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Tischer Creek Fish Kill and Enforcement Report

How a drinking water discharge led to loss of over 1,500 brook trout in Duluth, Minnesota.

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Case narrative

A fish kill occurred on Duluth's Tischer Creek (S-004) Wednesday, July 31, 2024. Minnesota Pollution Control Agency (MPCA) and Minnesota Department of Natural Resources (DNR) correspondence with the city of Duluth - engineering indicated that 1.7 million gallons of chloraminated water was released into the creek from the Woodland Reservoir located at 801 Minneapolis Avenue between July 31 and August 1. (Figure 1). Operations related to lowering the water level in the reservoir inadvertently caused cavitation in the pumps used to move water into the distribution system. City staff drained the remaining water from the reservoir into the city storm sewer system at the corner of East Mankato Street and Allendale Avenue. (Figure 1).

Draining occurred over a 15-hour period and water flowed 4,050 lineal feet via the storm sewer, ultimately reaching the stream via two conveyance routes (Mankato Street and Allendale Street) (Figure 1). Flow rate peaked at 4,800 gallons per minute (gpm) or 10.7 cubic feet per second (cfs). The normal flow for this part of the stream was measured at 0.19 cfs on August 1. This indicates that the drinking water discharge increased the flow of Tischer Creek to 56 times its normal flow.

Water samples from the reservoir collected by city staff on August 2 indicated the presence of free chlorine at 1.59 parts per million (ppm) and monochloramine at 1.61 ppm, as well as free ammonia at 0.53 ppm, nitrate at 0.58 ppm and a pH of 9.07. Water temperature was 62 F (16.7 C), but city staff indicated it would have been several degrees cooler during the time of the release.

Water temperature data collected by a continuous stream monitor indicate a 7-degree Celsius drop in water temperature from the normal regime of the stream corresponding to the date and time of release from the reservoir indicating that water temperature was roughly the expected temperature of the Woodland Reservoir water (Figure 2).

The MPCA and DNR staff mobilized field teams on August 2, 2024, to collect field data and fish samples. The extent of the fish kill was determined to begin at geographic (gps) coordinates (DD) (46.83842, -92.08079) and ending at (46.82247, -92.07307) for a total reach of approximately 1.7 miles (Figure 1). Evidence of recent high-water levels, approximately 21" above the level observed on August 3, were documented along the kill stream reach (Figure 5). The MPCA and DNR documented a count of 1,409 dead fish, including 772 brook trout, of which at least 57 were more than 10 inches long (Figure 4). A relatively complete kill of aquatic life was observed within the kill reach and included other species besides brook trout including blacknose dace, creek chubs, white suckers, yellow perch, pumpkinseed sunfish, brook sticklebacks as well as crayfish, leeches, and other aquatic invertebrates (not systematically identified). However, some blacknose dace and brook trout were able to be collected via electrofishing from within the stream reach on August 2.

The total number of fish killed during the event would have exceeded the number counted on August 2 as expired small fish in streams are quickly depleted by scavengers and autolysis, evidence of which was observed (Figure 6). Estimates of fish carcasses lost in the first 24 hours post mortality event in small streams may be up to 60% (Labay 1999). To account for fish carcasses lost between the report of the event on August 1 and counting on August 2, an additional three 100 yard transects were counted on August 3 and used to estimate a total mortality of 1,588 brook trout and at least 760 other fishes.

Determination of cause

One significant detail from this event is that the water released was chloraminated, a potable water disinfection method employed by public water systems that involves the addition of ammonia to water supplies before or after addition of chlorine to produce monochloramine. Chloramine is more stable

than free chlorine in potable water supplies and reduces the formation of other decontamination by-products making it an effective alternative for treating water for human consumption. However, both chlorine and chloramine are (equally) toxic to aquatic life and the concentration of either chemical normally found in potable water is sufficient to cause mortality of most fish species (Zillich 1972). The stability of chloramine relative to free chlorine increases the risk of its introduction into surface water following a spill (Pasternak 2003). The spill into Tischer Creek is an example of this increased risk as water traveled 0.75 miles through the stormwater system before reaching the stream, but unlike free chlorine which dissipates rapidly from water, chloramine would not have decreased in concentration.

