Compilation of Select Health Risk Assessment Documents for Parcels A and B: 2008 to 2013

Nevada Environmental Response Trust Site
Henderson, Nevada

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	RTCs November 12, 2010	**Northgate Environmental Management, Inc. (Northgate)** Response to Comments re: Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada, dated June 29, 2010.
11	**NDEP Comments** May 23, 2011	**Nevada Division of Environmental Protection (NDEP)** NDEP Response to: Revised Tech Memo: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Tronox LLC, Henderson, Nevada, Dated: November 12, 2010.
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14	**Meeting Minutes** July 26, 2013	**Nevada Division of Environmental Protection (NDEP)** Conference Call re: Response to Comments Parcels A&B Soil Gas Health Risk Assessment, Meeting Minutes.

Notes:
HRA = Health risk assessment
RTCs = Response to comments

Tab 1

Basic Environmental Company (BEC) Technical Memorandum
Data Review for 2007 Tronox Parcels A/B Investigation
BMI Industrial Complex, Clark County, Nevada, Revision 1

February 11, 2008

Basic Environmental
COMPANY

TECHNICAL MEMORANDUM

To: Shannon Harbour (NDEP)

From: Ranajit Sahu (BEC)

cc: Brian Rakvica (NDEP)
Jim Najima (NDEP)
Teri Copeland
Paul Black (Neptune and Co.)

Date: February 11, 2008

Subject: Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation, BMI Industrial Complex, Clark County, Nevada, Revision 1

Introduction

The objective of this Technical Memorandum is to present the results of the Phase 2 soil investigation Basic Environmental Company (BEC) and Tronox performed for the Tronox Parcels "A" and "B" (portions of APN Nos. 178-01-401-001, 178-12-101-002, 178-12-201-006, and 178-12-601-005). Parcels A and B will collectively be referred to as the Site for the purposes of this Data Review Technical Memorandum. The Site is located north of Warm Springs Road, 1/4 mile west of the intersection with Boulder Highway, in Henderson, Nevada. Figure 1 illustrates the location of the subject Site relative to the Tronox property. Figures 2 and 3 show details of Parcels A and B themselves. It should be noted that the Nevada Pick-A-Part facility is not a part of the Site.

This revision of the Data Review Technical Memorandum, Revision 1, incorporates comments received from the NDEP, dated January 10, 2008, on Revision 0 of the report, dated December 6, 2007. The NDEP comments and BRC's response to these comments are included in Attachment A. Also included in Attachment A is a redline/strikeout version of the text showing the revisions from the December 6, 2007 version of the technical memorandum.

The Site, which represents a portion of the Tronox property, is comprised of primarily of vacant land, and includes an area in the northeast corner of the Parcel formerly leased by Lavern Vohs. BEC also recognizes that other historic uses/disposals on or near the Site may have occurred. A Phase 1 investigation has been performed on the Site. The Phase 1 investigation, Site visits and historical aerial photographs analysis indicate the presence of certain debris, gravel, fill and

concrete/asphalt piles, an abandoned baghouse of unknown origin, and multiple five gallon pails of what appears to be oil to be located on the Site. In addition, there are at least two "homeless" camps that may or may not be currently in use on the Site. Given the vicinity of BMI Industrial Companies, it is also possible that the Site or portions thereof could also have been indirectly impacted by such operations. Legal descriptions of the properties are included in Attachment B.

Therefore, this current investigation was conducted to provide data to confirm existing data and fill identified data gaps with regards to possible contaminant distribution on this property. The sampling was conducted in accordance to the NDEP-approved *Phase 2 Sampling and Analysis Plan to Conduct Soil Characterization* (BEC 2007). The Site investigation involved collection of random soil matrix samples placed within a 4-acre grid across the Site. The grid was modified from a square grid pattern based on the following: 1) started the grid along the western parcel boundary (for each parcel independently), 2) combined partial grids with either other partial grids or whole grids (which resulted in irregular shaped grid cells), and 3) made all grids approximately four acres in size. Grid sizes ranged from 1.2 to 4.5 acres. The random sample locations were supplemented with judgmental sampling locations targeting specific site features (e.g., miscellaneous pile locations). The rationale for the various judgmental sampling locations is provided below:

- Parcel A, grid cell 'A-A3' – gravel pile location;
- Parcel A, grid cell 'A-A2' – historical northwestern ditch;
- Parcel A, grid cell 'A-C3' – abandoned baghouse of unknown origin;
- Parcel B, grid cell 'B-A4' – debris pile location;
- Parcel B, grid cell 'B-A4' – fill pile location;
- Parcel B, grid cell 'B-B2' – concrete/asphalt pile location;
- Parcel B, grid cell 'B-C2' – concrete/asphalt pile location;
- Parcel B, grid cell 'B-C2' – debris pile location; and
- Parcel B, grid cell 'B-A4' – multiple five gallon pails of what appears to be waste oil.

Soil borings were advanced with a hollow-stem auger to a total depth of 10 feet below ground surface (bgs). Soil samples were collected at approximately zero (i.e., surface) and 10 feet bgs. The Site investigation involved collecting enough samples for completion of a statistically sufficient assessment of chemical distribution, and if desired, to provide a robust data set upon which to perform a screening-level human health risk assessment.

Parcel A and the adjacent Parcel B were not directly used for any manufacturing or waste disposal activities. They are located north of the BMI facilities, and adjacent to other industrial properties. Based on the data collected, a No Further Action Determination (NFAD) is being sought from the NDEP in order to support future industrial/commercial use on this Site. No

residential use is planned. Specifically, this technical memorandum includes the following primary tasks:

- Summary of data;
- Statistical comparison to background concentrations;
- Data usability evaluation;
- Data adequacy evaluation; and
- Screening-level health risk assessment.

Each of these tasks is discussed below.

Data Summary

Sixty-four (64) samples were collected from 32 sample locations. Sample locations for this current investigation are shown on Figures 2 and 3. Results of the investigation are presented in Attachment C, and electronically on CD. All data have been validated per the NDEP-approved *Data Validation Summary Report* (DVSR) (BEC and ERM 2007; approved in letter from Shannon Harbour of the NDEP to Susan Crowley, dated December 6, 2007).

Following the first round of sampling, surface soil from several areas of the property, around sample locations TSB-AJ-03, TSB-AR-06, TSB-AR-08, TSB-AR-09, TSB-AR-10, TSB-AR-12, TSB-AR-13, TSB-AR-14, TSB-BJ-02, TSB-BR-05 was scraped and removed due to the detection of long amphibole asbestos fibers at these locations. Post-scrape samples were collected and analyzed for asbestos from 10 locations within these areas. During the second round of sampling, a single long amphibole asbestos fiber was detected in sample TSB-BR-05-PS. Therefore, further scraping around this location was performed. In addition, sample locations TSB-AR-11 and TSB-BJ-01 contained 8 and 19 long chrysotile asbestos fibers, respectively. Therefore, further scraping around these locations was also performed. Final samples were collected from locations TSB-BR-05, TSB-AR-11, and TSB-BJ-01 following the second and third scrapings. Figure 4 shows all areas of surface soil that were scraped and removed. Based on this, the original surface sample data for asbestos from these locations were removed from further evaluation and the re-sampled asbestos results are used instead. Both pre-scrape and post-scrape asbestos results are included in Attachments C and D.

The consequences of the asbestos remediation are that the new surface layer of the Site could have different concentrations of chemicals than those that were measured prior to remediation. However, because there are no historical uses of the Site, it is reasonable to assume that the

concentration distribution has not changed in any important way. It might also be reasonable to assume that concentrations are now lower for some chemicals (*e.g.*, dioxins), because of the removal of some soil. Although a quantitative evaluation of the depth-profile of the chemicals has not been conducted, a qualitative review of the data indicate that generally volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) were primarily detected in surface soil only (for example, 1,3-dichlorobenzene, 1,4-dichlorobenzene, benzo[a]pyrene, benzo[a]anthracene, benzo[b]fluoranthene, hexachlorobenzene), while concentrations are not appreciably different with depth for those chemicals detected in both surface and subsurface soil. A review of the data in Attachment C indicates that it is reasonable to assume that the previous samples are still representative of current conditions. Therefore, because only asbestos was re-analyzed for in the post-scrape samples, the original measured surface soil data at the Site for all other chemicals is retained for the evaluations conducted below.

The results also indicated that uranium isotope analytical results are biased low in comparison to the 2005 shallow soil background dataset, as presented in the *Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity* (BRC and TIMET 2007). A comparison of the methods used for preparation and analysis indicate that the primary difference between the background and Site uranium isotope data is that the sample preparation method in the background dataset used a total dissolution method, while the Site dataset used a nitric acid preparation method. Because of the incompatibility between the two datasets, two approaches were developed to account for and correct this low bias associated with the Site uranium isotope data. The two approaches are similar, in that they both base the re-calculation of the Site uranium isotope activities on the use of the uranium metal analytical results. These approaches and re-calculations are presented in detail in Attachment E. The recommended approach provides a reasonable means to correct for the low-biased measured uranium isotope data, to obtain a Site dataset that is compatible with the shallow soil background dataset, without being overly conservative. The corrected uranium isotope data were used in the evaluations and comparisons discussed below.

Using the compound-specific information presented in Table 2 of the Quality Assurance Project Plan (QAPP; BRC, ERM and MWH 2007a), the comparison levels for each chemical included in the investigation were compiled and compared. Specific soil comparison levels used for this effort were as follows:

- U.S. Environmental Protection Agency (USEPA) Region 9 industrial soil Preliminary Remediation Goals (PRGs) (USEPA 2004a); and

- Soil screening levels (SSLs) protective of groundwater assuming dilution attenuation factors (DAFs) of 1 and 20 (USEPA 2004a).

A DAF of one is used when little or no dilution or attenuation of soil leachate concentrations is expected. Although the property is greater than 30 acres, because of the depth to groundwater (approximately 25 to 30 feet bgs) and the absence of fractured media or karst topography, consistent with USEPA (2002a) recommendations, SSLs using a DAF of 20 were also considered appropriate for comparison purposes for the property. A summary of the data for the property, including identification of number of instances that chemical concentrations exceed each of the comparison levels are listed in Table 1, and summarized below.

Except as discussed below, there are no chemicals or instances where concentrations exceed comparison levels. Although there are numerous instances where arsenic and radionuclides exceed the USEPA Region 9 industrial PRG, there are no instances where arsenic and only a few instances where any radionuclides exceeded their respective 2005 shallow soil background levels, and, as evaluated further below.

Dioxins/furans toxic equivalency quotients (TEQs) were compared to the Agency for Toxic Substances and Disease Registry (ATSDR) action level of 1.0 parts per billion (ppb; ATSDR 1997). The ATSDR action level is used to identify where potential health effects may be of concern at a site. There were no instances where dioxins/furans TEQs exceeded this level.

In addition, although there are some instances where VOCs have been detected, as noted above there are no instances of a VOC exceeding the USEPA Region 9 industrial PRG. However, USEPA Region 9 PRGs do not account for potential migration of VOCs from the subsurface into indoor air. In general USEPA does not recommend evaluating the indoor air exposure pathway using soil matrix data (USEPA 2002b). Because no potential source areas were identified at the Site, soil vapor data were not collected. The indoor air exposure pathway is not considered a pathway of concern because 1) VOCs were detected only sporadically, and no hot spots were identified (see Determination of Exposure Point Concentrations section below); 2) the levels are generally below USEPA Region 9 industrial PRGs, recognizing that these values do not account for indoor air exposures; and 3) no potential sources of VOCs were identified on the property, and the data support this conclusion.

Depth to groundwater at the property is approximately 25 to 30 feet bgs, as measured at monitoring wells H-49A [26.8 feet bgs], H-56A [24.4 feet bgs], and H-58A [30.2 feet bgs]). There are several instances where cadmium and beta-BHC exceed their USEPA SSLs. For beta-BHC, most of these instances were in surface soil, with only five samples collected at 10

feet bgs above the USEPA SSL with a highest concentration of 0.038 mg/kg versus the SSLs of 0.003 and 0.0001 mg/kg (for SSL DAF 1 and 20, respectively). The DAF of 1 for beta-BHC is extremely low and is often exceeded by non-detects as well. There is a known source of beta-BHC in soil and groundwater off-Site and the concentrations of this compound at this Site are considered insignificant relative to upgradient data. If beta-BHC were to leach to groundwater it is unlikely that the contribution from this Site could be detected.

Based upon a review of available groundwater data in the region, cadmium does not appear to be leaching to groundwater and is not a concern at this time. It is also noted that there are only three locations above the SSL DAF 1 and these concentrations are only marginally elevated (0.59 mg/kg maximum versus an SSL of 0.4 mg/kg). All cadmium detections are well below the SSL DAF 20 (8 mg/kg). If cadmium were to leach to groundwater it is expected that this matter could be addressed by the existing groundwater treatment system, as necessary.

In addition, given the discussion above, there is no indication that concentrations increase with depth, further supporting the conclusion that the site is not a likely source of impacts to groundwater. This is further supported by the low level of detected chemicals most associated with potential groundwater impacts (*e.g.*, VOCs, some organochlorine pesticides). In addition, a review of Tronox Phase A data collected deeper than 10 feet bgs (from 15 to 25 feet bgs) further support this conclusion as the results from deeper samples are generally consistent with those collected from surface to 10 feet bgs. Therefore, potential impacts to groundwater, and subsequent groundwater exposures were not further evaluated. It should be noted that development of the property will not preclude future groundwater investigation or remediation activities that may need to be conducted by BEC.

Several monitoring wells are located within these properties, which are used by several of the BMI plant operating companies. For example, Tronox collected a groundwater sample from monitoring well M95 during it's recent (December 2006) Phase A source area investigation. Low parts per billion (ppb) levels of several VOCs were detected in this sample. Chloroform was detected at 350 ppb. In addition, Stauffer Management Company LLC (Stauffer), Montrose Chemical Corporation of California (Montrose), Syngenta Crop Protection, Inc., and Pioneer Americas, LLC (the Companies) conducted quarterly groundwater samples from three monitoring wells within the property (H-49A, H-56A, and H-58A). Similar results were found to the Tronox sampling event, that is, low ppb levels of VOCs. No chemicals, including VOCs, were found at levels in wells within the Site higher than wells located upgradient of Parcels A and B in any of the previous sampling events. This suggests that there are not any on-Site sources of groundwater impacts.

This includes the potential vapor intrusion to indoor air from groundwater exposure pathway. The chloroform plume associated with the industrial facilities lies primarily to the east of the Site. Given levels of VOCs detected in groundwater beneath the site are generally lower (for example, 350 ppb chloroform at M95 versus 1,400 ppb at PC67 to the east) than those within this plume, the Site is immediately downgradient of the groundwater treatment system, and depth to groundwater is greater at the Site than locations to the northeast, it is likely that vapor intrusion impacts and concerns from groundwater are less than those associated with the chloroform plume.

Following remediation there were 23 chrysotile asbestos fibers detected from throughout the property, with nine of these long fibers (see Attachment D). There were no amphibole asbestos fibers detected from throughout the property. There are no comparison levels available for asbestos. Asbestos is further evaluated in the screening-level health risk assessment.

Conceptual Site Model

The conceptual site model (CSM) is used to describe relationships between chemicals and potentially exposed human receptor populations, thereby delineating the relationships between the suspected sources of chemicals identified at the property, the mechanisms by which the chemicals might be released and transported in the environment, and the means by which the receptors could come in contact with the chemicals. The CSM provides a basis for defining data quality objectives and developing exposure scenarios.

The CSM considers current and potential future land-use conditions. Currently, the property is undeveloped. Current receptors that may use the property include on-site trespassers. Therefore, current exposures to native soils at the property are likely to be minimal. In addition, exposures to future on-site workers will be much greater than current exposures. For example, future receptors include commercial/industrial workers who are assumed to be exposed to soil at the property for 250 days per year for 25 years which is much greater than any current exposures.

USEPA (1989) guidance states that potential future land use should be considered in addition to current land use when evaluating the potential for human exposure at a site. Therefore, the CSM also considers other future land-uses. For example, the CSM includes the planned use of the property for redevelopment into commercial use. The potentially exposed populations and their potential routes of exposure are presented in Figure 5.

Potential Source Areas

As discussed above nine areas were identified in the Sampling and Analysis Plan that warranted further investigation. These areas are shown on Figures 2 and 3. Judgemental soil samples were collected from each of these areas.

Potential Human Exposure Scenarios

Given the planned development of the property, potential human receptors include on-site construction workers, on-site indoor commercial workers, on-site outdoor maintenance workers, and on-site visitors. However, as discussed below, not all of these receptors are evaluated in the screening-level health risk assessment. Potential migration pathways, exposure pathways, and routes of exposure are shown on Figure 5.

Although several potential human receptors may occur on the property in the future, the screening-level health risk assessment focuses on the commercial/industrial receptor. This receptor is considered to have the highest level of exposure at the property, as supported by the comparison levels that have been developed in the project QAPP (BRC, ERM and MWH 2007a). Other receptors generally have lower exposures, and thus lower risk estimates. Therefore, risk estimates generated for commercial/industrial receptors will be protective of other potential receptors at the property. The only exception to this is construction worker exposures to asbestos. This is because asbestos risks are only evaluated for the dust inhalation exposure pathway, with construction activities generating more dust than under normal circumstances. Therefore, the screening-level health risk assessment also evaluates the construction worker receptor for asbestos exposures.

Evaluation of Concentrations Relative to Background Conditions

The comparison of property-related soil concentrations to background levels was conducted using the existing, shallow soils background data set presented in the *Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity* (BRC and TIMET 2007). Background comparisons were performed using the Quantile test, Slippage test, the *t*-test, and the Wilcoxon Rank Sum test with Gehan modification. The computer statistical software program, Guided Interactive Statistical Decision Tools (GISdT®; Neptune and Company 2007), was used to perform all statistical comparisons. A summary of the results of this evaluation, including summary statistics, is presented in Tables 2 and 3.

The results of this comparison indicate that levels of cadmium, total chromium, hexavalent chromium, lead, molybdenum, niobium, potassium, sodium, tin, titanium, and uranium exceed background levels. Although the comparison statistics indicate that these metals levels at the property are above background, small analytical differences or small differences related to geologic or depth differences as seen in the background dataset may be responsible for these results. Given that these chemicals are not expected to be found as contaminants at the Site, it is likely that the property and background datasets are representative of a single population. However, as discussed below, these metals are considered in the screening-level health risk assessment. Cumulative probability plots and boxplots are presented in Attachment F.

In addition, background comparisons indicate that uranium isotope levels exceed background levels, while none of the other radionuclides fail background comparisons at all. In fact, some of the site radionuclides appear to be slightly lower than background. It might be reasonable to assume that the differences are the result of minor analytical differences, and that all radionuclides are at background concentrations. However, the uranium isotopes are considered in the screening-level health risk assessment.

Data Usability Evaluation

The primary objective of the data review and usability evaluation was to identify appropriate data for use in the screening-level health risk assessment. The analytical data were reviewed for applicability and usability following procedures in the *Guidance for Data Usability in Risk Assessment (Part A)* (USEPA 1992a) and USEPA (1989). A quality assurance/quality control (QA/QC) review of the analytical results was conducted during the sampling events. According to the USEPA Data Usability Guidance, there are six principal evaluation criteria by which data are judged for usability in risk assessment. The six criteria are:

- availability of information associated with site data;
- documentation;
- data sources;
- analytical methods and detection limits;
- data review; and
- data quality indicators, including precision, accuracy, representativeness, comparability, and completeness.

A summary of these six criteria for determining data usability is provided below.

Criterion I – Availability of Information Associated with Site Data

The usability analysis of the site characterization data requires the availability of sufficient data for review. The required information is available from documentation associated with the site data and data collection efforts. The following lists the information sources and the availability of such information for the data usability process:

- A property description provided in the NDEP-approved Sampling and Analysis Plan (BEC 2007) identifies the location and features of the property, the characteristics of the vicinity, and contaminant transport mechanisms.
- A site map with sample locations is provided in Figures 2 and 3.
- Sampling design and procedures were provided in the NDEP-approved Sampling and Analysis Plan (BEC 2007).
- Analytical methods and detection limits are provided in Attachment C.
- A complete data set is provided in Attachment C.
- A narrative of qualified data is provided with each analytical data package, the laboratory provided a narrative of QA/QC procedures and results. These narratives are included as part of the NDEP-approved DVSR (BEC and ERM 2007).
- QC results are provided by the laboratory, including blanks, replicates, and spikes. The laboratory QC results are included as part of the NDEP-approved DVSR (BEC and ERM 2007).
- Data flags used by the laboratory were defined adequately as part of the NDEP-approved DVSR (BEC and ERM 2007).
- Electronic files containing the raw data made available by the laboratory are included as part of the NDEP-approved DVSR (BEC and ERM 2007).

Criterion II – Documentation Review

The objective of the documentation review is to confirm that the analytical results provided are associated with a specific sample location and collection procedure, using available

documentation. For the purposes of this data usability analysis, the chain-of-custody forms prepared in the field were reviewed and compared to the analytical data results provided by the laboratory to ensure completeness of the data set. Based on the documentation review, all samples analyzed by the laboratory were correlated to the correct geographic location at the property. Field procedures included documentation of sample times, dates and locations, other sample specific information such as depth bgs were also recorded. Information from field forms generated during sample collection activities was imported into the project database.

The analytical data were reported in a format that provides adequate information for evaluation, including appropriate quality control measures and acceptance criteria. Each laboratory report describes the analytical method used, provides results on a sample by sample basis along with sample specific detection limits, and provides the results of appropriate quality control samples such as laboratory control spike samples, sample surrogates and internal standards (organic analyses only), and matrix spike samples. All laboratory reports, except for asbestos, provided the documentation required by USEPA's Contract Laboratory Program (USEPA 2003a, 2004b,c) which includes chain of custody records, calibration data, QC results for blanks, duplicates, and spike samples from the field and laboratory, and all supporting raw data generated during sample analysis. Reported sample analysis results were imported into the project database.

The recommended method for providing asbestos data which are useful for risk assessment purposes was performed by EMSL Analytical Inc in Westmont, New Jersey. This laboratory is not currently certified in the State of Nevada, but has California and national accreditation for asbestos analysis.

To interpret measurements of asbestos in soils, it is necessary to establish the relationship between the asbestos concentrations observed in soils and concentrations that will occur in air when such soil is disturbed by natural or anthropogenic forces. This is because asbestos is a hazard when inhaled (see, for example, Berman and Crump 2001; USEPA 2003b). In fact, the Modified Elutriator Method (Berman and Kolk 2000), which was the method employed to perform the analyses presented in this report, was designed specifically to facilitate prediction of airborne asbestos exposures based on bulk measurements (see, for example, Berman and Chatfield 1990).

