



## CLINTON COUNTY HEALTH DEPARTMENT NEW! WATER SYSTEM DISINFECTION APPLICATION PACKET

- All PUBLIC WATER SYSTEMS MUST DISINFECT THEIR WATER SUPPLY!
- This Department recommends that a design professional; i.e., professional engineer or registered architect be engaged to prepare plans for installation of a water supply disinfection system. However, if an owner agrees to undertake all responsibility for the design and installation of relatively uncomplicated systems costing less than \$5,000, a design professional may not be required if disinfection of a ground water source is the sole treatment and all acceptance conditions are met.
- You have 2 choices: **(1) ULTRAVIOLET LIGHT** or **(2) CHLORINATION**
- **You must provide source water background information on Page 3 (yellow sheet)**
- A 4-log inactivation of viruses is required by the Surface Water Treatment Rule. Under the Groundwater Rule, 4-log inactivation of viruses is required based upon raw water quality. The 4-log inactivation is calculated the same for both rules. **Due to the new Groundwater Rule (12/1/2009), all NEW water systems using chlorine for disinfection must meet 4-log virus inactivation/removal.**

### Pros and Cons of UV Light versus Chlorination:

#### UV LIGHT

ADVANTAGES	DISADVANTAGES
No contact tanks required	May need pre-treatment of water
No chemicals to mix or handle	<b>Not for use with an external distribution system</b>
No disinfection by-products created	No residual disinfection provided
No effect on water taste or odor	Automatic solenoid shut-off valve required
Requires less space	Start-up costs may be expensive
	Additional water sampling required prior to approval
	<b>Does not meet 99.99% removal/inactivation of viruses (as may be required by the Ground Water Rule)</b>
	When things go wrong – water shuts off!

#### CHLORINATION

ADVANTAGES	DISADVANTAGES
Provides residual disinfection	Requires chemical handling and mixing
Inexpensive to operate	Contact tank(s) required
OK to use with external (underground) distribution system	Causes disinfection by-product formation
Usually no need for pre-treatment	May impart taste and odors to water
	Requires <b>DAILY</b> chlorine measurement

### CONSIDERATIONS:

If you choose **ULTRAVIOLET LIGHT**, you must have a raw water sample collected and tested by a certified laboratory for the parameters listed on Page 5. The results must be attached to this application for review. If the results indicate that pre-treatment is necessary, your proposal must also include additional information on the type of pre-treatment proposed. After completing the water tests, refer to Pages 5-9 (purple sheets).

If you choose **CHLORINATION**, at least 90% of all microbiological samples of raw water during the previous six months from the source(s) in question must not exceed 20 fecal coliform per 100 milliliters or 100 total coliform per 100 milliliters. If both fecal and total coliform analyses are performed, the fecal coliform results will take precedence. The treated water quality must meet the drinking water standards. The results must be attached to this application. After completing the water tests, refer to Pages 11-12 (light blue sheets).

Lt. green

**CLINTON COUNTY HEALTH DEPARTMENT**

**Formal Request for Small Water System Disinfection Plan Approval**

I request that the attached schematic for **Ultraviolet /Chlorine Disinfection** (circle one) and related information be accepted in lieu of plans prepared by a design professional. I certify that the aforementioned information is correct and accurate and the estimated cost of the project is less than \$5,000. I agree to assume all responsibility for the disinfection system including hiring a design professional and replacement of the system if requested should the system fail to perform as required by Subpart 5-1 of the State Sanitary Code. I agree not to make changes to the proposed system without receiving prior approval from this office.

Facility Name \_\_\_\_\_

Facility Address (911 Address) \_\_\_\_\_

PWS ID# NY09\_\_ \_\_ \_\_ \_\_ \_\_

Owner Name (Print Clearly) \_\_\_\_\_

Owner Mailing Address \_\_\_\_\_

Owner Telephone Number \_\_\_\_\_ email: \_\_\_\_\_

Owner Signature \_\_\_\_\_ Date \_\_\_\_\_

Applicant information (If different form Owner)

Applicant Name (Print Clearly) \_\_\_\_\_

Applicant Mailing Address \_\_\_\_\_

Applicant Telephone Number \_\_\_\_\_ email: \_\_\_\_\_

Applicant Signature \_\_\_\_\_ Date \_\_\_\_\_

**HEALTH DEPARTMENT USE ONLY:**

Required Fee \_\_\_\_\_ (\$60.00 – single service connection; \$120.00 – multiple service connections)

Date Fee Paid \_\_\_\_\_ Receipt # \_\_\_\_\_

Intake/Acceptance Recommended by \_\_\_\_\_ Date \_\_\_\_\_

Project Entered in eHIPS by \_\_\_\_\_ Date \_\_\_\_\_

Engineering Review Accepted by \_\_\_\_\_ Date \_\_\_\_\_

Plans Approved by (letter sent) \_\_\_\_\_ Date \_\_\_\_\_

Pre-Op Inspection by \_\_\_\_\_ Date \_\_\_\_\_

Final \*Letter of Approval by \_\_\_\_\_ Date \_\_\_\_\_

**\* Final approval of project requires field inspection by a CCHD Sanitarian or Engineer\***

## WATER SOURCE INFORMATION FOR CHLORINE OR UV DISINFECTION

1. Facility Name \_\_\_\_\_ PWS ID# NY09 \_\_\_\_\_  
Source Description \_\_\_\_\_  
Well Casing Diameter \_\_\_\_\_ Total Well Depth \_\_\_\_\_ Casing Depth \_\_\_\_\_  
Static Water Level in Well \_\_\_\_\_ (feet below ground level).  
Dynamic (pumping) Water Level in Well \_\_\_\_\_ Feet Below Ground Level.

