An Initial Study into the Effects of Fireworks on the Water Quality of Lake George

Photo by Eric Paparatto

The Lake George Association

Fireworks & Lake George

- **Background**
  - **Lake George fireworks**
  - **Fireworks contaminants**
- **Study and Results**

Funding for this study provided by the Helen V. Froehlich Foundation

Fireworks & Lake George

- **Fireworks in LGV on Thursdays in July and August**
- **Private facilities such as The Sagamore also have displays**
- **Other municipalities such as Bolton and Hague**
- **No permit required – so exact number and location of all displays not known**

Timeline

- **In past years, discussion at both the LGV Planning Board and LGPC meetings has arisen over concern about fireworks.**
- **In 2008, due to a number of shows right in a row, interest arose again, a bit louder this time.**
- **2008: Bill Dow of LG Steamboat Company used barge for 11 Village shows and other contracted shoots – for a total of 21 shows that year.**

Timeline

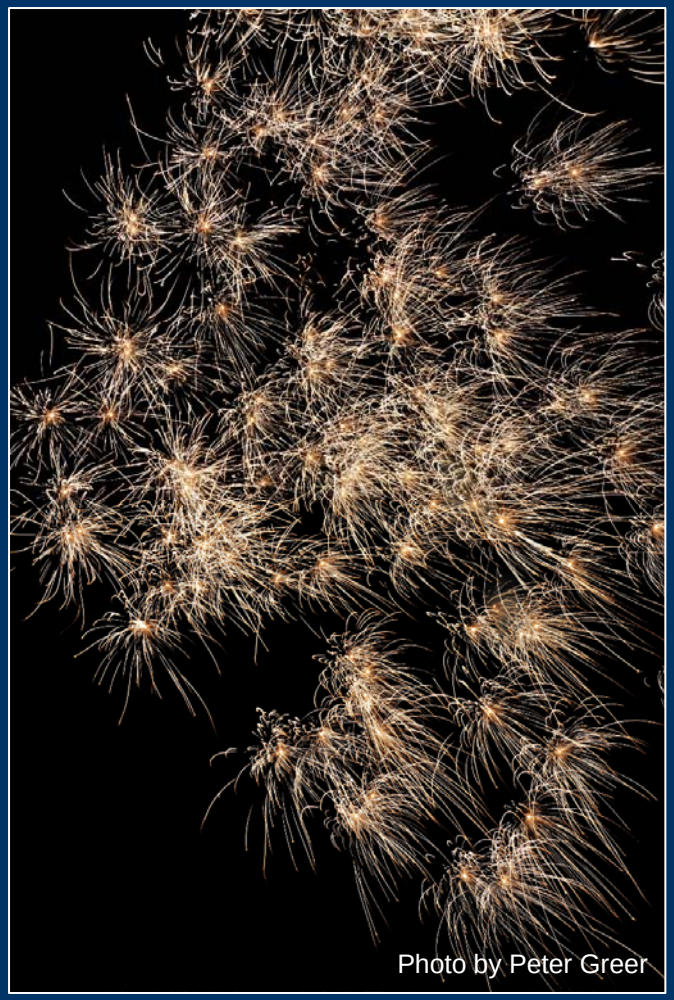
- **LGA hosted meeting in October of 2008 with local officials.**
- **LGA followed up by meeting with Jeff Alonzo, owner of Alonzo Fireworks, the company hired for most shows on the lake**

Fireworks & Lake George

- **There were still a lot of questions, so we decided to follow up with a study in the summer of 2009**

Environmental Impacts of Fireworks

- **Short term predictable impacts**
  - **Elevated noise levels**
  - **Accumulation of debris**
  - **Smoke suspended in the air**
- **The long term, less obvious impacts of fireworks on the environment are not well understood.**