The Modified Elutriator Method incorporates collection of samples that are re-suspended and then forced through an airway and filter. Asbestos structures are isolated and concentrated as part of the respirable dust fraction of a sample and analytical measurements are reported as the number of asbestos structures per mass of respirable dust in the sample. These are precisely the

dimensions required to combine such measurements with published dust emission and dispersion models to convert them to asbestos emission and dispersion estimates. Thus, because published dust emission and dispersion models can be used to address many of the exposure pathways of interest in this study, these can be combined with measurements from the Modified Elutriator Method to predict airborne exposures and assess the attendant risks.

Criterion III –Data Sources

The review of data sources is performed to determine whether the analytical techniques used in the site characterization process are appropriate for risk assessment purposes. The data collection activities were developed to characterize a broad spectrum of chemicals potentially present on the property, including asbestos, VOCs, SVOCs, metals, radionuclides, dioxins/furans, asbestos, polynuclear aromatic hydrocarbons (PAHs), organochlorine pesticides (OCPs), and petroleum hydrocarbons.

The State of Nevada is in the process of certifying the laboratories used to generate the analytical data. As such, standards of practice in these laboratories follow the quality program developed by the Nevada Revised Statutes (NRS) and are within the guidelines of the analytical methodologies established by the USEPA. Based on the review of the available information, the data sources for chemical and physical parameter measurements are adequate for use in a risk assessment.

Criterion IV – Analytical Methods and Detection Limits

In addition to the appropriateness of the analytical techniques evaluated as part of Criterion III, it is necessary to evaluate whether the detection limits are low enough to allow adequate characterization of risks. At a minimum, this data usability criterion can be met through the determination that routine USEPA and U.S. Department of Energy (DOE) reference analytical methods were used in analyzing samples collected from the property. Attachment C identifies the USEPA and DOE methods that were used in conducting the laboratory analysis of soil samples. Each of the identified USEPA methods are considered the most appropriate method for the respective constituent class and each was approved by NDEP as part of the Sampling and Analysis Plan (BEC 2007).

Laboratory reporting limits were based on those outlined in the reference method, the Sampling and Analysis Plan, and the *BRC Closure Plan* (BRC, ERM, and DBSA 2007). In accordance with respective laboratory standard operating procedures (SOPs), the analytical processes

included performing instrument calibration, laboratory method blanks, and other verification standards used to ensure quality control during the analyses of collected samples.

The range of detection limits achieved in field samples was compared to USEPA Region 9 industrial PRGs (USEPA 2004a). Although n-nitrosodi-n-propylamine had a number of reporting limits that exceeded its respective PRGs, none of the method detection limits were above industrial PRGs. beta-BHC and several SVOCs had method detection limits above the USEPA SSLs; however, given the discussion provided previously, migration of chemicals at the property to groundwater is considered unlikely. Therefore, the detection limits are considered adequate for risk assessment purposes.

Criterion V – Data Review

The data review portion of the data usability process focuses primarily of the quality of the analytical data received from the laboratory. Soil and soil vapor sample data were subject to data validation. A DVSR was prepared as a separate deliverable (BEC and ERM 2007). The analytical data were validated according to the internal procedures using the principles of USEPA National Functional Guidelines (USEPA 1999, 2001, 2002c, 2004b,c) and were designed to ensure completeness and adequacy of the data set. Any analytical errors and/or limitations in the data have been addressed and an explanation for data qualification provided in the respective data tables. The results of ERM's data review for these issues are presented in the DVSR and are summarized below.

Although certain laboratory limits, such as percent recovery (PR) and relative percent difference (RPD) between sample and duplicate, were exceeded for 53 compounds or analyses, as identified by the laboratory (and confirmed during ERM's review of the data), there does not appear to be a wide-spread effect on the quality of the analytical results. Furthermore, based on a review of the laboratory narratives (provided in the laboratory reports in the DVSR), the laboratory does not believe that the observed exceedances of laboratory criteria represent a concern.

For 1,740 out of 16,498 analytical results, quality criteria were not met and various data qualifiers were added to indicate limitations and/or bias in the data. The definitions for the data qualifiers, or data validation flags, used during validation are those defined in SOP-40 (BRC, ERM and MWH 2007b) and the project QAPP (BRC, ERM and MWH 2007a). Sample results were rejected based on findings of serious deficiencies in the ability to properly collect or analyze the sample and meet QC criteria. Only one analytical result (TPH as diesel at sample location TSB-AR-07-10 at 10 feet bgs) was rejected in the entire dataset. Only rejected data were considered unusable for decision-making purposes and rejected analytical results are not used in

the screening-level health risk assessment. Sample results qualified as estimated were affected by special circumstances and are likely to be quantitatively biased to some degree; estimated analytical results are used in the screening-level health risk assessment. Data qualified as anomalous represents an analyte or compound that was not detected above the sample quantitative limit and such data are used in the screening-level health risk assessment. These data usability decisions follow the guidelines provided in the *Guidance for Data Usability in Risk Assessment (Part A)* (USEPA 1992a).

Criterion VI – Data Quality Indicators

Data quality indicators (DQIs) are used to verify that sampling and analytical systems used in support of project activities are in control and the quality of the data generated for this project is appropriate for making decisions affecting future activities. The DQIs address the field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and risk assessment. The DQIs include precision, accuracy, representativeness, comparability, and completeness (PARCC). The project QAPP provides the definitions and specific criteria for assessing DQIs using field and laboratory QC samples and is the basis for determining the overall quality of the data set. Data validation activities included the evaluation of PARCC parameters, and all data not meeting the established PARCC criteria were qualified during the validation process using the guidelines presented in the *National Functional Guidelines for Laboratory Data Review, Organics and Inorganics and Dioxin/Furans* (USEPA 1999, 2001, 2002c, 2004d). Detailed discussion of and tables with specific exceedances, with respect to precision and accuracy, is provided in the DVSR (BEC and ERM 2007).

Representativeness is the degree to which data accurately and precisely represent a characteristic of the population at a sampling point or an environmental condition (USEPA 2002c). There is no standard method or formula for evaluating representativeness, which is a qualitative term. Representativeness is achieved through selection of sampling locations that are appropriate relative to the objective of the specific sampling task, and by collection of an adequate number of samples from the relevant types of locations. The sampling locations were selected randomly in order to adequately assess the exposure areas. The samples were analyzed for a broad spectrum of analyses across the property. Samples were delivered to the laboratory in coolers with ice to minimize the loss of analytes. At times the samples were received outside the recommended temperature range or were analyzed beyond the holding time. Sample specific results are discussed in the DVSR.

Completeness is commonly expressed as a percentage of measurements that are valid and usable relative to the total number of measurements made. Analytical completeness is a measure of the number of overall accepted analytical results, including estimated values, compared to the total number of analytical results requested on samples submitted for analysis after review of the analytical data. Some of the data were eliminated due to data usability concerns. The percent completeness for the property is 99.9 percent.

Comparability is a qualitative characteristic expressing the confidence with which one dataset can be compared with another. The desire for comparability is the basis for specifying the analytical methods; these methods are generally consistent with those used in previous investigations of the property. The comparability goal is achieved through using standard techniques to collect and analyze representative samples and reporting analytical results in appropriate units.

Data Adequacy

Sample size calculations were conducted for four analytes (arsenic, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin [2,3,7,8-TCDD], beta-BHC, and chrysotile asbestos) for the property. The formula used here for calculation of sample size is based on a non-parametric test (the Wilcoxon signed rank test), and on simulation studies performed by Pacific Northwest National Laboratories that formed the basis for an approximate formula that is based on the normal distribution. Essentially, the formula is the one that would be used if a normal-based test were being performed, but an adjustment is made (multiply by 1.16) to account for the intent to perform a non-parametric test. The formula is as follows:

$$n = 1.16\left[\frac{s^2}{\Delta^2}(z_{1-\alpha} + z_{1-\beta(\mu)})^2 + 0.5z_{1-\alpha}^2\right]$$

where,

n	=	number of samples
s	=	estimated standard deviation of concentrations/fibers
Δ		width of the gray region (the difference between the threshold value in stated in the hypothesis and the point at which β is specified)
α		significance level or Type I error tolerance
$\beta(\mu)$		Type II error tolerance; and
z		quantile from the standard normal distribution

For each chemical, inputs for the calculations include an estimate of the variance from the measured data, a desired significance level, and desired power of the test that must be specified at a concentration of interest (which determines the tolerable difference from the threshold value). The calculations provided here cover a range of Type I and Type II error tolerances, and the point at which the Type II error is specified. Results are presented in Table 4. In Table 4, various combinations of input values are used, including: values of α of 5%, 10% and 15%; values of β of 15%, 20%, and 25%; and a gray region of width 10%, 20% and 30% of the threshold level. It is clear from Table 4 that the number of samples collected is adequate for the property.

Screening-Level Health Risk Assessment

The comparison levels in the Data Review section above do not take into account cumulative effects, nor do they consider all potential exposure pathways (for example, the indoor air pathway). Therefore, the purpose of the screening-level health risk assessment is to determine if chemical concentrations in property soils are: (1) either representative of background conditions; or (2) do not pose an unacceptable risk to human health and the environment under current and anticipated future use conditions.

Human health risks are represented by estimated theoretical upper-bound cancer risks and non-cancer hazards derived in accordance with standard USEPA methods. The acceptable risk levels defined by USEPA for the protection of human health, and following those discussed previously with NDEP, are:

1. For non-carcinogenic compounds, the acceptable criterion is a cumulative hazard index (HI) of one or less. If the screening HI is determined to be greater than 1.0, target organ-specific HIs will be calculated for primary and secondary organs. The final risk goal will be to achieve target organ-specific non-carcinogenic HIs of less than 1.0; and

2. For known or suspected chemical and radionuclide carcinogens, the acceptable ceiling for a cumulative incremental lifetime cancer risk (ILCR) ranges from 10^{-6} to 10^{-4}. The risk goal established by the NDEP is 10^{-6}.

3. Where background levels exceed risk level goals, metals and radionuclides in Site soils are targeted to have risks no greater than those associated with background conditions.

4. For asbestos, calculations are based upon cancer criterion and a risk goal of 10^{-6}.

This screening-level health risk assessment follows the basic procedures outlined in USEPA *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (RAGS; USEPA 1989). Other guidance documents were also consulted for the screening-level health risk assessment.

Selection of Chemicals of Potential Concern

The broad suite of analytes sampled for was the initial list of chemicals of potential concern (COPCs) at the property. However, in order to ensure that a risk assessment focuses on those substances that contribute the greatest to the overall risk (USEPA 1989); only one procedure was used to eliminate the chemicals for quantitative evaluation in the screening-level health risk assessment:

- identification of chemicals with detected levels which are at or less than background concentrations (where applicable).

The procedure for evaluating chemicals relative to background conditions was presented above.

Another criterion that may warrant chemical reduction is the frequency of detection. In general, chemicals exhibiting a low frequency of detection will not contribute significantly to the risk estimates. USEPA (1989) suggests that chemicals with a frequency of detection less than or equal to five percent, with the exception of metals, known human carcinogens, and persistent, bioaccumulative, and toxic (PBT) chemicals as defined by the USEPA PBT program (USEPA 2007b), may be considered for elimination. However, no chemicals were eliminated from further evaluation based on the frequency of detection criteria.

Determination of Exposure Point Concentrations

A representative exposure concentration is a COPC-specific and media-specific concentration value. In risk assessment, these exposure concentrations are values incorporated into the exposure assessment equations from which potential baseline human exposures are calculated. Due to the uncertainty associated with determining the true average concentration at a site, where direct measurements of the site average are unavailable, the USEPA recommends using the lower of the maximum detected concentration or the 95 percent upper confidence limit (UCL) as the concentration of a chemical to which an individual could be exposed over time (USEPA 1992b). For the 95 percent UCL concentration approach, the 95 percent UCL is typically computed in order to represent the area-wide exposure point concentrations. The 95 percent UCL is defined as the value that, when calculated repeatedly for randomly drawn

subsets of site data, equals or exceeds the true mean 95 percent of the time (USEPA 1992b). The purpose for using the 95 percent UCL is to take into account the different concentrations a person may be exposed to on any given day. That is, an individual will be exposed to a range of concentrations that exist at an exposure area, from non-detect to the maximum concentration, over an entire exposure period.

However, while it may be more realistic to develop exposure concentrations consistent with the proposed development of the Site, the maximum concentration was selected as the exposure point concentration for each COPC, regardless of location, for evaluating Site risks in order to identify the worst-case risks for the Site. It is conservatively assumed that individuals will be exposed to a consistent maximum COPC concentration in soil, based on the assumptions used in the assessment, regardless of where they are on the Site. That is, fluctuations in chemical concentrations, either spatially or temporally, are not considered.

The exposure point concentrations for asbestos were based on the pooled analytical sensitivity of the dataset. Therefore, asbestos exposure point concentrations are determined differently than those for the other COPCs. The pooled analytical sensitivity was calculated as follows:

$$Pooled\ Analytical\ Sensitivity = 1/\left[\sum_i (1/analytical\ sensitivity\ \ for\ trial\ i)\right]$$

Two estimates of the asbestos concentration were evaluated, best estimate and upper bound as defined in the draft methodology (USEPA 2003b). The best estimate concentration is similar to a central tendency estimate, while the upper bound concentration is comparable to a reasonable maximum exposure estimate. The pooled analytical sensitivity is multiplied by the number of chrysotile or amphibole structures to estimate concentration:

$$\text{Estimated Bulk Concentration } (10^6 \text{ s/gPM10}) = \text{Long fiber count} \times \text{Pooled analytical sensitivity}$$

For the best estimate, the number of fibers measured is incorporated into the calculation above. The upper bound of the asbestos concentration was also evaluated. It is calculated as the 95 percent UCL of the Poisson distribution where the mean equals the number of structures detected. In EXCEL, the following equation may be employed to calculate this value:

$$\text{95\% UCL of Poisson Distribution } (10^6 \text{ s/gPM10}) = \text{CHIINV}(1 - \alpha, 2 \times (\text{Long fiber count} + 1)/2)$$

This value is then multiplied by the pooled analytical sensitivity to estimate the upper bound concentration. The intent of the risk assessment methodology was to predict the risk associated with airborne asbestos.

In order to quantify the airborne asbestos concentration, the estimated dust levels or particulate emission factors were used:

$$\text{Estimated Airborne Concentration } (s/cm^3) = \text{Estimated bulk concentration } (10^6 \text{ s/gPM10}) \times \text{Estimated dust level } (ug/cm^3)$$

Risk Assessment Methodology

The method used in this screening-level health risk assessment consists of a simple comparison of maximum detected concentrations to USEPA Region 9 industrial PRGs. Several chemicals have both cancer and non-cancer toxicity criteria. For these chemicals USEPA calculates PRGs for both cancer and non-cancer endpoints; however only the lower value is published in its PRG table. The other value is included in a separate spreadsheet table. This other value is shown on Table 1 as the 'Secondary Industrial PRG' and is included in the screening-level risk assessment calculations.

Methods for Assessing Non-Cancer Health Effects

In this assessment, adverse non-cancer health effects were characterized by comparing the maximum measured soil concentrations with an exposure level at which no adverse health effects are expected to occur for a long period of exposure (i.e., USEPA Region 9 PRGs). Maximum measured soil concentrations and PRGs are compared by dividing the maximum measured soil concentration by the PRG, as shown below:

$$Hazard\ Quotient = \frac{Maximum\ Measured\ Soil\ Concentration}{Industrial\ Soil\ PRG}$$

If a person's representative exposure concentration is less than the PRG (i.e., if the hazard quotient is less than one), the chemical is considered unlikely to pose a significant non-cancer health hazard to individuals under the given exposure conditions assumed in the exposure parameters assumed in deriving the applicable PRG.

In accordance with standard risk assessment protocol, the hazard quotients for multiple chemicals are summed to determine whether the cumulative effect poses a potential health concern. The sum of the hazard quotients is known as a hazard index (HI).

$$Hazard\ Index = \sum Hazard\ Quotients$$

An HI less than 1.0 indicates the exposure is unlikely to be associated with a potential health concern.

Methods for Assessing Cancer Risks

Carcinogenic risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of a chemical exposure. When utilizing PRGs, carcinogenic risks are evaluated much in the same manner as hazard quotients.

$$Cancer\ Risk = \frac{Maximum\ Mesured\ Soil\ Concentration}{Industrial\ Soil\ PRG} \times 10^{-6}$$

In this fashion the PRG converts a measured concentration to incremental risk of an individual developing cancer. Because cancer risks are averaged over a person's lifetime, longer term exposure to a carcinogen will result in higher risks than shorter term exposure to the same carcinogen, if all other exposure assumptions are constant.

It is assumed that cancer risks from various exposure routes are additive. Thus, the result of the assessment is a high-end estimate of the total carcinogenic risk.

$$Total\ Carcinogenic\ Risk = \sum Risk_{individual\ \ chemicals}$$

Upper-bound carcinogenic risk estimates were compared to the USEPA acceptable risk range of 1 in 10,000 (10^{-4}) and 1 in 1 million (10^{-6}) and NDEP's acceptable level of 10^{-6}. If the estimated risk falls within or below this risk range, the chemical is considered unlikely to pose an unacceptable carcinogenic risk to individuals under the given exposure conditions. A risk level of 1×10^{-5} (1 E-5) represents a probability of one in 100,000 that an individual could develop cancer from exposure to the potential carcinogen under a defined set of exposure assumptions.

Uncertainty Analysis

Risk estimates are values that have uncertainties associated with them. These uncertainties, which arise at every step of a risk assessment, are evaluated to provide an indication of the uncertainty associated with a risk estimate. Risk assessments are not intended to estimate actual risks to a receptor associated with exposure to chemicals in the environment. In fact, estimating actual risks is impossible because of the variability in the exposed or potentially exposed populations. Therefore, risk assessment is a means of estimating the probability that an adverse health effect (*e.g.*, cancer, impaired reproduction) will occur in a receptor in order to assist in

decision making regarding the protection of human health. The multitude of conservative assumptions used in risk assessments guard against underestimation of risks.

Risk estimates are calculated by combining site data, assumptions about individual receptor's exposures to impacted media, and toxicity data. The uncertainties in this screening-level health risk assessment can be grouped into three main categories that correspond to these steps:

- Uncertainties in environmental sampling and analysis
- Uncertainties in assumptions concerning exposure scenarios
- Uncertainties in toxicity data and dose-response extrapolations

Some of the specific uncertainties associated with this screening-level health risk assessment are discussed below.

The use of maximum concentrations across both Parcels A and B causes an unusual form of conservatism in the results. That is, if a similar risk assessment had been performed separately for Parcels A and B, then these screening risk assessments would produce lower risks. The maximum concentration must be less in one area than in the other, for each chemical in turn.

The use of maximum concentrations also assumes that individuals will be exposed to a consistent maximum concentration regardless of where they are on the Site. That is, fluctuations in chemical concentrations, either spatially or temporally, are not considered.

The uranium isotope analyses are different between the background and Site datasets. The primary difference between the background and Site uranium isotope data is that the sample preparation method in the background dataset used a total dissolution method, while the Site dataset used a nitric acid preparation method. Because of incompatibility between the two datasets, an approach was used to account for and correct the low bias associated with the Site uranium isotope data. The approach used to ratio up uranium isotope concentrations is somewhat crude and may overstate the concentrations. It is anticipated that since thorium and radium isotopes are consistent with background, it is likely that actual uranium isotopic concentrations are also consistent with background. However, in the interest of completing the NFAD for the Parcels A and B, the "corrected" uranium data were used.

Because of the surface soil remediation for asbestos, the new surface layer of the Site could have different chemical concentrations than those that were measured prior to remediation. Because only asbestos was re-analyzed for in the post-scrape samples, the original measured surface soil data at the Site for all other chemicals was retained for further evaluation.

However, because there are no historical uses of the Site, and based on the depth profiles of the chemicals, it is reasonable to assume that the concentration distribution did not change in any important way. It might also be reasonable to assume that concentrations are now lower for some chemicals (*e.g.*, dioxins), because of the removal of some soil.

Overall, the exposure assumptions and toxicity criteria are considered conservative and the risk estimates calculated in this screening-level health risk assessment are likely to overestimate rather than underestimate potential risks.

Screening-Level Health Risk Assessment Results

This screening-level health risk assessment has evaluated potential risks to human health associated with chemicals detected in soil at the Tronox Parcels A and B located within the Tronox property in Clark County, Nevada. The calculated theoretical upper-bound ILCRs and non-cancer health effects are presented in Table 1. Asbestos risk calculations are presented in Table 5. All calculation spreadsheets for this screening-level health risk assessment are included in Attachment C.

The risk estimates are based on reasonable worst-case exposure scenarios, which results in estimates of the potential high-end risks associated with the property, which are more conservative than a reasonable maximum exposure scenario. The total cumulative non-cancer HI for future commercial/industrial receptors at the property is 0.27, which is below the target HI of 1.0. Because the total cumulative HI is below 1.0, the potential for adverse health effects is considered unlikely.

The total theoretical upper-bound ILCR for future commercial/industrial receptors at the property for non-radionuclides is 1×10^{-6}. The ILCR is equal to the risk goal of 1×10^{-6}. Because the total theoretical upper-bound ILCR is equal to the risk goal, these results indicate that future receptor exposures at the property should not result in unacceptable non-radionuclide carcinogenic risks.

The total theoretical upper-bound ILCR for future commercial/industrial receptors at the property for radionuclides is 3×10^{-6}. Although the ILCR is above the risk goal of 1×10^{-6}; this is comparable to the theoretical upper-bound ILCR for background levels of the uranium isotopes of 3×10^{-6}. Therefore, these results indicate that future receptor exposures at the property should not result in unacceptable radionuclide carcinogenic risks.

The estimated risks for death from lung cancer or mesothelioma for asbestos exposures to outdoor maintenance worker receptors were below 1×10^{-6}. For construction workers, the best estimate and upper bound concentrations of asbestos range from 1×10^{-7} to 8×10^{-7} for chrysotile fibers, and from zero to 5×10^{-6} for amphibole fibers. No long amphibole structures have been detected at the property. The upper bound estimated risk for death from lung cancer or mesothelioma is associated with the UCL of the Poisson distribution which assumes the mean amphibole concentration is equal to three long amphibole structures per cubic centimeter. However, the high-end risk estimate for deaths from lung cancer or mesothelioma of 5×10^{-6} is an overly conservative value for the following reasons:

- It is based on a 95 percent UCL of the Poisson distribution of three long amphibole structures although no long amphibole structures have been detected at the property following remediation; and

- The values from Tables 8-2 of USEPA (2003a) should only be used for structures longer than 10 μm and thinner than 0.4 μm; and are recommended only for constant lifetime exposures, not short term exposures such as construction activities.

Thus, the results of the screening-level health risk assessment indicate that exposures to chemicals in soil at the property should not result in adverse health effects to all future on-site receptors.