Water samples collected by the city of Duluth indicated a total chlorine concentration (chloramine level) of 1.61 ppm. Chloramine has a similar toxicity to free chlorine for aquatic organisms, and a concentration of only 0.4 ppm is considered immediately toxic to most fish species and over 30 times more toxic than levels lethal to sensitive fish like young trout (0.05 ppm) (Zillich 1972) and 25 times more toxic than the U.S. Environmental Protection Agency (EPA) (1985) species mean acute value (SMAV) of 0.062 ppm established for rainbow trout. The mechanism of mortality caused by chlorine toxicity is a combination of hemolytic anemia as chlorine/chloramines inhibit the ability of red blood cells to carry oxygen, leading to red blood cell lysis and asphyxiation. Additionally, chlorine/chloramines cause characteristic damage to the epithelium of the gills which are organs responsible for most of the gas and ion exchange fish need to gather oxygen and release carbon dioxide as well as ammonia produced in their tissues. This characteristic damage presents as fluid buildup between the epithelium of the primary and secondary lamellae of the gill filaments (Figure 7).

The release of reservoir water likely delivered a similar concentration of chloraminated water to Tischer Creek as was present in the reservoir given the high cfs of the released water, the drop in water temperature to the reservoir water temperature and evidence of significantly increased flow within the kill site. Though secondary in consideration to chloramine toxicity, other rapid changes in water conditions such as the sharp drop in water temperature, the presence of ammonia, nitrate, and a rapid change in pH would also have contributed to fish stress (see Table 1 for stream water conditions).

The rapid rate of the Tischer Creek mortality event is also consistent with chlorine toxicity (i.e. almost no mortality observed during the field investigations on August 2 and August 3) indicating that virtually all fish and aquatic invertebrate mortality occurred in the first 24 hours of the event (EPA 1984). This rate of mortality contrasts with that of other causes of mortality such as infectious disease, and chronic water quality issues that have protracted mortality periods of days or weeks. Furthermore, brook trout observed within the kill reach were observed (video available upon request) suffering signs consistent with chlorine toxicity such as agitated movement, convulsions, and severe disorientation. These behavioral signs are distinct from other water quality issues or pathogenic disease which generally cause depressed activity and may be accompanied by external lesions (Zillich 1972).

The most compelling evidence indicating chlorine toxicity as the primary cause of this mortality event was the apparent lack of external pathology on brook trout and black nose dace collected within the kill site accompanied with marked gill pathology characteristic of chlorine toxicity (Figure 7). Both species showed diffuse edema and detachment of the epithelium of the gill lamellae in conjunction with anemia (low red blood cell counts) and the presence of enlarged mucus cells is consistent/indicative of chlorine toxicity. The combination of these factors in addition to the evidence from the field investigation is indicative of chlorine toxicity caused by the release of chloraminated water by city of Duluth operations.

Fish Kill Timeline:

July 31: Duluth city utility operations begin draining Woodland reservoir at 1:00 p.m.

August 1: Woodland reservoir draining is completed at 7:00 a.m.

August 1: Minnesota Duty Officer (MDO) is notified of a fish kill on Tischer Creek by a city resident and the Interagency Fish Kill Response (IFR) team is notified.

August 2: Duluth City Parks Department is notified of a fish kill occurring on Tischer Creek via email. City of Duluth Engineering inquired after water utility work at the reservoir. The city reported the water release to the Minnesota Duty Officer on Aug. 2.

August 2: MPCA and DNR staff mobilized field staff to the kill site to collect fish samples and field data.

August 3: DNR returned to the kill site to obtain count adjustment data – fish samples are preserved for analysis.

August 13: Additional chloraminated water spill from Woodland Reservoir reported.

August 13: MPCA returned to the kill site to survey the invertebrate community in the kill reach.

