

Spring 2010 Indoor Air Quality Sampling and Analysis Report
Tronox LLC
Henderson, Nevada

September 22, 2010

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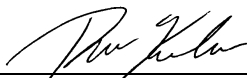
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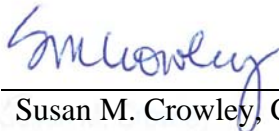


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Responsible Certified Environmental Manager (CEM) for this project

I hereby certify that all laboratory analytical data was generated by a laboratory certified by the NDEP for each constituent and media presented herein.

I hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of my knowledge, comply with all applicable federal, state and local statutes, regulations and ordinances.



Susan M. Crowley, CEM 1428 Exp.:03/08/11
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FIGURE

- 1 Site Map Showing Air Sampling Locations

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- 1 Summary of Air Sampling Field Measurements
- 2 Summary of Air Sampling Analytical Results
- 3 Summary and Comparison of Site Data

APPENDIX

- A Laboratory Report (included on CD)



1.0 INTRODUCTION

This report presents the results of indoor air testing performed by Northgate Environmental Management, Inc. (Northgate) on June 21, 2010 at the Tronox LLC (Tronox) facility located in Henderson, Nevada (the Site). The report describes the methods and procedures used to implement the *Revised Indoor Air Quality Investigation Work Plan, Tronox LLC Facility, Henderson, Nevada* (Work Plan; Northgate, 2010a,b) approved by the Nevada Division of Environmental Protection (NDEP) on June 18, 2010 (NDEP, 2010). As described in a June 16, 2010 memo to NDEP (Northgate, 2010c), air sampling data will be used as part of the uncertainty evaluation in the Site-wide soil gas health risk assessment (HRA) evaluation to address the indoor air vapor intrusion exposure pathway.

1.1 Background

In May 2008, a soil gas survey was conducted under the oversight of NDEP as part of the Phase B Source Area Investigation at the Site. Analytical results for samples collected during the soil gas survey were presented in a Data Validation Summary Report (DVSR) that was submitted to NDEP on October 13, 2008 (ENSR, 2008) and approved by NDEP on October 20, 2008. In general, chloroform, trichloroethene (TCE), and carbon tetrachloride were detected at elevated concentrations in soil gas samples obtained at the Site; however, the results of previous investigations indicated that some of these elevated volatile organic compound (VOC) concentrations in soil gas may be associated with off-site groundwater sources.

As the initial step of the Indoor Air Quality (IAQ) investigation, a building evaluation was conducted on May 5 and 6, 2010 to collect information on the location of buildings, type of building construction, foundation, building ventilation (e.g., heating, ventilation, and air conditioning [HVAC]; open building; etc.), and building occupancy use (including possible use of products containing VOCs by building occupants). The June 3, 2010 technical memorandum *Proposed Indoor Air Sampling Locations, Tronox Facility, Henderson, Nevada, Supplement to Indoor Air Quality Investigation Work Plan, Henderson, Nevada* (Northgate, 2010b) presented the results of the building evaluation. The memorandum recommended that the IAQ investigation include the Unit Building 3, the Administration Building, the wash/change house (wash house), the boron production facility, the maintenance shop, the laboratory, the field office, and the steam plant; however, sampling at the maintenance shop became unfeasible following a recent fire that rendered the building uninhabitable. An additional outdoor location was selected between Unit Buildings 4 and 5 in the vicinity where VOC concentrations in soil gas have previously been detected above average.



The objective of the IAQ sampling and analysis program was to collect data to evaluate the indoor air vapor intrusion exposure pathway and use the findings to supplement the indoor air modeling efforts to be conducted as part of the HRA. This initial round of sampling was not intended to provide information to quantitatively extrapolate between modeled versus measured indoor air concentration or to address issues associated with the variability of indoor air sample results. Tronox will continue discussions with NDEP regarding the potential applicability of indoor air sampling results in the HRA. This report includes a description of the methods used to collect and analyze samples during the June 21, 2010 sampling event, a summary of field measurements recorded during the event, and tabulated analytical results. As presented in the approved Work Plan, the target analytes consisted of chloroform, TCE, and carbon tetrachloride.