***For all source types a groundwater under direct influence (GUDI) determination may be required.***

\_\_\_\_\_ Well Log Attached  
\_\_\_\_\_ Plot Plan Attached (required – see Page 4)

2. Water Pump (may be in the well)  
Manufacturer \_\_\_\_\_ Model \_\_\_\_\_ Type \_\_\_\_\_  
Pump Rating \_\_\_\_\_ gpm at \_\_\_\_\_ psi pressure.  
Pressure switch setting: **ON** at \_\_\_\_\_ psi. **OFF** at \_\_\_\_\_ psi.

A minimum pressure of 20 psi is needed at user taps and fixtures.

3. Totalizing water meter location \_\_\_\_\_, (daily records should be maintained when the water system is in use).  
4. Pressure tank equipped with a pressure gauge. Capacity in gallons \_\_\_\_\_.  
5. Raw water sampling tap location \_\_\_\_\_.  
6. Treated water sampling tap location \_\_\_\_\_. (If chlorinating, free chlorine residual reading should be a minimum of 0.5 mg/L).

## **PLOT PLAN OF SITE**

Place North arrow on the map.

Show all buildings, indicate height of building in stories; **Document the location and distance of the following features from each building and water supply source:**

- |  |                                  |                  |
|--|----------------------------------|------------------|
| --Septic or sewage system components                 | --Streams or other surface water | --Roads          |
| --Storm & sanitary sewers                            | --Drainage swales & ditches      | --Waste lagoons  |
| --Parking lots (specify surface type)                | --Property lines                 | --Pool & beaches |
| --Other sources of microbial contamination (specify) | --Manure piles                   |                  |
| --Other sources of chemical contamination (specify)  | --Fuel storage                   |                  |

If possible, document predominant slope of land at site showing surface features relative to water source and potential contamination sources.



## UV LIGHT TESTING PARAMETERS\*\*\*

### Raw Water (before any treatment) quality data:

- Total Coliform
- Fecal Coliform
- Heterotrophic plate count
- And the following inorganic and physical constituents:

#### PARAMETER

Iron  
Manganese  
Hardness (calcium)  
Hydrogen Sulfide  
Turbidity  
Color  
Suspended Solids  
UV Absorbance or UV Transmittance

#### UPPER GUIDANCE LEVELS\*

0.3 mg/L  
0.05 mg/L  
120 mg/L  
Non-detect  
1 NTU  
15 APHA units  
10 mg/L  
0.155 cm<sup>-1</sup> or 70% (lower limit)

\* **IF ANY** of these levels are exceeded, then pre-treatment will be required and re-testing of the water will be required to show parameter is met after installation of pre-treatment equipment.

All testing must be conducted by a New York State Certified Laboratory

\*\*\* UV light disinfection system alone does NOT provide 4-log (99.99%) virus removal/inactivation\*\*\*\*

**\*\*RESULTS OF ALL TESTING MUST BE SUBMITTED WITH THIS APPLICATION\*\***

## CLINTON COUNTY HEALTH DEPARTMENT Ultraviolet Unit Review and Approval Checklist

Applications must include sufficient information and/or meet the required criteria pertaining to all of the following guidelines listed below upon submittal to the Health Department.

- Does your system require 4-log (99.99%) removal/inactivation of viruses? UV light disinfection does NOT provide this. **As a result of the Groundwater Rule, should you be required to meet 4-log virus removal/inactivation you will be required to install additional treatment.**
- Does your water system provide water to more than one building? If yes, one UV unit is probably not acceptable for your water system. Please contact your inspector and discuss installing a continuous chlorination system. It may also be possible to install UV units in each building. If the answer is no, then proceed to the next item.
- A sketch or schematic of the water system showing all plumbing and treatment (meters, storage tanks, raw and finished water sampling taps, filters, softeners, disinfection, etc..) An example of an acceptable schematic is given (See Page 7)
- Manufacturer information sheets for the system components.
- Raw water results of satisfactory quality. If no, you need to choose another method of disinfection or install water treatment before the UV unit, so that water entering the unit does meet the parameters.
- A plot plan showing the location of the well, sewage disposal system, buildings, etc...
- A well log showing gallons per minute, depth of casing, soil conditions, capacity and type of pump.
- A signed and dated formal request (See Page 9).
- The proposed UV light must meet the design criteria below.
  - Ultraviolet radiation at a wavelength of 254 nm must be applied at a minimum dosage of 40,000  $\mu\text{W}/\text{cm}^2$  (same as 40  $\text{mW}/\text{cm}^2$ ).
  - Maximum water depth in the chamber, measured from the tube surface to the chamber wall shall not exceed 3" unless the applicant can demonstrate the ability to achieve the requisite UV intensity transmitted through the proposed depth.
  - The ultraviolet tubes shall be:
    - Jacketed so that a proper operating tube temperature is maintained and;
    - The jacket shall be of quartz or high silica glass with similar optical characteristics.
  - Unit designed to permit mechanical cleaning of the water contact surface of the jacket without disassembly of the unit or be of such design that quick disassembly is possible for surface cleaning.
  - An automatic flow control valve, accurate within the expected pressure range, shall be installed to restrict flow to the maximum design flow of the treatment unit. The treatment unit shall be located before any storage tanks.
  - An accurately calibrated ultraviolet intensity meter, properly filtered to restrict its sensitivity to the disinfection spectrum, shall be installed in the wall of the disinfection chamber at the point of greatest water depth from the tube(s).
  - A flow diversion valve or automatic shut-off valve (solenoid valve) shall be installed which will permit flow into the potable water system only when at least the minimum ultraviolet dosage is applied. When power is not being supplied to the unit, the valve should be in a closed (fail safe) position which prevents the flow of water into the potable water system.
  - An automatic, audible alarm shall be installed to warn of malfunction or shutdown.
  - The unit shall be designed to protect the operator against electrical shock (GFI protection) or excessive radiation.
  - Installation of the unit shall be in a protected enclosure not subject to extremes in temperature.
  - A spare ultraviolet tube and other necessary equipment to affect prompt repair by qualified personnel properly instructed in the operation and maintenance of the equipment shall be provided on-site.
  - A copy of the bioassay results for the specified unit must be submitted. The bioassay shall have been performed by an independent laboratory for the manufacturer and be for the full operation range (i.e; 100-70%).