Enforcement

Chloraminated potable drinking water entered the city of Duluth storm sewer system prior to entering Tischer Creek. Therefore, this case was referred to the MPCA's Municipal Stormwater unit for enforcement. MPCA staff reached out to Minnesota Department of Natural Resources (DNR), Minnesota Department of Health (MDH), Minnesota Department of Agriculture (MDA), and the Natural Resource Damage Assessment (NRDA) (as per the Interagency Fish Kill Guidance document) to determine appropriate levels of involvement of each agency. It was ultimately determined that only the NRDA would take part in this enforcement action, along with the MPCA.

MPCA Municipal Stormwater staff met with city of Duluth staff on August 15, 2024, to discuss the fish kill. MPCA staff directed city of Duluth staff to update their Stormwater Pollution Prevention Program (SWPPP) Standard Operating Procedures (SOP) to prevent any future planned discharges of potable drinking water into the city's Municipal Separate Storm Sewer System (MS4) system. On October 30, 2024, city of Duluth staff submitted documentation that demonstrated that the city had changed its procedures to prevent planned discharges of potable water into the city's MS4 system.

The MPCA determined that the water quality impacts of the potable water discharge constituted a Nuisance Condition under Minn. R. 7050.0210. The MPCA engaged in a formal enforcement process and ultimately issued a Stipulation Agreement against the city of Duluth for the discharge. The NRDA determined that the discharge had significantly impacted the natural resource and developed an impact statement and settlement agreement to address those impacts.

Enforcement Press Release

City of Duluth reaches settlement with MPCA, DNR on 2024 fish kill, MPCA Press Release, March 30, 2026.

The city of Duluth will pay a \$12,000.00 fine and spend \$190,000.00 in compensation for a 2024 incident that led to a fish kill in Tischer Creek. The compensation is a natural resource damage assessment (NRDA) claim for the incident that killed an estimated 2,300 fish. Nearly 1,600 of those fish were brook trout.

The incident occurred in August of 2024 when city crews released about 1.7 million gallons of treated drinking water from the Woodland Reservoir into Tischer Creek after experiencing a pump problem while sanitizing the reservoir. The water contained chlorine and ammonia as part of the drinking water treatment process and was considered safe to drink but fatal to fish.

The NRDA funds will be used for future restoration projects such as projects that remove barriers to fish migration and allow them to return to the impacted portion of the creek. The city will also implement a learn-to-fish program in coordination with the Hartley Nature Center.

The city of Duluth completed several corrective actions that include changes to the city's stormwater pollution prevention program. It establishes processes and procedures to prevent future discharges from the drinking water system directly to lakes, rivers, streams, and wetlands.

The MPCA remains committed to protecting human health and the environment by enforcing rules and regulations and limiting pollution emissions and discharges from facilities. When regulated parties do not fully comply with regulatory requirements, the resulting pollution can be harmful to people and the environment.

When calculating penalties, the MPCA considers how seriously the violations affected or could have affected the environment, and whether they were first-time or repeat violations. The agency also attempts to recover the economic benefit the company gained by failing to comply with environmental laws in a timely manner.

The NRDA aims to evaluate environmental harm caused by the release. They identify responsible parties and ensure the public is compensated for lost recreational and ecological benefits by implementing restoration projects benefiting the impacted resources.

Appendix A: Figures

Figure 1: Location of water discharges to Tischer Creek and inter-agency fish kill response efforts.