2.0 SAMPLING AND ANALYSIS METHODS

On June 21, 2010, Tronox performed air sampling in accordance with the approved Work Plan (Northgate, 2010a,b) and corresponding technical memoranda, and collected a total of 23 air samples, including 15 indoor samples, six outdoor samples near the vicinity of building air intakes, and two ambient air samples. Air inlet samples were located as close as possible to air intake locations. Rooftop air inlet samples were not obtained due to access and safety limitations and potential sample compromise from excess heat on the rooftops. In some instances, inlet samples were moved to areas that afforded more sample protection. On the day of sampling, a certified industrial hygienist inspected the buildings to ensure consistency with the information gathered during the initial building evaluation. The following sections describe the sampling locations and activities.

2.1 Sample Locations

Tronox collected a total of 23 air samples at locations shown on Figure 1 and summarized below:

- Unit Building 3 (seven indoor and one proximate air intake sample);
- Administration Building (one indoor and two outdoor air samples);
- Wash/change house (one indoor and one proximate air intake sample);
- Boron production facility (two indoor samples);
- Laboratory (two indoor and one proximate air intake sample);
- Field office (one indoor and one proximate air intake sample);
- Steam plant (one indoor sample);
- Between Unit Building 4 and 5 (one outdoor ambient air sample); and
- West of the laboratory (one outdoor upwind ambient air sample).

The following sections describe the number and type of samples collected at each location.

2.1.1 Unit Building 3

A total of six indoor air samples were collected inside four offices and one break room at the engineering office in the Unit Building 3 basement, including one duplicate sample located in one of the offices. An additional indoor air sample was collected on the unit floor (open area) of the building. One outdoor air sample was collected near the air intake on the south side of the Unit Building 3 engineering office.



2.1.2 Administration Building

One indoor air sample was collected inside an office room at the Administration Building. Two outdoor air samples were collected on the south side of the Administration Building near the back parking lot area. Only one outdoor sample was planned but a second sample was obtained after the sample flow controller on the initial sample was thought to be compromised.

2.1.3 Wash/Change House

One indoor air sample was collected in the men's shower room at the wash house, and one outdoor air sample was collected on the west side of the building near the air intake of the men's portion of the wash house.

2.1.4 Boron Production Facility

Two indoor air samples were collected inside the Boron Production Facility, including one sample in a control room and a second sample in the supervisor's office.

2.1.5 Laboratory

Two indoor air samples were collected inside the laboratory, one sample in each of the two chemists' offices. One outdoor air sample was collected near the air intake on the north side of the laboratory building.

2.1.6 Field Office

One indoor air sample was collected inside the field office trailer, and one outdoor air sample was collected near the air intake on the west side of the trailer.

2.1.7 Steam Plant

One indoor air sample was collected inside a control room at the steam plant.

2.1.8 Between Unit Buildings 4 and 5

One ambient outdoor air sample was collected between Unit Buildings 4 and 5.



2.1.9 West of the Laboratory

One upwind outdoor air sample was collected at a location approximately 50 feet west of the laboratory.

2.2 Sampling and Analysis Methods

Air samples were collected using passivated steel 6-liter Summa canisters for selected ion monitoring (SIM) analysis by Environmental Analysis Service, Inc. (EAS), an Environmental Laboratory Approval Program certified laboratory. All sampling media (both flow controllers and canisters) were provided and certified by the laboratory. Sampling was conducted between 7 a.m. and 7 p.m. (normal Site working hours), with indoor air samples collected over an approximate 8-hour work day.

