in the monthy report referenced below (7.4(h)i).

(f) Reallocations of funds between projects, or the application of funds to new items, shall require approval of the CEO.

(g) Transfers from operating budget to capital budget shall require the approval of the Manager of Corporate Services and the CEO.

(h) The Manager of Engineering shall report the status of the Capital Budget to the CEO as follows:

i. Monthly commitments and Capital Project Budget Tracking by the tenth work day of each month; and,
ii. Management Discussion and Analysis on Project status (budget and timeline), to be submitted to the Manager of Corporate Services for inclusion in quarterly reports.

8.0 Classification of Accounts Procedure

8.1 Objective

(a) To provide the framework for a classification of accounts designed to provide financial information necessary to manage AFNWA effectively and efficiently.

(b) To describe the classifications and their relationships.

8.2 Accounting Framework

All transactions shall be posted in accordance with Accounting Standards for Not for Profit Organizations. Furthermore, AFNWA shall ensure that all transactions are associated with a department, and a funding source so that comprehensive reporting can be produced.

8.3 Accounting Structure

(a) The Accounting Structure provides a breakdown of AFNWA activity.

(b) Based on Funding Agreements and Departments, this structure will be used to provide Funders and AFNWA participating communities with reports which will indicate how funds were spent to attain organizational objectives.

(c) The Accounting Structure shall enable the Manager of Corporate Services to plan, budget, account for, report and monitor program activities relative to approved objectives and goals.

(d) AFNWA will allocate the costs of core administrative expenses to the appropriate operating and capital budgets.

(e) The Accounting Structure shall provide the framework for the assignment of budget responsibility and for the identification of financial accountability.

8.4 Authorities

(a) The CEO will be informed of additions, deletions and changes relating to the Accounting Structure.

(b) The Manager of Corporate Services/Chief Financial Officer recommends additions, deletions and changes to the General Ledger Accounting Structure and Accounting Structure.

(c) The Manager of Corporate Services/Chief Financial Officer will ensure that the accounting information system be set up to limit access or to ensure no unauthorized changes/additions/deletions of accounts/vendors/customers.

(d) The Audit and Finance Committee will be informed of additions, deletions or changes to the Accounting Structure.

9.0 Policy/Procedure for Contracting Professional Services

9.1 Purpose and Scope

This policy is to establish guidelines for Employees to use when contracting for professional services and applies to all AFNWA Employees.

9.2 Management Policy

When contracting for professional services, the CEO must ensure that "Best Value" is obtained. Refer to the AFNWA Procurement Policy or the Finance Office for further information regarding Procurement Processes and Requests for Proposals.

9.2.1 Capacity to Contract

(a) Only the CEO and one of the Officers of the Corporation may legally bind the AFNWA. Accordingly, the AFNWA Executive staff are the only employees that are authorized to draft or amend AFNWA contracts. Employees must fill out the applicable contract forms and attach appropriate written authorization and provide to the CEO.

(b) The AFNWA Executive must ensure that two copies of the 'Contract' for the contractor are attached to the 'Contractor Information/Authorization Form'. This package must be routed through proper approvals.

(c) Every contract must have the written approval of the CEO. Should a contract be less than $100,000.00 the CEO has the authority to approve the contract.

(d) If the contract is over $100,000.00 then after the CEO gives the written approval of the contract, it is presented to the AFNWA Board for final approval.

(e) Contracts must be authorized before the work begins. Under special circumstances, work may begin prior to a written contract based on written approval by the CEO. Where work commences before proper authorization, the responsible Department Manager must provide a letter to the CEO recommending justification on why this is required.

(f) Each contract must have a contract number assigned by the Manager of Corporate Services.

(g) Any amendments to existing contracts must be approved, in writing, by the CEO.

9.2.2 Sole Sourcing

(a) Where the total value of the contract is up to $50,000, including amendments, the CEO may sole source to an individual or firm. Exceptions to this limit require the approval of the AFNWA Board. The CEO must ensure that he or she verify the professional daily or hourly rate for the contractor.

(b) Resumes and references should be obtained prior to sole sourcing. Typically, two letters from another organization or government which also hired the contractor would be sufficient. Furthermore, a sole source justification must accompany the contract which states why this contractor was selected and why this is the only contractor who can

perform the work.

9.2.3 Competitive Bidding

Refer to AFNWA Procurement Policy or Finance Office for further information regarding the competitive bidding/RFP/RFQ processes.

9.2.4 Contract Splitting

Contract splitting is not allowed. For purposes of this policy, contract splitting is defined as the dividing of a total contract requirement into one or more smaller contracts in order to avoid the contract authority guidelines set forth in this policy or any other financial or administrative policies of AFNWA.

9.2.5 Employer –Contractor Relationship

(a) Under no circumstances may a contractor be in an Employee – Employer relationship with AFNWA. For example, a contractor may not:

i. have AFNWA assets (e.g. cell phone, computers, etc.);
ii. be provided with an office in an AFNWA premises;
iii. be on the AFNWA payroll;
iv. have their hours of work determined by an AFNWA Employee;
v. have a time sheet signed by an AFNWA Employee; and/or,
vi. be subject to the day-to-day direction of an AFNWA Employee.

(b) Under no circumstances may a contract be entered into with an individual which would have, or could reasonably be seen to have, the effect of creating an Employer-Employee relationship with AFNWA.

9.2.6 Professional Fees

(a) AFNWA will pay for Professional fees and travel expenses (with original receipts). The contract must clearly set out what AFNWA will be paying for (e.g. professional fees, travel up to a maximum amount).

(b) Professional fees should only be paid upon receipt of a written invoice signed by the contractor and a previously agreed upon deliverable (e.g. report, activity report, etc.).

(c) A contract advance may be provided to the contractor from 30 up to a maximum of 50 percent, of the value of the contract, depending on the circumstances. Under no circumstances may contract advance exceed 50 percent of the value of the contract. A contract advance may only be provided were the contractor is a:

i. sole proprietor and requires funds to commence the requested project
ii. universities, colleges or other educational institutions;
iii. small firm that requires financial assistance to commence the project.

9.2.7 Contract Management

Every Manager must ensure that no payment is made in excess of the contract price. At yearend, each Manager must ensure that all invoices are received by the contractor if the contract is to be charged to the old year.

Details regarding contract progress are to be included in the Quarterly Management Discussion and Analysis regarding progress, target completion dates, and anticipated total cost.

9.2.8 Contractor Evaluation

At the conclusion of each contract, the responsible Manager must complete an Evaluation Form, available through the Finance Office or Manager of Corporate Services. This completed form must be forwarded to the Manager of Corporate Services and made available to all other Department Managers.

9.3 Roles and Responsibilities

(a) The CEO is responsible for making decisions within program budgets.

(b) The Manager of Corporate Services is responsible for:

i. making decisions within program budgets; and,
ii. reporting instances of non-compliance to this policy to the Audit and Finance Committee.

(c) Employees of the AFNWA are responsible for:

i. adherence to this policy; and
ii. ensuring that best value is obtained on contracts and all purchases.

(d) A Department Manager has the responsibility to:

i. inform their staff of this policy for Contracting Professional Services;
ii. bring to the attention of the Manager of Corporate Services and CEO, any instances of noncompliance to this policy; and,
iii. bring to the attention of the Manager of Corporate Services and CEO for decision any circumstances where there may be doubt.

Annex A

AFNWA Finance and Audit Committee

Terms of Reference

Specific Responsibilities

The Board delegates the following roles and responsibilities to the Finance & Audit Committee:

(a) Financial Statements

Delegated Committee Role	Responsibilities
Review and recommend to the Board	1. Receipt and review of quarterly financial statements from the CFO and approval of annual audited financial statements 2. Approval of the financial content of the Annual Report 3. The appropriateness of accounting policies and financial reporting practices used by the AFNWA 4. Any significant proposed changes in financial reporting and accounting policies and practices to be adopted by the AFNWA 5. Appropriate resolution of all major financial issues 6. Approval of annual business plans developed by management, including balanced scorecard measures and targets 7. Approval of operating and capital budgets and amendments thereto
Decide/approve and report to the Board	8. Changes in financial and accounting disclosures to be adopted by the AFNWA; report same to the Board
Monitor and report highlights to the Board	9. Quarterly and annual financial performance of the AFNWA (budget year to date with variance analysis) including: • Quarterly reporting on operations with the level of actual to budget variance by functional area including an explanation of variances greater than 5%the functional area • Quarterly reporting on the level of actual to budget details of approved capital projects • Annual carry forward of project budgets if required including details on unused amounts, reasons for carry-forwards and how amounts will be spent

	10. Public reports on published financial statements (to the extent such releases discuss the financial position or operating results) for consistency of disclosure with the financial statements themselves 11. Key estimates and judgments of Management that may be material to the financial reporting of the AFNWA 12. New or pending developments in accounting and reporting standards that may affect the AFNWA

(b) Internal Controls and Risk Oversight Management

Delegated Committee Role	**Responsibilities**
Review and recommend to the Board	13. Review and recommend to the Board the approval of an enterprise risk management framework
Monitor and report highlights to the Board	14. Monitor and report to the Board on the effectiveness of the AFNWA enterprise risk management system through a bi-annual risk assessment 15. Monitor and report to the Board on the adequacy and effectiveness of the AFNWA internal control system and information systems through quarterly reports from the CFO 16. Reports from the CEO on any issues, events or pending matters that may affect the AFNWA's relationship with its clients and business partners, or which place at risk the organization's resources, reputation or achievement of its goals and objectives; report on these to the Board as the Committee considers appropriate 17. Annual overview and discussion of the inventory of AFNWA plans in place to address emergency response/business continuity issues

(c) External Audit

Delegated Committee Role	**Responsibilities**
Review and recommend to the Board	18. The appointment of an external auditor
Decide/approve and report to the Board	19. The terms of the annual external audit engagement plan, including but not limited to the following: (i) engagement letter (ii) objectives and scope of the external audit work

	(iii) materiality limit set by external auditors (iv) areas of audit risk (v) staffing, and in particular, the lead audit partner and the audit partner responsible for reviewing the audit, including partner rotation (vi) timetable, and proposed fees 20. In advance, where the estimated fee for such services is greater **than $10,000**, the non-audit services to be provided by the external auditor's firm or its affiliates (including the estimated fees) in accordance with a policy established by Management and approved by the Finance & Audit Committee, consider the impact on the independence of the external audit work and receive an annual report thereon from Management 21. Assess the performance and independence of the external auditor
Monitor and report highlights to the Board	22. The work of the external auditor 23. The plan, conduct and reporting of the annual external audit, including but not limited to the following: • any difficulties encountered, or restriction imposed by Management, during the annual audit. • any significant accounting policies or financial reporting issues, alternative Accounting Standards for Not-For-Profit Organizations (ASNPO methods discussed with Management, ramifications and external auditors' preferred alternative, and any other material written communications with Management. • the external auditor's evaluation of the AFNWA system of internal controls, procedures and documentation. • the post audit or management letter containing any findings or recommendations of the external auditor including Management's response thereto and the subsequent follow-up to any identified internal control weaknesses. • any significant disagreements between management and the external auditor with regard to financial reporting. • any other matters that the external auditor brings to the attention of the Finance & Audit Committee; and • any issues relating to review or appointment of external auditors 24. Direct and open communication among the Finance & Audit Committee and the external auditor.

(d) Compliance and Other Oversight

Delegated Committee Role	Responsibilities
Monitor and report to the Board	25. Annually the AFNWA insurance coverage of significant business risks and uncertainties 26. Annual report from the CEO of any litigation matters that could significantly affect the financial statements 27. Exception reports from the CEO regarding any significant actual or anticipated non-compliance with any legal or regulatory requirements, or inter-jurisdictional agreement 28. Quarterly Management Representations on regular, statutory reporting requirements 29. Responses by Management to material information requests from government or regulatory authorities 30. Receive annual report of expenses of Board, senior management and employees 31. Receive annual audit report of expenses of Board, senior management and employees.

(e) Other Duties

The Finance & Audit Committee will investigate (or cause an investigation to be undertaken) and recommend a resolution to the Board of any issues or concerns referred to it by the Governance and Policy Committee (as the point of entry for any complaints or concerns) arising from complaints under the AFNWA Code of Conduct that may relate to a breakdown of financial disclosure controls or internal controls over financial reporting. Depending upon the nature of the complaint, the Committee may delegate the investigation and resolution of the complaint to Senior Management.

The Committee will also carry out such other duties as may be determined from time to time by resolution of the Board.

Committee Functioning

The Finance & Audit Committee will have access to Management and AFNWA documents as required/appropriate. It will also be provided with the resources necessary to carry out its responsibilities. The Finance & Audit Committee may engage independent counsel and other advisors and set and pay the compensation for any advisors so engaged.

In co-ordination with the Governance and Policy Committee, the Committee shall annually review and assess the adequacy of its mandate in relation to evolving best practices and evaluate its effectiveness in fulfilling its mandate.

The Finance &Audit Committee may establish a subcommittee to review any matters deemed appropriate by the Committee Chair. The subcommittee will provide its recommendation to the Finance & Audit Risk Committee.

The secretary to the Committee shall be the Recording Secretary and is responsible for:

- Ensuring that minutes are prepared recording decisions, recommendations and general discussion of the Committee

- Ensuring that decisions and recommendations of the Committee are forwarded to the Board for its next meeting
- Compiling and distributing the agenda of Committee meetings at least five (5) days prior to the Committee meetings, and
- Ensuring that action points identified are carried out.

Membership

The Board appoints Directors to committees. The Finance & Audit Committee will consist of three (3) Directors, one of whom shall be appointed as Chair of the Committee by the Board Chair.

All members of the Finance & Audit Committee shall meet the standard of financial literacy, which entails the ability to read and understand financial statements that present a breadth and level of complexity of accounting issues that are generally comparable to the breadth and complexity of the issues that can reasonably be expected to be raised by the AFNWA financial statements. Committee members shall exercise the care, diligence and skill that a person of ordinary prudence would exercise in dealing with the property of another person and shall use all relevant knowledge and skill that the member possesses.

All committee members shall be independent of management of the AFNWA. At least one committee member shall have accounting or financial management expertise.

Ex officio, non-voting members of the Finance & Audit Committee include: Chief Executive Officer, Chief Financial Officer and Recording Secretary.

Any Director who is a member of the Finance & Audit Committee serves at the pleasure of the Board Chair.

From time to time, additional non-voting resources may be added to the Committee by the Board Chair where considered necessary to enable the Committee to fulfill its mandate.

Meetings

The Finance & Audit Committee shall meet at least four (4) times per year, with additional meetings at the call of the Committee Chair, or as directed by the Board. The AFNWA external auditor, or any two members of the Finance & Audit Committee, may call a special meeting of the Finance & Audit Committee by contacting the Committee Chair.

The agenda will normally be set by the Committee Chair based upon the Committee's work plan and annual objectives. Committee members or the Board Chair may also suggest agenda items to the Committee Chair. The agenda and background material for meetings will be delivered to members at least five (5) days prior to the Committee meeting.

The Finance & Audit Committee will have separate private meetings with the external auditors, Management or any other persons to discuss any matters that the Committee or these groups believe should be discussed.

The external auditor shall attend meetings of the Finance & Audit Committee if either has requested the opportunity to do so or has been requested to do so by a Finance & Audit Committee member. The external auditors may be invited to make presentations to the Finance & Audit Committee, as appropriate.

Quorum & Decision Making

A quorum for the transaction of business at a meeting of the Committee will be a majority of Directors appointed to the Committee.

The Committee will attempt to reach consensus on recommendations to the Board on decisions delegated to the Committee. In exceptional circumstances, where consensus does not appear to be possible, the Committee may refer the matter directly to the Board without a recommendation.

Accountability and Reporting to the Board

The Chair of the Committee will prepare written reports for the Board on the work of the Committee and will be guided in the preparation of these reports by a reporting template for Committees.

Committee Objectives, Annual Work Plan and Timetable

In consultation with the Board Chair, the Committee will formulate annual objectives for the Finance & Audit Committee for each year and review progress against them at least annually.

The Committee will annually establish a work plan for its scheduled committee meetings, which plan will include any specific priorities assigned to the Committee by the Board. The attached table sets out the basic work plan to be used as a starting point each year.

Finance & Audit Committee Agenda Item	**Q1**	**Q2**	**Q3**	**Q4**
Financial Statements - Reviews external audited annual financial statements and recommends to the Board.	X			
- Recommends unaudited quarterly financial statements, including public reports on financial statements for consistency of disclosure with financial statements.	X	X	X	X
- Reviews quarterly and annual financial performance of the AFNWA and reports highlights to the Board.	X	X	X	X
- Approves financial content of the Annual Report.	X			
- Receive mid-year and annual report from the external actuary to understand the valuation of the organization's liabilities.	X			
Corporate Plan and Budget - Reviews and recommends Annual Business Plan, including balanced scorecard measures and targets and proposed rate of return.			X	
- Reviews and recommends operating and capital budgets, including proposed rate of return.			X	
Internal Controls and Risk Oversight				
- Monitors and reports to the Board on the effectiveness of the enterprise risk management system				X
- Reviews and discusses inventory of plans in place to address emergency response/business continuity issues and reports highlights to the Board.		X		
External Auditors - Approves terms of yearly engagement letter.				X

- Monitors and reports to the Board on the plan, conduct and reporting of the annual external audit.	X			
- Annual *in camera* meeting with External Auditor.	X			
Compliance and Other Oversight - Recommends quarterly reports on goods and services procurement, statutory employer remittances and OH&S compliance.	X	X	X	X
- Receives annual report from the CEO of any litigation matters that could significantly affect the financial statements.	X			
- Receives annual report of expenses of Executive Committee and Board	X			
- Receives annual audit report of expenses of Board, senior management and employees				X
- Receives results of annual Committee evaluation process			X	

APPENDIX A: Travel Rates

Mileage

The rates payable in cents per kilometer for the use of privately owned vehicles driven on authorized government business travel are .55 cents.

Allowances

The standard for accommodation is a single room, in a safe environment, conveniently located and comfortably equipped.

Total cost of Hotel/Motel accommodations not to exceed $200.00 per night taxes included within the Atlantic Provinces. Total cost of Hotel/Motel accommodation is not to exceed $250.00 per night taxes included if traveling domestically outside of Atlantic Canada or Internationally. Any exceptions to this amount require the approval of the CEO for employees and the Chair or Vice Chair for Board members and the CEO.

Private accommodations will be paid at a rate of $50.00 per night.

Meals

The rates payable for Meals per day are as follows:

Breakfast	17.23
Lunch	17.04
Supper	42.92
Daily Rate	$77.19

Incidental expenses

Incidental rate payable for each night in a hotel/private accommodation is $17.30 per night of overnight stay.

APPENDIX B

AFNWA CORPORATE CREDIT CARD AGREEMENT

BETWEEN:

THE Atlantic First Nations Water Authority (hereinafter referred to as "AFNWA")

and _____ (hereinafter referred to as the "Cardholder")

All Cardholders have been issued an AFNWA Corporate Credit Card. This card is a privilege and thus carries a responsibility. The Cardholder agrees to adhere to the AFNWA Travel Directive (as approved and amended from time to time) and the applicable AFNWA policies for continued use of the credit card privilege:

(a) This card is intended for AFNWA corporate/business expenses only.

(b) All expenses are to be claimed on approved AFNWA Credit Card Reconciliation forms with original receipts attached.

(c) Diligent protection of the number and expiry date is the AFNWA employee's responsibility. It is not recommended to give this information out in emails or over cell phones.

(d) Purchases that are outside the Cardholder's ordinary business expenses (as listed below), as they may vary from cardholder to cardholder, require pre-approval from a Manager.

Any violations of the AFNWA Travel Directive and the above noted rules regarding the usage of the corporate credit card will result in the loss of use of the credit card privileges. There are to be no personal expenses charged to the Corporate Credit Card.

If you have read and understood the AFNWA Travel Directive and relevant policies and if you are in agreement with the above noted terms/conditions and the corporate credit card cardholder agreement, please sign and date below.

Identified ordinary business expenses specific to Cardholder:

Cardholder Signature: _____

Name, Title: _____

Date: _____

Manager Signature: _____

ANNEX P

Atlantic First Nations Water Authority

Financial Policies and Procedures Manual

Acknowledgement

I, _____ , hereby acknowledge that I have received a copy of the Atlantic First Nations Water Authority **Financial Policy and Procedure Manual** (dated _____ , _____).

I have read and understood that the provisions of the Financial Policy and Procedures Manual impacts upon my employment or placement with the AFNWA.

Name (Please Print)

_____

Signature

_____

Date

_____

Witness

_____

Item # 7
AFNWA Board
November 30 2022

TO: Chief Wilbert Marshall, Chair and Members of the AFNWA Board

SUBMITTED BY: **Original Signed by**
Chantal LeBlanc, Manager of Corporate Services & CFO

APPROVED: **Original Signed by**
Carl Yates, interim CEO

DATE: **November 25, 2022**

SUBJECT: **Investment Policy**

ORIGIN

Governance Manual, approved November 6, 2020.

RECOMMENDATION

It is recommended that the AFNWA Board approve the Investment Policy, in its substantive form attached.

BACKGROUND

AFNWA has secured funding through a long-term Funding Agreement, a schedule to the Service Delivery Transfer Agreement, which includes capital and operating funds for the next ten years. Within the Funding Agreement, AFNWA will receive 50% of the Operating budget and 70% of the Capital budget on April 1st of each year, with the remainder due on September 1st.

DISCUSSION

The negotiated fund disbursement schedule is likely to result in significant deposits during the Spring and Fall of each year. AFNWA has drafted an investment policy, seeking the Board's pre-approval to invest these deposits, within parameters, in an effort to maximize deposit interest.

A summary of relevant items addressed by the draft policy is as follows:

- All investments must be made in guaranteed income funds and careful consideration must be made to ensure that sufficient liquidity is maintained.
- Investments must be made in socially responsible funds and borrowing funds to invest is strictly prohibited.
- The approval for transferring funds into and out of investments is primarily the responsibility of the Investment Committee which consists of the CEO and CFO.
- A detailed description of current and forecasted investments, together with anticipated interest revenue, as prepared by the Investment Manager (AFNWA Controller) is to be included with the regular quarterly financial update to the Audit and Finance Committee.
- Regular reviews of the portfolio must be conducted with the investment firm and AFNWA is not restricted to maintaining funds with one investment firm.

BUDGET IMPLICATIONS

In the interest of being conservative, Investment revenue was not included in the budget as a revenue stream for AFNWA. This revenue could be allocated to programs and/or activities within the Business Plan that require additional funding support.

ALTERNATIVES

None to be discussed.

ATTACHMENT

Draft Investment Policy

Report Prepared by: original signed by
Chantal LeBlanc, Manager of Corporate Services & CFO
(902) 603-0312

Financial Reviewed by: original signed by
Carl Yates, M.A.Sc., P.Eng., interim CEO, (902) 603-0312

Investment Policy

DRAFT for AFNWA Board Approval
November 22, 2022

Atlantic First Nations Water Authority is a First Nations owned non-profit organization (incorporated under Canada Not for Profit Act on July 18, 2018). The mission of AFNWA is to provide safe, clean drinking water and wastewater in all participating First Nations communities in Atlantic Canada, delivered by a regional water authority owned and operated by First Nations. In all things that we do, we strive to apply First Nations traditional knowledge and culture, including environmental stewardship, the spiritual aspects of water and Two–Eyed Seeing.

1. PURPOSE OF INVESTMENT GUIDELINES

The Investment Guidelines set out the authorities and responsibilities for the investment of restricted and unrestricted funds of AFNWA to remain focused on achieving the short- and long-term investment goals of the organization.

AFNWA will ensure that all investment activities are in compliance with relevant legislation.

2. ROLES & RESPONSIBILITIES

The Investment Committee will act in an advisory capacity to the Board of Directors, which has the responsibility to monitor the performance of the Portfolio.

The Investment Committee will assist the Board of Directors in developing an Investment Policy and investment guidelines annually and propose recommended changes required, for approval by the Board of Directors.

The Investment Committee shall consist of the Chief Financial Officer and the Chief Executive Officer and shall be responsible for the overall management of the invested funds in accordance with this policy.

The Investment Manager shall be the AFNWA Controller and shall be responsible for preparing reports and managing transactions for review and approval by the Investment Committee.

The Investment Agency/Agencies shall be the investment firm or financial institution who holds AFNWA investments, which may or may not refer to multiple entities.

3. INVESTMENT OBJECTIVES

The basic investment objectives are to ensure that funds will be invested in a prudent and effective manner and shall be sufficient to support cash flow requirements as they arise.

The expected required rate of return is to be targeted at a level which supports AFNWA's ongoing operations and to protect the value of the portfolio against inflation.

All investments are to be made in a way that protects the principal investment, that is to say, only guaranteed investment funds are to be undertaken (Refer to Appendix I for further details). The mix of investments or investment agencies as well as the term of the investments is to be determined by the Investment Committee, so long as the nature of the investments is in accordance with this policy.

The funds held by AFNWA are classified as either Short-Term Portfolio or Long-Term Portfolio.

Primary investment objectives for Short-Term Portfolio (less than 6 months) are:

- to preserve capital
- to maintain liquidity necessary to meet cash requirements
- to optimize the rate of return

Primary investment objectives for Long-Term Portfolio (6 months or longer) are:

- to preserve capital
- to optimize the rate of return, within acceptable risk levels as set by the Board of Directors in this policy.

4. AUTHORIZED INVESTMENTS

The AFNWA has a low appetite for investment risk and will participate in guaranteed investment funds with reputable investment agencies only.

Examples of these investments include, but aren't limited to:

- Canadian Treasury Bills
- Municipal Promissory Notes
- Provincial Treasury Bills
- Term Deposits
- Guaranteed Investment Certificates
- Federal, Provincial, Municipal Bonds and Debentures
- Corporate Bonds and Debentures
- Any obligations unconditionally guaranteed by the federal government of Canada
- Any obligations unconditionally guaranteed by a provincial government of Canada

5. RESTRICTIONS

There will be no borrowing from any source to make investments.

6. SOCIALLY RESPONSIBLE INVESTING

We define Socially Responsible Investing as making no investments in companies which are inconsistent with the AFNWA's corporate values. Furthermore, investments in projects that are detrimental to the environment or to cultural diversity should not be considered. We request that our Investment Committee consider these values when suggesting possible investments.

7. RESPONSIBILITIES OF THE INVESTMENT MANAGER(S)

The Investment Committee shall invest the funds of AFNWA within these specific written guidelines and in accordance with the Investment Objectives. In carrying out their duties and responsibilities, the Investment Committee shall exercise such competence and skill as may be expected of a prudent, diligent Investment Committee in similar circumstances.

The Investment Manager will report to the Investment Committee and shall prepare reports, which shall contain, as a minimum:

Monthly

- list of portfolio holdings and their maturity dates and values
- List of transactions for the month

Quarterly

- Quarterly and past 12-month total return calculations
- Economic and market commentary with forecasts for the next 12-month or other relevant period
- In addition, investment manager should have at least one formal meeting a year with the Investment Committee and Investment Agency to review the portfolio performance and discuss strategy for the ensuing period and make at least one presentation per year to the Board of Directors. Manager will refer, on a timely basis, any contentious issue so that guidance may be sought from the Investment Committee.

Investment Manager and Investment Committee must disclose any material interest in any investment or proposed transaction. All investment activities must be conducted in accordance with the AFNWA Code of Conduct and Conflict of Interest Policy.

The Investment Committee shall provide as much notice as possible regarding cash requirements or additional funds available for investment. But as these may not always be known in advance, consideration of this factor will be taken into account in assessing investment performance.

9. REVIEW OF INVESTMENT MANAGER(S) SERVICES

It is the responsibility of the Board of Directors to monitor the performance of the Investment Agency on an ongoing basis with input from the Investment Committee and Manager. Circumstances which could require a special review of an Investment Agency appointment include, but are not limited to:

- Changes in ownership, personnel, structure, investment philosophy, style or approach of the investment management firm, which might adversely affect the potential performance and/or risk level of the fund portfolio(s). It is expected that the Investment Manager(s) will routinely advise the Investment Committee of any significant changes within the firm.
- Unauthorized departure from the stated investment guidelines. (Note: If the Investment Manager(s') believes the guidelines are no longer appropriate, the Investment Manager(s') should make a recommendation for amending the policy.)
- Investment performance which over a reasonable period of time is less than the anticipated performance targets or the standards as outlined in this policy.

10. FUND WITHDRAWALS

Cash flow activity will be reported by the appropriate AFNWA staff to the Investment Committee and Board of Directors on a quarterly basis. This information will enable the Investment Committee to prepare a notice to the Board of Directors of any anticipated significant change in expected investment income. This information is relevant when the Committee and Board are reviewing the expectations and outcomes of the Investment Manager(s) performance. Any change of expectation should be documented and included in Board minutes.

The Investment Committee and the Board of Directors should be advised by the appropriate Investment Manager if an unscheduled fund withdrawal is required from the investment account.

APPENDIX I: Short-term and Long-term Portfolio Definitions

Short -term Portfolio can consist of

i) Unrestricted operating reserve funds
ii) Money designated for Capital budget items scheduled within the next 90 days.

These funds may need to be accessed within 6 months and should be put on a revolving quarterly maturity. IE: A portion of funds mature each quarter and can then be withdrawn or re-invested.

Long-term Portfolio can consist of

i) Externally restricted funds –Funds restricted by any external agency that are designated for use in a specific project with an approximated cash requirements that are 6 months or greater. Investment income made from this fund is to be re-invested.
ii) Internally Restricted Funds – Funds restricted internally that are designated for use in a specific project with an approximated cash requirements that are 6 months or greater. Investment income made from this fund is immediately available for use by AFNWA.

ITEM # 8
AFNWA Board
30 November 2022

TO: Chief Wilbert Marshall, Chair, and Members of the AFNWA Board

SUBMITTED BY: original signed by
James Trimble, Manager of Operations

APPROVED BY: original signed by
James Trimble, Manager of Operations

DATE: November 25, 2022

SUBJECT: **Water Quality Regulations**

ORIGIN

Transition Implementation Plan approved by AFNWA Board on June 24, 2020, and report presented at Board meeting of November 24, 2021. Board approval of water and wastewater quality regulatory and Nujo'tme'k Samuqwan/ Wolankeyutomune Samaqan safety plans (NSSP/WSSP) framework at meeting of January 26, 2022.

RECOMMENDATION

It is recommended that the AFNWA Board approve the interim drinking water regulations in the substantive form attached with an effective date of December 1, 2022.

BACKGROUND

At the Board meeting of January 26, 2022, staff received approval for a framework for water and wastewater quality regulations and NSSP/WSSP. The regulatory aspect included the recognition that Environment and Climate Change Canada would continue the role of regulator for compliance with the federal Wastewater Systems Effluent Regulations [WSER]. In recognition that there is no national regulatory agency or national regulations for drinking water at present,

options were presented for an interim oversight agency until such time that a national regulator is identified. It is expected that national regulations and a corresponding regulator will emerge after the replacement of the Safe Drinking Water for First Nations Act that was repealed on June 23, 2022. Through discussions with the Centre for Water Resources Students (CWRS), it was suggested that the First Nations and Inuit Health Branch of ISC, with support of the ISC-Regional Office, could play an interim oversight role for AFNWA to ensure conformance to the Guidelines for Canadian Drinking Water Quality [GCDWQ].

DISCUSSION

The above recommendations was discussed with two members of the EHS Committee on November 22, 2022 , however , due to lack of quorum , the recommendation is being made directly by staff.

With direction of the Board on January 26, 2022, staff worked with CWRS to develop a set of interim drinking water regulations consistent with the GCDWQ and based to a large extent on those utilized in Nova Scotia which are most aligned with best practice in Canada. In this regard, the proposed regulations will ensure a consistent approach across all of the communities within the Wabanaki territory who become members of AFNWA. The regulations were sent to ISC for their feedback with recommendations and suggested edits incorporated in the final draft attached. As part of the development of the regulations, AFNWA and ISC recognized limitations within ISC to provide oversight in certain technical areas and as a result overtures were made to NS Environment and Climate Change [NSECC] for support. As a result, ISC and NSECC are working towards a contractual relationship to close the identified gaps necessary for substantive compliance oversight. Notwithstanding this arrangement, FNIHB will serve as the one window for AFNWA as the lead oversight agency. The term oversight has been used intentionally in recognition that neither FNIHB or NSCEE have any authority to regulate AFNWA.

From recent discussions with ISC, it is expected that a contract with NSECC will be in place to begin oversight of the regulations developed for AFNWA by April 1, 2023. In the meantime, staff are requesting approval from the Environment, Health and Safety Committee to adopt the interim regulations effective December 1, 2022 in recognition that some First Nations communities will become members of AFNWA on that date. As expected, AFNWA will work closely with the First Nations and Inuit Health Branch to transition from the current oversight system to the new framework endorsed by the AFNWA Board

BUDGET IMPLICATIONS

Funds for the development of the interim regulations were contained in the 2022/23 Operations budget. Funds for the implementation of the regulatory and NSSP/WSSP framework are included in future Operations and Capital budgets.

ATTACHMENT

Interim Regulations_AFNWA_2022.pdf

Report Prepared by: original signed by
James Trimble, Manager of Operations, 902-603-0312

Financial Reviewed by: original signed by
Chantal Leblanc, CFO/ Manager of Corporate Services
902-603-0312

Report Approved by: original signed by
Carl Yates, interim CEO, 902-603-0312

ATLANTIC FIRST NATIONS WATER AUTHORITY INC.

DRINKING WATER REGULATORY GUIDANCE AND COMPLIANCE STANDARDS

Version 3.0

November 14, 2022

Drinking Water Regulatory Guidance and Compliance Standards

Prepared for:

Atlantic First Nations Water Authority, Inc.

13 Treaty Trail Millbrook, NS B6L 1W1

Prepared by:
Centre for Water Resources Studies
Dalhousie University
1360 Barrington St. D514
Halifax, NS B3H 4R2
T: 902.494.6070
F: 902.494.3105
water@dal.ca

Table of Contents

1.0 Introduction and Context

Following the repeal of the 2013 Safe Drinking Water for First Nations Act (SDWFNA), there are no regulations covering drinking water quality in First Nation reserves on federal lands and no regulating body empowered to provide oversight. The Atlantic First Nation Water Authority (AFNWA) is set to assume responsibility and liability of participating First Nation drinking water and wastewater systems (and represent communities engaged in municipal transfer agreements (MTAs) in 2022. The AFNWA, as the first Indigenous owned and operated water utility in Canada, is charting a path for Indigenous service delivery and has acknowledged that a regulatory framework is imperative for its mission of providing safe, clean drinking water and wastewater to participating First Nations communities. The AFNWA, in coordination with Indigenous Services Canada (ISC), contracted the Centre for Water Resources Studies (CWRS) at Dalhousie University to develop an interim regulatory framework for drinking water and wastewater services. The framework was the culmination of an international jurisdictional scan that incorporated best practices from provincial, Indigenous, and international examples that provided a complimentary integration of regulatory compliance standards and risk-based management practices. The framework includes 24 recommendations to address water and wastewater management.

Regulatory Compliance Standards: Drinking Water

This guidance document presents in-depth protocols, standards, and processes associated with the compliance standards identified in the regulatory framework. The purpose of this document is to establish and clearly define requirements for each compliance standard, with a particular focus on drinking water standards, as there are no federal regulations for drinking water at this time. This document does not include guidance for wastewater compliance, as that information is made available through, and regulated by, Environment and Climate Change Canada (ECCC).

2.0 Structure and Format

2.1 Regulatory Framework: Compliance Standards, Regulations, and Nujo'tme'k Samqwan Safety Plans/Wolankeyutomune Samaqan Safety Plans

Drinking water regulations and associated compliance activities

Within the 14 compliance recommendations in the regulatory framework, there are **10 that include specific compliance standards pertinent to the production and delivery of clean and safe drinking water**. These components are defined in detail in this document. In many instances regulations and guidance was taken from the Nova Scotia context and adapted to fit the unique situation of the AFNWA.

Wastewater regulations

Because wastewater effluent quality is regulated at the federal level through the Fisheries Act (Wastewater Systems Effluent Regulations, pollution prevention provisions and Deposit Out of the Normal Course of Events (DONCE) Notification requirements) this document does not provide guidance on this matter. Environment and Climate Change Canada (ECCC), in coordination with Fisheries and Oceans Canada (DFO), act as the regulatory agency for wastewater effluent discharge into all receiving bodies.

Integration with Nujo'tme'k Samqwan safety plans

The risk-based management cycle, Nujo'tme'k Samqwan Safety Plans (NSSP), is built on the World Health Organizations (WHO) Water Safety Planning framework. Nujo'tme'k Samqwan translates in Mi'kmaq to "we take care of the water". The Wolastoqey translation of "we take care of the water" is Wolankeyutomune Samaqan (WS), so the Wolastoqey abbreviation for safety planning is WSSP. This risk-based improvement cycle will be developed in concert with the compliance standards and provide a holistic proactive management approach centered on the Wabanaki world-view of protecting and caring for the water. Where applicable, this guidance document references where the regulatory framework components inform and intersect with the NSSP process.

2.2 Federal Regulations

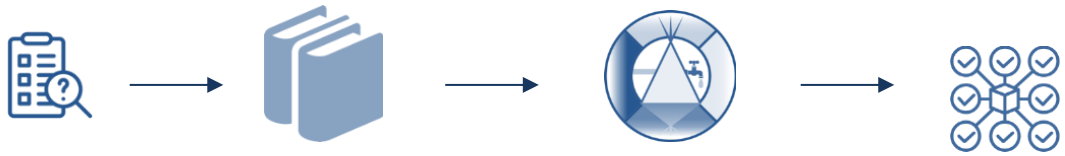
While there are federal regulations setting minimum performance standards for centralized wastewater systems (> 100m^3/day treatment volume) and general federal requirements regarding the release of deleterious substances into fish inhabited waters under the Fisheries Act, there are limited regulations regarding drinking water services. Because the provision of safe drinking water is devolved to provincial and municipal governments, the only intersection of drinking water provision and federal regulations is related to the endangerment of fish in surface waters. No federal regulations exist to address the withdrawal of water from aquifers. Where federal regulations do apply, namely through the following legislation:

- Fisheries Act
- Species at Risk Act

this document will provide details of the regulations and descriptions of compliance standards and processes. Additionally, applicable Federal and Provincial Occupational Health and Safety legislation and regulations will be included here as necessary.

2.3 Governance Best Practices

Where there are no federal regulations to establish drinking water standards and requirements, various jurisdictional best practices will be applied, per the Interim Regulatory Framework developed for the AFNWA. In many cases, governance was taken, in part or in whole, from Nova Scotia's Environment Act and associated regulations and standards. For each of the compliance standards in the framework, the text from the regulations, standards, guidelines, etc. was adopted and cited. Edits and alterations were made, as necessary, to adapt the language and details to the AFNWA context. Mentions of "Ministers", "Acts", "Regulators", etc. were removed and appropriate conditions were embedded, i.e., "oversight entity", "compliance monitoring unit", etc.



Compliance standard defined
Each of the 14 compliance standards are defined and related to the larger AFNWA regulatory and risk-management framework

Reference documents identified
Guiding documentation cited details of the jurisdiction, legislation, and regulations used to establish the compliance standard will be cited

Adaptation to a First Nations context
The full language of the compliance standard, as adapted from the applied jurisdiction is provided, with external links, as needed

Integration of standards and risk-management cycle
In many instances, compliance standards are interdependent or integrated with other compliance standards or the risk-management cycle. These instances will be described and linked, as necessary

Figure 2-1. Process for developing compliance standards.

3.0 Overview: Regulatory Compliance Standards

The Water and Wastewater Quality Regulatory and NSSP/WSSP Framework is composed of both compliance and risk management elements. The individual elements are shown below with a summary of regulatory compliance standards associated with the provision of safe, clean drinking water. Components in gray boxes represent regulatory compliance standards that will be described in detail in this document.

Figure 3-1. Overview of the 14 compliance standard recommendations in the regulatory framework.

4.0 Compliance Monitoring Unit

4.1 AFNWA Compliance Strategy

Coordination across the AFNWA organization structure will ensure that operational, monitoring, infrastructural, and reporting activities are conducted in such a way as to achieve conformance and adherence to the regulatory framework and associated compliance activities. A compliance monitoring unit, populated by key positions indicated in Table 4.1, will be responsible for overseeing the AFNWA's compliance performance.

Table 4-1. Roles and responsibilities of the membership of the Compliance Monitoring Unit.

Manager of Operations	Oversee relevant operational components of compliance program, including developing record keeping processes for monitoring, calibration, and sampling activities. Oversee Operator training and certification efforts and maintaining training logs.
Manager of Engineering	Oversee relevant infrastructure components of a compliance program, including maintenance logs, adverse event details related to infrastructure issues, changes or improvements to treatment processes, etc.
Superintendent of Operations	Communicate and operationalize compliance activities with operations staff, including development of Standard Operating Procedures, training materials, and other matters related to sampling and monitoring, reporting, and issue escalation practices.
Operations Engineer	Coordinate integration of compliance standards and practices with NSSP/WSSP and relate proactive risk-management knowledge to the compliance process.
Regulatory Compliance Coordinator	Synthesize all relevant compliance information and activities in a harmonized way and identify any issues of noncompliance or performance deviation. Communicate compliance information to other stakeholders within the AFNWA.

5.0 Compliance Standard: Source Water Withdrawal

FEDERAL LEGISLATIONS AND AGENCIES

Fisheries Act

All eligible surface water projects must avoid causing death of fish and the harmful alteration, disruption, or destruction of fish habitat.

Species at Risk Act

All eligible surface water projects must consider if the work may result in the death, harm, harassment, capture or taking possession of an aquatic species at risk or damage the residence of an aquatic species at risk.

DFO – FPP

The Fish and Fish Habitat Protection Policy Statement is available for applications to review and understand the framework used to review projects to ensure conservation of fish and fish habitat.

Fisheries Protection Program
Attention: Referrals Secretariat
Fisheries and Oceans Canada
PO Box 1006
Dartmouth, Nova Scotia B2Y 4A2
Telephone: 902-426-3909
Fax: 902-426-7174
Email: ReferralsMaritimes@dfo-mpo.gc.ca

Fisheries and Oceans Canada Requirements

All surface water withdrawal designs should be forwarded to the Department of Fisheries and Oceans Canada (DFO) Fisheries Protection Program (FPP) for review and comment under the Fisheries Act and Species at Risk Act.

The applicant must provide engineering drawings of the intake which must confirm that pump intakes are screened to prevent the entrainment or impingement of fish. Entrainment occurs when a fish is drawn into a water intake and cannot escape. Impingement occurs when an entrapped fish is held in contact with the intake screen and is unable to free itself.

Fine screens used at an end-of-pipe intake, where water is being extracted from fish-bearing waters, must conform to the Department of Fisheries and Oceans (DFO) document Freshwater Intake End-of-Pipe Fish Screen Guidelines. The If the intake is from a fish-bearing water source and fine screens are only provided at the facility (i.e. not at the end of intake pipe), the screen design and flow velocity maximums must adhere to the DFO guidelines, and additional provisions may be required to allow fish to escape the intake structure. The local regulatory authority may require review and approval of the intake and screening design.
Fine screens used at the inlet of a surface water treatment facility should meet the following requirements[1]:

- Provide a screen opening between 150% to 200% of the conveyance channel;
- Provide a head loss no greater than 1.5 m;
- Have a mesh between 6 and 9 mm;
- Have a velocity of the net screen openings not greater than 0.6 m/s at maximum design flow and minimum submergence (lower requirements may be imposed by regulatory agencies for certain species of fish);

Coarse screens (bar and/or trash racks) may be required upstream of fine screens. Coarse screens should be constructed using 13 to 19 mm bars inclined at 30 degrees from vertical, providing 25 to 75 mm openings[2].

[1] Details taken from the Interim Code of Practice: End-of-pipe fish protection screens for small water intakes in freshwater
[2] Design specifications taken from ACWWA Design of Water Treatment Process

6.0 Compliance Standard: Source Water Protection

PROVINCIAL REFERENCES

NS Environment Act

Nova Scotia requires a source water protection plan for all municipal drinking water sources, which includes five distinct steps to facilitate hazard identification, risk assessment and developing and executing a monitoring plan. This approach to source water protection aligns well with the substantial body of work that First Nations communities have done regarding source water protection.

NS Treatment Standards

Nova Scotia Treatment Standards for Municipal Drinking Water Systems contain the detailed requirements for source water protection plans.

Overview

Effective water treatment begins with source water protection to minimize the input of fecal contamination from human and animal sources and chemical contamination from human activities. Source water protection is the first barrier in the multiple-barrier approach recommended for the production of safe and clean drinking water in Canada.

Minimum Requirements

The AFNWA is responsible for taking reasonable steps to protect the source water from contamination. Minimum requirements for source water protection plans (SWPP) developed by the AFNWA, as the water utility responsible for the source, should be developed using the five steps described below:

- Step 1 - Form a Source Water Protection Advisory Committee
- Step 2 - Delineation a Source Water Protection Area Boundary
- Step 3 - Identify Potential Contaminants and Assess Risk
- Step 4 - Develop a Source Water Protection Management Plan
- Step 5 - Develop a Monitoring Program to Evaluate the Effectiveness of a Source Water Protection Plan

The AFNWA should complete the risk identification process[3] depending on the source type as follows:

- surface water - within the natural watershed boundary;
- groundwater under the direct influence of surface water (GUDI) - within the natural watershed boundary and the 25-year time-of-travel; or other reasonable boundaries established by the AFNWA that make sense relative to the Reserve boundaries;
- non-GUDI - within the 25-year time-of-travel, or other reasonable boundaries established by the AFNWA that make sense relative to the Reserve boundaries

Drinking water systems with large natural watershed boundaries may focus their management strategies on high-risk activities and activities close to the intake. They may also consider a graduated risk management approach based on distance from the intake. Examples of high-risk activities include: wastewater discharges, agricultural uses, residential development, chemical plants, etc. A monitoring plan to support source water protection must be developed and included in the Annual Sampling Plan for each system. Further guidance on developing a source water protection plan can be found in Appendix 6-A.

Initial SWPP must be submitted to the oversight entity by October 1st. Any alterations to the SWPP must be addressed in both the Annual Sampling plan and Annual Report. An important part of the risk assessment and mitigation cycle is continued improvement. Updated SWPPs must be available upon request for the purpose of on-site inspections and audits as part of the larger compliance and NSSP/WSSP oversight efforts.

[3] Additional details for accomplishing this five-step approach are available through NSECC or the Canadian Environmental Law Association's Source Water Protection in Indigenous Communities Legal Tool Kit

7.0 Compliance Standard: Receiving Water Protection

Receiving water protection refers to wastewater effluent management and is dependent on the vulnerability and sensitivity of the receiving body and nature of the treated effluent. The regulatory framework addresses wastewater effluent through the application of federal regulations and the use of NSSP/WSSPs. Specific requirements regarding wastewater effluent monitoring and reporting are not included in this compliance guidance document.

Wastewater regulations

Following WSER requirements, as legislated under the Fisheries Act, any centralized wastewater system that treats > 100m^3/d must complete an identification report and subsequent monitoring reports per the WSER standards.

All wastewater systems releasing effluent must adhere to the Fisheries Act pollution prevention provisions and Deposit Out of the Normal Course of Events (DONCE) Notification requirements for reporting spills and releases, regardless of daily treatment volume.

Integration with NSSP/WSSPs

Beyond the WSER standards, the AFNWA should establish Effluent Discharge Objectives (EDOs) following the technical guidance of the CCME WWME procedures as a matter of risk management.

8.0 Compliance Standard: Facility Requirements

PROVINCIAL REFERENCES

NS Treatment Standards

Nova Scotia Treatment Standards for Municipal Drinking Water Systems contain the detailed requirements for treatment process and facility design.

NS Approval to Operate

Nova Scotia Approvals to Operate set the facility requirements for water and wastewater systems, as legislated by the Environment Act - Chapter 1, Activities Designation Regulations, and Water and Wastewater Facilities and Public Drinking Water Supplies Regulations.

The application for an Approval to Operate for a drinking water system requires that facilities meet the recommendations of the Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution, and Operation of Drinking Water Supply Systems.

Overview

The Atlantic Canada Water Supply Guidelines, design guidelines published by the Atlantic Canada Water and Wastewater Association (ACWWA), is the regional standard guiding the development of water supply projects in Atlantic Canada.

Requirements

The Atlantic Canada Water Supply Guidelines document (as amended and updated from time to time) serves to provide evidence-based best practices in water supply development. All new projects or system upgrades should be designed to the specifications detailed in the Atlantic Canada Guidelines.

Existing systems that do not meet the guidelines established in the most recent publication of the Atlantic Canada Water Supply Guidelines should develop corrective action plans, as necessary, to address the highest-risk deficiencies first, as determined by the NSSP/WSSP process.

The Guidelines, where appropriate, defer to provincial regulations and standards in recognition of notable variations in provincial water governance in the Atlantic region. Where such deference occurs, the AFNWA should follow Nova Scotia standards, or work with the oversight entity to determine appropriate action.

Section 9 of this document, Treatment and Distribution Requirements, includes direct reference to the use of The Atlantic Canada Water Supply Guidelines as a guiding document for system design. In general, these guidelines, and any additional technical details provided in Section 9 and associated Appendices, shall be followed to standardize the design, construction, commissioning, and operation of Community Drinking Water Systems participating in the AFNWA. If there is a discrepancy between the treatment standards outlined in Section 9 and the Atlantic Canada Water Supply Guidelines, the more stringent shall apply.

9.0 Compliance Standard: Treatment and Distribution Requirements

PROVINCIAL REFERENCES

NS Environment Act

The Nova Scotia Environment Act establishes the standards and regulations that determine the level of treatment of municipal systems and the monitoring and reporting approaches for these systems.

NS Treatment Standards

Nova Scotia Treatment Standards detail key infrastructural and operational practices required for the provision of safe drinking water, including log removal requirements, instrumentation and alarm requirements, treatment redundancies, and monitoring practices.