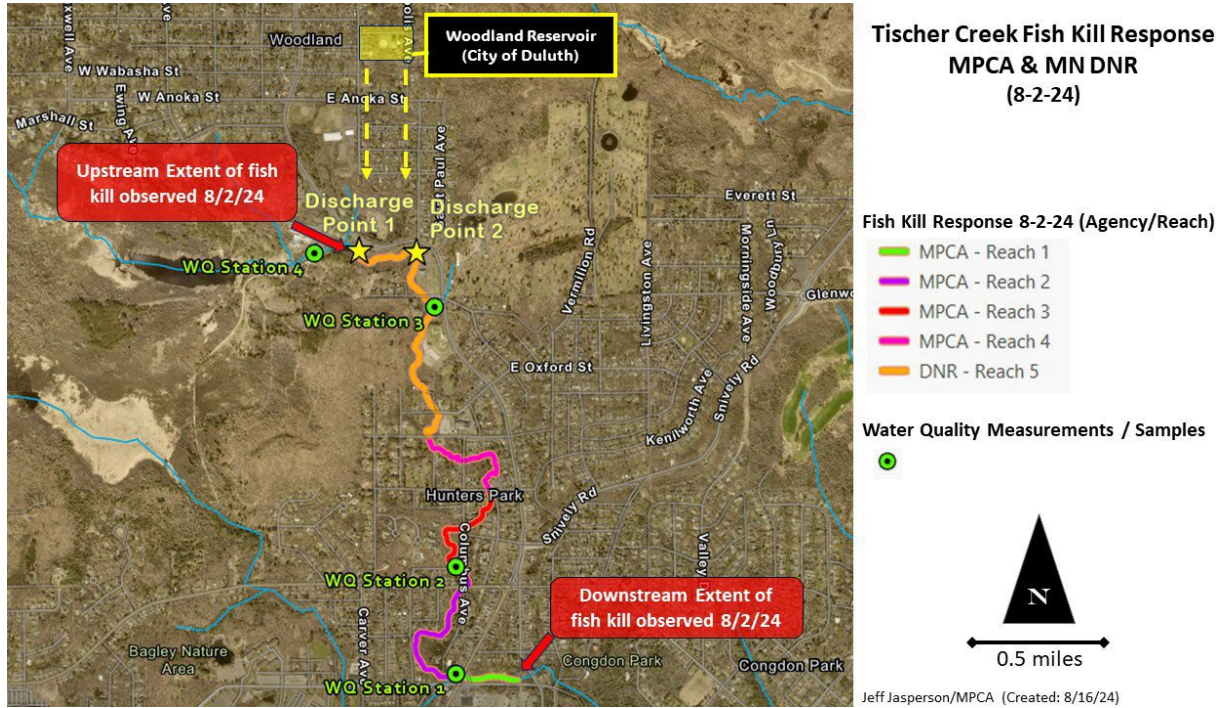


Table 1: Summary of field water chemistry measurements collected at four stations during fish kill response on 8/2/24.

Tischer Creek WQ Measurements 8/2/2024 (YSI ProDSS Meter)				
	10:15 AM	10:30 AM	11:00 AM	11:15 AM
YSI Measurements	Station 1	Station 2	Station 3	Station 4
Water Temperature	20.5	18.5	17.2	16.9
Sp. Conductivity	535	522	508	493
Dissolved Oxygen	6.79	8.53	8.46	8.71
pH	7.42	7.67	7.68	7.77
Transparency (S-Tube)	100+	100+	100+	100+

Figure 2: Continuous stream temperature data recorded above (Hartley Park) and within (Como Park) the fish kill impacted area of Tischer Creek. The Hartley Park monitoring station is located approximately 0.1 miles upstream of the drinking water discharge point, while the Como Park station is 0.4 miles downstream of the discharge point. Temperature data recorded at 30-minute intervals.

