

ACUTE POLLUTION IN A CONTEXT OF CHRONIC STRESS: ASSESSING A TOXIC CHEMICAL SPILL TO TRAIL CREEK, AN URBAN STREAM IN THE OCONEE RIVER BASIN, ATHENS, GEORGIA

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REFERENCE: *Proceedings of the 2011 Georgia Water Resources Conference*, held April 11–13, 2011, at the University of Georgia.

Abstract. Trail Creek in Athens, Georgia made headlines in late July and early August, 2010, when its water turned bright blue and became toxic to aquatic life following a catastrophic fire at a chemical plant near its headwaters. Roughly 700,000 gallons of firefighting water mixed with chemicals stored in large volume onsite, running off to deliver formaldehyde and 1,4-dichlorobenzene in high concentrations to East Fork Trail Creek. This runoff also included several other constituents in lesser concentrations, such as acetone, toluene, and additional benzene compounds.

The spill resulted in a fish kill throughout roughly 4 miles of Trail Creek to its confluence with the North Oconee River. State officials estimated the fish kill to be in excess of 15,000 individuals, and said it was one the largest recorded fish kills in the state in roughly 20 years. There was no fish kill observed in the North Oconee River, to which Trail Creek drains, but the river ran a turquoise color for multiple days. Terrain and hydrology contributed to the long persistence of contamination in the water column, with attendant odor and discoloration, throughout the length of Trail Creek.

The incident and its aftermath have raised many important questions about chemical pollution events, their prevention, and proper response procedures. Ecosystem impacts, both acute and chronic, are a topic of high interest in this case, and local researchers and non-profit organizations, which were highly involved in initial response and public information efforts after the spill, are presently monitoring ecological recovery in Trail Creek.

INTRODUCTION

Many streams in urban and developed areas are under chronic stress, and such streams can be vulnerable to acute disturbance and/ or toxic pollution as well. The Upper Oconee watershed, a portion of the Altamaha River basin in Northeast Georgia, has provided two examples of acute toxic events within the last decade. In 2003, Hunnicutt Creek, a tributary of the Middle Oconee River in Athens, Georgia, was severely damaged throughout its entire length by an oil spill to a headwater tributary. Trail Creek, the subject of this paper, is a tributary of the North

Oconee River in Athens, Georgia, and was damaged by a severe chemical spill in 2010.

Trail Creek drains areas of urbanized land cover in its lower runs, primarily on its main stem. The main stem passes through backyards in residential neighborhoods and through two public parks. The headwaters of Trail Creek's east and west forks are largely rural, consisting mostly of pastureland, forest and some commercial, institutional and residential land use. The headwater drainage of East Fork Trail Creek is made up largely of open land, but includes industrial land use as well. It was in a portion of this industrial zone that the toxic chemical spill occurred in summer 2010.



Figure 1. Trail Creek immediately above its confluence with the North Oconee River, July 29, 2010.

Shortly after midnight on July 28, 2010, a fire broke out at J&J Chemical Company on Trans Tech Drive in Athens, Georgia. J&J Chemical Co., based in Athens, Georgia, produces and sells portable sanitation products, deodorizers, cleaners, degreasers, graffiti removers, urinal blocks/ cakes, plastic urinal screens and other products for use in commercial restrooms and portable toilets. Fueled by large volumes of flammable chemicals stored on-site, the fire grew very large and was not controlled until late in the day on July 28 (HEPACO, 2010). Local emergency responders from the Athens-Clarke County Fire Department applied approximately 700,000 gallons of water in the course of fighting the fire (HEPACO, 2010). This water mixed with chemicals stored on-site, overwhelming a small sedimentation pond and running off via a small unnamed tributary into East Fork Trail Creek not far above the stream's entrance into a low-gradient wetland area. Runoff to an adjacent property and the unnamed tributary consisted of burning liquid described as a "river of fire" by emergency response personnel on-site (HEPACO, 2010). Soil contamination was most severe on-site and in the area where this runoff initially slowed on level ground near the unnamed tributary (Eddie Williams, Georgia EPD, *pers. comm.*). Whole trees were burned from ground to canopy in the area of this burning liquid runoff (*pers. obsv.*).