Treatment and distribution requirements are dependent on the quality and characteristics of the source water and involve many barriers in the source-to-tap path. The AFNWA is responsible for determining water quality characteristics of the source water and applying necessary treatment based on source water type. The following treatment standards are adapted from Nova Scotia's Treatment Standards for Municipal Drinking Water Systems, which reference the use of the *Atlantic Canada Water Supply Guidelines*, to guide treatment and distribution requirements.

9.1 Requirements Related to the Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol)

Following Nova Scotia's process for determining groundwater under the direct influence of surface water (GUDI), the AFNWA shall ensure that all groundwater wells in their system have been classified in accordance with the Protocol for Determining Groundwater Under the Direct Influence of Surface Water as outlined in Appendix 9-A (GUDI Protocol). The GUDI Protocol (provides a process for determining whether a water well is classified as "groundwater under the direct influence of surface water" (GUDI) and, if so, its specific GUDI risk classification. This classification determines the applicable treatment and monitoring requirements.

a. A system that relies on groundwater must ensure that all wells in the community supply have been classified in accordance with Nova Scotia's Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol) (Appendix 9-A), as amended from time to time.
b. A well assigned a GUDI classification prior to the transfer of assets to the AFNWA, does not need to be re-assessed, unless water quality or system performance evidence indicates a need for reclassification based on Appendix 9-A section A.3.6.
c. The AFNWA is responsible for completing the GUDI Protocol as outlined in Appendix 9-A and submitting the resulting GUDI classification to the oversight entity for review and acceptance.
d. GUDI classifications must be made by a Qualified Hydrogeologist registered to practice in a recognized organization within Canada. The classifying Qualified Hydrogeologist is considered the person responsible for all aspects of the GUDI Protocol assessment and this includes a duty to ensure the proper collection, integrity and use of data in accordance with the GUDI Protocol and recommendation regarding the assignment of natural filtration credits.
e. It is the responsibility of the AFNWA to evaluate the recommendation of the Qualified Hydrogeologist and submit to the oversight agency for application of a natural filtration credit.
f. The completion of the GUDI Protocol, the classification, and assignment of natural attenuation credit should be reviewed by the oversight entity.

9.2 Adequate Treatment and Distribution

The second barrier in the multiple barrier approach involves making water safe by having adequate treatment in place to remove natural or manmade contaminants and maintaining a high-quality distribution system. This is achieved by determining what contaminants are present in the water supply and installing adequate treatment methods to remove the contaminants, including disinfection to inactivate microorganisms. A high-quality distribution system is reliable, providing a continuous supply of potable water at adequate pressure.

9.2.1 Treatment and Operational Requirements for Surface Water and GUDI Sources without a Natural Filtration Log Credit[4]

9.2.1.1 General Requirements

a. Using both the engineered filtration and disinfection processes, the Community Drinking Water System must meet the following treatment efficiencies:
   i. Treatment shall ensure 3-log reduction of Giardia and Cryptosporidium; and
   ii. Treatment shall ensure 4-log reduction of viruses.
b. Primary disinfection though the use of chlorine, UV, and/or accepted alternate disinfectant such as chlorine dioxide or ozone shall achieve a minimum of 0.5-log inactivation for Giardia when used in conjunction with filtration. The disinfection log inactivation shall be based on CT/IT values calculated as described in Section 9.7.
c. The AFNWA shall adhere to the requirements outlined in Table 9.1 based on the type of primary disinfectant used.

Table 9-1. Operational requirements based on type of primary disinfectant.

Primary Disinfectant	Requirements
Free Chlorine Note: Chloramines are not acceptable for use as a primary disinfectant	a. The water system shall meet the required CT value, at a minimum, as outlined in Section 9.7 and Appendix 9-D. b. In the event the minimum required CT is not achieved, contingencies shall be in place to prevent the distribution of inadequately disinfected water. c. The AFNWA shall work collaboratively with the oversight entity to determine if site-specific requirements may apply.
Ultraviolet (UV) Light	The water system shall meet the following requirements: a. UV systems must provide a minimum dosage of 40 mJ/cm^2 at all points within the reactor at all times when water is passing through the unit, unless an alternate dose has been accepted by the oversight entity. b. UV intensity and flow through the reactors shall be monitored a minimum of once every five minutes to ensure UV dose is greater than or equal to 40 mJ/cm^2, or alternate acceptable dose. c. UV transmittance shall be calculated at a minimum of daily. d. Contingencies shall be in place to prevent the distribution of water if the UV dose drops below 40 mJ/cm^2, or alternate acceptable dose, including during lamp warm-up time. Water flow shall be stopped, directed to waste, or another method of disinfection shall be used. e. In the event of UV bulb breakage during operation, contingencies shall be in place to prevent the distribution of inadequately disinfected water. f. The UV disinfection unit shall be equipped with UV sensors reading calibrated UV intensity. The UV sensors shall be calibrated on a monthly basis. Off-line reference sensors used for calibration shall be of equal quality to the on-line sensors and shall be calibrated annually.

[4] High-risk GUDI sources are not eligible to receive a natural filtration log credit.

	g. The AFNWA shall record the results of the calibration as part of their QA/QC program and provide the results to the oversight entity upon request. h. The UV system shall be equipped with an alarm notification and shutdown procedures in the event of: – High temperature in the reactor, lamp, ballast or transformer; – High flow rate that causes dose to fall below design specifications; – Low UV dose; – Low UV intensity; – UV has shutdown; or – Any other emergency situation. i. The UV transmittance analyzer shall be calibrated weekly. j. UV lamp operation shall be monitored in a manner that ensures bulb replacement can be accomplished prior to the maximum lamp life expectancy. k. The AFNWA shall receive written verification from an independent third party that the manufacturer's system will continually meet the 40 mJ/cm^2 requirement, or alternate acceptable dose, and provide this information to the oversight entity upon request. l. The AFNWA shall work collaboratively with the oversight entity to determine if site-specific requirements may apply.
Chlorine Dioxide	a. The water system shall meet the required CT value, at a minimum, as outlined in Section 9.7 and Appendix 9-D. b. In the event the minimum CT is not achieved, contingencies shall be in place to prevent the distribution of inadequately disinfected water. c. The feed dose shall not exceed a maximum of 1.2 mg/L. d. The AFNWA shall work collaboratively with the oversight entity to determine if site-specific requirements may apply.
Ozone	a. The water system shall meet the required CT value at a minimum as outlined in Section 9.7 and Appendix 9-D. b. In the event the minimum CT is not achieved, contingencies shall be in place to prevent the distribution of inadequately disinfected water. c. The AFNWA shall work collaboratively with the oversight entity to determine if site-specific requirements may apply.

9.2.1.2 Primary Disinfection

Disinfection Units

a. The Community Drinking Water System shall have a minimum of two primary disinfection units to ensure that inadequately disinfected water is not distributed.
b. Each disinfection unit shall be capable of meeting the maximum day demand flow.
c. Where more than two disinfection units are provided, the maximum day demand flow shall be met when the largest unit is out of service.

Monitoring

See Appendix 9-H for details relating to monitoring requirements. Monitoring requirements include:

Continuous on-line monitoring of the primary disinfection process is required at each Community Drinking Water System.

Measurements must be taken and recorded at a minimum of once every five minutes to ensure that inadequately disinfected water does not enter the distribution system.

a. Water systems shall be equipped with alarm capabilities to notify operations staff if the disinfection process fails to operate properly to prevent inadequately disinfected water from being distributed. Contingencies shall be in place to prevent the distribution of inadequately disinfected water.

Standard Operating Procedures (SOPs)

a. SOPs for the disinfection process shall be developed, implemented, and communicated to all operations staff and documented in the operations manual (as developed by the AFNWA for each system).
b. The procedures and a log indicating the date and method of communication to staff shall be made available to the oversight entity (and/or auditors) upon request.
c. SOPs shall indicate the design ranges for achieving CT (e.g., for free chlorine disinfection - minimum temperature and chlorine residual; maximum flow and pH) and/or IT (e.g., minimum UV intensity, minimum UV transmittance, and maximum water flow).
d. When operational conditions are outside the design ranges for achieving CT/IT, the AFNWA shall notify the oversight entity as soon as the AFNWA becomes aware, investigate the cause, and take necessary corrective action. CT/IT shall be calculated during every such event
e. SOPs shall establish a reporting mechanism to include near misses and incidents in the NSSP/WSSP hazard identification and risk assessment cycle no more than six (6) months after the event.

9.2.1.3 Turbidity and Filtration Requirements

a. Continuous or grab sample monitoring for turbidity is required at least once a day for the raw water prior to pre-treatment.
b. Filters:
    i. A minimum of two filters or membrane units (redundancy) are required.
    ii. Where two filters or membrane units are provided, each shall be capable of supplying maximum daily demands with the largest filter or membrane out of service.
    iii. Where more than two filters or membrane units are provided, the maximum day demand shall be met with the largest filter or membrane out of service.
c. Based on the type of filtration technology, the AFNWA shall adhere to the requirements outlined in Table 9.2.
d. The filtration process shall be operated in such a manner as to remove an individual filter or membrane unit from service if the turbidity exceeds the values specified in Table 9.2.
e. Filtration processes for pathogen reduction are required to be continuously monitored, with turbidity measurements collected and recorded at a minimum frequency of once every five minutes.
f. Filtration processes shall have a shut off feature and alarm when turbidity criteria are not achieved.
g. The AFNWA shall notify the oversight entity as soon as they become aware of turbidity values that do not meet the requirements of Table 9.2.
h. SOPs for the filtration process shall be developed, implemented, and communicated to all operations staff and documented in the operations manual (as developed by the AFNWA for each system).
The procedures and log of communication shall be made available to the oversight entity upon request.
i. SOPs shall establish a reporting mechanism to include near misses and incidents in the NSSP/WSSP hazard identification and risk assessment cycle no more than six (6) months after the event.

9.2.2 Treatment and Operational Requirements for Non-GUDI and GUDI Sources with a Natural Filtration Log Credit(s)

As the operational requirements are similar for both non-GUDI and GUDI sources assigned a natural filtration log credit, the AFNWA shall adhere to the requirements outlined in this section. Where there are differences in requirements for non-GUDI and GUDI sources assigned a natural filtration log credit, the differences are specified.

The Community Drinking Water System using a GUDI source of supply may apply a natural filtration log credits(s) as outlined in Appendix 9-B[5], based on the recommendation of a Qualified Hydrogeologist. The oversight entity must be made aware of the application of a natural filtration log credit and may review hydrogeological data used for the assignment of such credits.

9.2.2.1 General Requirements

Non-GUDI

Treatment shall be sufficient to ensure 4 log reduction of viruses for each well or, if water from individual wells is combined, for the combined flow.

Low-Risk and Medium-Risk GUDI

a. Using both the natural filtration and disinfection processes, the AFNWA shall meet the following treatment efficiencies:
    i. Treatment shall be sufficient to ensure 3-log reduction of Giardia and Cryptosporidium; and
    ii. Treatment shall be sufficient to ensure 4-log reduction of viruses.
b. For Low-Risk GUDI: based on the assessment by a Qualified Hydrogeologist, verified natural filtration allows a 3-log reduction credit to be assigned for Giardia and Cryptosporidium treatment.
c. For Medium-Risk GUDI: based on the assessment by a Qualified Hydrogeologist, verified natural filtration allows a 1-log reduction credit to be assigned for Giardia and Cryptosporidium treatment.

9.2.2.2 Primary Disinfection Requirements

The AFNWA shall adhere to the requirements outlined in Table 9.1 based on the type of primary disinfectant used.

Disinfection:

a. For non-GUDI and low-risk GUDI assigned a natural filtration log credit, primary disinfection through the use of chlorine, UV, and/or an acceptable alternate disinfection method shall contribute a minimum of 4-log inactivation for viruses for each well or, if water from individual wells is combined, for the combined flow.
b. For medium-risk-GUDI assigned a natural filtration log credit, primary disinfection through the use of chlorine, UV, and/or an acceptable alternate disinfection method shall contribute a minimum of 2-log inactivation for Giardia and Cryptosporidium and 4-log reduction viruses for each well or, if water from individual wells is combined, for the combined flow.
c. The disinfection log inactivation shall be based on CT/IT values calculated as described in Section 9.7.

Disinfection Units:

a. Flow from each well or the combined flow, if water from individual wells is combined, shall have a minimum of two primary disinfection units configured to apply disinfection treatment at all times to ensure that inadequately disinfected water does not enter the water distribution system, unless the AFNWA can ensure system-wide redundancy and provides validation to the oversight entity.
    i. Each disinfection unit shall be capable of meeting the maximum day demand flow.
b. Where more than two disinfection units are provided, the maximum day demand flow shall be met when the largest unit is out of service.

[5] Appendix 9-B explains the application procedure for Nova Scotia Environment and Climate change. This process can be applied by the AFNWA and the assignment of log reduction credits can be done based on the recommendations of the Qualified Hydrogeologist completing the GUDI assessment. AFNWA assumes all responsibility for the application of such credits.

Monitoring:

See Appendix 9-H for details relating to monitoring requirements. Monitoring requirements include:

a. Continuous on-line monitoring of the primary disinfection process is required at each Community Drinking Water System with measurements taken at a minimum of once every five minutes to ensure that inadequately disinfected water does not enter the distribution system.
b. Water systems shall be equipped with alarm capabilities to notify operations staff if the disinfection process fails to operate properly to prevent inadequately disinfected water from being distributed

Standard Operating Procedures (SOPs):

a. SOPs for the disinfection process shall be developed, implemented and communicated to all operations staff and documented in the operations manual(as developed by the AFNWA for each system).
b. The procedures and a log indicating the date and method of communication to staff shall be made available to the oversight entity upon request.
c. SOPs shall indicate the design ranges for achieving CT (e.g., for free chlorine disinfection - minimum temperature and chlorine residual; maximum flow and pH) and/or IT (e.g., minimum UV intensity, minimum UV transmittance, and maximum water flow).
d. When operational conditions are outside the design ranges for achieving CT/IT, the AFNWA shall notify the oversight entity as soon as they become aware, investigate the cause, and take necessary corrective action. CT/IT shall be calculated during every such event.
e. SOPs shall establish a reporting mechanism to include near misses and incidents in the NSSP/WSSP hazard identification and risk assessment cycle no more than six (6) months after the event.

9.2.2.3 Turbidity Requirements

Non-GUDI

a. The turbidity levels entering the water distribution system from each well or combination of wells shall not exceed 1.0 NTU in:
    i. at least 95% of the measurements taken by grab sample for each calendar month; or
    ii. at least 95% of the time each calendar month if continuous monitoring is the method of turbidity measurement.
b. A daily grab sample, collected once per day, or continuous monitoring, with measurements taken at no more than five-minute intervals, is required at each wellhead or combined flow.
c. If the Community Drinking Water System cannot meet the 1.0 NTU turbidity requirements described in these standards, the AFNWA may apply a less stringent value, in consultation with the oversight entity, provided the AFNWA can demonstrate to the oversight entity that the turbidity is not health-related and that the disinfection process is not compromised by the use of a less stringent value.

Low-Risk and Medium-Risk GUDI

a. The turbidity value at each wellhead shall be equal to or less than 1.0 NTU in:
    i. at least 95% of the measurements; or
    ii. at least 95% of the time based on each calendar month.
b. Continuous turbidity monitoring and recording is required for each GUDI well, with measurements taken at no more than five-minute intervals.
c. If the Community Drinking Water System cannot meet the 1.0 NTU turbidity requirements described in these standards, the AFNWA may apply a less stringent value, in consultation with the oversight entity, provided the AFNWA can demonstrate to the oversight entity that the turbidity is not health-related and that the disinfection process is not compromised by the use of a less stringent value.

9.3 Bacterial Monitoring and Treatment Requirements in Groundwater Systems during the GUDI Evaluation

a. For groundwater wells, a minimum of two raw water bacteria (total coliform and *E.coli)* samples shall be collected to assess the water quality screening criteria in Step 1 of the GUDI Protocol (Appendix 9-A), as amended from time to time. These samples must be collected at the middle and end of the 72-hour pumping test.
b. If a well being assessed under the GUDI protocol has bacteria detected in either of the two raw water samples, the AFNWA must carry out additional sampling to confirm whether bacteria continue to be present.
    i. The AFNWA must collect a minimum of two additional samples, separated by a minimum of 24 hours, as outlined in Section A.2.1 of Appendix 9-A.
    ii. If any of the additional samples contain bacteria, the well shall fail Step 1, unless additional corrective action is undertaken, and further additional sampling demonstrates the well does not contain bacteria in the latest two consecutive samples.
    iii. The iterative process of corrective action to a well followed by additional sampling may only be carried out twice before Step 1 results must be determined.
c. For groundwater wells that fail Step 1 of the GUDI Protocol (Appendix 9-A), as amended by Nova Scotia Environment and Climate Change from time to time, for reasons other than water quality, the following shall apply:
    i. The well may be connected to the distribution system to allow the completion of Steps 2 and 3 of the Protocol, in which case, the following shall apply:
    – The well shall be equipped with a disinfection system capable of achieving 4-log reduction for viruses;
    – A minimum of 0.4 mg/L free chlorine residual shall be maintained at the end of the distribution system; and
    – Twice weekly sampling and analysis for total coliform and *E.coli* bacteria of water in the distribution system shall be conducted.
d. If the well failed Step 1 due to total coliform or *E.coli* bacteria presence, or if any subsequent samples are confirmed for bacteria, and the well is connected to the distribution system for the completion of the GUDI Protocol, the following shall apply:
    i. The well shall be equipped with a disinfection system capable of achieving 3- log reduction for protozoa;
    ii. The well shall be equipped with a disinfection system capable of achieving 4- log reduction for viruses;
    iii. A 0.4 mg/L free chlorine residual shall be maintained at the furthest point in the distribution system; and
    iv. Twice weekly sampling and analysis for total coliform and *E.coli* bacteria of water in the distribution system shall be conducted.
e. Step 2 of the GUDI Protocol shall be completed under proposed “normal operating conditions” (e.g., proposed flow rate, well on/off cycling, etc.) for 52 weeks of operation in accordance with the GUDI Protocol (Appendix 9-A), as amended from time to time.
f. Step 3 shall be completed in accordance with the GUDI Protocol (Appendix 9-A), as amended from time to time

9.3.1 Bypassing Treatment

9.3.1.1 Notification

When it is necessary to use a by-pass to divert water around one or more treatment processes required to achieve log reduction requirements for enteric viruses and protozoa, the AFNWA shall immediately notify the oversight entity provide rationale for the need to bypass treatment and identify the anticipated period of time that the by- pass will be necessary.

9.3.1.2 Boil Water Advisory

When it is necessary to use a by-pass to divert water around one or more treatment processes, the AFNWA shall immediately initiate a boil water advisory as outlined in Section 13.4.2 of this document. The AFNWA shall maintain the boil advisory until, through consultation with the oversight entity, it is appropriate to rescind it.

9.4 Requirements for Distribution Systems

All AFNWA systems, regardless of source water type, must comply with the requirements outlined in this section. Distribution system integrity: It is recommended the AFNWA have active programs in place to deal with threats to distribution system integrity, including ageing infrastructure, leaks, pressure transients, storage tanks, and pumping stations. These programs can be managed through NSSP/WSSP.

9.4.1 Secondary Disinfection

9.4.1.1 Free Chlorine

For Community Drinking Water Systems using free chlorine as their secondary disinfectant, the following requirements must be met:

a. The disinfection process shall be operated in such a manner so as to ensure that a minimum free chlorine residual of 0.2 mg/L is achieved throughout the water distribution system at all times, except for systems using groundwater sources undergoing a GUDI assessment where the water is distributed for human consumption. In this case a minimum free chlorine residual of 0.4 mg/L shall be achieved throughout the water distribution system at all times.
b. The maximum free chlorine residual shall not exceed 4 mg/L.

9.4.1.2 Chloramines

For Community Drinking Water Systems using chloramines (combined chlorine) as their secondary disinfectant, the following requirements must be met:

a. The disinfection process shall be operated in such a manner as to ensure that a minimum combined chlorine residual of 1 mg/L is achieved throughout the water distribution system at all times.
b. The maximum combined chlorine residual shall not exceed 3 mg/L.

9.4.1.3 Monitoring

See Appendix 9-H for details relating to monitoring requirements. Monitoring requirements include:

a. Continuous monitoring and recording of the free or combined chlorine residual is required for finished water leaving the Community Drinking Water treatment facility and entering the water distribution system with measurements taken at no more than five-minute intervals.
b. Continuous monitoring and recording of the free or combined chlorine residual is required for the water leaving any water storage structure within the water distribution system, with measurements taken at no more than five-minute intervals.
c. Monitoring of the water distribution system for free or combined chlorine residual is required. Unless specified otherwise in the system-specific Guidance Document, sampling frequency is the same as for bacteriological sampling requirements as stated in Section 12.3 of this document.

9.4.1.4 Notification

The AFNWA shall immediately notify the oversight entity and undertake corrective action if the minimum free or combined chlorine residual drops below the minimum required concentration.

9.4.1.5 Standard Operation Procedures (SOPs)

SOPs for the secondary disinfection process shall be developed, implemented, and communicated to all operations staff and documented in the operations manual (as developed by the AFNWA for each system). The procedures and the log of communication shall be made available upon request by the oversight entity. SOPs shall establish a reporting mechanism to include near misses and incidents in the NSSP/WSSP hazard identification and risk assessment cycle no more than six (6) months after the event.

9.4.2 Distribution System Turbidity

a. A turbidity value of 5.0 NTU or less shall be achieved in the water distribution system.
b. Unless specified otherwise in the system-specific Compliance Document, sampling and testing frequency is the same as for bacteriological sampling requirements as stated in Section 12.3 of this document.
c. Where turbidity values of greater than 5.0 NTU are observed in the water distribution system, the AFNWA shall investigate the cause, notify the oversight entity immediately, and take corrective action as necessary.

9.5 Cross-Connection Control

The AFNWA should develop and implement a Cross- Connection Control Program to protect the Community Drinking Water System from contamination due to cross-connections from commercial, institutional, industrial, multi-unit residential, and agricultural facilities, at a minimum, and avoid any cross-connections within the Community Drinking Water System.

This program should be managed through NSSP/WSSP.

9.6 Corrosion Control, Lead and Copper Sampling

a. The treated water shall minimize corrosion of the water distribution and/or plumbing systems.
b. The AFNWA shall adhere to the minimum corrosion monitoring program requirements included in Section 12.5 of this document. See Appendix 9-H for additional details.
c. The AFNWA shall adhere to the minimum sampling, notification, corrective action, and reporting requirements for lead and copper outlined in Section 12.5 of this document.
    i. If the AFNWA receives a laboratory analysis result for lead or copper above the maximum acceptable concentration as specified in the most recent version of Health Canada's Guidelines for Canadian Drinking Water Quality, as amended from time to time, the AFNWA shall immediately notify the oversight entity, notify the residence owner within 14 days of receiving the results from the lab and prepare a corrective action plan to address the exceedance as outlined in Section 12.5 of this document.
    ii. The AFNWA shall submit the corrective action plan to the oversight entity on or before October 31st of the same year the lead or copper exceedance occurred.
    iii. The corrective action plan shall be reviewed by the oversight entity.

9.7 Minimum Treatment Requirements and Process for Assigning Pathogen Log Reduction Credits to Filtration and Disinfection Processes

The purpose of this section (adapted from Appendix C of the Nova Scotia Treatment Standard, included in this document its totality in Appendix 9-C) is to outline the requirements for the assignment of log reduction credits for the removal or inactivation of pathogenic microorganisms (enteric protozoa, viruses, and bacteria) in Community Drinking Water Systems. This information must be used by the AFNWA, design engineer, and any other person or persons responsible for the planning and design of new Community Drinking Water Systems or when considering modifications to existing systems. Bacterial reduction is typically sufficient if treatment systems are designed to meet enteric protozoa and virus log reduction requirements outlined in this document.

9.7.1 Minimum Treatment Requirements

The AFNWA shall ensure the level of treatment provided to remove or inactivate pathogenic organisms is commensurate with the source water type, as outlined in Table 9.2. Where multiple raw water sources are combined and treated in the same Community Drinking Water System, the minimum log reduction requirements shall be based on the source water with the highest log reduction requirements for enteric protozoa and viruses.

Table 9-2. Minimum pathogen log reduction and treatment requirements.

Source Water Type	Minimum Required Pathogen Log Inactivation and Removal			Minimum Treatment
	Cryptosporidium oocysts	Giardia cysts	Viruses	
Surface Water and GUDI sources not assigned a natural filtration log credit	3- log	3-log	4-log	Engineered filtration and disinfection • Filtration shall be assigned treatment credits as outlined in Table 9.3. • Disinfection shall provide a minimum 0.5 log inactivation of Giardia cysts. • Where UV is used as a primary disinfectant and additional log inactivation is required for enteric viruses, chemical disinfection shall be used to meet the remaining log inactivation criteria for enteric viruses. • Where UV, ozone, or chlorine dioxide is used as a primary disinfectant, free chlorine or chloramines shall be used to provide secondary disinfection of the distribution system.
Medium-risk GUDI sources assigned a natural filtration log credit	3- log	3-log	4-log	Filtration and disinfection • Filtration may be via natural in-situ attenuation as outlined in Appendix 9-B • Natural filtration is assigned a 1 log reduction for Cryptosporidium oocysts and Giardia cysts. • If the natural filtration log credit is awarded, UV disinfection is required to meet the remaining log reduction requirements for Cryptosporidium oocysts and Giardia cysts. • Chemical disinfection is required to meet remaining log inactivation criteria for viruses and provide secondary disinfection of the distribution system.
Low-risk GUDI sources assigned a natural filtration log credit	3-log	3-log	4-log	Filtration and disinfection • Filtration may be via natural in-situ attenuation as outlined in Appendix 9-B • Natural filtration is assigned a 3-log reduction for Cryptosporidium oocysts and Giardia cysts. • Chemical disinfection is required to meet remaining log inactivation criteria for viruses and provide secondary disinfection of the distribution system
Non-GUDI sources	0-log	0-log	4-log	Disinfection • Chemical disinfection is required to meet log inactivation criteria for viruses and provide secondary disinfection of the distribution system.

9.7.2 Determining Log Removal Credits for Filtration and Disinfection Treatment Processes

The following steps shall be taken by the AFNWA or design engineer to determine the log removal credits for enteric protozoa and viruses assigned to the filtration process, if applicable, and the remaining credits that the disinfection process shall be designed to achieve:

a. Confirm the log reduction requirements for the source water type as outlined in Table 9.2.
b. Find the filtration log removal credits associated with the type of filtration system(s) employed as outlined in Table 9.3 and subtract this from the requirements specified in Table 9.2.
c. Determine if any additional filtration credits are available from enhanced filtration performance (if applicable) and subtract this from the remainder above.
d. The result is the log inactivation portion that shall be met by the disinfection process.

Systems using surface water and GUDI sources not assigned a natural filtration log credit: Engineered filtration is required for surface water and GUDI sources not assigned a natural filtration log credit. Additionally, a minimum of 0.5-log inactivation for Giardia must be provided by the disinfection process.

9.7.3 Treatment Credits for Filtration (Log Removal)

Drinking water treatment technologies meeting the turbidity limits and operational requirements outlined in Table 9.3 will be assigned the corresponding log removal credits for Cryptosporidium, Giardia and viruses.

Community Drinking Water Supplies with Engineered Filtration: If the AFNWA or design engineer believes the engineered filtration technology can achieve a higher log removal credit than is identified in Table 9.3, a higher log removal credit may be applied by the AFNWA, in consultation with the oversight entity, based on a demonstration of filter performance. For example, Community Drinking Water Systems with conventional or direct filtration that achieve 0.15 NTU 95% of the time each calendar month in combined filter effluent are eligible to receive an additional 0.5-log removal credit for protozoa. Community Drinking Water Systems with conventional or direct filtration that achieve 0.15 NTU 95% of the time each calendar month in individual filter effluent are eligible to receive an additional 1.0-log removal credit for protozoa.

Table 9-3. Log removal credits assigned to treatment technologies meeting prescribed turbidity limits and other requirements.

Treatment Technology	Protozoa Credit		Virus Credit[6]	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
	Cryptosporidium[6]	Giardia[6]		
Conventional filtration[7] – includes chemical mixing, coagulation, flocculation, clarification, and rapid gravity filtration	3.0-log		2.0-log	a. Shall be less than or equal to 0.2 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month. b. Shall not exceed 1.0 NTU at any time. c. Filter-to-waste[8] - filters shall be capable of directing filtered water to waste or recycle immediately following a backwash for a period of time until the filtrate turbidity value is below 0.2 NTU d. For direct filtration systems that use free chlorine alone as their primary disinfectant, to achieve log reduction requirements for Cryptosporidium, the turbidity shall be less than or equal to 0.15 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month.
Direct filtration[7] - includes chemical mixing, coagulation,	2.5-log		1.0-log	

[6] Disinfection shall provide a minimum 0.5-log inactivation for Giardia unless a higher log inactivation credit is required. Where disinfection is used to address any shortfall in the log reduction requirements for Cryptosporidium, an alternate disinfectant such as UV, chlorine dioxide or ozone shall be required.

[7] Community Drinking Water Supplies with conventional or direct filtration that achieve 0.15 NTU 95% of the time each calendar month in combined or individual filter effluent are eligible to receive additional log removal credits for protozoa to meet minimum treatment requirements as follows: combined 0.5-log; individual 1.0-log.

[8] Alternatives that demonstrate an equivalent benefit to filter-to-waste may be considered by the AFNWA and oversight entity on a case-by-case basis for existing facilities. All new systems shall include a filter-to-waste provision.

flocculation, and rapid gravity filtration			
Slow sand filtration	3.0-log	2.0-log	a. Shall be less than or equal to 1.0 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month. b. Shall not exceed 3.0 NTU at any time. c. Filter-to-waste[8] shall be provided to ensure filtered water, immediately after filter cleaning, is directed to a waste or recycle stream.
Diatomaceous earth filtration	3.0-log	1.0-log	a. Shall be less than or equal to 1.0 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month. b. Shall not exceed 3.0 NTU at any time. c. Filter-to-waste[8] shall be provided to ensure filtered water, immediately after filter backwashing, is directed to a waste or recycle stream.
Micro-filtration[9],[10],[11]	Removal efficiency demonstrated through challenge testing and verified by direct integrity testing	No credit	a. Shall be less than or equal to 0.1 NTU in at least 99% of the measurements made or at least 99% of the time each calendar month. b. If turbidity exceeds 0.1 NTU for more than 15 minutes, direct integrity testing shall be immediately conducted on the membrane treatment unit. c. Shall not exceed 0.3 NTU at any time. d. Filter-to-waste[8] shall be provided for operational flexibility. e. The membrane system used for pathogen reduction shall have continuous indirect integrity testing. f. Continuous indirect integrity testing shall be conducted at a minimum frequency of once every 5 minutes. Indirect integrity testing shall follow that outlined in the EPA Membrane Filtration Guidance Manual, as amended from time to time. g. The actual removal efficiency of a membrane shall be verified by third party challenge testing. Acceptable challenge testing shall follow that provided in the EPA Membrane Filtration Guidance Manual, as amended from time to time. h. Direct integrity testing shall be able to verify a log removal value equal to or greater than the removal credit awarded to the membrane filtration process. i. Direct integrity testing shall be conducted on each membrane filtration unit at least once per day and as soon as the AFNWA becomes aware when the turbidity exceeds 0.1 NTU for more than 15 minutes
Ultra-filtration[9,10,11]	Removal efficiency demonstrated through challenge testing and verified by direct integrity testing.	Removal efficiency demonstrated through challenge testing and verified by direct integrity testing	

[9]If membrane filtration is the sole treatment technology employed, disinfection shall follow the filtration process to meet virus inactivation requirements.

[10] Membrane removal efficiency shall be demonstrated through challenge testing and verified by direct integrity testing. See Appendix 9-G for additional information on membrane filtration.

[11] If the unit passes direct integrity testing, it may continue to be used for water treatment; if not, the unit shall be taken out of service.

Reverse osmosis and nanofiltration[9,10,11]	Removal efficiency demonstrated through challenge testing and verified by direct integrity testing.	Removal efficiency demonstrated through challenge testing and verified by direct integrity testing.	a. Shall be less than or equal to 0.1 NTU in at least 99% of the measurements made or at least 99% of the time each calendar month. b. Shall not exceed 0.3 NTU at any time. c. Filter-to-waste[8] - a filter-to-waste feature shall be provided for operational flexibility. d. To assign pathogen log reduction credits for reverse osmosis and nano-filtration units, direct integrity testing shall be available to verify removal efficiency. e. If the membrane process is assigned pathogen log reduction credits, the AFNWA shall adhere to the following additional requirements: i. The membrane system used for pathogen reduction shall have continuous indirect integrity testing. ii. Continuous indirect integrity testing shall be conducted at a minimum frequency of once every 5 minutes. Indirect integrity testing shall follow that outlined in the EPA's Membrane Filtration Guidance Manual, as amended from time to time. f. The actual removal efficiency of a membrane shall be verified by third party challenge testing. Acceptable challenge testing shall follow that provided in the EPA's Membrane Filtration Guidance Manual, as amended from time to time. g. Direct integrity testing shall be able to verify a log removal value equal to or greater than the removal credit awarded to the membrane filtration process. h. Direct integrity testing shall be conducted on each membrane filtration unit at least once per day and as soon as the AFNWA becomes aware when the turbidity exceeds 0.1 NTU for more than 15 minutes.
Cartridge filtration, one unit (1 micron absolute pore size)	2.0-log	No credit	a. For systems serving less than 500 persons, differential pressure across the filter medium is measured and recorded a minimum of once daily and does not exceed the manufacturer's requirements. b. For systems serving more than 500 persons, differential pressure across the filter medium is continuously measured and recorded at a minimum frequency of one measurement every five minutes and does not exceed the manufacturer's requirements. c. Shall be less than or equal to 0.3 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month. d. Shall not exceed 1.0 NTU at any time. e. The cartridge filtration process is tested and confirmed by an independent testing agency for at least 3 log removal of Cryptosporidium oocysts or surrogate particles. Challenge testing shall demonstrate at least 3 log removal of Cryptosporidium oocysts and Giardia cysts.
Cartridge filtration, two units in series (1 micron absolute pore size)	2.5-log	No credit	

Natural In-situ Attenuation for Medium Risk GUDI Sources[12]	1.0-log[13]	No credit	a. Shall be less than or equal to 1.0 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month at each individual GUDI wellhead. b. Continuous turbidity monitoring - required at each individual GUDI wellhead. c. Microscopic Particulate Analysis[8] - MPA testing is required every two years for each individual GUDI well following a significant rainfall in accordance with Step 3 of the GUDI protocol[8].
Natural In-situ Attenuation for Low-Risk GUDI Sources[12]	3.0-log[13]	No credit	a. Shall be less than or equal to 1.0 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month at each individual GUDI wellhead or the combined flow. b. Continuous turbidity monitoring - required at each individual GUDI wellhead. c. Microscopic Particulate Analysis[8] - MPA testing is required every two years for each individual GUDI well following a significant rainfall in accordance with Step 3 of the GUDI protocol[8].

9.7.4 Disinfection Credits (Log Inactivation)

Disinfection is required to inactivate any microbial pathogens that pass through previous treatment processes.

a. Disinfection shall provide any remaining log reduction credits necessary to meet the minimum treatment requirements specified in Table 9.2.
b. Where disinfection is used to address any shortfall in the log reduction requirements for Cryptosporidium, an alternate disinfectant such as UV, chlorine dioxide, or ozone is required.
c. Where UV disinfection is used to inactivate protozoa, chemical disinfection is required to meet remaining log inactivation requirements for viruses.
d. Where UV, chlorine dioxide, or ozone are used as primary disinfectants, free chlorine or chloramines must be used to provide secondary disinfection of the distribution system.

9.7.4.1 CT Concepts for Chemical Disinfection

As per Nova Scotia's treatment standards, this Compliance Guidance Document requires application of the CT concept for chemical disinfection. CT is calculated by multiplying the disinfectant concentration (C) by the time that 10 percent of the water is in contact with the disinfectant (T10). T10 is calculated by multiplying the theoretical hydraulic detention time (e.g., tank volume divided by flow rate) by baffling factor of the contact chamber. T10 may also be established by tracer studies.

[12] A natural filtration log credit may be assigned if the Guidelines for the Determination of Natural Filtration Log Removal for Protozoa are followed (Appendix 9-B) and a Qualified Hydrogeologist recommends the application of the credit.
[13] MPA testing shall be completed in accordance with Step 3 of the Protocol for Determining Groundwater Under the Direct Influence of Surface Water as outlined in Appendix 9-A (e.g. if there is a 15 day time-of-travel, then the well shall be sampled 15 days after a surface water event)

The CT equation is as follows:
Formula: CT = Concentration (mg/L) x Time (minutes) x Baffling Factor

Acceptable Primary Disinfectants

The AFNWA shall use acceptable chemical disinfectants outlined in this document, including free chlorine, chlorine dioxide, or ozone. Due to the poor disinfecting capability of chloramines, chloramines are not accepted as a primary disinfectant.

Baffling Factors

The baffling factor used in CT calculations shall be acceptable to the oversight entity. Baffling factors are provided in Table 9.4. Examples of baffling factors to use for sample contact chamber designs are included in Appendix 9-E.

Clearwell or Storage Tank Volume and Flowrate

For Community Drinking Water Systems that include the volume of water in the clearwell or on-site storage tank for CT determination, the calculation shall be made based on the minimum operating level in the tank. The highest flow condition shall also be confirmed (inflow or outflow).

Note: Distribution system storage is not eligible for CT credits. The required CT shall be achieved before the community drinking water supply's first customer.

9.7.4.2 CT Ratio (CT Achieved/CT Required)

a. The AFNWA shall compare the calculated CT achieved using the equation above to the CT required. The CT required is found in log inactivation tables for Cryptosporidium, Giardia and/or viruses first published by the US EPA. CT tables for free chlorine, chlorine dioxide, and ozone are included in Appendix 9-D. The science-based impacts of pH and temperature on the effectiveness of some disinfectants have been taken into account where applicable.
b. The AFNWA shall ensure the ratio of the calculated value (CT achieved) to the table value (CT required) is equal to or greater than one to receive log inactivation credits for the disinfection process.
c. The AFNWA shall ensure design ranges for the disinfection process are set for worst case scenarios For free chlorine, worst case design ranges typically include the following:
   • Lowest temperature of the water to be disinfected;
   • Highest pH value of the water to be disinfected with chlorine;
   • Lowest chlorine residual found at the outlet of the designated chlorine contact volume; and
   • Minimum contact time (typically occurs under highest flow conditions).

Sample CT calculations are provided in Appendix 9-F for various sources and treatment technologies.
Where free chlorine is used, it is recommended that the AFNWA minimizes the formation of disinfection by-products. However, this should be done in consideration of operational requirements (e.g., water quality and quantity, distribution system disinfectant residual, etc.) and without compromising the effectiveness of disinfection.

9.7.4.3 Disinfection Byproducts

The AFNWA shall balance effective disinfection for microbial protection against the creation of disinfection by-products.

The AFNWA shall make every effort to maintain concentrations of disinfection by-products as low as reasonably achievable without compromising the effectiveness of primary disinfection.

Table 9-4. Baffling factors and baffling descriptions.

Baffling Condition	Baffling Factor T10/T0	Baffling Description
Unbaffled (mixed flow)	0.1	• Agitated basin • Very low length-to-width ratio • High inlet and outlet flow velocities • High potential for stagnant zones and short-circuiting
Poor	0.3	• Single or multiple unbaffled inlets and outlets • No intra-basin baffles • Potential for stagnant zones or short-circuiting
Average	0.5	• Baffled inlet or outlet • Some intra-basin baffles
Superior	0.7	• Perforated inlet baffle • Serpentine or perforated intra-basin baffles • Outlet weir or perforated launders • Most of tank volume is utilized
Perfect (plug flow)	1	• Length to width ratio greater than or equal to 10:1 • Perforated inlet, outlet and intra-basin baffles

9.7.5 IT Concept for UV Disinfection

These treatment standards require application of the IT concept. IT is calculated by multiplying the UV intensity (I) by the exposure time (T) to demonstrate that required disinfection credits are achieved.

Formula: UV dose = UV intensity (Watts/cm^2) x Time of exposure (seconds)

The amount of UV light delivered to pathogens in a reactor is called “UV dose” and is measured in millijoules per square centimetre (mJ/cm^2). The UV dose depends on:
- UV intensity, or magnitude of UV light, measured by UV intensity sensors in Watts/cm^2 or Watts/m^2;
- UV transmittance (UVT); and
- Water flow rate and hydraulics in the reactor.

Previous Nova Scotia treatment standards required a minimum UV dose (IT) of 40 mJ/cm^2 for all Community Drinking Water Supplies. A UV dose of 40 mJ/cm^2 achieves 0.5-log reduction for viruses based on adenovirus inactivation.

a. Where UV light is used for primary disinfection, chemical disinfection shall be required to meet any remaining log inactivation criteria for viruses.
b. Where UV light is used for primary disinfection a lower UV dose than 40mJ/cm^2 may be acceptable to the oversight entity for enteric protozoa (i.e., Giardia, Cryptosporidium) based on required log inactivation credits, UV lamp design and validation, energy conservation goals, etc.
c. For virus inactivation, the target microorganism will remain adenovirus (0.5 log inactivation at 40 mJ/cm^2) for community drinking water supplies unless the AFNWA demonstrates that there is no risk of adenovirus being

present. In this case, rotavirus may be considered the target virus. Log inactivation credits will be considered, in consultation with the oversight entity, on a system-specific basis.

d. Where UV light is used as a primary disinfectant, free chlorine or chloramines shall be required to provide secondary disinfection of the distribution system.
e. To receive inactivation credit, a UV reactor must operate within the validated limits (e.g., intensity is greater than the minimum specified, flow is below the maximum specified, UVT is above the minimum specified).

UV systems are required to have a shut off feature and alarm when the equipment malfunctions, loses power or ceases to provide the appropriate level of disinfection.

10.0 Compliance Standard: Facility Classification

PROVINCIAL REFERENCES

NS Water and Wastewater Facilities and Public Drinking Water Supplies Regulations

These regulations dictate how systems must be classified based on service population and treatment system complexity.

NS Facility Classification Standards

These standards assign point values for treatment processes and plant characteristics and guide classification schemes.

10.1 Drinking Water Systems

Following the NS Water and Wastewater Facilities and Public Drinking Water Supplies Regulations per the Environment Act, all public water and wastewater facilities must use the NS Facility Classification Standards to classify the system. Per the Standards, water and wastewater treatment facility classification is based on a point system developed by the Association of Boards of Certification (ABC) for use by certifying authorities such as Nova Scotia Environment (NSE), and in this application, the AFNWA. Facilities are rated according to their size, population served and unit processes. Classification is assigned using the following point system:

Table 10-1.Classification of water and wastewater treatment facilities based on point assignment.

Points Received	Class of Facility
30 points or less	Class I
31-55 points	Class II
56-75 points	Class III
76 points or more	Class IV

10.1.1 Classification of water distribution facility

An AFNWA owned system for producing, collecting, storing or transmitting potable water must be classified under these guidelines as a water distribution facility.

A groundwater supply that only disinfects must be classified under these guidelines as a water distribution facility.

An AFNWA administrator must classify the distribution facility as a Class I, II or III facility in accordance with the population it serves and as shown in the following table:

Table 10-2. Classification of distribution system is based on population served.

Population Served	Class of Facility
500* - 1500	Class I
1501 - 15 000	Class II
15 001 or more	Class III

* Any AFNWA centralized drinking water system serving less than 500 people will be classified as a Class I distribution system. This is a deviation from the Nova Scotia Water and Wastewater Facilities and Public Drinking Water Supplies Regulations.

10.1.2 Classification water treatment facilities

A water treatment facility shall use Table 10.3 to determine the classification of the facility. A water system with a secure groundwater supply (i.e. not under the direct influence of surface water or non - GUDI) and only disinfection is to be classified as a water distribution system, not a water treatment facility.

Per the Facility Classification Standards, each unit process shall have points assigned only once. Unless otherwise noted, the full amount of points shall be assigned. For multiple identical process units, do not double count. For example, a plant that has two flocculators should be given two points, NOT four points. However, for a plant having more than one type of unit for each process, points accrue for each unique unit type.

Table 10-3. Point assignations for drinking water treatment system processes and characteristics.

Item	Points
Size	
Design flow average day, or peak month's average day, whichever is larger (1 point per 1.892 million litres. Round up.) Design flow: Consider this to be the design capacity of the plant. Examples 40 MLD = 19 points 18.9 MLD = 10 points (20 points maximum allowed)	1 - 20
Water Supply Sources (Rating based on public health significance)	
Seawater/saltwater	0
Groundwater (non-GUDI)	0
Groundwater under the direct influence of surface water (GUDI)	8
Surface water	10
Average Raw Water Quality Variation – Applies to all sources (surface and groundwater). Key is the effect on treatment process changes that would be necessary to achieve optimized performance	
Little to no variation – no treatment provided except disinfection	0
Minor variation – e.g. "High quality" surface source appropriate for slow sand filtration	1
Moderate variation in chemical feed, dosage changes made monthly	2
Variations significant enough to require pronounced and/or very frequent changes	5
Severe variations - source subject to non-point discharges, agricultural / urban storm runoff, flooding	7
Raw water quality subject to agricultural or municipal waste point source discharges	8
Raw water quality subject to industrial waste pollution	10
Raw water quality is subject to:	
Taste and/or odour for which treatment process adjustments are routinely made[14]	2

Colour > 15 TCU (not due to precipitated metals)[14]	3
Iron and/or manganese: Fe (2 points) or Mn (3 points) concentrations above aesthetic objective 3 points maximum allowed[14]	2 - 3
Algal growths for which treatment process adjustments are routinely made[14]	3
Chemical Treatment/Addition Process	
Fluoridation	4
Disinfection/Oxidation (Note: Points are additive to a maximum of 15 points allowed for this category.) Check all that apply: • Chlorination: Hypochlorites (5 points) If generated on site (add 1 point) Chlorine gas (8 points) Chloramination (10 points) Chlorine dioxide (10 points) • Ozonation (10 points) • UV Irradiation (2 points) • Iodine, Peroxide, or similar (5 points) • Potassium permanganate (4 points) (if used with greensand filtration do not give 4 points)	0 - 15
pH adjustment for process control (e.g. pH adjustment aids coagulation	4
Stability or Corrosion Control (If the same chemical is used for both Corrosion Control and pH adjustment, count points only once)	4
Coagulation / Flocculation and Filter Aid	
Primary coagulant addition	6
Coagulant aid / Flocculant chemical addition (in addition to primary coagulant use)	2
Flocculation	2
Filter aid addition (non-ionic/anionic polymers)	2
Clarification/Sedimentation	
Sedimentation (plain, tube, plate)	4

[14] Raw water quality is subject to:
• Taste and/or odour for which treatment process adjustments are routinely made (2 points): 1) T&O issue has been identified in a pre-design report, etc., 2) a process has been installed to address, and 3) operational control adjustments are made at least seasonally. Do not give points to T&O when there is no specific additional impact on operation. E.g. if system is already pre-chlorinating for disinfection, give no points for T&O.
• Colour > 15 TCU (not due to precipitated metals) (3 points) with following exceptions. Colour will be considered elevated and points assigned when levels exceed 75 Total Colour Units (TCU) for conventional filtration, 40 TCU for direct filtration, or 15 TCU for all other technologies, except reverse osmosis (no points).
• Iron and/or manganese: Fe (2 points), Mn (3 points) (3 points maximum allowed) with following exceptions: for applications for manganese greensand filters. For applications of manganese greensand filters, iron and manganese levels will be considered elevated when their combined levels exceeds 1.0 mg/L (3 points).
• Algal growths for which treatment process adjustments are routinely made (3 points): Raw water will be considered subject to algae growths when treatment processes are specifically adjusted due to the presence of high levels of algae on at least a weekly basis for at least two months each year.

Contact adsorption	6
Other Clarification processes (air flotation - DAF, ballasted clarification, etc)	6
Upflow clarification ("sludge blanket clarifier")[15]	8
Filtration	
Granular media filtration (Surface water / GUDI) < 122 lpm / sq m	10
Granular media filtration (Surface water / GUDI) > 122 lpm / sq m	20
Groundwater filtration	6
Membrane filtration	10
Diatomaceous earth (pre-coat filtration)	10
Cartridge / bag filters	5
Pre-filtration (staged filtration, pressure sand w/o coagulation, etc.): add one point per stage to a maximum of 3 points	1 - 3
Slow sand	5
Other Treatment Processes	
Aeration	3
Air stripping (including diffused air, packed tower aeration	5
Ion-exchange/softening	5
Greensand filtration	10
Lime-soda ash softening (includes: chemical addition, mixing/flocculation/clarification/filtration - do not add points for these processes separately)	20
Granular activated carbon filter (do not assign points when included as a bed layer in another filter)	5
Powdered activated carbon	2
Reservoir management employing chemical addition	2
Blending sources with significantly different water quality • To achieve health related compliance (4 points) • For aesthetic reasons (2 points)	2 - 4
Electrodialysis	15
Other: The AFNWA, in consultation with the oversight entity, may assign 2 to 15 additional points for processes not listed elsewhere in this document. (Specify: _____)	2 - 15

[15] Upflow clarification ("sludge blanket clarifier") - 8 points - Includes such proprietary units as Super-Pulsator. These units include processes for flocculation and sedimentation. Important note: these are not the same as adsorption clarifiers.