**CLINTON COUNTY HEALTH DEPARTMENT**

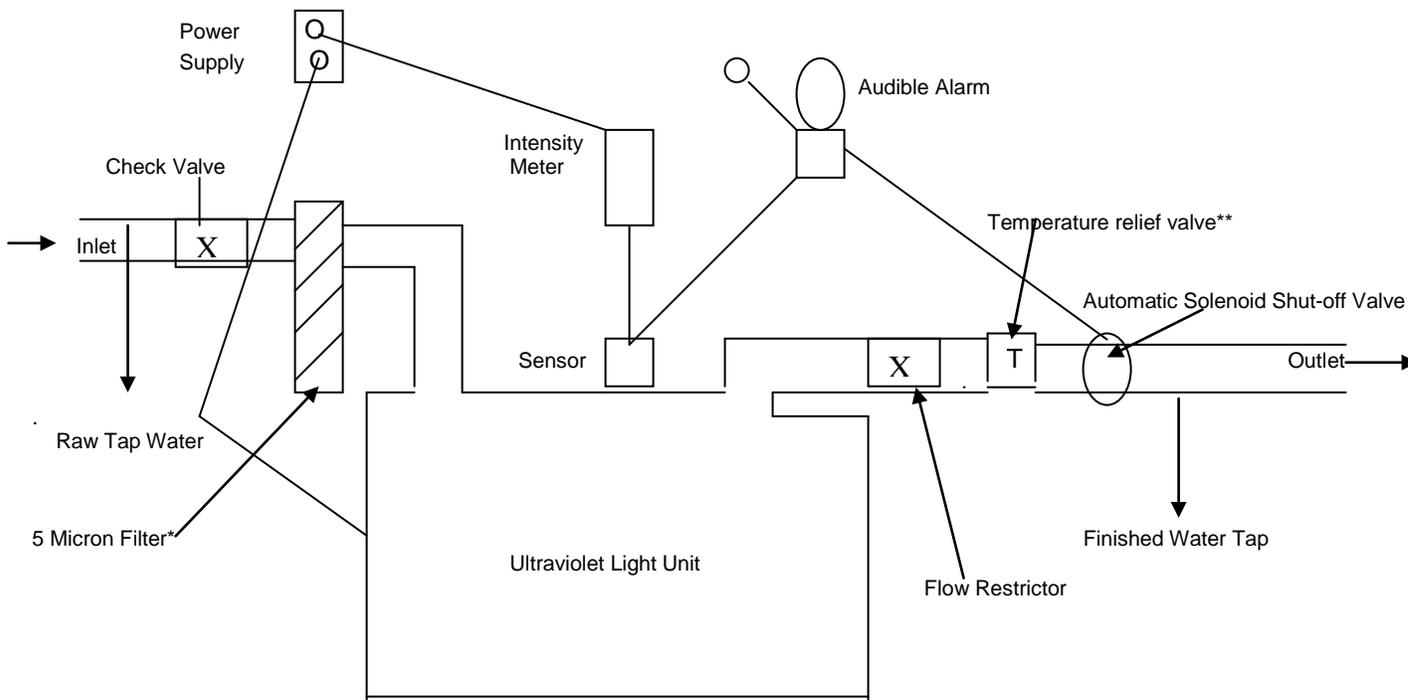
**ULTRAVIOLET DISINFECTION UNIT SCHEMATIC (GENERIC)**

Facility Name \_\_\_\_\_ PWS ID# NY \_\_\_\_\_

- **Fill in manufacturers and model numbers for all components**
- **Enclose manufacturer's specifications for ALL components of the UV system with this application**
- **UV light disinfection does NOT provide 4-log removal/inactivation of viruses. As a result of the Groundwater Rule, should you be required to meet 4-log virus removal/inactivation, you will be required to install additional treatment.**

Manufacturer \_\_\_\_\_ UV Model# \_\_\_\_\_  
 NSF or Equivalent Approved \_\_\_\_\_ UV Intensity & Dosage \_\_\_\_\_  
 Flow Rate (mfg) \_\_\_\_\_ Intensity Meter \_\_\_\_\_  
 Automatic Shut-off Valve \_\_\_\_\_ Micron Filter Provided\* \_\_\_\_\_  
 Alarm: Audible \_\_\_\_\_ Visible \_\_\_\_\_ Location to be Installed \_\_\_\_\_  
 Temperature relief valve Y/N Manufacturer \_\_\_\_\_ Minimum system flow \_\_\_\_\_ gpm  
 Water Softener Needed: Yes / No Flow Restrictor \_\_\_\_\_ gpm  
 Manufacturer \_\_\_\_\_ Model # \_\_\_\_\_

A partial schematic of an acceptable **UV LIGHT** installation is shown below. It may be used as a guide for the proposed installation of the above-noted facility. Please provide a **complete** water train schematic, showing **ALL** components of the water train such as softeners, filters or other treatment from well to distribution system (See Page 8). All information requested in this application must be completed and all construction must be in accordance with the accepted application.