The samples were collected using a sampling train of components that regulate the rate and duration of sampling into the Summa canisters. For indoor air sampling, the flow controllers were set to collect approximately 5 liters of air over an 8-hour sampling interval. For outdoor air sampling, the flow controllers were preset by the laboratory to collect approximately 5 liters of air over an approximate 9- to 10-hour sampling interval. Outdoor sampling began 1 to 2 hours prior to indoor air sampling and continued to be collected until approximately 30 minutes prior to the end of the corresponding indoor air sampling period. All indoor air samples were collected at a height approximately 3 to 5 feet above the floor to represent a height at which occupants are normally seated. Outdoor samples were generally obtained near the vicinity of air intakes and were collected at heights ranging from 2 to 6 feet.

Table 1 summarizes the sampling field records, including sampling start and end times, temperature readings, initial and final canister pressure measurements, and calculated sample duration.

Between June 22 and 23, 2010, the air samples were transferred under proper chain-of-custody protocol to the EAS laboratory. EAS analyzed the 23 air samples between June 29 and July 2, 2010 for concentrations of the target analytes (chloroform, carbon tetrachloride, and TCE) using the U.S. Environmental Protection Agency (USEPA) Method TO-15 gas chromatograph/mass spectrometry (GC/MS) SIM. A detailed description of TO-15 GC/MS SIM is included in the laboratory report in Appendix A.



2.3 Meteorological Data

Localized meteorological data for the sample date were obtained from the National Oceanographic and Atmospheric Administration (NOAA) for the Henderson Executive Airport meteorological station, which is located near Las Vegas.

Over the 12-hour sample period on June 21, 2010:

- Temperatures ranged from a low of 74° Fahrenheit (°F), in the early morning to a high of 95°F in the afternoon;
- No precipitation was reported during the sampling event;
- The observed barometric pressure ranged between a high of 29.76 inches of mercury (in. Hg) in the late morning and a low of 29.67 in. Hg at the end of the sampling event; and
- The wind was predominately blowing from the southwest at an average speed of approximately 13 miles per hour.



3.0 SAMPLING AND ANALYSIS RESULTS

3.1 Air Sample Test Results

This section presents a brief description of the indoor, outdoor, and ambient air results for each sampling location (e.g., building, facility, or outdoor area). A summary of chemical analytical results for all samples is presented in Table 2, and laboratory analytical reports are presented in Appendix A.

3.1.1 Unit Building 3

Seven indoor air samples were collected and analyzed for the target analytes: six samples (including one duplicate) were collected from office spaces, and one was collected from the Unit Building floor area. Chloroform concentrations in the office space samples ranged from 1.203 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) to 1.997 $\mu\text{g}/\text{m}^3$. TCE concentrations ranged from 3.154 $\mu\text{g}/\text{m}^3$ to 15.782 $\mu\text{g}/\text{m}^3$. Carbon tetrachloride was not detected above its laboratory reporting limit (RL) in three of the six office samples, and ranged from 0.733 $\mu\text{g}/\text{m}^3$ to 0.857 $\mu\text{g}/\text{m}^3$ in the other three. Target analytes were below the RLs in the floor area sample, and chloroform and carbon tetrachloride were also below their respective method detection limits (MDLs).

One outdoor building air intake sample was also collected and analyzed for the target analytes, with no constituent detected above the RLs.

3.1.2 Administration Building

Chloroform, carbon tetrachloride, and TCE were detected at concentrations of 0.53 $\mu\text{g}/\text{m}^3$, 1.12 $\mu\text{g}/\text{m}^3$, 2.827 $\mu\text{g}/\text{m}^3$, respectively, in the one indoor air sample collected. Constituents were below their corresponding RLs in the two building air intake samples, except for chloroform, which was present in one sample at a concentration of 0.618 $\mu\text{g}/\text{m}^3$.