Residual Disposal	
Discharge to surface, sewer, or equivalent (0 points) • On-site disposal, land application (1 point) • Discharge lagoon / drying bed, with no recovery / recycling - e.g downstream outfall (1 point) • Backwash recovery/recycling: discharge to basin or lagoon and then to source (2 points) • Backwash recovery/recycling: discharge to basin or lagoon and then to plant intake (3 points)	0 - 3
Facility Characteristics	
Instrumentation - Use of SCADA or similar instrumentation systems to provide data, with: • Monitoring / alarm only, no process operation - plant has no automated shutdown capability (0 points) • Limited process operation - e.g. remote shutdown capability (1 point) • Moderate process operation - alarms and shutdowns, plus partial remote operation of plant (2 points) • Extensive or total process operation - alarms and shutdowns, full remote operation of plant possible (4 points)	0 - 4
Total number of assigned points	**Use Table 10.1 to determine classification**

10.2 Wastewater Systems

Per the Facility Classification Standards, a centralized wastewater treatment facility shall use Table 10.5 to determine the classification of the facility. A wastewater system with only collection, lift stations, and disinfection is to be considered as a wastewater collection system and not a wastewater treatment facility.

Table 10-4.Classification of collection system is based on population served.

Population Served	Class of Facility
500* - 1500	Class I
1501 - 15 000	Class II
15 001 or more	Class III

* Any AFNWA centralized wastewater collection system serving less than 500 people will be classified as a Class I collection system. This is a deviation from the Nova Scotia Water and Wastewater Facilities and Public Drinking Water Supplies Regulations.

Table 10-5. Point assignations for wastewater treatment system processes and characteristics.

Item	Points
Size	
Maximum population served, peak day. 1 point per 10,000 population served or any fraction thereof	1 - 10
Design flow average day or peak month's average day, whichever is larger. One (1) point per 3.785 million litres or any fraction thereof	1 - 10
Variation in raw waste (6 point maximum)[16]	
Variations do not exceed those normally or typically expected	0
Recurring deviations or excessive variation of 100 to 200% in strength and/or flow	2
Recurring deviations or excessive variation of more than 200% in strength and/or flow	4
Raw wastes subject to toxic waste discharges	6
Impact of septage or truck-hauled waste (0 point minimum to 4 points maximum)	0 - 4
Preliminary Treatment	
Plant pumping of main flow	3
Screening or comminution	3
Grit removal	3
Equalization	1
Primary Treatment	
Clarifiers	5
Imhoff tanks or similar	5
Secondary Treatment	
Fixed-film reactor	10
Activated sludge	15
Stabilization ponds without aeration	5
Stabilization ponds with aeration	8
Tertiary Treatment	
Polishing ponds for advanced waste treatment	2
Chemical/physical advanced waste treatment without secondary treatment	15

[16] The key concept is frequency and/or intensity of deviation or excessive variation from normal or typical fluctuations; such as deviation can be in terms of strength, toxicity, shock loads, I/I, with points from 0 to 6.

Chemical/physical advanced waste treatment following secondary treatment	10
Biological or chemical/biological advanced waste treatment	12
Nitrification by designed extended aeration only	2
Ion exchange for advanced waste treatment	10
Reverse osmosis, electrodialysis and other membrane filtration techniques	15
Advanced waste treatment chemical recovery, carbon regeneration	4
Media filtration	5
Additional Treatment Processes	
Chemical additions (2 points each for a maximum of 6 points)	2 - 6
Dissolved air flotation (for other than sludge thickening)	8
Intermittent sand filter	2
Recirculating intermittent sand filter	3
Micro-screens	5
Generation of oxygen	5
Solids Handling	
Solids stabilization	5
Gravity thickening	2
Mechanical de-watering	8
Anaerobic digestion of solids	10
Utilization of digester gas for heating or co-generation	5
Aerobic digestion of solids	6
Evaporative sludge drying	2
Solids reduction (including incineration, wet oxidation)	12
On-site landfill for solids	2
Solids composting	10
Land application of biosolids by contractor	2
Land application of biosolids under direction of facility operator in direct responsible charge	10
Disinfection	
Chlorination or ultraviolet irradiation	5

Ozonation	10
Effluent Discharge (10 point maximum)	
Mechanical post aeration	2
Direct recycle and reuse	6
Land treatment and disposal (surface or subsurface)	4
Instrumentation	
The use of Supervisory Control and Data Acquisition (SCADA) or similar instrumentation systems to provide data with no process operation	0
The use of SCADA or similar instrumentation systems to provide data with limited process operation	2
The use of SCADA or similar instrumentation systems to provide data with moderate process operation	4
The use of SCADA or similar instrumentation systems to provide data with extensive or total process operation	6
Laboratory Control – Bacteriological/Biological[17]	
Lab work done outside the plant	0
Push-button or visual methods for simple tests such as pH, settleable solids	3
Additional procedures such as Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), gas analysis, titrations, solids, volatile content	5
More advanced determinations such as specific constituents; nutrients; total oils, phenols	7
Highly sophisticated instrumentation such as atomic absorption, gas chromatography	10
Total number of assigned points	**Use Table 10.1 to determine classification**

11.0 Compliance Standard: Operator Certification

[17] The key concept is to credit laboratory analyses done on-site by facility personnel.

PROVINCIAL REFERENCES

NS Water and Wastewater Facilities and Public Drinking Water Supplies Regulations

These regulations dictate the process to obtain an Operator Certificate from NSECC and detail reciprocity, renewal, and expiration processes.

These Regulations also provide standards on qualified operators in overall direct responsible charge for municipal systems in Nova Scotia.

11.1 Certification of Operator

Following industry best practice, as set by the Association of Boards of Certification (ABC) and adopted by Nova Scotia Environment and Climate Change, the AFNWA will require operators to obtain at least one of the four available certificates:

(a) water treatment operator certification certificate;
(b) water distribution operator certification certificate;
(c) wastewater treatment operator certification certificate;
(d) wastewater collection operator certification certificate.

Each type of operator certification certificate must be issued in one of the following classes:
Operator-in-training;

(a) Class I;
(b) Class II;
(c) Class III;
(d) Class IV.

An operator who holds a certificate qualifying them to be an operator issued by one of the following is deemed to hold an operator certification certificate[18], for the equivalent type of facility and at an equivalent class level, for 2 years after December 01, 2022, when these regulations come into force, unless the certificate is sooner replaced, suspended or cancelled:

(a) an administrator from NSECC;
(b) other reciprocal jurisdiction.

11.2 Nova Scotia requirements and processes for Operator Certification

For reference, the details of NS Water and Wastewater Facilities and Public Drinking Water Supplies Regulations that pertain to operator certification have been reproduced below with necessary adaptations. Any comments or clarifications are footnoted throughout.

Reciprocal certification of operator

16 An operator who is certified by the ABC or by a certification agency recognized by the Department[19] as equivalent to the ABC may be issued an operator certification by an administrator for an equivalent type of facility at a class level at the discretion of an administrator, if the person applies and provides the information requested by an administrator.

Deemed certification of operator with water or wastewater treatment certificate

17 (1) Unless the water treatment operator certification states otherwise, an operator who holds a valid Class I, Class II, Class III or Class IV water treatment operator certification is deemed to also hold a Class I water distribution operator certification certificate for the purposes of operating components in a water distribution facility that affect a water treatment facility.

(2) Unless the wastewater treatment operator certification certificate states otherwise, a person who holds a Class I, Class II, Class III or Class IV wastewater treatment operator certification is deemed to also hold a Class I wastewater collection operator certification for the purposes of operating components in a wastewater collection facility that affect a wastewater treatment facility.

[18] The Nova Scotia Water and Wastewater Facilities and Public Drinking Water Supplies Regulations uses the phrase "certification certificate". For ease of reading this term has been changed to "certification" throughout.
[19] Or any certification agency recognized by the AFNWA.

Operator certification certificate application

18 To apply for an operator certification, an applicant must submit all of the following to the NSECC Minister:

(a) a properly completed application, on a form approved by the Minister or an administrator;
(b) proof that they have met the education requirements of Section 19;
(c) proof that they have met the operating experience requirements of Section 19;
(d) before their certificate is issued, proof that they have passed the exam as required by Section 20;
(e) before their certificate is issued, the fee established by the Minister.

Education and operating experience requirements for operator certification certificate

19 (1) An applicant for an operator certification certificate must meet the education and operating experience requirements for the class of certificate applied for as set out in the following table:

Education and Operating Experience Requirements for Classes of Operator Certification Certificates	
Operator-in-training certificate	
Education	**Operating experience**
grade 12 high school diploma, **or** general equivalency diploma (GED), **or** equivalent education	none
Class I operator certification certificate	
Education	**Operating experience**
grade 12 high school diploma, **or** general equivalency diploma (GED), **or** equivalent education	1 year of operating experience at a Class I or higher facility
Class II operator certification certificate	
Education	**Operating experience**
grade 12 high school diploma, **or** general equivalency diploma (GED), **or** equivalent education	3 years of operating experience at a Class I or higher facility
Class III operator certification certificate	
Education	**Operating experience**
grade 12 high school diploma, **or** general equivalency diploma (GED), **or**	4 years of operating experience at a Class II or higher facility, including 2 years of direct responsible charge experience

equivalent education

and

2 years of post-secondary education, **or**

90 CEUs of acceptable training

Class IV operator certification certificate	
Education	**Operating experience**
grade 12 high school diploma, **or** general equivalency diploma (GED), **or** equivalent education **and** 4 years of post-secondary education, **or** 180 CEUs of acceptable training	4 years of operating experience at a Class III or higher facility, including 2 years of direct responsible charge experience

(2) Post-secondary education or CEUs required for an operator certification must be
(a) in engineering, the water or wastewater field or in a related science; or
(b) acceptable to an administrator.

(3) Operating experience required for an operator certification must be
(a) acquired through actual operating experience at the same type of facility as the type of certificate that is applied for; and
(b) acceptable to an administrator.

(4) Direct responsible charge experience required for an operator certification must be experience acquired while in direct responsible charge or overall direct responsible charge.

Exam requirements for operator certification certificate

20 **(1)** An applicant for an operator certification must write and pass an exam for the type and class of certificate applied for.

(2) An exam for an operator certification must be approved by the Minister or an administrator and the pass mark for the exam must be set by the Minister or an administrator.

(3) An applicant for a Class I, II, III or IV operator certification may write an exam only if all of the following apply:

(a) they already hold the same type of operator certification in the next lower class;
(b) their operator certification certificate is valid;
(c) they have the operating experience and education required by Section 19.

(4) An applicant for an Operator-in-training operator certification may write an exam only for an Operator-in-training certification.

(5) Despite clause (3)(a), an applicant who is deemed to hold a Class I water distribution or Class I wastewater collection operator certification under Section 17 must write and pass an exam for a Class I operator certification before they are permitted to write an exam for a Class II operator certification.

(6) Despite clause (3)(c), an administrator may, in accordance with guidelines and policies established by the Department, allow an applicant to write an exam before the applicant has the operating experience required for the type and class of operator certification certificate applied for if the applicant already holds an operator certification that is valid, of the same type and in the next lower class.

Substituting surplus education for operating experience

21 **(1)** An applicant for a Class II, III or IV operator certification who does not have the operating experience for the class of certificate applied for as set out in Section 19 may substitute surplus education for the required operating experience in accordance with, and up to the maximums set out in the following table:

Surplus Education that may be Substituted for Required Operating Experience			
Class of Certificate	**Surplus Education**	**May be Substituted for**	**Maximum Substitution**
Class I	_	_	no substitution permitted
Class II	1 year of post-secondary education **or** 45 CEUs of acceptable training	1 year of operating experience	Up to 50% of operating experience
Class III or Class IV	1 year of post-secondary education **or** 45 CEUs of acceptable training	1 year of operating experience **or** 1 year of direct responsible charge experience	Up to 50% of operating experience **or** Up to 50% of direct responsible charge experience

(2) Surplus education that is substituted in accordance with subsection (1) for required operating experience

(a) must meet the requirements of subsection 19(2); and
(b) cannot be used as education required for an operator certification.

Substituting surplus operating experience for education

22 **(1)** An applicant for an operator certification who does not have the education for the class of certificate applied for as set out in Section 19 may substitute surplus operating experience for the required education in accordance with, and up to the limits set out in the following table:

Surplus Operating Experience that may be Substituted for Required Education			
Class of Certificate	**Surplus Operating Experience**	**May be Substituted for**	**Maximum Substitution**
All Classes	1 year of operating experience	2 years of grade school (grades 1 to 8)	no limit
All Classes	1 year of operating experience	1 year of high school (grades 9 to 12)	no limit
Class III	1 year of direct responsible charge experience in a Class II or higher facility	1 year of post-secondary education	1 year of post-secondary education
Class IV	1 year of direct responsible charge experience in a Class III or higher facility	1 year of post-secondary education	2 years of post-secondary education

(2) Surplus operating experience that is substituted in accordance with subsection (1) for required education

(a) must meet the requirements of subsections 19(3) and (4); and

(b) cannot be used as operating experience required for an operator certification.

Operator certification certificate

23 **(1)** An applicant who satisfies the requirements of these regulations for the type and class of operator certification certificate applied for may be issued a certificate under subsection 64(1) of the Act[20].

(2) An operator certification must be in a form approved by the Minister or an administrator.

(3) An operator certification certificate expires 4 years after the date it is issued.

(4) An operator certification certificate is not transferable.

(5) An operator must produce their operator certification certificate to an administrator or inspector on request.

Renewal of operator certification certificate

24 **(1)** A certified operator may renew their operator certification certificate by submitting all of the following to the Minister at least 60 days before the date their certificate expires:

(a) a properly completed renewal application, on a form approved by the Minister or an administrator;

(b) the renewal fee established by the Minister;

(c) for a Class I or II operator,

[20] The Act referenced here is the Nova Scotia Environment Act, which establishes the legislative authority for Nova Scotia to issue Operator certification certificates.

(i) if the operator has not been designated in overall direct responsible charge, proof satisfactory to an administrator that the operator completed at least 2.4 CEUs of acceptable training during the term of their current certificate, or

(ii) if the operator has been designated in overall direct responsible charge, proof satisfactory to an administrator that the operator completed at least 4.8 CEUs of acceptable training during the term of their current certificate;

(d) for a Class III or Class IV operator, proof satisfactory to an administrator that the operator completed at least 4.8 CEUs of acceptable training during the term of their current certificate.

(2) An Operator-in-training operator certification certificate is not renewable.

Expired operator certification certificates

25 (1) An operator certification certificate that has expired and has not been renewed under Section 24 may be re-issued for the same type and class of operator certification certificate if the holder submits all of the following to the Minister:

(a) a properly completed renewal application, on a form approved by the Minister or an administrator;
(b) the fee established by the Minister;
(c) proof satisfactory to an administrator that the operator has obtained the CEUs of acceptable training required by clause 24(1)(c) or (d).

(2) An operator who applies to renew an operator certification certificate that has been expired for 3 years or longer must re-write and pass the exam for the type and class of certificate applied for.

Owner must provide resources to get required CEUs

26 An owner of a facility must provide the resources necessary for an operator to get the CEUs of acceptable training required to renew their operator certification certificate.

Facility Operation

Facility must have qualified operator in overall direct responsible charge[21]

27 (1) An owner of a new or non-operational facility must designate an operator who meets the requirements of Section 28 to be in overall direct responsible charge before the facility begins operating.

(2) An owner of a facility that is operational on the date these regulations[22] come into force and that has a facility classification certificate must designate an operator who meets the requirements of Section 28 to be in overall direct responsible charge no later than the 30th day after the date these regulations come into force.

(3) Despite subsections (1) and (2), an owner of

(a) a non-transient public drinking water supply, as defined in Part 2, that must be classified under Section 9 or 10 as a water treatment facility or a water distribution facility[23]; or

[21] Given the absence of regulations for drinking water services on Federal lands, the role of an operator in overall direct responsible charge is notional. It is recommended that the AFNWA follow Nova Scotia standards regarding the designation of an operator in overall direct responsible charge.
[22] The AFNWA is not under this obligation, however it is recommended as a best practice.
[23] Subsection (3)(a) does not apply to the AFNWA, as there will be no transient systems managed by the AFNWA.

(b) a facility that under subsection 7(3) must obtain a facility classification certificate no later than 1 year after the date these regulations come into force[24],

must designate an operator who meets the requirements of Section 28 to be in overall direct responsible within three months of the transfer of the system operations to the AFNWA and in accordance with the facility's required class:

(4) Once a facility is required to have an operator designated to be in overall direct responsible charge, the owner of the facility must ensure that there is always an operator who meets the requirements of Section 28 designated and in overall direct responsible charge.

Qualifications of operator in overall direct responsible charge

28 (1) An operator who is in overall direct responsible charge must hold a valid operator certification certificate that is

(a) applicable to the type of facility; and
(b) at a class level that is equal to or greater than the class of the facility.

(2) An owner must not designate an operator-in-training to be in overall direct responsible charge.

Absence of operator in overall direct responsible charge

29 (1) If the operator in overall direct responsible charge is absent or unable to act, an owner must

(a) designate another operator who meets the requirements of Section 28 to be in overall direct responsible charge; or
(b) despite subsection 27(4), assign temporary overall direct responsible charge to an operator who holds a valid operator certification certificate that is

(i) applicable to the type of facility, and
(ii) at a class level that is no more than one class lower than the class of the facility.

(2) Temporary overall direct responsible charge for a facility must not be assigned under clause (1)(b) for more than 150 days in any consecutive 12 months.

(3) An owner must not assign temporary overall direct responsible charge under clause (1)(b) to an operator who holds an Operator-in-training operator certification certificate.

Transition plan for facility without designated operator

30 (1) An owner must submit a transition plan to the oversight entity if

(a) despite subsection 27(4), they cannot designate an operator who meets the requirements of Section 28 to be in overall direct responsible charge; and
(b) they cannot assign temporary overall direct responsible charge to an operator who meets the requirements of clause 29(1)(b).

(2) A transition plan must be
(a) shared with the oversight entity and reviewed (should be in accordance with the *Transition Plan Guide[25]*); and

[24] The timing of these regulations is not pertinent to the AFNWA, however it is recommended that an AFNWA facility obtain a facility classification no later than 1 year after the community joins the AFNWA.
[25] The Transition Plan Guide is available here: https://novascotia.ca/nse/water.operator.certification/docs/TransitionPlanGuide.pdf and is attached as Appendix 3.

(b) submitted to the oversight entity no later than 90 days after the first day that the facility is without an operator who meets the requirements of Section 28 designated and in overall direct responsible charge as required by Section 27.

12.0 Compliance Standard: Monitoring

PROVINCIAL REFERENCES

NS Environment Act

The Nova Scotia Environment Act establishes the standards and regulations that determine the relationship between treatment of source water and the monitoring and reporting approaches for these systems.

NS Part I Guidelines for Monitoring Municipal Public Water Supplies

Nova Scotia Part I Guidelines for Monitoring detail monitoring locations, frequencies, and reporting criteria to ensure drinking water quality meets or exceeds the Guidelines for Canadian Drinking Water Quality.

NS Requirements for Lead and Copper Management: Municipal Public Water Supplies

Nova Scotia released an updated guidance document for lead and copper monitoring following new information from Health Canada, including the usefulness of Random Daytime Sampling procedures to characterize lead exposure and the establishment of a new MAC for lead, 5ppb.

These guidelines are to assist the AFNWA with developing and implementing an acceptable water quality monitoring program for each participating community.

The objective of these monitoring requirements is to ensure that consumers of water provided by the AFNWA have safe drinking water, and further, that all water is cared for in a good way. Systematic water quality monitoring, immediate notification and corrective action are essential elements to a comprehensive water supply protection program.

The AFNWA shall use these guidelines to develop and implement a water quality monitoring program that supports the maintenance and optimization of water system operations and protects water for all relations and future generations.

12.1 Authority

Regular Testing - The regulatory framework adopted by the AFNWA requires the regular monitoring of drinking water quality for the parameters listed in these guidelines (adapted from Nova Scotia's Guidelines for Monitoring Public Drinking Water Supplies), as well as other substances as may be recommended by the oversight entity. Samples are to be collected in the manner and with the frequency set out in the Nova Scotia Guidelines for Monitoring Public Drinking Water Supplies (as detailed herein, or in keeping with future versions of the Guidelines), the GCDWQ, or as recommended by the oversight entity. It is recommended that drinking water quality testing be completed by approved laboratories in accordance with NSECC's Policy on Acceptable Certification of Laboratories, as amended from time to time.

Immediate Notification and Corrective Action - The regulatory framework adopted by the AFNWA requires the Authority to:

- notify the oversight entity immediately upon becoming aware of an adverse health related water quality sample result; and
- take corrective action as set out in this Compliance Guidance Document (See Section13.5) or as may be recommended by the oversight entity.

Provision of Safe Drinking Water - The interim regulatory framework adopted by the AFWNA requires the AFNWA to ensure that the microbiological, physical and chemical characteristics of a Community Drinking

Water System do not exceed the maximum acceptable concentration (MAC)[26] for substances listed in the most recent version of Health Canada's Guidelines for Canadian Drinking Water Quality, as amended from time to time.

12.2 Roles and Responsibilities

12.2.1 Drinking Water System Steward (AFNWA)

The AFNWA is responsible for delivering safe drinking water to the consumer. This responsibility includes routine monitoring of the drinking water system, informing the community members and the oversight entity if water quality fails to meet the health-related criteria set out in the most recent version of the GCDWQ and for taking corrective action to restore drinking water quality. The AFNWA is also responsible for contacting the oversight entity as soon as they become aware of any circumstances that may result in unsafe water being supplied to the consumer such as equipment failure and/or malfunction. The AFNWA shall have contingency plans in place to address poor water quality, major fluctuations in system flows and/or pressure, or a prolonged interruption in the supply of water, etc., as a part of the NSSP/WSSP.

It is the responsibility of the AFNWA to develop, implement, and maintain operational manuals and SOPs, as needed, to meet the requirements set forth in this Compliance Guidance Document.

12.2.2 ISC (Oversight Entity)

Indigenous Services Canada through the First Nations and Inuit Health Branch (FNIHB), including Environmental Public Health Officers, Public Health Physicians, and Environmental Public Health Division – National, has been designated as the lead agency to provide advisory oversight for the AFNWA to support the provision of safe and reliable water supplies to participating communities (as stipulated in the Community Agreement).

To carry out this role, FNIHB will review, in an advisory capacity, documentation related to the design and operation of water distribution and water treatment facilities, including facility classifications, operator certifications, annual performance reports, audits and inspections of facilities. FNIHB staff will make recommendations to support water quality monitoring programs, including providing advice regarding appropriate corrective action plans to address any problems that may arise. FNIHB will make recommendations, when necessary, to support the provision of clean drinking water and the execution of the standards of the regulatory framework outlined in this Guidance Document.

12.2.3 Water Quality Lab (Lab)

The lab conducts analyses of drinking water samples following procedures defined in the latest edition of the Standard Methods for the Examination of Water and Wastewater, published jointly by the American Public Health Association, the American Water Works Association and the Water Environment Federation, or an alternative method acceptable to the oversight entity. The lab also participates in quality control, quality assurance and accreditation programs, as required, to ensure accurate results. All sample analyses are to be performed by an accredited laboratory, as guided by Nova Scotia's Policy on Acceptable Certification of Laboratories (See Appendix 12-B).

[26] A maximum acceptable concentration (MAC) means the health-related criteria specified for substances in the most recent version of Health Canada's Guidelines for Canadian Drinking Water Quality, which when present above the set concentration have known or suspected adverse health effects.

12.3 Monitoring for Microbiological Quality

12.3.1 Routine Monitoring – Total Coliform and Escherichia coli (*E.coli*)

The AFNWA shall monitor the Community Drinking Water System for total coliforms and *E.coli* bacteria. Coliform bacteria (total or *E.coli*) are indicator organisms used to determine the efficacy of treatment and the integrity of the waterworks system. They are surrogates for less abundant and more difficult to detect human pathogens.

The AFNWA shall ensure that samples are tested for the presence of total coliform and *E.coli* bacteria using methods listed in the latest edition of Standard Methods for the Examination of Water and Wastewater. Routine[27] samples may be analyzed using a presence/absence (P/A) method as opposed to a quantitative method. Confirmation sample(s), collected in response to a positive routine sample, shall be analyzed by a quantitative method such as Most Probable Number (MPN) to understand the magnitude of impact to the system.

12.3.1.1 Sample Frequency, Number and Location

The minimum number of total coliform and *E.coli* samples the AFNWA shall collect from the system is shown in Table 12.1.

Table 12-1. Minimum Number of Bacteria Samples per Month Based on Population Served

Population Served	Minimum Number of Samples per Month*
Up to 5,000	4
5,000 to 90,000	1 per 1,000 persons
More than 90,000	90 + (1 per additional 10,000 persons)

* The AFNWA shall collect samples from the system on a weekly basis to equal the minimum number of samples per month.

* The AFNWA shall collect samples from the system on a weekly basis to equal, or exceed, the minimum number of samples per month.

* These sampling frequencies will be applied to very small systems with at least 5 connections to a centralized system., Community Drinking Water Systems with less than 100 people can request a reduced sampling requirement on an as-needed basis. Consultation with the Oversight Entity will be required before an alternative sampling schedule can be applied.

At the time of sample collection, the AFNWA shall measure the disinfectant residual and turbidity at each sample location. Sampling frequency from the system shall be at least weekly. Samples must be collected in accordance with the facility's approved annual sampling plan.

The sampling locations shall be chosen to be representative of the waterworks system and include central and peripheral locations. In many cases the number of samples necessary to obtain an accurate representation of a waterworks system will exceed these minimums. The approved annual sampling plan shall take precedence over these guidelines if increased sampling frequencies and/or locations are needed to achieve representative samples.
Buildings with prolonged periods of low or no water use should be avoided as sampling locations.

For systems using surface water supplies, at least one water sample per week shall be collected from the point where the treated water enters the distribution system.

[27] Routine Sample means a water sample collected from the municipal drinking water facility for microbiological, chemical, radiological or physical quality to fulfill sampling requirements stated in this Guidance Document.

The oversight entity may request alteration the frequencies, locations, numbers and parameters to be monitored depending on local conditions and analytical results.

12.3.1.2 Sample Collection and Preservation

All samples for total coliform and *E.coli* bacteria shall be collected and transported to the lab according to the standard procedures outlined in Appendix 12-A and SOPs developed by the AFNWA.

12.3.1.3 Reporting of Sample Results

The AFNWA shall ensure that results of all samples collected for bacteriological analysis (total coliforms or *E.coli*) are sent from the lab to the Regulatory Compliance Coordinator at the AFNWA. The AFNWA shall record summaries of sample results in a uniform manner. The minimum information required on the Chain of Custody (CoC) form is date, time, location of sample collection, sampler's name, parameter(s), and test result(s) including residual chlorine at the time of sample collection. The AFNWA shall maintain records of sample results, including the original lab certificates and supporting CoCs for a minimum of two years from the collection date and make them available to auditors and/or oversight entity upon request.

Whenever the presence of coliforms is detected (total or *E.coli*), the lab shall immediately notify the AFNWA and oversight entity and forward the results to the oversight entity. The AFNWA shall also immediately notify the oversight entity and forward the results to the oversight entity immediately after they receive the results from the lab. Receipt of any results sent electronically must be confirmed by telephone.

Upon receipt of sample results indicating the presence of total coliforms or *E.coli*, the AFNWA shall comply with details included in Section 13 of this document. If results indicate deficiencies that require or may require a boil water advisory (refer to section 13.4.1 of this document), the AFNWA shall notify and work cooperatively with the oversight entity.

12.3.2 Enteric Viruses

Health Canada has established a health-based treatment goal of a minimum 4-log reduction for enteric viruses based on source water quality. In the event of a suspected or confirmed outbreak, the oversight entity may, in consultation with appropriate public health resources, recommend the AFNWA to sample for enteric viruses and provide the laboratory results. As per the Treatment Requirements detailed in Section 9 of this document, all AFNWA community drinking water supplies must provide treatment to achieve a minimum 4-log reduction of enteric viruses.

12.3.3 Enteric Protozoa

Health Canada has established a health-based treatment goal of a minimum 3-log reduction for Giardia and Cryptosporidium based on the source water quality. In the event of a suspected or confirmed outbreak, the oversight entity may, in consultation with appropriate public health resources, recommend the AFNWA to sample for Giardia and Cryptosporidium and provide the laboratory results. As per the Treatment Requirements detailed in Section 9 of this document, all AFNWA community drinking water systems supplied by surface water or groundwater under the direct influence (GUDI) of surface water must provide treatment to achieve a minimum 3-log reduction for Giardia and Cryptosporidium.

12.3.4 Microbial Particulate Analysis (MPA)

Drinking water supplies that have been classified as GUDI – Medium and Low Risk (risk levels identified in Table 12.2 below) shall conduct MPA testing every two years for each individual GUDI well, in the spring and following a rainfall. Any MPA testing shall be completed in accordance with Step 3 of the Protocol for Determining Groundwater Under the Direct Influence of Surface Water (Appendix 9-A).

If the classification of any GUDI well increases, the oversight entity shall be notified immediately and the AFNWA shall take any necessary corrective action.

Table 12-2. Microbial Particulate Analysis (MPA) Risk Levels.

Risk Level	MPA Score
Low	< 10
Medium	10 – 19
High	> 20

12.3.5 Compliance – Microbiological Parameters

The AFWNA shall ensure that the drinking water meets the requirements for microbiological quality as set out in the most recent edition of the GCDWQ and this document (which is based on the most recent Nova Scotia Treatment Standards for Municipal Drinking Water Systems, as amended from time to time.)

All community drinking water facilities must meet the following:

- *E.coli* – MAC none (0) detectable per 100mL (may be reported as absent or <1);
- Total Coliforms – MAC none (0) detectable per 100mL (may be reported as absent or <1);
- Enteric Viruses – Treatment goal minimum 4-log reduction.

Community drinking water supplies that obtain their water from surface water or GUDI sources must also meet the following:

- Enteric Protozoa (Giardia and Cryptosporidium) – Treatment goal minimum 3-log reduction

As total coliform bacteria are not uniformly distributed in water and are subject to considerable variations in public health significance, this MAC will be applied in AFNWA community drinking water systems as outlined in Section 13 of this document. When a boil water advisory is necessary, the AFNWA shall comply with section 13.4.2.

Compliance with treatment goals for viruses and protozoa is determined by monitoring the disinfection (CT4/IT5) and filtration (turbidity) processes. Information regarding the parameters to be monitored, location and frequency is outlined in each systems-specific Compliance Guidance Document and Annual Sampling Plan.

12.4 Monitoring for Chemical, Physical and Radiological Quality

The AFNWA must meet specific standards for water quality and operations. This section discusses parameters that the AFWNA must monitor to ensure the production of clean, safe drinking water. Compliance with these sampling requirements shall be demonstrated through each system's annual sampling plan that must be submitted to the oversight entity on or before October 1st of each year. The oversight entity may recommend modifications to these parameters as part of a facility's compliance requirements. Any conditions included in the facility's Annual Sampling Plan will always take precedence over these Guidelines.

12.4.1 General Chemical and Physical Water Quality Parameters

The AFNWA shall monitor for general chemical and physical water quality. The parameters to be monitored are shown in Table 12.3 and include inorganic and physical parameters with recommended limits in the GCDWQ and some with no guideline values.

Table 12-3. General Chemical and Physical Parameters

Alkalinity	Colour	pH
Aluminum	Conductivity	Potassium
Ammonia	Copper	Selenium
Antimony	Fluoride	Sodium
Arsenic	Hardness	Strontium
Barium	Iron	Sulphate
Boron	Lead	Total Dissolved Solids
Cadmium	Magnesium	Total Organic Carbon
Calcium	Manganese	Turbidity
Chloride	Nitrate	Uranium
Chromium	Nitrite	Zinc

12.4.1.1 Sample Frequency, Number and Location

The AFNWA shall sample a surface water or GUDI supply at least annually or a secure (Non-GUDI) groundwater supply at least once every two years. On each occasion two samples shall be collected: one sample from the raw water source and one sample from a point after treatment. The same sample points shall be used each year. If there is reason to suspect the presence of other substances not listed in Table 12.3 in a community drinking water supply, the AFNWA shall monitor for these substances to ensure that their concentrations are below acceptable MAC limits.

The oversight entity, in consultation with the AFNWA, may recommend alterations to the frequencies, locations, number of samples and parameters to be monitored depending on local conditions, analytical results, risk assessments conducted as part of the source water protection planning process or changes to the GCDWQ.

12.4.2 Health-Related Parameters – Guidelines for Canadian Drinking Water Quality

The health-related parameters in the most recent version of GCDWQ are required to be measured every five-years for raw and treated water to ensure the supply does not exceed the MAC. Depending on the parameter, specific timing for sample collection may be indicated (e.g. pesticides, cyanobacterial toxins, etc.). In consultation with the oversight entity, the AFNWA shall increase the sampling frequency for parameters that have detectable levels. Compliance with the MAC established for a substance is required by the regulatory framework adopted by the AFNWA.

12.4.3 Radionuclides

The AFNWA shall sample for the presence of radioactivity using gross alpha and gross beta screening rather than measurements of individual radionuclides. If screening levels are exceeded (0.5 Bq/L for gross alpha and 1.0 Bq/L for gross beta), then concentrations of specific radionuclides shall be analyzed, in accordance with recommendations from GCDWA and Health Canada technical guidance.

12.4.4 Disinfection By-Products

Disinfection by-products (DBP) are chemical compounds formed by the reaction of a disinfectant with a precursor (e.g. natural organic matter). DBP of concern include: trihalomethanes (THMs), halo-acetic acids (HAAs), chlorate, chlorite, bromate, and N-nitrosodimethylamine (NDMA). Additional monitoring information is outlined below.

12.4.4.1 Trihalomethanes (THMs)

Trihalomethanes form as a byproduct of disinfection with chlorine. THMs shall be sampled quarterly in AFNWA systems that use chlorine as a disinfectant. Samples shall be collected in areas of the distribution system with the highest

potential THM concentration(s) such as areas with the longest disinfectant retention times - typically the farthest points from chlorine injection site. A compliance value is determined by averaging the last four quarterly sample results separately for each sample location, if more than one location is sampled (i.e., locational running annual average[28] (LRRA)). Once a compliance value is determined for each sample location, non-GUDI groundwater supplies with THM concentrations less than 0.01 mg/L (10 µg/L) may request a reduction in sampling frequency to annual. Surface water and GUDI sources are not eligible for this reduction in sampling.

12.4.4.2 Haloacetic Acids (HAAs)

Haloacetic acids form as a byproduct of disinfection with chlorine. HAAs shall be sampled quarterly in AFNWA systems that use chlorine as a disinfectant. Samples for HAA analysis shall be collected where historical data show the highest HAA concentration. Where historical data is not available, HAA concentrations shall be monitored in the middle and extremities of the distribution system. Areas where disinfectant residuals are significantly lower than the system average (e.g., residence time) shall be targeted. In systems with booster chlorination stations and water tanks/reservoirs, HAA concentrations shall be monitored downstream of these components. A compliance value is determined by averaging the last four quarterly sample results separately for each sample location (i.e., locational running annual average[28]). Once a compliance value is determined for each sample location, non-GUDI groundwater supplies with HAA concentrations less than 0.01mg/L (10 µg/L) may adopt, in consultation with the oversight entity, a reduced sample frequency to annual sampling. Surface water and GUDI sources are not eligible for this reduction in sampling.

12.4.4.3 Chlorate

Chlorate forms as a by-product of disinfection with chlorine dioxide and can form in sodium hypochlorite solutions that are not properly stored. Chlorate shall be sampled quarterly in AFNWA systems using chlorine dioxide as a disinfectant. Chlorate samples shall be collected at the mid-point and far-point[29] of the distribution system. Chlorate shall also be sampled in systems using sodium hypochlorite as a disinfectant and when solutions are stored for longer than three months. Chlorate samples shall be collected where treated water enters the distribution system.

12.4.4.4 Chlorite

Chlorite forms as a by-product of disinfection with chlorine dioxide. Chlorite shall be sampled quarterly in AFNWA systems that use chlorine dioxide as a disinfectant. Samples for chlorite analysis shall be collected at the mid-point and far-point of the distribution system.

12.4.4.5 Bromate

Bromate forms when ozone reacts with naturally occurring bromide and in sodium hypochlorite solutions that are not properly stored. Sodium hypochlorite solutions should be stored in a cool, dry location away from sunlight where the temperature does not exceed 30°C. Bromate shall be sampled monthly in AFNWA systems that use ozone as a disinfectant. Bromate shall also be sampled in AFNWA systems whenever sodium hypochlorite is used as a disinfectant and when solutions are stored for longer than three months. Samples for bromate analysis shall be collected where treated water enters the distribution system.

12.4.4.6 N-Nitrosodimethylamine (NDMA)

NDMA forms as a by-product of disinfection with chloramines. It may also form in chlorinated systems with nitrogen or humic substances present in the source water. NDMA shall be sampled quarterly in AFNWA systems that rely on surface water sources that practice chlorination or any utility that practices chloramination. For systems that practice chlorination and have nitrogen or humic substances present in the source water, a sample for NDMA shall be collected where treated water enters the distribution system. For systems that practice chloramination, samples for NDMA shall

[28] The locational running annual average (LRAA) is calculated by averaging the concentration of the last four quarterly samples from each sampling point. E.g. Site A sample results: Q1: 45, Q2: 65, Q3:73, Q4: 85. Site A LRAA = 67.

[29] Far-point is defined as a location in the distribution system with the longest disinfectant retention time; typically, farthest from the disinfectant injection site.

be collected where treated water enters the distribution system and a far-point in the distribution system. The AFNWA systems that chlorinate and have nitrogen or humic substances present in the source water, may request a reduction from quarterly sampling to annual, if sampling consistently (e.g., over a year period) confirms the absence of NDMA in treated water entering the distribution system.

12.4.5 Manganese

Manganese is a naturally occurring element found widely in surface water and groundwater sources in Atlantic Canada. It is largely attributed to the weathering of manganese-bearing rocks and soils; however, anthropogenic sources including mining and industrial activities may impact water sources, and can also be introduced through impurities in treatment chemicals and coagulant material.

Routine Monitoring

With the introduction of a health-based guideline for manganese, enhanced monitoring is required to capture seasonal variation in source water and ensure public health protection. The minimum monitoring requirements are outlined in Table 12.4.

Table 12-4. Routine Monitoring Requirements.

Source	Sample Location	Frequency
Groundwater	Raw water (prior to treatment)	Twice per year (spring and fall)
	Entering the distribution system	Quarterly
	Distribution system*	Quarterly
Surface Water	Raw water (prior to treatment)	Quarterly
	Entering the distribution system	Quarterly
	Distribution system*	Quarterly

*Distribution system sample locations should provide an overall assessment of manganese levels in the distribution. Examples of suitable manganese sample locations will depend on system-specific distribution system characteristics as well as water quality. Consideration should be given to the following:

- Proximity to treatment plant;
- Evidence of increased biofilm;
- Areas with long stagnation or other indicators of poor water quality;
- Areas with evidence of increased corrosion;
- Event-based sampling following main breaks, hydrant flushing etc.

Distribution sampling locations used for assessing corrosion may also be used if these locations meet the intent of assessing manganese concentrations throughout the system.

Reduced Sampling

Specific systems may be eligible for a reduction in sampling if one of the following conditions are met:

- If raw water manganese concentrations are less than the aesthetic objective (AO) for a period of 2 consecutive years, the AFNWA may reduce raw water sampling to once per year for surface water sources or once every two years for groundwater sources.

- If treatment is installed to reduce manganese, the AFWNA may reduce raw water sampling to once per year for surface water sources or once every two years for groundwater sources.
  Quarterly sampling of the water leaving the plant and the distribution system sampling will still be required.

Historical manganese data must meet the minimum monitoring requirements (source, frequency and location) outlined in Table 12.4 for consideration. The AFNWA, in consultation with the oversight entity, will make the determination for decreased sampling frequency.

The AFNWA is required to continue monitoring per the requirements outlined in their latest approved sampling plan until consultation and advice is provided by the oversight entity.

12.4.6 Cyanobacterial Toxins

Cyanobacteria, commonly referred to as blue-green algae, are capable of producing toxins known as cyanotoxins that can cause negative health effects in humans. To be protective of public health, the following guidance on monitoring and sampling algal blooms shall be adhered to:

1) Visual Inspection

AFNWA systems using surface water supplies shall visually monitor the source water at the intake weekly between May and October. Additional locations for visual inspection can include banks and shorelines if the source is known or suspected to be susceptible to the formation of blooms. Early visual signs of a bloom may include water that appears unusually cloudy or the presence of what appears to be fine grass clippings. Colours can range from grey, tan to olive, blue-green to bright blue or red. As the bloom develops, the water may take on a “pea soup” or “spilled paint” appearance. A fresh bloom can smell like newly mown grass. Older, decaying blooms may smell like rotting garbage. If an algal bloom is suspected or confirmed visually, sampling shall be conducted as outlined in Step 2 below.

2) Sampling

The AFNWA shall notify the oversight entity as soon as they become aware of a suspected bloom and conduct sampling:

- Raw and treated water samples shall be tested for Total Microcystins;

Note: It is recommended that raw water samples be tested for species identification and cell count as this information may inform on-going sampling requirements, removal efficiency of treatment processes, potential optimization needs and the types of toxins that may be present.

The oversight entity may also advise the AFNWA to take samples for additional toxin analysis (e.g. anatoxins, saxitoxins etc.). This will be determined in consultation with the oversight entity. Any bloom shall be treated as potentially toxic and a significant health risk until sampling confirms otherwise. In consultation with the oversight entity, the AFNWA may issue a “Do Not Consume” or a “Do Not Use” advisory while waiting for laboratory results, or if the source water is considered vulnerable. Field test kits can be used by the AFNWA as a qualitative (presence/absence) tool for determining if a bloom is toxic but do not provide quantitative analysis that can be used to determine if treated drinking water concentrations of cyanobacterial toxins are below the MAC.

3) Nutrient Source Identification

The AFNWA shall initiate an evaluation of potential nutrient sources by conducting a site visit of the waterbody and surrounding watershed. Any bloom formation must be noted in the NSSP/WSSP and Source Water Protection Plans to ensure future risk mitigation strategies are considered. Potential sources of nutrients can include:

- Stormwater runoff
- Agricultural runoff
- Industrial runoff
- Wastewater effluent
- Faulty septic systems
- Household fertilizers

Additional sampling may be conducted in the watershed to confirm source of nutrients or bloom including but not limited to:

- Phosphorus
- Nitrogen
- Turbidity
- Temperature
- pH
- TOC
- Dissolved oxygen
- Chlorophyll A
- Phycocyanin
- Cell count
- Algal speciation
- Cyanobacterial toxins

4) Analysis of Laboratory Results
The AFNWA shall notify the oversight entity upon receipt of any laboratory sample results. If treated water results exceed the GCDWQ cyanobacterial toxin MAC, the AFNWA, in consultation with the oversight entity, shall issue a "Do Not Consume" or a "Do Not Use" advisory if one has not already been issued. If the raw water results exceed the GCDWQ cyanobacterial toxin MAC but the treated water results are below the guideline MAC, the AFNWA will consult with the oversight entity to determine whether to issue an advisory. If both the raw and treated water results are below the GCDWQ cyanobacterial toxin MAC, the AFNWA, in consultation with the oversight entity, may remove the advisory if one was issued.

Additional responses may be required based on the results of the algae species identification and cell counts. The oversight entity may recommend additional treatment, increased sampling frequency or other water restrictions dependent on- site specific conditions, size of the bloom and laboratory results.

5) On-going Sampling During a Bloom
On-going cyanobacterial toxin testing (frequency, parameters, sampling locations, etc.) will be determined by the AFNWA, in consultation with the oversight entity, on a case-by-case basis.

12.4.7 Sample Collection and Preservation

The AFNWA shall collect samples for chemical, physical and radiological quality in accordance with the methodology provided by the water testing lab. Some parameters require specialized sampling techniques (e.g., disinfection by-products, cyanobacterial toxins, pesticides etc.).

12.4.8 Reporting of Sample Results

The AFNWA shall ensure that all sample results are sent from the lab to the AFNWA. The AFNWA shall record summaries of routine sample results in a uniform manner. The minimum information required in the summary is date, time, location of sample collection, sampler's name, parameter, and the test result. The AFNWA shall maintain records of sample results, including the original lab certificates, for a minimum of ten years from the date of collection and make the results available to the oversight entity upon request.

Whenever a sample exceeds a MAC, the lab shall immediately notify the oversight entity and forward the results to appropriate personnel at the oversight entity. Upon receipt of sample results exceeding a MAC, the AFNWA shall immediately notify the oversight entity office by telephone and forward a copy of the results to appropriate personnel. All results sent electronically from the AFNWA must be confirmed with the oversight entity by telephone.

Upon receipt of sample results indicating a MAC is exceeded, the AFNWA shall comply with section 12.4.9 of this document, "Re-sampling Procedure", and information in Section 13.4.3, "Health-related Chemical Exceedance". If a

"Do Not Consume" or "Do Not Use" advisory is required (refer to section 13.4.4), the AFNWA shall comply with section 13.4.4.

12.4.9 Re-sampling Procedure

Where results indicate that a MAC has been exceeded, the AFNWA shall collect a confirmation sample for that parameter immediately after receiving notification from the lab. If a confirmation sample cannot be collected within 24 hours (e.g. weekend, holiday, etc.), the AFNWA shall immediately notify the oversight entity with a proposed sample date. The oversight entity, in consultation with appropriate public health resources, may recommend the AFNWA to take special precautions to ensure the protection of public health while awaiting the sample results from the lab.

If the confirmation sample indicates that the MAC is exceeded for the parameter of concern, the AFNWA shall immediately notify the oversight entity by way of telephone and forwarded copy of the results. All results sent electronically from the AFNWA must be confirmed with the oversight entity by telephone.

The AFNWA shall comply with details included in section 13.4.3, "Health-related Chemical Exceedance". If a "Do Not Consume" or "Do Not Use" advisory is required (refer to section 13.4.4), the AFNWA shall comply with section 13.4.4. If the confirmation sample indicates that the MAC is not exceeded for the parameter of concern, the oversight entity may recommend that additional samples be taken to further evaluate the need for compliance.

12.4.10 Compliance – Chemical, Physical and Radiological Parameters

Any AFNWA system in which the level of a substance is confirmed to exceed a MAC, upon re-sampling, is out of compliance with the regulatory framework adopted by the AFNWA. The AFNWA, in consultation with the oversight entity, shall take corrective action as outlined in section 13.4.3.2, "Procedure for Responding to a Sample that Exceeds a Health-Related Chemical Parameter".

12.5 Corrosion Monitoring Program

A corrosion monitoring program is required by the AFNWA to ensure that the distributed water is not corrosive. While the main contaminant of concern is lead, corrosion of other distribution system metals such as copper, iron, etc. can affect the aesthetic quality of the water as well as increase deterioration rates of distribution system infrastructure and premise plumbing materials. This section outlines the minimum corrosion monitoring requirements as well as additional recommended monitoring to enhance a system's corrosion assessment/control program.

12.5.1 Corrosion Assessment Monitoring Requirements

To assess the corrosivity of water, the AFNWA is required to undertake the minimum sampling requirements outlined in Table 12.5.

The AFNWA may wish to undertake additional monitoring on a regular or event-based frequency with the inclusion of additional parameters and/or by increasing the monitoring frequency as corrosion cannot readily be measured by any single method. Corrosion indices (e.g., Langlier Index) are no longer supported by Health Canada or the American Water Works Association (AWWA) as the sole means to assess the corrosivity of water distributed. Additional monitoring is recommended in the following circumstances:

- To gather baseline corrosion data;
- To assess corrosion of distribution system material;
- To conduct advanced corrosion modelling;
- During/after planned changes to the treatment process;
- Following a watermain break, spring flushing programs or hydrant flushing.

Table 12-5. Corrosion Assessment Monitoring Requirements

Parameters	Location	Frequency
Distribution System Monitoring - *number of required distribution samples included in Table 6*		
Alkalinity	Point of entry to the distribution system and representative locations[30] in distribution system	Quarterly
pH		
Temperature		
Conductivity		
Chlorine or Chloramine Residual		
Corrosion Inhibitor Residual (if used)		
Distribution System Monitoring – Optional Parameters		
Zinc	Point of entry to the distribution system and representative locations[30] in distribution system	Quarterly
Iron		
Chloride and Sulphate		
Total Dissolved Solids		
Hardness		
Dissolved Inorganic Carbonate (DIC)		
Aluminum		
Manganese		
Ammonia		
Natural Organic Matter		
Microbiological parameters (HPC)		
Oxidation Reduction Potential (ORP)		

12.5.1.1 Corrosion Assessment - Distribution System Monitoring

Corrosion assessment monitoring of the distribution system not only provides information on the corrosivity of the distributed water but can also be used to inform process changes and corrective actions required to reduce lead and other metal concentrations at the tap. Alkalinity, pH, temperature, conductivity, dissolved oxygen, disinfectant residual, and corrosion inhibitor residual (if used) are considered the minimum parameters required. These parameters shall be sampled quarterly at the point-of-entry to the distribution system along with representative locations throughout the distribution system. The minimum number of distribution monitoring sites is based on the population served (refer to Table 12. 6). In some cases, additional sites may be required to adequately characterize the distribution system. The sample locations shall be flushed to remove stagnant water prior to sample collection.

Samples for lead shall also be collected annually during the warmest month from representative locations throughout the distribution system based on population served. These samples are used to determine the presence of lead and identify the source of lead due to fittings and/or other components in the distribution system. (refer to Section 12.6 and Table 12.7 for additional details on lead monitoring, including the sampling method recommended by Health Canada).

[30] Representative locations include hydraulically distinct areas, locations with evidence of increased biofilm, areas with evidence of long stagnation or other indicators of poor water quality such as discolored water complaints, areas with evidence of increased corrosion (e.g. increased number of breaks and/or leaks etc.).

Table 12-6. Minimum Number of Distribution System Corrosion Monitoring Sites Required

System Size (# of people served)	Number of Sampling Points in the Distribution System
≤ 100	1
101 – 500	1
501 – 3,300	2
3,301 – 10,000	4
10,001 – 100,000	6
> 100,000	10

12.6 Lead and Copper Monitoring

Following the most recent guidance from Health Canada, these sections outline a comprehensive monitoring program for lead and copper (referenced from Nova Scotia's Requirements for Lead and Copper Management: Municipal Public Drinking Water Supplies).