Summary

Based on the results of the 2007 investigation, this data review, and the screening-level health risk assessment, concentration levels of chemicals at the Tronox Parcels A and B property are not at levels of concern for human health risk for an industrial scenario. In summary, BEC concludes that an NFAD for the property is warranted.

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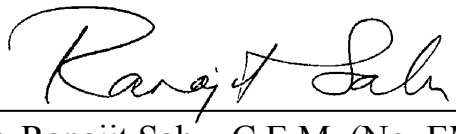
Attachments: Table 1 – Soil Data and Screening-Level Risk Assessment Results Summary
Table 2 – Site and Background Summary Statistics
Table 3 – Background Comparison Summary
Table 4 – Data Adequacy Evaluation
Table 5 – Asbestos Risk Summary
Figure 1 – Tronox/BEC Parcel Map with Tronox Source Areas
Figure 2 – Parcel A Sample Locations
Figure 3 – Parcel B Sample Locations
Figure 4 – Areas Remediated for Asbestos
Figure 5 – Conceptual Site Model Diagram for Potential Human Exposures
Attachment A – Tronox/BEC Response to Comments and Redline Version of Text (RLSO on CD)
Attachment B – Legal Descriptions for Tronox Parcels A and B
Attachment C – 2007 Tronox Parcels A/B Investigation Data (Database on CD)
Attachment D – January 9, 2008 Asbestos Data Review for 2007 Tronox Parcels A/B Investigation Memorandum
Attachment E – December 18, 2007 Uranium Isotope Data Review for 2007 Tronox Parcels A/B Investigation Memorandum
Attachment F – Probability Plots and Boxplots (on CD)

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



February 11, 2008

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2009) Date
BRC Project Manager

FIGURES

N

Parcel "A"

Parcel "B"

Parcel "C"

Parcel "D"

Parcel "E"

Parcel "F"

Parcel "G"

Parcel "H"

Parcel "I"

Parcel "J"

600 300 0 600

Feet

Tronox Property

Monitoring Wells

Historical Ditches

Tronox/BEC Parcels

NFA to be obtained later

NFA to be obtained now

Parcels included in this Data Review

TIMET NFA Area

Tronox Potential Source Area

Tronox Potential Source Area That is Less Defined

BEC / Tronox Parcels A/B Data Review
BMI Common Areas, Henderson, Nevada

FIGURE 1

TRONOX/BEC PARCEL MAP WITH TRONOX SOURCE AREAS

Basic Environmental COMPANY

Prepared by: MKJ Date 01/30/08

JOB No. 0069073
FILE: GIS/BEC/TRONOX/FIGURE_1.MXD

Sampling Location

Monitoring Well

Gravel Pile

4-Acre Random Sampling Grid (Grid ID = "A-X#")

Sample ID Nomenclature:

TSB-BR(J)-01

- TSB-BR: Parcel ID
- (J): Random Sample
- J: Judgmental Sample
- 01: Sample Number

February 2007 Aerial from AirPhotoUSA.

BEC / Tronox Parcels A/B Data Review
BMI Common Areas, Henderson, Nevada

FIGURE 2

PARCEL A
SAMPLE LOCATIONS

Basic Environmental COMPANY

Prepared by:	Date	JOB No. 0069073
MKJ	01/30/08	FILE: GIS/BEC/TRONOX/FIGURE_2.MXD

- Sampling Location
- Monitoring Well
- Approximate Fill Pile Location
- Approximate Debris Pile Location
- Approximate Concrete/Asphalt Pile Location
- 4-Acre Random Sampling Grid (Grid ID = "B-X#")

Sample ID Nomenclature:

TSB-BR(J)-01

- TSB-BR: Parcel ID
- (J): Random Sample
- -01: Sample Number
- J: Judgmental Sample

February 2007 Aerial from AirPhotoUSA.

BEC / Tronox Parcels A/B Data Review
BMI Common Areas, Henderson, Nevada

FIGURE 3

PARCEL B
SAMPLE LOCATIONS

Basic Environmental COMPANY

Prepared by:	Date	JOB No. 0069073
MKJ	01/30/08	FILE: GIS/BEC/TRONOX/FIGURE_3.MXD

Asbestos Sample Location

Remediated Areas*

February 2007 Aerial from AirPhotoUSA.

*These areas have had a minimum of 4" of soil removed for remediation purposes.

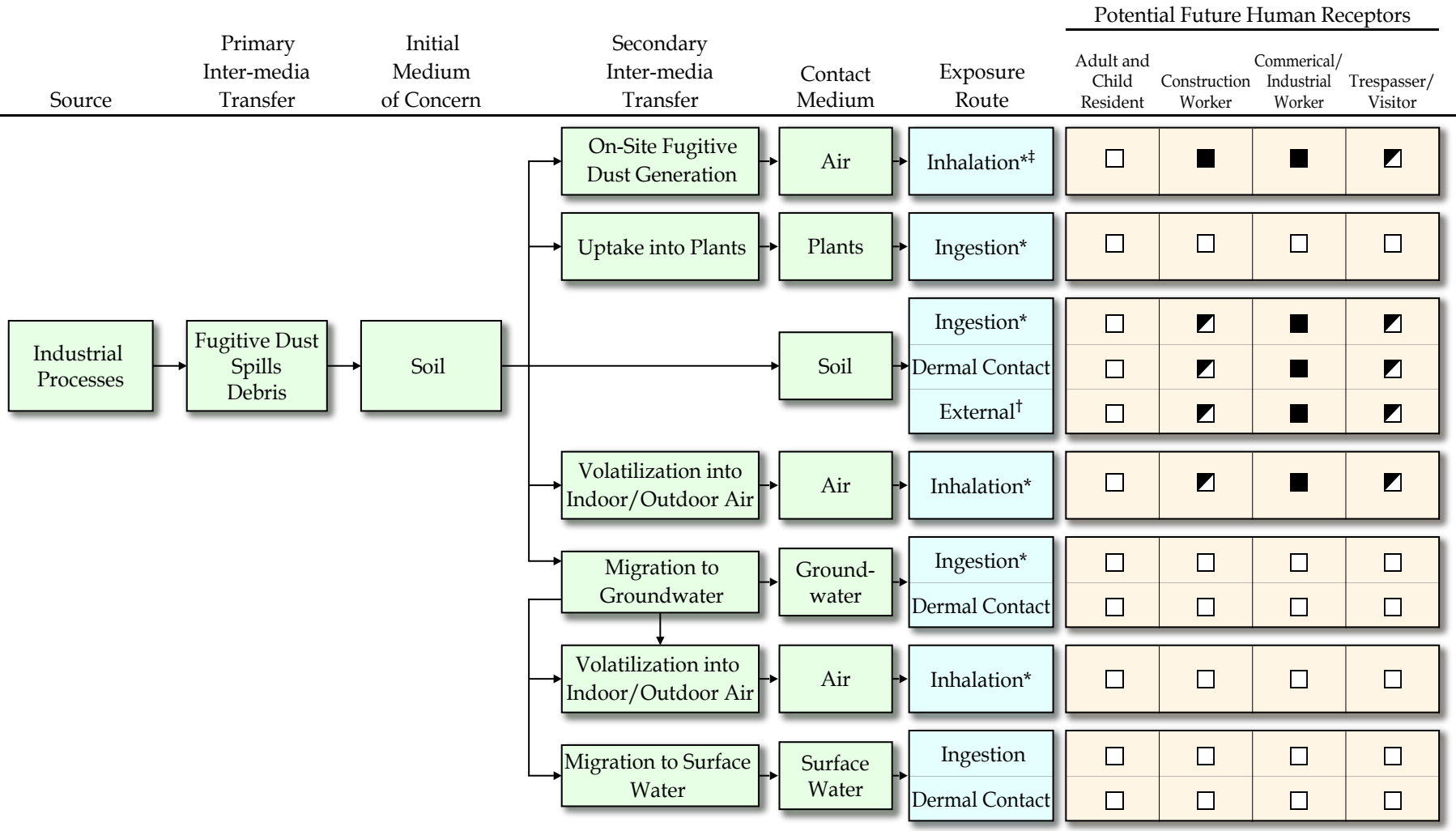
BEC / Tronox Parcels A/B Data Review
BMI Common Areas, Henderson, Nevada

FIGURE 4

ASBESTOS REMEDIATION AREAS

Basic Environmental COMPANY

Prepared by:	Date	JOB No. 0069073
MKJ	01/30/08	FILE: GIS/BEC/TRONOX/FIGURE_4.MXD



□ - Incomplete or insignificant exposure pathway.
■ - Complete or potentially complete exposure pathway.
◩ - Although a potentially complete exposure pathway, only commerical/industrial worker receptors (and construction workers for asbestos exposures) were evaluated in the screening-level health risk assessment (see text).
*Includes radionuclide exposures.
†Only radionuclide exposures.
‡Includes asbestos exposures.

BEC / Tronox Parcels A/B Data Review
BMI Common Areas, Henderson, Nevada

FIGURE 5

CONCEPTUAL SITE MODEL DIAGRAM FOR POTENTIAL HUMAN EXPOSURES

Basic Environmental COMPANY

Prepared by: MKJ | Date 01/30/08 | JOB No. 0069073 | FILE: GIS/BEC/TRONOX/FIGURE_5.AI

TABLES

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Total Count	Detect Count	Detect Frequency	Min. Detect[a]	Max. Detect[a]	Location of Max. Detect	Min. Non-Detect Limit[b]	Max. Non-Detect Limit[b]
Dioxins/Furans	TCDD TEF[n]	pg/g	32	32	100%	0.73	472	TSB-BJ-05-0	--	--
Asbestos[i]	Chrysotile	Structures	30	4	13%	0	3	TSB-AR-05/ TSB-BJ-05	--	--
	Amphibole	Structures	30	0	0%	--	--	--	--	--
General Chemistry	Bromide	mg/kg	64	28	44%	0.69	7.8	TSB-AJ-02-10	2.5	3.1
	Bromine	mg/kg	64	28	44%	1.4	15.7	TSB-AJ-02-10	5.1	6.3
	Chlorate	mg/kg	64	17	27%	1.4	17	TSB-BR-02-10	5.1	6.3
	Chloride	mg/kg	64	62	97%	3.3	2,210	TSB-AR-06-0-DUP	2	206
	Chlorine	mg/kg	64	62	97%	6.6	4,410	TSB-AR-06-0-DUP	4.1	411
	Chlorite	ug/kg	3	0	0%	--	--	--	220	250
	Fluoride	mg/kg	64	41	64%	0.39	4.3	TSB-BJ-04-10	1	1.3
	Nitrate (as N)	mg/kg	64	64	100%	0.33	229	TSB-AR-06-0-DUP	0.2	10.4
	Nitrite (as N)	mg/kg	64	1	2%	0.45	0.45	TSB-AJ-03-0	0.2	0.25
	Orthophosphate as P	mg/kg	64	2	3%	2	2	TSB-AR-11-0	5.1	6.3
	Perchlorate	ug/kg	64	63	98%	53.4	41,600	TSB-BJ-03-10	40.6	2480
	Sulfate	mg/kg	64	64	100%	9.1	8,870	TSB-AR-12-10	5.1	265
Glycols/Alcohols	Ethanol	ug/kg	64	0	0%	--	--	--	250	310
Metals	Aluminum	mg/kg	64	64	100%	6,780	9,750	TSB-BJ-01-0	10.1	12.5
	Antimony	mg/kg	64	54	84%	0.11	0.42	TSB-BR-02-0	1	1.3
	Arsenic	mg/kg	64	64	100%	2.3	5.8	TSB-BR-04-10	2	2.5
	Barium	mg/kg	64	64	100%	148	269	TSB-BJ-01-10	4.1	5
	Beryllium	mg/kg	64	64	100%	0.41	0.65	TSB-BJ-01-10	0.2	0.25
	Boron	mg/kg	64	0	0%	--	--	TSB-BR-06-10	20.3	25
	Cadmium	mg/kg	64	52	81%	0.069	0.59	TSB-BJ-02-0	0.1	0.13
	Calcium	mg/kg	64	64	100%	15,600	75,300	TSB-AR-13-10	101	125
	Chromium (Total)	mg/kg	64	64	100%	7.3	17	TSB-BR-04-10	2	2.5
	Chromium (VI)	mg/kg	61	25	41%	0.18	0.58	TSB-BJ-04-0	1	1.3
	Cobalt	mg/kg	64	64	100%	4.6	7.5	TSB-BR-02-0	0.41	0.5
	Copper	mg/kg	64	64	100%	11.3	31	TSB-BR-02-0	2	2.5
	Iron	mg/kg	64	64	100%	10,100	17,200	TSB-BJ-02-0	10.1	12.5
	Lead	mg/kg	64	64	100%	6.5	136	TSB-BR-03-0	0.61	0.75
	Lithium	mg/kg	64	56	88%	10.9	22.6	TSB-AR-13-10	10.1	26.4
	Magnesium	mg/kg	64	64	100%	6,690	13,600	TSB-BR-05-10	101	125
	Manganese	mg/kg	64	64	100%	218	668	TSB-BR-02-0	0.41	0.5
	Mercury	ug/kg	64	40	63%	7.3	17.5	TSB-BJ-04-0	33.8	41.7
	Molybdenum	mg/kg	64	31	48%	0.48	1.4	TSB-AR-04-10	1	1.3
	Nickel	mg/kg	64	64	100%	11.2	23.7	TSB-AJ-02-0	1	1.3
	Niobium	mg/kg	64	2	3%	1.6	2	TSB-AR-08-0	5.1	6.3
	Palladium	mg/kg	64	64	100%	0.3	1.2	TSB-AR-13-10	0.2	0.25
	Phosphorus (as P)	mg/kg	64	64	100%	527	1,510	TSB-BR-02-0	101	125
	Platinum	mg/kg	64	0	0%	--	--	--	0.2	0.25
	Potassium	mg/kg	64	64	100%	2,040	4,800	TSB-AR-06-0-DUP	20.3	25

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Total Count	Detect Count	Detect Frequency	Min. Detect[a]	Max. Detect[a]	Location of Max. Detect	Min. Non-Detect Limit[b]	Max. Non-Detect Limit[b]
Metals	Selenium	mg/kg	64	0	0%	--	--	--	1	1.3
	Silicon	mg/kg	64	64	100%	128	1,320	TSB-AR-02-0	50.7	62.6
	Silver	mg/kg	64	64	100%	0.081	0.82	TSB-BR-03-0	0.41	0.5
	Sodium	mg/kg	64	64	100%	244	1,720	TSB-AR-06-0	40.6	50.1
	Strontium	mg/kg	64	64	100%	120	487	TSB-AR-13-10	1	1.3
	Sulfur	mg/kg	64	26	41%	443	5,980	TSB-AR-12-10	1010	2550
	Thallium	mg/kg	64	0	0%	--	--	TSB-BR-06-10	0.41	0.5
	Tin	mg/kg	64	56	88%	0.4	1.5	TSB-BR-02-0	0.41	0.5
	Titanium	mg/kg	64	64	100%	504	982	TSB-BJ-02-0	1	1.3
	Tungsten	mg/kg	64	0	0%	--	--	TSB-BR-06-10	1	1.3
	Uranium	mg/kg	64	64	100%	0.69	3.1	TSB-AR-13-10	0.2	0.25
	Vanadium	mg/kg	64	64	100%	24.2	53.4	TSB-BJ-02-0	2	2.5
	Zinc	mg/kg	64	64	100%	25.9	211	TSB-BJ-01-0	4.1	5
	Zirconium	mg/kg	64	64	100%	4.9	27.3	TSB-BJ-02-10	20.3	25
Organochlorine Pesticides	2,4-DDD	ug/kg	64	4	6%	2	17	TSB-BR-01-0	1.7	19
	2,4-DDE	ug/kg	64	11	17%	2.1	150	TSB-BR-01-0	1.7	19
	4,4-DDD	ug/kg	64	2	3%	7.5	18	TSB-BJ-05-0	1.7	19
	4,4-DDE	ug/kg	64	19	30%	1.8	310	TSB-BR-01-0	1.7	19
	4,4-DDT	ug/kg	64	10	16%	2.3	99	TSB-BR-01-0	1.7	19
	Aldrin	ug/kg	64	0	0%	--	--	--	1.7	19
	alpha-BHC	ug/kg	64	0	0%	--	--	--	1.7	19
	alpha-Chlordane	ug/kg	64	0	0%	--	--	--	1.7	19
	beta-BHC	ug/kg	64	31	48%	1.7	190	TSB-BR-01-0	1.7	19
	Chlordane	ug/kg	64	0	0%	--	--	--	17	190
	delta-BHC	ug/kg	64	0	0%	--	--	--	1.7	19
	Dieldrin	ug/kg	64	0	0%	--	--	--	1.7	19
	Endosulfan I	ug/kg	64	0	0%	--	--	--	1.7	19
	Endosulfan II	ug/kg	64	0	0%	--	--	--	1.7	19
	Endosulfan sulfate	ug/kg	64	0	0%	--	--	--	1.7	19
	Endrin	ug/kg	64	1	2%	7	7	TSB-BR-01-0	1.7	19
	Endrin aldehyde	ug/kg	64	2	3%	2.7	3.6	TSB-AR-12-0	1.7	19
	Endrin ketone	ug/kg	64	0	0%	--	--	--	1.7	19
	gamma-Chlordane	ug/kg	64	0	0%	--	--	--	1.7	19
	Heptachlor	ug/kg	64	0	0%	--	--	--	1.7	19
	Heptachlor epoxide	ug/kg	64	0	0%	--	--	--	1.7	19
	Lindane	ug/kg	64	0	0%	--	--	--	1.7	19
	Methoxychlor	ug/kg	64	0	0%	--	--	--	3.3	37
	Toxaphene	ug/kg	64	0	0%	--	--	--	68	760
Petroleum Hydrocarbons	TPH (as Gasoline)	mg/kg	64	0	0%	--	--	--	0.1	0.13
	TPH (as Diesel)	mg/kg	64	0	0%	--	--	--	25	31
	Oil/Grease	mg/kg	64	0	0%	--	--	--	203	250

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Total Count	Detect Count	Detect Frequency	Min. Detect[a]	Max. Detect[a]	Location of Max. Detect	Min. Non-Detect Limit[b]	Max. Non-Detect Limit[b]
Radionuclides	Radium-226	pCi/g	64	64	100%	0.837	1.48	TSB-AJ-01-10	0.0487	0.0944
	Radium-228	pCi/g	64	64	100%	1.4	2.13	TSB-BR-06-0	0.0978	0.18
	Thorium-228	pci/g	64	63	98%	0.973	2.17	TSB-BR-06-0	0.1	0.1
	Thorium-230	pci/g	64	64	100%	0.308	2.03	TSB-AR-3-10	0.1	0.1
	Thorium-232	pci/g	64	63	98%	1.1	2.36	TSB-BR-04-0	0.1	0.1
	Uranium-233/234[k]	pci/g	64	64	100%	0.82	3.69	TSB-AR-13-10	--	--
	Uranium-235/236[k]	pci/g	64	64	100%	0.05	0.22	TSB-AR-13-10	--	--
	Uranium-238[k]	pci/g	64	64	100%	0.81	3.65	TSB-AR-13-10	--	--
SVOCs	1,2,4,5-Tetrachlorobenzene	ug/kg	64	0	0%	--	--	--	330	410
	1,2-Diphenylhydrazine	ug/kg	64	0	0%	--	--	--	330	410
	1,4-Dioxane	ug/kg	64	0	0%	--	--	--	330	410
	1-Nonanal	ug/kg	64	0	0%	--	--	--	10	13
	2,2'-/4,4'-Dichlorobenzil	ug/kg	64	0	0%	--	--	--	330	2800
	2,4,5-Trichlorophenol	ug/kg	64	0	0%	--	--	--	330	410
	2,4,6-Trichlorophenol	ug/kg	64	0	0%	--	--	--	330	410
	2,4-Dichlorophenol	ug/kg	64	0	0%	--	--	--	330	410
	2,4-Dimethylphenol	ug/kg	64	0	0%	--	--	--	330	410
	2,4-Dinitrophenol	ug/kg	64	0	0%	--	--	--	1600	2000
	2,4-Dinitrotoluene	ug/kg	64	0	0%	--	--	--	330	410
	2,6-Dinitrotoluene	ug/kg	64	0	0%	--	--	--	330	410
	2-Chloronaphthalene	ug/kg	64	0	0%	--	--	--	330	410
	2-Chlorophenol	ug/kg	64	0	0%	--	--	--	330	410
	2-Methylnaphthalene	ug/kg	64	0	0%	--	--	--	330	410
	2-Nitroaniline	ug/kg	64	0	0%	--	--	--	1600	2000
	2-Nitrophenol	ug/kg	64	0	0%	--	--	--	330	410
	3,3'-Dichlorobenzidine	ug/kg	64	0	0%	--	--	--	1600	2000
	3-Methylphenol & 4-Methylphenol	ug/kg	64	0	0%	--	--	--	670	830
	3-Nitroaniline	ug/kg	64	0	0%	--	--	--	1600	2000
	4-Bromophenyl phenyl ether	ug/kg	64	0	0%	--	--	--	330	410
	4-Chloro-3-Methylphenol	ug/kg	64	0	0%	--	--	--	330	410
	4-Chlorophenyl phenyl ether	ug/kg	64	0	0%	--	--	--	330	410
	4-Nitrophenol	ug/kg	64	0	0%	--	--	--	1600	2000
	Acenaphthene	ug/kg	64	10	16%	65	1,000	TSB-AJ-01-10	51	63
	Acenaphthylene	ug/kg	64	0	0%	--	--	--	100	130
	Acetophenone	ug/kg	64	0	0%	--	--	--	330	410
	Aniline	ug/kg	64	0	0%	--	--	--	330	410
	Anthracene	ug/kg	64	0	0%	--	--	--	30	38
	Azobenzene	ug/kg	64	0	0%	--	--	--	330	410
	Benzenethiol	ug/kg	64	0	0%	--	--	--	330	410
	Benzo(a)anthracene	ug/kg	64	1	2%	55	55	TSB-AR-01-0-DUP	15	19
	Benzo(a)pyrene	ug/kg	64	1	2%	19	19	TSB-BJ-03-0	15	19