3.1.3 Wash/Change House

Chloroform, carbon tetrachloride and TCE were detected in the one indoor air sample collected at concentrations of 3.417 $\mu\text{g}/\text{m}^3$, 0.793 $\mu\text{g}/\text{m}^3$, 0.601 $\mu\text{g}/\text{m}^3$, respectively. Chloroform and TCE were both below their respective RLs in the building air intake sample, while carbon tetrachloride was detected at a concentration of 0.815 $\mu\text{g}/\text{m}^3$.



3.1.4 Boron Production Facility

The indoor air sample from the control room contained chloroform, carbon tetrachloride, and TCE concentrations of 0.843, 0.79, and 0.572 $\mu\text{g}/\text{m}^3$, respectively. The sample from the supervisor's office contained these constituents at 0.759, 1.018, and 0.655 $\mu\text{g}/\text{m}^3$, respectively.

3.1.5 Laboratory

Two indoor air samples from two adjacent offices within the laboratory were collected and analyzed for the target analytes. TCE was below its RL in both samples, while chloroform concentrations ranged from 1.773 to 2.388 $\mu\text{g}/\text{m}^3$, and carbon tetrachloride concentrations ranged from 1.35 to 1.413 $\mu\text{g}/\text{m}^3$.

No constituent was detected above the RLs in the one outdoor building air intake sample, and TCE was also not detected above its MDL.

3.1.6 Field Office Trailer

Chloroform and carbon tetrachloride were detected at concentrations of 1.332 $\mu\text{g}/\text{m}^3$ and 1.437 $\mu\text{g}/\text{m}^3$, respectively, in the one indoor air sample collected, while TCE was below its RL. In the one outdoor building air intake sample, all constituents were below their corresponding RLs, with TCE also below its MDL.

3.1.7 Steam Plant

Carbon tetrachloride was detected at a concentration of 0.857 $\mu\text{g}/\text{m}^3$ in the one indoor air sample collected, while both chloroform and TCE were below their corresponding RLs.

3.1.8 Between Unit Buildings 4 and 5

In the one outdoor air sample collected, TCE was detected at a concentration of 1.024 $\mu\text{g}/\text{m}^3$, and both chloroform and carbon tetrachloride were below their corresponding RLs.

3.1.9 West of the Laboratory

One outdoor air sample was collected and analyzed for the target analytes, with no constituent detected above RL. TCE was also below its MDL.



3.2 Data Validation

The resulting data from the field and laboratory were examined for conformity to standard quality assurance indicators. The detailed laboratory quality assurance report is included in Appendix A along with the laboratory reports. The findings were:

- With the exception of one outdoor sample at the Administration Building, no sampling equipment conditions were noted. A second sample was obtained at the Administration Building as the first sample's flow controller was thought to be compromised. Both outdoor samples resulted in sample size limitations and elevated detection limits;
- It is also noted that some outdoor proximate inlet air samples were moved as much as 5 to 10 feet from their original locations at various times throughout the day to remove them from direct sunlight and excessive temperatures. The movement of the samples within short distances does not appear to have impacted results;
- The laboratory spike recovery values of 107% (chloroform and carbon tetrachloride) and 102% (TCE), and duplicate laboratory spike recoveries of 106% (chloroform and carbon tetrachloride) and 108% (TCE), were within the laboratory quality control (QC) limits of 70 to 130%;
- The duplicate sample result for the pair IA-U3-02-001 and IA-U3-02-002 (Unit Building 3) showed the TCE concentration to differ by a factor of approximately 2.5, whereas there were insignificant differences in the duplicate results for chloroform and carbon tetrachloride. Review of the TCE results indicates that the duplicate concentration ($15.782 \mu\text{g}/\text{m}^3$) is likely a valid result as other TCE concentrations in the range of 10 to $15 \mu\text{g}/\text{m}^3$ were reported in the nearby offices. Additionally, there was no indication of contamination in the sampling media, as duplicate results for chloroform and carbon tetrachloride were in good agreement; and
- The detection limits for several of the indoor and outdoor air samples were elevated due to sample size limitations. However, none of the detection limits was elevated more than 2.5 times.