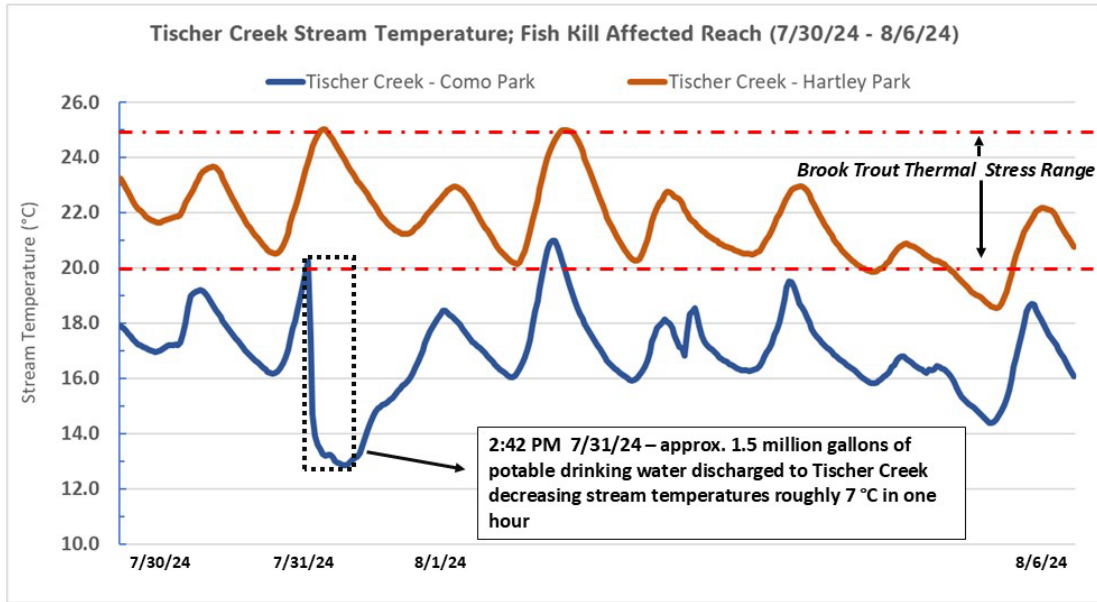


Figure 3: Continuous stream monitoring station temperature monitor above (Hartley Park) and within (Como Park) the fish kill impacted area of Tischer Creek. The Hartley Park monitoring station is located approximately 0.1 miles upstream of the drinking water discharge point, while the Como Park station is 0.4 miles downstream of the discharge point. Temperature data recorded at 30-minute intervals.



Figure 4: Fish carcasses and moribund fish observed during interagency fish kill investigation.



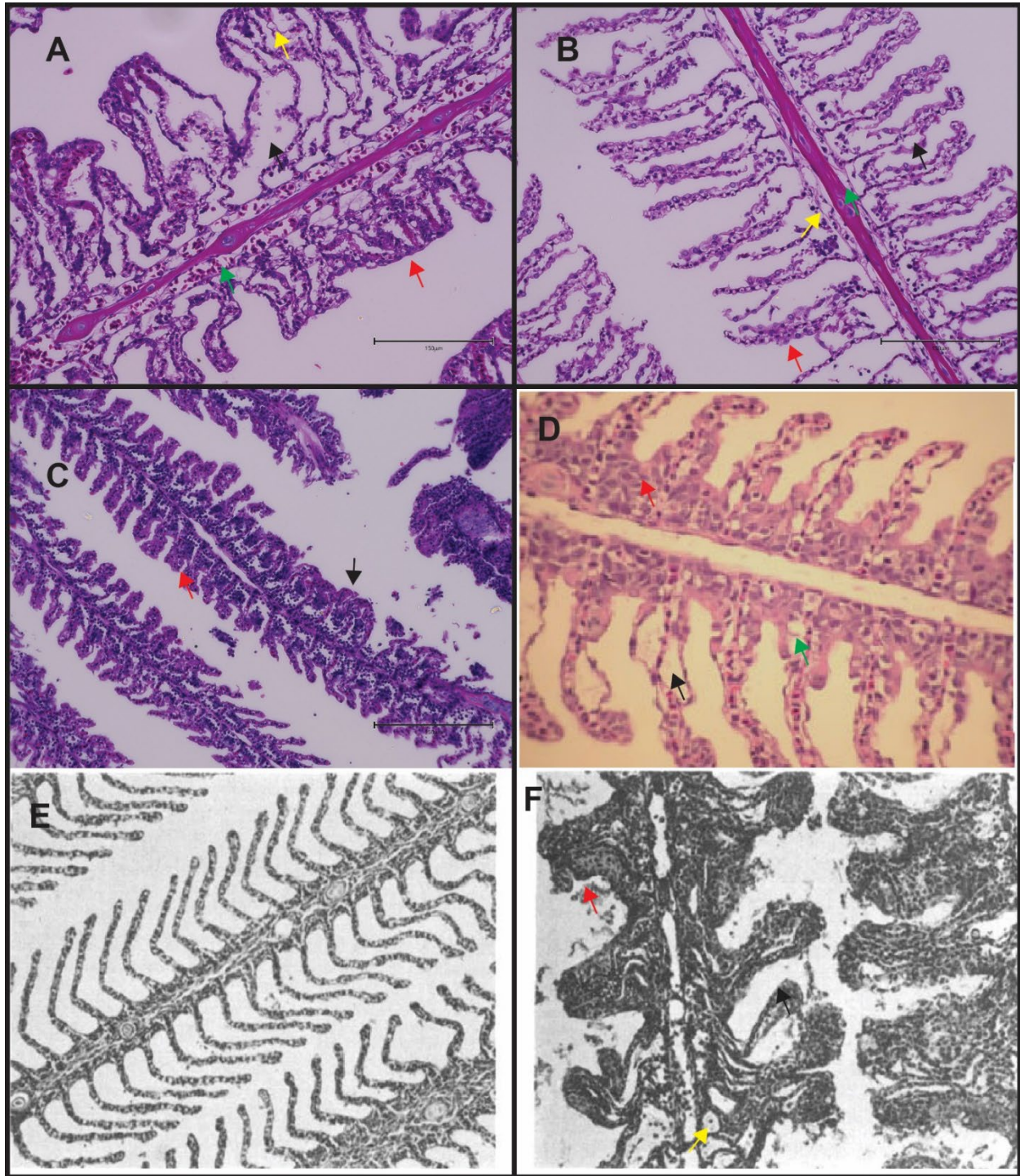
Figure 5: Evidence of recent water level increase in Tischer Creek (photographed 8/3/24).