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Total Count	Detect Count	Detect Frequency	Min. Detect[a]	Max. Detect[a]	Location of Max. Detect	Min. Non-Detect Limit[b]	Max. Non-Detect Limit[b]
SVOCs	Benzo(b)fluoranthene	ug/kg	64	1	2%	21	21	TSB-BJ-03-0	15	19
	Benzo(g,h,i)perylene	ug/kg	64	0	0%	--	--	--	30	38
	Benzo(k)fluoranthene	ug/kg	64	0	0%	--	--	--	15	19
	Benzoic acid	ug/kg	64	0	0%	--	--	--	1600	2000
	Benzyl alcohol	ug/kg	64	0	0%	--	--	--	330	410
	Benzyl butyl phthalate	ug/kg	64	4	6%	42	420	TSB-BJ-04-0	330	410
	bis(2-Chloroethoxy) methane	ug/kg	64	0	0%	--	--	--	330	410
	bis(2-Chloroethyl) ether	ug/kg	64	0	0%	--	--	--	330	410
	bis(2-Chloroisopropyl) ether	ug/kg	64	0	0%	--	--	--	330	410
	bis(2-Ethylhexyl) phthalate	ug/kg	64	2	3%	37	140	TSB-BR-03-0	330	410
	bis(p-Chlorophenyl) disulfide	ug/kg	64	0	0%	--	--	--	330	410
	bis(p-Chlorophenyl) sulfone	ug/kg	64	0	0%	--	--	--	330	410
	Carbazole	ug/kg	64	0	0%	--	--	--	330	410
	Chrysene	ug/kg	64	2	3%	18	24	TSB-BJ-03-0	15	19
	Dibenzo(a,h)anthracene	ug/kg	64	0	0%	--	--	--	30	38
	Dibenzofuran	ug/kg	64	0	0%	--	--	--	330	410
	Dibutyl phthalate	ug/kg	64	1	2%	50	50	TSB-BR-03-0	330	410
	Diethyl phthalate	ug/kg	64	0	0%	--	--	--	330	410
	Dimethyl phthalate	ug/kg	64	0	0%	--	--	--	330	410
	Di-n-octyl phthalate	ug/kg	64	0	0%	--	--	--	330	410
	Diphenyl sulfone	ug/kg	64	0	0%	--	--	--	330	410
	Fluoranthene	ug/kg	64	0	0%	--	--	--	330	410
	Fluorene	ug/kg	64	0	0%	--	--	--	330	410
	Hexachlorobenzene	ug/kg	64	1	2%	49	49	TSB-BR-01-0	330	410
	Hexachlorocyclopentadiene	ug/kg	64	0	0%	--	--	--	1600	2000
	Hydroxymethyl phthalimide	ug/kg	64	0	0%	--	--	--	330	410
	Indeno(1,2,3-cd)pyrene	ug/kg	64	0	0%	--	--	--	15	19
	Isophorone	ug/kg	64	0	0%	--	--	--	330	410
	Naphthalene	ug/kg	64	0	0%	--	--	--	330	410
	Nitrobenzene	ug/kg	64	0	0%	--	--	--	330	410
	N-nitrosodi-n-propylamine	ug/kg	64	0	0%	--	--	--	330	410
	N-nitrosodiphenylamine	ug/kg	64	0	0%	--	--	--	330	410
	o-Cresol	ug/kg	64	0	0%	--	--	--	330	410
	Octachlorostyrene	ug/kg	64	1	2%	41	41	TSB-BR-01-0	330	410
	p-Chloroaniline	ug/kg	64	0	0%	--	--	--	330	410
	p-Chlorothiophenol	ug/kg	64	0	0%	--	--	--	330	410
	Pentachlorobenzene	ug/kg	64	0	0%	--	--	--	330	410
	Pentachlorophenol	ug/kg	64	0	0%	--	--	--	1600	2000
	Phenanthrene	ug/kg	64	0	0%	--	--	--	30	38
	Phenol	ug/kg	64	0	0%	--	--	--	330	410
	Phenyl Disulfide	ug/kg	64	0	0%	--	--	--	330	410

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Total Count	Detect Count	Detect Frequency	Min. Detect[a]	Max. Detect[a]	Location of Max. Detect	Min. Non-Detect Limit[b]	Max. Non-Detect Limit[b]
SVOCs	Phenyl Sulfide	ug/kg	64	0	0%	--	--	--	330	410
	Phthalic acid	ug/kg	64	0	0%	--	--	--	1600	2000
	p-Nitroaniline	ug/kg	64	0	0%	--	--	--	1600	2000
	Pyrene	ug/kg	64	0	0%	--	--	--	30	38
	Pyridine	ug/kg	64	0	0%	--	--	--	670	830
VOCs	1,1,1,2-Tetrachloroethane	ug/kg	64	0	0%	--	--	--	5	6.3
	1,1,1-Trichloroethane	ug/kg	64	0	0%	--	--	--	5	6.3
	1,1,2,2-Tetrachloroethane	ug/kg	64	0	0%	--	--	--	5	6.3
	1,1,2-Trichloroethane	ug/kg	64	0	0%	--	--	--	5	6.3
	1,1-Dichloroethane	ug/kg	64	0	0%	--	--	--	5	6.3
	1,1-Dichloroethylene	ug/kg	64	0	0%	--	--	--	5	6.3
	1,1-Dichloropropene	ug/kg	64	0	0%	--	--	--	5	6.3
	1,2,3-Trichlorobenzene	ug/kg	64	0	0%	--	--	--	5	6.3
	1,2,3-Trichloropropane	ug/kg	64	0	0%	--	--	--	5	6.3
	1,2,4-Trichlorobenzene	ug/kg	64	1	2%	0.9	0.9	TSB-AJ-01-10	5	6.3
	1,2,4-Trimethylbenzene	ug/kg	64	34	53%	0.23	0.57	TSB-AR-13-10	5	6.3
	1,2-Dibromo-3-chloropropane	ug/kg	64	0	0%	--	--	--	10	13
	1,2-Dichlorobenzene	ug/kg	64	0	0%	--	--	--	5	6.3
	1,2-Dichloroethane	ug/kg	64	0	0%	--	--	--	5	6.3
	1,2-Dichloroethylene	ug/kg	64	0	0%	--	--	--	10	13
	1,2-Dichloropropane	ug/kg	64	0	0%	--	--	--	5	6.3
	1,3,5- Trichlorobenzene	ug/kg	64	0	0%	--	--	--	5	6.3
	1,3,5-Trimethylbenzene	ug/kg	64	0	0%	--	--	--	5	6.3
	1,3-Dichlorobenzene	ug/kg	64	0	0%	--	--	--	5	6.3
	1,3-Dichloropropane	ug/kg	64	0	0%	--	--	--	5	6.3
	1,4-Dichlorobenzene	ug/kg	64	0	0%	--	--	--	5	6.3
	2,2,3-Trimethylbutane	ug/kg	64	0	0%	--	--	--	5	6.3
	2,2-Dichloropropane	ug/kg	64	0	0%	--	--	--	5	6.3
	2,2-Dimethylpentane	ug/kg	64	0	0%	--	--	--	5	6.3
	2,3-Dimethylpentane	ug/kg	64	0	0%	--	--	--	5	6.3
	2,4-Dimethylpentane	ug/kg	64	0	0%	--	--	--	20	25
	2-Chlorotoluene	ug/kg	64	0	0%	--	--	--	5	6.3
	2-Nitropropane	ug/kg	64	0	0%	--	--	--	10	13
	2-Phenylbutane	ug/kg	64	0	0%	--	--	--	5	6.3
	3,3-dimethylpentane	ug/kg	64	0	0%	--	--	--	10	13
	3-ethylpentane	ug/kg	64	0	0%	--	--	--	5	6.3
	3-Methylhexane	ug/kg	64	0	0%	--	--	--	5	6.3
	4-Chlorothioanisole	ug/kg	64	0	0%	--	--	--	330	410
	4-Chlorotoluene	ug/kg	64	0	0%	--	--	--	5	6.3
	Acetone	ug/kg	64	9	14%	6.5	16	TSB-BJ-01-10	20	25
	Acetonitrile	ug/kg	64	0	0%	--	--	--	50	63

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Total Count	Detect Count	Detect Frequency	Min. Detect[a]	Max. Detect[a]	Location of Max. Detect	Min. Non-Detect Limit[b]	Max. Non-Detect Limit[b]
VOCs	Benzene	ug/kg	64	0	0%	--	--	--	5	6.3
	Bromobenzene	ug/kg	64	0	0%	--	--	--	5	6.3
	Bromodichloromethane	ug/kg	64	0	0%	--	--	--	5	6.3
	Bromomethane	ug/kg	64	0	0%	--	--	--	10	13
	Carbon disulfide	ug/kg	64	0	0%	--	--	--	5	6.3
	Carbon tetrachloride	ug/kg	64	0	0%	--	--	--	5	6.3
	Freon 11	ug/kg	64	0	0%	--	--	--	5	6.3
	Freon 12	ug/kg	64	0	0%	--	--	--	10	13
	Freon 113	ug/kg	64	0	0%	--	--	--	5	6.3
	Chlorobenzene	ug/kg	64	0	0%	--	--	--	5	6.3
	Chlorobromomethane	ug/kg	64	0	0%	--	--	--	5	6.3
	Chlorodibromomethane	ug/kg	64	0	0%	--	--	--	5	6.3
	Chloroethane	ug/kg	64	0	0%	--	--	--	10	13
	Chloroform	ug/kg	64	0	0%	--	--	--	5	6.3
	Chloromethane	ug/kg	64	0	0%	--	--	--	10	13
	cis-1,2-Dichloroethylene	ug/kg	64	0	0%	--	--	--	5	6.3
	cis-1,3-Dichloropropylene	ug/kg	64	0	0%	--	--	--	5	6.3
	Cymene	ug/kg	64	0	0%	--	--	--	5	6.3
	Dibromomethane	ug/kg	64	0	0%	--	--	--	5	6.3
	Dichloromethane	ug/kg	64	0	0%	--	--	--	5	6.3
	Ethylbenzene	ug/kg	64	3	5%	0.2	0.24	TSB-AR-07-10	5	6.3
	Hexachloro-1,3-butadiene	ug/kg	64	0	0%	--	--	--	330	410
	Hexachloroethane	ug/kg	64	0	0%	--	--	--	330	410
	Hexane, 2-methyl-	ug/kg	64	0	0%	--	--	--	5	6.3
	Isopropylbenzene	ug/kg	64	0	0%	--	--	--	5	6.3
	m,p-Xylene	ug/kg	64	0	0%	--	--	--	5	6.3
	Methyl disulfide	ug/kg	64	0	0%	--	--	--	5	6.3
	Methyl ethyl ketone	ug/kg	64	0	0%	--	--	--	20	25
	Methyl iodide	ug/kg	64	0	0%	--	--	--	5	6.3
	Methyl isobutyl ketone	ug/kg	64	0	0%	--	--	--	20	25
	Methyl n-butyl ketone	ug/kg	64	0	0%	--	--	--	20	25
	MTBE (Methyl tert-butyl ether)	ug/kg	64	0	0%	--	--	--	5	6.3
	n-Butyl benzene	ug/kg	64	0	0%	--	--	--	5	6.3
	n-Heptane	ug/kg	64	0	0%	--	--	--	5	6.3
	n-Propyl benzene	ug/kg	64	0	0%	--	--	--	5	6.3
	o-Xylene	ug/kg	64	0	0%	--	--	--	5	6.3
	Styrene (monomer)	ug/kg	64	0	0%	--	--	--	5	6.3
	tert-Butyl benzene	ug/kg	64	0	0%	--	--	--	5	6.3
	Tetrachloroethylene	ug/kg	64	0	0%	--	--	--	5	6.3
	Toluene	ug/kg	64	11	17%	0.24	0.65	TSB-BR-06-10	5	6.3
	trans-1,2-Dichloroethylene	ug/kg	64	0	0%	--	--	--	5	6.3

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Total Count	Detect Count	Detect Frequency	Min. Detect[a]	Max. Detect[a]	Location of Max. Detect	Min. Non-Detect Limit[b]	Max. Non-Detect Limit[b]
VOCs	trans-1,3-Dichloropropylene	ug/kg	64	0	0%	--	--	--	5	6.3
	Tribromomethane	ug/kg	64	0	0%	--	--	--	5	6.3
	Trichloroethylene	ug/kg	64	0	0%	--	--	--	5	6.3
	Vinyl acetate	ug/kg	64	0	0%	--	--	--	5	6.3
	Vinyl chloride	ug/kg	64	0	0%	--	--	--	5	6.3
	Xylenes (total)	ug/kg	64	0	0%	--	--	--	10	13

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.
b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.
c - From USEPA Region 9 preliminary remediation goals (PRG) table, Oct. 2004 (and the 2007 USEPA radionuclide PRG webpage; http://epa-prgs.ornl.gov/radionuclides). Values used are industrial soil PRGs. Several chemicals have both cancer and non-cancer toxicity criteria. For these chemicals USEPA calculates PRGs for both cancer and non-cancer endpoints; however only the lower value is published in its PRG table. The other value is included in a separate spreadsheet table. This other value is shown on this table as the 'Secondary Industrial PRG' and is included in the screening-level risk assessment calculations.
d - Values used are the maximum from the shallow soils background dataset presented in the Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity (BRC/TIMET 2007).
e - Based on results of statistical comparison tests performed between shallow background and site datasets (see Table 3).
f - Non-cancer hazard indices were calculated by dividing the maximum detected value by its PRG (or secondary PRG). The total non-cancer hazard index is the sum of all chemical-specific hazard indices.
g - Theoretical upper-bound incremental lifetime cancer risks were calculated by were calculated by dividing the maximum detected value by its PRG (or secondary PRG) times 1E-6. The total incremental lifetime cancer risk is the sum of all chemical-specific cancer risks.
h - Agency for Toxic Substances and Disease Registry (ATSDR) action level of 1.0 parts per billion (ppb).
i - Asbestos results shown are for long protocol structures (>10um).
j - Reporting limits exceed industrial PRGs; however, in all cases MDL is below PRG.
k - Calculated activities for the uranium isotopes are based on Approach #1 presented in the Uranium Isotope Data Review for 2007 Tronox Parcels A/B Investigation memorandum (see Attachment E).

TABLE 1
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TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Count of Detects > PRG	SSL (DAF = 1)[c]	Count of Detects > SSL (1)	SSL (DAF = 20)[c]	Count of Detects > SSL (20)
Dioxins/Furans	TCDD TEF[n]	pg/g	472	1,000	ca	--	0	--	--	--	--
Asbestos[i]	Chrysotile	Structures	3	--	--	--	--	--	--	--	--
	Amphibole	Structures	--	--	--	--	--	--	--	--	--
General Chemistry	Bromide	mg/kg	7.8	--	--	--	--	--	--	--	--
	Bromine	mg/kg	15.7	--	--	--	--	--	--	--	--
	Chlorate	mg/kg	17	--	--	--	--	--	--	--	--
	Chloride	mg/kg	2,210	--	--	--	--	--	--	--	--
	Chlorine	mg/kg	4,410	--	--	--	--	--	--	--	--
	Chlorite	ug/kg	--	--	--	--	--	--	--	--	--
	Fluoride	mg/kg	4.3	36,900	nc	--	0	--	--	--	--
	Nitrate (as N)	mg/kg	229	--	--	--	--	--	--	--	--
	Nitrite (as N)	mg/kg	0.45	--	--	--	--	--	--	--	--
	Orthophosphate as P	mg/kg	2	--	--	--	--	--	--	--	--
	Perchlorate	ug/kg	41,600	>100,000	--	--	0	--	--	--	--
	Sulfate	mg/kg	8,870	--	--	--	--	--	--	--	--
Glycols/Alcohols	Ethanol	ug/kg	--	--	--	--	--	--	--	--	--
Metals	Aluminum	mg/kg	9,750	>100,000	nc	--	0	--	--	--	--
	Antimony	mg/kg	0.42	409	nc	--	0	0.3	3	5	0
	Arsenic	mg/kg	5.8	1.6	ca	260	64	1	64	29	0
	Barium	mg/kg	269	66,600	nc	--	0	82	64	1600	0
	Beryllium	mg/kg	0.65	1940	ca	--	0	3	0	63	0
	Boron	mg/kg	--	>100,000	nc	--	0	--	--	--	--
	Cadmium	mg/kg	0.59	451	nc	3,000	0	0.4	4	8	0
	Calcium	mg/kg	75,300	--	--	--	--	--	--	--	--
	Chromium (Total)	mg/kg	17	448	nc	--	0	--	--	--	--
	Chromium (VI)	mg/kg	0.58	64	ca	2,500	0	2	0	38	0
	Cobalt	mg/kg	7.5	1,920	ca	--	0	--	--	--	--
	Copper	mg/kg	31	40,900	nc	--	0	--	--	--	--
	Iron	mg/kg	17,200	>100,000	nc	--	0	--	--	--	--
	Lead	mg/kg	136	800	nc	--	0	--	--	--	--
	Lithium	mg/kg	22.6	20,400	nc	--	0	--	--	--	--
	Magnesium	mg/kg	13,600	--	--	--	--	--	--	--	--
	Manganese	mg/kg	668	19,500	nc	--	0	--	--	--	--
	Mercury	ug/kg	17.5	--	--	--	--	--	--	--	--
	Molybdenum	mg/kg	1.4	5,110	nc	--	0	--	--	--	--
	Nickel	mg/kg	23.7	20,400	nc	--	0	7	64	130	0
	Niobium	mg/kg	2	--	--	--	--	--	--	--	--
	Palladium	mg/kg	1.2	--	--	--	--	--	--	--	--
	Phosphorus (as P)	mg/kg	1,510	--	nc	--	--	--	--	--	--
	Platinum	mg/kg	--	--	--	--	--	--	--	--	--
	Potassium	mg/kg	4,800	--	--	--	--	--	--	--	--

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Count of Detects > PRG	SSL (DAF = 1)[c]	Count of Detects > SSL (1)	SSL (DAF = 20)[c]	Count of Detects > SSL (20)
Metals	Selenium	mg/kg	--	5,110	nc	--	0	0.3	0	5	0
	Silicon	mg/kg	1,320	--	--	--	--	--	--	--	--
	Silver	mg/kg	0.82	5,110	nc	--	0	2	0	34	0
	Sodium	mg/kg	1,720	--	--	--	--	--	--	--	--
	Strontium	mg/kg	487	>100,000	nc	--	0	--	--	--	--
	Sulfur	mg/kg	5,980	--	--	--	--	--	--	--	--
	Thallium	mg/kg	--	68	nc	--	0	--	--	--	--
	Tin	mg/kg	1.5	>100,000	nc	--	0	--	--	--	--
	Titanium	mg/kg	982	>100,000	nc	--	0	--	--	--	--
	Tungsten	mg/kg	--	--	--	--	--	--	--	--	--
	Uranium	mg/kg	3.1	204	nc	--	0	--	--	--	--
	Vanadium	mg/kg	53.4	1,020	nc	--	0	300	0	6000	0
	Zinc	mg/kg	211	>100,000	nc	--	0	620	0	12000	0
	Zirconium	mg/kg	27.3	--	--	--	--	--	--	--	--
Organochlorine Pesticides	2,4-DDD	ug/kg	17	--	--	--	--	--	--	--	--
	2,4-DDE	ug/kg	150	--	--	--	--	--	--	--	--
	4,4-DDD	ug/kg	18	9,950	ca	--	0	0.8	0	16	0
	4,4-DDE	ug/kg	310	7,020	ca	--	0	3	0	54	0
	4,4-DDT	ug/kg	99	7,020	ca	>100,000	0	2	0	32	0
	Aldrin	ug/kg	--	101	ca	19,000	0	0.02	0	0.5	0
	alpha-BHC	ug/kg	--	359	ca	>100,000	0	0.00003	0	0.0005	0
	alpha-Chlordane	ug/kg	--	--	--	--	--	0.5	0	10	0
	beta-BHC	ug/kg	190	1,260	ca	>100,000	0	0.0001	31	0.003	26
	Chlordane	ug/kg	--	--	--	--	--	0.5	0	10	0
	delta-BHC	ug/kg	--	--	--	--	--	--	--	--	--
	Dieldrin	ug/kg	--	108	ca	31,000	0	0.0002	0	0.004	0
	Endosulfan I	ug/kg	--	--	--	--	--	0.9	0	18	0
	Endosulfan II	ug/kg	--	--	--	--	--	0.9	0	18	0
	Endosulfan sulfate	ug/kg	--	--	--	--	--	--	--	--	--
	Endrin	ug/kg	7	>100,000	nc	--	0	0.05	0	1	0
	Endrin aldehyde	ug/kg	3.6	--	--	--	--	--	--	--	--
	Endrin ketone	ug/kg	--	--	--	--	--	--	--	--	--
	gamma-Chlordane	ug/kg	--	--	--	--	--	0.5	0	10	0
	Heptachlor	ug/kg	--	383	ca	>100,000	0	1	0	23	0
	Heptachlor epoxide	ug/kg	--	189	ca	8,000	0	0.03	0	0.7	0
	Lindane	ug/kg	--	1,740	ca	>100,000	0	0.0005	0	0.009	0
	Methoxychlor	ug/kg	--	>100,000	nc	--	0	8	0	160	0
	Toxaphene	ug/kg	--	1,570	ca	--	0	2	0	31	0
Petroleum Hydrocarbons	TPH (as Gasoline)	mg/kg	--	--	--	--	--	--	--	--	--
	TPH (as Diesel)	mg/kg	--	--	--	--	--	--	--	--	--
	Oil/Grease	mg/kg	--	--	--	--	--	--	--	--	--