Fireworks Contaminants

Firework Ingredients and their Dangers

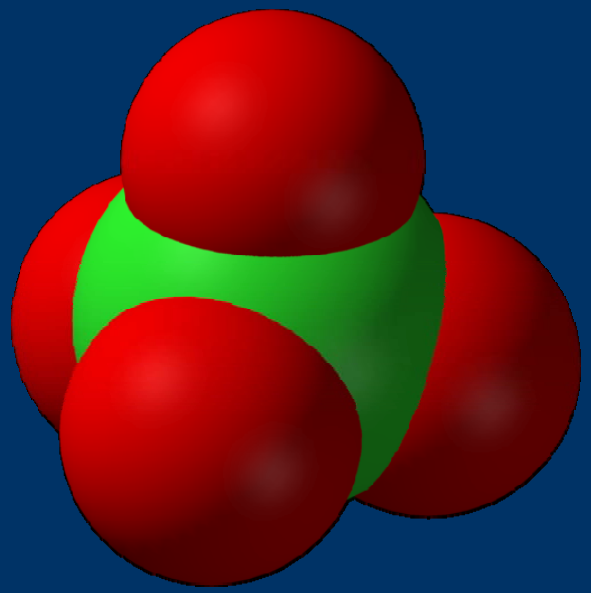
Fireworks are composed of many different elements, each contributing to the noise, color or propellant. While these ingredients combine to form a beautiful spectacle, many of them are very dangerous. Here's a list of a few common firework ingredients, their use, and what makes them so dangerous.

Toxic Element	Fireworks Usage	Toxic Effect of Fallout Dust & Fumes
Lead Nitrate/Dioxide/Chloride	oxidizer	Bioaccumulation; developmental danger for children and the unborn; may remain airborne for days; poisonous to plants and animals
Barium	glittering greens	Extremely poisonous, radioactive
Lithium	blazing reds	Slightly toxic
Rubidium	purple colors	Slightly radioactive; can replace calcium in body
Strontium	blazing reds	Can replace calcium in body; can be radioactive
Copper compounds	blues	Dioxin pollution
Aluminum	brilliant whites	Contact dermatitis
Ammonium Perchlorate	propellant	Can contaminate ground and surface waters; can disrupt thyroid functions
Cadmium	firework colors	Extremely toxic, carcinogenic; can bioaccumulate
Potassium Nitrate	in black powder	Toxic dusts, carcinogenic sulfur-coal compounds
Sulfur Dioxide	gaseous byproduct of sulfur combustion	Acid rain from sulphuric acid affects water sources, vegetation and causes property damage

List from NH DES fact sheet "Fireworks and New Hampshire's Lakes"

Perchlorate

- New Age Contaminant
- Propellant in fireworks
- Does not combust 100%
- Health and environmental concerns associated with perchlorate are still not well understood
- Attenuation in aquatic systems may be linked to the availably of organic carbon to provide energy for perchlorate reducing bacteria



ClO_4^-

Perchlorate

- **Absorbed by the thyroid gland in place of iodine**
- **Can interfere with the production of thyroid hormone, which is essential to metabolism and mental development (so exposure thought to be especially harmful to fetuses)**

- **No federal or NYS drinking water standard for perchlorate**

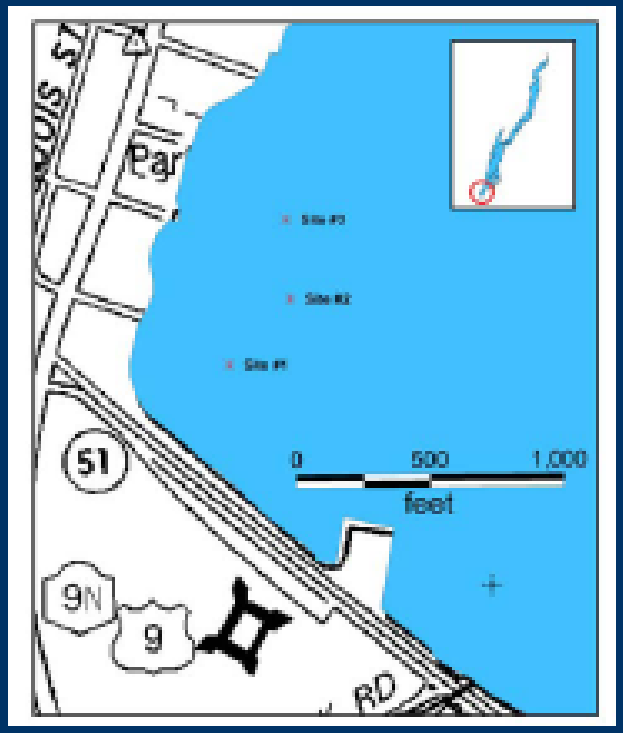
Antimony and Barium

- **Antimony (Sb)**
  - **Used for glitter effects**
  - **Shown to cause heart problems and stomach ulcers at increased concentrations in humans.**

- **Barium (Ba)**
  - **Used for green color and to stabilize other volatile elements**
  - **Water soluble forms of barium have been linked to increased blood pressure, kidney and heart damage, and breathing difficulties in humans and can bioaccumulate in fish and other aquatic organisms**