12.6.1 Planning the Sampling Program

Prior to conducting sampling the AFNWA shall perform a survey of their distribution system to identify areas at a higher risk of lead and copper release due to the presence of lead service lines; lead containing solders; brass fittings; galvanized steel, unplasticized polyvinyl chloride, copper pipes and fittings.

Given the health effects of lead and that there is no safe level, sample locations shall be prioritized based on the presence of lead containing materials in the distribution and plumbing system.

Where records are available on the construction materials used for service lines and fittings, the AFNWA shall select locations for sampling in the following sequence:

1) At least 50% of sample locations have lead service lines, where present (high risk location);
2) Sample locations that have copper pipe with lead solders (medium risk location); and
3) Sample locations with brass fittings containing lead (low risk location)

Where records are not available on the construction materials used for service lines and fittings, the AFNWA shall select locations for sampling based on the date of construction in this order:

1) Built prior to 1975 (high risk location);
2) Built after 1975, but before 1986 (medium risk location); and
3) Built after 1986 (low risk location)[31]

12.6.2 Collecting Samples

The AFNWA shall collect the minimum number of samples outlined in Table 12.7 for lead and copper from residences and multi-unit residential buildings, in accordance with the requirements outlined in this section. Both lead and copper can be analyzed from the same sample.

The AFNWA must include the method of sampling (i.e., random daytime testing (RDT), profile sampling (PS)) on the laboratory's sample submission form/CoC. The method of sampling shall be abbreviated and included as part of the sample location information (e.g., 126 Sussex Drive-RDT, location A-PS).

[31] It is recognized that what is considered a low risk sample location for lead may be a high risk location for coper. Given that there is no safe level of lead, sample locations shall be prioritized based on the potential presence of lead containing materials.

12.6.2.1 Single unit and multi-unit residences (less than or equal to 6 units)

Sampling Protocol

The AFNWA shall collect samples for lead and copper utilizing the RDT protocol from the minimum number of sample locations identified in Table 12.7. The samples must be taken from the kitchen cold water faucet, as this is the location most often used to obtain water for cooking and drinking purposes. If there is a point-of-use treatment device on the kitchen faucet an alternate location such as a bathroom cold water faucet shall be used.

Samples shall be collected in wide mouth bottles without removing faucet aerator or screen at an uninterrupted flowrate representative of typical household use. Do not collect samples from residences that have a point-of-entry treatment device, such as a water softener.

Table 12-7. Sampling Protocol for Single Unit and Multi-Unit Residences (less than or equal to 6 units)

Number of People Served*	Number of Sample Locations (Annual)
≤ 500	5
501 – 3,300	10
3,301 – 10,000	20
10,001 – 100,000	30
> 100,000	50

*Number of people served refers to the average population served by the community drinking water supply.

To meet the minimum number of samples in any given sampling period, the AFNWA shall not collect multiple samples from the same single unit or multi-unit residence (less than or equal to 6 units).

12.6.2.2 Investigate to Determine the Source of Lead

Note: There is no requirement to investigate the source of copper as it is an acceptable plumbing material. There is no requirement to investigate the source of lead if the service line material is already known.

For location(s) that exceed the MAC for lead, the AFNWA shall submit a plan to the oversight entity on or before October 31st of the same year in which the initial sample(s) was collected. The plan shall outline how the AFNWA plans to determine the source of lead demonstrating compliance with this section and include a schedule for implementation.

If the premise owner(s) and/or occupants will not allow the AFNWA to carry out the actions outlined in this section, the AFNWA will be considered in compliance if they complete the following communication requirements and assessments to rule out the source of lead is from their distribution system infrastructure:

• Carryout notification to premise owners and/or occupants within 14 days or receiving MAC exceedance result;
• Carryout notification of recommended measures the owner(s) and/or occupant(s) can take to reduce their exposure:

The following measures shall be included in the letter or email notification from the AFNWA to the premise owner(s) and/or occupants to outline measures they can take to reduce their exposure:

• Flush pipes by running the water until it is cold (about a minute) after water has been sitting in pipes for several hours (e.g. first thing in the morning, after work, etc.);
• Use a drinking water treatment device certified to meet the National Sanitation Foundation (NSF) standards 53 or 58 (reverse osmosis units) for the removal of lead and copper. While a faucet mounted unit is preferred, pitcher style filters are also acceptable;
• Inspect and clean faucet aerators or screens monthly. If there is debris, inspect and clean

more frequently to remove particles that may contain lead;
- Replace brass faucets and valves with those certified to have a low lead content; and
- If the private side of the service line is composed of lead, replace it.

- Verify the lead and copper concentrations leaving the treatment facility are below the MAC; and
- Verify the lead and copper concentrations at a nearby location in the distribution system are below the MAC. An acceptable nearby location may be a fire hydrant, or closest approved microbiological or corrosion monitoring location within the same hydraulic zone.

For Single Detached Residences

If acceptable to the premise owner(s) and/or occupants, the AFNWA shall conduct profile sampling at each single detached residence that exceeded the lead MAC to determine the source (i.e., household plumbing versus lead service line). Profile samples may be collected at any time during the year.

Profiling Sampling Protocol

Profile samples must be collected at the kitchen cold water faucet, as this is the location most often used to obtain water for cooking and drinking purposes. If there is a point-of-use treatment device on the kitchen faucet, an alternate location such as the bathroom cold water faucet shall be used. Allow water to stagnate in pipes for a minimum of 6 hours. During the stagnation period, no water can be used in the residence. This includes water for flushing toilets, showering, laundering clothes, etc. It is best to collect the samples first thing in the morning or after work, if water is not used during the day. A minimum of four 1-L bottles must be collected in wide mouth bottles. Depending on the pipe material, length, and diameters, additional sample volumes may be required to cover the pipe volume from the sample location to the water main. If present, do not remove the faucet aerator or screen. Without flushing and ensuring minimal wastage between bottles, turn on the cold-water faucet and fill each of the 1-L bottles, consecutively. Do not collect samples from residences with a point-of-entry treatment device.

In lieu of profile sampling, the AFNWA may use hydro excavation to determine the presence of a lead service line. If the AFNWA selects an alternate method to determine the source of lead, the method shall be reviewed by the oversight entity prior to implementation.

For Multi-unit Residences

Due to the difficulty in coordinating stagnation periods for each unit in multi-unit residences, the AFNWA may use an alternate method such as hydro excavation to identify the presence of a lead service line. If the AFNWA selects a method other than hydro excavation, the method shall be reviewed by the oversight entity prior to implementation.

12.6.3 Data Interpretation and Action

To inform appropriate corrective actions, the AFNWA shall interpret the results of profile sampling to determine if the source of lead is the service line and/or premise plumbing. The AFNWA shall notify the oversight entity and the premise owner(s) by mail or email of the results of their investigation within 30 days of identifying the source of lead. If profile sampling was conducted, the AFNWA shall include a copy of the laboratory analysis report with their notification to the oversight entity. As the oversight entity is already aware of the initial exceedance, there is no requirement to immediately notify the oversight entity if the profile sample results exceed the MAC.

For AFNWA drinking water supplies that have a partial or complete service line inventory identifying the presence of lead service lines, the AFNWA may submit a lead service line removal plan to the oversight entity for review.

Once the plan is reviewed and any recommendations are made by the oversight entity, the AFNWA will be required to report on their progress annually as part of their annual report due on or before April 1st.

If the source of lead is determined to be fixtures and plumbing within the residence(s), the AFNWA must coordinate with the oversight entity to share sampling results, ensure the occupants of the residence(s) are informed, and

appropriate remediation steps are taken. All further lead and copper sampling needed to verify remediation will be done in coordination with ISC, on a case-by-case basis.

12.6.4 Annual Sampling Plan

The AFNWA shall include the following information from their lead and copper management program in each system's Annual Sampling Plan:

- Lead and copper sampling method (e.g., RDT);
- Number of residences that will be targeted for sampling.

The AFNWA shall include, in an Appendix to the Annual Sampling Plan, a document describing:
- Rationale for selecting the residence (e.g., lead service line, date of construction); and
- Methods implemented and/or planned to obtain participants.

The AFNWA shall submit the Annual Sampling Plans to the oversight entity on or before October 1st of each year.

12.7 Source Water Protection Monitoring

The source water protection planning process requires the development of a monitoring program. Parameters shall be sampled by the AFNWA, at the frequency identified in the implementation schedule, to evaluate the effectiveness of the source water protection plan. Monitoring associated with this program shall be designed to evaluate changes in the source water protection area. These parameters should be, in part, derived from the hazard identification and risk assessment steps in NSSP/WSSP. The AFNWA shall review and update the plan and implementation schedule on a yearly basis. The status and activities of the plan and any modifications made shall be included in the facility's annual report that must be submitted to the oversight entity on or before April 1st of each year.

12.8 Operational Monitoring

There are several critical water quality parameters that are monitored throughout the treatment process and distribution system to ensure the production and delivery of safe drinking water to consumers. This includes parameters to evaluate the efficiency of the treatment processes (e.g., disinfection, filtration, etc.).

Additional information can be found in the facility's system-specific Compliance Guidance Document and Section 9 of this document. Monitoring requirements defined in a facility's approved annual sampling plan will always take precedence.

12.8.1 Turbidity

Turbidity is considered an important surrogate measure for microbiological quality. Increased turbidity may be associated with a contamination event or may interfere with disinfection. Turbidity limits measured in nephelometric turbidity units (NTU) are found in Section 9 of this document and the system-specific Compliance Guidance Document. If the turbidity exceeds requirements outlined in the facility's Compliance Guidance Document, the AFNWA is required to report the exceedance to the oversight entity immediately, investigate the cause, and take appropriate corrective action.

For surface water and GUDI sources not assigned a natural filtration log credit, raw water turbidity shall be monitored continuously or by a grab sample at least once per day. Individual filter turbidity shall be monitored continuously (i.e., minimum of one measurement every five minutes). The turbidity of filtered water directed to waste shall be monitored continuously or by a grab sample during the filter-to-waste step.

For medium- and low-risk GUDI sources awarded a natural filtration log credit, turbidity shall be monitored continuously for each GUDI well at the wellhead.

For non-GUDI sources, turbidity shall be monitored continuously or by a daily grab sample at each individual wellhead or the combined flow from multiple wells.

For all sources, distribution system turbidity shall be monitored weekly at the same locations where samples are collected for total coliform and *E.coli* bacteria.

12.8.2 Primary Disinfection

The chemical disinfection process is considered effective if the ratio of the achieved CT[32] value (calculated) to the required CT value (from CT table) is equal to or greater than one. Chemical disinfectants acceptable for primary disinfection include free chlorine, chlorine dioxide and ozone. Parameters necessary to calculate disinfection efficiency must be monitored to ensure design criteria are met during primary disinfection. Typically, design ranges are set for worst case scenarios that affect the primary disinfectant. For chlorine, examples include max flow, min. temperature, min. disinfectant residual, and max pH.

The effectiveness of the disinfection process using ultra-violet (UV) light is determined by a concept known as IT[33]. The amount of UV light delivered to pathogens in the reactor is called the UV dose and is measured in mJ/cm^2. Parameters necessary to calculate the effectiveness of UV disinfection include UV intensity, UV transmittance, and flow rate. Where UV light is used for primary disinfection, chemical disinfection shall be required to meet log inactivation criteria for viruses.

To ensure the effectiveness of the disinfection process, information regarding the parameters to be monitored, frequency and location are found in Section 9 of this document and in each system-specific Compliance Guidance Document and approved Annual Sampling Plan.

Information on calculating CT/IT, CT reference tables, and baffling factor are found in the most recent version of the Nova Scotia Treatment Standards for Municipal Drinking Water Systems, or in Appendices 9-G, 9-E, and 9-F of this document. The AFNWA shall immediately report to the oversight entity any instance where the required CT/IT was not achieved.

Incidents of inadequate CT/IT must be included in the NSSP/WSSP and included in the annual risk assessment process.

12.8.3 Secondary Disinfection

Community Drinking Water Systems use secondary disinfection to maintain an effective disinfectant residual in the distribution system. Acceptable secondary disinfectants include free chlorine and chloramines.

If free chlorine is used as a secondary disinfectant, the process shall be operated to ensure a minimum free chlorine residual of 0.2 mg/L is maintained throughout the system and does not exceed 4.0 mg/L.

If chloramines are used for secondary disinfection, the process shall be operated to ensure a minimum of 1.0 mg/L combined chlorine residual is achieved throughout the water distribution system and does not exceed 3.0 mg/L.

To ensure the effectiveness of the secondary disinfection process, the AFNWA is required to monitor the disinfectant residual at the locations and with the frequencies specified in the system-specific Compliance Guidance Document and approved Annual Sampling Plan. The AFNWA shall immediately report to the oversight entity when the minimum secondary disinfectant residual is not achieved.

Incidents of inadequate disinfection residual must be included in the NSSP/WSSP and included in the annual risk assessment process.

[32] CT = Concentration of Chemical Disinfectant (mg/L) X Time (minutes) X Baffling Factor
[33] IT (UV Dose) = Ultraviolet Intensity ($watts/cm^2$) X Time of Exposure (seconds)

12.8.4 Fluoride

If an AFNWA system includes fluoridation of the water, the AFNWA shall monitor daily for fluoride concentrations at a location where the water enters the distribution system. Health Canada recommends an optimal concentration of fluoride in drinking water of 0.7 mg/L. The AFNWA shall record fluoride measurements daily in a uniform manner and make the results available to the oversight entity upon request.

12.8.5 Free Ammonia, Nitrate and Nitrite

Any AFNWA facility practicing chloramination shall monitor weekly for free ammonia, nitrate and nitrite in the distribution system. Sampling points shall include distribution system storage (e.g., water tanks, reservoirs, etc.) and dead ends.

13.0 Compliance Standard: Reporting

PROVINCIAL REFERENCES

NS Treatment Standards

Nova Scotia Treatment Standards for Municipal Drinking Water Systems contain the detailed requirements for treatment processes and facility design.

NS Approval to Operate

Nova Scotia Approvals to Operate set the reporting requirements for water and wastewater systems, as legislated by the Environment Act - Chapter 1, Activities Designation Regulations, and Water and Wastewater Facilities and Public Drinking Water Supplies Regulations.

The Approval to Operate for a drinking water system provides system-specific requirements related to water quality criteria and key operational standards to ensure that water utility owners provide safe and reliable drinking water.

Overview

Reporting requirements established under provincial jurisdictions are legislated and regulated according to the responsible Minister and regulatory body. Nova Scotia best practices have been referenced for the reporting model described here, but in the absence of a legislated regulatory body and no parallel Ministerial relationship, there has been significant adaptation. Further, as the AFNWA and its relationships with both communities and the oversight entity mature, reporting requirements may need to be revised to meet the needs of the AFNWA, communities, and oversight entity. The process by which this document will be revised is to be determined and agreed upon by the AFNWA and oversight entity.

Requirements

Reporting and information sharing between the AFNWA and oversight entity will be continuous and occur:

- Annually - in the form of an annual system performance report
- Immediately – in the case of adverse or incident events
- Ad hoc – as needed to address emergent concerns that are not instances of immediate reporting

Reporting and information sharing between the AFNWA and its participating communities will also be continuous and required through NSSP/WSSP.

13.1 Annual Reporting Requirements

13.1.1 Annual Report

Annual Report - By April 1 of each year

The AFNWA shall prepare and submit to the oversight entity an annual performance report for each participating community. The annual report shall contain, but not be limited to, the following information:

1. Description of the Water System/Theory of Operation
    a. a summary and discussion of the quantity of water supplied during the reporting period on a per month basis showing design values, maximum daily flow and average daily flow for each month and any other parameters or conditions related to water quantity supply and use;
    b. a summary of the water system including source water, intake or wellhead facilities, treatment processes, reservoirs, chemical storage and feed systems, and stand-by power facility;
    c. a summary of areas of non-compliance with the Facilities Requirements (Section 8) Treatment and Distribution Requirements (Section 9) as stated in this Compliance Guidance Document and the actions to be taken to address these issues.

2. Water quality monitoring program
    a. a summary and interpretation of analytical results obtained in accordance with the monitoring and recording section of these Guidelines (Section 12) and system-specific compliance guidance documents, including an explanation for any exceedance of the maximum acceptable concentration (MAC) of health-related parameters listed in the GCDWQ, latest edition and the actions taken to address the exceedance;
    b. annual trend graphs for parameters that are continuously monitored; monthly trend analysis of turbidity data at all points of monitoring; a list of the names of each laboratory utilized and the parameters analyzed by each lab;
    c. verification that the operational conditions remained within the design range for achieving CT or IT;
    d. updates on the status of the source water protection plan, including any modifications to the plan or implementation schedule, and a summary of activities taken to achieve the goals and objectives of the plan;
    e. a review of the QA/QC program to validate the measurements obtained from continuous monitoring equipment and for all analysis conducted at the Facility or a non-certified laboratory

3. Incidences and upset conditions
    a. date and description of any emergency or upset conditions which occurred during the period being reported upon and action taken to correct them, including all drinking water advisories (date issued/removed, cause, and corrective action);
    b. all incidents of chlorine residual below the stipulated value with a description of actions taken;
    c. all incidents of operational conditions outside the design ranges, CT or IT calculations shall be provided with a summary of corrective actions taken;
    d. records of any violations of these Guidelines and system-specific compliance guidance documents and actions taken by the AFNWA to correct those violations;

4. Operator certification level and training
    a. a list of each operator and their level of certification, including plans on assisting operators to achieve certification, as necessary.

13.1.2 Annual Sampling Plan

Annual Sampling Plan - By October 1 of each year

The AFNWA shall prepare and submit to the oversight entity an annual sampling plan. The annual sampling plan shall recommend a monitoring program for the following year, highlighting any changes and the reason for the change. The annual monitoring program shall include:

• *Compliance monitoring, including QA/QC requirements*: this category of sampling includes identifying all the parameters, as well as location and frequency, which are required by these Guidelines;

• *Source water characterization monitoring*.

13.2 Ad hoc Reporting Requirements

The AFNWA shall notify the oversight entity when the following occurs:

a) when any extensions to or modifications of the Facility are proposed which would affect system-specific compliance criteria, as detailed in these Guidelines or outlined in the system-specific guidance document;

b) whenever the AFNWA becomes aware of any new or relevant information respecting any adverse effect that actually results, or may potentially result, from any activity related to compliance, as detailed in these Guidelines or outlined in the system-specific guidance document;

c) if sampling is changed such that a sample is analyzed by a lab that does not meet the adopted "Policy on Acceptable Certification of Laboratories" (excluding those parameters that are allowed to be tested on-site or by a non-certified lab);

d) if a sampling location is proposed to be moved or re-located.

13.3 Immediate Reporting Requirements

The AFNWA shall immediately notify the oversight entity when the following occurs:

a) whenever the presence of total coliforms or *E.coli* bacteria is detected;

b) upon receipt of results that indicate a maximum acceptable concentration has been exceeded;

c) lack of disinfection or failure of key water treatment process, including when it is necessary to use a treatment by-pass (see Section 9.3.1.1 for details);

d) use of emergency water supply from an untreated or inadequately treated source;

e) a serious incident of raw water contamination;

g) prior to the use of a back-up water supply;

h) any incidents of non-compliance with the system-specific Compliance Guidance Document, including but not limited to failure of an integrity test and exceedance of turbidity values outlined in system-specific Compliance Guidance Document;

i) any other incident that may adversely affect the quality of water within the system, (i.e. line breaks that result in loss of service, aesthetic water quality issues or deemed to potentially result in contamination of part of the distribution system);

j) if the chlorine residual in the water distribution system is non-compliant;

k) if the GUDI status of a well changes (for groundwater only);

l) if a system loses its Operator in Direct Responsible Charge (ODRC) and there is no back up ODRC.

13.4 Adverse Water Quality Response

13.4.1 Bacteriological Presence

13.4.1.1 Immediate Notification

The AFNWA shall contact the oversight entity immediately, by telephone, as soon as they receive notification from the lab of any sample result(s) indicating the presence of total coliform or *E.coli* bacteria. The AFNWA shall also forward a copy of the results to the oversight entity. Receipt of any results sent electronically from the AFNWA to oversight entity must be confirmed by telephone. Any incident that occurs after business hours shall be reported, by telephone, to the Regional Environmental Public Health Manager (REHM) or delegate.

When corrective action involves increased sampling and/or weekend/holiday sampling, the AFNWA shall immediately notify the lab and arrange for access to lab services.

13.4.1.2 Procedure for Responding to the Presence of Coliform Bacteria During Routine Monitoring

The following section describes the actions required by the AFNWA when routine monitoring shows the presence of total coliforms or *E.coli.* The response varies based on the type and prevalence of bacteria present in the distribution system.

13.4.1.3 Total Coliforms Present, E.coli Absent

If a routine sample is present for total coliform bacteria, in the absence of *E.coli*, the AFNWA shall immediately notify the oversight entity by telephone and collect a confirmation sample from all locations showing the presence of total coliform bacteria.

The AFNWA shall also measure the disinfectant residual and turbidity at each confirmation sample location.

• If there is inadequate residual (below compliance requirements) at location(s) within the distribution system, increase disinfection dosage and, if necessary, flush water mains. If there is inadequate disinfection (below compliance requirements) of the water entering the distribution system, notify the oversight entity and issue a boil water advisory (BWA) (refer to section 13.4.2).

• If the turbidity is elevated in the distribution system (e.g., not in compliance with approval requirements or higher than normal for a given location), evaluate the effectiveness of treatment and integrity of the transmission/distribution system. Check the turbidity of the water leaving each filter (if present), the turbidity of the water entering and within the distribution system. Determine the potential for a breach in the integrity of the transmission/ distribution system (e.g., main break, etc.).

The confirmation sample shall be analyzed by a quantitative method (MPN) to determine the magnitude of contamination (refer to Section 12.3). The AFNWA shall coordinate with the lab to ensure samples are analyzed as soon as they are received.

If a BWA was issued, the advisory may be confined only to those residents serviced by the portion of the system affected and not the entire distribution system. This will be determined on a case-by-case basis in consultation with the oversight entity.

13.4.1.4 E.coli Present at a Single Location

If a routine sample is present for *E.coli* bacteria, the AFNWA shall immediately notify the oversight entity, by telephone, upon receiving notification of the sample results from the lab. The oversight entity will notify the appropriate public health resources.

The AFNWA shall immediately begin an investigation to explain the presence of bacteria (refer to section 13.4.1.6) and collect a minimum of three confirmation samples for every location that showed the presence of *E.coli* bacteria. The AFNWA shall immediately notify the oversight entity, by telephone and in writing (e.g., email), of the results of the investigation and take corrective action to restore water quality. The confirmation samples shall be collected from the *E.coli* positive location as well as an upstream and a downstream location. Where possible, upstream and downstream sample locations should be within five active service connections of the sample location that tested positive for *E.coli* bacteria. If no suitable sample collection locations can be found within five service connections, the utility should make every effort to locate alternate upstream and downstream sampling points within the same hydraulic zone as the positive *E.coli* sample.

If a positive result is obtained from a dead-end in the distribution system, a minimum of two confirmation samples shall be collected: one from the *E.coli* positive location and one from an adjacent location.

The AFNWA shall also measure the disinfectant residual and turbidity at each confirmation sample location.

• If there is inadequate residual at location(s) within the distribution system, increase disinfection dosage and, if necessary, flush water mains. If there is inadequate disinfection of the water entering the distribution system, notify the oversight entity and issue BWA (refer to section 13.4.2).

• If the turbidity is elevated in the distribution system (e.g., not in compliance with these Guidelines or system-specific compliance guidance document requirements or higher than normal for a given location), evaluate the effectiveness of treatment and integrity of the transmission/distribution system. Check the turbidity of the water leaving each filter (if present), the turbidity of the water entering and within the distribution system. Determine the potential for a breach in the integrity of the transmission/ distribution system (e.g., main break, etc.).

Confirmation samples shall be analyzed by a quantitative method (MPN) to determine the magnitude of contamination (refer to Section 12.3). The AFNWA shall coordinate with the lab to ensure the samples are analyzed when received.

Depending on the results of the investigation, the oversight entity may recommend the AFNWA to issue a boil advisory in accordance with section 13.4.1.6. The boil advisory may be confined only to those residents serviced by the portion of the system affected and not the entire distribution system. This will be determined on a case-by-case basis in consultation with the oversight entity.

13.4.1.5 E.coli Present at Multiple Locations

If routine sampling indicates the presence of *E.coli* bacteria at multiple sample locations, the AFNWA shall immediately notify the oversight entity, by telephone, upon receiving notification of the sample results from the lab. The oversight entity will notify the appropriate public health resources.

The AFNWA shall immediately issue a boil water advisory in accordance with section 13.4.2 and begin an investigation to explain the presence of *E.coli* bacteria as described in section 13.4.1.6. Depending on circumstances, the BWA may be confined only to those residents serviced by the portion of the system affected and not the entire distribution system. This will be determined on a case-by-case basis in consultation with the oversight entity.

The AFNWA shall immediately notify the oversight entity, by telephone and in writing (e.g., email), of the results of the investigation and take corrective action to restore water quality. The AFNWA shall collect three confirmation samples for every routine sample that showed the presence of *E.coli* bacteria.

The confirmation samples shall be collected from the *E.coli* positive locations, an upstream and a downstream location, adjacent to the locations that tested positive. Where possible, upstream and downstream sample locations should be within five active service connections of the sample locations that tested positive for total coliform and *E.coli* bacteria. If no suitable locations can be found within five service connections, the utility should make every effort to locate alternative upstream and downstream sampling points within the same hydraulic zone as the positive *E.coli* samples. If a positive result is obtained from a dead-end in the distribution system, a minimum of two confirmation samples shall be collected: one from the *E.coli* positive location and one from an adjacent location.

The AFNWA shall also measure the disinfectant residual and turbidity at each confirmation sample location.

• If there is inadequate residual (below compliance requirements) at location(s) within the distribution system, increase disinfection dosage and, if necessary, flush water mains.

• If the turbidity is elevated in the distribution system (e.g., not in compliance with these Guidelines or system-specific compliance guidance document requirements or higher than normal for a given location), evaluate the effectiveness of treatment and integrity of the transmission/distribution system. Check the turbidity of the water leaving each filter (if present), the turbidity of the water entering and within the distribution system. Determine the potential for a breach in the integrity of the transmission/ distribution system (e.g. main break, etc.).

Confirmation samples shall be analyzed by a quantitative method (MPN) to determine the magnitude of contamination (refer to Section 12.3). The AFNWA shall coordinate with the lab to ensure samples are analyzed as soon as they are received.

13.4.1.6 Conducting an Investigation

When a sample shows the presence of *E.coli* bacteria or a confirmation sample confirms the presence of total coliform bacteria, the AFNWA shall immediately begin an investigation to explain the presence of bacteria. In consultation with the oversight entity, the AFNWA shall consider the following on a case-by case basis:

1) Assess source water quality

a) Determine if there has been a recent inflow of water from a contaminated source;

b) Determine if there have been recent changes in source water quality (e.g. fluctuation in turbidity, etc.).

2) Evaluate the effectiveness of treatment

a) Determine if there has been a recent interruption in treatment;

b) Determine if disinfection equipment is working properly. Calculate CT/IT to confirm requirements are met;

c) Measure the disinfectant residual leaving the plant;

d) Determine if the turbidity of water leaving each filter and the turbidity of the water entering the distribution system meets approval requirements;

e) Collect samples of water leaving the treatment plant for bacteriological quality;

f) Determine if the required log reduction for viruses (i.e. all systems) and protozoa (i.e. systems relying on surface water and GUDI sources) is achieved;

3) Evaluate the integrity of the transmission/distribution system

a) Determine if water quality has deteriorated due to cross-connections, repairs, construction, loss of pressure, etc.

b) When the system was last flushed was anything unusual noted?

c) Was the system recently de-pressurized?

d) Has there been any recent construction on the system? What is the location and type of recent repair? Were the mains disinfected after the repair?

e) Have there been any water quality complaints?

4) Enumerate coliform bacteria in samples to assess the degree of contamination and possible entry point;

5) Consider further microbiological analysis of samples collected from the system;

6) Review the history of the system and possibility for biofilm formation as per Appendix 13-B.

This list is provided as guidance only. The AFNWA is ultimately responsible for carrying out the investigation to determine the cause of the contamination event. The AFNWA shall immediately notify the oversight entity, by telephone and in writing (e.g. email), of the results of the investigation and take corrective action to restore water quality.

13.4.2 Boil Water Advisories (BWA)

13.4.2.1 Deficiencies that Require a Boil Water Advisory

Deficiencies that require a BWA advisory include:

1) The presence of *E.coli* in multiple samples collected from the drinking water system on the same day;

2) The confirmed presence of *E.coli* in a confirmation sample collected from the same location in the drinking water system;

3) The presence of *E.coli* in a single sample collected from the distribution system together with other evidence that indicates the water supply system may present a threat to public health (e.g. low chlorine residual, high turbidity, water main break, etc.);

4) Lack of disinfection (i.e. all systems) or failure of a key water treatment process (e.g. filtration process for systems relying on surface water or GUDI sources);

5) Use of an emergency water supply from a system that does not have treatment to meet log reduction requirements for viruses (i.e. all systems), and protozoa (i.e. Giardia and Cryptosporidium – systems relying on surface water or GUDI sources);

6) Other circumstances which, in the opinion of the AFNWA, in consultation with the oversight entity, constitutes a risk to public health (e.g. Giardia, Cryptosporidium contamination, etc.);

7) Evidence of an outbreak of waterborne illness as determined by appropriate public health resources (the risk to young children, elderly and immuno-compromised people should be considered in a decision);

8) A serious incident of raw water contamination; and

9) Loss of positive pressure in the entire drinking water distribution system or portion of the service area, at street level, following AWWA protocols for disinfecting water mains[34].

13.4.2.2 Deficiencies That May Require a Boil Water Advisory

Prior to issuing an BWA for the deficiencies listed below, the AFNWA shall consult with the oversight entity. Deficiencies that may require a BWA include, but are not limited to:

1) The presence of *E.coli* in a single sample collected from the system if the results of the investigation suggest potential contamination of the supply and/or the AFNWA is unable to collect a confirmation sample immediately;

2) Suspected cross-connection;

3) Indicators of poor water quality as evidenced by sample results indicating the presence of total coliform in the water leaving the treatment plant and other indicators of poor water quality such as high turbidity, low chlorine residual, etc.

13.4.2.3 Boil Water Advisory Protocol and Communication Plan

Initiating the BWA

Where one or more of the conditions described in Section 13.4.2.1 exists, the AFNWA shall initiate a BWA and contact the oversight entity immediately.

[34] AWWA resources can be found at file:///Users/meganfuller/Downloads/Meeting-the-new-guidelines-for-main-break-classification-1.pdf and https://www.mwa.co.th/download/prd01/reference/AWWA_std/Disinfecting_Water_Mains.pdf

Where one or more of the conditions described in Section 13.4.2.2 exists, the AFNWA may initiate a BWA after consultation with the oversight entity.

If oversight entity is aware of a potential serious health risk, it will recommend the AFNWA to initiate a BWA.

When a BWA is to be initiated, the AFNWA shall provide a Communication Plan to the oversight entity. A communication plan for all types of water advisories should be developed as part of the AFNWA's emergency notification process. Depending on the circumstances of the advisory, the oversight entity may recommend modifications to the Plan, in consultation with the AFNWA. During the BWA, there should be frequent communication between the oversight entity and the AFNWA.

For additional guidance on the communication of water advisories to the public, the AFNWA can reference the most recent version of the "Drinking Water Advisory Communication Toolbox". The document is a collaborative effort by the U.S. Centers for Disease Control and Prevention, U.S. Environmental Protection Agency, American Water Works Association, and the U.S Department of Health and Human Services.

Procedure for Public Notification

1) The AFNWA will inform the public in a method and frequency acceptable to the oversight entity;

A BWA must be effectively communicated to the public. At a minimum, the Communication Plan should contain the following information:

• Who at the AFNWA will oversee the notification (position, telephone number);

• Who the AFNWA will notify directly including names and telephone numbers for the oversight entity, large users, and users with high-risk populations (e.g. schools, health care facilities, industries, etc.);

• What messaging will be communicated to the public (refer to Appendix 13-C for guidance from Nova Scotia's Guidelines for Monitoring Public Drinking Water Supplies);

• How the public will be notified (e.g. social media, website, radio, television, newspaper and/or other print media, etc.);

• How the public will be kept informed of the status of the BWA and how frequently once the BWA has been issued (e.g. hourly announcements on the radio, daily updates on social media and/or other print media, etc.); and

• Once the BWA is removed by the AFNWA, in consultation with the oversight entity, how the removal of the BWA will be communicated to the public including messaging, AFNWA contact person, how frequently the public will be notified and for what duration.

All methods of communication to the public are to be maintained throughout the duration of the BWA. In the case of an immediate serious public health threat other methods of notification, such as door-to-door and installation of signage, may be necessary. This will be determined in consultation with the oversight entity and appropriate public health resources.

Suggested Wording

"Due to recent water quality test results that do not meet the Guidelines for Canadian Drinking Water Quality, residents are advised to boil all water for at least 1 minute after the water reaches a rolling boil, for the purposes of drinking, preparing infant formulas, preparing juices and ice cubes, washing fruits and vegetables, cooking, dental hygiene or any other activity that may result in human consumption. This is to be done until further notice" (refer to Appendix 13-C).

Follow up Communication Plan

After a BWA has been issued, the AFNWA shall keep the public informed about the status of the BWA. How the public will be kept informed and how frequently they will be updated on the status of the BWA shall be included in the Communication Plan. For example, the AFNWA could update the public hourly using announcements placed on social media and/or local radio stations. The AFNWA may also choose to put a telephone hot line in place during the BWA to allow affected residents to call with any questions they may have.

Some businesses, institutions, industries or health care facilities may have to take additional precautions during a BWA (refer to Appendix 13-E). There may be circumstances where these facilities should be contacted as part of the AFNWA's Communication Plan to assure compliance with these precautions.

Once the BWA is removed by the AFNWA, the AFNWA shall notify the public of the removal of the BWA in accordance with their Communication Plan.

Instructions for Boiling and Disinfecting Tap Water

During a BWA it is essential that all water to be used for the following activities be boiled for at least one minute after it reaches a rolling boil:

1) drinking;

2) preparing infant formulas;

3) preparing juices and ice cubes;

4) washing fruits and vegetables;

5) cooking;

6) dental hygiene; or

7) any other activity that may result in human consumption.

Detailed instructions for boiling and disinfecting tap water during a boil water advisory are included in Appendix 13-D. Instructions for businesses, institutions, industries or health care facilities that may have special requirements when the boil water advisory is in effect are provided in Appendix 13-E.

Removing the Boil Water Advisory

A BWA will be removed by the AFNWA, in consultation with oversight entity. Under normal circumstances a BWA will be removed when the following criteria are met:

1) When the treatment, distribution, or operational malfunction has been corrected, sufficient finished water displacement has occurred in the water works system to eliminate potentially contaminated water, and system performance indicates barriers are in place to protect health (e.g., disinfectant residual, turbidity, etc.); and

2) The GCDWQ for bacteriological quality are met for 2 consecutive sets of samples separated by a minimum of 24 hours.

If a BWA is not issued due to the presence of bacteria, the oversight entity may recommend altering of the process for removing the BWA so that two samples for total coliform and *E.coli* bacteria separated by a minimum of 24 hours are

not required to lift the BWA. Prior to lifting the BWA, the AFNWA, through communication with the oversight entity, must be satisfied that altering the process will not result in a risk to public health.

13.4.3 Health-related Chemical Exceedance

13.4.3.1 Immediate Notification

The AFNWA shall notify the oversight entity immediately, by telephone, of any sample result exceeding a MAC. Results sent electronically from the AFNWA to the oversight entity, must be confirmed by telephone. Any incident that occurs after business hours shall be reported, by telephone, to the Regional Environmental Public Health Manager (REHM) or delegate.

13.4.3.2 Procedure for Responding to a Sample that Exceeds a Health-Related Chemical Parameter

If a routine sample exceeds the MAC for a chemical parameter, specified in the most recent edition of the GCDWQ, the AFNWA shall:

1) Notify the oversight entity immediately, by telephone as soon as they become aware of the exceedance.

2) Collect a confirmation sample for the parameter(s) of concern immediately upon receiving notification of the sample results from the lab. If the AFNWA cannot collect a confirmation sample within 24 hours (e.g. weekend, holiday, etc.), they shall immediately notify the oversight entity as soon as they have made this determination. The oversight entity may recommend the AFNWA to take special precautions to ensure the protection of public health while awaiting the confirmation sample results from the lab.

a) If the confirmation sample indicates the MAC is not exceeded for the parameter(s) of concern, the AFWNA may return to routine sampling. The oversight entity may recommend additional samples be taken to further evaluate the need for corrective action.

b) If the confirmation sample indicates that the MAC is exceeded for the parameter(s)of concern, the AFNWA shall notify the oversight entity immediately. The oversight entity will notify appropriate public health resources and determine if a recommendation to issue a “Do Not Consume” or “Do Not Use” advisory is warranted. If an advisory is deemed necessary by the AFNWA, in consultation with the oversight entity, the AFNWA shall immediately issue the advisory in accordance with section 13.4.4.

3) If the confirmation sample indicates the MAC is exceeded, the AFNWA shall develop an action plan for addressing such non-compliance issues. The action plan shall be prepared and submitted to the oversight entity within 30 calendar days from when the AFNWA was notified by the lab that the confirmation sample exceeded the MAC.

The action plan shall:

a) Determine why the water exceeds the MAC;

b) Select a corrective action(s) to remove the source of contamination, provide treatment or switch to an acceptable alternate potable water supply. When an alternate water supply is recommended, it is important to ensure the microbiological safety of the supply before use;

c) Provide a schedule for implementation of the corrective action(s) for meeting the MAC.

4) After implementing the corrective action(s), the AFNWA shall collect a sample for the parameter(s) of concern to demonstrate that the concentration is below the MAC (refer to the GCDWQ, latest version).

If the water sample indicates that the corrective action(s) was not effective to reduce the concentration(s) below the MAC, the AFNWA shall re-submit a corrective action plan (refer to Appendix 13-F).

13.4.4 Do Not Consume and Do Not Use Advisories

A "Do Not Consume" or "Do Not Use" advisory is issued in situations where there is a potential or confirmed incident of contamination (natural or man-made) when the contaminant of concern may not be removed or inactivated by boiling; when there is a significant risk from ingestion, dermal contact, or inhalation of the contaminant; or when an unknown or unexpected chemical contaminant is detected in the drinking water system.

A "Do Not Consume" or "Do Not Use" advisory is issued in the following circumstances:

a) The occurrence of an event that may have or has caused massive contamination to the drinking water supply (e.g., oil spill in source water);

b) Exceedance of the guideline value (MAC) for a chemical contaminant with an acute health effect from short-term exposure;

c) The presence of a chemical contaminant with no established guideline but which may pose a health risk from short term exposure;

d) Circumstances in the opinion of the AFNWA, in consultation with the oversight entity and appropriate public health resources, constitute a risk to public health.

A "Do Not Consume" advisory is issued where exposure to the contaminant is only a concern through ingestion. A "Do Not Consume" advisory is issued to advise the community to avoid using the water for drinking, preparing food, beverages, or ice cubes, washing fruits and vegetables, oral hygiene and/or any other use that may result in human consumption. Boiling the water does not remove the contaminant.

A "Do Not Use" advisory is issued where dermal or inhalation exposure to the contaminant could affect the skin, eyes, and/or nose. A "Do Not Use" advisory is issued to advise the community to avoid the water for all domestic purposes including all uses identified for a "Do Not Consume" advisory as well as activities such as showering and bathing. Boiling the water does not remove the contaminant.

13.4.4.1 Do Not Consume or Do Not Use Advisory Protocol and Communication Plan

Initiating the Advisory

Where one or more of the conditions described in section 13.4.3.2 exists, the AFNWA shall contact the oversight entity immediately to consult on the need to issue an advisory. The oversight entity will notify the appropriate public health resources.

When an advisory is to be initiated, the AFNWA shall provide a Communication Plan in writing to the oversight entity. The information contained in the plan and how it will be communicated to affected residents shall be developed as part of the AFNWA's emergency notification/contingency planning process. Depending on the circumstances of the advisory, the oversight entity may recommend modifications to the Plan, in consultation with the AFNWA.

During the advisory, there should be frequent communication between the oversight entity and the AFNWA.

For additional guidance on the communication of water advisories to the public, the AFNWA can reference the most recent version of the "Drinking Water Advisory Communication Toolkit", a collaborative effort by the U.S. Centers for Disease Control and Prevention, U.S. Environmental Protection Agency, American Water Works Association, and the U.S Department of Health and Human Services.

Procedure for Public Notification

1) The AFNWA will inform the public in a method and frequency acceptable the oversight entity.

The “Do Not Consume” or “Do Not Use” advisory must be effectively communicated to the public. At a minimum, the Communication Plan shall contain the following information:

• Who at the AFNWA will oversee the notification (position, telephone number);

• Who the AFNWA will notify directly including names and telephone numbers for the oversight entity, large users, and users with high-risk populations (e.g., institutions, health care facilities, industries, etc.);

• What messaging will be communicated to the public (Appendix 13-C);

• How the public will be notified (e.g., social media, website, radio, television, newspaper and/ or other print media, etc.);

• How the public will be kept informed of the status of the advisory and how frequently once the advisory has been issued (e.g., hourly announcements on the radio, daily updates on social media and/or other print media, etc.); and

• Once the advisory is removed by the AFNWA, in consultation with the oversight entity, how the removal will be communicated to the public including messaging, AFNWA contact person; how frequently the public will be notified and for what duration.

All methods of communication to the public are to be maintained throughout the duration of the advisory being in effect. In the case of an immediate serious public health threat other methods of notification, such as door-to-door and installation of signage, may be necessary.

Suggested Wording

Specific precautions will depend on the contaminant of concern. The following wording may need to be modified.

Do Not Consume Advisory

“Due to recent water quality test results that do not meet the Guidelines for Canadian Drinking Water Quality, consumers are advised not to use their water for drinking, preparing infant formulas, preparing juices and ice cubes, washing fruits and vegetables, cooking, dental hygiene, or any other activity that may result in human consumption. This is to be done until further notice. Boiling the water will not remove the contaminant.” (Refer to Appendix 13-C for an example media release.)

Do Not Use Advisory

“Due to recent water quality test results that do not meet the Guidelines for Canadian Drinking Water Quality, consumers are advised not to use their water for any purpose that may result in consumption such as drinking, preparing infant formulas, preparing juices and ice cubes, washing fruits and vegetables, cooking, and dental hygiene, etc. Consumers are also advised not to use the water for showering or bathing. This is to be done until further notice. Boiling the water will not remove the contaminant”. (Refer to Appendix 13-C for an example media release.)

Follow up Communication Plan

After the “Do Not Consume” or “Do Not Use” advisory has been issued, the AFNWA shall keep the public informed about the status of the advisory. How the public will be kept informed and how frequently they will be updated on the status of the advisory shall be included in the Communication Plan. For example, the AFNWA could update the public hourly using announcements placed on social media and/or local radio stations. The AFNWA may also choose to put a telephone hot line in place during the advisory to allow affected residents to call with any questions they may have.

Some businesses, institutions, industries, or health care facilities may have to take additional precautions during the advisory. These facilities should be contacted as part of the AFNWA's Communication Plan.

Once the advisory is removed by the AFNWA, in consultation with the oversight entity, the AFNWA shall notify the public of the removal of the advisory in accordance with their Communication Plan.

Removing the Do Not Consume or Do Not Use Advisory

The "Do Not Consume" or "Do Not Use" advisory will be removed by the AFNWA, in consultation with the oversight entity, when a risk to public health no longer exists. Under usual circumstances, the advisory will be removed when the event that prompted the issuance of the advisory is resolved and this is confirmed through sampling, where appropriate.

The advisory will be removed when one or more of the following is confirmed, as appropriate for the situation:

a) Where there is evidence that the quality of the source water shows no contamination, and the drinking water is safe for drinking and other uses;

b) Where there is evidence that the source of the hazardous contaminant has been removed and the distribution system has been thoroughly flushed. Plumbing systems internal to buildings should also be flushed;

c) If the advisory was due to a chemical spill impacting the source of the drinking water supply, when the spill has been cleaned up and a sample(s) has been collected to confirm this;

d) When failures with the treatment process/distribution system have been addressed and operational parameters/samples can confirm this;

e) Once appropriate treatment has been installed to remove or reduce the level of the contaminant and a sample has been collected to confirm this.

13.5 Corrective Action Plans

There are numerous occurrences that warrant the submission of corrective action plans by the AFNWA to the oversight entity, these include, but are not limited to:

- Bacteriological presence – immediate corrective actions implemented, and corrective action plan submitted to address any findings from the investigation, as outlined in section 13.4.1.
- Health related exceedance – Corrective Action plan to the oversight entity within 30 days of the incident result and include details outlined in section 13.4.3.2.
- Well reclassification – corrective actions necessary to address well reclassification from low-risk to higher-risk classifications, as outlined in section 9.1.
- Corrosion Control Monitoring – corrective action in response to Lead exceedance mitigation, in keeping with the requirements detailed in Section 12.6.3 (Data Interpretation and Action).
- Incidents of chlorine residual below stipulated value and description of actions taken, as detailed in section 9.4.3 and to be included in the Annual Report (see section 13.1.1).
- Operational conditions outside of design range for CT/IT and corrective actions taken, as detailed in section 9.4.2 and to be included in the Annual Report (see section 13.1.1).
- Violations of treatment and monitoring requirements established in this Guidance Document or system-specific compliance document requirements, including incident, or upset condition occurrence and corrective actions taken (lack of duplicate disinfection processes, lack of alarm call outs for continuous monitoring requirements, line breakage, use of back-up water supply, serious incident of raw water contamination, failure of key treatment process, etc.)

14.0 Compliance Standard: System Specific Compliance Guidance Documents

PROVINCIAL REFERENCES

NS Treatment Standards

Nova Scotia Treatment Standards for Municipal Drinking Water Systems contain the detailed requirements for treatment process and facility design.

NS Approval to Construct and Approval to Operate

Nova Scotia Approvals to Construct and Operate set key facility requirements for water and wastewater systems, as legislated by the Environment Act - Chapter 1, Activities Designation Regulations, and Water and Wastewater Facilities and Public Drinking Water Supplies Regulations.

The application for Approval to Construct details the requirements for system upgrades and new builds, including treatment, monitoring, and bypass guidance during construction on existing systems.

The application for an Approval to Operate for a drinking water system requires that facilities meet the recommendations of the Atlantic Canada Guidelines.

Overview

With no established regulator or regulations, there is no authoritative body to issue approvals or permits for operation of drinking water treatment systems. Approvals to Construct and Operate, in a provincial model, details system-specific applications of regulations and sets operating terms and conditions. While there is no direct path for adapting Approvals to Operate for the AFNWA, it is recognized as a best practice. In the interim, the AFNWA will develop System-Specific Compliance Guidance Documents (SCGD) that will serve as operating terms and conditions for each participating system in the AFNWA.

Requirements

Each drinking water treatment and/or distribution system (in the case of MTAs) will have a SCGD developed by the AFNWA, in consultation with the oversight entity. The SCGD will establish specific treatment, monitoring, and reporting requirements for each system, per the Regulatory Framework adopted by the AFNWA as developed here in this Compliance Guidance Document.

The SCGD will be used to develop the Annual Sampling plan, align with the reporting requirements in the Annual Report, and will set immediate and ad hoc reporting requirements, including system upgrades and construction activities.

This Guidance Document details the system performance requirements, monitoring requirements, and reporting standards that must be maintained for participating AFNWA treatment and distribution systems from source to tap. To ensure that these requirements and standards are translated and applied fully for each system, a SCGD will be drafted for each system to codify the operating conditions necessary for each system and clarify the roles of the AFNWA and oversight entity in ensuring safe and clean drinking water.

In a provincial model, Approvals to Operate apply specific requirements outlined in regulations, standards, and guidelines to individual systems. The approval allows for system-specific conditions to dictate performance requirements, including altered monitoring schedules (either increased or decreased), deviations in treatment requirements (dependent on source water quality and other system-specific characteristics), etc. In the context of the AFNWA SCGDs, formalized between the AFNWA and oversight entity, will likewise apply the requirements outlined in this Guidance Document, on a case-by-case, system-specific basis. Where issues of non-compliance exist, SCGDs will include a description of non-compliance, alternative requirements for the system, and reference to the timeline of corrective actions.

The SCGD will include, at a minimum:

- Immediate and Annual reporting requirements
- List of documentation to be available onsite, at the request of oversight entity
- Operational requirements (including log reduction requirements)
- Primary disinfection requirements
- Filtration requirements
- Sampling and monitoring requirements
- Reporting requirements related to system upgrades and construction activities.

SCGD will be developed for participating AFNWA systems immediately following the transfer of services and liability from the community to the AFNWA. SCGD will be reviewed on an annual basis by the AFNWA and any changes in system treatment and or sampling capabilities will be communicated by the AFNWA to the oversight entity and the SCGD will be revised. The oversight entity will review and accept changes to the SCGD as necessary.

15.0 Compliance Standard: Occupational Health and Safety

PROVINCIAL LEGISLATION

NS Occupational Health & Safety Act

NB Workplace Health, Safety, and Compensation Commission and Workers' Compensation Appeals Tribunal Act

NB Workers' Compensation Act

NB Occupational Health and Safety Act

PEI Occupational Health and Safety Act

Provincial legislation and related regulations will set certain OH&S standards and practices for the AFNWA.

FEDERAL LEGISLATION

Canada Labour Code Part II

Because First Nation reserves are on federal land, Federal legislation also applies to certain OH&S matters.

Overview

Workers' rights and safety is central to ensuring safe drinking water in First Nations communities. The jurisdictional complexities of First Nations requires that the AFNWA abide by a range of provincial and federal legislation and related regulations.