\* The 5 micron filter is required. \*\*Temperature relief valve is required for low-flow situations

ltpink

## UV LIGHT PROPOSED SCHEMATIC – Draw Below

Be sure to include the following in your drawing:

_____ Well	_____ Pressure Tank	_____ Raw Water Tap
_____ Pressure Switch	_____ Pressure Gauge	_____ Water Meter*
_____ Flow Restrictor	_____ Audible & Visible Alarm	_____ UV Light
_____ Water Softener	_____ Intensity Meter	_____ 5 Micron Filter
_____ Distribution System	_____ Automatic Solenoid Shut-off Valve	

\*Meters should be installed **horizontally** with at least 2 feet of pipe before and after.

# OPERATOR'S RESPONSIBILITIES RECOGNIZED AND ACCEPTED

## Ultraviolet Instructions for Water Supply Operation

Upon receiving approval for the proposed ultraviolet light disinfection unit schematic, installation of the unit is permitted. If changes are made during installation, you must contact the Health Department for prior approval. The checklist below is an obligatory testing schedule to maintain sufficient water quality standards. Records must be kept as part of an operational log to be maintained at the facility with relevant entries made for dates and types of maintenance as well as repairs, including annual bulb replacement and quartz sleeve cleaning.

- After installation, before serving water to the public, you must contact the Health Department to arrange for an inspection of the new ultraviolet unit.
- After the unit is installed correctly, the water must be analyzed for microbiological quality according to the following schedule:
  - o One sample during the first week of installation **DUE BY** \_\_\_\_\_
  - o One sample at end of first month of operation **DUE BY** \_\_\_\_\_
  - o One routine sample quarterly or monthly of each operational year, depending upon your routine sampling schedule.
- A. The owner must maintain a weekly operational log as designated by the Health Department.
- B. Intensity meter readings must be in the proper range for disinfection at all times.
- C. Bulb shall be changed at least annually and a spare bulb shall always be available at the facility.
- D. Any interruption in treatment of a drinking water supply shall be reported immediately to this department. No change in source or method of treatment of a drinking water supply shall be made without first notifying and securing the approval of this office.
- E. The operator/owner understands that UV light disinfection does NOT provide 4-log removal/inactivation of viruses. As a result of the Groundwater Rule (promulgated 12/2/1009), should this system be required to meet 4-log virus removal/inactivation, additional treatment will be required to be installed.**

Send all completed operation reports to: **Clinton County Health Department**  
**133 Margaret Street**  
**Plattsburgh, NY 12901**

Direct any questions to: \_\_\_\_\_ at (518) 565-4870.

I, \_\_\_\_\_, \_\_\_\_\_ am the designated  
(Print Name) (Title)  
water operator at \_\_\_\_\_. I am authorized with absolute control of  
(Facility Name)  
all water system operation (record keeping, sampling and maintenance). To fulfill my responsibilities, I have read and understood: (1) the above instructions and; (2) operation report instructions and blanks. I will record daily activities and observations and test for bacteria as required by my sampling schedule, test for nitrate annually and immediately report to CCHD any emergencies as defined on the operation report instruction sample.

\_\_\_\_\_  
Signature of Water Operator

\_\_\_\_\_  
Date

I, \_\_\_\_\_ have given and explained the above  
(CCHD Sanitarian)  
mentioned information.