The entire length of Trail Creek took on a vivid electric blue color and gave off pungent chemical odors. While strongest during the first week to two weeks after the spill, the discoloration and odor continued for several months (*pers. obsv.*). The blue coloration did not appear in the lower main stem of Trail Creek until the morning of July 29, the day following the fire (Chris Manganiello, *pers. comm.*). Terrain and hydrology in the headwaters wetland area – specifically the low gradient of the stream there – appeared to influence the initial delayed release of pollutants to the lower runs of the stream and, in part, the persistence of the pollutants' presence in the lower runs of the stream. The blue coloration was released only slowly from the low-gradient wetland area to the rest of the stream over a period of multiple weeks (*pers. obsv.*).

TOXICITY FINDINGS AND REMEDIATION EFFORTS

The surface runoff from J&J Chemical contained high concentrations of formaldehyde and 1,4-dichlorobenzene, along with other chemical constituents in lesser concentrations (HEPACO, 2010). On July 30, HEPACO contractors retained by J&J Chemical Company measured 1,4-dichlorobenzene as high as 15,500 ug/L at the Athena Drive crossing of East Fork Trail Creek, and 407 ug/L in the main stem of Trail Creek at Dudley Park, not far above its confluence with the North Oconee River (E. Williams,

pers. comm.: Surface Water Sample Results from J&J Chemical Company Fire Releases). The Ambient Water Quality Criteria for 1,4-dichlorobenzene is 190 ug/L (U.S. EPA). HEPACO measured formaldehyde in concentrations of 5,550 ug/L at the Athena Drive crossing and in concentrations of 2,310 ug/L at Dudley Park on July 30 (E. Williams, *pers. comm.*: Surface Water Sample Results from J&J Chemical Company Fire Releases).

Concentrations of 1,4-dichlorobenzene in some off-site samples in East Fork Trail Creek remained above the instream water quality standard of the Georgia Rules for Water Quality Control at least until mid-August, and did not fall below detectability limits until November (E. Williams, *pers. comm.*). Surface water sampling ceased detecting formaldehyde by early September. This was also roughly when the bright blue coloration became no longer as distinctly visible as it had been shortly after the spill (E. Williams, *pers. comm.*; *pers. obsv.*). Trail Creek gave off strong chemical odors throughout its entire length especially when the blue coloration was strongest, and continued giving off a faint chemical odor – presumably from perfume oils that were spilled – even into the following year, 2011 (*pers. obsv.*).

Other chemical constituents in the spill reportedly included acetone, glutaraldehyde, diethyl phthalate, 1,2-dichlorobenzene, p-isopropyltoluene, naphthalene, styrene and toluene (HEPACO, 2010). In much of the surface water sampling throughout Trail Creek soon after the spill, however, the high dilution rates that were needed to analyze the high concentrations of the primary constituents of concern, 1,4-dichlorobenzene and formaldehyde, may have masked the presence or degree of concentration of these other constituents (E. Williams, *pers. comm.*).



Figure 2. East Fork Trail Creek at Olympic Drive, Athens, GA, July 29, 2010

Over a four-month period, Dr. Marsha Black and colleagues collected samples of Trail Creek water and tested them for acute and chronic toxicity to the microcrustacean *Ceriodaphnia dubia*, following whole effluent toxicity (WET) protocol as specified by the U.S. EPA. Black and colleagues (2011) report acute toxicity in Trail Creek water collected within two weeks after the spill, and some low-level toxicity in samples collected eight weeks after the spill.



Figure 3 North Oconee River at Whitehall Road, July 30, 2010

In August 2010, modified WET tests conducted by Dr. Black and colleagues to evaluate the effectiveness of activated charcoal in removing toxicity from Trail Creek water helped lead to the installation of two sets of activated charcoal filters by HEPACO contractors under the direction of the Georgia Environmental Protection Division along upper East Fork Trail Creek (Ted Jackson, GA EPD, *pers. comm.*). Activated carbon filtration began on Aug. 12 but was hampered by high storm flows in the stream for many of the following days. By Sept. 7, with 1,4-dichlorobenzene concentrations no longer decreasing significantly, the remediation contractors switched from activated carbon filtration to surface water air sparging at the same two sites. HEPACO ceased air sparging operations on Oct. 1, 2010. Throughout the autumn of 2010, chemical concentrations in Trail Creek typically rose after rainfall events, while remaining below instream water quality standards (E. Williams, *pers. comm.*).