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Count of Detects > PRG	SSL (DAF = 1)[c]	Count of Detects > SSL (1)	SSL (DAF = 20)[c]	Count of Detects > SSL (20)
Radionuclides	Radium-226	pCi/g	1.48	0.026	ca	--	64	--	--	--	--
	Radium-228	pCi/g	2.13	0.15	ca	--	64	--	--	--	--
	Thorium-228	pci/g	2.17	0.26	ca	--	63	--	--	--	--
	Thorium-230	pci/g	2.03	20	ca	--	0	--	--	--	--
	Thorium-232	pci/g	2.36	19	ca	--	0	--	--	--	--
	Uranium-233/234[k]	pci/g	3.69	32	ca	--	0	--	--	--	--
	Uranium-235/236[k]	pci/g	0.22	0.40	ca	--	0	--	--	--	--
	Uranium-238[k]	pci/g	3.65	1.8	ca	--	10	--	--	--	--
SVOCs	1,2,4,5-Tetrachlorobenzene	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	1,2-Diphenylhydrazine	ug/kg	--	2,150	ca	--	0	--	--	--	--
	1,4-Dioxane	ug/kg	--	>100,000	ca	--	0	--	--	--	--
	1-Nonanal	ug/kg	--	--	--	--	--	--	--	--	--
	2,2'-/4,4'-Dichlorobenzil	ug/kg	--	--	--	--	--	14	0	270	0
	2,4,5-Trichlorophenol	ug/kg	--	>100,000	nc	--	0	0.008	0	0.2	0
	2,4,6-Trichlorophenol	ug/kg	--	61,600	nc	>100,000	0	0.05	0	1	0
	2,4-Dichlorophenol	ug/kg	--	>100,000	nc	--	0	0.4	0	9	0
	2,4-Dimethylphenol	ug/kg	--	>100,000	nc	--	0	0.01	0	0.3	0
	2,4-Dinitrophenol	ug/kg	--	>100,000	nc	--	0	4E-05	0	0.0008	0
	2,4-Dinitrotoluene	ug/kg	--	>100,000	nc	--	0	0.00003	0	0.0007	0
	2,6-Dinitrotoluene	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	2-Chloronaphthalene	ug/kg	--	>100,000	nc	--	0	0.2	0	4	0
	2-Chlorophenol	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	2-Methylnaphthalene	ug/kg	--	--	--	--	--	--	--	--	--
	2-Nitroaniline	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	2-Nitrophenol	ug/kg	--	--	--	--	--	0.0003	0	0.007	0
	3,3'-Dichlorobenzidine	ug/kg	--	3,830	ca	--	0	--	--	--	--
	3-Methylphenol & 4-Methylphenol	ug/kg	--	--	--	--	--	--	--	--	--
	3-Nitroaniline	ug/kg	--	82,100	ca	>100,000	0	--	--	--	--
	4-Bromophenyl phenyl ether	ug/kg	--	--	--	--	--	--	--	--	--
	4-Chloro-3-Methylphenol	ug/kg	--	--	--	--	--	--	--	--	--
	4-Chlorophenyl phenyl ether	ug/kg	--	--	--	--	--	--	--	--	--
	4-Nitrophenol	ug/kg	--	--	--	--	--	29	0	570	0
	Acenaphthene	ug/kg	1,000	>100,000	nc	--	0	--	--	--	--
	Acenaphthylene	ug/kg	--	--	--	--	--	--	--	--	--
	Acetophenone	ug/kg	--	--	--	--	--	--	--	--	--
	Aniline	ug/kg	--	>100,000	ca	>100,000	0	590	0	12000	0
	Anthracene	ug/kg	--	>100,000	ca	--	0	--	--	--	--
	Azobenzene	ug/kg	--	15,700	ca	--	0	--	--	--	--
	Benzenethiol	ug/kg	--	--	--	--	--	0.08	0	2	0
	Benzo(a)anthracene	ug/kg	55	2,110	ca	--	0	0.4	0	8	0
	Benzo(a)pyrene	ug/kg	19	211	ca	--	0	0.2	0	5	0

TABLE 1
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Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Count of Detects > PRG	SSL (DAF = 1)[c]	Count of Detects > SSL (1)	SSL (DAF = 20)[c]	Count of Detects > SSL (20)
SVOCs	Benzo(b)fluoranthene	ug/kg	21	2,110	ca	--	0	--	--	--	--
	Benzo(g,h,i)perylene	ug/kg	--	--	--	--	--	2	0	49	0
	Benzo(k)fluoranthene	ug/kg	--	21,100	ca	--	0	20	0	400	0
	Benzoic acid	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Benzyl alcohol	ug/kg	--	>100,000	nc	--	0	810	0	930	0
	Benzyl butyl phthalate	ug/kg	420	>100,000	nc	--	0	--	--	--	--
	bis(2-Chloroethoxy) methane	ug/kg	--	--	--	--	--	0.00002	0	0.0004	0
	bis(2-Chloroethyl) ether	ug/kg	--	575	ca	--	0	--	--	--	--
	bis(2-Chloroisopropyl) ether	ug/kg	--	7,350	ca	>100,000	0	--	--	--	--
	bis(2-Ethylhexyl) phthalate	ug/kg	140	>100,000	ca	>100,000	0	--	--	--	--
	bis(p-Chlorophenyl) disulfide	ug/kg	--	--	--	--	--	--	--	--	--
	bis(p-Chlorophenyl) sulfone	ug/kg	--	>100,000	nc	--	0	0	0	0.6	0
	Carbazole	ug/kg	--	86,200	ca	--	0	8	0	160	0
	Chrysene	ug/kg	24	>100,000	ca	--	0	0.08	0	2	0
	Dibenzo(a,h)anthracene	ug/kg	--	211	ca	--	0	--	--	--	--
	Dibenzofuran	ug/kg	--	>100,000	nc	--	0	270	0	2300	0
	Dibutyl phthalate	ug/kg	50	>100,000	nc	--	0	--	--	--	--
	Diethyl phthalate	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Dimethyl phthalate	ug/kg	--	>100,000	nc	--	0	10000	0	10000	0
	Di-n-octyl phthalate	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Diphenyl sulfone	ug/kg	--	>100,000	nc	--	0	210	0	4300	0
	Fluoranthene	ug/kg	--	>100,000	nc	--	0	28	0	560	0
	Fluorene	ug/kg	--	>100,000	nc	--	0	0.1	0	2	0
	Hexachlorobenzene	ug/kg	49	1,080	ca	>100,000	0	20	0	400	0
	Hexachlorocyclopentadiene	ug/kg	--	>100,000	nc	--	0	0.02	0	0.5	0
	Hydroxymethyl phthalimide	ug/kg	--	--	--	--	--	0.7	0	14	0
	Indeno(1,2,3-cd)pyrene	ug/kg	--	2,110	ca	--	0	0.03	0	0.5	0
	Isophorone	ug/kg	--	>100,000	ca	>100,000	0	4	0	84	0
	Naphthalene	ug/kg	--	>100,000	nc	--	0	0.007	0	0.1	0
	Nitrobenzene	ug/kg	--	>100,000	nc	--	0	0.000002	0	0.00005	0
	N-nitrosodi-n-propylamine	ug/kg	--	246	ca	--	0[j]	0.06	0	1	0
	N-nitrosodiphenylamine	ug/kg	--	>100,000	ca	>100,000	0	0.8	0	15	0
	o-Cresol	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Octachlorostyrene	ug/kg	41	--	--	--	--	0.03	0	0.7	0
	p-Chloroaniline	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	p-Chlorothiophenol	ug/kg	--	--	--	--	--	--	--	--	--
	Pentachlorobenzene	ug/kg	--	>100,000	nc	--	0	0.001	0	0.03	0
	Pentachlorophenol	ug/kg	--	9,000	ca	>100,000	0	--	--	--	--
	Phenanthrene	ug/kg	--	--	--	--	--	5	0	100	0
	Phenol	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Phenyl Disulfide	ug/kg	--	--	--	--	--	--	--	--	--

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Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Count of Detects > PRG	SSL (DAF = 1)[c]	Count of Detects > SSL (1)	SSL (DAF = 20)[c]	Count of Detects > SSL (20)
SVOCs	Phenyl Sulfide	ug/kg	--	--	--	--	--	--	--	--	--
	Phthalic acid	ug/kg	--	--	--	--	--	--	--	--	--
	p-Nitroaniline	ug/kg	--	82,100	ca	>100,000	0	210	0	4200	0
	Pyrene	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Pyridine	ug/kg	--	>100,000	nc	--	0	--	--	--	--
VOCs	1,1,1,2-Tetrachloroethane	ug/kg	--	7,280	ca	>100,000	0	0.1	0	2	0
	1,1,1-Trichloroethane	ug/kg	--	>100,000	nc	--	0	0.0002	0	0.003	0
	1,1,2,2-Tetrachloroethane	ug/kg	--	929	ca	>100,000	0	0.0009	0	0.02	0
	1,1,2-Trichloroethane	ug/kg	--	1,610	ca	>100,000	0	1	0	23	0
	1,1-Dichloroethane	ug/kg	--	>100,000	nc	--	0	0.003	0	0.06	0
	1,1-Dichloroethylene	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	1,1-Dichloropropene	ug/kg	--	--	--	--	--	--	--	--	--
	1,2,3-Trichlorobenzene	ug/kg	--	--	--	--	--	--	--	--	--
	1,2,3-Trichloropropane	ug/kg	--	76	ca	79,000	0	0.3	0	5	0
	1,2,4-Trichlorobenzene	ug/kg	0.9	>100,000	nc	--	0	--	--	--	--
	1,2,4-Trimethylbenzene	ug/kg	0.57	>100,000	nc	--	0	--	--	--	--
	1,2-Dibromo-3-chloropropane	ug/kg	--	2,020	ca	11,000	0	0.9	0	17	0
	1,2-Dichlorobenzene	ug/kg	--	>100,000	nc	--	0	0.001	0	0.02	0
	1,2-Dichloroethane	ug/kg	--	603	ca	28,000	0	--	--	--	--
	1,2-Dichloroethylene	ug/kg	--	--	--	--	--	0.001	0	0.03	0
	1,2-Dichloropropane	ug/kg	--	742	ca	21,000	0	--	--	--	--
	1,3,5- Trichlorobenzene	ug/kg	--	--	--	--	--	--	--	--	--
	1,3,5-Trimethylbenzene	ug/kg	--	69,700	nc	--	0	--	--	--	--
	1,3-Dichlorobenzene	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	1,3-Dichloropropane	ug/kg	--	>100,000	nc	--	0	0.1	0	2	0
	1,4-Dichlorobenzene	ug/kg	--	7,870	ca	>100,000	0	--	--	--	--
	2,2,3-Trimethylbutane	ug/kg	--	--	--	--	--	--	--	--	--
	2,2-Dichloropropane	ug/kg	--	--	--	--	--	--	--	--	--
	2,2-Dimethylpentane	ug/kg	--	--	--	--	--	--	--	--	--
	2,3-Dimethylpentane	ug/kg	--	--	--	--	--	--	--	--	--
	2,4-Dimethylpentane	ug/kg	--	--	--	--	--	--	--	--	--
	2-Chlorotoluene	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	2-Nitropropane	ug/kg	--	--	--	--	--	--	--	--	--
	2-Phenylbutane	ug/kg	--	--	--	--	--	--	--	--	--
	3,3-dimethylpentane	ug/kg	--	--	--	--	--	--	--	--	--
	3-ethylpentane	ug/kg	--	--	--	--	--	--	--	--	--
	3-Methylhexane	ug/kg	--	--	--	--	--	--	--	--	--
	4-Chlorothioanisole	ug/kg	--	--	--	--	--	--	--	--	--
	4-Chlorotoluene	ug/kg	--	--	--	--	--	0.8	0	16	0
	Acetone	ug/kg	16	>100,000	nc	--	0	--	--	--	--
	Acetonitrile	ug/kg	--	>100,000	nc	--	0	0.002	0	0.03	0

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Count of Detects > PRG	SSL (DAF = 1)[c]	Count of Detects > SSL (1)	SSL (DAF = 20)[c]	Count of Detects > SSL (20)
VOCs	Benzene	ug/kg	--	1,410	ca	>100,000	0	--	--	--	--
	Bromobenzene	ug/kg	--	92,200	nc	--	0	0.03	0	0.6	0
	Bromodichloromethane	ug/kg	--	1,830	ca	>100,000	0	0.01	0	0.2	0
	Bromomethane	ug/kg	--	13,100	nc	--	0	2	0	32	0
	Carbon disulfide	ug/kg	--	>100,000	nc	--	0	0.003	0	0.07	0
	Carbon tetrachloride	ug/kg	--	549	ca	7,300	0	--	--	--	--
	Freon 11	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Freon 12	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Freon 113	ug/kg	--	>100,000	nc	--	0	0.07	0	1	0
	Chlorobenzene	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Chlorobromomethane	ug/kg	--	--	--	--	--	0.02	0	0.4	0
	Chlorodibromomethane	ug/kg	--	2,550	ca	>100,000	0	--	--	--	--
	Chloroethane	ug/kg	--	6,490	ca	>100,000	0	0.03	0	0.6	0
	Chloroform	ug/kg	--	470	ca	>100,000	0	--	--	--	--
	Chloromethane	ug/kg	--	>100,000	nc	--	0	0.02	0	0.4	0
	cis-1,2-Dichloroethylene	ug/kg	--	>100,000	nc	--	0	0.0002	0	0.004	0
	cis-1,3-Dichloropropylene	ug/kg	--	--	--	--	--	--	--	--	--
	Cymene	ug/kg	--	--	--	--	--	--	--	--	--
	Dibromomethane	ug/kg	--	>100,000	nc	--	0	0.001	0	0.02	0
	Dichloromethane	ug/kg	--	20,500	ca	>100,000	0	0.7	0	13	0
	Ethylbenzene	ug/kg	0.24	>100,000	nc	--	0	--	--	--	--
	Hexachloro-1,3-butadiene	ug/kg	--	22,100	ca	>100,000	0	0.1	0	2	0
	Hexachloroethane	ug/kg	--	>100,000	ca	>100,000	0	--	--	--	--
	Hexane, 2-methyl-	ug/kg	--	--	--	--	--	--	--	--	--
	Isopropylbenzene	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	m,p-Xylene	ug/kg	--	--	--	--	--	--	--	--	--
	Methyl disulfide	ug/kg	--	--	--	--	--	--	--	--	--
	Methyl ethyl ketone	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Methyl iodide	ug/kg	--	--	--	--	--	--	--	--	--
	Methyl isobutyl ketone	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	Methyl n-butyl ketone	ug/kg	--	--	--	--	--	--	--	--	--
	MTBE (Methyl tert-butyl ether)	ug/kg	--	70,000	ca	>100,000	0	--	--	--	--
	n-Butyl benzene	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	n-Heptane	ug/kg	--	--	--	--	--	--	--	--	--
	n-Propyl benzene	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	o-Xylene	ug/kg	--	--	--	--	--	0.2	0	4	0
	Styrene (monomer)	ug/kg	--	>100,000	nc	--	0	--	--	--	--
	tert-Butyl benzene	ug/kg	--	>100,000	nc	--	0	0.003	0	0.06	0
	Tetrachloroethylene	ug/kg	--	1,310	ca	>100,000	0	0.6	0	12	0
	Toluene	ug/kg	0.65	>100,000	nc	--	0	0.03	0	0.7	0
	trans-1,2-Dichloroethylene	ug/kg	--	>100,000	nc	--	0	0.0002	0	0.004	0

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TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Count of Detects > PRG	SSL (DAF = 1)[c]	Count of Detects > SSL (1)	SSL (DAF = 20)[c]	Count of Detects > SSL (20)
VOCs	trans-1,3-Dichloropropylene	ug/kg	--	--	--	--	--	0.04	0	0.8	0
	Tribromomethane	ug/kg	--	>100,000	ca	>100,000	0	0.003	0	0.1	0
	Trichloroethylene	ug/kg	--	115	ca	>100,000	0	8	0	170	0
	Vinyl acetate	ug/kg	--	>100,000	nc	--	0	0.0007	0	0.01	0
	Vinyl chloride	ug/kg	--	746	ca	>100,000	0	10	0	210	0
	Xylenes (total)	ug/kg	--	>100,000	nc	--	0	--	--	--	--

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.
b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.
c - From USEPA Region 9 preliminary remediation goals (PRG) table, Oct. 2004 (and the 2007 USEPA radionuclide PRG webpage; http://epa-prgs.ornl.gov/radionuclides). Values used are industrial soil PRGs. Several chemicals have both cancer and non-cancer toxicity criteria. For these chemicals USEPA calculates PRGs for both cancer and non-cancer endpoints; however only the lower value is published in its PRG table. The other value is included in a separate spreadsheet table. This other value is shown on this table as the 'Secondary Industrial PRG' and is included in the screening-level risk assessment calculations.
d - Values used are the maximum from the shallow soils background dataset presented in the Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity (BRC/TIMET 2007).
e - Based on results of statistical comparison tests performed between shallow background and site datasets (see Table 3).
f - Non-cancer hazard indices were calculated by dividing the maximum detected value by its PRG (or secondary PRG). The total non-cancer hazard index is the sum of all chemical-specific hazard indices.
g - Theoretical upper-bound incremental lifetime cancer risks were calculated by were calculated by dividing the maximum detected value by its PRG (or secondary PRG) times 1E-6. The total incremental lifetime cancer risk is the sum of all chemical-specific cancer risks.
h - Agency for Toxic Substances and Disease Registry (ATSDR) action level of 1.0 parts per billion (ppb).
i - Asbestos results shown are for long protocol structures (>10um).
j - Reporting limits exceed industrial PRGs; however, in all cases MDL is below PRG.
k - Calculated activities for the uranium isotopes are based on Approach #1 presented in the Uranium Isotope Data Review for 2007 Tronox Parcels A/B Investigation memorandum (see Attachment E).

TABLE 1
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CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Max. Bkgrd[d]	Count of Detects > Bkgrd	Above Bkgrd?[e]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Non-Cancer Hazard Index[f]	Incremental Lifetime Cancer Risk[g]
Dioxins/Furans	TCDD TEF[n]	pg/g	472	--	--	--	1,000	ca	--	--	5 E-7
Asbestos[i]	Chrysotile	Structures	3	--	--	--	--	--	--	--	See Table 5
	Amphibole	Structures	--	--	--	--	--	--	--	--	
General Chemistry	Bromide	mg/kg	7.8	--	--	--	--	--	--	--	--
	Bromine	mg/kg	15.7	--	--	--	--	--	--	--	--
	Chlorate	mg/kg	17	--	--	--	--	--	--	--	--
	Chloride	mg/kg	2,210	1,110	9	--	--	--	--	--	--
	Chlorine	mg/kg	4,410	--	--	--	--	--	--	--	--
	Chlorite	ug/kg	--	--	--	--	--	--	--	--	--
	Fluoride	mg/kg	4.3	2.5	3	--	36,900	nc	--	0.00012	--
	Nitrate (as N)	mg/kg	229	102	1	--	--	--	--	--	--
	Nitrite (as N)	mg/kg	0.45	0.21	1	--	--	--	--	--	--
	Orthophosphate as P	mg/kg	2	--	--	--	--	--	--	--	--
	Perchlorate	ug/kg	41,600	--	--	--	>100,000	--	--	--	--
	Sulfate	mg/kg	8,870	4,130	1	--	--	--	--	--	--
Glycols/Alcohols	Ethanol	ug/kg	--	--	--	--	--	--	--	--	--
Metals	Aluminum	mg/kg	9,750	15,300	0	No	>100,000	nc	--	--	--
	Antimony	mg/kg	0.42	0.5	0	No	409	nc	--	--	--
	Arsenic	mg/kg	5.8	7.2	0	No	1.6	ca	260	--	--
	Barium	mg/kg	269	836	0	No	66,600	nc	--	--	--
	Beryllium	mg/kg	0.65	0.89	0	No	1940	ca	--	--	--
	Boron	mg/kg	--	11.6	0	No	>100,000	nc	--	--	--
	Cadmium	mg/kg	0.59	0.13	22	Yes	451	nc	3,000	0.0013	2 E-10
	Calcium	mg/kg	75,300	82,800	0	No	--	--	--	--	--
	Chromium (Total)	mg/kg	17	16.7	1	Yes	448	nc	--	0.038	--
	Chromium (VI)	mg/kg	0.58	0.32	4	Yes	64	ca	2,500	0.00052	2 E-8
	Cobalt	mg/kg	7.5	16.3	0	No	1,920	ca	--	--	--
	Copper	mg/kg	31	30.5	1	No	40,900	nc	--	--	--
	Iron	mg/kg	17,200	19,700	0	No	>100,000	nc	--	--	--
	Lead	mg/kg	136	35.1	2	Yes	800	nc	--	0.17	--
	Lithium	mg/kg	22.6	26.5	0	No	20,400	nc	--	--	--
	Magnesium	mg/kg	13,600	17,500	0	No	--	--	--	--	--
	Manganese	mg/kg	668	1,090	0	No	19,500	nc	--	--	--
	Mercury	ug/kg	17.5	110	0	No	--	--	--	--	--
	Molybdenum	mg/kg	1.4	2.0	0	Yes	5,110	nc	--	0.00027	--
	Nickel	mg/kg	23.7	30	0	No	20,400	nc	--	--	--
	Niobium	mg/kg	2	2.8	0	Yes	--	--	--	--	--
	Palladium	mg/kg	1.2	1.5	0	No	--	--	--	--	--
	Phosphorus (as P)	mg/kg	1,510	2,010	0	No	--	nc	--	--	--
	Platinum	mg/kg	--	0.099	0	No	--	--	--	--	--
	Potassium	mg/kg	4,800	3,890	5	Yes	--	--	--	--	--

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Max. Bkgrd[d]	Count of Detects > Bkgrd	Above Bkgrd?[e]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Non-Cancer Hazard Index[f]	Incremental Lifetime Cancer Risk[g]
Metals	Selenium	mg/kg	--	0.60	0	No	5,110	nc	--	--	--
	Silicon	mg/kg	1,320	4,150	0	No	--	--	--	--	--
	Silver	mg/kg	0.82	0.26	1	No	5,110	nc	--	--	--
	Sodium	mg/kg	1,720	1,320	5	Yes	--	--	--	--	--
	Strontium	mg/kg	487	808	0	No	>100,000	nc	--	--	--
	Sulfur	mg/kg	5,980	--	--	--	--	--	--	--	--
	Thallium	mg/kg	--	1.8	0	No	68	nc	--	--	--
	Tin	mg/kg	1.5	0.80	4	Yes	>100,000	nc	--	0.000015	--
	Titanium	mg/kg	982	1,010	0	Yes	>100,000	nc	--	0.0098	--
	Tungsten	mg/kg	--	2.5	0	No	--	--	--	--	--
	Uranium	mg/kg	3.1	2.7	3	Yes	204	nc	--	0.015	--
	Vanadium	mg/kg	53.4	59.1	0	No	1,020	nc	--	--	--
	Zinc	mg/kg	211	121	2	No	>100,000	nc	--	--	--
	Zirconium	mg/kg	27.3	179	0	No	--	--	--	--	--
Organochlorine Pesticides	2,4-DDD	ug/kg	17	--	--	--	--	--	--	--	--
	2,4-DDE	ug/kg	150	--	--	--	--	--	--	--	--
	4,4-DDD	ug/kg	18	--	--	--	9,950	ca	--	--	2 E-9
	4,4-DDE	ug/kg	310	--	--	--	7,020	ca	--	--	4 E-8
	4,4-DDT	ug/kg	99	--	--	--	7,020	ca	>100,000	0.00099	1 E-8
	Aldrin	ug/kg	--	--	--	--	101	ca	19,000	--	--
	alpha-BHC	ug/kg	--	--	--	--	359	ca	>100,000	--	--
	alpha-Chlordane	ug/kg	--	--	--	--	--	--	--	--	--
	beta-BHC	ug/kg	190	--	--	--	1,260	ca	>100,000	0.0019	2 E-7
	Chlordane	ug/kg	--	--	--	--	--	--	--	--	--
	delta-BHC	ug/kg	--	--	--	--	--	--	--	--	--
	Dieldrin	ug/kg	--	--	--	--	108	ca	31,000	--	--
	Endosulfan I	ug/kg	--	--	--	--	--	--	--	--	--
	Endosulfan II	ug/kg	--	--	--	--	--	--	--	--	--
	Endosulfan sulfate	ug/kg	--	--	--	--	--	--	--	--	--
	Endrin	ug/kg	7	--	--	--	>100,000	nc	--	0.00019	--
	Endrin aldehyde	ug/kg	3.6	--	--	--	--	--	--	--	--
	Endrin ketone	ug/kg	--	--	--	--	--	--	--	--	--
	gamma-Chlordane	ug/kg	--	--	--	--	--	--	--	--	--
	Heptachlor	ug/kg	--	--	--	--	383	ca	>100,000	--	--
	Heptachlor epoxide	ug/kg	--	--	--	--	189	ca	8,000	--	--
	Lindane	ug/kg	--	--	--	--	1,740	ca	>100,000	--	--
	Methoxychlor	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Toxaphene	ug/kg	--	--	--	--	1,570	ca	--	--	--
Petroleum Hydrocarbons	TPH (as Gasoline)	mg/kg	--	--	--	--	--	--	--	--	--
	TPH (as Diesel)	mg/kg	--	--	--	--	--	--	--	--	--
	Oil/Grease	mg/kg	--	--	--	--	--	--	--	--	--