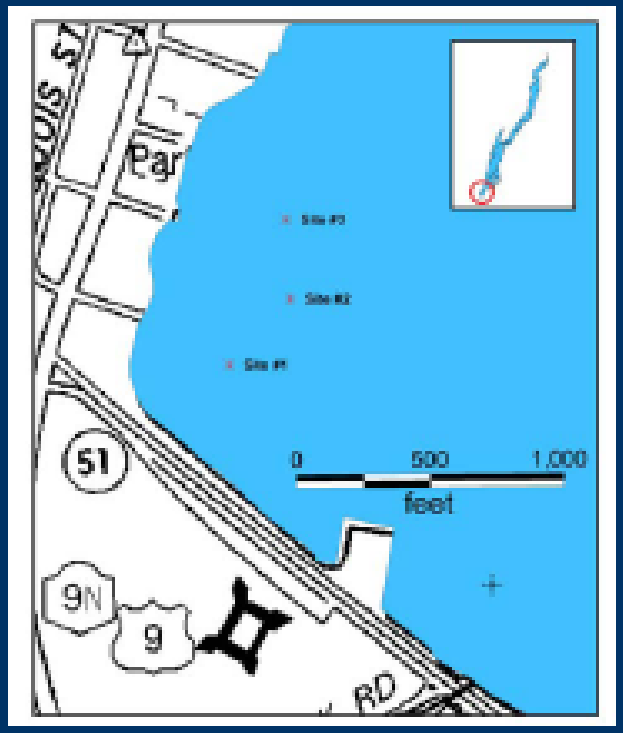
Study Design and Methods

- **Surface water samples collected at three sites in Lake George Village near weekly fireworks displays.**
- **Sampled in June before any 2009 displays, and then during July**
- **Example: for show on July 3, samples collected on July 2,4, and 5th at 8 am.**



Study Design and Methods

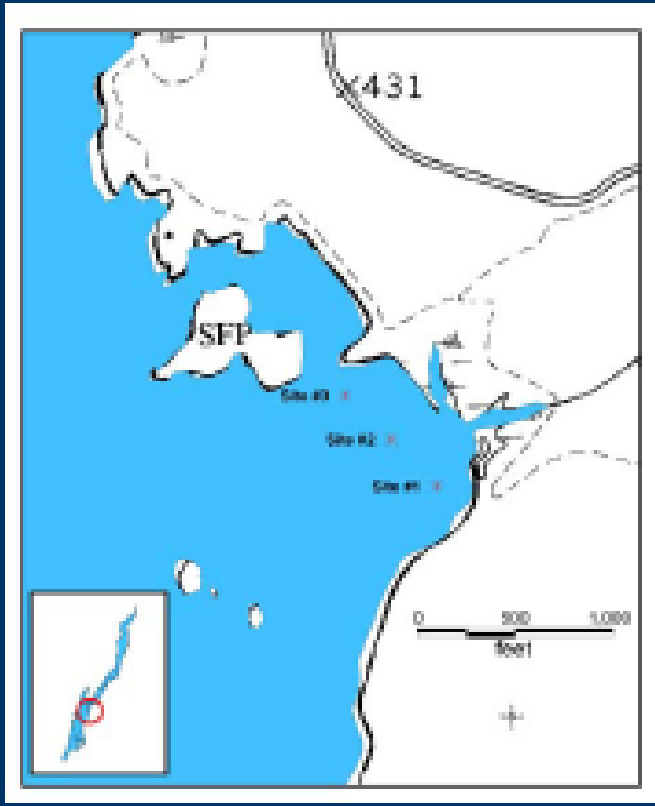
- **2 samples collected at each site, 1 for Perchlorate analysis and one for Antimony and Barium**
- **We collected samples before and after 5 fireworks events, so a total of 9 samples were analyzed for each contaminant for each event.**



Study Design and Methods

- **We also collected sediment at the three sites in LG Village where the water samples were taken, and at a different site with similar bottom conditions, but where for as best as we could tell no fireworks had even been deployed.**

- **This was done just once.**



Sediment samples taken near Shelving Rock

Results - Perchlorate

- No measurable change in perchlorate levels was detected at an MDL of 0.0012 mg/L
- Reported in reference to level of 000.2 mg/L since that is the MASS DEP's drinking water standard for perchlorate – the only state that has established a standard