**THIS PAGE LEFT BLANK**

**CLINTON COUNTY HEALTH DEPARTMENT**

**Chlorination Schematic REFER TO CT WORKSHEET FOR DETERMINING CONTACT VOLUME REQUIRED TO MEET the GROUNDWATER RULE**

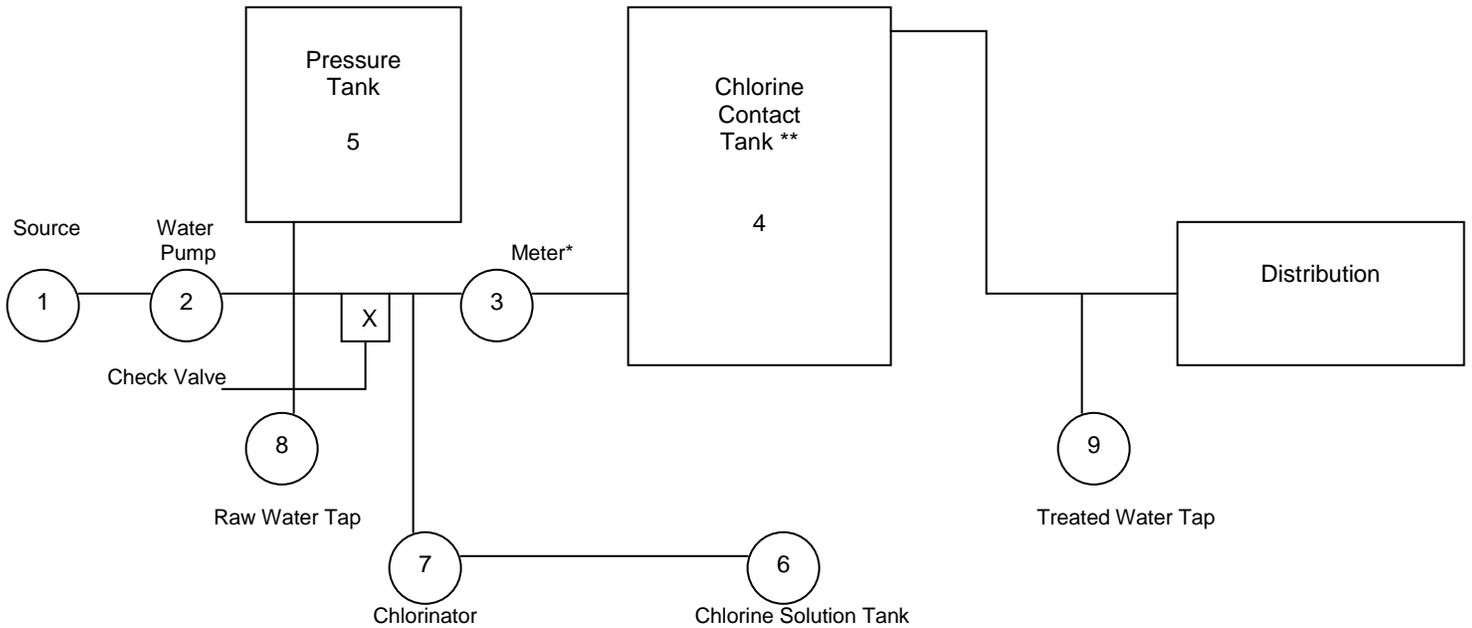
Facility Name \_\_\_\_\_ Facility PWS ID # \_\_\_\_\_

**Chlorine contact tank:** Capacity in gallons \_\_\_\_\_. This tank must be plumbed so the entire capacity is utilized (i.e., water enters at the bottom and exits at the top). A minimum of 30 minutes chlorine contact shall be provided. Multiply the pump rating on Page 3 by 30 to size the tank in gallons. If more than one source is used, the total of the pump ratings of all sources shall be multiplied by 30. **Example:** A 10 gpm pump requires a 300-gallon contact tank (i.e., 10 gpm x 30 minutes = 300 gallons).

**Chlorine solution tank:** Capacity in gallons \_\_\_\_\_. A 20 to 30 gallon plastic tank with cover manufactured for water treatment use is generally used. Venting of the tank to the outdoors is desirable.

**Hypochlorinator:** A positive displacement chemical metering pump equipped with an anti-siphon 4 in 1 valve. Manufacturer \_\_\_\_\_ Model \_\_\_\_\_. Rating (gallons per day) \_\_\_\_\_ at \_\_\_\_\_ psi. The chlorinator must be electrically interconnected with the well pump so both start and stop simultaneously. Each well pump needs its own chlorinator unless the chlorinator is meter-driven.

A schematic of an acceptable chlorinator installation is shown below. It may be used as a guide for the proposed chlorination installation at the above-noted facility. **\* Please modify the schematic below to show YOUR system including any additional treatment such as softeners or filters.** All information requested in this application must be completed and all construction must be in accordance with the accepted application.



\*Meters should be installed **horizontally** with at least 2 feet of pipe on either side.

\*\*See CT worksheet for estimating size.

Lt. blue

# OPERATOR'S RESPONSIBILITIES RECOGNIZED AND ACCEPTED

## Chlorination Instruction for Water Supply Operation

- A. Free chlorine residuals should be checked and recorded at least once per day. A DPD type test kit must be used.
- B. Free chlorine residual tests should be taken at the treated water sampling tap daily and at various cold water taps throughout the distribution system occasionally.
- C. Free chlorine residual readings should be at least 0.5 mg/L at the treated water sampling tap and at least 0.2 mg/L throughout the distribution system.
- D. Any interruption in treatment of a drinking water supply shall be reported immediately to this office. No change in the source or method of treatment of a drinking water supply shall be made without first notifying and securing approval of this office.
- E. Note in the remarks column the sampling point (i.e., kitchen tap, Room 16 bathroom tap, main building outside tap, etc.) and any unusual circumstances (i.e., equipment failure, drinking water complaints, etc...).
- F. Each chlorine solution tank should be calibrated for consistent solution strength. When refilling the solution tank, the ratio of disinfectant to water added shall remain the same (i.e., a 20-gallon tank requiring one pint of liquid chlorine to maintain a given concentration should have ½ pint of liquid chlorine added when 10 gallons of water are needed to refill the tank). The amount of liquid chlorine needed should be determined by measurement (i.e., markings on the outside of the tank or a measuring rod). Estimating the amount of disinfectant needed to refill the tank often results in extremely low or high readings.

Send completed operation reports to: **CLINTON COUNTY HEALTH DEPARTMENT**  
**133 MARGARET STREET**  
**PLATTSBURGH, NY 12901**

Direct any questions to \_\_\_\_\_ at (518) 565-4870.