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CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Max. Bkgrd[d]	Count of Detects > Bkgrd	Above Bkgrd?[e]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Non-Cancer Hazard Index[f]	Incremental Lifetime Cancer Risk[g]
Radionuclides	Radium-226	pCi/g	1.48	2.36	0	No	0.026	ca	--	--	--
	Radium-228	pCi/g	2.13	2.94	0	No	0.15	ca	--	--	--
	Thorium-228	pci/g	2.17	2.28	0	No	0.26	ca	--	--	--
	Thorium-230	pci/g	2.03	3.01	0	No	20	ca	--	--	--
	Thorium-232	pci/g	2.36	2.23	1	No	19	ca	--	--	--
	Uranium-233/234[k]	pci/g	3.69	2.84	3	Yes	32	ca	--	--	1 E-7
	Uranium-235/236[k]	pci/g	0.22	0.21	1	Yes	0.40	ca	--	--	6 E-7
	Uranium-238[k]	pci/g	3.65	2.37	4	Yes	1.8	ca	--	--	2 E-6
SVOCs	1,2,4,5-Tetrachlorobenzene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	1,2-Diphenylhydrazine	ug/kg	--	--	--	--	2,150	ca	--	--	--
	1,4-Dioxane	ug/kg	--	--	--	--	>100,000	ca	--	--	--
	1-Nonanal	ug/kg	--	--	--	--	--	--	--	--	--
	2,2'-/4,4'-Dichlorobenzil	ug/kg	--	--	--	--	--	--	--	--	--
	2,4,5-Trichlorophenol	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	2,4,6-Trichlorophenol	ug/kg	--	--	--	--	61,600	nc	>100,000	--	--
	2,4-Dichlorophenol	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	2,4-Dimethylphenol	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	2,4-Dinitrophenol	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	2,4-Dinitrotoluene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	2,6-Dinitrotoluene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	2-Chloronaphthalene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	2-Chlorophenol	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	2-Methylnaphthalene	ug/kg	--	--	--	--	--	--	--	--	--
	2-Nitroaniline	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	2-Nitrophenol	ug/kg	--	--	--	--	--	--	--	--	--
	3,3'-Dichlorobenzidine	ug/kg	--	--	--	--	3,830	ca	--	--	--
	3-Methylphenol & 4-Methylphenol	ug/kg	--	--	--	--	--	--	--	--	--
	3-Nitroaniline	ug/kg	--	--	--	--	82,100	ca	>100,000	--	--
	4-Bromophenyl phenyl ether	ug/kg	--	--	--	--	--	--	--	--	--
	4-Chloro-3-Methylphenol	ug/kg	--	--	--	--	--	--	--	--	--
	4-Chlorophenyl phenyl ether	ug/kg	--	--	--	--	--	--	--	--	--
	4-Nitrophenol	ug/kg	--	--	--	--	--	--	--	--	--
	Acenaphthene	ug/kg	1,000	--	--	--	>100,000	nc	--	0.01	--
	Acenaphthylene	ug/kg	--	--	--	--	--	--	--	--	--
	Acetophenone	ug/kg	--	--	--	--	--	--	--	--	--
	Aniline	ug/kg	--	--	--	--	>100,000	ca	>100,000	--	--
	Anthracene	ug/kg	--	--	--	--	>100,000	ca	--	--	--
	Azobenzene	ug/kg	--	--	--	--	15,700	ca	--	--	--
	Benzenethiol	ug/kg	--	--	--	--	--	--	--	--	--
	Benzo(a)anthracene	ug/kg	55	--	--	--	2,110	ca	--	--	3 E-8
	Benzo(a)pyrene	ug/kg	19	--	--	--	211	ca	--	--	9 E-8

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TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Max. Bkgrd[d]	Count of Detects > Bkgrd	Above Bkgrd?[e]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Non-Cancer Hazard Index[f]	Incremental Lifetime Cancer Risk[g]
SVOCs	Benzo(b)fluoranthene	ug/kg	21	--	--	--	2,110	ca	--	--	1 E-8
	Benzo(g,h,i)perylene	ug/kg	--	--	--	--	--	--	--	--	--
	Benzo(k)fluoranthene	ug/kg	--	--	--	--	21,100	ca	--	--	--
	Benzoic acid	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Benzyl alcohol	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Benzyl butyl phthalate	ug/kg	420	--	--	--	>100,000	nc	--	0.0042	--
	bis(2-Chloroethoxy) methane	ug/kg	--	--	--	--	--	--	--	--	--
	bis(2-Chloroethyl) ether	ug/kg	--	--	--	--	575	ca	--	--	--
	bis(2-Chloroisopropyl) ether	ug/kg	--	--	--	--	7,350	ca	>100,000	--	--
	bis(2-Ethylhexyl) phthalate	ug/kg	140	--	--	--	>100,000	ca	>100,000	0.0041	4 E-9
	bis(p-Chlorophenyl) disulfide	ug/kg	--	--	--	--	--	--	--	--	--
	bis(p-Chlorophenyl) sulfone	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Carbazole	ug/kg	--	--	--	--	86,200	ca	--	--	--
	Chrysene	ug/kg	24	--	--	--	>100,000	ca	--	--	2 E-10
	Dibenzo(a,h)anthracene	ug/kg	--	--	--	--	211	ca	--	--	--
	Dibenzofuran	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Dibutyl phthalate	ug/kg	50	--	--	--	>100,000	nc	--	0.0041	--
	Diethyl phthalate	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Dimethyl phthalate	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Di-n-octyl phthalate	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Diphenyl sulfone	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Fluoranthene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Fluorene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Hexachlorobenzene	ug/kg	49	--	--	--	1,080	ca	>100,000	0.0041	4 E-7
	Hexachlorocyclopentadiene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Hydroxymethyl phthalimide	ug/kg	--	--	--	--	--	--	--	--	--
	Indeno(1,2,3-cd)pyrene	ug/kg	--	--	--	--	2,110	ca	--	--	--
	Isophorone	ug/kg	--	--	--	--	>100,000	ca	>100,000	--	--
	Naphthalene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Nitrobenzene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	N-nitrosodi-n-propylamine	ug/kg	--	--	--	--	246	ca	--	--	--
	N-nitrosodiphenylamine	ug/kg	--	--	--	--	>100,000	ca	>100,000	--	--
	o-Cresol	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Octachlorostyrene	ug/kg	41	--	--	--	--	--	--	--	--
	p-Chloroaniline	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	p-Chlorothiophenol	ug/kg	--	--	--	--	--	--	--	--	--
	Pentachlorobenzene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Pentachlorophenol	ug/kg	--	--	--	--	9,000	ca	>100,000	--	--
	Phenanthrene	ug/kg	--	--	--	--	--	--	--	--	--
	Phenol	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Phenyl Disulfide	ug/kg	--	--	--	--	--	--	--	--	--

TABLE 1
SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Max. Bkgrd[d]	Count of Detects > Bkgrd	Above Bkgrd?[e]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Non-Cancer Hazard Index[f]	Incremental Lifetime Cancer Risk[g]
SVOCs	Phenyl Sulfide	ug/kg	--	--	--	--	--	--	--	--	--
	Phthalic acid	ug/kg	--	--	--	--	--	--	--	--	--
	p-Nitroaniline	ug/kg	--	--	--	--	82,100	ca	>100,000	--	--
	Pyrene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Pyridine	ug/kg	--	--	--	--	>100,000	nc	--	--	--
VOCs	1,1,1,2-Tetrachloroethane	ug/kg	--	--	--	--	7,280	ca	>100,000	--	--
	1,1,1-Trichloroethane	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	1,1,2,2-Tetrachloroethane	ug/kg	--	--	--	--	929	ca	>100,000	--	--
	1,1,2-Trichloroethane	ug/kg	--	--	--	--	1,610	ca	>100,000	--	--
	1,1-Dichloroethane	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	1,1-Dichloroethylene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	1,1-Dichloropropene	ug/kg	--	--	--	--	--	--	--	--	--
	1,2,3-Trichlorobenzene	ug/kg	--	--	--	--	--	--	--	--	--
	1,2,3-Trichloropropane	ug/kg	--	--	--	--	76	ca	79,000	--	--
	1,2,4-Trichlorobenzene	ug/kg	0.9	--	--	--	>100,000	nc	--	0.000063	--
	1,2,4-Trimethylbenzene	ug/kg	0.57	--	--	--	>100,000	nc	--	0.000063	--
	1,2-Dibromo-3-chloropropane	ug/kg	--	--	--	--	2,020	ca	11,000	--	--
	1,2-Dichlorobenzene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	1,2-Dichloroethane	ug/kg	--	--	--	--	603	ca	28,000	--	--
	1,2-Dichloroethylene	ug/kg	--	--	--	--	--	--	--	--	--
	1,2-Dichloropropane	ug/kg	--	--	--	--	742	ca	21,000	--	--
	1,3,5- Trichlorobenzene	ug/kg	--	--	--	--	--	--	--	--	--
	1,3,5-Trimethylbenzene	ug/kg	--	--	--	--	69,700	nc	--	--	--
	1,3-Dichlorobenzene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	1,3-Dichloropropane	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	1,4-Dichlorobenzene	ug/kg	--	--	--	--	7,870	ca	>100,000	--	--
	2,2,3-Trimethylbutane	ug/kg	--	--	--	--	--	--	--	--	--
	2,2-Dichloropropane	ug/kg	--	--	--	--	--	--	--	--	--
	2,2-Dimethylpentane	ug/kg	--	--	--	--	--	--	--	--	--
	2,3-Dimethylpentane	ug/kg	--	--	--	--	--	--	--	--	--
	2,4-Dimethylpentane	ug/kg	--	--	--	--	--	--	--	--	--
	2-Chlorotoluene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	2-Nitropropane	ug/kg	--	--	--	--	--	--	--	--	--
	2-Phenylbutane	ug/kg	--	--	--	--	--	--	--	--	--
	3,3-dimethylpentane	ug/kg	--	--	--	--	--	--	--	--	--
	3-ethylpentane	ug/kg	--	--	--	--	--	--	--	--	--
	3-Methylhexane	ug/kg	--	--	--	--	--	--	--	--	--
	4-Chlorothioanisole	ug/kg	--	--	--	--	--	--	--	--	--
	4-Chlorotoluene	ug/kg	--	--	--	--	--	--	--	--	--
	Acetone	ug/kg	16	--	--	--	>100,000	nc	--	0.00025	--
	Acetonitrile	ug/kg	--	--	--	--	>100,000	nc	--	--	--

TABLE 1
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CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Max. Bkgrd[d]	Count of Detects > Bkgrd	Above Bkgrd?[e]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Non-Cancer Hazard Index[f]	Incremental Lifetime Cancer Risk[g]
VOCs	Benzene	ug/kg	--	--	--	--	1,410	ca	>100,000	--	--
	Bromobenzene	ug/kg	--	--	--	--	92,200	nc	--	--	--
	Bromodichloromethane	ug/kg	--	--	--	--	1,830	ca	>100,000	--	--
	Bromomethane	ug/kg	--	--	--	--	13,100	nc	--	--	--
	Carbon disulfide	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Carbon tetrachloride	ug/kg	--	--	--	--	549	ca	7,300	--	--
	Freon 11	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Freon 12	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Freon 113	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Chlorobenzene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Chlorobromomethane	ug/kg	--	--	--	--	--	--	--	--	--
	Chlorodibromomethane	ug/kg	--	--	--	--	2,550	ca	>100,000	--	--
	Chloroethane	ug/kg	--	--	--	--	6,490	ca	>100,000	--	--
	Chloroform	ug/kg	--	--	--	--	470	ca	>100,000	--	--
	Chloromethane	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	cis-1,2-Dichloroethylene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	cis-1,3-Dichloropropylene	ug/kg	--	--	--	--	--	--	--	--	--
	Cymene	ug/kg	--	--	--	--	--	--	--	--	--
	Dibromomethane	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Dichloromethane	ug/kg	--	--	--	--	20,500	ca	>100,000	--	--
	Ethylbenzene	ug/kg	0.24	--	--	--	>100,000	nc	--	0.000063	--
	Hexachloro-1,3-butadiene	ug/kg	--	--	--	--	22,100	ca	>100,000	--	--
	Hexachloroethane	ug/kg	--	--	--	--	>100,000	ca	>100,000	--	--
	Hexane, 2-methyl-	ug/kg	--	--	--	--	--	--	--	--	--
	Isopropylbenzene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	m,p-Xylene	ug/kg	--	--	--	--	--	--	--	--	--
	Methyl disulfide	ug/kg	--	--	--	--	--	--	--	--	--
	Methyl ethyl ketone	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Methyl iodide	ug/kg	--	--	--	--	--	--	--	--	--
	Methyl isobutyl ketone	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Methyl n-butyl ketone	ug/kg	--	--	--	--	--	--	--	--	--
	MTBE (Methyl tert-butyl ether)	ug/kg	--	--	--	--	70,000	ca	>100,000	--	--
	n-Butyl benzene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	n-Heptane	ug/kg	--	--	--	--	--	--	--	--	--
	n-Propyl benzene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	o-Xylene	ug/kg	--	--	--	--	--	--	--	--	--
	Styrene (monomer)	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	tert-Butyl benzene	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Tetrachloroethylene	ug/kg	--	--	--	--	1,310	ca	>100,000	--	--
	Toluene	ug/kg	0.65	--	--	--	>100,000	nc	--	0.000063	--
	trans-1,2-Dichloroethylene	ug/kg	--	--	--	--	>100,000	nc	--	--	--

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SOIL DATA AND SCREENING-LEVEL RISK ASSESSMENT RESULTS SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Parameter of Interest	Chemical	Result Unit	Max. Detect[a]	Max. Bkgrd[d]	Count of Detects > Bkgrd	Above Bkgrd?[e]	Industrial PRG[c]	PRG Basis	Secondary Industrial PRG[c]	Non-Cancer Hazard Index[f]	Incremental Lifetime Cancer Risk[g]
VOCs	trans-1,3-Dichloropropylene	ug/kg	--	--	--	--	--	--	--	--	--
	Tribromomethane	ug/kg	--	--	--	--	>100,000	ca	>100,000	--	--
	Trichloroethylene	ug/kg	--	--	--	--	115	ca	>100,000	--	--
	Vinyl acetate	ug/kg	--	--	--	--	>100,000	nc	--	--	--
	Vinyl chloride	ug/kg	--	--	--	--	746	ca	>100,000	--	--
	Xylenes (total)	ug/kg	--	--	--	--	>100,000	nc	--	--	--
									Total Non-Cancer Hazard Index:	0.27	
									Total Incremental Lifetime Cancer Risk - Non-Radionuclides:		1 E-6
									Total Incremental Lifetime Cancer Risk - Radionuclides:		3 E-6

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.
b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.
c - From USEPA Region 9 preliminary remediation goals (PRG) table, Oct. 2004 (and the 2007 USEPA radionuclide PRG webpage; http://epa-prgs.ornl.gov/radionuclides). Values used are industrial soil PRGs. Several chemicals have both cancer and non-cancer toxicity criteria. For these chemicals USEPA calculates PRGs for both cancer and non-cancer endpoints; however only the lower value is published in its PRG table. The other value is included in a separate spreadsheet table. This other value is shown on this table as the 'Secondary Industrial PRG' and is included in the screening-level risk assessment calculations.
d - Values used are the maximum from the shallow soils background dataset presented in the Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity (BRC/TIMET 2007).
e - Based on results of statistical comparison tests performed between shallow background and site datasets (see Table 3).
f - Non-cancer hazard indices were calculated by dividing the maximum detected value by its PRG (or secondary PRG). The total non-cancer hazard index is the sum of all chemical-specific hazard indices.
g - Theoretical upper-bound incremental lifetime cancer risks were calculated by were calculated by dividing the maximum detected value by its PRG (or secondary PRG) times 1E-6. The total incremental lifetime cancer risk is the sum of all chemical-specific cancer risks.
h - Agency for Toxic Substances and Disease Registry (ATSDR) action level of 1.0 parts per billion (ppb).
i - Asbestos results shown are for long protocol structures (>10um).
j - Reporting limits exceed industrial PRGs; however, in all cases MDL is below PRG.
k - Calculated activities for the uranium isotopes are based on Approach #1 presented in the Uranium Isotope Data Review for 2007 Tronox Parcels A/B Investigation memorandum (see Attachment E).

TABLE 2
SITE AND BACKGROUND SUMMARY STATISTICS
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA
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	Background								Site								
Chemical	No. of Detects	Total Samples	Percent Detects	Minimum Detect	Maximum Detect	Median	Mean	Standard Deviation	No. of Detects	Total Samples	Percent Detects	Minimum Detect	Maximum Detect	Median	Mean	Standard Deviation	Units
Metals																	
Aluminum	120	120	100%	3,740	15,300	8,420	8,899	2,653	64	64	100%	6,780	9,750	8,555	8,430	689	mg/kg
Antimony	49	120	41%	0.12	0.50	0.16	0.24	0.13	54	64	84%	0.11	0.42	0.17	0.23	0.15	mg/kg
Arsenic	120	120	100%	2.1	7.2	3.9	4.1	1.1	64	64	100%	2.3	5.8	3.0	3.2	0.85	mg/kg
Barium	120	120	100%	73	836	190	223	126	64	64	100%	148	269	199	200	27	mg/kg
Beryllium	120	120	100%	0.16	0.89	0.54	0.56	0.16	64	64	100%	0.41	0.65	0.51	0.51	0.048	mg/kg
Boron	78	104	75%	3.4	12	4.3	4.5	2.3	0	64	0%	NA	NA	10	11	0.45	mg/kg
Cadmium	16	120	13%	0.052	0.16	0.065	0.070	0.017	52	64	81%	0.069	0.59	0.11	0.14	0.11	mg/kg
Calcium	104	104	100%	8,160	82,800	23,650	28,130	14,860	64	64	100%	15,600	75,300	26,450	29,370	10,570	mg/kg
Chromium (Total)	120	120	100%	2.6	17	8.8	8.9	2.9	64	64	100%	7.3	17	11	11	2.0	mg/kg
Chromium (VI)	0	104	0%	NA	NA	0.13	0.13	0.0042	25	61	41%	0.18	0.58	0.50	0.42	0.14	mg/kg
Cobalt	120	120	100%	3.7	16	8.3	8.2	2.5	64	64	100%	4.6	7.5	6.1	6.1	0.70	mg/kg
Copper	120	120	100%	7.8	31	17	17	4.2	64	64	100%	11	31	14	15	3.1	mg/kg
Iron	120	120	100%	5,410	19,700	13,050	12,810	3,263	64	64	100%	10,100	17,200	13,050	13,090	1,337	mg/kg
Lead	120	120	100%	3.0	35	7.8	9.4	5.1	64	64	100%	6.5	136	9.9	15	20	mg/kg
Lithium	104	104	100%	7.5	27	13	14	4.3	56	64	88%	11	23	14	14	3.7	mg/kg
Magnesium	120	120	100%	4,580	17,500	9,425	9,505	3,046	64	64	100%	6,690	13,600	8,420	8,693	1,235	mg/kg
Manganese	120	120	100%	151	1,090	419	425	135	64	64	100%	218	668	338	361	93	mg/kg
Mercury	93	120	78%	0.0084	0.11	0.015	0.018	0.015	40	64	63%	0.0073	0.018	0.014	0.014	0.0038	mg/kg
Molybdenum	120	120	100%	0.17	2.0	0.48	0.55	0.28	31	64	48%	0.48	1.4	0.55	0.63	0.20	mg/kg
Nickel	120	120	100%	7.8	30	15	15	4.2	64	64	100%	11	24	14	14	2.1	mg/kg
Niobium	69	104	66%	1.1	2.8	1.3	1.25	0.64	2	64	3%	1.6	2.0	2.6	2.6	0.19	mg/kg
Palladium	104	104	100%	0.14	1.5	0.40	0.46	0.24	64	64	100%	0.30	1.2	0.42	0.47	0.16	mg/kg
Platinum	5	104	5%	0.045	0.099	0.022	0.024	0.011	0	64	0%	NA	NA	0.11	0.11	0.0048	mg/kg
Potassium	104	104	100%	625	3,890	1,535	1,730	733	64	64	100%	2,040	4,800	2,855	2,956	592	mg/kg
Selenium	52	120	43%	0.10	0.60	0.079	0.18	0.13	0	64	0%	NA	NA	0.50	0.53	0.032	mg/kg