Requirements

The AFNWA must work with both provincial and federal Labour boards to determine where provincial Acts and federal Acts establish workers' rights, safety, training, and compensation requirements. As a Not-for-Profit functioning on First Nations reserves with both First Nations and non-Indigenous workers, significant legal guidance will be necessary to ensure all workers' rights are protected.

16.0 Communication and Emergency Planning

The Regulatory Framework recommends that the AFNWA develop processes to monitor and respond to community feedback. It is also recommended that the AFNWA develop community engagement and reporting mechanisms to build trust and transparency in their delivery of clean drinking water and safe treatment of wastewater. While these efforts will be crucial for the success of the AFNWA, the Framework does not require specific communication standards or practices be met. These important functions should be managed through NSSP/WSSP and collaboration with participating communities. Likewise, Emergency Response Planning (ERP) will be central to the AFNWA's mission and should be managed through NSSP/WSSP. The complexity of ERP within each participating community, in partnership with provincial agencies and adjacent municipalities extends beyond the role of a single oversight entity or regulatory instrument.

17.0 Continuous Improvement

This Compliance Guidance Document is a static reflection of current best practices and evidence-based standards, which will inevitably require updating and modernization over time. The AFNWA, in collaboration with its Board of Directors and oversight entity, should develop processes to review and revise this Compliance Guidance Document, as necessary, until the new proposed water legislation to replace the 2013 *Safe Drinking Water for First Nations Act* and any potential regulations come into force.

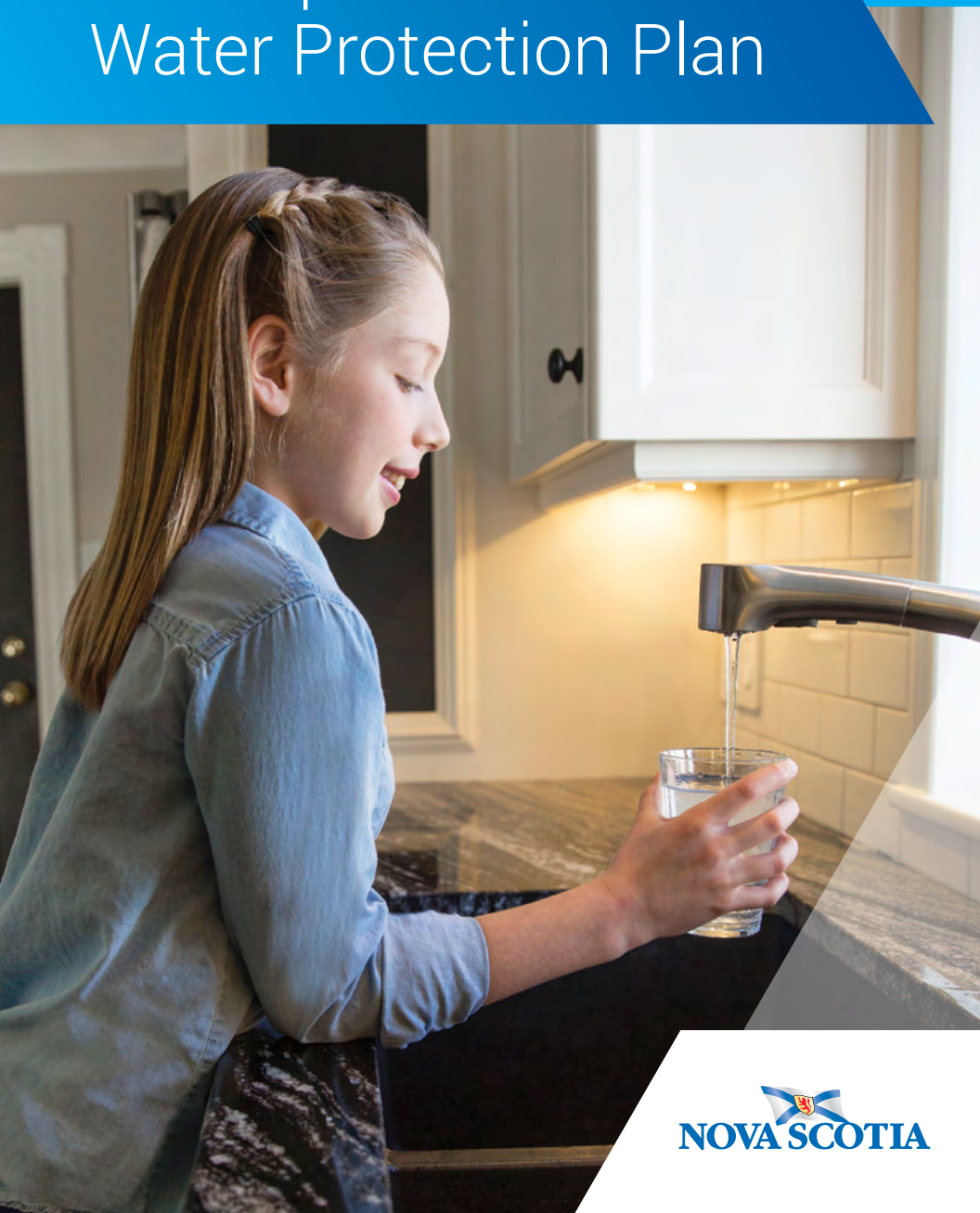
Appendices Table of Contents

Appendix 6-A

A Guide for Water Utilities and Municipalities

DEVELOPING A

Municipal Source Water Protection Plan



NOVA SCOTIA

A Guide for Water Utilities and Municipalities

DEVELOPING A

Municipal Source Water Protection Plan

Protecting the sources of our drinking water is a cornerstone of *A Drinking Water Strategy for Nova Scotia*. Without source protection, delivering a sustainable supply of the highest quality drinking water becomes much more difficult to achieve.

Nova Scotia Environment has published a five-part guide to implementing source protection for water supplies. This booklet summarizes these technical documents so that all Nova Scotians can become familiar with the need to have diligent, technically valid protection plans for water sources.

Table of Contents

Introduction

The vast majority of Nova Scotians already enjoy high-quality, safe drinking water. However, even the most remote, and seemingly pristine, water source may contain some impurities. In October 2002, the province released *A Drinking Water Strategy For Nova Scotia*, which provides the framework for managing drinking water supplies across the province. It describes a multiple-barrier approach to clean, safe drinking water.

Nova Scotia Environment (NSE) has published a five-part series of technical documents that provide detailed guidance for those who have to deliver effective source water protection plans. This booklet summarizes the protection process and the solutions offered by the technical documents.

Background

The most cost-effective way to ensure a safe source water supply is to prevent drinking water problems from developing in the first place. This is best achieved with an effective source water protection plan. Source water is untreated water from streams, rivers, lakes, or underground aquifers that is used to supply private wells and public drinking water supplies.

Although water is a renewable resource, there are limits to its quality and quantity. The quality of our drinking water sources is threatened by land development, runoff from agricultural, commercial, and industrial sites, and aging wastewater infrastructure, to name a few. To protect our source water we must manage the human activity that creates these threats. Protecting source water makes good sense in three ways. It makes good public health sense, good economic sense, and good environmental sense. Protecting drinking water sources also protects the water resource for many uses.

Nova Scotia's multiple barrier approach has three lines of defence:

- **Keeping Clean Water Clean**—We must select the highest quality sources of water and protect these sources to prevent contamination.

- **Making It Safe**—We must treat water to remove natural and man made impurities.

- **Proving It's Safe**—We must consistently monitor water quality and take swift, corrective action when deficiencies are identified. The success of these barriers relies on the involvement and vigilance of us all: government, business, landowners, public interest groups, and individual citizens.

Need for Commitment

Source water protection requires a strong commitment at the local level. The process we have developed employs a combination of management approaches but above all it is a consensus-driven process. Its success depends upon the collaboration of all stakeholders. The cooperation of multiple stakeholders allows communities to carry out mutually beneficial, locally developed and administered source water protection programs that achieve the long-term goal of providing high quality drinking water.

How to Design a Plan for Source Water Protection

Communities must learn about the risks and threats to their drinking water supply so they can make informed choices about protecting them from contamination. The following pages provide a summary of the steps necessary to develop a source water protection plan for a drinking water supply area. Detailed guides for each step in the process are also available.

Step 1

Form a Source Water Protection Advisory Committee

The municipality or water utility is responsible for forming an advisory committee to champion source water protection. The composition of the committee should reflect the jurisdictional make-up of the source water supply area. The committee may include municipal councillors, municipal and water utility engineers, landowners, and residents living within the source water supply area. You may also need to hire specialized technical consultants to complete some steps.

The advisory committee must understand its roles and responsibilities and, more importantly, the consensus-based approach to addressing issues that relate to water quality. Consequently, in Step One the mandate of the advisory committee must be clearly defined. Specifically, all of the following should be clearly stated in the plan: roles of the committee members, their responsibilities, whom they report to, and their length of term. NSE can help you to choose the composition of the committee and to clarify its roles and responsibilities.

Step 2

Delineate the Source Water Protection Area Boundary

The second step is to identify and delineate the boundary of the source water supply area, which may be either a surface water or groundwater supply. The Step Two booklet provides detailed technical information on recommended delineation procedures. During this step, the advisory committee may solicit public input to ensure that there are no gaps in the information that describes the source water supply area.

Step 3

Identify Potential Contaminants and Assess Risks

The third step is to identify and document potential sources of contamination and to assess the risk they pose to the source water supply area. Once you have identified potential sources of water contamination, conduct an assessment of the level of risk they pose to the source water supply area. This may include identifying ecologically sensitive sites within the source water supply area. The intent of Step Three is to provide the advisory committee with an understanding of the types of activities and associated contaminants that have the potential to impair water quality. This forms the basis for management planning (Step Four).

Step 4

Develop and Adopt a Source Water Protection Management Plan

By this time the advisory committee should have a good working knowledge of the source water supply area. It must now develop management goals and objectives, and prepare the overall source water protection plan. It is critical that the committee set goals that are both technically sound and achievable. To be achievable, the goals must recognize the need to protect a water supply source, while also considering economic activity within the protection area and the way of life enjoyed by residents and landowners.

The source water protection plan is often based on a combination of the most appropriate management practices for the source water supply area. The plan may incorporate a range of available options and techniques known as the ABCs of source water protection:

- (A)cquisition of land. The direct ownership of land in the source water supply area affords one of the highest levels of water quality protection.

- (B)ylaws. Adopt or amend land-use bylaws or develop a new municipal planning strategy. These instruments allow regulation of land uses permitted in source water supply areas. You can find more information in the Department of Municipal Affairs Local Government Resource Handbook: *Municipal Water Supply Watershed Planning Model,* section 5.7.

- (B)est Management Practices. Use best management practices and guidelines to manage activities that take place in the source water supply area.

- (C)ontingency Plans. If there's a spill or other event that threatens the quality or quantity of the source water, a well-prepared contingency plan will allow continued protection of public health.

- (D)esignation. The Environment Act allows for the designation of Protected Water Areas. Designation allows a water utility or municipality to regulate activities like swimming, fishing and logging within a delineated area. You can find more information in Nova Scotia Environment technical document, Designation of a Protected Water Area.

- (E)ducation. Work with stakeholders in the source water supply area to teach them about drinking water and water resource stewardship.

Once the advisory committee has identified the range of options available to manage the drinking water supply, Nova Scotia Environment can review the plan. We will review the plan with respect to the Department's programs and policies. If a municipal planning strategy and land-use bylaws are used as a mechanism to protect the source water supply area, Municipal Affairs (DMA) should also be consulted.

The proposed plan should be presented to the public for comments prior to final submission to NSE.

Step 5

Monitor and Evaluate the Plan

Once you have implemented your source water protection plan, you will need to set up procedures for continuous evaluation. One of the key components of evaluation is to monitor for water quality contaminants entering the source water supply. Besides water quality monitoring, you will need to put into place a formalized source water protection plan review process. This procedure will evaluate the performance of the plan and ensure that it is updated thus ensuring that the plan remains current with changing conditions and priorities in the source water supply area.

Both the water utility or municipality and the advisory committee will need to continue to work with stakeholders to ensure that the management mechanisms incorporated into the source water protection plan are contributing to the maintenance of water quality or quantity. Note that the advisory committee's role is on-going. The protection plan may continue to develop and change to reflect changes within the source water supply area over time.

Developing A Source Water Protection Plan: Summary Chart

Step 1 **Advisory Committee**	1) The committee should reflect the jurisdictional make-up of the water supply area. It is important to include municipal councillors,water utility engineers, planners, landowners, and residents from the area 2) In addition, the committee may also include stakeholders from sectors such as agriculture, forestry, and other commercial operations
Step 2 **Delineate Boundary**	1) Use maps and land-use information to delineate the boundary of the watershed area or groundwater capture zone 2) Mark the water supply boundary on a 1:50,000 scale (or less) map 3) The committee may solicit public input during this step in order to provide information about the watershed
Step 3 **Assess Risks**	1) Conduct a comprehensive assessment of all land-use activities within the water supply area 2) Determine what activities impact or impair water quality 3) Identify potential future sources of contamination 4) Assess the risk that each activity or source of contamination will have on the source water 5) The committee may solicit public input at this step

	NSE can provide input into the composition of the committee and advise on roles and responsibilities	DELIVERABLES	Formation of Watershed or Wellfield Advisory Committee
	The boundary of the water supply area may be submitted to NSE for review and comments		Delineation of Source Water Protection Area Boundary
	NSE can review the committee's risk assessment of their water supply and provide input		Assessment of Vulnerability to Contamination

Summary Chart *continued*

Step 4 **Management Plan**	1) Compile all information and set goals and objectives 2) Evaluate options 3) Develop management strategies to reduce negative impacts to water quality. Management options may include the following: (A)cquisition of land (B)ylaws – municipal planning for land-use (B)est Management Practices (C)ontingency planning for emergency situations (D)esignation (E)ducation 4) Public consultation
Step 5 **Monitor and Evaluate**	1) Develop a monitoring program and schedule 2) Continue to evaluate the effectiveness of the management plan 3) Develop a mechanism for the committee to respond to impairment or changes in water quality 4) Modify the plan if necessary

NSE can provide input into the development of management practices and will review the final plan

Comprehensive Source Water Protection Plan

DELIVERABLES

NSE can provide technical assistance. Contact NSE in the event of contamination

Monitor Water Quality to Evaluate the Effectiveness of the Plan

For More Information

This document briefly outlines the process for developing and implementing source water protection plans. Companion booklets give more detail about each step in the process:

Step 1: Form a Source Water Protection Advisory Committee

Step 2: Delineate a Source Water Protection Area Boundary

Step 3: Identify Potential Contaminants and Assess Risk

Step 4: Develop a Source Water Protection Management Plan

Step 5: Develop a Monitoring Program to Evaluate the Effectiveness of a Source Water Protection Plan

This series is part of Nova Scotia's Drinking Water Strategy.
For a copy of the strategy document, visit our website at www.novascotia.ca/nse/water/ or contact:
Nova Scotia Environment
Water Resources Unit
Suite 1800
1894 Barrington Street
PO Box 442
Halifax, NS B3J 2P8
Phone: (902) 424-3600
Fax: (902) 424-0501
Web address: www.novascotia.ca/nse

For information about municipal planning and land-use bylaws, contact:
Department of Municipal Affairs
Planning & Advisory Services Section
P.O. Box 216
Halifax, B3J 2M4
Phone: (902) 424-6642
Fax: (902) 424-0821
Web address: www.novascotia.ca/dma

Glossary

Aquifer
Any water-bearing stratum of rock, earth, or gravel that has sufficient porosity and permeability to yield ample supplies of groundwater in the form of wells or springs.

Best Management Practices (BMPs)
Methods, measures, or practices to prevent or reduce water pollution. BMPs are applied as a system of practices rather than a single practice. BMPs are selected on the basis of site-specific conditions that reflect natural background conditions and political, social, economic, and technical feasibility.

Groundwater
Water beneath the ground that is stored in an aquifer from which wells, springs, and groundwater runoff are supplied.

Source Water Protection
An approach to managing drinking water supplies based on (1) the formation of an advisory committee to guide the development of the plan, (2) an inventory of land-uses and activities within the source water supply area, (3) determination of existing and potential threats to the drinking water supply, (4) the development of management strategies designed to reduce and eliminate threats to the drinking water supply, contingency planning, and (5) monitoring program to evaluate the effectiveness of the overall plan. This approach encourages collaboration with all stakeholders within the source water supply area.

Source Water Supply Area
Refers to the area from which a water supply utility withdraws its drinking water. A source water supply area may consist of surface water, known as a watershed, or may be a groundwater supply area, known as an aquifer and delineated as a wellfield.

Surface Water
Water that exists on the surface of the earth in the form of lakes, rivers, streams, brooks, and ponds.

Watershed
A geographic area of land and surface water within the confines of a topographical drainage divide.

Appendix 9-A

Nova Scotia Treatment Standards for

Municipal Drinking Water Systems

Appendix A

Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol)

NOVA SCOTIA

APPENDIX A

Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol)

Appendix to the Nova Scotia Treatment Standards for Municipal Drinking Water Systems published by the Department of Environment and Climate Change

Updated May 2022

Table of Contents

A1 Introduction

The purpose of this document is to provide a process for determining whether a water well is classified as either groundwater under the direct influence of surface water (GUDI) or as non-GUDI. This classification is used for determining water supply treatment requirements. The GUDI assessment process described in this document is based on guidance provided by U.S.EPA (1991), AWWA (1996), AWWA (2001) and the Ontario MOE (2001). Treatment requirements and the general requirements related to the use of this Protocol are provided in the main body and additional appendices of the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time.

All municipal water well sources in Nova Scotia must be initially assessed for their GUDI classification. GUDI is an acronym for "groundwater under the direct influence of surface water. It refers to situations where microbial pathogens can travel from surface water through an aquifer to a water well. GUDI is defined as (U.S.EPA, 1991): "*any water beneath the surface of the ground with:*

i. *significant occurrence of insects or other macro-organisms, algae, organic debris, or large-diameter pathogens such as Giardia lamblia or Cryptosporidium; or*

ii. *significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions."*

Part (ii) of the definition is typically assessed first and involves determining whether there is a significant hydraulic connection between the groundwater source (that supplies the water well) and surface water. A significant hydraulic connection implies that groundwater rapidly recharged by surface water could allow microbial pathogens to enter the groundwater source. Part (i) of the definition relates to whether there are particulates present in the well water that are indicative of surface water. This is determined using Microscopic Particulate Analysis (MPA) which analyzes for significant numbers of macro-organisms, pathogens, algae, and other surrogate indicators of surface water.

A1.1 Nova Scotia GUDI

The Nova Scotia GUDI assessment process consists of three steps. The steps are shown on the flow chart in Figure A.1 and an explanation of each step is provided in Section A2 of this appendix. The process can take up to two years to complete due to the monitoring requirements under Steps 2 and 3.

Step 1 is a screening step used to rapidly identify obvious non-GUDI water wells based on available information.

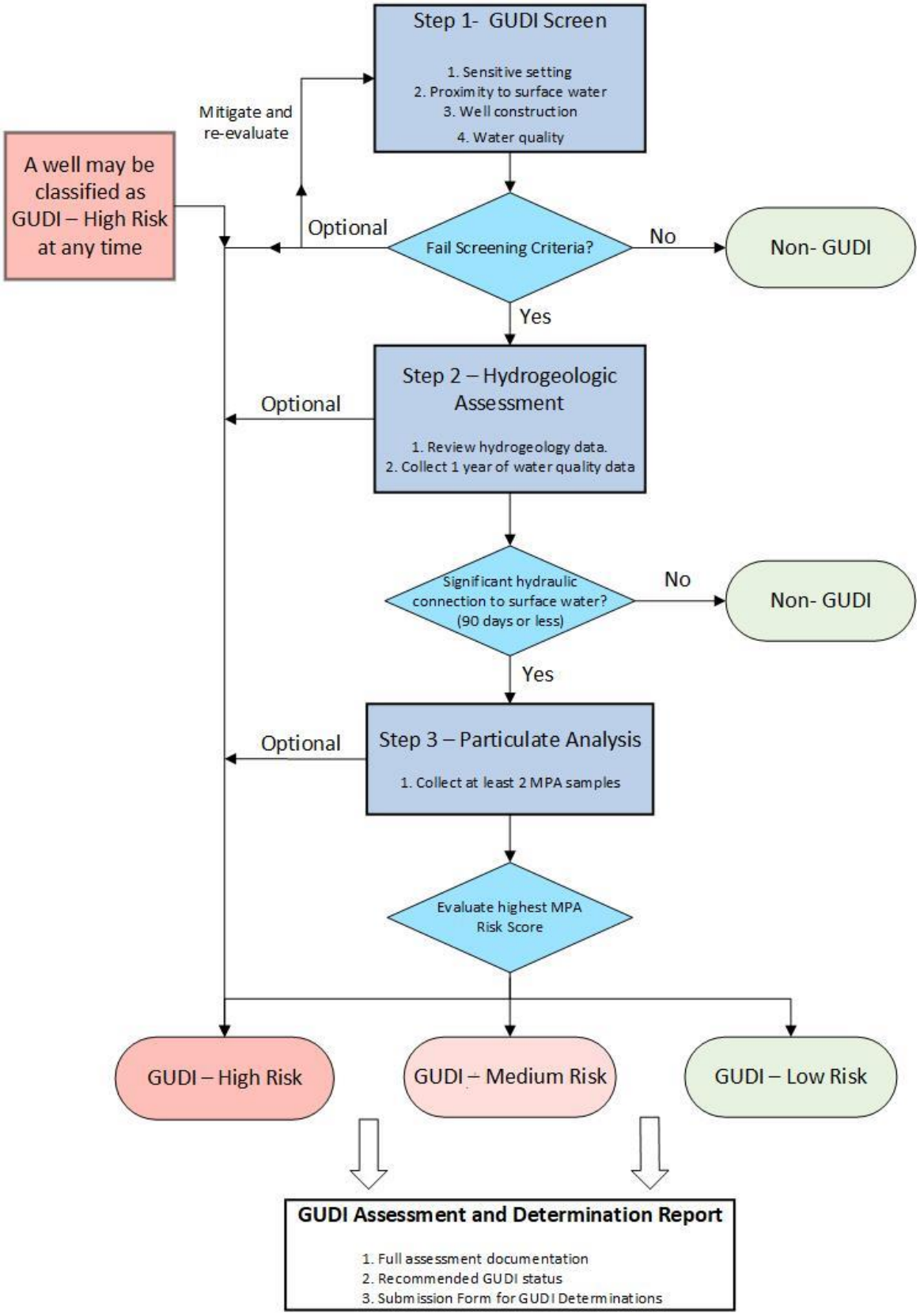
Step 2 is used to determine if there is a hydraulic connection through the aquifer that could allow rapid recharge of the well by water directly influenced by surface water (including infiltrating precipitation). Rapid recharge means recharge that occurs between the well and surface water with a travel time of 90 days or less.

In addition, Step 2 includes a review of available hydrogeologic information and one year of water quality monitoring at the wellhead and a nearby surface water body.

Step 3 is used to determine if there are surface water particulates (e.g., insects, organic debris, etc.) or pathogens present in the well that indicate it has been influenced by surface water. This is done using the Microscopic Particulate Analysis (MPA), which evaluates the presence and significance of indicators in sample results. The travel time results from Step 2 are needed to determine when the MPA samples are to be collected.

The completion of the process results in a GUDI classification of low, medium or high risk. The risk classification determines the required treatment for the source, as provided in the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems (Part III - Requirements for Adequate Treatment and Operation)*, as amended from time to time.

Figure A.1: GUDI Assessment Flow Chart



A1.2 General Requirements

The following general requirements must be met during the GUDI assessment process:

a. GUDI assessments shall be carried out by, or under the supervision of, a Qualified Hydrogeologist which is defined here as a person with hydrogeology training and experience, registered to practice in Nova Scotia by the Association of Professional Geoscientists of Nova Scotia (Geoscientists Nova Scotia) or the Association of Professional Engineers of Nova Scotia (Engineers Nova Scotia). The classifying Qualified Hydrogeologist is considered the person responsible for all aspects of the GUDI Protocol assessment including a duty to ensure the proper collection, integrity and use of data in accordance with the GUDI Protocol.

b. A GUDI assessment shall be completed for each individual well in a wellfield. Following a complete GUDI assessment, each individual well shall be classified as either GUDI (Low, Medium or High Risk) or non-GUDI.

c. For water wells undergoing Step 2 and Step 3 of the GUDI assessment, raw water samples shall be collected from each individual well and not from a point in the distribution system where water has already been mixed with water from other sources.

d. MPA samples represent a “snapshot in time” and they are not the only piece of evidence to be considered when determining the GUDI classification of a water supply. The Qualified Hydrogeologist making the assessment must consider all available information when making a GUDI determination.

e. A well may be determined to be GUDI at any point in the process of evaluation without completing all three steps of the full assessment. In this case, the final classification must be GUDI High Risk, to ensure adequate treatment for protection of public health.

f. If there is significant uncertainty following the GUDI assessment, it is appropriate to err on the side of public health and safety and consider the well to be GUDI High Risk. If a water well is declared GUDI – High Risk at any point in the process, additional investigation steps are not required.

g. A GUDI Assessment and Determination Report and the Submission Form shall be completed for all water wells undergoing a GUDI assessment and provided to the Department of Environment and Climate Change (Department). These must be acceptable to the Department Regional Hydrogeologist.

A2 GUDI Assessment Process

A2.1 Step 1 – Screening Evaluation

The objective of this step is to identify obvious non-GUDI water wells that do not need further investigation. The screening step will normally include a review of relevant water supply information, well construction details and a site visit. If the well passes Step 1 it can be classified as non-GUDI. If the well fails Step 1 it shall proceed to Step 2, or be declared GUDI – High Risk.

For a water well to be considered non-GUDI it must satisfy all of the four screening criteria listed below (A2.1.1–A2.1.4). If it does not meet all four criteria, it fails Step 1 and proceeds to Step 2.

A2.1.1 Sensitive Settings

Sensitive settings are locations where wells have a greater probability of being contaminated by surface water. The water well location and the source of groundwater shall not fall into any of the following sensitive setting categories:

a. Spring;

b. Infiltration gallery;

c. Horizontal collection well;

d. Karst aquifer;

e. Unconfined or surficial aquifer;

f. Fractured bedrock with surface outcropping within 60 m; or

g. Enhanced recharge infiltration systems.

A2.1.2 Proximity to Surface Water

The well must be farther than 60 metres from the location of the nearest surface water body, which includes water bodies with intermittent or permanent water conditions. A surface water body is defined as water open to the atmosphere and subject to surface runoff, such as ponds, lakes, wetlands, lagoons, reservoirs, estuaries, rivers, streams, brooks and ditches.

A2.1.3 Well Construction

The well shall:

a. Have a well casing that extends at least 12 metres below ground surface;

b. Have a fully grouted well casing annular seal that will prevent surface water or shallow infiltration groundwater from migrating within the annular space and entering the well. In line with ACWWA (2022), "Grout should extend from the bottom of the casing to a point immediately below the pitless adapter connection.";

c. Meet the requirements outlined in the current version of the Nova Scotia *Well Construction Regulations*; and

d. Comply with the ACWWA (2022, or most recent update) *Atlantic Canada Water Supply Guidelines*.

If there is a discrepancy between well construction requirements in the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems, the Nova Scotia Well Construction Regulations or the Atlantic Canada Water Supply Guidelines*, as amended from time to time, the more stringent requirements shall apply.

A2.1.4 Water Quality

a. Water quality is to be assessed from raw, untreated well water samples for each individual well where GUDI status is being determined.

b. For all water wells, a minimum of two (2) raw water samples shall initially be collected to assess bacteria (total coliform and *E. coli*). To pass Step 1, both samples must meet the criteria of 0 MPN/100 ml, or "absent" for both total coliform and *E. coli*.

A2.1.5 Step 1 Results

a. A well that passes Step 1 may be classified as a non-GUDI well.

b. If a well initially appears likely to fail any criteria in Step 1 due to well construction issues, modifications can be made to the well prior to completing Step 1 to attempt to meet the screening criteria. If any well construction improvements are planned, they must be completed prior to proceeding to Step 2 because changes to the well may affect the results of Step 2 and Step 3. In such cases, refer to Section A3.5 *GUDI – Corrections and Uncertainties*.

c. If the well fails Step 1 because bacteria (total coliform and *E. coli*) were detected and confirmed, corrective actions can be made that may include additional well disinfection.

d. Following any modifications, or corrective action during Step 1 additional sampling shall then be carried out to determine whether bacteria continue to be present.

    - The Approval Holder must collect a minimum of two additional bacteria samples, separated by a minimum of 24 hours, as outlined in Section A2.1.4.
    - If any of the additional samples contain bacteria, the well shall fail Step 1, unless additional corrective action is undertaken, and further additional sampling demonstrates the well does not contain bacteria in the latest two consecutive samples.
    - The iterative process of corrective action to a well, followed by additional sampling, may only be carried out twice before Step 1 results must be determined.

e. Wells that do not complete or may otherwise fail Step 1 also have the option to directly be determined as GUDI – High Risk and treat accordingly.

f. Refer to the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems – Part III, Section 3, Bacterial Monitoring and Treatment Requirements in Groundwater Systems* During the GUDI Evaluation for treatment and monitoring requirements for wells that are connected to a distribution system, prior to the completion of the GUDI Protocol.

A2.2 Step 2 – Hydrogeological Investigation

The objective of Step 2 is to evaluate site hydrogeological conditions and determine if there is a hydraulic connection that could allow rapid recharge of the well by surface water or precipitation. Step 2 includes the collection of one year of groundwater levels and water quality data (turbidity, temperature, pH, and electrical conductivity) and a review of available hydrogeologic information. Additional hydrogeologic data may also be collected if the review of available data indicates there is insufficient information to determine if a hydraulic connection is present.

The well(s) being assessed during Step 2 will typically be in probationary production and must be pumped at the anticipated withdrawal rates. The pumping rates in place during the Step 2 assessment must be documented in the GUDI Assessment and Determination Report. Any future desired increases to well withdrawal rates may necessitate re-evaluation of Step 2.

The hydrogeologic information review shall be used to assess whether there is potential for a hydraulic connection and to estimate the time-of-travel (TOT) between the well and surface water (including rain or snow melt water). The review shall include, but not necessarily be limited to, an evaluation of the information outlined below in subsections A2.2.1-A2.2.4.

A2.2.1 Well and Aquifer Conditions

The review must include a description of well and aquifer conditions including:

a. Well characteristics (well depth, casing depth, annular seal, etc.);

b. Local geology and stratigraphy; and

c. Aquifer characteristics (e.g. aquifer type, properties of confining or unconfined layers, unsaturated zone thickness, hydraulic conductivity, effective porosity, type of aquifer porosity – primary (pore space) or secondary (fracture), depth to water bearing zones, and the physical degree of connection between the surface water and aquifer – does the surface water body penetrate the aquifer?).

A2.2.2 Surface Water Monitoring

a. Raw water quality data shall be collected at the well and any nearby surface water body (within 150 metres, or a larger distance as determined by a Qualified Hydrogeologist's assessment) for a period of one year to determine if there is a close relationship between changes in the surface water quality and the well water quality. Patterns are best recognized from one-year hydrographs; however, a shorter evaluation time may be sufficient if a hydraulic connection is recognized early in the monitoring program.

b. Precipitation data (including snow melt data if applicable) shall be used for comparison to the groundwater temperature, pH and electrical conductivity data. A standard rainfall gauge shall be used at the well site to measure precipitation. The precipitation records from an Environment and Climate Change Canada station, or another recognized and documented climate station, can be used in lieu of an on-site standard rainfall gauge, if the climate station is located within 10 km of the wellhead.

c. Physical characteristics of the surface water body (e.g. type, width and length, surface area, depth, seasonal flow rates and substrate conditions) shall be collected and documented.

A2.2.3 Groundwater Quality Monitoring

a. Water quality parameters shall be collected for a period of one year and shall include, but not necessarily be limited to turbidity, temperature, pH, and electrical conductivity. These parameters shall be measured on a weekly basis at a minimum, however hourly or daily measurements collected with a datalogger are recommended. Additional water quality parameter measurements such as water chemistry (e.g., metals and/or general ionic parameters) may be helpful for providing additional data during the evaluation.

b. Microbiological testing shall include total coliform and *E. coli* bacteria collected on at least a monthly basis, or more frequently if a well is providing water supply, while undergoing GUDI Step 1, 2 or 3. Additional microbiological testing such as for enterococci or heterotrophic plate counts (HPC) may be helpful in providing additional data during the evaluation.

c. The water quality data shall be plotted and the graphs reviewed for significant and rapid shifts in water characteristics and obvious similarities between the surface water and groundwater data. The time lag, or amplitude shift, between peaks or inflection points of the surface water and groundwater turbidity, temperature, pH and electrical conductivity graphs shall be used to estimate the time of travel (TOT).

d. In cases where there is no surface water body within 150 m of the wellhead to be monitored, it is acceptable to evaluate only the effects of rainfall (precipitation) infiltration effects on the well. For this, the use of a standard rainfall gauge for monitoring quantity is acceptable. This methodology requires measurement of the daily quantity of rainfall. The water quality characteristics of rainfall are not required as monitoring parameters, however, concurrent ambient air, or ground surface temperature monitoring with rainfall measurement is recommended.

e. To assess potential groundwater connection to surface infiltration from rain, measured groundwater parameters such as turbidity, temperature, pH, and electrical conductivity are used as indicators by evaluating any time lag, or amplitude shift, between peaks or inflection points of the groundwater graphs that could be related to time plots of rainfall quantity. The assumption being made is that rainfall infiltration is of different physical and chemical quality and may influence groundwater quality parameters shifts. An estimate of TOT can then be made.

A2.2.4 Groundwater Hydraulic Conditions

a. Hydraulic conditions shall be assessed based on data from a well pumping test (normally required under the *Activity Designation Regulations* for water withdrawal approval) and may also include other data. This assessment shall include evaluation of:

    - Hydraulic gradients (including vertical and horizontal flow gradients) between the well and the surface water body or any observation wells;
    - Variation of surface water levels with time;
    - Variations in observation well/aquifer static water levels;
    - Groundwater drawdown levels over time; and
    - Calculated groundwater flow velocities during pumping (where data is available).

b. Water level data shall be collected in each pumping well. Minimum daily measurements are required and hourly data collected by automatic data loggers is recommended.

c. The water level data shall be plotted on groundwater hydrographs to visualize periods of high and low groundwater levels as potential responses correlated with surface water factors including precipitation events, snow melt events, pumping well drawdown and surface water recharge.

d. Finally, where equivalent porous media conditions are assumed applicable to the water supply aquifer, an additional estimate of TOT using the groundwater flow seepage velocity equation (v=ki/n) may be used to provide a comparative theoretical estimate. For this, input data from pumping tests (where available) will provide the best results.

A2.2.5 Step 2 Results

a. Groundwater TOT between the well and surface water source(s), including infiltrating precipitation, shall be determined based on all the data collected from meeting the requirements outlined in A2.2.1 through to A2.2.4. All results and the methods used to determine TOT shall be summarized, compared and presented in the GUDI assessment documentation submitted to the Department.

b. Correlations of one-year groundwater and surface water chemical and physical water quality hydrograph data (including water quality, groundwater levels and precipitation monitoring) shall be included in the documentation as well as the groundwater TOT between surface water and the water supply well.

c. The well is considered rapidly recharged if the TOT is less than 90 days.

d. Based on the results of data collected during Step 2, the Qualified Hydrogeologist shall determine if there is a hydraulic connection that could allow rapid recharge of the well by surface water, rain or snow melt water within 90 days. If there is no such hydraulic connection, the well passes Step 2 and can be classified as non-GUDI. If there is a hydraulic connection that could allow recharge within 90 days, or if no conclusions can be reached in Step 2, then the well fails Step 2, is considered to be GUDI and shall proceed to Step 3 to determine risk level, i.e., low, medium, or high.

A2.3 Step 3 – Microscopic Particulate Analysis (MPA)

Wells that fail Step 2 have demonstrated a potentially significant and relatively rapid (within 90 days) hydraulic connection between groundwater and surface water. The objective of Step 3 is to determine the degree to which natural filtration provides removal of pathogens potentially present in surface waters, during recharge to wells. MPA testing evaluates the significance and occurrence of large diameter pathogenic organisms themselves (i.e. *Giardia lamblia* and *Cryptosporidium*) as well as macro-organisms, algae, etc., that are indicators for the potential transport of surface water pathogens.

Step 3 is determined using Microscopic Particulate Analysis (MPA) in accordance with the method described in U.S. EPA, 1992, or an alternative method approved in writing by a Department Regional Hydrogeologist. In addition to the U.S. EPA 1992 method, the Department recommends the MPA modifications outlined in the following document: *Approved Modifications to the MPA Consensus Method for use in Nova Scotia* (NSE July 2013).

a. A minimum of two MPA samples shall be collected and analyzed following the recommended laboratory procedures for each well being evaluated. In addition, if an intermittent or permanent surface water body is present within 150 m of the well, or within a larger distance as determined to be of concern for the situation by a Qualified Hydrogeologist, the surface water body also shall have concurrent MPA samples collected.

b. Samples are to be collected during periods when there is the greatest probability that surface water is impacting groundwater as described below. The results from Step 2 shall be used to help select the most appropriate MPA sampling times (e.g., if there is a 15 day TOT, then the well shall be sampled 15 days after a heavy rainfall).

c. One sample shall be collected in the late spring (May or June) and one sample is to be collected in the late fall (October, November or December). Samples shall be collected following the TOT estimated from Step 2 after a heavy rainfall (25 mm within 48 hrs) or equivalent snow melt.

d. Any proposed modifications to sample collection based on sample timing, rainfall volumes or, rain/snow melt combinations outside of those described above must be submitted to the Department Regional Hydrogeologist for approval, prior to implementation. It is important to note that, while very important, optimal timing of MPA sampling is difficult to verify, and that MPA results are only part of the information to be used in the overall GUDI treatment determination.

e. The MPA scores shall be evaluated based on the risk factors specified by the U.S. EPA (1992) as follows:

    - Low risk = MPA score < 10
    - Medium risk = MPA score 10 to 19
    - High risk = MPA score >20

f. MPA results shall be submitted to the Department in the Qualified Hydrogeologist's GUDI Assessment and Determination Report, including documentation of the timing of the MPA sample collection relative to weather events and confirming that the timing corresponds to a period in which there is the greatest probability that surface water is impacting groundwater in the sampled well, as described above.

Although Step 3 is designed to sample for MPA at the times of greatest risk to a water supply there is no assurance that low MPA results at any one time indicates complete absence of pathogens or related indicators in a water supply. The occurrence of pathogenic organisms in surface water is unpredictable and may occur at any time. For this reason, there is a requirement for regular monitoring for pathogens in wells that have demonstrated any level of GUDI conditions.

A3 GUDI Classification

The final determination of whether a well is GUDI (Low, Medium or High Risk) or non-GUDI shall be based on the evidence collected during Steps 1, 2, and 3 and is subject to review and acceptance by a Department Regional Hydrogeologist. If accepted, the GUDI classification shall be used in the determination of treatment and follow-up monitoring requirements, following the provisions of the main body of this document, the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time.

A3.1 Non-GUDI

Wells that pass the Step 1 Screening Evaluation, or that have no evidence of existing or potential significant hydraulic connection with surface water (i.e., Step 2 is passed) shall be classified as non-GUDI. These are considered secure groundwater sources.

A3.2 GUDI - Low Risk

A well that fails Step 2 and for which all the MPA scores during Step 3 are low risk, shall be considered GUDI - Low Risk.

A3.3 GUDI - Medium Risk

A well that fails Step 2 and has any medium risk MPA scores (but no high risk scores) during Step 3 shall be classified as GUDI – Medium Risk.

A3.4 GUDI – High Risk

A well that fails Step 2 and has any high risk MPA scores during Step 3, or for which the option to classify as GUDI – High Risk has been made at any time during either Step 1 or Step 2, shall be classified as GUDI – High Risk.

A3.5 GUDI - Corrections and Uncertainties

If corrective action(s) are completed to correct deficiencies following Step 1, Step 2 or Step 3 (such as well construction or water quality), the well may potentially be reclassified. However, to do so all relevant parts of both Step 2 and Step 3 may need to be repeated (if already conducted) and the results re-assessed, as they may be impacted by the corrective action(s).

Prior to proceeding with corrective action(s), the proposed approach must be accepted in writing by a Department Regional Hydrogeologist. If the well is reclassified, ongoing monitoring requirements may be required, as per the guidance on the modification of sources in US EPA (1991).

The process for potential reclassification of wells is provided below.

A3.6 GUDI – Reclassification Process

Reclassification of Wells

Reclassification of a previously classified well may be required, or requested, if there are changes to the well construction, or well setting, that could cause significant changes to the groundwater and surface water interaction and affect water quality. This includes changes to both a lower classification (e.g. low risk GUDI), or to a higher risk classification (e.g. high risk GUDI). The conditions for reclassification must be documented by the Approval Holder in its System Assessment Report. The process for determining whether reclassification is required is as follows:

a. Changes to the GUDI classification of a well to a lower category may be considered following the collection of at least five years of MPA sample results demonstrating favourable MPA scores (i.e. sample results should consistently be lower than the previously established MPA risk levels).

b. If the operational monitoring MPA risk scores of any low-risk GUDI well increases to medium- or high-risk, or if the MPA risk scores of any medium-risk GUDI increases to high-risk, the Approval Holder must immediately notify the Department and take any necessary corrective action. Corrective actions could include such things as modifying the well construction, providing additional filtration treatment for protozoa based on the new GUDI classification, etc.

c. The System Assessment Report must evaluate changes to conditions relevant to GUDI, including observed changes to detailed information from Section A.2.1 and Section A.2.2, and determine if there is a need to re-assess the classification at that time. At any time, relevant other information indicating potential increased risk conditions must also be evaluated by the Approval Holder for the effects on classification.

d. All requests for reclassification must be submitted to a Department Regional Hydrogeologist for acceptance and shall include all relevant MPA scores and an evaluation of all GUDI assessment work completed to-date. The evaluation shall be completed by a Qualified Hydrogeologist.

e. Changes from GUDI to non-GUDI status will not be considered unless the change is validated by a new, complete GUDI assessment incorporating all steps of the GUDI Protocol.

f. Reclassification may be required at any time, at the discretion of the Department.

A4 GUDI Assessment and Determination Report

The GUDI Assessment and Determination Report must be prepared and signed by a Qualified Hydrogeologist.

Detailed documentation of all steps, data, interpretation, and findings used for recommending the GUDI determination shall be documented in a GUDI Assessment and Determination Report that is to be submitted to a Department Regional Hydrogeologist for review and acceptance. Reports ending with Step 1 or Step 2 are to include all information up to and including the completion of the final step taken in their process.

In addition, the A.5 Submission Form for GUDI Determinations is to be completed and submitted as part of the completed Report for all determinations.

Clear recommendations for the GUDI Determination shall be made as well as recommended follow-up actions such as additional work or enhanced monitoring that may be relevant, or required, following the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*, as amended from time to time.

A5 Submission Form for GUDI Determinations

Section	Summary Condition	Indicate Findings	
Step 1	**Screening Criteria** (see APPENDIX A - Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol) for complete description of requirements)	**Meets Summary Condition**	
		Yes	**No**
Sensitive Settings	Shall include none of the following settings:		
	• Spring		
	• Infiltration gallery		
	• Horizontal collection well		
	• Well in karst aquifer		
	• Unconfined or surficial aquifer		
	• Fractured bedrock aquifer with surface outcropping within 60 m		
	• Enhanced recharge/infiltration systems		
Proximity to Surface Water	Well is greater than 60 metres from an intermittent or permanent surface water body or drainage ditch (as defined in Section)		
Well Construction	Well meets all current Well Construction Regulations and includes the following additional protections: – 12 m of steel casing – Fully grouted well casing annular seal (from bottom of casing to pitless adapter)		

Section	Summary Condition	Indicate Findings	
Step 1	**Screening Criteria** (see APPENDIX A - Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol) for complete description of requirements)	**Meets Summary Condition**	
		Yes	**No**
Water Quality	Well has at least 2 (initial) current or 2 (additional investigation), consecutive raw (untreated) groundwater samples with results for total coliform and *E. coli* bacteria confirming: 0 MPN/100 ml or "Absent"		
Step 1 Results	1. Finding that shows <u>all</u> "Yes" = Pass and is considered "non-GUDI" and a secure Groundwater source 2. <u>Any</u> finding of "No" = Fail and, unless first corrected, must continue with Step 2 Hydrogeological Investigation	☐ **Pass Step 1**	☐ **Fail Step 1**

Section	Summary Condition	Indicate Findings	
Step 2	**Hydrogeological Investigation** Summary (see APPENDIX A - Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol) for complete description)	**Investigation Complete**	
		Yes	**No**
Well and Aquifer Conditions	• Well characteristics • Local geology and stratigraphy • Aquifer characteristics		
Surface Water Monitoring	• Raw water quality data collected at the well • Water quality data from nearby (<150 m) surface water body if available • Monitoring period of at least one year • Precipitation data collected onsite or from an ECCC weather station within 10 km • Description of surface water body within 150 m		
Groundwater Quality	• Groundwater physical/chemical quality parameters - turbidity,		

Section	Summary Condition	Indicate Findings	
Step 2	**Hydrogeological Investigation** Summary (see APPENDIX A - Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol) for complete description)	**Investigation Complete**	
		Yes	**No**
Monitoring	temperature, pH and electrical conductivity (plus other indicators) • Data shall be plotted, compared and evaluated to surface water indicators • Determine time lag, or amplitude shift for indicators • Groundwater microbiology – total coliform, *E. coli* (plus other indicators)		
Groundwater Hydraulic Conditions	• Vertical and horizontal hydraulic gradients • Variation of surface water levels with time • Groundwater levels over time • Data shall be plotted, compared and evaluated to surface water indicators • Determine time lag, or amplitude shift for indicators • Groundwater flow velocities calculated during pumping test • Plot groundwater hydrographs to visualize variations over time • Correlate with surface water factors including precipitation events, snow melt events, pumping well drawdown and surface water recharge • Estimate of time-of-travel (TOT) based on groundwater hydraulic observations • Additional optional theoretical estimate of TOT using the groundwater flow seepage velocity equation (v=ki/n) (for comparison only)		
Step 2 Results	• Summarize all the data collected in Step 2 and provide a determination for groundwater time-of-travel (TOT) between supply intake and surface water source(s). Includes:		

Section	Summary Condition	Indicate Findings	
Step 2	**Hydrogeological Investigation** Summary (see APPENDIX A - Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol) for complete description)	**Investigation Complete**	
		Yes	**No**
	– Evaluation of TOT based on time lag/amplitude shifts in water quality data hydrographs – Evaluation of TOT based on time lag/amplitude shifts water level hydrographs and surface water data – For comparison only – provide optional theoretical groundwater velocity TOT		
	• Groundwater time-of travel (TOT) to well is more than 90 days	☐ **Pass Step 2 = non-GUDI**	
	• The well is considered rapidly recharged if the groundwater TOT is less than 90 days; or • If no conclusions can be reached in Step 2, then the well fails Step 2 and shall proceed to Step 3		☐ **Fail Step 2 = GUDI**

Section	Summary Condition	Indicate Findings	
STEP 3	**Microscopic Particulate Analysis (MPA)** Summary (see APPENDIX A - Protocol for Determining Groundwater Under the Direct Influence of Surface Water (GUDI Protocol) for full description)	**Investigation Completed (Yes/No)**	**MPA Lab Findings (EPA Risk Category = Low, Medium or High)**
	• Follow the USEPA 1992 Consensus Method; may include the Department of Environment and Climate Change's Approved Modifications (NSE July 2013) • For each: 1. Water supply well; and 2. Surface water body within 150 m (if present) – Collect a minimum of two MPA samples – Sample during both the Spring and Fall periods following Step 2 requirements – Following local rainfall of >25 mm in 48 hrs or equivalent snow melt – Sampling time following rain/snow melt event based on Step 2 TOT		
Step 3 Results	Classification as reported by accredited laboratory for Low, Medium or High Risk based on EPA methodology		

GUDI Classification	GUDI Classification	Recommendation Category	
		Non-GUDI	GUDI (type)
	The GUDI Classification must be one of the following types (a classification is not in effect until accepted in writing by the Department): • Non-GUDI • GUDI Low Risk • GUDI Medium Risk • GUDI High Risk		

A4 Report	GUDI Assessment And Determination Report	Completed	
		Yes	No
	• Report and form completed and submitted • Includes description of any follow up work or enhanced monitoring recommended • Signed below by a Qualified Hydrogeologist registered to practice in Nova Scotia by the Association of Professional Geoscientists of Nova Scotia (Geoscientists Nova Scotia) or the Association of Professional Engineers of Nova Scotia (Engineers Nova Scotia). • Final recommended GUDI classification of each well is clearly specified in the report		

Qualified Hydrogeologist Declaration

I acknowledge it is an offence under Section 158 of the Environment Act to provide false or misleading information and confirm to the best of my knowledge and belief the information provided in this form and supporting documentation is true and accurate and complies with the relevant provisions of the *Environment Act* and the *Nova Scotia Treatment Standards for Municipal Drinking Water Systems*.

By signing below, I confirm my qualifications as prescribed within the standards. In addition, I confirm I have followed and ensured that all aspects of the *Protocol for Determining Groundwater Under the Direct Influence of Surface Wate*r have been met in the GUDI assessment and reporting.

Signature: _____ Date: _____

Name (Print): _____

Professional Association: _____

Registration Number:_____

A6 References

American Water Works Association (AWWA). 1996. Determining Groundwater Under the Direct Influence of Surface Water.

American Water Works Association (AWWA). 2001. Investigation of Criteria for GWUDI Determination.

Atlantic Canada Water and Wastewater Association (ACWWA). 2022. Atlantic Canada Water Supply Guidelines.

Nova Scotia Environment (NSE). July 2013. Approved Modifications to the MPA Consensus Method for use in Nova Scotia.