	Perchlorate (ClO4–) mg/L		
Date	Site 1	Site 2	Site 3
6/17/2009	<0.002	<0.002	<0.002
6/20/2009	<0.002	<0.002	<0.002
6/21/2009	<0.002	<0.002	<0.002
7/2/2009	<0.002	<0.002	<0.002
7/4/2009	<0.002	<0.002	<0.002
7/5/2009	<0.002	<0.002	<0.002
7/8/2009	<0.002	<0.002	<0.002
7/10/2009	<0.002	<0.002	<0.002
7/11/2009	<0.002	<0.002	<0.002
7/15/2009	<0.002	<0.002	<0.002
7/17/2009	<0.002	<0.002	<0.002
7/18/2009	<0.002	<0.002	<0.002
7/22/2009	<0.002	<0.002	<0.002
7/24/2009	<0.002	<0.002	<0.002
7/25/2009	<0.002	<0.002	<0.002

Results- Barium and Antimony

- **Antimony also had no measurable change at a reporting limit of 0.005 mg/L and while barium had a slight changes, there were no measureable trends.**

Antimony (Sb) mg/L			
Date	Site 1	Site 2	Site 3
6/17/2009	<0.005	<0.005	<0.005
6/20/2009	<0.005	<0.005	<0.005
6/21/2009	<0.005	<0.005	<0.005
7/2/2009	<0.005	<0.005	<0.005
7/4/2009	<0.005	<0.005	<0.005
7/5/2009	<0.005	<0.005	<0.005
7/8/2009	<0.005	<0.005	<0.005
7/10/2009	<0.005	<0.005	<0.005
7/11/2009	<0.005	<0.005	<0.005
7/15/2009	<0.005	<0.005	<0.005
7/17/2009	<0.005	<0.005	<0.005
7/18/2009	<0.005	<0.005	<0.005
7/22/2009	<0.005	<0.005	<0.005
7/24/2009	<0.005	<0.005	<0.005
7/25/2009	<0.005	<0.005	<0.005

Table 2: Antimony concentrations at three sampling sites from June 17 – July 25.

Barium (Ba) mg/L			
Date	Site 1	Site 2	Site 3
6/17/2009	0.006	0.006	0.006
6/20/2009	0.006	0.006	0.006
6/21/2009	0.006	0.006	0.006
7/2/2009	0.005	0.005	0.005
7/4/2009	0.005	0.005	0.006
7/5/2009	0.005	0.005	0.005
7/8/2009	0.006	0.006	0.006
7/10/2009	0.006	0.006	0.005
7/11/2009	0.006	0.005	0.006
7/15/2009	0.006	0.006	0.005
7/17/2009	0.006	0.006	0.006
7/18/2009	0.005	0.006	0.006
7/22/2009	0.006	0.006	0.006
7/24/2009	0.006	0.006	0.006
7/25/2009	0.006	0.006	0.006

Table 3: Barium concentrations at three sampling sites from June 17 – July 25.

Results - sediment

Sediment Samples: 10/7/2009	Perchlorate (ClO_4^-) mg/L
Lake George Village—Site 1	<0.002
Lake George Village—Site 2	<0.002
Lake George Village—Site 3	<0.002
Shelving Rock—Site 1	<0.002
Shelving Rock—Site 2	<0.002
Shelving Rock—Site 3	<0.002

Discussion

- We found no changes in the contaminants that we tested for before or after fireworks events
- We also found very low levels of these contaminants
- However, these results are only preliminary

Further Study is still Needed

- **Other studies elsewhere have found changes in perchlorate levels associated with fireworks (they could measure smaller amounts than the lab we used could).**
- **We also only tested for a few of the possible contaminants**
- **Our findings are available for others who may wish to pursue this subject further**

Looking Ahead

- **Perchlorate-free fireworks are available – however they cost more.**
- **While our study findings do not suggest the need at this time – we acknowledge that it is by no means comprehensive – so we can not know for certain if there is a need to be concerned over perchlorate or not – all we can do is weigh our options based on the knowledge we have available to us**
- **It might still be a prudent idea to investigate the cost of perchlorate-free fireworks – and set a good example for other lakes to follow…**

In the mean time…

- It seems to be a good idea to keep track of the fireworks displays over Lake George
- A simple registration form could be required for anyone to have a show over the lake
- This way we could keep track of the number of shows, where they take place, and what fireworks are used

More Info

- **Our full report with data is available on the LGA table along with the article from the journal *Oceanography* based on our study**

- **We also have a number of references to scientific literature related to Perchlorate – and popular news articles about conflicts over fireworks in the back of the report.**