In fall 2010, Dr. Jay Shelton and colleagues tested for toxicity in Trail Creek sediments using the aquatic crustacean *Hyallolela azteca*, finding toxicity to be significantly higher in samples from the wetland area near J&J Chemical Company than from elsewhere in Trail Creek or in reference samples (J. Shelton, *pers. comm.*). However, Shelton and colleagues also found evidence of

other chemicals not known to have come from the J&J Chemical Company fire. It is possible, though by no means clear, that other chemicals in East Fork Trail Creek sediments may have come from a prior chemical spill reported to have taken place at Noramco Pharmaceuticals, whose manufacturing facility neighbors the J&J Chemical property and the wetland area of East Fork Trail Creek (HEPACO, 2010). Despite the lack of knowledge about the source of additional contaminants, these findings by Shelton and colleagues serve, at a minimum, as a reminder of the many, various and often unknown acute pollution sources which urban streams may face. This is in addition to the chronic stressors typically influencing a stream like Trail Creek simply by virtue of the urbanized land cover making up a significant portion of its drainage.

As of this writing, it is unclear what further remediation actions, if any, may be taken in Trail Creek. Any further remediation ordered by Georgia EPD depends on the information in the Closure Report of the Remedial Action Plan (dated Aug. 20, 2010), due to Georgia EPD in late January, 2011.

BIOLOGICAL DAMAGE AND RECOVERY MONITORING

Fish kill investigators with the Georgia Department of Natural Resources Wildlife Resources Division documented a fish kill throughout the 4-mile affected reach of Trail Creek to its confluence with the North Oconee River on July 29, 2010. Based on specimens collected, they estimated the total number killed at 15,850 fishes (O'Rourke 2010). This was said to be the one of the largest documented fish kill events in Georgia in roughly 20 years (Shearer 2010). The investigators also observed dead turtles, frogs, crayfish and dragonflies, especially in the low-gradient wetland area, where I also observed a dead turtle (O'Rourke 2010; *pers. obsv.*). They found depressed dissolved oxygen (DO) only where the chemical spill first entered East Fork Trail Creek, and found normal DO levels at other sampling locations downstream throughout Trail Creek (O'Rourke 2010). They did not (nor did I) find evidence of a fish kill at any point in the North Oconee River, into which Trail Creek drains (O'Rourke 2010; *pers. obsv.*).

The spill was devastating to the aquatic macroinvertebrate community in Trail Creek as well. On Aug. 14, 2010, volunteers with the Upper Oconee Watershed Network (UOWN) performed their quarterly monitoring on streams throughout the Athens area, focusing more attention than usual on Trail Creek. UOWN employs the Georgia Adopt-A-Stream biotic index, in which streams are scored using the Save Our Streams (SOS) Program of the Izaak Walton League of America, which is based on the presence or absence of "sensitive,"

“somewhat sensitive,” and “tolerant” invertebrate taxa. Numerical biotic scores are used to indicate water quality (excellent > 22, good = 17-21, fair = 11-16, poor < 11) (Georgia AAS 2004).

A sampling site in Dudley Park on the lower main stem of Trail Creek, near its mouth, received a very poor score of 3 on the Georgia Adopt-A-Stream biotic index on Aug. 14 (UOWN, *unpublished*). By Nov. 13, when the group sampled the stream again, the same site scored a 6 on the index, still in the “poor” category (UOWN, *unpublished*). UOWN plans to continue monitoring macroinvertebrate recovery in Trail Creek, and has added sites on the East Fork nearer to J&J Chemical Company for biological monitoring. The group has received some financial support from the Oconee Rivers Audubon Society for this effort. The recovery of life in the stream is a topic of high interest among the local public and the local news media. This high level of local interest in this particular incident has also brought about a greater degree of public discussion in the local media and elsewhere of stream health in general.

LESSONS LEARNED: PREVENTION AND RESPONSE

The response by public agencies to the Trail Creek chemical spill revealed problems that have been and continue to be the topic of assessment in the local community and at Georgia EPD. Many of these problems centered on public information regarding the environmental and human health hazard posed by the spill. Public notification, in turn, was dependent on effective interagency and intergovernmental coordination. This intergovernmental coordination was somewhat lacking during the response to the fire and spill. An After Action Review by Emergency Response staff at Georgia EPD identified problems in intergovernmental communication during the J&J Chemical Company fire, which slowed state officials’ response to the fire and surface water spill. The same Review proposed adjustments to the structure of Emergency Response staffing at Georgia EPD in order to attempt to address some of these problems.