Ontario Ministry of the Environment (MOE). 2001. Terms of Reference, Hydrogeological Study to Examine Groundwater Sources Potentially Under DirectInfluence of Surface Water. October 2001.

U.S. Environmental Protection Agency (U.S.EPA). 1991. Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Waters. U.S. Environmental Protection Agency, Office of Drinking Water. March 1991.

U.S. Environmental Protection Agency (U.S.EPA). 1992. Consensus Method for Determining Groundwater Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA). U.S. Environmental Protection Agency. EPA 910/9-92-029. October 1992.

Appendix 9-B

APPENDIX B

Guidelines for the Determination of Natural Filtration Log Removal Credits for Protozoa

B1 Introduction

Natural filtration refers to the ability of an aquifer to remove microscopic particulates,such as *Giardia and Cryptosporidium*, as groundwater migrates through the aquifer towards a water well. Natural filtration is most appropriately applied as one component of a treatment process and is best suited to systems with minimal influence of surface water.

The purpose of this appendix is to outline the criteria for determining which Municipal Public Drinking Water Supply systems in Nova Scotia that use groundwater as a source are eligible for a natural filtration log removal credit for protozoa and describe how these Municipal Public Drinking Water Supplies can apply for this credit.

B2 Eligible Systems

A Municipal Public Drinking Water Supply system is eligible for a natural filtration log removal credit if it meets the following conditions:

a. All three steps of the *Protocol for Determining Groundwater Under the Direct Influence of Surface Water* (GUDI Protocol - Appendix A), as amended from time to time, have been completed;

b. The supply has been determined to be GUDI;

c. The supply has been determined to be medium or low risk based on the Microscopic Particulate Analysis (MPA) results from Step 3 of the GUDI Protocol; and

d. An additional MPA test, taken after the Step 3 GUDI Protocol MPA samples, confirms the well is medium or low risk.

B3 How to Apply for a Natural Filtration Credit

To be awarded a natural filtration credit, eligible Approval Holders shall apply in writing to the Department district office where the water system is located.

The written application shall include the following information for each well:

a. Water supply name;

b. Well name and map showing well location;

c. Confirmation that the well has completed the GUDI Protocol and it has been classified as a GUDI - Medium Risk or GUDI - Low Risk; and

d. Confirmation that, based on geological maps, well log information, and water supply information, the well is not located in one of the following settings:

   – Spring;

   – Infiltration gallery;

   – Horizontal collection well;

   – Karst aquifers; or

   – Enhanced recharge infiltration systems.

e. Results from an additional MPA test, taken after the Step 3 GUDI Protocol MPA samples, to confirm the well is medium or low risk.

f. Groundwater quality data from Step 2, in particular raw water turbidity data and raw water total coliform and *E. coli*.

g. Assessment of wells with respect to their potential location within floodplains. Floodplain location can be assessed using existing information such as flood maps, local topography, geomorphology, municipal documents, local historical knowledge and air photos. If wells are either known to be, or may have high likelihood of being within 1:100 year floodplains it is expected that contingency plans will be developed to mitigate flooding effects on the wells.

h. Confirmation that the well is not located within 60 metres of a surface water body that has the potential for stream channel erosion. Note that the potential for stream channel erosion can be evaluated by examining the history of high-flow and flood events at the site and by reviewing air photographs for evidence of stream channel meander.

The information submitted shall be complete and acceptable to the Department.

The applicant will receive a written response from the Department indicating whether a natural filtration credit will be awarded.

B4 Criteria for Awarding a Natural Filtration Credit

Natural filtration log removal credits will be awarded by the Department to eligible systems on a case-by-case basis.

To be considered for a natural filtration credit, medium or low risk GUDI systems are required to perform at least one additional MPA test, taken after the Step 3 MPA samples, to confirm the original MPA results collected during Step 3 of the GUDI study. The additional MPA test shall be collected when the well is most susceptible to surface water influence as described and determined in Appendix A.

If the additional MPA results indicate that the sample has a high risk score, the system is not eligible for a natural filtration credit.

If the results of the additional MPA testing confirm results of medium or low risk scores, the system is eligible for a natural filtration credit.

- All medium risk GUDI systems will receive a 1.0 log removal credit for protozoa, unless there are site-specific reasons that indicate a natural filtration log removal credit should not be awarded.
- All low risk GUDI systems will receive a 3.0 log removal credit for protozoa, unless there are site-specific reasons that indicate natural filtration log removal credits should not be awarded.

Site-specific issues will also be considered by the Department when awarding a natural filtration credit.

Appendix 9-C

APPENDIX C

Minimum Treatment Requirements and Process for Assigning Pathogen Log Reduction Credits to Filtration and Disinfection Processes

C1 Purpose

The purpose of this appendix is to outline the requirements for the assignment of log reduction credits for the removal or inactivation of pathogenic microorganisms (enteric protozoa, viruses, and bacteria) in Municipal Public Drinking Water Supply systems. This information must be used by the Approval Holder, design engineer, and any other person or persons responsible for the planning and design of new Municipal Public Drinking Water Supply systems in Nova Scotia or when considering modifications to existing systems. Bacterial reduction is typically sufficient if treatment systems are designed to meet enteric protozoa and virus log reduction requirements outlined in this document.

C2 Minimum Treatment Requirements

The Approval Holder shall ensure the level of treatment provided to remove or inactivate pathogenic organisms is commensurate with the source water type, as outlined in Table C1.

Where multiple raw water sources are combined and treated in the same Municipal Public Drinking Water Supply, the minimum log reduction requirements shall be based on the source water with the highest log reduction requirements for enteric protozoa and viruses.

Table C1: Minimum Pathogen Log Reduction and Treatment Requirements

Source Water Type	Minimum Required Pathogen Log Inactivation and Removal			Minimum Treatment
	***Cryptosporidium* oocysts**	***Giardia* cysts**	**Viruses**	
Surface Water and GUDI sources not assigned a Department-accepted natural filtration log credit	3-log	3-log	4-log	**Engineered filtration and disinfection** • Filtration shall be assigned treatment credits as outlined in Table C2. • Disinfection shall provide a minimum 0.5 log inactivation of *Giardia* cysts. • Where UV is used as a primary disinfectant and additional log inactivation is required for enteric viruses, chemical disinfection shall be used to meet the remaining log inactivation criteria for enteric viruses. • Where UV, ozone, or chlorine dioxide is used as a primary disinfectant, free chlorine or chloramines shall be used to provide secondary disinfection of the distribution system.
Medium-risk GUDI sources assigned a Department-accepted natural filtration log credit	3-log	3-log	4-log	**Filtration and disinfection** • Filtration may be via natural in-situ attenuation as outlined in Appendix B • Natural filtration is assigned a 1 log reduction for *Cryptosporidium* oocysts and *Giardia* cysts. • If the natural filtration log credit is awarded, UV disinfection is required to meet the remaining log reduction requirements for *Cryptosporidium* oocysts and *Giardia* cysts. • Chemical disinfection is required to meet remaining log inactivation criteria for viruses and provide secondary disinfection of the distribution system.
Low-risk GUDI sources assigned a Department-accepted natural filtration	3-log	3-log	4-log	**Filtration and disinfection** • Filtration may be via natural in-situ

Source Water Type	Minimum Required Pathogen Log Inactivation and Removal			Minimum Treatment
	***Cryptosporidium* oocysts**	***Giardia* cysts**	**Viruses**	
log credit				attenuation as outlined in Appendix B • Natural filtration is assigned a 3-log reduction for *Cryptosporidium* oocysts and *Giardia* cysts. • Chemical disinfection is required to meet remaining log inactivation criteria for viruses and provide secondary disinfection of the distribution system.
Non-GUDI sources	0-log	0-log	4-log	**Disinfection** • Chemical disinfection is required to meet log inactivation criteria for viruses and provide secondary disinfection of the distribution system.

C3 Determining Log Removal Credits for Filtration and Disinfection Treatment Processes

The following steps shall be taken by the Approval Holder or design engineer to determine the log removal credits for enteric protozoa and viruses assigned to the filtration process, if applicable, and the remaining credits that the disinfection process shall be designed to achieve:

a. Confirm the log reduction requirements for the source water type as outlined in Table C1.

b. Find the filtration log removal credits associated with the type of filtration system(s) employed as outlined in Table C2 and subtract this from the requirements specified in Table C1.

c. Determine if any additional filtration credits are available from enhanced filtration performance (if applicable) and subtract this from the remainder above.

d. The result is the log inactivation portion that shall be met by the disinfection process.

Systems using surface water and GUDI sources not assigned a Department-accepted natural filtration log credit: Engineered filtration is required for surface water and GUDI sources not assigned a Department-accepted natural filtration log credit. Additionally, a minimum of 0.5-log inactivation for *Giardia* must be provided by the disinfection process.

C4 Treatment Credits for Filtration (Log Removal)

Drinking water treatment technologies meeting the turbidity limits and operational requirements outlined in Table C2 will be assigned the corresponding log removal credits for *Cryptosporidium, Giardia* and viruses by the Department.

Municipal Public Drinking Water Supplies with Engineered Filtration: If the Approval Holder or design engineer believes the engineered filtration technology can achieve a higher log removal credit than is identified in Table C2, a higher log removal credit may be granted by the Department based on a demonstration of filter performance. For example, Municipal Public Drinking Water Supply systems with conventional or direct filtration that achieve 0.15 NTU 95% of the time each calendar month in combined filter effluent are eligible to receive an additional 0.5-log removal credit for protozoa. Municipal Public Drinking Water Supply systems with conventional or direct filtration that achieve 0.15 NTU 95% of the time each calendar month in individual filter effluent are eligible to receive an additional 1.0-log removal credit for protozoa.

Table C2- Log Removal Credits Assigned to Treatment Technologies Meeting Prescribed Turbidity Limits and Other Requirements

Treatment Technology	Protozoa Credit		Virus Credit[1]	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
	Cryptosporidium[1]	*Giardia* [1]		
Conventional filtration[2] – includes chemical mixing, coagulation, flocculation, clarification, and rapid gravity filtration	3.0-log		2.0-log	a. Shall be less than or equal to 0.2 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month. b. Shall not exceed 1.0 NTU at any time. c. Filter-to-waste[3] - filters shall be capable of directing filtered water to waste or recycle immediately following a backwash for a period of time until the filtrate turbidity value is below 0.2 NTU d. For direct filtration systems that use free chlorine alone as their primary disinfectant, to achieve log reduction requirements for *Cryptosporidium*, the turbidity shall be less than or equal to 0.15 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month.
Direct filtration [2] - includes chemical mixing, coagulation,flocculation, and rapid gravityfiltration	2.5-log		1.0-log	
Slow sand filtration	3.0-log		2.0-log	a. Shall be less than or equal to 1.0 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month. b. Shall not exceed 3.0 NTU at any time. c. Filter-to-waste[3] shall be provided to ensure filtered water, immediately after filter cleaning, is directed to a waste or recycle stream.
Diatomaceous earth filtration	3.0-log		1.0-log	a. Shall be less than or equal to 1.0 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month. b. Shall not exceed 3.0 NTU at any time. c. Filter-to-waste[3] shall be provided to ensure filtered water, immediately after filter backwashing, is

Treatment Technology	Protozoa Credit		Virus Credit[1]	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
	Cryptosporidium[1]	*Giardia* [1]		
				directed to a waste or recycle stream.
Micro-filtration[4,5,6]	Removal efficiency demonstrated through challenge testing and verified by direct integrity testing.		No Credit	a. Shall be less than or equal to 0.1 NTU in at least 99% of the measurements made or at least 99% of the time each calendar month. b. If turbidity exceeds 0.1 NTU for more than 15 minutes, direct integrity testing shall be immediately conducted on the membrane treatment unit. c. Shall not exceed 0.3 NTU at any time. d. Filter-to-waste[3] shall be provided for operational flexibility. e. The membrane system used for pathogen reduction shall have continuous indirect integrity testing. f. Continuous indirect integrity testing shall be conducted at a minimum frequency of once every 5 minutes. Indirect integrity testing shall follow that outlined in the EPA *Membrane Filtration Guidance Manual*, as amended from time to time. g. The actual removal efficiency of a membrane shall be verified by third party challenge testing. Acceptable challenge testing shall follow that provided in the EPA *Membrane Filtration Guidance Manual*, as amended from time to time. h. Direct integrity testing shall be able to verify a log removal value equal to or greater than the removal
Ultra-filtration[4,5,6]	Removal efficiency demonstrated through challenge testing and verified by direct integrity testing.		Removal efficiency demonstrated through challenge testing and verified by direct integrity testing.	

Treatment Technology	Protozoa Credit		Virus Credit[1]	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
	Cryptosporidium[1]	*Giardia* [1]		
				credit awarded to the membrane filtration process. i. Direct integrity testing shall be conducted on each membrane filtration unit at least once per day and as soon as the Approval Holder becomes aware when the turbidity exceeds 0.1 NTU for more than 15 minutes.
Reverse osmosis and nanofiltration[4,5,6]	Removal efficiency demonstrated through challenge testing and verified by direct integrity testing.		Removal efficiency demonstrated through challenge testing and verified by direct integrity testing.	a. Shall be less than or equal to 0.1 NTU in at least 99% of the measurements made or at least 99% of the time each calendar month. b. Shall not exceed 0.3 NTU at any time. c. Filter-to-waste[3]- a filter-to-waste feature shall be provided foroperational flexibility. d. To assign pathogen log reduction credits for reverse osmosis and nano-filtration units, direct integrity testing shall be available to verify removal efficiency. e. If the membrane process is assigned pathogen log reduction credits by the Department, the Approval Holder shall adhere to the following additional requirements: i. The membrane system used for pathogen reduction shall have continuous indirect integrity testing. ii. Continuous indirect integrity testing shall be conducted at a minimum frequency of once every 5 minutes. Indirect integrity testing shall follow that outlined in the EPA's *Membrane Filtration Guidance Manual*, as amended from time to time. f. The actual removal efficiency of a membrane shall

Treatment Technology	Protozoa Credit		Virus Credit[1]	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
	Cryptosporidium[1]	*Giardia* [1]		
				be verified by third party challenge testing. Acceptable challenge testing shall follow that provided in the EPA's *Membrane Filtration Guidance Manual*, as amended from time to time. g. Direct integrity testing shall be able to verify a log removal value equal to or greater than the removal credit awarded to the membrane filtration process. h. Direct integrity testing shall be conducted on each membrane filtration unit at least once per day and as soon as the Approval Holder becomes aware when the turbidity exceeds 0.1 NTU for more than 15 minutes.

Treatment Technology	Protozoa Credit		Virus Credit[1]	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
	Cryptosporidium[1]	*Giardia* [1]		
Cartridge filtration, one unit (1 micron absolute pore size)	2-log		No credit	a. For systems serving less than 500 persons, differential pressure across the filter medium is measured and recorded a minimum of once daily and does not exceed the manufacturer's requirements. b. For systems serving more than 500 persons, differential pressure across the filter medium is continuously measured and recorded at a minimum frequency of one measurement every five minutes and does not exceed the manufacturer's requirements. c. Shall be less than or equal to 0.3 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month. d. Shall not exceed 1.0 NTU at any time. e. The cartridge filtration process is tested and confirmed by an independent testing agency for at least 3 log removal of *Cryptosporidium* oocysts or surrogate particles. Challenge testing shall demonstrate at least 3 log removal of *Cryptosporidium* oocysts and *Giardia* cysts.
Cartridge filtration, two units in series (1 micron absolute pore size)	2.5-log		No credit	
Natural In-situ Attenuation for Medium Risk GUDI Sources[7]	1.0-log [7]		No credit	a. Shall be less than or equal to 1.0 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month at each individual GUDI wellhead. b. Continuous turbidity monitoring - required at each individual GUDI wellhead. c. Microscopic Particulate Analysis[8] - MPA testing is required every two years for each individual GUDI well following a significant rainfall in

Treatment Technology	Protozoa Credit		Virus Credit[1]	Individual Filter Turbidity Limits (unless stated otherwise) and Operational Requirements
	Cryptosporidium[1]	*Giardia* [1]		
				accordance with Step 3 of the GUDI protocol[8].
Natural In-situ Attenuation for Low-Risk GUDI Sources[7]	3.0-log[7]		No credit	a. Shall be less than or equal to 1.0 NTU in at least 95% of the measurements made or at least 95% of the time each calendar month at each individual GUDI wellhead or the combined flow. b. Continuous turbidity monitoring - required at each individual GUDI wellhead. c. Microscopic Particulate Analysis[8] - MPA testing is required every two years for each individual GUDI well following a significant rainfall in accordance with Step 3 of the GUDI protocol[8].

1 Disinfection shall provide a minimum 0.5-log inactivation for *Giardia* unless a higher log inactivation credit is required. Where disinfection is used to address any shortfall in the log reduction requirements for *Cryptosporidium*, an alternate disinfectant such as UV, chlorine dioxide or ozone shall be required.

2 Municipal Public Drinking Water Supplies with conventional or direct filtration that achieve 0.15 NTU 95% of the time each calendar month in combined or individual filter effluent are eligible to receive additional log removal credits for protozoa to meet minimum treatment requirements as follows: combined 0.5-log; individual 1.0-log.

3 Alternatives that demonstrate an equivalent benefit to filter-to-waste may be considered by the Department on a case-by-case basis for existing facilities. All new systems shall include a filter-to-waste provision.

4 If membrane filtration is the sole treatment technology employed, disinfection shall follow the filtration process to meet virus inactivation requirements.

5 Membrane removal efficiency shall be demonstrated through challenge testing and verified by direct integrity testing. See Appendix G for additional information on membrane filtration.

6 If the unit passes direct integrity testing, it may continue to be used for water treatment; if not, the unit shall be taken out of service.

7 A natural in-situ attenuation log credit may be assigned if the *Guidelines for the Determination of Natural Filtration Log Removal for Protozoa* are followed (Appendix B) and the Department Regional Hydrogeologist accepts the determination in writing.

8 MPA testing shall be completed in accordance with Step 3 of the Protocol for Determining Groundwater Under the Direct Influence of Surface Water as outlined in Appendix A (e.g. if there is a 15 day time-of-travel, then the well shall be sampled 15 days after a surface water event).

C5 Disinfection Credits (Log Inactivation)

Disinfection is required to inactivate any microbial pathogens that pass through previous treatment processes.

a. Disinfection shall provide any remaining log reduction credits necessary to meet the minimum treatment requirements specified in Table C1.

b. Where disinfection is used to address any shortfall in the log reduction requirements for *Cryptosporidium*, an alternate disinfectant such as UV, chlorine dioxide, or ozone is required.

c. Where UV disinfection is used to inactivate protozoa, chemical disinfection is required to meet remaining log inactivation requirements for viruses.

d. Where UV, chlorine dioxide, or ozone are used as primary disinfectants, free chlorine or chloramines must be used to provide secondary disinfection of the distribution system.

C5.1 CT Concept for Chemical Disinfection

Nova Scotia's treatment standards require application of the CT concept for chemical disinfection. CT is calculated by multiplying the disinfectant concentration (C) by the time that 10 percent of the water is in contact with the disinfectant (T10). T10 is calculated by multiplying the theoretical hydraulic detention time (e.g., tank volume divided by flow rate) by the baffling factor of the contact chamber. T10 may also be established by tracer studies.

The CT equation is as follows:

Formula: CT = Concentration (mg/L) x Time (minutes) x Baffling Factor

C5.1.1 Acceptable Primary Disinfectants

The Approval Holder shall use Department-accepted chemical disinfectants including free chlorine, chlorine dioxide, or ozone. Due to the poor disinfecting capability of chloramines, chloramines are not accepted by the Department as a primary disinfectant.

C5.1.2 Baffling Factors

The baffling factor used in CT calculations shall be acceptable to the Department. Baffling factors are provided in Table C3. Examples of baffling factors to use for sample contact chamber designs are included in Appendix E.

C5.1.3 Clearwell or Storage Tank Volume and Flowrate

For Approval Holders that include the volume of water in the clearwell or on-site storage tank for CT determination, the calculation shall be made based on the minimum operating level in the tank. The highest flow condition shall also be confirmed (inflow or outflow).

Note: Distribution system storage is not eligible for CT credits. The required CT shall be achieved before the municipal public drinking water supply's first customer.

C5.1.4 CT Ratio (CT Achieved/CT Required)

a. The Approval Holder shall compare the calculated CT achieved using the equation above to the CT required. The CT required is found in log inactivation tables for *Cryptosporidium*, *Giardia* and/or viruses first published by the US EPA. CT tables for free chlorine, chlorine dioxide, and ozone are included in Appendix D. The science-based impacts of pH and temperature on the effectiveness of some disinfectants have been taken into account where applicable.

b. The Approval Holder shall ensure the ratio of the calculated value (CT achieved) to the table value (CT required) is equal to or greater than one to receive log inactivation credits for the disinfection process.

c. The Approval Holder shall ensure design ranges for the disinfection process are set for worst case scenarios For free chlorine, worst case design ranges typically include the following:

    - Lowest temperature of the water to be disinfected;
    - Highest pH value of the water to be disinfected with chlorine;
    - Lowest chlorine residual found at the outlet of the designated chlorine contact volume; and
    - Minimum contact time (typically occurs under highest flow conditions).

Sample CT calculations are provided in Appendix F for various sources and treatment technologies.

Where free chlorine is used, it is recommended that the Approval Holder minimizes the formation of disinfection by-products. However, this should be done in consideration of operational requirements (e.g., water quality and quantity, distribution system disinfectant residual, etc.) and without compromising the effectiveness of disinfection.

C5.1.5 Disinfection Byproducts

The Approval Holder shall balance effective disinfection for microbial protection against the creation of disinfection by-products.

The Approval Holder shall make every effort to maintain concentrations of disinfection by-products as low as reasonably achievable without compromising the effectiveness of primary disinfection.

Table C3: Baffling Factors

Baffling Condition	Baffling Factor T10/T0	Baffling Description
Unbaffled (mixed flow)	0.1	• Agitated basin • Very low length-to-width ratio • High inlet and outlet flow velocities • High potential for stagnant zones and short-circuiting
Poor	0.3	• Single or multiple unbaffled inlets and outlets • No intra-basin baffles • Potential for stagnant zones or short-circuiting
Average	0.5	• Baffled inlet or outlet • Some intra-basin baffles
Superior	0.7	• Perforated inlet baffle • Serpentine or perforated intra-basin baffles • Outlet weir or perforated launders • Most of tank volume is utilized
Perfect (plug flow)	1	• Length to width ratio greater than or equal to 10:1 • Perforated inlet, outlet and intra-basin baffles

C5.2 IT Concept for UV Disinfection

These treatment standards require application of the IT concept. IT is calculated by multiplying the UV intensity (I) by the exposure time (T) to demonstrate that required disinfection credits are achieved.

Formula: UV dose = UV intensity (Watts/cm^2) x Time of exposure (seconds)

The amount of UV light delivered to pathogens in a reactor is called "UV dose" and is measured in millijoules per square centimetre (mJ/cm^2). The UV dose depends on:

- UV intensity, or magnitude of UV light, measured by UV intensity sensors in Watts/cm^2 or Watts/m^2;
- UV transmittance (UVT); and
- Water flow rate and hydraulics in the reactor.

Previous treatment standards required a minimum UV dose (IT) of 40 mJ/cm^2 for all Municipal Public Drinking Water Supplies. A UV dose of 40 mJ/cm^2 achieves 0.5-log reduction for viruses based on adenovirus inactivation.

a. Where UV light is used for primary disinfection, chemical disinfection shall be required to meet any remaining log inactivation criteria for viruses.

b. Where UV light is used for primary disinfection a lower UV dose than 40mJ/cm^2 may be acceptable to the Department for enteric protozoa (i.e., *Giardia, Cryptosporidium*) based on required log inactivation credits, UV lamp design and validation, energy conservation goals, etc.

c. For virus inactivation, the target microorganism will remain adenovirus (0.5 log inactivation at 40 mJ/cm^2) for municipal drinking water supplies unless the Approval Holder demonstrates that there is no risk of adenovirus being present. In this case, rotavirus may be considered the target virus. Log inactivation credits will be considered and accepted by the Department on a system-specific basis.

d. Where UV light is used as a primary disinfectant, free chlorine or chloramines shall be required to provide secondary disinfection of the distribution system.

e. To receive inactivation credit, a UV reactor must operate within the validated limits (e.g., intensity is greater than the minimum specified, flow is below the maximum specified, UVT is above the minimum specified).

f. UV systems are required to have a shut off feature and alarm when the equipment malfunctions, loses power or ceases to provide the appropriate level of disinfection.

Additional information is provided in Appendix G.

Appendix 9-D

APPENDIX D

Log Inactivation Information and Tables for Free Chlorine, Chlorine Dioxide, Ozone and Ultraviolet (UV) Light

D1 $CT_{required}$

$CT_{required}$ can be determined by the following methods:

- From CT disinfection tables first published by USEPA; or
- Calculated from equation (for *Giardia* only).

D1.1 Reading $CT_{required}$ from US EPA Disinfection Tables:

CT values can be read from the tables, which follow in the appendix, using the following parameters:

- Required log reduction;
- Minimum temperature of the water;
- Maximum pH of the water; and
- Free chlorine residual concentration before first consumer (when using free chlorine).

Note that tables are specific to target organism (*Giardia*, *Cryptosporidium,* viruses) and type of disinfectant (free chlorine, chlorine dioxide, ozone, UV).

Since water treatment facilities rarely operate at pH, temperature and chlorine concentrations that exactly match the values listed in the CT tables, $CT_{Required}$ must be determined by one of the following methods:

- Linear interpolation method;
- Approximation method.

D1.1.1 Linear Interpolation Method

Linear interpolation method may have to be used several times to find intermediate values for chlorine, temperature and pH (see example 2 in Appendix F).

Because of the complexity of this process, the approximation method is frequently used to find $CT_{required}$.

D1.1.2 The Approximation Method

With the approximation method, conservative values for pH, temperature, and residual disinfectant concentration are used to select a CT value from the table. It is a conservative method that slightly underestimates the actual effectiveness of the disinfection process. However, it requires no mathematical calculations and therefore is simpler and reduces errors.

To find the $CT_{required}$ from the tables using the approximation method:

- Find the CT table for the temperature that is equal or (next) lower to the actual measured water temperature. For example, if the measured water temperature is 7^0C use a table for 5^0C.
- Go to the section of the table for the pH which is equal to or (next) higher than the actual measured pH of the water. For example, if the measured pH is 6.3, use the pH 6.5 section.
- Use the free chlorine concentration that is equal or (next) higher than the actual concentration measured at the plant. For example, if the measured free chlorine concentration is 1.5 mg/L, use the 1.6 mg/L row.

For example, find the $CT_{required}$ for the 0.5 log inactivation credit for *Giardia* and thefollowing water parameters:

- temperature = 7^0C;
- pH =6.7;
- free chlorine = 1.7 mg/L.

Since there is no table for 7^0C, we should select the table with the next lower temperature, which in this case is a table for 5^0C. This table contains pH values 6.5 and pH 7.0. Since our measured value is 6.7, we choose the next higher value, that is pH 7. Finally looking at free chlorine concentration, we see that table contains values for concentrations 1.6 mg/L and 1.8 mg/L. With a measured value of 1.7 mg/L, we use the next higher value, in this case 1.8 mg/L. Using this process, the $CT_{required}$ would be 27.

CT log inactivation tables have been provided in this appendix to facilitate thecalculation of $CT_{required}$ via the linear interpolation or approximation method.

D2 Calculating $CT_{required}$ from Equation (for *Giardia* Only)

The following equation, developed by Martin (1993), is most often used in disinfection calculations for *Giardia*.

$$CTrequired = 0.2828 * pH^{2.69} * Cl^{0.15} * (\log reduction) * 0.933^{temp-5}$$

Where :

CT: Required inactivation number

pH: Measure of the acidity or basicity

Cl: Free chlorine concentration

Log reduction: Required logarithmic reduction in Giardia

Temp: Water temperature

Please note this equation does not apply to *Cryptosporidium* which is not inactivated by chlorine. See the log inactivation tables for alternate disinfectants for *Cryptosporidium* inactivation.

The following table compares $CT_{required}$ as determined by the approximation method and the Martin equation for two scenarios.

Log Reduction Required	Temperature (°C)	pH	Chlorine Residual (mg/L)	Approximation Method[1]	Martin
0.5	0.5	6	0.8	24	23.15
0.5	0.5	7	1.4	37	38.12

Notes:

1. Values taken from the CT tables

CT Log Inactivation Values for *Giardia* using Free Chlorine at 0.5°C

Free Chlorine Concentration mg/L	pH ≤ 6						pH = 6.5						pH = 7.0						pH = 7.5					
	Log Inactivation						Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	23	46	69	91	114	137	27	54	82	109	136	163	33	65	98	130	163	195	40	79	119	158	198	237
0.6	24	47	71	94	118	141	28	56	84	112	140	168	33	67	100	133	167	200	40	80	120	159	199	239
0.8	24	48	73	97	121	145	29	57	86	115	143	172	34	68	103	137	171	205	41	82	123	164	205	246
1	25	49	74	99	123	148	29	59	88	117	147	176	35	70	105	140	175	210	42	84	127	169	211	253
1.2	25	51	76	101	127	152	30	60	90	120	150	180	36	72	108	143	179	215	43	86	130	173	216	259
1.4	26	52	78	103	129	155	31	61	92	123	153	184	37	74	111	147	184	221	44	89	133	177	222	266
1.6	26	52	79	105	131	157	32	63	95	126	158	189	38	75	113	151	188	226	46	91	137	182	228	273
1.8	27	54	81	108	135	162	32	64	97	129	161	193	39	77	116	154	193	231	47	93	140	186	233	279
2	28	55	83	110	138	165	33	66	99	131	164	197	39	79	118	157	197	236	48	95	143	191	238	286
2.2	28	56	85	113	141	169	34	67	101	134	168	201	40	81	121	161	202	242	50	99	149	198	248	297
2.4	29	57	86	115	143	172	34	68	103	137	171	205	41	82	124	165	206	247	50	99	149	199	248	298
2.6	29	58	88	117	146	175	35	70	105	139	174	209	42	84	126	168	210	252	51	101	152	203	253	304
2.8	30	59	89	119	148	178	36	71	107	142	178	213	43	86	129	171	214	257	52	103	155	207	258	310
3	30	60	91	121	151	181	36	72	109	145	181	217	44	87	131	174	218	261	53	105	158	211	263	316

Free Chlorine Concentration mg/L	pH = 8.0						pH = 8.5						pH ≤9.0					
	Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	46	92	139	185	231	277	55	110	165	219	274	329	65	130	195	260	325	390
0.6	48	95	143	191	238	286	57	114	171	228	285	342	68	136	204	271	339	407
0.8	49	98	148	197	246	295	59	118	177	236	295	354	70	141	211	281	352	422
1	51	101	152	203	253	304	61	122	183	243	304	365	73	146	219	291	364	437
1.2	52	104	157	209	261	313	63	125	188	251	313	376	75	150	226	301	376	451
1.4	54	107	161	214	268	321	65	129	194	258	323	387	77	155	232	309	387	464
1.6	55	110	165	219	274	329	66	132	199	265	331	397	80	159	239	318	398	477
1.8	56	113	169	225	282	338	68	136	204	271	339	407	82	163	245	326	408	489
2	58	115	173	231	288	346	70	139	209	278	348	417	83	167	250	333	417	500
2.2	59	118	177	235	294	353	71	142	213	284	355	426	85	170	256	341	426	511
2.4	60	120	181	241	301	361	73	145	218	290	363	435	87	174	261	348	435	522
2.6	61	123	184	245	307	368	74	148	222	296	370	444	89	178	267	355	444	533
2.8	63	125	188	250	313	375	75	151	226	301	377	452	91	181	272	362	453	543
3	64	127	191	255	318	382	77	153	230	307	383	460	92	184	276	368	460	552

CT units = min·mg/L

Source: USEPA (1991) Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

CT Log Inactivation Values for *Giardia* using Free Chlorine at 5ºC

Free Chlorine Concentration mg/L	pH ≤ 6						pH = 6.5						pH = 7.0						pH = 7.5					
	Log Inactivation						Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	16	32	49	65	81	97	20	39	59	78	98	117	23	46	70	93	116	139	28	55	83	111	138	166
0.6	17	33	50	67	83	100	20	40	60	80	100	120	24	48	72	95	119	143	29	57	86	114	143	171
0.8	17	34	52	69	86	103	20	41	61	81	102	122	24	49	73	97	122	146	29	58	88	117	146	175
1	18	35	53	70	88	105	21	42	63	83	104	125	25	50	75	99	124	149	30	60	90	119	149	179
1.2	18	36	54	71	89	107	21	42	64	85	106	127	25	51	76	101	127	152	31	61	92	122	153	183
1.4	18	36	55	73	91	109	22	43	65	87	108	130	26	52	78	103	129	155	31	62	94	125	156	187
1.6	19	37	56	74	93	111	22	44	66	88	110	132	26	53	79	105	132	158	32	64	96	128	160	192
1.8	19	38	57	76	95	114	23	45	68	90	113	135	27	54	81	108	135	162	33	65	98	131	163	196
2	19	39	58	77	97	116	23	46	69	92	115	138	28	55	83	110	138	165	33	67	100	133	167	200
2.2	20	39	59	79	98	118	23	47	70	93	117	140	28	56	85	113	141	169	34	68	102	136	170	204
2.4	20	40	60	80	100	120	24	48	72	95	119	143	29	57	86	115	143	172	35	70	105	139	174	209
2.6	20	41	61	81	102	122	24	49	73	97	122	146	29	58	88	117	146	175	36	71	107	142	178	213
2.8	21	41	62	83	103	124	25	49	74	99	123	148	30	59	89	119	148	178	36	72	109	145	181	217
3	21	42	63	84	105	126	25	50	76	101	126	151	30	61	91	121	152	182	37	74	111	147	184	221

Free Chlorine Concentration mg/L	pH = 8.0						pH = 8.5						pH ≤ 9.0					
	Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	33	66	99	132	165	198	39	79	118	157	197	236	47	93	140	186	233	279
0.6	34	68	102	136	170	204	41	81	122	163	203	244	49	97	146	194	243	291
0.8	35	70	105	140	175	210	42	84	126	168	210	252	50	100	151	201	251	301
1	36	72	108	144	180	216	43	87	130	173	217	260	52	104	156	208	260	312
1.2	37	74	111	147	184	221	45	89	134	178	223	267	53	107	160	213	267	320
1.4	38	76	114	151	189	227	46	91	137	183	228	274	55	110	165	219	274	329
1.6	39	77	116	155	193	232	47	94	141	187	234	281	56	112	169	225	281	337
1.8	40	79	119	159	198	238	48	96	144	191	239	287	58	115	173	230	288	345
2	41	81	122	162	203	243	49	98	147	196	245	294	59	118	177	235	294	353
2.2	41	83	124	165	207	248	50	100	150	200	250	300	60	120	181	241	301	361
2.4	42	84	127	169	211	253	51	102	153	204	255	306	61	123	184	245	307	368
2.6	43	86	129	172	215	258	52	104	156	208	260	312	63	125	188	250	313	375
2.8	44	88	132	175	219	263	53	106	159	212	265	318	64	127	191	255	318	382
3	45	89	134	179	223	268	54	108	162	216	270	324	65	130	195	259	324	389

CT units = min·mg/L

Source: USEPA (1991) Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

CT Log Inactivation Values for *Giardia* using Free Chlorine at 10°C

Free Chlorine Concentration mg/L	pH ≤ 6						pH = 6.5						pH = 7.0						pH = 7.5					
	Log Inactivation						Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	12	24	37	49	61	73	15	29	44	59	73	88	17	35	52	69	87	104	21	42	63	83	104	125
0.6	13	25	38	50	63	75	15	30	45	60	75	90	18	36	54	71	89	107	21	43	64	85	107	128
0.8	13	26	39	52	65	78	15	31	46	61	77	92	18	37	55	73	92	110	22	44	66	87	109	131
1	13	26	40	53	66	79	16	31	47	63	78	94	19	37	56	75	93	112	22	45	67	89	112	134
1.2	13	27	40	53	67	80	16	32	48	63	79	95	19	38	57	76	95	114	23	46	69	91	114	137
1.4	14	27	41	55	68	82	16	33	49	65	82	98	19	39	58	77	97	116	23	47	70	93	117	140
1.6	14	28	42	55	69	83	17	33	50	66	83	99	20	40	60	79	99	119	24	48	72	96	120	144
1.8	14	29	43	57	72	86	17	34	51	67	84	101	20	41	61	81	102	122	25	49	74	98	123	147
2	15	29	44	58	73	87	17	35	52	69	87	104	21	41	62	83	103	124	25	50	75	100	125	150
2.2	15	30	45	59	74	89	18	35	53	70	88	105	21	42	64	85	106	127	26	51	77	102	128	153
2.4	15	30	45	60	75	90	18	36	54	71	89	107	22	43	65	86	108	129	26	52	79	105	131	157
2.6	15	31	46	61	77	92	18	37	55	73	92	110	22	44	66	87	109	131	27	53	80	107	133	160
2.8	16	31	47	62	78	93	19	37	56	74	93	111	22	45	67	89	112	134	27	54	82	109	136	163
3	16	32	48	63	79	95	19	38	57	75	94	113	23	46	69	91	114	137	28	55	83	111	138	166

Free Chlorine Concentration mg/L	pH = 8.0						pH = 8.5						pH ≤ 9.0					
	Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	25	50	75	99	124	149	30	59	89	118	148	177	35	70	105	139	174	209
0.6	26	51	77	102	128	153	31	61	92	122	153	183	36	73	109	145	182	218
0.8	26	53	79	105	132	158	32	63	95	126	158	189	38	75	113	151	188	226
1	27	54	81	108	135	162	33	65	98	130	163	195	39	78	117	156	195	234
1.2	28	55	83	111	138	166	33	67	100	133	167	200	40	80	120	160	200	240
1.4	28	57	85	113	142	170	34	69	103	137	172	206	41	82	124	165	206	247
1.6	29	58	87	116	145	174	35	70	106	141	176	211	42	84	127	169	211	253
1.8	30	60	90	119	149	179	36	72	108	143	179	215	43	86	130	173	216	259
2	30	61	91	121	152	182	37	74	111	147	184	221	44	88	133	177	221	265
2.2	31	62	93	124	155	186	38	75	113	150	188	225	45	90	136	181	226	271
2.4	32	63	95	127	158	190	38	77	115	153	192	230	46	92	138	184	230	276
2.6	32	65	97	129	162	194	39	78	117	156	195	234	47	94	141	187	234	281
2.8	33	66	99	131	164	197	40	80	120	159	199	239	48	96	144	191	239	287
3	34	67	101	134	168	201	41	81	122	162	203	243	49	97	146	195	243	292

CT units = min·mg/L

Source: USEPA (1991) Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

CT Log Inactivation Values for *Giardia* using Free Chlorine at 15°C

Free Chlorine Concentration mg/L	pH ≤ 6						pH = 6.5						pH = 7.0						pH = 7.5					
	Log Inactivation						Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	8	16	25	33	41	49	10	20	30	39	49	59	12	23	35	47	58	70	14	28	42	55	69	83
0.6	8	17	25	33	42	50	10	20	30	40	50	60	12	24	36	48	60	72	14	29	43	57	72	86
0.8	9	17	26	35	43	52	10	20	31	41	51	61	12	24	37	49	61	73	15	29	44	59	73	88
1	9	18	27	35	44	53	11	21	32	42	53	63	13	25	38	50	63	75	15	30	45	60	75	90
1.2	9	18	27	36	45	54	11	21	32	43	53	64	13	25	38	51	63	76	15	31	46	61	77	92
1.4	9	18	28	37	46	55	11	22	33	43	54	65	13	26	39	52	65	78	16	31	47	63	78	94
1.6	10	19	28	37	47	56	11	22	33	44	55	66	13	26	40	53	66	79	16	32	48	64	80	96
1.8	10	19	29	38	48	57	11	23	34	45	57	68	14	27	41	54	68	81	16	33	49	65	82	98
2	10	19	29	39	48	58	12	23	35	46	58	69	14	28	42	55	69	83	17	33	50	67	83	100
2.2	10	20	30	39	49	59	12	23	35	47	58	70	14	28	43	57	71	85	17	34	51	68	85	102
2.4	10	20	30	40	50	60	12	24	36	48	60	72	14	29	43	57	72	86	18	35	53	70	88	105
2.6	10	20	31	41	51	61	12	24	37	49	61	73	15	29	44	59	73	88	18	36	54	71	89	107
2.8	10	21	31	41	52	62	12	25	37	49	62	74	15	30	45	59	74	89	18	36	55	73	91	109
3	11	21	32	42	53	63	13	25	38	51	63	76	15	30	46	61	76	91	19	37	56	74	93	111

Free Chlorine Concentration mg/L	pH = 8.0						pH = 8.5						pH ≤ 9.0					
	Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	17	33	50	66	83	99	20	39	59	79	98	118	23	47	70	93	117	140
0.6	17	34	51	68	85	102	20	41	61	81	102	122	24	49	73	97	122	146
0.8	18	35	53	70	88	105	21	42	63	84	105	126	25	50	76	101	126	151
1	18	36	54	72	90	108	22	43	65	87	108	130	26	52	78	104	130	156
1.2	19	37	56	74	93	111	22	45	67	89	112	134	27	53	80	107	133	160
1.4	19	38	57	76	95	114	23	46	69	91	114	137	28	55	83	110	138	165
1.6	19	39	58	77	97	116	24	47	71	94	118	141	28	56	85	113	141	169
1.8	20	40	60	79	99	119	24	48	72	96	120	144	29	58	87	115	144	173
2	20	41	61	81	102	122	25	49	74	98	123	147	30	59	89	118	148	177
2.2	21	41	62	83	103	124	25	50	75	100	125	150	30	60	91	121	151	181
2.4	21	42	64	85	106	127	26	51	77	102	128	153	31	61	92	123	153	184
2.6	22	43	65	86	108	129	26	52	78	104	130	156	31	63	94	125	157	188
2.8	22	44	66	88	110	132	27	53	80	106	133	159	32	64	96	127	159	191
3	22	45	67	89	112	134	27	54	81	108	135	162	33	65	98	130	163	195

CT units = min·mg/L

Source: USEPA (1991) Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

CT Log Inactivation Values for *Giardia* using Free Chlorine at 20°C

Free Chlorine Concentration mg/L	pH ≤ 6						pH = 6.5						pH = 7.0						pH = 7.5					
	Log Inactivation						Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	6	12	18	24	30	36	7	15	22	29	37	44	9	17	26	35	43	52	10	21	31	41	52	62
0.6	6	13	19	25	32	38	8	15	23	30	38	45	9	18	27	36	45	54	11	21	32	43	53	64
0.8	7	13	20	26	33	39	8	15	23	31	38	46	9	18	28	37	46	55	11	22	33	44	55	66
1	7	13	20	26	33	39	8	16	24	31	39	47	9	19	28	37	47	56	11	22	34	45	56	67
1.2	7	13	20	27	33	40	8	16	24	32	40	48	10	19	29	38	48	57	12	23	35	46	58	69
1.4	7	14	21	27	34	41	8	16	25	33	41	49	10	19	29	39	48	58	12	23	35	47	58	70
1.6	7	14	21	28	35	42	8	17	25	33	42	50	10	20	30	39	49	59	12	24	36	48	60	72
1.8	7	14	22	29	36	43	9	17	26	34	43	51	10	20	31	41	51	61	12	25	37	49	62	74
2	7	15	22	29	37	44	9	17	26	35	43	52	10	21	31	41	52	62	13	25	38	50	63	75
2.2	7	15	22	29	37	44	9	18	27	35	44	53	11	21	32	42	53	63	13	26	39	51	64	77
2.4	8	15	23	30	38	45	9	18	27	36	45	54	11	22	33	43	54	65	13	26	39	52	65	78
2.6	8	15	23	31	38	46	9	18	28	37	46	55	11	22	33	44	55	66	13	27	40	53	67	80
2.8	8	16	24	31	39	47	9	19	28	37	47	56	11	22	34	45	56	67	14	27	41	54	68	81
3	8	16	24	31	39	47	10	19	29	38	48	57	11	23	34	45	57	68	14	28	42	55	69	83

Free Chlorine Concentration mg/L	pH = 8.0						pH = 8.5						pH ≤ 9.0					
	Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	12	25	37	49	62	74	15	30	45	59	74	89	18	35	53	70	88	105
0.6	13	26	39	51	64	77	15	31	46	61	77	92	18	36	55	73	91	109
0.8	13	26	40	53	66	79	16	32	48	63	79	95	19	38	57	75	94	113
1	14	27	41	54	68	81	16	33	49	65	82	98	20	39	59	78	98	117
1.2	14	28	42	55	69	83	17	33	50	67	83	100	20	40	60	80	100	120
1.4	14	28	43	57	71	85	17	34	52	69	86	103	21	41	62	82	103	123
1.6	15	29	44	58	73	87	18	35	53	70	88	105	21	42	63	84	105	126
1.8	15	30	45	59	74	89	18	36	54	72	90	108	22	43	65	86	108	129
2	15	30	46	61	76	91	18	37	55	73	92	110	22	44	66	88	110	132
2.2	16	31	47	62	78	93	19	38	57	75	94	113	23	45	68	90	113	135
2.4	16	32	48	63	79	95	19	38	58	77	96	115	23	46	69	92	115	138
2.6	16	32	49	65	81	97	20	39	59	78	98	117	24	47	71	94	118	141
2.8	17	33	50	66	83	99	20	40	60	79	99	119	24	48	72	95	119	143
3	17	34	51	67	84	101	20	41	61	81	102	122	24	49	73	97	122	146

CT units = min·mg/L

Source: USEPA (1991) Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

CT Log Inactivation Values for *Giardia* using Free Chlorine at 25°C

Free Chlorine Concentration mg/L	pH ≤ 6						pH = 6.5						pH = 7.0						pH = 7.5					
	Log Inactivation						Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	4	8	12	16	20	24	5	10	15	19	24	29	6	12	18	23	29	35	7	14	21	28	35	42
0.6	4	8	13	17	21	25	5	10	15	20	25	30	6	12	18	24	30	36	7	14	22	29	36	43
0.8	4	9	13	17	22	26	5	10	16	21	26	31	6	12	19	25	31	37	7	15	22	29	37	44
1	4	9	13	17	22	26	5	10	16	21	26	31	6	12	19	25	31	37	8	15	23	30	38	45
1.2	5	9	14	18	23	27	5	11	16	21	27	32	6	13	19	25	32	38	8	15	23	31	38	46
1.4	5	9	14	18	23	27	6	11	17	22	28	33	7	13	20	26	33	39	8	16	24	31	39	47
1.6	5	9	14	19	23	28	6	11	17	22	28	33	7	13	20	27	33	40	8	16	24	32	40	48
1.8	5	10	15	19	24	29	6	11	17	23	28	34	7	14	21	27	34	41	8	16	25	33	41	49
2	5	10	15	19	24	29	6	12	18	23	29	35	7	14	21	27	34	41	8	17	25	33	42	50
2.2	5	10	15	20	25	30	6	12	18	23	29	35	7	14	21	28	35	42	9	17	26	34	43	51
2.4	5	10	15	20	25	30	6	12	18	24	30	36	7	14	22	29	36	43	9	17	26	35	43	52
2.6	5	10	16	21	26	31	6	12	19	25	31	37	7	15	22	29	37	44	9	18	27	35	44	53
2.8	5	10	16	21	26	31	6	12	19	25	31	37	8	15	23	30	38	45	9	18	27	36	45	54
3	5	11	16	21	27	32	6	13	19	25	32	38	8	15	23	31	38	46	9	18	28	37	46	55

Free Chlorine Concentration mg/L	pH = 8.0						pH = 8.5						pH ≤ 9.0					
	Log Inactivation						Log Inactivation						Log Inactivation					
	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3	0.5	1	1.5	2	2.5	3
≤ 0.4	8	17	25	33	42	50	10	20	30	39	49	59	12	23	35	47	58	70
0.6	9	17	26	34	43	51	10	20	31	41	51	61	12	24	37	49	61	73
0.8	9	18	27	35	44	53	11	21	32	42	53	63	13	25	38	50	63	75
1	9	18	27	36	45	54	11	22	33	43	54	65	13	26	39	52	65	78
1.2	9	18	28	37	46	55	11	22	34	45	56	67	13	27	40	53	67	80
1.4	10	19	29	38	48	57	12	23	35	46	58	69	14	27	41	55	68	82
1.6	10	19	29	39	48	58	12	23	35	47	58	70	14	28	42	56	70	84
1.8	10	20	30	40	50	60	12	24	36	48	60	72	14	29	43	57	72	86
2	10	20	31	41	51	61	12	25	37	49	62	74	15	29	44	59	73	88
2.2	10	21	31	41	52	62	13	25	38	50	63	75	15	30	45	60	75	90
2.4	11	21	32	42	53	63	13	26	39	51	64	77	15	31	46	61	77	92
2.6	11	22	33	43	54	65	13	26	39	52	65	78	16	31	47	63	78	94
2.8	11	22	33	44	55	66	13	27	40	53	67	80	16	32	48	64	80	96
3	11	22	34	45	56	67	14	27	41	54	68	81	16	32	49	65	81	97

CT units = min·mg/L

Source: USEPA (1991) Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

CT Values for Inactivation of Viruses by Free Chlorine

Temperature (°C)	Log Inactivation					
	2		3		4	
	pH		pH		pH	
	6 to 9	10	6 to 9	10	6 to 9	10
0.5	6	45	9	66	12	90
5	4	30	6	44	8	60
10	3	22	4	33	6	45
15	2	15	3	22	4	30
20	1	11	2	16	3	22
25	1	7	1	11	2	15

CT units = min·mg/L
Source: USEPA (1991) Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

CT Log Inactivation Values for *Cryptosporidium* using Chlorine Dioxide

Log Inactivation	Water Temperature (°C)										
	0.5	1	2	3	5	7	10	15	20	25	30
0.25	159	152	139	128	107	90	69	45	29	19	12
0.50	318	304	279	256	215	180	139	90	58	37	24
1.00	636	609	558	511	429	361	278	179	116	75	48
1.50	954	913	837	767	644	541	416	269	174	112	73
2.00	1271	1217	1115	1022	859	721	555	359	232	150	97
2.50	1589	1521	1394	1278	1073	901	694	449	290	187	121
3.00	1907	1826	1673	1533	1288	1082	833	538	348	225	145

CT units = min·mg/L
Source: (2006) Code of Federal Regulations, 40 CFR 141.720.