A data usability evaluation will be prepared as part of the Site-wide soil gas HRA after completion of the second round of air sampling.



4.0 INTERPRETATION AND DISCUSSION

The objective of the Spring 2010 IAQ sampling event was to collect data to supplement the indoor air modeling efforts and the uncertainty evaluation conducted as part of the Site-wide soil gas HRA. After the second round of testing is completed, the measured air concentrations will be evaluated in terms of modeled indoor air concentrations, and the vapor intrusion pathway will be more fully evaluated as part of the HRA report.

Several factors may influence the concentrations of chemicals measured in indoor air, including building-specific operations and ventilation systems and environmental factors such as ambient and building sources. Statistical interpretation of this initial round of indoor air sampling results is limited based on the small data set. Table 3 provides a summary of average indoor and outdoor measured concentrations for the target analytes and a general comparison to occupational exposure levels, NDEP-modified risk-based commercial indoor air basic comparison levels (BCLs), and EPA-reported indoor commercial and ambient concentrations.

As shown in Table 3, indoor concentrations of target analytes are significantly below their respective occupational exposure levels. Additionally, the mean indoor air concentrations of the target analytes are below their respective risk-based commercial air concentrations for a 1×10^{-5} risk level.

The mean and range of indoor versus outdoor concentrations of carbon tetrachloride were fairly similar, with the highest measured indoor air concentrations detected in the laboratory and the field office. The highest chloroform concentrations were detected in the wash house and laboratory buildings, with higher concentrations reported for indoor versus outdoor levels. TCE had the greatest variability of measurements in both indoor and outdoor samples, with the highest concentrations detected in the Unit Building 3.

Tronox will continue to implement the *IAQ Investigation Work Plan*. An additional air sampling event is scheduled for November/December 2010 in accordance with the requirements of the Work Plan to understand the different seasonal meteorological conditions and potential differences in the building operations and activities. A fall 2010 IAQ sampling and analysis report will be submitted to NDEP by December 31, 2010.



5.0 REFERENCES

- ENSR Corporation (ENSR), 2008. *Revised Data Validation Summary Report Phase B Source Area Investigation Soil Gas Survey, Tronox LLC Facility, Henderson, Nevada*. October 20, 2008.
- Nevada Division of Environmental Protection (NDEP), 2010. Memorandum Response to: *Indoor Air Quality Investigation and Proposed Indoor Air Sampling Locations* (technical memorandum dated June 3, 2010). June 16, 2010.
- Nevada Division of Environmental Protection (NDEP), 2010. Response to NDEP Comments on *Proposed Indoor Air Sampling Locations, Tronox Facility, Henderson, Nevada, Supplement to Indoor Air Quality Investigation Work Plan, Henderson, Nevada*, dated April 22, 2010. June 18, 2010.
- Northgate Environmental Management, Inc. (Northgate), 2010a. *Revised Indoor Air Quality Investigation Work Plan, Tronox LLC Facility, Henderson, Nevada*. April 22, 2010.
- Northgate, 2010b. *Proposed Indoor Air Sampling Locations, Tronox Facility, Henderson, Nevada, Supplement to Indoor Air Quality Investigation Work Plan, Henderson, Nevada*, (technical memorandum). June 3, 2010.
- Northgate, 2010c. Memorandum and Response to Comments RE: *Indoor Air Quality Investigation and Proposed Indoor Air Sampling Locations* (technical memorandum dated June 3, 2010) and *Response to NDEP Comments on Proposed Indoor Air Sampling Locations, Tronox Facility, Henderson, Nevada, Supplement to Indoor Air Quality Investigation Work Plan, Henderson, Nevada*, dated April 22, 2010. June 16, 2010.



TABLES



FIGURE



**APPENDIX A
LABORATORY REPORT**

(Included on CD)