In January 2011, the report of the Athens-Clarke County (ACC) Overview Commission, an appointed body which periodically reviews the general operations of the Athens-Clarke County Unified Government, recommended that the ACC Manager’s Office “[u]se the Trail Creek spill (2010) as a case study to evaluate the effectiveness of the Athens-Clarke County Emergency Management Agency Emergency Operations Plan,” in view of both communications and chain-of-command responsibilities. An internal Athens-Clarke County memorandum in August 2010 identified specific problems

especially in the notification of local elected officials about the severity of the spill.

In the wake of this incident, local citizens have discussed reviving an active, formal Local Emergency Planning Committee to improve the dissemination of information about what materials are present in local industrial and research facilities. This could better inform fire response in addition to enabling a more timely understanding of what materials may have been spilled in any similar case in the future.

Measures such as the thrust for creation of a Local Emergency Planning Committee for Athens-Clarke County could be among the key positive outcomes from the Trail Creek chemical spill. It is also worth considering faster strategies for surface water remediation when a wetland area affects the downstream dispersion of chemical contamination, as it appeared to do in this case. In this regard it is well worth taking note of the key role that academic researchers at the University of Georgia played in informing the surface water remediation efforts on East Fork Trail Creek.

ACKNOWLEDGMENTS

I thank Dr. Marsha Black, Dr. Amy Rosemond, Dr. Jay Shelton and their students at the University of Georgia for their attention to Trail Creek after the J&J Chemical Company spill. Ted Jackson and Eddie Williams of the Georgia Department of Natural Resources Environmental Protection Division, Hazardous Waste Management Program, who are cited in several instances here, have been very helpful in providing information on the remediation of the J&J Chemical Company property and Trail Creek. Several nonprofit organizations have been instrumental in work involving Trail Creek in the wake of this incident alongside the Oconee River Project of Altamaha Riverkeeper: the Upper Oconee Watershed Network, Athens Grow Green Coalition, Georgia River Network and Oconee Rivers Audubon Society. Chris Manganiello, cited here, is a member of two of these organizations and a resident of the Chicopee-Dudley neighborhood near Trail Creek; his observations of the stream and attention to this issue have been very helpful as well. This manuscript benefited from the useful comments and suggestions of two anonymous reviewers and of Jessica Sterling, a Masters Degree student in the Odum School of Ecology at the University of Georgia.

REFERENCES

- 2010 Athens-Clarke County Overview Commission. Review of the Athens-Clarke County Unified Government. Athens, Georgia. 82 pp.
- Black, M., E. Roberts, S. Fuller, K. Kaur, A. Martin, M. Chan, M.K. Crews, S. Doydora, C. Hill, V.

- Leviton, R. Lisk, W. Mason-Deese, M. Natrajan, H. Plumber and C. Zipperer. 2011. Acute and Chronic Toxicity in an Urban Creek Receiving Runoff from an Industrial Fire. *Proceedings of the 2011 Georgia Water Resources Conference*, Athens, Georgia.
- Crotty, Patrick. 2003. Spill Worst on Record in Athens. *Athens Banner-Herald*. Aug. 18.
- Georgia Adopt-A-Stream, 2004. Biological & Chemical Stream Monitoring. Georgia Department of Natural Resources Publication. Atlanta, Georgia. 66 pp.
- HEPACO, Inc., 2010. Remedial Action Plan: J&J Chemical Company, Athens, GA. Tucker, Georgia. 65 pp.
- O'Rourke, Patrick, 2010. Fish Kill Investigation: East Fork Trail Creek/ Trail Creek, Athens, GA – Clarke County. Georgia Department of Natural Resources Wildlife Resources Division. Social Circle, Georgia. 6 pp.
- Shearer, Lee. 2010. 15,000 Fish Estimated Killed by Toxins. *Athens Banner-Herald*. Aug. 6.
- United States Environmental Protection Agency. *National Recommended Water Quality Criteria*. <http://water.epa.gov/scitech/swguidance/waterquality/standards/current/index.cfm>. Viewed February 2011.