CT Log Inactivation Values for *Giardia* using Chlorine Dioxide

Log Inactivation	Water Temperature (°C)					
	<1	5	10	15	20	25
0.50	10	4	4	3	3	2
1.00	21	9	8	6	5	4
1.50	32	13	12	10	8	6
2.00	42	17	15	13	10	7
2.50	52	22	19	16	13	9
3.00	63	26	23	19	15	11

CT Log Inactivation Values of Viruses using Chlorine Dioxide, pH 6-9

Log Inactivation	Temperature (°C)					
	≤1	5	10	15	20	25
2	8.4	5.6	4.2	2.8	2.1	1.4
3	25.6	17.1	12.8	8.6	6.4	4.3
4	50.1	33.4	25.1	16.7	12.5	8.4

CT units = min·mg/L
Source: USEPA (1991) Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

CT Log Inactivation Values for *Cryptosporidium* using Ozone

Log Inactivation	Temperature (°C)									
	≤0.5	1	2	3	5	7	10	15	20	25
0.5	12	12	10	9.5	7.9	6.5	4.9	3.1	2.0	1.2
1.0	24	23	21	19	16	13	9.9	6.2	3.9	2.5
1.5	36	35	31	29	24	20	15	9.3	5.9	3.7
2.0	48	46	42	38	32	26	20	12	7.8	4.9
2.5	60	58	52	48	40	33	25	16	9.8	6.2
3.0	72	69	63	57	47	39	30	19	12	7.4

CT units = min·mg/L
Source: (2006) Code of Federal Regulations, 40 CFR 141.720.

CT Log Inactivation Values for *Giardia* using Ozone

Log Inactivation	Temperature (°C)					
	≤1	5	10	15	20	25
0.5	0.48	0.32	0.23	0.16	0.12	0.08
1.0	0.97	0.63	0.48	0.32	0.24	0.16
1.5	1.5	0.95	0.72	0.48	0.36	0.24
2.0	1.9	1.3	0.95	0.63	0.48	0.32
2.5	2.4	1.6	1.2	0.79	0.6	0.4
3.0	2.9	1.9	1.43	0.95	0.72	0.48

CT units = min·mg/L
Source: USEPA (1991) Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

CT Inactivation Values for Viruses using Ozone

Log Inactivation	Temperature (°C)					
	≤1	5	10	15	20	25
2	0.9	0.6	0.5	0.3	0.25	0.15
3	1.4	0.9	0.8	0.5	0.4	0.25
4	1.8	1.2	1	0.6	0.5	0.3

CT units = min·mg/L
Source: USEPA (1991) Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources.

UV Dose Log Inactivation Values for *Cryptosporidium*, *Giardia*, and Viruses

Log Inactivation	*Cryptosporidium*	*Giardia*	Viruses*
0.5	1.6	1.5	39
1.0	2.5	2.1	58
1.5	3.9	3.0	79
2.0	5.8	5.2	100
2.5	8.5	7.7	121
3.0	12	11	143
3.5	15	15	163
4.0	22	22	186

* Based on adenovirus inactivation.

Source (2006) Code of Federal Regulations, 40 CFR 141.720

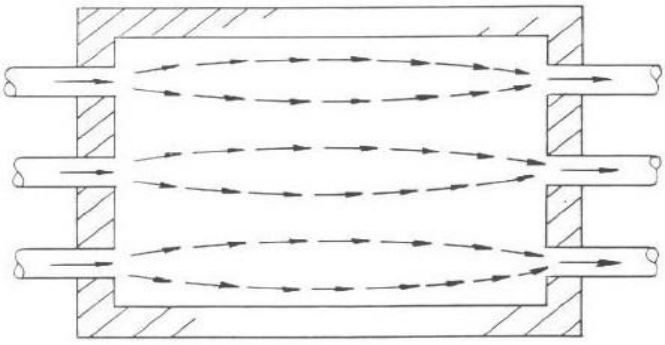
Appendix 9-E

APPENDIX E

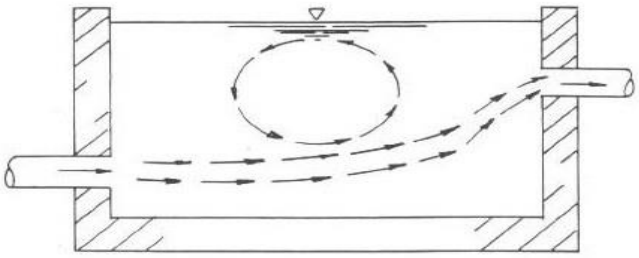
Baffling Factors for Sample Contact Chamber Designs

E1 Poor Baffling

- T_{10}/T_0 = 0.3
- single or multiple unbaffled inlets and outlets
- no intra-basin baffles
- potential for stagnant zones and short-circuiting



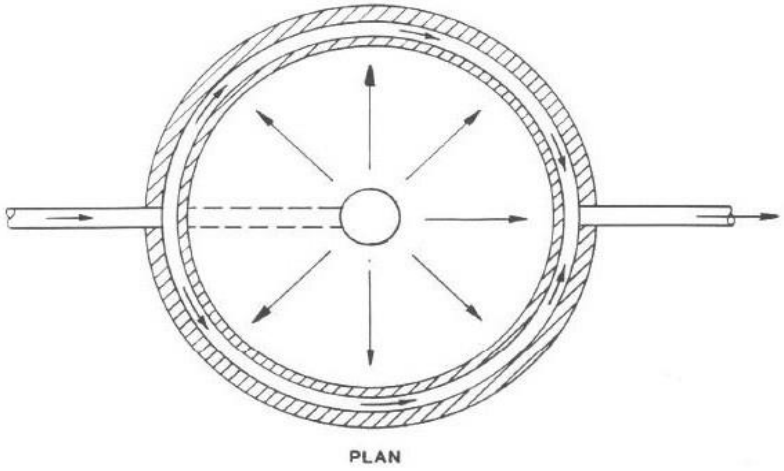
PLAN



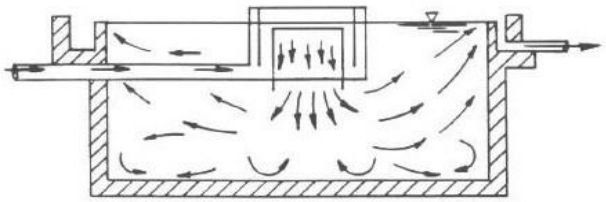
SECTION

E2 Average Baffling

- T_{10}/T_0 = 0.5
- baffled inlet or outlet
- some intra-basin baffles



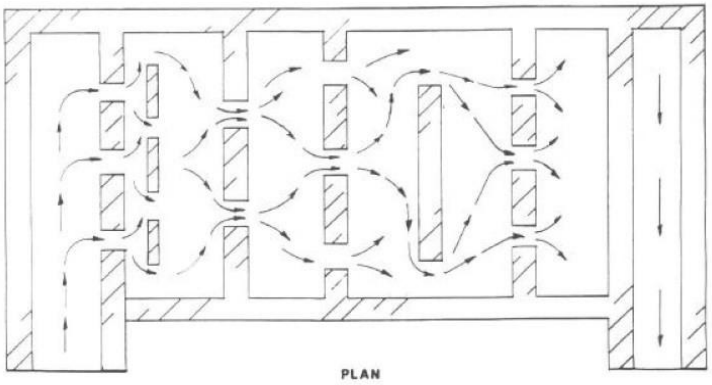
PLAN

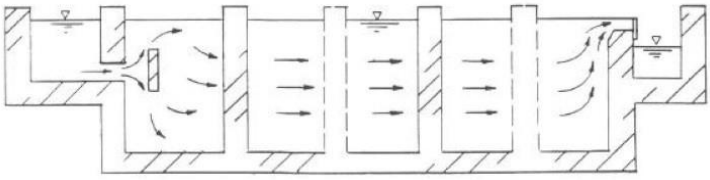


SECTION

E3 Superior Baffling

- T_{10}/T_0 = 0.7
- perforated inlet baffle
- serpentine or perforated intra-basin baffles
- outlet weir or perforated launders
- most of tank volume utilized





Appendix 9-F

APPENDIX F

Sample CT Calculations

EXAMPLE 1

Source Water - Surface Water

The source water is surface water from a river.

Treatment Requirements

Based on source water conditions, the treatment requirements are set at:

3.0-log reduction for *Cryptosporidium* and *Giardia*;

4.0-log reduction for viruses.

Filtration Credits (Log Removal)

The treatment facility is a direct filtration plant. Individual filter effluent turbidity was reviewed and meets the limits of 0.2 NTU 95% of the time. Therefore, this facility receives the following filtration credits towards meeting the treatment requirements:

2.5-log reduction for *Cryptosporidium*;

2.5-log reduction for *Giardia*;

1.0-log reduction for viruses.

Based on the above, log inactivation (disinfection) must provide the following log reduction:

Cryptosporidium		3.0-log reduction required
	Subtract	2.5-log filtration credit
	Equals	**0.5-log** inactivation credit needed
Giardia		3.0-log reduction required
	Subtract	2.5-log filtration credit
	Equals	**0.5-log** inactivation credit needed
Viruses		4.0-log reduction required
	Subtract	1.0-log filtration credit
	Equals	**3.0-log** inactivation credit needed

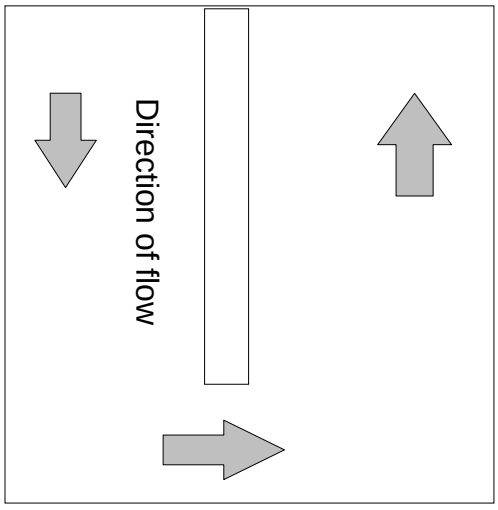
Treatment Deficiency #1

Because this facility has a shortfall in log removal credits for *Cryptosporidium*, an alternate disinfectant such as UV, chlorine dioxide or ozone will be required to meet treatment requirements.

In this example, UV is selected. The UV unit has a minimum dose of 40 mJ/cm^2. This is sufficient to receive a 4-log inactivation credit for *Cryptosporidium* and *Giardia* (see IT tables in Appendix D) which meets the above shortfalls. UV is only assigned a 0.5-log inactivation credit for viruses based on adenovirus. As such, 2.5-log inactivation is required by chlorine.

Disinfection Credits (Log Inactivation)

The contact chamber has the following configuration:



Contact Chamber Specifications:

Volume:	270 cubic metres
Max. Flow:	4.1 MLD
Dimensions:	9.1 m x 10 m x 3 m
Baffling:	Single Baffle
Min. Temperature:	5^{o}C
Highest pH:	7.6

This facility uses free chlorine for primary disinfection. In the winter, the facility has a minimum of 1.0 mg/L free chlorine residual leaving the contact chamber.

Based on the configuration of the contact chamber the length to width ratio is 2:1, which is poor. A baffling factor of 0.3 can be used.

Tank low level occurs when the tank is 70% full.

CT Calculation

Volume of chamber: 270 cubic metres = 270 000 L = 0.27 ML x 0.7 (low level) = 0.189ML

Contact time$_{actual}$: Volume ÷ Max. Flow = 0.189 ML ÷ 4.1 MLD = 0.0461 days x 24hours per day x 60 minutes per hour = 66.4 minutes

CT_{actual}: Concentration of disinfectant x contact time x baffling factor = 1.0 mg/L x 66.4 minutes x 0.3 = 19.9 mg.min/L

$CT_{required}$ (*Giardia*): UV disinfection is providing 4.0-log inactivation for *Cryptosporidium* and *Giardia*.

Adequate for 0.5-log *Giardia*? Yes

$CT_{required}$ (Viruses): Referring to the CT tables in Appendix D, 8 mg.min/L provides 4-log inactivation of viruses at 5°C, pH 6-9

Adequate for viruses? $CT_{actual} \div CT_{required} = 19.9 \div 8 = 2.49$ (greater than 1)
Therefore adequate

Conclusion

This facility will require the installation of an alternate disinfectant, in this example UV, to provide sufficient disinfection for Cryptosporidium and Giardia inactivation. Chemical disinfection will also be required to provide adequate disinfection for virus inactivation based on adenovirus.

EXAMPLE 2

Source Water - Surface Water

The source water is surface water from a lake.

Treatment Requirements

Based on source water conditions, the treatment requirements are set at:

- 3.0-log reduction for *Cryptosporidium* and *Giardia*;
- 4.0-log reduction for viruses.

Filtration Credits (Log Removal)

The treatment facility is a conventional filtration plant. Individual filter effluent turbidity was reviewed and meets the limits of 0.2 NTU 95% of the time. Therefore, this facility receives the following filtration credits towards meeting the treatment requirements:

- 3.0-log reduction for *Cryptosporidium*;
- 3.0-log reduction for *Giardia*;
- 2.0-log reduction for viruses.

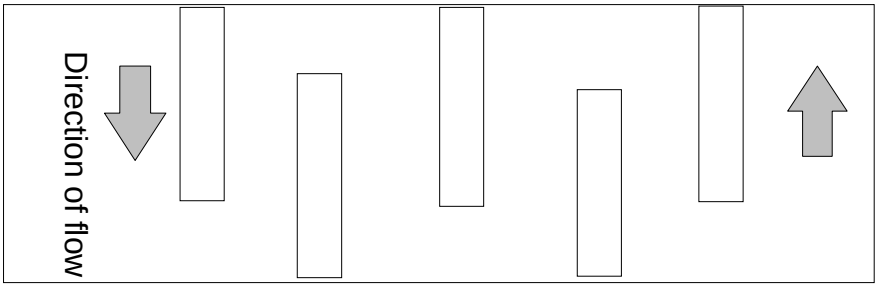
Based on the above, log inactivation (disinfection) must provide the following log reduction:

Cryptosporidium		3.0-log reduction required
	Subtract	3.0-log filtration credit
	Equals	**0.0-log** inactivation credit needed
Giardia		3.0-log reduction required
	Subtract	3.0-log filtration credit
	Equals	**0.0-log** inactivation credit needed
Viruses		4.0-log reduction required
	Subtract	2.0-log filtration credit
	Equals	**2.0-log** inactivation credit needed

There is no shortfall in log removal credits for *Cryptosporidium* in this example.

Disinfection Credits (Log Inactivation)

The contact chamber has the following configuration:



Contact Chamber Specifications:	
Volume:	303 cubic metres
Max. Flow:	3.1 MLD
Dimensions:	5.1 m x 20 m x 3 m
Baffling:	Five Baffles
Min. Temperature:	7°CHighest pH:7.3

This facility uses free chlorine for primary disinfection. In the winter, the facility has a minimum of 0.4 mg/L free chlorine residual leaving the contact chamber.

Based on the configuration of the contact chamber the length to width ratio is 4:1, and multiple baffles, which is good. A baffling factor of 0.7 can be used.

Tank low level occurs when the tank is 85% full.

CT Calculation

Volume of chamber: 303 cubic metres = 303 000 L = 0.303 ML x 0.85 (low level) = 0.258 ML

Contact time$_{actual}$: Volume ÷ Max. Flow = 0.258 ML ÷ 3.1 MLD = 0.0832 days x 24 hours per day x 60 minutes per hour = 119.8 minutes

CT_{actual}: Concentration of disinfectant x contact time x baffling factor =0.4 mg/L x 119.8 minutes x 0.7 = 33.5

Adequate for 0.5-log *Giardia*? Referring to CT Tables in Appendix D:

CT at 5°C and pH 7.0 = 23

CT at 5°C and pH 7.5 = 28

CT at 10°C and pH 7.0 = 18

CT at 10° and pH 7.5 = 21

Therefore:

CT at 7°C and pH 7.3 = 21.6 mg.min/L

CT_{actual} ÷ $CT_{required}$ = 33.5 ÷ 21.6 = 1.55 (greater than 1)

Therefore adequate

$CT_{required}$ (Viruses): Referring to CT tables in Appendix D,

8.0 mg.min/L provides 4.0-log inactivation of viruses

Adequate for viruses? CT_{actual} ÷ $CT_{required}$ = 33.5 ÷ 8.0 = 4.19 (greater than 1)

Therefore adequate

Conclusion

This facility adequately removes and inactivates *Cryptosporidium*, *Giardia* and *viruses* and meets Nova Scotia's Drinking Water Treatment Standards.

EXAMPLE 3

Source Water - High Risk GUDI Source

This example demonstrates the requirements for groundwater under the direct influence of surface water. The results from the GUDI protocol indicate that the drilled wells serving the facility have been classified as GUDI – High Risk. This classification has been accepted in writing by a Department Regional Hydrogeologist.

Treatment Requirements

Since the facility has been classified as GUDI – High Risk, the facility requires engineered filtration for pathogen reduction. The treatment requirements for this facility are:

- 3 - Log reduction for *Cryptosporidium* and *Giardia*;
- 4 - Log reduction for viruses.

Filtration Credits (Log Removal)

The facility has a micro-filtration (MF) membrane system with pre-coagulation. Individual filter effluent turbidity was reviewed and meets the limits of 0.1 NTU 99% of the time. Direct integrity testing indicates that the membrane provides 3.14-log removal for protozoa (e.g. *Cryptosporidium* oocysts and *Giardia* cysts). The system receives no credits for the removal for viruses. Therefore, this facility receives the following filtration credits towards meeting the treatment requirements:

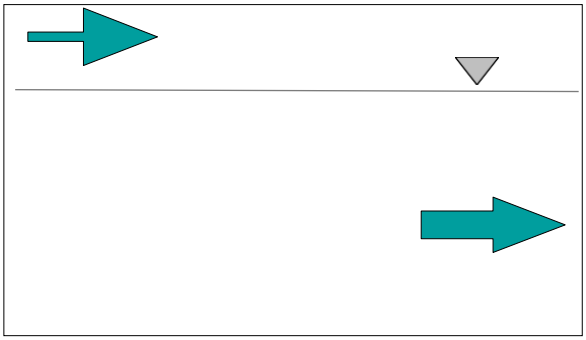
- 3.14-log reduction for *Cryptosporidium*;
- 3.14-log reduction for *Giardia*;
- 0.0-log reduction for viruses.

Based on the above, log inactivation must provide the following log reduction:

Cryptosporidium		3.00-log reduction required
	Subtract	3.14-log filtration credit
	Equals	**0.0-log** inactivation credit needed
Giardia		3.00-log reduction required
	Subtract	3.14-log filtration credit
	Equals	**0.0-log** inactivation credit needed
Viruses		4.0-log reduction required
	Subtract	0.0-log filtration credit
	Equals	**4.0-log** inactivation credit needed

There is no shortfall in log removal credits for *Cryptosporidium* in this example.

The contact chamber has the following configuration:



Contact Chamber Specifications:

Volume:	750 cubic metres
Max. Flow:	12.5 MLD
Dimensions:	5.1 m x 20 m x 3 mBaffling:no baffles, inlet at top of basin, outletat bottom of basin
Min. Temperature:	5°CHighest pH:7.5

The facility uses free chlorine. In the winter, the facility has a minimum of 1.2 mg/ L free chlorine leaving the contact chamber.

Based on the configuration of the contact chamber, there is no baffling with poor mixing. A baffling factor of 0.1 can be used.

Tank low level occurs when the tank is 85% full.

CT Calculation

Volume of chamber: 750 cubic metres = 750 000 L = 0.750 ML x 0.85 (low level) = 0.6375 ML

Contact time$_{actual}$: Volume ÷ Max. Flow = 0.6375 ML ÷ 12.5 MLD = 0.051 days x 24 hours per day x 60 minutes per hour = 73.4 minutes

CT$_{actual}$: Concentration of disinfectant x contact time x baffling factor = 1.2 mg/L x 73.4 minutes x 0.1 = 8.81 mg.min/L

CT$_{required}$ (*Giardia*): Referring to the CT tables in Appendix D, for 0.5-log inactivation of *Giardia* at 5°C and pH 7.5,

CT = 28 mg.min/L

Adequate for 0.5-log *Giardia*?

$CT_{actual} \div CT_{required} = 8.81 \div 28 = 0.31$ (less than 1)

Therefore <u>not</u> adequate

CT$_{required}$ (Viruses): Referring to the CT tables in Appendix D, 8 mg.min/L provides 4.0-log inactivation of viruses at 5°C, pH 6-9

Adequate for viruses? $CT_{actual} \div CT_{required} = 8.81 \div 8 = 1.1$ (greater than 1)
Therefore adequate

Conclusion

The current configuration of the contact chamber is <u>not</u> sufficient to provide 0.5-log inactivation for *Giardia*.The contact chamber can be increased in size, the baffling improved, the chlorine residual increased or UV disinfection can be added.

EXAMPLE 4

Source Water - Medium Risk GUDI Source

This example demonstrates the requirements for groundwater under the direct influence of surface water. The results from the GUDI protocol indicate that the drilled wells serving the facility have been classified as GUDI – Medium Risk. This classification has been accepted in writing by a Department Regional Hydrogeologist.

Treatment Requirements

Since the facility has been classified as a GUDI – Medium Risk, the treatment requirements for this facility are:

- 3 - Log reduction for *Cryptosporidium* and *Giardia*;
- 4 - Log reduction for viruses.

Filtration Credits (Log Removal)

A medium risk GUDI facility is eligible for a 1.0-log natural filtration credit for protozoa if the *Guidelines for the Determination of Natural Filtration Log Removal for Protozoa* are followed (see Appendix B) and a Department Regional Hydrogeologist accepts the determination in writing. This process has been completed and accepted by the Department.

Therefore, this facility receives the following filtration credits towards meeting the treatment requirements:

- 1.0-log reduction for *Cryptosporidium*;
- 1.0-log reduction for *Giardia*;
- 0.0-log reduction for viruses.

Based on the above, log inactivation must provide the following log reduction:

Cryptosporidium		3.0-log reduction required
	Subtract	1.0-log filtration credit
	Equals	**2.0-log** inactivation credit needed
Giardia		3.00-log reduction required
	Subtract	1.0-log filtration credit
	Equals	**2.0-log** inactivation credit needed
Viruses		4.0-log reduction required
	Subtract	0.0-log filtration credit
	Equals	**4.0-log** inactivation credit needed

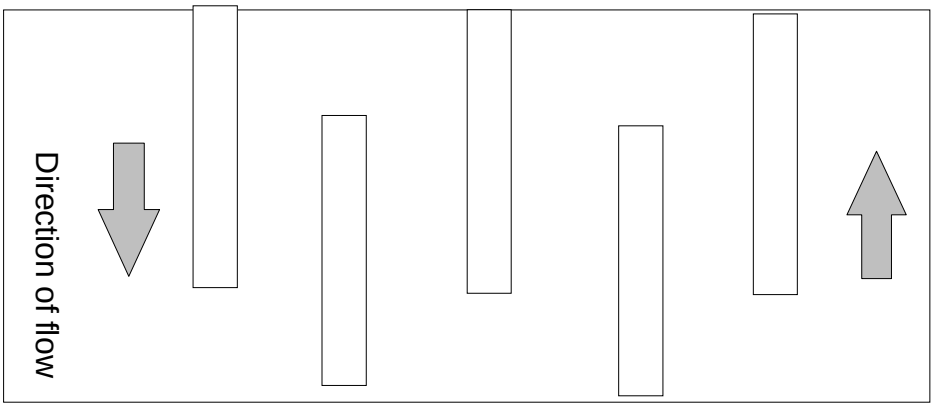
Treatment Deficiency #1

Because this facility has a shortfall in log removal credits for *Cryptosporidium*, an alternate disinfectant such as UV, chlorine dioxide or ozone will be required to meet treatment requirements.

In this example, UV is selected. The UV provides a minimum dose of40 mJ/cm^2. This is sufficient to receive a 4-log inactivation credit for *Cryptosporidium* and *Giardia* (see IT tables in Appendix D) which meets the above shortfalls. UV is only assigned a 0.5-log inactivation credit for viruses based on adenovirus. As such, 3.5-log inactivation for viruses must be addressed. In this example, chlorine is selected to inactivate viruses.

Disinfection Credits (Log Inactivation)

The contact chamber has the following configuration:



Contact Chamber Specifications:

Volume:	450 cubic metres
Max. Flow:	4.5 MLD
Dimensions:	5 m x 30 m x 3 m
Baffling:	Five BafflesMin. Temperature: 10^{o}C Highest pH:7.5

The facility uses free chlorine for virus disinfection. The facility has a minimum of 0.5 mg/L free chlorine residual leaving the contact chamber.

Based on the configuration of the contact chamber the length to width ratio is 4:1, and has multiple baffles, which is good. A baffling factor of 0.7 can be used.

The tank is configured such that it is always full (e.g. outlet weir controls water level).

CT Calculation

Volume of chamber: 450 cubic metres = 450 000 L = 0.450 ML x 1 (low level) = 0.450 ML

Contact time$_{actual}$: Volume ÷ Max. Flow = 0.450 ML ÷ 4.5 MLD = 0.1 days x 24 hours per day x 60 minutes per hour = 144 minutes

CT_{actual}: Concentration of disinfectant x contact time x baffling factor = 0.5 mg/L x 144 minutes x 0.7 = 50.4

$CT_{required}$ (*Giardia*): UV disinfection is providing 4.0-log inactivation for *Cryptosporidium* and *Giardia*.

Adequate for 0.5-log *Giardia*? Yes

$CT_{required}$ (Viruses): Referring to the CT tables in Appendix D, 6 mg·min/L provides 4.0-log inactivation of viruses at 10°C, pH 6-9

Adequate for viruses?

$CT_{actual} \div CT_{required} = 50.4 \div 6 = 8.4$ (greater than 1)
Therefore adequate

Conclusion

This facility will require the installation of an alternate disinfectant, in this example UV, to provide sufficient disinfection for *Cryptosporidium* and *Giardia* inactivation. Chemical disinfection will also be required to provide adequate disinfection for virus inactivation.

EXAMPLE 5

Source Water - Non-GUDI

This example demonstrates the requirements for a non-GUDI source. The results from the GUDI protocol indicate that the drilled wells serving the facility have been classified as non-GUDI. This classification has been accepted in writing by a Department Regional Hydrogeologist.

Treatment Requirements

Since the facility has been classified as non-GUDI, the treatment requirements for this facility are:

- 4 - Log reduction for viruses.

Treatment Adequacy

A non-GUDI facility does not require engineered filtration for pathogen reduction. Therefore, only disinfection is required for the 4-log inactivation of viruses. The Approval Holder has two choices for primary disinfection: chemical disinfection only or UV and chemical disinfection.

The facility well field is located 2.1 km from the first customer with a 12 " ductile iron watermain, which provides plug flow. The baffling factor for the water main is 1. The maximum flow in the system is 4.5 MLD.

The minimum water temperature is 5^0 C.

With chemical disinfection only the utility ensures that the minimum free chlorine concentration at the first customer is 0.4 mg/L.

This facility is considering UV as an added barrier for disinfection, but wanted to compare the two choices before making the final selection.

Option 1: Chemical disinfection only

Volume of the chamber

= Length of water main x cross-sectional area

= 2100 m x 0.073 sq. m = 153 cu. m = 0.153 ML

Contact time$_{actual}$

= Volume/Max. Flow = 0.153 ML /4.5 MLD = 0.034 days x 24 hours per day x 60 minutes per hour = 49.0 min.

CT_{actual} = Concentration of disinfectant x contact time x baffling factor

CT_{actual} = 0.4 mg/L x 49.0 min x 1.0

CT_{actual} = 19.6 mg min/L

$CT_{required}$ (viruses):

Referring to CT Tables in Appendix D, 8 mg·min/L provides 4.0-log inactivation at 5^0 C, pH 6-9

Adequate for viruses?

CT= CT_{actual} ÷ $CT_{required}$ = 19.6 ÷ 8 = 2.45 (greater than 1)

Therefore adequate

Option 2: UV with chemical disinfection

UV will only provide 0.5-log inactivation for viruses based on adenovirus so chemical disinfection will be required for 3.5-log inactivation of viruses. Given that the chemical disinfection would provide most of the inactivation the Approval Holder reduced the free chlorine concentration to 0.3 mg /L as a cost saving measure.

CT_{actual} = Concentration of disinfectant x contact time x baffling factor

CT_{actual} = 0.3 mg/L x 49.0 min x 1.0

CT_{actual} = 14.7 mg-min/L

CT = CT_{actual} ÷ $CT_{required}$ = 14.7 ÷ 8 = 1.84 (greater than 1)

Adequate for viruses? The CT is greater than one, therefore, it is adequate.

Conclusion

Both options are sufficient for disinfection. Since the facility only obtains a 0.5-log reduction credit for viruses for the UV unit based on adenovirus, the Approval Holder must evaluate the additional capital and operating costs of the UV unit, reduced cost of chlorine addition and risk benefit.

EXAMPLE 6

Source Water - Low Risk GUDI Source

This example demonstrates the requirements for groundwater under the direct influence of surface water. The results from the GUDI protocol indicate that the drilled wells serving the facility have been classified as GUDI – Low Risk. This classification has been accepted in writing by the Department Regional Hydrogeologist.

Treatment Requirements

Since the facility has been classified as a GUDI – Low Risk, the treatment requirements for this facility are:

- 3 - Log reduction for *Cryptosporidium* and *Giardia*;
- 4 - Log reduction for viruses.

Filtration Credits (Log Removal)

A low risk GUDI facility is eligible for a 3.0-log natural filtration credit for protozoa if the *Guidelines for the Determination of Natural Filtration Log Removal for Protozoa* are followed (see Appendix B) and the Department's Regional Hydrogeologist accepts the determinationin writing. This process has been completed and accepted by the Department.

Therefore, this facility receives the following filtration credits towards meeting the treatmentrequirements:

- 3.0-log reduction for *Cryptosporidium*;
- 3.0-log reduction for *Giardia*;
- 0.0-log reduction for viruses.

Based on the above, log inactivation must provide the following log reduction:

Cryptosporidium		3.0-log reduction required
	Subtract	3.0-log filtration credit
	Equals	**0.0-log** inactivation credit needed
Giardia		3.0-log reduction required
	Subtract	3.0-log filtration credit
	Equals	**0.0-log** inactivation credit needed
Viruses		4.0-log reduction required
	Subtract	0.0-log filtration credit
	Equals	**4.0-log** inactivation credit needed

Treatment Adequacy

A low-risk GUDI source does not require engineered filtration for pathogen reduction. Therefore, only disinfection is required for the 4-log inactivation of viruses. The facility has two choices for primary disinfection: chemical disinfection only or UV and chemical disinfection. The facility chooses chemical disinfection only through the use of free chlorine.

The facility well field is located 2.1 km from the first customer with a 12" ductile iron water main, which provides plug flow. The baffling factor for the water main is 1. The maximum flow in the system is 4.5 MLD.

The minimum water temperature is 5^0 C.

With chemical disinfection only the utility ensures that the minimum free chlorine concentration at the first customer is 0.4 mg/L.

Volume of the chamber

= Length of water main x cross-sectional area
= 2100 m x 0.073 sq. m = 153 cu. m = 0.153 ML

Contact time$_{actual}$

= Volume/Max. Flow = 0.153 ML /4.5 MLD = 0.034 days x 24 hours per day x 60 minutes per hour = 49.0 min

CT Calculation

CT_{actual} = Concentration of disinfectant x contact time x baffling factor

CT_{actual} = 0.4 mg / L x 49.0 min x 1.0

CT_{actual} = 19.6 mg min/L

$CT_{required}$ (viruses):

Referring to CT Tables in Appendix D, 8 mg·min/L provides 4.0-log inactivation at 5^0 C, pH 6-9

Adequate for viruses?

CT= $CT_{actual} \div CT_{required}$ = 19.6 ÷ 8 = 2.45 (greater than 1)
Therefore adequate

Conclusion

With the Department accepted natural filtration log credit and chemical disinfection this facility adequately removes and inactivates *Cryptosporidium*, *Giardia* and viruses and meets Nova Scotia's Drinking Water Treatment Standards.

Appendix 9-G

Appendix G

Technical Considerations for Filtration and Disinfection Processes

G.1 Ultraviolet (UV) Light Disinfection

The use of UV disinfection systems for water treatment is becoming more common in Nova Scotia. UV dose delivery depends on a number of factors including reactor design (hydrodynamics), flow rate, UV transmittance of water, UV intensity, lamp output, lamp placement, aging, fouling and microbe inactivation kinetics. A safety factor is added to establish a design dose and is established through UV validation.

UV validation testing is usually conducted by the UV manufacturer or a third party to pre-validate their reactors to determine the operating conditions under which a UV reactor would deliver the validated dose. The validation testing is conducted for the full-scale testing of the reactor that will actually be used in field and inactivation of a test micro-organism with dose-response characteristics quantified through bioassay tests. The operating conditions include flow rate, UV intensity, UV lampstatus, an account for UV absorbance of the water, lamp fouling, aging inlet and outlet piping configuration of the UV reactor and measurement of uncertainty of on-line sensors, etc.

The purpose of this appendix is to specify minimum requirements when UV is used for primary disinfection. UV systems should be designed taking into account:

- Redundancy and reliability;
- Minimum dose and performance requirements;
- UV transmittance (UVT); and
- Scaling and fouling.

G.1.1 Redundancy and Reliability

a. A minimum of two UV treatment units are required in parallel to provide redundancy regardless of the design of the system.

b. Where two units are provided, each unit shall be capable of meeting the maximum day demand flow. Where more than two units are provided, the maximum day demand flow shall be met with the largest unit out of service.

c. The UV dose must be equal to or greater than 40 mJ/cm^2, or Department accepted alternate dose.

d. UV intensity and flow through the reactors, shall be monitored a minimum of once every five minutes to ensure the UV dose is greater than or equal to 40 mJ/cm^2 or Department accepted alternate dose.

e. Provisions shall be in place to prevent the distribution of water if UV dosedrops below 40 mJ/cm^2, or Department accepted alternate dose.

f. Each UV unit shall be equipped with an alarm notification and shutdown in the event of:

- High temperature in the reactor, lamp, ballast or transformer;
- High flow rates that causes the dose to fall below design specifications;
- Low UV dose;
- Low UV intensity;
- Low UVT that causes dose to fall below design specifications;
- UV has shutdown; or
- Any other emergency situation.

Note: NSF 55, Class A units are acceptable for small systems with flow less than 25 lgpm (30 USgpm).

g. In the case of a power outage or power quality problems, which cause one or more of the UV units to become inoperable, contingencies shall be in place that prevent inadequately disinfected water from being distributed, including during the lamp warm-up time.

h. The UV disinfection unit shall be equipped with UV sensors reading calibrated UV intensity. The UV sensors shall be calibrated on a monthly basis. Off-line reference sensors used for calibration shall be of equal quality to the on-line sensors and shall be calibrated annually.

i. UVT analyzers shall be calibrated weekly.

j. UV equipment replacement components shall be equal to or better than components used during validation.

k. The UV lamp shall be monitored in a manner that ensures bulb replacement is accomplished prior to the maximum lamp life expectancy.

l. In the case of UV bulb breakage during operation, provisions shall be in place to contain the broken lamp, and contingencies shall be in place that prevent inadequately disinfected water from being distributed.

G.1.2 Minimum Dose and Performance Requirements

a. UV systems shall be certified to provide a minimum dose of 40 mJ/cm^2 or a Department-accepted alternate dose at all points within the reactor at all times when water is passing through the treatment process. Acceptable certification includes:
    - US EPA UVDGM;
    - German guideline DVGW W294;
    - Austrian standard ONORM M 5873; and
    - NSF Standard 55 Class A (for small systems with flow less than 25 Igpm (30 USgpm))

b. The Approval Holder shall provide to the Department an independent third-party validation that demonstrates the manufacturer's system will meet the 40 mJ/cm^2 or Department accepted alternate dose. The UV dose shall be sufficient to ensure log inactivation requirements.

c. If the UV dose is inadequate to achieve the required virus reduction, UV shall be followed by another disinfectant such as chlorine with the appropriate CT to achieve log inactivation requirements for viruses.

d. UV shall always be followed by a secondary disinfectant such as chlorine to maintain a residual in the water distribution system.

e. The quality of the raw water entering the UV system shall meet the manufacturer's requirements or pre-treatment shall be installed to ensure the quality of the raw water entering the UV system meets the manufacturer's requirements.

f. If the UV manufacturer has not specified water quality requirements, the following are recommended:
    - Turbidity: <1.0 NTU;
    - Hardness: <120 mg/L;
    - Iron: <0.3 mg/L;
    - Manganese: <0.05 mg/L;
    - Hydrogen sulfide: not detectable;
    - Total suspended solids: <10 mg/L;
    - pH: 6.5-9.5;
    - Total coliforms: <1000/100mL; and
    - UVT: >75%

G.1.3 UV Transmittance (UVT)

a. UVT is an important water quality parameter for determining the efficacy of the UV unit. UVT is a measure of the UV light at 254 nm that transmits through the water column in the UV chamber. UVT is described by the following equation.

$$UVT = 100 \times 10^{-A254}$$

b. Knowledge of the UV254 absorbance/transmittance of the water to be treated is critical when designing for good performance of UV systems.

c. Design of UV systems should ideally be based on the worst-case water transmittance of at least 12 months of UVT data for each facility (e.g. using the 5th percentile of monthly, bimonthly or weekly samples) (Bolton and Cotton, 2008).

d. UV units should be installed with UV sensors so that %UVT is calculated at a minimum daily. Alarms should be installed and configured in such a manner that alarms sound when UVT is below the manufacturer's specifications.

G.1.4 Scaling and Fouling

a. Scaling and fouling of the quartz sleeve can have a significant influence on disinfection efficacy. Over time, water quality parameters can form or deposit on the sleeve and interfere with the UV light penetrating the water column. Scaling and fouling results from the presence of metals, hardness, alkalinity, and particulate suspended in the water column.

b. Scaling and fouling can be controlled if proper maintenance of the UV unit has been performed. Frequency of cleaning will vary depending on the water quality characteristics. Maintenance of the quartz sleeve shall be performed based on the manufacturer's recommendations.

c. UV units shall have on-line mechanical sleeve cleaning devices or provision for physical-chemical cleaning.

G.2 On-site Generation of Sodium Hypochlorite

G.2.1 Salt Quality

The salt supplied shall be tested and certified as meeting the specifications of NSF 60. The salt shall contain no organic binders, flow control agents or resin cleaning material.

G.2.2 Equipment Quality

The electrolyzer and generator shall be certified as meeting the specifications of NSF 61 for use in drinking water systems.

G.2.3 Redundancy

A minimum of two electrolyzers are required to provide redundancy. Where two units are provided, each shall be capable of meeting the maximum day demand flow. Where more than two disinfection units are provided, the maximum day flow shall be met with the largest unit out of service.

G.2.4 Other Requirements

Appropriate precautions shall be in place to handle hydrogen gas.

G.3 Membrane Treatment Technology Requirements

The use of membranes for water treatment is becoming more common, especially in Nova Scotia. The purpose of this appendix is to state the requirements that membrane water treatment plants shall be required to meet in Nova Scotia with regard to:

- The number of membrane treatment units (e.g., trains, skids, racks, stages, etc.)
- Challenge Testing
- Direct Integrity Testing
- Continuous Indirect Integrity Testing
- Turbidity
- Filter-to-waste

G.3.1 Number of Membrane Treatment Units

Case studies of existing membrane plants have shown that having additional capacity has been extremely beneficial to deal with unexpected fouling rates and the corresponding decrease in flux to compensate for the higher fouling rates (AWWARF, 2004). The EPA *Membrane Filtration Guidance Manual*, as amended from time to time states that standard operational unit processes such as backwashing, chemical cleaning, and integrity testing may be problematic if it becomes necessary to conduct these processes more frequently than was planned. The effect can be more pronounced for smaller systems with fewer membrane treatment units. As well, filter redundancy is an industry-wide practice that helps ensure that a safe and a consistent quality and quantity of water is provided.

G.3.2 Membrane Treatment Units Used for Pathogen Reduction Credits

a. A minimum of two membrane treatment units are required in parallel to provide redundancy regardless of the design capacity of the system.

b. Where only two units are provided, each shall be capable of meeting the maximum daily design flow at the approved flux rate.

c. Where more than two membrane treatment units are provided, the maximum daily design flow shall be met with the largest unit out of service at the approved flux rate.

d. Design parameters established by manufacturer shall not be exceeded.

G.3.3 Integrated Membrane Systems

An integrated membrane system is one that incorporates microfiltration/ ultrafiltration (MF/UF) for pathogen reduction credits followed by nanofiltration/reverse osmosis (NF/RO) for the reduction of organics to reduce the formation of disinfection by-products.

Membrane treatment units used for pathogen reduction credits shall meet the requirements outlined G.3.2. In addition, the Approval Holder shall provide documentation that there will be no operational scenarios where the NF/RO system for organics reduction will be operated without pre-treatment by the MF/UF system for pathogen reduction unless stipulated in the Approval to Operate.

Membrane treatment units used for the reduction of organics shall meet the following requirements:

a. 0 to 1,000 m^3/d - one or two membrane treatment units may be provided.

   Where only one membrane treatment unit is provided, the following requirements shall apply:

   - a shelf spare shall be provided for the following equipment: pressure pump, pressure meter, transducer, pressure switches, conductivity meter, fuses and any other unique electrical device.
   - the unit shall be sized to meet 100% of the maximum daily design flow at the approved flux rate.

   Where two membrane treatment units are provided:

   - each unit may be sized to meet a minimum of 50% of the maximum daily design flow at the approved flux rate.

b. 1,001 to 2,000 m^3/d - a minimum of two membrane treatment units shall be provided. Each unit may be sized to meet a minimum of 50% of the maximum daily design flow at the approved flux rate.

c. Greater than 2,000 m^3/d - a minimum of two membrane treatment units shall be provided. Where only two units are provided, each shall be capable of meeting the maximum daily design flow at the approved flux rate. Where more than two membrane treatment units are provided, the maximum daily design flow shall be met with the largest unit out of service at the approved flux rate.

Regardless of the capacity of the membrane units, the design parameters set by the manufacturer shall not be exceeded.

G.3.4 Challenge Testing

The objective of challenge testing is to demonstrate pathogen removal efficiency. It is intended to be a one-time, product-specific test to establish the maximum log reduction credit that the product is eligible to receive. Challenge testing involves seeding the feed water with an acceptable challenge particulate and measuring the log reduction in the concentration of the challenge particulate between the feed and filtrate. Testing shall be conducted on a full-scale membrane module or small-scale module that is identical in material and similar in construction as that used at the treatment facility.

The actual removal efficiency of a membrane shall be verified by third party challenge testing. This is a one-time product specific test and is not site-specific. Acceptable challenge testing shall follow that provided in the EPA *Membrane Filtration Guidance Manual*, as amended from time to time, or an acceptable equivalent. This documentation shall be provided to the Department upon request.

G.3.5 Direct Integrity Testing

The purpose of direct integrity testing is to verify the removal efficiency of a membrane filtration system on an ongoing basis during operation. This will verify that the membrane has no integrity breaches of a magnitude that would compromise the ability of the membrane to achieve the pathogen reduction required. Direct integrity testing is a physical test applied directly to the pathogen barrier associated with a membrane treatment unit (e.g. an individual train, skid, rack, stage, etc.) in order to identify and isolate integrity breaches.

Direct integrity testing is commonly accomplished using pressure-based tests or marker-based tests. As new types of direct integrity tests are developed in the future, they may be used provided the basic requirements for test resolution, sensitivity, and frequency can be satisfied.

G.3.6 Membrane Treatment Units Used for Pathogen Reduction Credits

The integrity of the membrane system and the actual removal efficiency of the membrane shall be demonstrated by direct integrity testing of the membrane under normal operating conditions. Direct integrity testing shall follow that outlined in the EPA *Membrane Filtration Guidance Manual*, as amended from time to time, or an acceptable equivalent.

Direct integrity testing shall be responsive to an integrity breach in the order of three micrometres or less.

Direct integrity testing shall be conducted on each membrane treatment unit at a frequency of no less than once each day that the unit is in operation. Less frequent testing may be approved if supported by demonstrated process reliability, the use of multiple barriers effective for cysts (*Giardia*), oocysts (*Cryptosporidium*) or viruses or reliable process safeguards.

G.3.7 Continuous Indirect Integrity Testing

The objective of continuous indirect integrity monitoring is to monitor a membrane filtrate system for significant integrity problems between direct integrity test applications. Indirect methods do not assess the integrity of the membrane barrier directly, but instead utilize water quality parameters as a surrogate to infer information about membrane integrity based on the levels of the monitored parameters relative to the known baseline in a fully integral system. Although indirect integrity monitoring is generally not as sensitive for detecting integrity breaches as the various direct methods, the indirect methods do have the advantage of being able to be applied to continuously monitor membrane filtrate quality during production, thus providing some means of assessing integrity between direct integrity test applications.

In addition to continuous turbidity monitoring, other methods of indirect testing include particle counting, particle monitoring, conductivity monitoring (for NF/RO systems), or others as deemed acceptable by the Department.

G.3.8 Membrane Treatment Units Used for Pathogen Reduction Credits

All membranes shall have continuous indirect integrity testing. Indirect integrity testing shall follow that outlined in the EPA *Membrane Filtration Guidance Manual*, as amended from time to time, or an acceptable equivalent.

Continuous indirect integrity testing shall be conducted at a minimum frequency of once every 5 minutes.

G.3.9 Integrated Membrane Systems

Membrane treatment units used for pathogen reduction credits - shall meet the requirements outlined in G.3.2 above.

Membrane treatment units used for the reduction of organics – the Approval Holder shall have a means of verifying the rejection rate and rectifying any performance issues.

G.3.10 Turbidity

The treated water turbidity levels from individual membrane units shall be based on continuous measurements of turbidity, using an on-line turbidimeter, with results recorded at a minimum frequency of once every five minutes.

If turbidity exceeds 0.1 NTU for more than 15 minutes, direct integrity testing shall be immediately conducted on the membrane treatment unit. If the unit passes direct integrity testing, it may continue to be used for water treatment; if not, the unit shall be taken out of service.

G.3.11 Filter-to-waste

A “filter-to-waste” feature shall be provided for:

- Initial start-up and commissioning of the membrane system;
- Those systems that have to be tested on-line during production in the event of a membrane integrity breach; and
- Emergency diversion of water.

The filter-to-waste feature for membranes is to provide operational flexibility and therefore shall not have any filter ripening conditions associated with it in an Approval to Operate.

G.4 Management of Waste Streams

Waste streams that are generated from backwash and cleaning cycles shall be managed properly. The use of membrane technology produces the following waste streams:

- Filter backwash wastewater;
- Filter backwash solids;
- Clean-in-place chemical waste;
- Chemically enhanced backwash (CEB) wastewater and solids.

The Approval Holder should provide an estimate of the waste stream composition and concentrations. It should be noted that membrane treatment processes may concentrate naturally-occurring compounds such as metals, solids and radionuclides in the waste streams.

G.4.1 Filter Backwash Water

The Approval Holder shall manage filter backwash water in accordance with Part V, Section 2.

G.4.2 Filter Backwash Solids

The Approval Holder shall manage filter backwash solids in accordance with Part V, Section 1.

G.4.3 Clean-in-place (CIP) Chemical Waste

Membranes require periodic chemical cleaning, which involves re-circulating cleaning chemicals and scouring the membrane surface, to reduce fouling. CIP chemical wastes shall be disposed in a manner that is acceptable to the Department. Neutralization of

cleaning solutions shall be provided including dechlorination such that the chlorine residual concentration shall not exceed 0.02 mg/l and adjustment of pH such that the pH is within a range of 6.5 to 9.0 (unless background values are outside this range in which case pH shall be within 0.2 of background). The CIP chemical waste stream may be neutralized in the process tank where CIP has taken place or transferred to a holding tank until neutralization has occurred.

G.4.4 Chemically Enhanced Backwash (CEB) Wastewater and Solids

Membranes may require periodic enhanced backwash, which involves injecting chlorine, caustic, or acid during a filter backwash cycle to improve, and lengthen cycles before CIP is required. CEB wastewater shall meet the requirements outlined in G.4.1 and G.4.3. CEB solids shall meet the requirements outlined in G.4.2.

Appendix 9-H

APPENDIX H

Minimum Sampling Requirements based on Source Water Type

Table of Contents

H1 Sampling Requirements for Municipal Public Drinking Water Supplies using Surface Water

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Turbidity		
Turbidity	Raw water	Continuous at no more than 5 minute intervals or daily grab
	Individual filter effluent	Continuous at no more than 5 minute intervals
	Filtered water directed to waste	Continuous at no more than 5 minute intervals or grab sample during filter-to-waste
	Distribution system sample points	Weekly grab sample
Primary Disinfection (Note: Parameters to be monitored depend on the disinfection method used)		
Free Chlorine		
Free Chlorine Residual	CT control point (water entering distribution system)	Continuous at no more than 5 minute intervals – must meet CT design criteria
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals - must meet CT design criteria
UV		
UV (IT)	UV chamber	Continuous at no more than 5 minute intervals – minimum UV dose of 40 mJ/cm^2 unless an alternate dose accepted by the Department.