Figure 6: Evidence of rapid decomposition and depredation on fish carcasses (photographed 8/3/24).



Figure 7: Characteristic histopathology of chlorine exposure (all images at 400x magnification and stained with H&E). A, B brook trout and C blacknose dace sampled from Tischer Creek exposure zone gill on 8/2/24. D rainbow trout exposed to a spill of 0.2 ppm chlorine (Chloride dioxide) – obtained from Mahjoor 2008. E and F, control and experimentally exposed rainbow trout (respectively) – exposed to 0.5 ppm chlorine (monochloramine) - obtained from Bass 1977. Characteristic pathology includes epithelial edema and lifting (black arrows), epithelial hyperplasia and fusing of secondary lamellae (red arrows), hypertrophy of chloride cells (yellow arrows), general anemia (images with green arrows). Note the normal appearance of gill lamellae and epithelium and red blood cell numbers observed in control (unexposed individual - E).



Appendix B: Timeline

1. [Update On Tischer Creek Fish Kill: 1.7 Million Gallons of Drinking Water Released - Fox21Online](#)
2. [Fish kill investigation shows 1.7 million gallons of chloraminated water drained from Duluth reservoir - KSTP.com 5 Eyewitness News](#)
3. [Fish kill investigation on Tischer Creek reports higher amount of water leaked - WDIO.com](#)
4. [City of Duluth responds to Tischer Creek fish kill \(northernnewsnow.com\)](#)
5. [Water Disinfection with Chlorine and Chloramine | Public Water Systems | Drinking Water | Healthy Water | CDC](#)
6. EPA 1985 – Ambient Water Quality Criteria for Chlorine
7. Pasternak 2003, An Ecological Risk Assessment for Inorganic Chloramines in Surface Water, Human and Ecological Risk Assessment 9,2 (453-482)
8. Bass 1977, Histopathological Effects of Chlorine Exposure on Bluegill (*Micropterus Macrochirus*) and rainbow trout (*Salmo Gairdneri*), Water Research 11 (731-735).
9. Siedel 2005, Have Utilities Switched to Chloramines?, Journal of American Water Works Association, 97,10.
10. Labay 1999, A Comparison of Fish Kill Counting Procedures on a Small Narrow Stream, North American Journal of Fisheries Management. 19 (209-214).
11. Zilich 1972, Combined Toxicity of Chlorine Residuals to Freshwater Fish, Journal (Water Pollution Control Federation), 44, 2 (212-220).