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CLARK COUNTY, NEVADA
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	Background								Site								
Chemical	No. of Detects	Total Samples	Percent Detects	Minimum Detect	Maximum Detect	Median	Mean	Standard Deviation	No. of Detects	Total Samples	Percent Detects	Minimum Detect	Maximum Detect	Median	Mean	Standard Deviation	Units
Silicon	104	104	100%	335	4,150	720	981	780	64	64	100%	128	1,320	513	509	268	mg/kg
Silver	16	120	13%	0.019	0.083	0.13	0.12	0.028	64	64	100%	0.081	0.82	0.11	0.12	0.090	mg/kg
Sodium	104	104	100%	111	1,320	452	486	286	64	64	100%	244	1,720	698	737	348	mg/kg
Strontium	104	104	100%	69	808	186	223	132	64	64	100%	120	487	178	199	69	mg/kg
Thallium	101	120	84%	0.10	1.8	0.51	0.65	0.46	0	64	0%	NA	NA	0.21	0.21	0.0090	mg/kg
Tin	103	104	99%	0.20	0.80	0.49	0.48	0.13	56	64	88%	0.40	1.5	0.52	0.54	0.23	mg/kg
Titanium	120	120	100%	200	1,010	504	510	171	64	64	100%	504	982	648	653	93	mg/kg
Tungsten	104	104	100%	0.49	2.5	1.05	1.18	0.43	0	64	0%	NA	NA	0.50	0.53	0.032	mg/kg
Uranium	103	103	100%	0.43	2.7	0.94	1.0	0.31	64	64	100%	0.69	3.1	1.0	1.2	0.51	mg/kg
Vanadium	120	120	100%	15	59	36	35	11	64	64	100%	24	53	32	33	4.6	mg/kg
Zinc	120	120	100%	15	121	37	37	13	64	64	100%	26	211	32	39	27	mg/kg
Zirconium	104	104	100%	60	179	125	126	27	64	64	100%	4.9	27	23	23	3.0	mg/kg
Radionuclides																	
Radium-226	104	104	100%	0.49	2.4	1.1	1.1	0.35	64	64	100%	0.84	1.5	1.0	1.0	0.13	pCi/g
Radium-228	84	84	100%	0.9	2.9	2.0	1.9	0.40	64	64	100%	1.4	2.1	1.8	1.8	0.16	pCi/g
Thorium-228	120	120	100%	1.1	2.3	1.7	1.7	0.28	63	64	98%	0.97	2.2	1.6	1.6	0.33	pCi/g
Thorium-230	120	120	100%	0.66	3.0	1.2	1.2	0.38	64	64	100%	0.31	2.0	1.2	1.2	0.30	pCi/g
Thorium-232	120	120	100%	1.1	2.2	1.6	1.6	0.27	63	64	98%	1.1	2.4	1.4	1.5	0.30	pCi/g
Uranium-233/234	120	120	100%	0.47	2.8	0.99	1.11	0.46	64	64	100%	0.82	3.7	1.19	1.43	0.61	pCi/g
Uranium-235/236	54	120	45%	0.037	0.21	0.041	0.053	0.043	28	64	44%	0.058	0.223	0.0432	0.066	0.046	pCi/g
Uranium-238	120	120	100%	0.45	2.4	1.0	1.1	0.37	64	64	100%	0.81	3.7	1.18	1.41	0.60	pCi/g

Note: Summary and background comparison statistics were performed using one-half the detection limit for metals and using GISdT® (Neptune and Company 2007).
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram

TABLE 3
BACKGROUND COMPARISON SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA
(Page 1 of 2)

Chemical	*t*- Test *p*	Quantile Test *p*	Slippage Test *p*	WRS Test *p*	Greater than Background?	Units	Basis
Metals							
Aluminum	9.7 E-1	1.0 E+0	1.0 E+0	5.3 E-1	NO	mg/kg	Multiple Tests
Antimony	6.4 E-1	9.7 E-1	1.0 E+0	1.0 E+0	NO	mg/kg	Multiple Tests
Arsenic	1.0 E+0	1.0 E+0	1.0 E+0	1.0 E+0	NO	mg/kg	Multiple Tests
Barium	9.7 E-1	9.8 E-1	1.0 E+0	1.4 E-1	NO	mg/kg	Multiple Tests
Beryllium	1.0 E+0	1.0 E+0	1.0 E+0	9.2 E-1	NO	mg/kg	Multiple Tests
Boron	2.3 E-50	1.0 E+0	1.0 E+0	0.0 E+0	NO	mg/kg	Non-Detect in Site Data
Cadmium	3.6 E-6	2.4 E-8	1.6 E-5	1.0 E+0	YES	mg/kg	Multiple Tests
Calcium	2.7 E-1	7.1 E-1	1.0 E+0	2.6 E-2	NO	mg/kg	Multiple Tests
Chromium (Total)	7.2 E-9	2.6 E-2	3.5 E-1	5.5 E-8	YES	mg/kg	WRS and *t* -Test
Chromium (VI)	6.0 E-24	3.1 E-6	NA	5.3 E-9	YES	mg/kg	WRS and *t* -Test
Cobalt	1.0 E+0	1.0 E+0	1.0 E+0	1.0 E+0	NO	mg/kg	Multiple Tests
Copper	1.0 E+0	1.0 E+0	3.5 E-1	1.0 E+0	NO	mg/kg	Multiple Tests
Iron	2.1 E-1	1.0 E+0	1.0 E+0	3.6 E-1	NO	mg/kg	Multiple Tests
Lead	1.8 E-2	2.6 E-2	1.2 E-1	1.0 E-5	YES	mg/kg	WRS and *t* -Test
Lithium	4.0 E-1	8.2 E-1	1.0 E+0	3.2 E-3	NO	mg/kg	Multiple Tests
Magnesium	9.9 E-1	1.0 E+0	1.0 E+0	9.8 E-1	NO	mg/kg	Multiple Tests
Manganese	1.0 E+0	1.0 E+0	1.0 E+0	1.0 E+0	NO	mg/kg	Multiple Tests
Mercury	9.9 E-1	1.0 E+0	1.0 E+0	3.0 E-2	NO	mg/kg	Multiple Tests
Molybdenum	9.2 E-3	3.3 E-1	1.0 E+0	0.0 E+0	YES	mg/kg	WRS and *t* -Test
Nickel	9.7 E-1	1.0 E+0	1.0 E+0	9.2 E-1	NO	mg/kg	Multiple Tests
Niobium	1.9 E-42	1.0 E+0	1.0 E+0	0.0 E+0	YES	mg/kg	Non-Detect in Background
Palladium	3.7 E-1	6.1 E-1	1.0 E+0	6.8 E-2	NO	mg/kg	Multiple Tests
Platinum	9.9 E-113	1.0 E+0	1.0 E+0	0.0 E+0	NO	mg/kg	Non-Detect in Site Data
Potassium	7.5 E-24	7.0 E-9	7.3 E-3	0.0 E+0	YES	mg/kg	Multiple Tests
Selenium	7.8 E-61	1.0 E+0	1.0 E+0	0.0 E+0	NO	mg/kg	Non-Detect in Site Data

TABLE 3
BACKGROUND COMPARISON SUMMARY
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA
(Page 2 of 2)

Chemical	*t*- Test *p*	Quantile Test *p*	Slippage Test *p*	WRS Test *p*	Greater than Background?	Units	Basis
Silicon	1.0 E+0	1.0 E+0	1.0 E+0	1.0 E+0	NO	mg/kg	Multiple Tests
Silver	4.5 E-1	3.5 E-1	5.7 E-15	1.0 E+0	NO	mg/kg	Multiple Tests
Sodium	1.9 E-6	9.0 E-3	7.3 E-3	2.6 E-6	YES	mg/kg	Multiple Tests
Strontium	9.4 E-1	7.1 E-1	1.0 E+0	5.1 E-1	NO	mg/kg	Multiple Tests
Thallium	1.0 E+0	1.0 E+0	1.0 E+0	1.0 E+0	NO	mg/kg	Multiple Tests
Tin	2.0 E-2	1.8 E-1	2.0 E-2	2.6 E-3	YES	mg/kg	Multiple Tests
Titanium	2.9 E-12	1.1 E-2	1.0 E+0	1.6 E-10	YES	mg/kg	Multiple Tests
Tungsten	1.0 E+0	1.0 E+0	1.0 E+0	4.9 E-1	NO	mg/kg	Multiple Tests
Uranium	2.9 E-3	2.0 E-2	5.5 E-2	5.8 E-3	YES	mg/kg	Multiple Tests
Vanadium	9.9 E-1	1.0 E+0	1.0 E+0	9.8 E-1	NO	mg/kg	Multiple Tests
Zinc	3.3 E-1	1.0 E+0	1.2 E-1	9.7 E-1	NO	mg/kg	Multiple Tests
Zirconium	1.0 E+0	1.0 E+0	1.0 E+0	1.0 E+0	NO	mg/kg	Multiple Tests
Radionuclides							
Radium-226	9.8 E-1	1.0 E+0	1.0 E+0	8.8 E-1	NO	pCi/g	Multiple Tests
Radium-228	1.0 E+0	1.0 E+0	1.0 E+0	1.0 E+0	NO	pCi/g	Multiple Tests
Thorium-228	1.0 E+0	1.0 E+0	1.0 E+0	1.0 E+0	NO	pCi/g	Multiple Tests
Thorium-230	7.7 E-1	6.6 E-1	1.0 E+0	5.2 E-1	NO	pCi/g	Multiple Tests
Thorium-232	1.0 E+0	1.0 E+0	3.5 E-1	1.0 E+0	NO	pCi/g	Multiple Tests
Uranium-233/234	1.8 E-4	2.7 E-3	4.1 E-2	6.1 E-7	YES	pCi/g	Multiple Tests
Uranium-235/236	2.5 E-4	5.7 E-1	3.4 E-1	4.1 E-7	YES	pCi/g	Multiple Tests
Uranium-238	6.4 E-5	4.1 E-3	1.4 E-2	2.1 E-6	YES	pCi/g	Multiple Tests

Note: Summary and background comparison statistics were performed using one-half the detection limit for metals and using GISdT® (Neptune and Company 2007).
BOLD with Highlight indicates Site concentrations are greater than background.
WRS = Wilcoxon Rank Sum Test with the Gehan Modification
mg/kg - milligrams per kilogram
pCi/g - picoCuries per gram

TABLE 4
DATA ADEQUACY EVALUATION
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Table 4a: Sample Size Results for Arsenic with Background = 7.2 mg/kg

Number of samples = 64		s = 0.85		
Threshold = 7.2 mg/kg		a = 5%	a = 10%	a = 15%
MDD = 10% (0.72 mg/kg)	b = 15%	13	10	8
	b = 20%	4	8	6
	b = 25%	3	7	5
MDD = 20% (1.44 mg/kg)	b = 15%	2	3	2
	b = 20%	2	3	2
	b = 25%	2	3	2
MDD = 30% (2.16 mg/kg)	b = 15%	2	2	1
	b = 20%	2	2	1
	b = 25%	2	2	1

Table 4b: Sample Size Results for 2,3,7,8-TCDD with PRG = 16 pg/g

Number of samples = 32		s = 2.33		
Threshold = 16 pg/g		a = 5%	a = 10%	a = 15%
MDD = 10% (1.6 pg/g)	b = 15%	19	14	11
	b = 20%	17	12	9
	b = 25%	15	10	8
MDD = 20% (3.2 pg/g)	b = 15%	6	4	3
	b = 20%	5	4	3
	b = 25%	5	3	2
MDD = 30% (4.8 pg/g)	b = 15%	4	2	2
	b = 20%	3	2	2
	b = 25%	3	2	1

Table 4c: Sample Size Results for beta-BHC with PRG = 1,260 µg/kg

Number of samples = 64		s = 31.2		
Threshold = 1,260 µg/kg		a = 5%	a = 10%	a = 15%
MDD = 10% (126 µg/kg)	b = 15%	2	1	1
	b = 20%	2	1	1
	b = 25%	2	1	1
MDD = 20% (252 µg/kg)	b = 15%	2	1	1
	b = 20%	2	1	1
	b = 25%	2	1	1
MDD = 30% (378 µg/kg)	b = 15%	2	1	1
	b = 20%	2	1	1
	b = 25%	2	1	1

Table 4d: Sample Size Results for Chrysotile Asbestos (50 long fibers = 1 x 10^{-6})

Number of samples = 30		s = 0.84		
Threshold = 50 long fibers		a = 5%	a = 10%	a = 15%
MDD = 10% (5 long fibers)	b = 15%	2	1	1
	b = 20%	2	1	1
	b = 25%	2	1	1
MDD = 20% (10 long fibers)	b = 15%	2	1	1
	b = 20%	2	1	1
	b = 25%	2	1	1
MDD = 30% (15 long fibers)	b = 15%	2	1	1
	b = 20%	2	1	1
	b = 25%	2	1	1

TABLE 5
ASBESTOS SCREENING-LEVEL RISK ASSESSMENT RESULTS
TRONOX PARCELS A/B INVESTIGATION
CLARK COUNTY, NEVADA

Baseline Risk Estimates (Based on Measured Asbestos Fibers-Post-Scrape)

Scenario	Estimated Airborne Chrysotile Concentrations[1] (s/cm^3)	Estimated Airborne Amphibole Concentrations[1] (s/cm^3)	Adjusted Chrysotile URF[2] $(s/cm^3)^{-1}$	Adjusted Amphibole URF[2] $(s/cm^3)^{-1}$	Estimated Chrysotile[3] Risk	Estimated Amphibole[3] Risk
LONG FIBERS						
Construction Worker-Best Estimate (No Dust Mit./1 Yr Exp.)	7.9 E-4	0.0 E+0	1.9 E-4	2.1 E-2	1 E-7	0 E+0
Construction Worker-Upper Bound (No Dust Mit./1 Yr Exp.)	1.4 E-3	2.6 E-4	1.9 E-4	2.1 E-2	3 E-7	5 E-6
Construction Worker-Best Estimate (with Dust Mit./0.5 Yr Exp.)[4]	3.4 E-4	0.0 E+0	9.7 E-5	1.1 E-2	3 E-8	0 E+0
Construction Worker-Upper Bound (with Dust Mit./0.5 Yr Exp.)[4]	6.0 E-4	1.1 E-4	9.7 E-5	1.1 E-2	6 E-8	1 E-6
Future Maintenance Worker-Best Estimate	6.3 E-7	0.0 E+0	4.2 E-3	4.6 E-1	3 E-9	0 E+0
Future Maintenance Worker-Upper Bound	1.1 E-6	2.1 E-7	4.2 E-3	4.6 E-1	5 E-9	1 E-7
Current/Future On-Site Trespasser-Best Estimate	6.3 E-7	0.0 E+0	1.1 E-4	1.2 E-2	7 E-11	0 E+0
Current/Future On-Site Trespasser-Upper Bound	1.1 E-6	2.1 E-7	1.1 E-4	1.2 E-2	1 E-10	3 E-9

Notes:
[1] Calculated based on estimated dust estimates and asbestos fiber concentrations.
[2] Calculated uing equation information from Table 8-2 of 2003 Methodology (Berman and Crump 2003).
[3] Estimated airborne concentrations × URF.
[4] A six-month construction period with dust mitigation (soil wetting) is considered a reasonable exposure scenario. A soil moisture content of 50 percent is assumed as a result of dust mitigation.
Best Estimate - Based on the pooled analytical sensitivity multiplied by the number of asbestos fibers found.
Upper Bound - Based on the 95% UCL of the Poisson distribution.

ATTACHMENT A

TRONOX/BEC RESPONSE TO COMMENTS AND
REDLINE VERSION OF TEXT

(RLSO ON CD)

Attachment A
Response to NDEP Comments Dated January 10, 2008 on the
Technical Memorandum – Data Review for the 2007 Tronox Parcels A/B Investigation
Dated December 6, 2007 (and Subsequent Supplemental Information)

This Response to Comments has been Prepared by BEC on Behalf of Tronox

1. General comment, examples of information provided by electronic mail which were used to supplement the review and understanding of Parcels A and B include (but are not limited to):
   a. Probability and box plots (exploratory data analysis);
   b. Revised data tables presenting USEPA SSLs (DAFI and DAF 20);
   c. Legal descriptions of Parcels A and B (expected to be recorded following the issuance of this NFA). These descriptions serve as the basis of understanding for the definition of Parcels A and B).
   d. In addition, several telephone conferences were held to discuss and clarify technical issues relating to Parcels A and B.

Response: *BEC has provided an updated version of the technical memorandum that includes all additions that have been prepared and submitted since the December 6, 2007 version of the memorandum. These include the asbestos technical memorandum (discussed on page 3 and included as Attachment C), the uranium technical memorandum (discussed on page 4 and included as Attachment D), and probability and boxplots (included as Attachment E).*

2. General comment, the additional documentation submitted since December 6, 2007 causes some of the very specific conclusions stated in the report to be incorrect. For example, on Page 4, uranium now exceeds the screening level. Some rewording in light of the update information would have been helpful.

Response: *As noted in response to comment #1 above, the revised technical memorandum incorporates changes as a result of the additional documentation since the December 6, 2007 submittal. See response to comment #1 on where these can be found in the revised technical memorandum.*

3. General comment, the report is lacking transparency in many ways. For example, the CSM is not provided in full, the data are not related back to the CSM fully (for example, consider how the radionuclides are handled), and the risk assessment is minimal. This comment is made in recognition that Parcels A and B appear to have only sporadic and low levels of contamination (now that the asbestos remediation has been performed), in which case a simple risk assessment can be deemed sufficient. However, NDEP expects greater level of detail in other risk assessments performed at TRONOX and elsewhere at the BMI Complex and Common Areas.

Response: *As noted in this comment, the simple risk assessment is considered sufficient for this site. It is anticipated that technical memoranda to be submitted for the other Tronox parcels*

(Parcels C, D, F, G, and H) will be similar to this technical memorandum, but may include more extensive risk assessments if sampling identifies the presence of more chemical impacts. All future BEC/BRC risk assessments for the other portions of the Eastside property will comply with the BRC Closure Plan methodology. No modifications have been made to the document in response to this comment.

4. General comment, a further consideration related to the asbestos remediation is that many of the sample locations have now been remediated or partially remediated. No mention is made of the consequence of this cleanup on the data analysis and risk assessment for all the other chemicals included in the screening risk assessment. The new surface layer could have different concentrations. However, it might be reasonable to assume that the concentration distribution has not changed in any important way for these chemicals. This should be related to the CSM. It might even be reasonable to assume that concentrations are now lower for some chemicals (e.g., dioxins), because of the removal of some soil. Whichever argument is made, it should have been included in the text, and defended in the context of the CSM. A further option is to compare the data across the different depths of data collection. For example, if the concentrations are similar at the different depth intervals of sampling, then it would be reasonable to assume that the old samples are still representative of the current conditions. Consideration of concentrations by depth would also be helpful for understanding the leaching pathway (e.g., to see if concentrations are increasing with depth), and could have resolved some background comparisons for some metals or radionuclides. For example, for several metals and radionuclides the site data are statistically lower than the background data. Without some explanation, this raises issues about the appropriateness of the comparisons.

Response: *BEC agrees that the post-scrape surface layer could have different concentrations; however, as noted in the comment it is unlikely that the concentration distribution has appreciably changed. Therefore, no changes have been made to the tables and calculations in the document. A qualitative analysis conducted comparing the data across the different depths, and text has been added to page 4 of the document discussing this issue. Briefly, a review of the results indicates that it is reasonable to assume that the previous samples are still representative of current conditions. In addition, text regarding the leaching pathway has also been added to page 6, given the results of the depth-comparison analysis. That is, there is no indication that concentrations increase with depth, further supporting the conclusion that the site is not a likely source of impacts to groundwater.*

5. General comment, Although the radionuclide activities appear to be small there are still some outstanding issues that should be addressed in the future. The immediate issues surrounding the radionuclide uranium and thorium analysis appear to have been resolved (methods have been fully identified, and adjustments have been made to the uranium radionuclide results), and we are comfortable enough with the methods used to predict uranium isotope concentrations for comparison with background and use in the risk assessment. Still of concern is that the uranium metal results fail background comparisons in Parcel A, but none of the other radionuclides fail background comparisons at all. In fact, some of the site radionuclides appear to be slightly lower than background. It might be reasonable to assume that the differences are the result of minor analytical differences, and that all radionuclides

are at background concentrations. However, the argument should have been made. The argument includes concerns about the different methods that have been used (gamma-spec for radium, alpha-spec with strong acid digestion for thorium, and alpha-spec with weak acid digestion for uranium as well as uranium as a metal by ICPMS). Since secular equilibrium is expected, the results should be similar for radionuclides within the same chain, but they are not statistically similar. The different methods might provide some explanation.

Our understanding of the Work Plan was that 10% of the samples submitted for gamma spec analysis for radium would also be submitted for alpha-spec (and beta-spec) analysis for radium. If this had been done, then a better understanding of these inconsistencies might be possible. In our experience, gamma-spec analysis is biased low for some radionuclides. If this is the case here, then this could explain the differences that are seen. Alternatively, a CSM is needed that explains the slightly high uranium concentrations in Parcel A versus Parcel B. Please note that deviations from the Work Plan are not acceptable without NDEP approval.

A further option that could be considered is to perform background comparisons with subsets of the background dataset. We have not looked at the background dataset to see if this would be helpful, however, we recognize that the background dataset shows differences by geology and depth.

The risks are small at this site, but inclusion of uranium in the screening risk assessment raises issues about secular equilibrium and, hence, whether radium should also be included in the risk assessment. Uranium is now driving the cancer endpoint risk assessment, hence the concern. Without uranium the incremental (screening level) risks are, instead, 1x10-6.

It is also not clear yet that it is appropriate to combine cancer risk for radionuclides with those for non-radionuclides. USEPA has for many years not combined risk assessments for these two chemical groups, and this has not been done previously for risk assessments at the BMI Complex and Common Areas. It would help to have a clearer explanation of what is really expected given the data, and the thoughts described above could help provide greater defensibility for the risk assessment. This issue should be discussed between the NDEP and TRX for development of future Deliverables.

Response: *Text has been added to page 8 that states that differences in radionuclide concentrations between background and site data are likely due to minor analytical differences. Text has also been added to page 4 discussing the uranium analysis issue, with reference to the uranium technical memorandum provided in Attachment D. Further background comparisons with subsets of the background dataset were not performed. BEC agrees that typically radionuclide risks are not summed with non-radionuclide risks; therefore, these radionuclide and non-radionuclide risks are presented separately in Table 1, and discussed separately on page 21.*

6. General comment, we note that use of maximum concentrations across Parcels A and B causes an unusual form of conservatism in the results. That is, if a similar risk assessment had been performed separately for Parcels A and B, then these screening risk assessments

would produce lower risks. The maximum concentration must be less in one area than in the other, for each chemical in turn. It would have been worth noting this in the uncertainty analysis.

Response: *BEC agrees with this comment. Text has been added to the uncertainty analysis section on page 20.*

7. General comment, it is not clear that it is appropriate to include lead in the HI calculation. Risk assessments for lead are often separated from the bulk of the risk assessment because of the source of information about lead risks. This would not affect the conclusions, but would raise beta-BHC and hexachlorobenzene to the level of drivers for the low HI presented. This issue should be discussed between TRX and the NDEP for the development of future Deliverables.

Response: *BEC agrees that typically lead risks are considered separately; however, given the screening nature of the risk assessment this was considered appropriate for this site. No modifications have been made to the document in response to this comment.*

8. General comment, analytical methods appear to be insufficient (not always providing low enough concentrations) for several analytes, including: antimony, boron, selenium, niobium, and platinum. In the case of antimony this causes failure of the statistical background comparisons tests, and failure of comparison with SSLs. It would be helpful if this issue could be addressed in future sampling events.

Response: *BEC is working to address the detection limit issue for the project in general. No modifications have been made to the document in response to this comment.*

9. General comment, please note that the USEPA no longer supports their Preliminary Remediation Goals. Consequently, some care should be taken to make sure that the most up to date toxicological information is being used in the screening risk assessment.