I, \_\_\_\_\_, \_\_\_\_\_ am the  
(Print Name) (Title)  
designated water operator at \_\_\_\_\_. I am authorized with  
(Name of Facility)  
absolute control of all water system operation (record keeping, sampling and maintenance). To fulfill my responsibilities, I have read and understand: (1) the above instructions and; (2) operation report instructions and blanks. I will record daily activities and observations, test for bacteria as required by my sampling schedule, test for nitrate annually and immediately report to CCHD any emergencies as defined on the operation report instruction sample.

\_\_\_\_\_  
(Signature of Water Operator)

\_\_\_\_\_  
(Date)

I \_\_\_\_\_ have given and explained the above mentioned  
(CCHD Sanitarian)  
information.

**SUBMITTAL CHECK LIST (FOR UV AND CHLORINATION)**

- \_\_\_\_\_ Signed application
- \_\_\_\_\_ Plot Plan of Site
- \_\_\_\_\_ Water Train Schematic
- \_\_\_\_\_ Water Test Parameter Sample Results (required for UV only)
- \_\_\_\_\_ Manufacturer's Spec Sheets for all Components (tanks, cartridge filters, UV lights, solenoid valves, softeners, etc.)
- \_\_\_\_\_ Completed Water Source Information Form
- \_\_\_\_\_ Paid Fee
- \_\_\_\_\_ Capacity Development form completed (NCWS or CWS)
- \_\_\_\_\_ Task and Time Schedule/Construction Sequence

**NEW WELLS**

- \_\_\_\_\_ POC Sample Results (Table 9B)
- \_\_\_\_\_ SOC Sample Results (Table 9C)
- \_\_\_\_\_ PRI Sample Results (Table 8B)
- \_\_\_\_\_ Nitrate Sample Results
- \_\_\_\_\_ Nitrite Sample Results
- \_\_\_\_\_ Raw TC Sample Results
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_ Pump Test (4hr.; 6hr.; 24hr.; 48hr.; 72hr.)
- \_\_\_\_\_ Well Driller's log
- \_\_\_\_\_ GUDI testing needed ( less than 50 feet of casing/ within 200 feet of surface water?)

**Water System Disinfection Packet for Small Systems – For assistance to determine compliance with the Groundwater Rule (GWR).**

The attached DRAFT “*Worksheet for Determining CT for 4-log Inactivation of Viruses*” is for **guidance purposes ONLY** to assist you in designing your new chlorination system. The Clinton County Health Department (CCHD) has final authority over the size of the required chlorine contact tank. Use this worksheet to assist in designing and choosing your contact tank(s) for chlorination. This worksheet does not apply to UV light or other disinfection methods. **UV light disinfection does NOT provide 4-log removal/inactivation of viruses. As a result of the Groundwater Rule, should you be required to meet 4-log virus removal/inactivation, you will be required to install additional treatment.**

Any data you have (meter readings or other flow data, well pump specifications, pipe diameters, etc.) to determine actual and possible average daily flows and peak flows will provide a more accurate determination of the proper size contact tank you will need. 4-Log removal / inactivation of viruses means 99.99% of the viruses that could occur in your water are no longer able to cause illness to a person who drinks the water.

CT is the free chlorine residual concentration (mg/L) multiplied by the time the water is in contact with the chlorine (minutes). See attached worksheet for more information.

**\* \* \* \* TAKE NOTE \* \* \* \* \***

**We strongly recommend that you DO NOT purchase ANY system components until your plan has been approved by the Clinton County Health Department (CCHD) and you have received WRITTEN approval from the CCHD.**

**UV light disinfection does NOT provide 4-log removal/inactivation of viruses. As a result of the Groundwater Rule, should you be required to meet 4-log virus removal/inactivation, you will be required to install additional treatment.**

## WORKSHEET FOR DETERMINING CT FOR 4-LOG INACTIVATION OF VIRUSES

This worksheet is for **estimation and guidance purposes only**. Final tank size determination is up to the Clinton County Health Department.

A 4-log inactivation of viruses is required by the Surface Water Treatment Rule. Under the Groundwater Rule, 4-log inactivation of viruses is required based upon raw water quality. The 4-log inactivation is calculated the same for both rules.

Chlorine concentration should be measured downstream of all components and upstream of the first customer or at the first finished water tap.

To determine the **contact time** of a system, use the following two formulas:

$$\text{Eq. 1} \quad \text{CT (mg/l * min)} = \text{Concentration (mg/l)} \times \text{Time (min)}$$

$$\text{Eq. 2} \quad \text{Time (min)} = \frac{\text{Volume of tank(s) (gal)} \times \text{baffling factor}}{\text{Peak flow (gal/min)}}$$

To determine the volume of the contact tank(s) needed, use the following formula:

$$\text{Eq. 3} \quad \text{Volume of tank(s) (gal)} = \frac{\text{CT (mg/l * min)} \times \text{peak flow (gal/min)}}{\text{Concentration (mg/l)} \times \text{baffling factor}}$$

Baffling factor based on tank configurations:

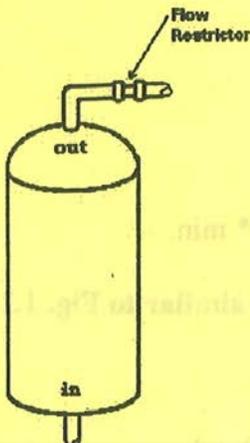


Fig. 1.1: in bottom/out top  
0.1 baffling factor

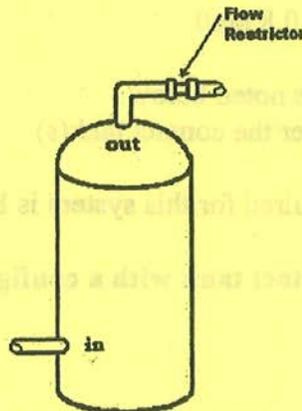


Fig. 1.2: in side/out top  
0.3 baffling factor

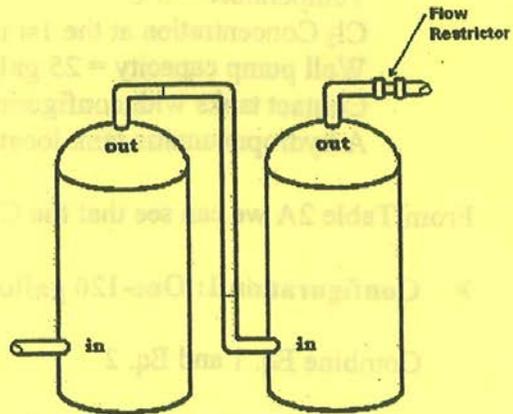


Fig 1.3: tanks in series in  
side/out top. 0.5 baffling factor

NOTE: See **Table 1** for baffling factor descriptions. Higher baffling factors may be assigned based on tank configurations (i.e., 0.7 for 3 tanks in series; 0.9 for 4 tanks in series). No credit is given to a tank with the same inlet and outlet (e.g. bladder pressure tank) See **Table 2**.

**The water service line before the first customer or first finished water tap may be used for contact time.** In this case, the baffling factor for the volume of water in the pipe will be 1.0. The volume of a pipe =  $\pi * r^2 * L * 7.481$  gal/ft<sup>3</sup>, where r = radius of pipe in feet and L = length of pipe in feet.

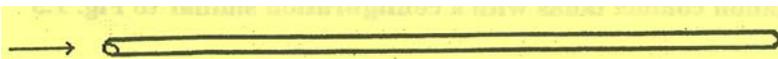


Fig 1.4 - Pipe, 1.0 Baffling Factor

**Table 1**

Baffling Condition	Baffle factor	Baffling Description
Unbaffled (mixed flow)	0.1	None, agitated basin, very low length to width ration, high inlet and outlet velocities.
Poor	0.3	Single or multiple unbaffled inlets and outlets, no intra-basin baffles.
Average	0.5	Baffled inlet or outlet with some intra-basin baffles
Superior	0.7	Perforated inlet baffle, serpentine or perforated intra-basin baffles, outlet weir.
Perfect	1.0	Very high length to width ration (pipeline flow), perforated inlet, outlet and intra-basin baffles.

**Table 2**

Tanks in series	Tank Configuration	Baffling Factor	Total Volume	Number/Size of Tank(s)
1	Fig 1.1	0.1	8650	1 – 8650 gal
	Fig 1.2	0.3	2884	1 – 2884 gal
2	Fig 1.1	0.3	2884	2 – 1442 gal
	Fig 1.3	0.5	1730	2 – 865 gal
3	Fig 1.1	0.5	1730	3 – 577 gal
	Fig 1.2	0.7	1236	3 – 412 gal
4	Fig 1.1	0.7	1236	4 – 309 gal
	Fig 1.2	0.9	962	4 – 241 gal

Determination of Peak Flow

Determination of peak flow should be on a case-by-case basis. Whenever possible, actual water meter readings should be used to determine peak flow. Another option is to use a flow restrictor installed after the contact tank(s). For small, uncomplicated systems, where a water meter or flow restrictor cannot be used, it may be appropriate to use the well pump capacity as the peak flow or determine the practical limitation on peak flow based on pipe size (i.e., 3/4" pipe will not realistically allow more than 7.5 gpm flow). However, complicating factors such as the location of hydropneumatic tank(s), distribution pumps, multiple water sources and complex distribution systems may necessitate an engineering evaluation to determine peak flow.

**Table 2A: CT (mg/l \* min) values for inactivation of viruses by free chlorine, pH 6-9**

Log Inactivation	1°C (34F)	5°C (41F)	10°C (50F)	15°C (59F)	20°C (68F)	25°C (77F)
2	5.8	4.0	3.0	2.0	1.0	1.0
3	8.7	6.0	4.0	3.0	2.0	1.0
3.5	10.2	7.0	5.0	3.5	2.5	1.5
4	11.6	8.0	6.0	4.0	3.0	2.0

Notes: 1. For temperatures not shown use interpolation to determine CT.

2. Temperature is measured at the entry point, for seasonally varied temps, use "worse case" i.e. coldest temp.

**Example #1**

Determine if the CT is adequate for 4-log virus inactivation at a groundwater system with the following characteristics:

pH = 6.5

Temperature = 5°C

Cl<sub>2</sub> concentration at the 1<sup>st</sup> user = 0.8 mg/l

Well pump capacity = 25 gal/min

Contact tank(s) with configuration as noted below

A hydropneumatic tank located after the contact tank(s)

From Table 2A we can see that the CT required for this system is 8.0 mg/l \* min.

➤ **Configuration 1: One 120-gallon contact tank with a configuration similar to Fig. 1.2**

Combine Eq. 1 and Eq. 2

$$CT = \text{Concentration} \times (\text{volume of tank(s)} \times \text{baffling factor} / \text{peak flow})$$

$$CT = 0.8 \text{ mg/l} \times (120 \times 0.3 / 25 \text{ gal/min}) = \underline{1.15 \text{ mg/l} \cdot \text{min}}$$

The available CT is not adequate.