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Chlorine Dioxide		
Chlorine Dioxide	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria
Ozone		
Ozone	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria
	Air Quality (off-gas destruct unit)	Continuous at no more than 5 minute intervals* *Should be interlocked with the ozone generator controls to shut down system if excess ozone is detected
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Secondary Disinfection (Note: Parameters to be monitored depend on the disinfection method used)		
Free Chlorine		
Free Chlorine Residual	Storage structure outlet	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Chloramines		
Combined Chlorine Residual	Storage structure outlet	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Microbial Quality		
Total Coliforms and *E. coli* (present/absent)	Water entering the distribution system	Weekly grab sample
	Distribution system sample points	Weekly grab sample
Viruses	Raw water	As requested by the Department
	Water distribution system	As requested by the Department
Giardia and Cryptosporidium	Raw water	As requested by the Department
	Water distribution system	As requested by the Department
Cyanobacteria	Raw water	Visual monitoring at least weekly for evidence of bloom formation from May to October.

<table>
<tr><th>Water Quality Parameters</th><th>Sample Location</th><th>Minimum Sampling Frequency</th></tr>
<tr><td rowspan="2">Cyanobacterial toxins - Total Microcystins</td><td>Raw water</td><td>During a bloom

Minimum of every 5 years as part of full health-related parameter suite (during warmest month)</td></tr>
<tr><td>Treated water</td><td>During a bloom

Minimum of every 5 years as part of full health-related parameter suite (during warmest month)</td></tr>
<tr><td colspan="3">Corrosion Monitoring Program</td></tr>
<tr><td>pH
Alkalinity
Conductivity
Temperature
Chlorine or chloramine residual
Corrosion inhibitor residual (if used)</td><td>Point of entry and representative locations within the distribution system based on population served:

<table><tr><td>Population Served</td><td># of distribution samples</td></tr><tr><td><100</td><td>1</td></tr><tr><td>101-500</td><td>2</td></tr><tr><td>501-3,300</td><td>3</td></tr><tr><td>3,301-10,000</td><td>4</td></tr><tr><td>10,001-100,000</td><td>6</td></tr><tr><td>>100, 000</td><td>10</td></tr></table></td><td>Quarterly grab sample</td></tr>
<tr><td>Lead and Copper</td><td colspan="2">As per the “Requirements for Lead and Copper Management Municipal Public Drinking Water Supplies”</td></tr>
</table>

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Process Control		
Water Volume	Raw water entering facility	Continuous at no more than 5 minute intervals -must meet CT/IT design criteria
Free ammonia (as N) – for facilities using chloramination	Select distribution system sample point(s)* *Sampling points should include distribution system storage and dead ends	Weekly
Nitrate/nitrite (as N) – for facilities using chloramination	Select distribution system sample point(s)* *Sampling points should include distribution system storage and dead ends	Weekly
Fluoride – for facilities that add fluoride	Water entering the distribution system	Daily
Disinfection By-products		
Total Trihalomethanes (THMs)	Select distribution system sample point(s) – representative of highest level. Areas in the distribution system with the longest disinfectant retention time.	Quarterly - locational running annual average (lraa) based on a minimum of 4 quarterly samples.
Haloacetic Acids (HAAs)	Select distribution system sample point(s) – where historical data show the highest concentration. Where historical data is not available concentrations shall be monitored in the middle and extremities of the distribution system.	Quarterly - locational running annual average (lraa) based on a minimum of 4 quarterly samples.
Chlorate and chlorite – if using chlorine dioxide	Select distribution system sample point(s) – mid-system and end locations	Quarterly
Chlorate – if storing sodium hypochlorite more than 3 months	Water entering distribution system	Quarterly

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Bromate – if using ozone	Select distribution system sample point(s) – water entering distribution system	Monthly
Bromate – if storing sodium hypochlorite more than 3 months	Water entering distribution system	Quarterly
N-Nitrosodimethylamine (NDMA) – if using chloramines for secondary disinfection	Water entering distribution system and far-point in distribution system	Quarterly
N-Nitrosodimethylamine (NDMA) – chlorinated systems	Water entering distribution system.	Quarterly * *After four quarterly samples collected over a year period the Approval Holder may request a reduction to annual sampling if NDMA is not detected in the treated water.

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Treatment Process - Backwash Wastewater Parameters, locations and frequencies in accordance with this standard, the operating approval and the accepted annual monitoring program.		
General Chemical and Physical Quality		
General chemical and physical parameters listed in the Guidelines for Monitoring Public Drinking Water Supplies Part I	Raw and treated water	Minimum annually
Manganese	Raw water (prior to treatment) Entering the distribution system Distribution system	Quarterly * The Approval Holder may request a reduction in sample frequency if it is determined that manganese is not a parameter of concern for the water supply.
Guidelines for Canadian Drinking Water Quality		
All health-related parameters in the Guidelines for Canadian Drinking Water Quality	Raw and treated water	Every 5 years unless system assessment report or source water protection plan requires more frequent monitoring.
Source Water Protection		
Parameters as per the source water protection monitoring program	Locations and frequencies in accordance with the source water protection monitoring program.	

H2 Sampling Requirements for Municipal Public Drinking Water Supplies using GUDI Sources not Assigned a Department-Accepted Natural Filtration Log Credit

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Turbidity		
Turbidity	Raw water	Continuous at no more than 5 minute intervals or daily grab
	Individual filter effluent	Continuous at no more than 5 minute intervals
	Filtered water directed to waste	Continuous at no more than 5 minute intervals or grab sample during filter-to-waste
	Distribution system sample points	Weekly grab sample
Primary Disinfection (Note: Parameters to be monitored depend on the disinfection method used)		
Free Chlorine		
Free Chlorine Residual	CT control point (water entering the distribution system)	Continuous at no more than 5 minute intervals – must meet CT design criteria
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria
UV		
UV (IT)	UV chamber	Continuous at no more than 5 minute intervals – minimum UV dose of 40mJ/cm^2 unless alternate dose has been accepted by the Department
Chlorine Dioxide		
Chlorine Dioxide	CT control point	Continuous at no more than

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
		5 minute intervals – must meet CT design criteria
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab- must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals – must meet cT design criteria
Ozone		
Ozone	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria
	Air Quality (off-gas destruct unit)	Continuous at no more than 5 minute intervals* *Should be interlocked with the ozone generator controls to shut down system if excess ozone is detected
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Secondary Disinfection (Note: Parameters to be monitored depend on the disinfection method used)		
Free Chlorine		
Free Chlorine Residual	Storage structure outlet	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Chloramines		
Combined Chlorine Residual	Storage structure outlet	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Microbial Quality		
Total Coliforms and *E. coli* (present/absent) * During the GUDI assessment if water is distributed for consumption twice weekly sampling is required for water entering the distribution system and distribution system sample points.	Water entering the distribution system	Weekly grab sample
	Distribution system sample points	Weekly grab sample
	Raw water from individual well(s)	As requested by the Department
Viruses	Raw water	As requested by the Department
	Water distribution system	As requested by the Department
Giardia and Cryptosporidium	Raw water	As requested by the Department
	Water distribution system	As requested by the Department

<table>
<tr><th>Water Quality Parameters</th><th>Sample Location</th><th>Minimum Sampling Frequency</th></tr>
<tr><td colspan="3">Corrosion Monitoring Program</td></tr>
<tr><td>pH
Alkalinity
Conductivity
Temperature
Chlorine or chloramine residual
Corrosion inhibitor residual (if used)</td><td>Point of entry and representative locations within the distribution system based on population served:
<table><tr><th>Population Served</th><th># of distribution samples</th></tr><tr><td><100</td><td>1</td></tr><tr><td>101-500</td><td>2</td></tr><tr><td>501-3,300</td><td>3</td></tr><tr><td>3,301-10,000</td><td>4</td></tr><tr><td>10,001-100,000</td><td>6</td></tr><tr><td>>100, 000</td><td>10</td></tr></table></td><td>Quarterly grab sample</td></tr>
<tr><td>Lead and Copper</td><td colspan="2">As per the “Requirements for Lead and Copper Management Municipal Public Drinking Water Supplies”</td></tr>
<tr><td colspan="3">Process Control</td></tr>
<tr><td>Water Volume</td><td>Raw water entering facility</td><td>Continuous at no more than 5 minute intervals- must meet CT/IT design criteria.</td></tr>
<tr><td>Free ammonia (as N) – for facilities using chloramination</td><td>Select distribution system sample point(s)*

*Sampling points should include distribution system storage and dead ends</td><td>Weekly</td></tr>
<tr><td>Nitrate/nitrite (as N) – for facilities using chloramination</td><td>Select distribution system sample point(s)*

* Sampling points should include distribution system storage and dead ends</td><td>Weekly</td></tr>
<tr><td>Fluoride – for facilities that add fluoride</td><td>Water entering the distribution system</td><td>Daily</td></tr>
</table>

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Disinfection By-products		
Total Trihalomethanes (THMs)	Select distribution system sample point(s) – representative of highest level. Areas in the distribution system with the longest disinfectant retention time.	Quarterly - locational running annual average (lraa) based on a minimum of 4 quarterly samples.
Haloacetic Acids (HAAs)	Select distribution system sample point(s) – where historical data show the highest concentration. Where historical data is not available concentrations shall be monitored in the middle and extremities of the distribution system.	Quarterly - locational running annual average (lraa) based on a minimum of 4 quarterly samples.
Chlorate and chlorite – if using chlorine dioxide	Select distribution system sample point(s) – mid-system and end locations	Quarterly
Chlorate – if storing sodium hypochlorite more than 3 months	Water entering distribution system	Quarterly
Bromate – if using ozone	Select distribution system sample point(s) – water entering distribution system	Monthly
Bromate – if storing sodium hypochlorite more than 3 months	Water entering distribution system	Quarterly
N-Nitrosodimethylamine (NDMA) – if using chloramines for secondary disinfection	Water entering distribution system and far-point in distribution system	Quarterly

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
N-Nitrosodimethylamine (NDMA) – chlorinated systems	Water entering distribution system.	Quarterly * * After four quarterly samples collected over a year period the Approval Holder may request a reduction to annual sampling if NDMA is not detected in the treated water.
Treatment Process Backwash Water Parameters, locations and frequencies in accordance with this standard, the operating approval and the accepted annual monitoring program.		
General Chemical and Physical Quality		
General chemical and physical parameters listed in the Guidelines for Monitoring Public Drinking Water Supplies Part I	Raw and treated water	Minimum annually
Manganese	Raw water (prior to treatment) Entering the distribution system Distribution system	Twice per year (spring and fall) Quarterly Quarterly * The Approval Holder may request a reduction in sample frequency, if it is determined that manganese is not a parameter of concern for the water supply.

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Guidelines for Canadian Drinking Water Quality		
All health-related parameters in the Guidelines for Canadian Drinking Water Quality	Raw and treated water	Every 5 years unless system assessment report or source water protection plan requires more frequent monitoring
Source Water Protection		
Parameters as per the source water protection monitoring program	Locations and frequencies in accordance with the source water protection monitoring program.	

H3 Sampling Requirements for Municipal Public Drinking Water Supplies using Medium Risk and Low Risk GUDI Sources with a Department-Accepted Natural Filtration Log Credit

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Turbidity		
Turbidity	Individual GUDI well (at wellhead)	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Primary Disinfection (Note: Parameters to be monitored depend on the disinfection method used)		
Free Chlorine		
Free Chlorine Residual	CT control point (water entering the distribution system)	Continuous at no more than 5 minute intervals – must meet CT design criteria
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals or daily grab– must meet CT design criteria
UV		
UV (IT)	UV chamber	Continuous at no more than 5 minute intervals. Minimum UV dose of 40mJ/cm^2 is required unless alternate dose has been accepted by the Department

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Chlorine Dioxide		
Chlorine Dioxide	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
Ozone		
Ozone	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria
	Air Quality (off-gas destruct unit)	Continuous at no more than 5 minute intervals* *Should be interlocked with the ozone generator controls to shut down system if excess ozone is detected
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Secondary Disinfection (Note: Parameters to be monitored depend on disinfection method used)		
Free Chlorine		
Free Chlorine Residual	Storage structure outlet	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Chloramines		
Combined Chlorine Residual	Storage structure outlet	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Microbial Quality		
Total Coliforms and *E. coli* (present/absent) * During the GUDI assessment if water is distributed for consumption twice weekly sampling is required for water entering the distribution system and distribution system sample points.	Water entering the distribution system	Weekly grab sample
	Distribution system sample points	Weekly grab sample
	Raw water from individual well(s)	As requested by the Department
Microscopic Particulate Analysis (MPA)	Raw water from each individual GUDI well	Every two years as per GUDI Protocol (Appendix A)
Viruses	Raw water	As requested by the Department
	Water distribution system	As requested by the Department
Giardia and Cryptosporidium	Raw water	As requested by the Department
	Water distribution system	As requested by the Department

<table>
<tr><th>Water Quality Parameters</th><th>Sample Location</th><th>Minimum Sampling Frequency</th></tr>
<tr><td colspan="3">Corrosion Monitoring Program</td></tr>
<tr><td>pH
Alkalinity
Temperature
Conductivity
Chlorine or chloramine residual
Corrosion inhibitor residual (if used)</td><td>Point of entry and representative locations within the distribution system based on population served:
<table><tr><th>Population Served</th><th># of distribution samples</th></tr><tr><td><100</td><td>1</td></tr><tr><td>101-500</td><td>2</td></tr><tr><td>501-3,300</td><td>3</td></tr><tr><td>3,301-10,000</td><td>4</td></tr><tr><td>10,001-100,000</td><td>6</td></tr><tr><td>>100, 000</td><td>10</td></tr></table></td><td>Quarterly grab sample</td></tr>
<tr><td>Lead and Copper</td><td colspan="2">As per the “Requirements for Lead and Copper Management Municipal Public Drinking Water Supplies”</td></tr>
</table>

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Process Control		
Water Volume	Each individual well	Continuous at no more than five minute intervals - must meet CT/IT design criteria.
Free ammonia (as N) – for facilities using chloramination	Select distribution system sample point(s)* *Sampling points should include distribution system storage and dead ends	Weekly
Nitrate/nitrite (as N) – for facilities using chloramination	Select distribution system sample point(s)* *Sampling points should include distribution system storage and dead ends	Weekly
Fluoride – for facilities that add fluoride	Water entering the distribution system	Daily
Disinfection By-products		
Total Trihalomethanes (THMs)	Select distribution system sample point(s) – representative of highest level. Areas in the distribution system with the longest disinfectant retention time.	Quarterly - locational running annual average (lraa) based on a minimum of 4 quarterly samples.
Haloacetic Acids (HAAs)	Select distribution system sample point(s) – where historical data show the highest concentration. Where historical data is not available concentrations shall be monitored in the middle and extremities of the distribution system.	Quarterly - locational running annual average (lraa) based on a minimum of 4 quarterly samples.
Chlorate and chlorite – if using chlorine dioxide	Select distribution system sample point(s) – mid-system and end locations	Quarterly
Chlorate – if storing sodium hypochlorite more than 3 months	Water entering distribution system	Quarterly

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Bromate – if using ozone	Select distribution system sample point(s) – water entering distribution system	Monthly
Bromate – if storing sodium hypochlorite more than 3 months	Water entering distribution system	Quarterly
N-Nitrosodimethylamine (NDMA) – if using chloramines for secondary disinfection	Water entering distribution system and far-point in distribution system	Quarterly

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Treatment Process Backwash Wastewater Parameters, locations, and frequencies in accordance with this standard, the operating approval and the accepted annual monitoring program.		
General Chemical and Physical Quality		
General chemical and physical parameters listed in the Guidelines for Monitoring Public Drinking Water Supplies Part I	Raw and treated water	Minimum annually
Manganese	Raw water (prior to treatment) Entering the distribution system Distribution system	• Twice per year (spring and fall) • Quarterly • Quarterly * The Approval Holder may request a reduction in sample frequency, if it is determined that manganese is not a parameter of concern for the water supply.
Guidelines for Canadian Drinking Water Quality		
All health-related parameters in the Guidelines for Canadian Drinking Water Quality	Raw and treated water	Every 5 years unless system assessment report or source water protection plan requires more frequent monitoring.
Source Water Protection		
Parameters as per the source water protection monitoring program	Locations and frequencies in accordance with the source water protection monitoring program.	

H4 Sampling Requirements for Municipal Public Drinking Water Supplies using Non-GUDI Sources

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Turbidity		
Turbidity	At individual wellheads or the combined flow	Continuous at no more than 5 minute intervals or daily grab sample.
	Distribution system sample points	Weekly grab sample
Primary Disinfection (Note: Parameters to be monitored depend on the disinfection method used)		
Free Chlorine		
Free Chlorine Residual	CT control point (water entering the distribution system)	Continuous at no more than 5 minute intervals – must meet CT design criteria
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals or daily grab– must meet CT design criteria
UV		
UV (IT)	UV chamber	Continuous at no more than 5 minute intervals. Minimum UV dose of 40mJ/cm^2 is required unless an alternate dose has been accepted by the Department

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Chlorine Dioxide		
Chlorine Dioxide	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals or daily grab– must meet CT design criteria
Ozone		
Ozone	CT control point	Continuous at no more than 5 minute intervals – must meet CT design criteria
	Air Quality (off-gas destruct unit)	Continuous at no more than 5 minute intervals* *Should be interlocked with the ozone generator controls to shut down system if excess ozone is detected
Temperature	CT control point	Continuous at no more than 5 minute intervals or daily grab – must meet CT design criteria
pH	CT control point	Continuous at no more than 5 minute intervals or daily grab– must meet CT design criteria

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Secondary Disinfection (Note: Parameters to be monitored depend on the disinfection method used)		
Free Chlorine		
Free Chlorine Residual	Storage structure outlet	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Chloramines		
Combined Chlorine Residual	Storage structure outlet	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Microbial Quality		
Total coliforms and *E. coli* (present/absent) * During the GUDI assessment if water is distributed for consumption twice weekly sampling is required for water entering the distribution system and distribution system sample points.	Distribution system sample points	Weekly grab sample
	Raw water from individual well(s)	As requested by the Department
Viruses	Raw water	As requested by the Department
	Water distribution system	As requested by the Department

<table>
<tr><th>Water Quality Parameters</th><th>Sample Location</th><th>Minimum Sampling Frequency</th></tr>
<tr><td colspan="3">Corrosion Monitoring Program</td></tr>
<tr><td>pH
Alkalinity
Conductivity
Temperature
Chlorine or chloramine residual
Corrosion inhibitor residual (if used)</td><td>Point of entry and representative locations within the distribution system based on population served:
<table><tr><th>Population Served</th><th># of distribution samples</th></tr><tr><td><100</td><td>1</td></tr><tr><td>101-500</td><td>2</td></tr><tr><td>501-3,300</td><td>3</td></tr><tr><td>3,301-10,000</td><td>4</td></tr><tr><td>10,001-100,000</td><td>6</td></tr><tr><td>>100, 000</td><td>10</td></tr></table></td><td>Quarterly grab sample</td></tr>
<tr><td>Lead and Copper</td><td colspan="2">As per the “Requirements for Lead and Copper Management Municipal Public Drinking Water Supplies”</td></tr>
</table>

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Process Control		
Water Volume	Each individual well	Continuous at no more than 5 minute intervals. Must meet CT/IT design criteria.
Free ammonia (as N) – for facilities using chloramination	Select distribution system sample point(s)* *Sampling points should include distribution system storage and dead ends	Weekly
Nitrate/nitrite (as N) – for facilities using chloramination	Select distribution system sample point(s)* *Sampling points should include distribution system storage and dead ends	Weekly
Fluoride – for facilities that add fluoride	Water entering the distribution system	Daily
Disinfection By-products		
Total Trihalomethanes (THMs)	Select distribution system sample point(s) – representative of highest level. Areas in the distribution system with the longest disinfectant retention time.	Quarterly*- locational running annual average (lraa) based on a minimum of 4 quarterly samples. * The Approval Holder may request a reduction in sample frequency to annual, if the lraa based on a minimum of four quarterly samples collected from each location is < 0.010mg/L.

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Haloacetic Acids (HAAs)	Select distribution system sample point(s) – where historical data show the highest concentration. Where historical data is not available concentrations shall be monitored in the middle and extremities of the distribution system.	Quarterly* - locational running annual average (lraa) based on a minimum of 4 quarterly samples. * The Approval Holder may request a reduction in sample frequency to annual, if the lraa based on a minimum of four quarterly samples collected from each location is < 0.010mg/L
Chlorate and chlorite – if using chlorine dioxide	Select distribution system sample point(s) – mid-system and end locations	Quarterly
Chlorate – if storing sodium hypochlorite more than 3 months	Water entering distribution system	Quarterly
Bromate – if using ozone	Select distribution system sample point(s) – water entering distribution system	Monthly
Bromate – if storing sodium hypochlorite more than 3 months	Water entering distribution system	Quarterly
N-Nitrosodimethylamine (NDMA) – if using chloramines for secondary disinfection	Water entering distribution system and far-point in distribution system	Quarterly

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Treatment Process Backwash Wastewater If required, parameters, locations and frequencies in accordance with this standard, the operating approval and the accepted annual monitoring program.		
General Chemical and Physical Quality		
General chemical and physical parameters listed in the Guidelines for Monitoring Public Drinking Water Supplies Part I	Raw and treated water	Minimum every two-years
Manganese	Raw water (prior to treatment) Entering the distribution system Distribution system	Twice per year (spring and fall) Quarterly Quarterly * The Approval Holder may request a reduction in sample frequency, if it is determined that manganese is not a parameter of concern for the water supply.
Guidelines for Canadian Drinking Water Quality		
All health-related parameters in the Guidelines for Canadian Drinking Water Quality	Raw and treated water	Every 5 years unless system assessment report or source water protection plan requires more frequent monitoring.
Source Water Protection		
Parameters as per the source water protection monitoring program	Locations and frequencies in accordance with the source water protection monitoring program.	

H5 Sampling Requirements for Municipal Public Drinking Water Supplies that Distribute Water Only

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
Turbidity		
Turbidity	Distribution system sample points	Weekly grab sample
Secondary Disinfection (Note: Parameters to be monitored depend on disinfection method used)		
Free Chlorine		
Free Chlorine Residual	Water Entering Distribution System	Continuous at no more than 5 minute intervals
	Storage structure outlet	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Chloramines		
Combined Chlorine Residual	Water Entering Distribution System	Continuous at no more than 5 minute intervals
	Storage structure outlet	Continuous at no more than 5 minute intervals
	Distribution system sample points	Weekly grab sample
Microbial Quality		
Total coliforms and *E. coli* (present/absent)	Distribution system sample points	Weekly grab sample
Viruses	Raw water	As requested by the Department
	Water distribution system	As requested by the Department

<table>
<tr><th>Water Quality Parameters</th><th>Sample Location</th><th>Minimum Sampling Frequency</th></tr>
<tr><td>Giardia and Cryptosporidium</td><td>Raw water</td><td>As requested by the Department</td></tr>
<tr><td></td><td>Water distribution system</td><td>As requested by the Department</td></tr>
<tr><td colspan="3">Corrosion Monitoring Program</td></tr>
<tr><td>pH
Alkalinity
Conductivity
Temperature
Chlorine or chloramine residual
Corrosion inhibitor residual (if used)</td><td>Entering distribution system and representative locations within the distribution system based on population served:

<table><tr><th>Population Served</th><th># of distribution samples</th></tr><tr><td><100</td><td>1</td></tr><tr><td>101-500</td><td>2</td></tr><tr><td>501-3,300</td><td>3</td></tr><tr><td>3,301-10,000</td><td>4</td></tr><tr><td>10,001-100,000</td><td>6</td></tr><tr><td>>100, 000</td><td>10</td></tr></table></td><td>Quarterly grab sample</td></tr>
<tr><td>Lead and Copper</td><td colspan="2">As per the “Requirements for Lead and Copper Management Municipal Public Drinking Water Supplies”</td></tr>
<tr><td colspan="3">Process Control</td></tr>
<tr><td>Water Volume</td><td>Entering distribution system</td><td>Continuous at no more than 5 minute intervals</td></tr>
<tr><td>pH</td><td>Entering distribution system</td><td>Continuous at no more than 5 minute intervals or daily grab</td></tr>
<tr><td>Free ammonia (as N) – for facilities using chloramination</td><td>Select distribution system sample point(s)*

*Sampling points should include distribution system storage and dead ends</td><td>Weekly</td></tr>
<tr><td>Nitrate/nitrite (as N) – for facilities using chloramination</td><td>Select distribution system sample point(s)*

*Sampling points should include distribution system</td><td>Weekly</td></tr>
</table>

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
	storage and dead ends	
Disinfection By-products		
Total Trihalomethanes (THMs)	Select distribution system sample point(s) – representative of highest level. Areas in the distribution system with the longest disinfectant retention time.	Quarterly - locational running annual average (lraa) based on a minimum of 4 quarterly samples. * If the Approval Holder of the supply where treated water is purchased received a reduction in sampling frequency to annual from the Department, the Approval Holder of the stand-alone distribution system may request a reduction in sample frequency to annual.
Haloacetic Acids (HAAs)	Select distribution system sample point(s) – where historical data show the highest concentration. Where historical data is not available concentrations shall be monitored in the middle and extremities of the distribution system.	Quarterly - locational running annual average (lraa) based on a minimum of 4 quarterly samples. * If the Approval Holder of the supply where treated water is purchased received a reduction in sample frequency from the Department to annual, the Approval Holder of the stand-alone distribution system may request a reduction in sample frequency to annual.
Chlorate and chlorite – if purchasing water from a treatment facility using chlorine dioxide	Mid-system and end locations of the distribution systems	Quarterly
Chlorate – if storing sodium hypochlorite more than 3 months	Water entering distribution system	Quarterly
Bromate – if purchasing water from a treatment facility using ozone	Water entering distribution system	Monthly
Bromate – if storing sodium hypochlorite more than 3 months	Water entering distribution system	Quarterly
N-Nitrosodimethylamine (NDMA) – if using chloramines for secondary	Water entering distribution system and far-point in distribution system	Quarterly

Water Quality Parameters	Sample Location	Minimum Sampling Frequency
disinfection		

General Chemical and Physical Quality		
General chemical and physical parameters listed in the Guidelines for Monitoring Public Drinking Water Supplies Part I	Select distribution system sample point(s)* *Sample location(s) shall be selected that are representative of the water distribution system.	Annual – for distribution systems served by surface water or GUDI sources. Every two years – for distribution systems served by non-GUDI groundwater sources.
Manganese	Select distribution system sample locations	Quarterly * The Approval Holder may request a reduction in sample frequency, if it is determined that manganese is not a parameter of concern in the treated water purchased for distribution.
Guidelines for Canadian Drinking Water Quality		
All health-related parameters in the Guidelines for Canadian Drinking Water Quality	As requested by the Department	As requested by the Department * The Approval Holder shall request a copy of the laboratory results from the treatment facility the water is obtained from and retain the results for a period of ten years.

Appendix 12-A

Appendix A

Sample Collection and Preservation - Microbiological Quality

Container

- Use a sterilized sample bottle containing sodium thiosulfate preservative (a chlorine neutralizer). Bottles are available from some local NSE offices, water quality laboratories, and from some hospitals. A list of approved laboratories is available on our website.
- Keep sample containers clean and free from contamination before and after collecting the sample. Do NOT open them prior to collecting the sample.
- Examine the sample bottle for cracks, a missing seal, or other signs that its sterility may be compromised. If any of these indications are found, discard the bottle and use a suitable one.
- Label the bottle with the water supply owner's name, location of the water source and/or sampling location, date, time, and the facility's approval number.

Flush the System

- Inspect the outside of the faucet. If water leaks around the outside of the faucet, select a different sampling site.
- Remove any aerators, strainers, attachments, or purification devices from the tap.
- If necessary, remove debris and sterilize the faucet outlet, for example by swabbing with a disinfecting wipe.
- DO NOT take samples from a flexible hose or garden hose or outside hose bib. Sample from the cold-water faucets only.
- Allow the water to run for a minimum of 5 minutes before collection. The intent is to remove stagnant water from the system and collect a sample that is representative of water in the distribution system, not the building.

Collect the Sample

- Record disinfectant residual. Normally free chlorine residual is measured; however, total chlorine residuals may be required on occasion. In either case, the chlorine residual should be recorded on the lab requisition form and be marked "F" or "T" to indicate free or total chlorine residual, respectively.
- Before taking the sample, reduce the tap flow rate to approximately the width of a pencil before taking the sample. The flow rate should be low enough to ensure that no splashing occurs as the container is filled. Do not adjust the flow rate while taking the sample. At sampling points where water runs continuously, do not adjust flow rate.

- While holding the sample container at the base, remove the seal around the cap before attempting to open the bottle.
- Remove the cap with the free hand. Be careful NOT TO TOUCH the inside of the bottle cap or bottle lip. Continue to hold the cap in one hand with the inside facing down while the bottle is being filled. Do NOT touch the interior of the cap or lay it down. Do NOT breathe on the bottle or cap.
- Do NOT rinse the bottle.
- Fill the bottle to the fill line. Do NOT allow the bottle to overflow. Carefully replace the cap.
- Complete the laboratory requisition form. Include all required information: approval number, sampling location, date, time, etc. and who took the sample. All water samples are to be analyzed for total coliform and *E. coli*.

Storage and Transport

- Samples shall be kept in a refrigerator or cooler with ice packs to maintain a temperature below 10°C until delivered to the lab. Samples should not be frozen.
- Transport the sample to the laboratory as soon as possible and within 24 hours of collection. Check ahead with the lab about day and/or time deadlines for sample acceptance to ensure meeting the 24-hour criterion.

Appendix 12-B

POLICY ON ACCEPTABLE CERTIFICATION OF LABORATORIES

NOVA SCOTIA
Environment and Labour

Approval Date: August 1, 2006 Effective Date: August 1, 2006

Approved By: Hon. Mark Parent, Minister

Version Control:	Replaces "Policy for the Accreditation of Laboratories" (November 30, 2000)

I. POLICY STATEMENT

Analytical results reported to Nova Scotia Environment and Labour (NSEL) shall be conducted by laboratories that meet the requirements of this policy. This document describes the requirements for laboratories to be considered acceptable by NSEL or by clients who submit analytical data to the department to fulfil data reporting requirements.

II. LEGISLATION

Section 8(2)(b) of the *Environment Act* states:

> **(2)** The Minister, for the purposes of the administration and enforcement of this Act, and after engaging in such public review as the Minister considers appropriate, shall
>
> > **(b)** establish and administer policies, programs, standards, guidelines, objectives, codes of practice, directives and approval processes pertaining to the protection and stewardship of the environment;

Section 23(1) of the *Environment Act* states:

> **(1)** Before accepting results from any laboratory, the Minister may require proof of acceptable certification of the laboratory.

III. POLICY OBJECTIVES

The objectives of this policy are to achieve the following:

- all analytical data generated or received by the department are reliable and are legally and technically defensible;
- analytical data from different sources and obtained at different times are of consistent quality and that Nova Scotia's analytical data are comparable to high quality analytical data from other jurisdictions;
- procedures are documented so that any anomalies, deficiencies or sources of error can be identified and addressed;
- the department receives full value when purchasing analytical services;
- approval holders and laboratories are given a clear indication of expectations; and
- the analytical data received by NSEL are consistent with national and international standards.

IV. APPLICATION

This Policy applies to:

- Laboratories providing environmental analytical services directly to NSEL;
- Persons responsible, consultants and their subcontractors submitting analytical data in support of terms and conditions of an approval, registration, order, release of substance reporting and remediation, contaminated site reports, regulations or legislation administered by NSEL.

V. POLICY DIRECTIVES

1. All analytical test results for bacteria in drinking water submitted to NSEL pursuant to the department's regulatory requirements shall be considered acceptable if conducted by one of the following:

    (a) Laboratory facilities accredited to ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Accreditation shall be granted to the laboratory by an agency that:

        (1) meets the requirements of ISO/IEC 17011, "Conformity Assessment - General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies"; and

(2) is a full member signatory to the International Laboratory Accreditation Cooperation.

(b) Laboratory facilities accredited by another agency recognized by NSEL to be equivalent to the requirements of ISO/IEC 17011.

2. All analytical test results for parameters other than bacteria in drinking water submitted to NSEL pursuant to the department's regulatory requirements shall be considered acceptable if conducted by one of the following:

(a) Laboratory facilities accredited to ISO/IEC 17025, "General Requirements for the Competence of Testing and Calibration Laboratories". Accreditation shall be granted to the laboratory by an agency that:

(1) meets the requirements of ISO/IEC 17011, "Conformity Assessment - General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies"; and
(2) is a full member signatory to the International Laboratory Accreditation Cooperation;

(b) Laboratory facilities accredited by another agency recognized by NSEL to be equivalent to the requirements of ISO/IEC 17011;

(c) Laboratory facilities maintaining an acceptable standard in a proficiency testing program conducted by the Canadian Association for Environmental Analytical Laboratories for all parameters being reported;

(d) Laboratory facilities maintaining an acceptable standard in proficiency or performance testing in another program considered acceptable to NSEL for all parameters being reported.

VI. POLICY GUIDELINES

NSEL may accept process data from on-line equipment or a laboratory that is not certified provided that:

1) the parameters are specified as a condition of an approval, registration, order, or NSEL approved monitoring program;

2) the approval holder establishes a quality assurance/quality control (QA/QC) program to validate measurements obtained from on-line equipment or for all analyses conducted by the non-certified laboratory for all process parameters specified in the approval, registration, order or NSEL approved monitoring program; and

3) the QA/QC program is acceptable to NSEL and a written statement to that effect is obtained prior to measurement and submission of analytical data.

NSEL may require that the QA/QC program include:

1) regular calibration and maintenance of on-line equipment;
2) retention and training of qualified technical staff;
3) participation in a proficiency testing program;
4) regular validation of results by an accredited laboratory.

VII. ACCOUNTABILITY

Managers are responsible for ensuring that staff are aware of and adhere to this policy.

VIII. INQUIRIES

Drinking water inquiries should be directed to:

- Supervisor, Drinking Water Management
  (902) 424-2378

All other inquiries should be directed to:

- Manager, Pollution Prevention
  (902) 424-2534

Dated: August 1, 2006

Original Signed by:
Hon. Mark Parent
Minister

Appendix 13-B

Appendix B

The Growth of Biofilm in a Water Works System

Introduction

Biofilm in a water works system refers to organic or inorganic surface deposits consisting of microorganisms, microbial products and debris. Biofilm may occur on interior pipe surfaces, in sediments, inorganic tubercles, suspended particles or virtually any substratum immersed in the aquatic environment. Biofilm may be evenly distributed or occur as sporadic random patches.

Public Health Significance

Portions of a biofilm lining the interior of a water pipe may periodically slough off into the passing water thereby seeding it with microorganisms contained in the biofilm. If such bacteria are coliforms, the occurrence must be considered a public health concern until it is proven that a treatment failure or contamination has not occurred. It is difficult to distinguish between a true biofilm event and an unexplained coliform occurrence. Determination of coliform contamination due to biofilm is usually a negative conclusion; that is, there are no observable coliforms in the treatment plant effluent, no identified breakdown in treatment barriers, no apparent cross-connection or other contamination of the water works system (breaks, construction, etc.). While a true coliform biofilm event may not in itself signal a public health risk, it may mask a real contamination event and therefore must be viewed with concern. The onus is on the owner to show that these coliform occurrences are a result of biofilm release into the water supply.

Characteristic of a Situation Where Biofilm May be the Cause of Bacteria Counts within a Water Works System

- No coliforms are detected in treatment plant effluent.
- Coliform bacteria persist in a water works system samples despite the maintenance of a disinfectant residual.
- Seasonal increase in coliform densities with highest recovery in warm summer months, decreasing in the fall.
- The duration of the coliform episode is prolonged for years.
- Growth of heterotrophic bacteria, detected using the heterotrophic plate count (HPC) method, frequently occurs before coliforms are detected.
- Coliform growth occurs as a randomized pattern in the water works system.
- Some predominant coliform species can be identified, such as Klebsiella, Enterobacter or Citrobacter.
- Coliform occurrence persists despite proper operation and maintenance practices being carried out, including: consistently maintaining positive pressure in the water works system; implementing aggressive cross-connection control; thoroughly flushing and disinfecting pipes after construction and repair; and providing efficient treatment.

Appendix 13-C

Appendix C

Draft Media Releases for Water Advisories

(Revise as necessary to fit specific circumstances)

a) Boil Water Advisory

Due to apparent contamination of the _____ public drinking water supply and the possibility of unsafe water, consumers are advised to boil all water for at least 1 minute, after it reaches a rolling boil, before drinking, preparing infant formulas, preparing juices and ice cubes, washing fruits and vegetables, cooking, dental hygiene or any other activity that may result in human consumption. This is to be done until further notice.

The water utility is doing all it can to determine the cause of the problem and to remedy it as quickly as possible. The water utility and Nova Scotia Environment are continuing to monitor the water quality closely and are working in close consultation.

Detailed instructions on water usage when a boil water advisory is in effect are available from the water utility or the local office of Nova Scotia Environment.

For further information regarding this notice call: _____

b) Do Not Consume Advisory

Due to water quality problems and the potential for unsafe water, residents of the _____ public drinking water supply are advised not to use their water for drinking, preparing infant formulas, preparing juices and ice cubes, washing fruits and vegetables, cooking, dental hygiene or any other activity that may result in human consumption. This is to be done until further notice. Boiling the water will not remove the contaminant.

The water utility is doing all it can to determine the cause of the problem and to remedy it as quickly as possible. The water utility is continuing to monitor the water quality closely and are working in close consultation with Nova Scotia Environment.

Detailed instructions on water usage when a “Do Not Consume” advisory is in effect are available from the water utility or the local office of Nova Scotia Environment

For further information regarding this notice call: _____

c) Do Not Use Advisory

Due to water quality problems and the potential for unsafe water, residents of the _____ public drinking water supply are advised not to use their water for any purpose that may result in human consumption such as drinking, preparing infant formulas, preparing juices and ice cubes, washing fruits and vegetables, cooking, and dental hygiene, or any other activity that may result in human consumption. Residents are also advised not to use the water for showering or bathing. This is to be done until further notice. Boiling the water will not remove the contaminant.

The water utility is doing all it can to determine the cause of the problem and to remedy it as quickly as possible. The water utility is continuing to monitor the water quality closely and are working in close consultation with Nova Scotia Environment.

Detailed instructions on water usage when a “do not use” advisory is in effect are available from the water utility or the local office of Nova Scotia Environment

For further information regarding this notice call: _____

Appendix 13-D

Appendix D

Instructions for Boiling and Disinfecting Tap Water During a Boil Advisory

During an advisory, it is essential that all water to be used for the following activities be boiled for at least one minute after it reaches a rolling boil:

- drinking;
- preparing infant formulas;
- preparing juices and ice cubes;
- washing fruits and vegetables;
- cooking;
- dental hygiene; or
- any other activity that may result in human consumption.

Holding water at a rolling boil for at least 1 minute will inactivate all waterborne pathogenic micro-organisms. Water can be boiled in a pot or kettle on a stove, an electric kettle without an automatic shut-off or in a microwave oven. If water is boiled in a microwave, it is advisable to include a glass rod or wooden or plastic stir stick.

Under most circumstances it is not necessary to boil water used for other household purposes. Adults, adolescents and older children may shower, bathe or wash using tap water but should avoid swallowing the water. Toddlers and infants should be sponge bathed. In non-outbreak situations, dishes and laundry may be washed in tap water, either by hand or by machine.

In the event of a waterborne outbreak as declared by the Medical Officer of Health, it may be necessary to advise the public to take additional precautions. In this situation, hands can continue to be washed with tap water utilizing proper handwashing technique, followed by the use of an alcohol-based hand sanitizer containing more than 60% alcohol. Alcohol based hand sanitizers should be rubbed into all areas of the hands until hands are dry. Hands should not be towel dried. If dishes are washed by hand they should be washed and rinsed in hot tap water, soaked in a dilute solution of household bleach (20 mL of unscented bleach in 10 L of water) for one minute and air dried. Alternatively, dishwashers with a hot water (final rinse temp 82°C) or sanitizing cycle will disinfect dishes. During an outbreak, it is advisable to provide pets with boiled water that has been cooled as they can transmit waterborne disease organisms to humans.

Additional instructions for businesses, institutions, manufacturing plants or health care facilities that may have special requirements when a boil water advisory is in effect are provided in Appendix E.

Appendix 13-E

Appendix E

Users That Must Take Particular Precautions During A Boil Advisory

a) Commercial Establishments (Restaurants, Hotels, etc.)

- All water that is to be provided directly to customers for drinking purposes must be treated by boiling the tap water for at least 1 minute, after it reaches a rolling boil, and then storing the water in clean, covered containers until used for serving. An alternative to this would be using commercially available "bottled water" from a supplier who is a member of the Canadian Bottled Water Association (CBWA) or the International Bottled Water Association (IBWA). Commercial coffee machines that achieve boiling temperatures as part of their design are exempt (see Notes).
- All foods (e.g. fruits and vegetables) that need washing are to be rinsed or soaked in tap water that has been boiled for at least 1 minute, after it reaches a rolling boil. An alternative to this would be using commercially available "bottled water" from a supplier who is a member of the Canadian Bottled Water Association (CBWA) or the International Bottled Water Association (IBWA).
- Tap water used as an ingredient in any food product that will be "ready to eat" without cooking (e.g. drink mixes, pudding, jellos, etc.) must be boiled for at least 1 minute, after it reaches a rolling boil. An alternative to this would be using commercially available "bottled water" from a supplier who is a member of the Canadian Bottled Water Association (CBWA) or the International Bottled Water Association (IBWA).
- Ensure that food handlers wash and rinse hands in water that has been treated with chlorine bleach.
- It is not necessary for bakeries to boil water that is part of a recipe or ingredient in a product that is to be baked. Water for other uses must be boiled.
- Disconnect ice machines and discard any ice and crushed ice products that has been made from this ice. All ice used during the boil water advisory must originate from tap water that has been boiled for at least 1 minute, after it reaches a rolling boil, or from a commercial ice supply distributor. Ice machines at the establishment must be emptied and not used for the duration of the boil water advisory. Lines to ice machines must be disinfected prior to reuse.
- All soft drink beverage lines connected directly to tap water for mixing must be disconnected for the duration of the boil water advisory. Use bottled water or canned beverages exclusively. Lines to soft drink canisters must be disinfected prior to reuse.
- Disconnect water vending machines unless the water is treated by an approved method. Disinfect lines prior to reuse.
- Disconnect vegetable spraying/sprinkler supplies. Disinfect lines prior to reuse.
- Commercial dishwashers that use hot water 82°C or above are considered satisfactory. Beverage glass washers that utilize a "cold" water rinse must not be used unless the rinse water can be changed to use hot water 82°C or above. For manually washed dishes, it is important that the sanitizer concentration be a minimum of 100 parts per million of chlorine. It is also important that dishes are allowed to air dry. Do not rinse with tap water.

- Use boiled water in all other uses in the kitchen such as washing and sanitizing cutting boards, counter tops, etc.
- All employees reporting that they are suffering from a diarrheal illness must be excluded from work and should be tested by their family doctor. They are not to return to work until symptoms have subsided. Good hand washing should be emphasized for all staff.

Notes:

Commercial coffee brewers generally operate at a brew temperature of 88°C - 90°C with this temperature being maintained in the water tank. Brewing is achieved by displacement of the hot water with cold water within the tank. The temperature attained by the hot water will control bacterial and protozoic organisms of concern during a boil water advisory. The temperature of the water should be verified using a metal stem probe thermometer by running a full cycle of the brewer with water, taking the temperature at a point below the funnel when the decanter is half full. The temperature at this point should be 72°C or higher.

The decanter used for filling the brewer with water should not be used for receiving the coffee before being washed and sanitized.

This exemption is not applicable to non-commercial or domestic type coffee brewers as there may be wide variations of temperatures in these machines.

Upon rescinding of a boil water advisory:

- Re-start and flush any water-using fixture or piece of equipment in accordance with the manufacturer's specifications. This may vary from fixture to fixture. Consult your facility engineer and/or manufacturer when restarting the equipment.
- Managers of large buildings with water-holding reservoirs should consult with their facility engineer about draining the reservoir.
- Follow the directions of your water utility or, as general guidance, run cold water faucets and drinking fountains for 3 minutes each.
- Run water softeners through a regeneration cycle.
- Drain and refill hot water heaters if set at a low temperature (below 64.2°C) taking all necessary precautions to avoid electrical shocks.
- Consult your facility engineer regarding pool and/or whirlpool operations.

b) Food Production

- **Dairy Plants** - The contaminated water must not contact products following the pasteurization procedure and water used in clean-in-place procedures and in cleaning of product related equipment must be properly chlorinated.
- **Bottling Plants** - Pre-superchlorination and chlorine removal must be a part of production procedure.
- **Ice Making** - It is prohibited to make ice for domestic purposes or for cooling or preservation of food for the duration of the boil water advisory unless the water has undergone proper treatment to inactivate microbial pathogens.

c) Hospitals, Clinics, Long Term Care Facilities, Nursing Homes, etc.

- Boil water or use an acceptable alternate potable water supply in all applications of tap water intended for human consumption or treatment procedures where a risk of infection is possible. **Assess all water usage in consultation with infection control personnel.**
- Patients and employees should not consume tap water that has not been disinfected, ice or drinks made with tap water that has not been disinfected, or raw foods rinsed with tap water that has not been disinfected.
- Disconnect ice machines and discard any ice and crushed ice products that have been made from this ice. All ice used during the boil water advisory must originate from tap water that has been boiled for at least 1 minute, after it reaches a rolling boil, or from a commercial ice supply distributor. Ice machines at the establishment must be emptied and not used for the duration of the boil water advisory. Lines to ice machines must be disinfected prior to reuse.
- For other food preparation and hand washing guidance, refer to the information provided under paragraph a) "commercial establishments".
- Disinfect water by:
  - Boiling at a rapid, rolling boil for 1 minute; or
  - Filtering through a reverse osmosis filter, an "absolute 1 micron" filter.
- An alternate to this would be using commercially available "bottled water" from a supplier who is a member of the Canadian Bottled Water Association (CBWA) or the International Bottled Water Association (IBWA).
- All employees reporting that they are suffering from a diarrheal illness must be excluded from work and should be tested by their family doctor. They are not to return to work until symptoms have subsided. Good hand washing should be emphasized for all staff.
- Restrict burn patients and patients with open sores or wounds from whirlpool treatments.
- Monitor patients closely for signs and symptoms of gastrointestinal illness.
- Sanitize dishes by washing in dishwashing machines that have a hot water cycle at 82°C or above. For manually washed dishes, it is important that the sanitizer concentration be a minimal of 100 parts per million of chlorine. It is also important that dishes are allowed to air dry. Do not rinse with tap water.

Notes:

Renal dialysis units are routinely treated with water using reverse osmosis. This is considered an acceptable treatment process for publicly supplied water under a boil water advisory.

Upon rescinding of a boil water advisory:

- Re-start and flush any water-using fixture or piece of equipment in accordance with the manufacturer's specifications. This may vary from fixture to fixture. Consult your facility engineer and/or manufacturer when restarting the equipment.

- Managers of large buildings with water-holding reservoirs should consult with their facility engineer about draining the reservoir.
- Follow the directions of your water utility or, as general guidance, run cold water faucets and drinking fountains for 3 minutes each.
- Run water softeners through a regeneration cycle.
- Drain and refill hot water heaters if set at a low temperature (below 64.2°C) taking all necessary precautions to avoid electrical shocks.
- Resume usual bathing practices and care for patients with breaks in the skin.
- Consult your facility engineer regarding pool and/or whirlpool operations.

d) Day Care Facilities

- Day care facilities in areas where a boil water advisory is in effect should be contacted and advised to use boiled or disinfected water for drinking, preparing infant formulas, preparing juices and ice cubes, washing fruits and vegetables and for all hand washing and dental hygiene.
- Children and employees should not consume tap water that has not been disinfected, ice or drinks made with tap water that has not been disinfected, or raw foods rinsed with tap water that has not been disinfected.
- Disinfect water by:
  - Boiling at a rapid, rolling boil for 1 minute; or
  - Filtering through a reverse osmosis filter, an “absolute 1 micron” filter.
- An alternate to this would be using commercially available “bottled water” from a supplier who is a member of the Canadian Bottled Water Association (CBWA) or the International Bottled Water Association (IBWA).
- All employees reporting that they are suffering from a diarrheal illness must be excluded from work and should be tested by their family doctor. They are not to return to work until symptoms have subsided. Good hand washing should be emphasized for all staff.
- Sanitize dishes by washing in dishwashing machines that have a hot water cycle at 82°C or above. For manually washed dishes, it is important that the sanitizer concentration be a minimum of 100 parts per million of chlorine. It is important that dishes be allowed to air dry. Do not rinse with tap water.

Upon rescinding of a boil water advisory:

- Re-start and flush any water-using fixture or piece of equipment in accordance with the manufacturer’s specifications. This may vary from fixture to fixture. Consult your facility engineer and/or manufacturer when restarting the equipment.
- Managers of large buildings with water-holding reservoirs should consult with their facility engineer about draining the reservoir.

- Follow the directions of your water utility or, as general guidance, run cold water faucets and drinking fountains for 3 minutes each if they have not been used in the last 24 hours.
- Run water softeners through a regeneration cycle.
- Drain and refill hot water heaters if set at a low temperature (below 64.2OC) taking all necessary precautions to avoid electrical shocks.

e) Dental Offices

- Dentists, in areas where a boil water advisory is in effect, should be contacted and advised to use boiled or bottled water for patients to drink or rinse and for all hand washing.
- It is also recommended that the high/low speed turbines run dry and a hand syringe of boiled water or sterile saline be used for cooling/rinsing the tooth and/or oral tissues.
- Regular hand piece maintenance (i.e. boiling and sterilizing) should continue per the manufacturer's instructions.
- To avoid any potential risk of contamination from the water supply that could occur from and during inadvertent use of dentist equipment with contaminated water during the advisory, dentists are advised to turn off the water supply to their dental units and sinks. If this is not possible, covering or taping the controls or outlets may be indicated (e.g. triplex syringe, water dispenser, cavitron, etc.).

f) Water Vending Outlets (Includes Wine and Beer Vending)

Assess each system individually.

Appendix 13-F

Appendix F

Summary Operational Procedures for Municipal Supplies Health-Related Chemical and Radiological Exceedance