➤ **Configuration 2: Two 120-gallon contact tanks with a configuration similar to Fig. 1.3**

Combine Eq. 1 and Eq. 2

$$CT = \text{Concentration} \times (\text{volume of tank(s)} \times \text{baffling factor} / \text{peak flow})$$

$$CT = 0.8 \text{ mg/l} \times (240 \text{ gal} \times 0.5 / 25 \text{ gal/min}) = \underline{3.84 \text{ mg/l} \cdot \text{min}}$$

March 25, 2008

DRAFT

Prepared by CNYRO Water Field Coordinators

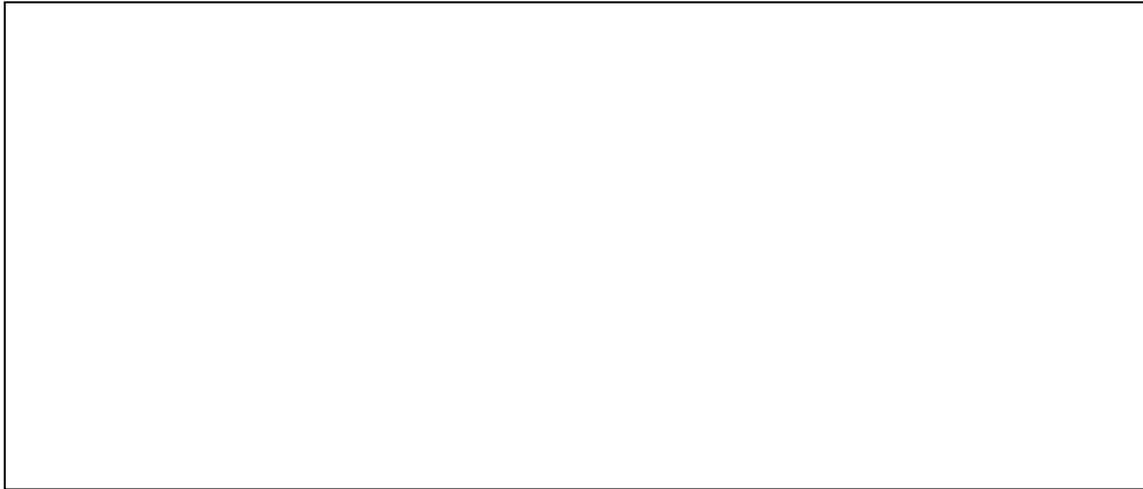
If a UV light is added to example #3, you only have to design for 3.5-log inactivation of viruses. UV disinfection (39 mj/cm<sup>2</sup> dose) is awarded 0.5-log inactivation of viruses according to Table 3 in the 12/7/2007 fact sheet. The CT required will only be 5, according to Table 2A. The equation will then read:

**Using Eq. 3:**                    
$$\frac{\text{CT} \times \text{Peak flow}}{\text{Concentration} \times \text{Baffling Factor}}$$

$(5 \text{ mg/l} \cdot \text{min} \times 10 \text{ gal/min}) / (0.2 \text{ mg/l} \times 0.3) = 834 \text{ gallons required for contact time (assuming one tank is used).}$

A substantial reduction in the size of the storage tank is needed when designing for 4-log inactivation of viruses instead of 0.5-log inactivation of *Giardia*.

**CT FORM**



System Diagram – include all pumps, tanks, treatment, hydropneumatic tanks, meters, ect...

**Water / System Characteristics**

Water Temperature: \_\_\_\_\_ Water pH: \_\_\_\_\_  
 Chlorine concentration at first tap/first customer: \_\_\_\_\_  
 Number / size of chlorine contact tanks: \_\_\_\_\_  
 Total storage provided: \_\_\_\_\_  
 Description of inlet and outlet on each contact tank: \_\_\_\_\_  
 \_\_\_\_\_

Baffling factor: \_\_\_\_\_  
 Average daily flow: \_\_\_\_\_ Peak flow: \_\_\_\_\_

Well pump capacity: \_\_\_\_\_  
 Does the system have a flow restrictor? Y / N If yes, size \_\_\_\_\_  
 Does the system have a UV light? Y / N If yes, size \_\_\_\_\_  
 Does the system have a raw water tap? Y / N

Determine available CT from above information.

$$CT_{ACT} \text{ (mg/l * min)} = \frac{\text{concentration (mg/l)} \times \text{volume of tank(s) (gal)} \times \text{baffling factor (from worksheet)}}{\text{Peak flow (gal/min)}}$$

$$\text{_____ (mg/l * min)} = \frac{\text{_____ (mg/l)} \times \text{_____ (gal)}}{\text{_____ (gal/min)}}$$

**Table 2A: CT (mg/l \* min) values for inactivation of viruses by free chlorine, pH 6-9**

Log Inactivation	1°C	5°C	10°C	15°C	20°C	25°C
2	5.8	4.0	3.0	2.0	1.0	1.0
3	8.7	6.0	4.0	3.0	2.0	1.0
3.5	10.2	7.0	5.0	3.5	2.5	1.5
4	11.6	8.0	6.0	4.0	3.0	2.0

If  $CT_{ACT}$  \_\_\_\_\_ >  $CT_{REQ}$  \_\_\_\_\_ there is sufficient contact time.