Response: *Agreed. Alternatively, BEC suggests that the Oak Ridge National Laboratory (ORNL) Preliminary Remediation Goals (PRGs) be considered in place of the USEPA Region 9 PRGs. The ORNL PRGs are updated more often than USEPA Region 9's; and the equations and parameters are similar to those used by USEPA Region 9. No modifications have been made to the document in response to this comment.*

10. General comment, the calculations performed to assess risk following the scraping of soils to address asbestos include a "duration of construction" of 130 days. The USEPA default is 250 days/year. It is not appropriate to deviate from default values without justification.

Response: *This comment ignores the fact that the asbestos risks were also performed using the USEPA default of 250 days per year, the results of which are what the decisions for the site are*

based on. The risks were also calculated for a construction duration of 130 days (six months; as well as consideration for soil wetting during construction) for context, since this is considered a more likely site-specific construction duration. A footnote has been added to the asbestos risk table (Table 5) providing justification for this value.

11. Page 2, we note that the term "robust" has a specific meaning in statistics that is different than intended here. Since the term is used in the context of the data, it is inappropriate. The word "sufficient" could be used instead. Please address this in the development of future Deliverables.

Response: *The word "robust" has been replaced with "sufficient" in the document.*

12. Pages 3 and 4, Data Summary, the NDEP has the following comments:
    a. NDEP does not concur with the use of a DAF of20 for this Site based on source area size and depth to groundwater.

Response: *As noted in comment 12b. below, a DAF of 1 was also used in the revised evaluation. This has been included in this revision to the technical memorandum.*

    b. TRX provided a revised evaluation of Site data versus SSLs with a DAF of 1 and it appears that this modification does not materially change the conclusions regarding the Site. At a DAF of 1 the only compounds that were detected and above background were: cadmium and beta-BHC.

Response: *Agreed. No modifications have been made to the document in response to this comment.*

    c. The DAF of 1 for beta-BHC is extremely low and is often exceeded by non-detects as well. This is not a useful metric for the basis of a decision and additional lines of evidence must be examined. There is a known source of beta-BHC in soil and groundwater off-Site and the concentrations of this compound at this Site are considered insignificant relative to upgradient data. If beta-BHC were to leach to groundwater it is unlikely that the contribution from this Site could be detected.

Response: *Agreed. Text reflecting this comment has been added to page 6 of the document.*

    d. Based upon a review of available groundwater data in the region, cadmium does not appear to be leaching to groundwater and is not a concern at this time. It is also noted that the cadmium concentrations at the Site do not appear to pose any health risks. It is also noted that there are only three locations above the SSL DAF 1 and these concentrations are only marginally elevated (0.59 mg/kg maximum versus an SSL of 0.4 mg/kg). All cadmium detections are well below the SSL DAF 20 (8 mg/kg). If cadmium were to leach to groundwater it is expected that this matter could be addressed by the existing groundwater treatment system, as necessary.

Response: *Agreed. Text reflecting this comment has been added to page 6 of the document.*

e. It would have been helpful to provide a site-specific model (e.g.: VLEACH to substantiate these concepts). Future Deliverables must address these issues in more detail.

Response: *Agreed. Site-specific modeling will be considered in future deliverables. Given the discussion on the text regarding potential impacts to groundwater (no site history of chemicals use, depth-concentration profiles), VLEACH modeling was not considered for this site. However, as stated previously, it will be considered in future deliverables. No modifications have been made to the document in response to this comment.*

f. Based upon the future use of this Site (commercial/industrial) it is expected that Site activities will not exacerbate the conditions in the soil.

Response: *Agreed. No modifications have been made to the document in response to this comment.*

13. Page 4. 1st full paragraph. This paragraph does not seem quite correct in light of the further information provided for uranium. As things stand, uranium as a radionuclide fails PRG comparisons and background comparisons.

Response: *Additional discussion on uranium has been added to this paragraph on page 8.*

14. Page 4, last paragraph, first sentence. It is not clear that this is accurate. The depth to groundwater is similar across the site, however, groundwater has been impacted across the BMI complex. The relevant issue here appears to be the low concentrations in the soil, in which case there is very limited source material for contamination in groundwater. The depth then helps support that argument, rather than the other way around. Beta-BHC appears as a potential problem across the site when SSL comparisons are made. This could be noted in the discussion (that the SSL for beta-BHC is very low, and hard to achieve anywhere at this site, and explain that SSLs are known to be very conservative). An alternative is to refine the model of transport to groundwater in this area using, for example, VLEACH.

Response: *Additional discussion on impacts to groundwater has been added to this paragraph, reflective of this comment, on page 6.*

15. Page 5, asbestos paragraph. More explanation is appropriate here, since amphibole was collected prior to remediation. Otherwise, what is stated here contradicts what is stated earlier.

Response: *Additional discussion on both amphibole and chrysotile detections, and the remedial measures taken to address these detections has been added to this paragraph on pages 6 and 7.*

16. Page 7. It appears as if mercury exceeds background as well, and should be carried into the screening risk assessment.

Response: *Mercury was inadvertently left out of the background comparison analysis. It has been added in for the revised technical memorandum. It should be noted that the mercury results presented on Table 1 are in units of ug/kg, not mg/kg as are the other metals. Results of the background comparison for mercury indicate that it does not exceed background levels.*

17. Page 7. Also, niobium should be considered to be less than background for the same reasoning that is used for platinum and selenium. In general the decision logic for the background comparisons should be consistent across metals and radionuclides.

Response: *Both platinum and selenium had no detected results in the site data, while both had detected results in the background data. Therefore, they were not considered to be above background at the site. Niobium on the other had, had no detected results in the background data, but had detected results in the site data (similar to chromium VI). Therefore, it was considered to be above background at the site (similar to chromium VI). To consider these all the same would not be following the same decision logic as implied in this comment. No modifications have been made to the document in response to this comment.*

18. Page 7. As noted in the general comments, more analysis, explanation and discussion is needed regarding uranium and the other radionuclides. It is not reasonable that uranium exceeds background and thorium and radium do not, given the likelihood of secular equilibrium.

Response: *As noted in response to comment #5 above, text has been added to pages 4 and 8 discussing the uranium analysis issue, with reference to the uranium technical memorandum provided in Attachment D.*

19. Page 7. The meaning of the following sentence is not clear "Although the comparison statistics indicate that these metals levels at the property are above background, the cumulative probability plots and box-and-whisker plots indicate that for several of these metals, the property and background datasets are most likely representative of a single population". Some more information needs to be provided to justify a conclusion that background comparisons fail statistically, but the property and background distributions come from the same population. For example, small analytical differences could be mentioned, or small differences might be related to geologic or depth differences as seen in the background dataset. And, the conclusion could be tied back to the CSM (that these chemicals are not expected to be found as contaminants).

Response: *Agreed. Text reflecting this comment has been added to page 8 of the document.*

20. Page 10, Review Criterion 3 and 4. It does not appear that the analytical methods are sufficiently sensitive for some of the metals. For example, the antimony data exhibit about 10 high values that exceed background, exceed SSLs, and otherwise create issues for data analysis.

Response: *BEC is working to address the detection limit issue for the project in general. No modifications have been made to the document in response to this comment.*

21. Page 10, Review Criterion 3. In addition, issues have been identified associated with the radionuclide analysis, as described in the general comment above. Different methods were used for thorium and uranium, creating differences in activities for radionuclides that are, arguably, in secular equilibrium. In addition, the work plan called for 10% analysis of radium by alpha-spec methods, which have not been performed.

Response: *As noted in response to comments #5 and #18 above, text has been added to page 4 discussing the uranium analysis issue, with reference to the uranium technical memorandum provided in Attachment D.*

22. Data adequacy section. The formula used is questionable, despite its publication in USEPA documents. The multiplier of 1.16 is based on some simulations that were performed at PNNL to evaluate the difference in power between parametric tests and non-parametric tests. On average in the simulations the difference was a factor of 1.16. This does not mean that this multiplier is appropriate for the characteristics of the data presented here. Because the multiplier is included, some of the statements made are not strictly correct. The test is not based on averages. It is based on the Wilcoxon Rank Sum test, which is a non-parametric test (although the basis of the formula depends on the standard test for normality, the 1.16 multiplier came from simulations of the nonparametric test). The use of z in this formula is also suspect, since its use implies a known standard deviation. The standard deviation is estimated here, in which case t should be used instead of z, and the formula should be based on a t-test instead of a z-test. Finally, results of 0 are not recommended. The raw results are decimal, and are, presumably rounded. It is not appropriate to round any results down, because at least the number on the raw result is needed to prove data adequacy under the assumptions made. That is, the minimum possible integer response should be 1. None of these comments or observations appears to make any substantial difference to the general conclusion that there are enough data, given the assumptions of the model. However, it would be preferable if the statistical analysis and explanation was tightened. These issues must be addressed prior to submittal of future Deliverables.

Response: *As noted in this comment, this formula was used, as published in USEPA documents. However, the formula has been replaced on page 15 by that used by Neptune and Company in the 2006 BEC TRECO risk assessment. Zero values in the table have been changed to 1. This issue is being evaluated and will be addressed prior to submittal of future deliverables.*

23. Data adequacy section. Also, since asbestos was a driver for action at this site, some calculations should be presented to verify that sufficient asbestos data have been collected.

Response: *Calculations for data adequacy for asbestos have been added to Table 4 and referenced in the text on page 15. Although there are insufficient samples to achieve a lxl0-6 RME risk for amphiboles, no long amphibole fibers were found throughout the property following remediation.*

24. Page 15 determination of EPCs. In the middle of the paragraph a statement is made that UCLs were computed. This does not appear to be the case. In addition, it appears initially as if all analytes were evaluated in this way, whereas, asbestos is not. In fact, the approach taken with asbestos to use analytical sensitivity is much more like using a UCL for the other ana1ytes. A clearer distinction could be made.

Response: *The following sentence on page 17 has been changed from "For the 95 percent UCL concentration approach, the 95 percent UCL was computed in order to represent the area-wide exposure point concentrations." to "For the 95 percent UCL concentration approach, the 95 percent UCL is typically computed in order to represent the area-wide exposure point concentrations." A sentence has been added on page 17 stating "Therefore, asbestos exposure point concentrations are different than those for the other COPCs."*

25. Uncertainty analysis. One more type of uncertainty, or bias, has been introduced in this risk assessment. That is, the use of maximum concentrations across both parcels. Using maxima is clearly conservative, but it is also conservative to apply the maximum to both parcels simultaneously. This could be discussed.

Response: *See response to comment #6 above.*

26. Uncertainty analysis. Some discussion of some of the specific uncertainties should be provided in this section.

Response: *Discussions on specific uncertainties associated with the screening-level health risk assessments have been added to pages 20 and 21. Namely, the issue of using maximum concentrations across both Parcels A and B, use of the original surface soil data following remediation, and the use of corrected uranium isotope data have been discussed.*

27. Page 19, 3rd paragraph. "The risk estimates are based on reasonable maximum exposure scenarios," This statement is not strictly true given the use of maximum concentrations in the screening risk assessment. These are not based on a reasonable exposure scenario, instead they are based on a very conservative exposure scenario.

Response: *Although the concentrations are maximum concentrations, the remainder of the exposure parameters are considered reasonable maximum, thus perhaps a more appropriate term would be to characterize the entire exposure as reasaonable worst case, which USEPA generally considers above the 90th percentile, but below the 98th percentile (above the 98th*

percentile is considered maximum exposure). The text has been revised to read "The risk estimates are based on reasonable worst-case exposure scenarios, which results in estimates of the potential high-end risks associated with the property, which are more conservative than a reasonable maximum exposure scenario."

28. Page 19, risk results. The risk results are different if uranium as a radionuclide is included. Some changes to the text are appropriate.

Response: *The text has been changed on page 22 to reflect the inclusion of the uranium risk results.*

29. Page 20, Summary. "Based on the results of the 2007 investigation, this data review, and the screening-level health risk assessment, there is no evidence to conclude that the Tronox Parcels A and B property is contaminated. In summary, BEC concludes that an NFAD for the property is warranted". This should be reworded. There is evidence of contamination, it is just that the concentrations levels are not at levels of concern for human health risk for the industrial scenario. Some chemicals exhibit concentrations greater than background, and some organic chemicals have been detected. In addition the RME risk for amphibole is 5xl0-6, which is based on zero detects of amphibole fibers, and, apparently, insufficient samples to achieve lxl0-6 risk.

Response: *The text on page 23 has been revised, reflective of this comment.*

30. Figure 4. The term "clean" should be clarified. That is, the site was cleaned because of asbestos contamination. As currently used, an implication is that the areas are clean for all chemicals.

Response: *Figure 4 has been replaced with that in the subsequent asbestos technical memorandum. This figure only refers to the areas remediated for asbestos.*

31. Table 1. Results for the pre-and post-remediation asbestos data are not presented in this table, although the main text suggests that they are.

Response: *Reference to Attachment C, which provides the pre- and post-remediation asbestos data is provided on page 3 of the document.*

32. Table 2 seems like it should be broken out into two separate tables. In addition, mercury appears elevated relative to background, however is not presented in Table 2.

Response: *See response to comment #16 regarding mercury. Table 2 has been separated into Tables 2 and 3 in the revised technical memorandum.*

33. Electronic mail (e-mail) containing boxplots, the boxplot for tin appears to contain an error in presentation.

Response: *The boxplot for tin has been corrected. In addition, boxplots are provided in Attachment E of the revised technical memorandum.*

34. Uranium Isotope Data Review for 2007 Tronox A/B Investigation, we note also that much of the needed discussion/explanation about radionuclide issues at this site are discussed in the uranium technical memorandum. Perhaps some discussion is needed with NDEP, but it does not seem unreasonable to conclude that the radionuclide activities at this site are similar to background. The only case based on the raw data for which background comparisons fail is uranium as a metal, and, whereas the failure is statistically significant, the difference in activities between site uranium and background uranium activities is small. If uranium is included in the risk assessment, then the risk (radionuclide and non-radionuclide summed, per the risk assessment technical memorandum) is 4xl0-6. However, it is 1xl0-6 if uranium is not included, and it is not clear that it needs to be included. We also note that, whereas, these issues are addressed in the memorandum, the issue concerning gamma-spec analysis for radium is not fully resolved and must be resolved in future investigations.

Response: *BEC concurs with the comment above relating to uranium. Regarding future radium analyses, BEC will attempt to analyze for radium 226 and 228 using separation methods 903.1 and 904, as opposed to the gamma method 901.1.The project QAPP is being modified to reflect this methodology.*

ATTACHMENT B

LEGAL DESCRIPTIONS FOR TRONOX PARCELS A AND B

2270 Corporate Circle, Suite 100
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Fax 702.263.7200
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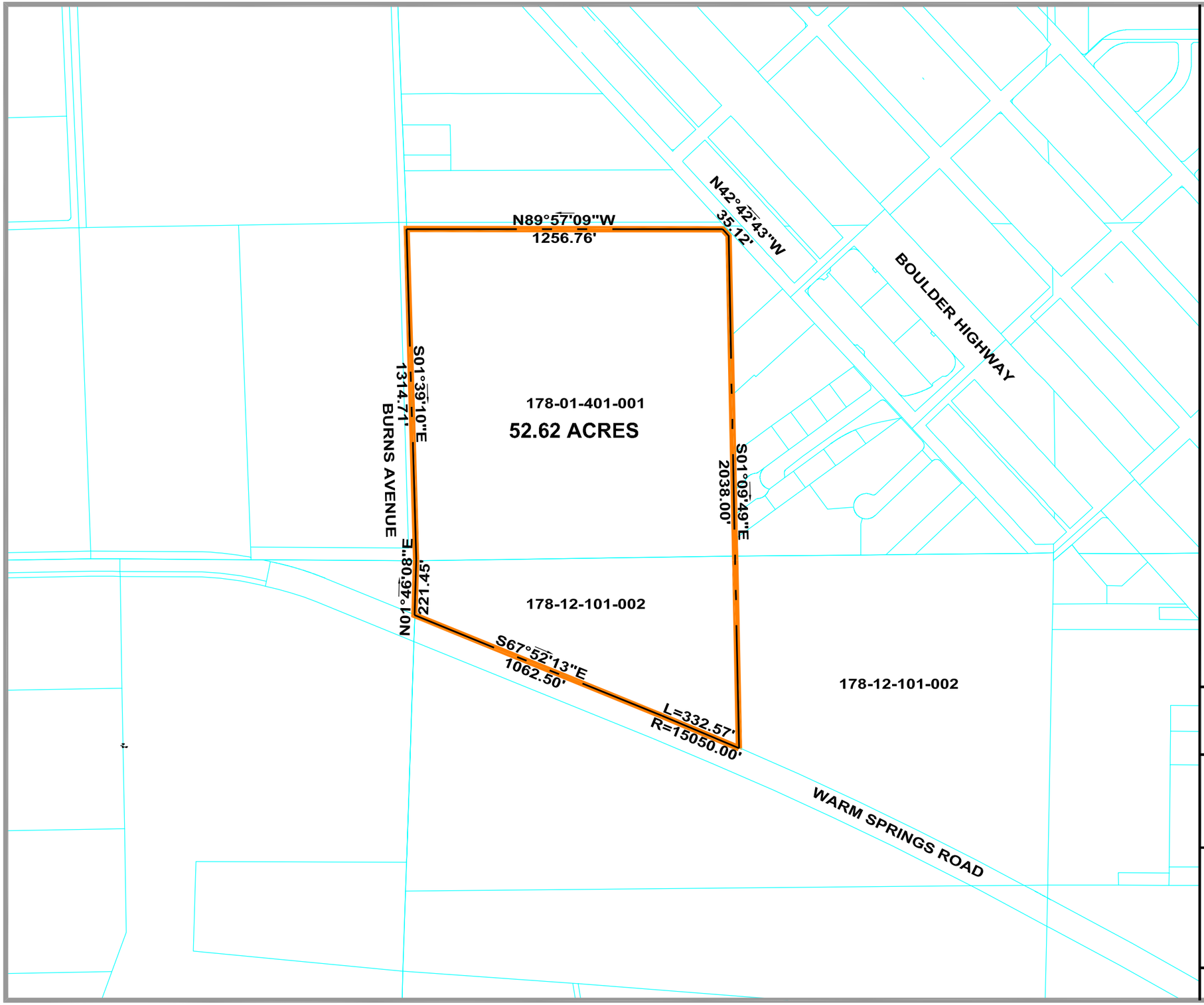
LEGAL DESCRIPTION
FOR TRONOX AREA "A"

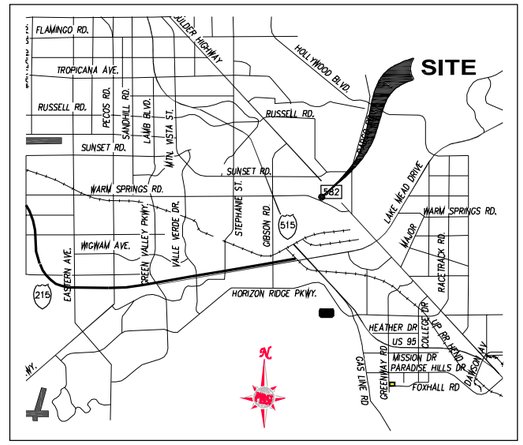
A PORTION OF THE SOUTHWEST QUARTER (SW 1/4) OF THE SOUTHWEST QUARTER (SW 1/4) OF SECTION 1 AND A PORTION OF THE NORTH HALF (N 1/2) OF SECTION 12 OF TOWNSHIP 22 SOUTH, RANGE 62 EAST, M.D.M., CLARK COUNTY, NEVADA, DESCRIBED AS FOLLOWS.

BEGINNING AT THE SOUTHWEST CORNER OF SAID SECTION 1; THENCE NORTH 01°39'10" WEST, ALONG THE WEST LINE OF THE SOUTHWEST QUARTER (SW 1/4) OF THE SOUTHWEST QUARTER (SW 1/4) OF SAID SECTION 1, A DISTANCE OF 1314.71 FEET TO THE NORTH LINE OF SAID SOUTHWEST QUARTER (SW 1/4) OF THE SOUTHWEST QUARTER (SW 1/4); THENCE SOUTH 89°57'09" EAST, DEPARTING SAID WEST LINE AND ALONG SAID NORTH LINE OF THE SOUTHWEST QUARTER (SW 1/4) OF THE SOUTHWEST QUARTER (SW 1/4), 1256.76 FEET; THENCE SOUTH 42°42'43" EAST, DEPARTING SAID NORTH LINE, 35.12 FEET TO THE EAST LINE OF SAID SOUTHWEST QUARTER (SW 1/4) OF THE SOUTHWEST QUARTER (SW 1/4); THENCE SOUTH 01°09'49" EAST, 2038.00 FEET TO THE NORTHERLY RIGHT-OF-WAY OF WARM SPRINGS ROAD, SAME BEING THE BEGINNING OF A NON-TANGENT CURVE CONCAVE NORTHEASTERLY HAVING A RADIUS OF 15050.00 FEET, A RADIAL LINE TO SAID BEGINNING BEARS NORTH 23°23'45" EAST; THENCE ALONG SAID NORTHERLY RIGHT-OF-WAY AND ALONG SAID CURVE TO THE RIGHT THROUGH A CENTRAL ANGLE OF 01°15'58", AN ARC LENGTH OF 332.57 FEET; THENCE NORTH 67°52'13" WEST, 1062.50 FEET TO THE WEST LINE OF THE NORTHWEST QUARTER (NW 1/4) OF SAID SECTION 12; THENCE NORTH 01°46'08" EAST, DEPARTING SAID RIGHT-OF-WAY AND ALONG SAID WEST LINE, 221.45 FEET TO **THE POINT OF BEGINNING.**

CONTAINING 2,292,314 SQUARE FEET (52.62 ACRES) MORE OR LESS, AS DETERMINED BY COMPUTER METHODS.

BASIS OF BEARINGS:
NORTH 89°00'41" EAST - BEING THE NORTH LINE OF THE NORTHWEST QUARTER (NW 1/4) OF SECTION 11, TOWNSHIP 22 SOUTH, RANGE 62 EAST, M.D.M., CLARK COUNTY, NEVADA AS SHOWN BY A MAP ON FILE IN THE OFFICE OF THE CLARK COUNTY RECORDER IN BOOK 82, PAGE 71 OF PLATS, OFFICIAL RECORDS.





VICINITY MAP

N.T.S.

LEGEND

PROPERTY LINE

ASSESSORS PARCEL LINES

N

SCALE: 1"=400'

THE LANDWELL COMPANY

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LANDWELL
TRONOX FIGURE "A"

APN: 178-01-401-001 & A PORTION OF 178-12-101-002

GROSS ACREAGE: 52.62 AC

SHEET 1 OF 1 DATE: 05/31/07 PROJECT NUMBER 511729.53 0100

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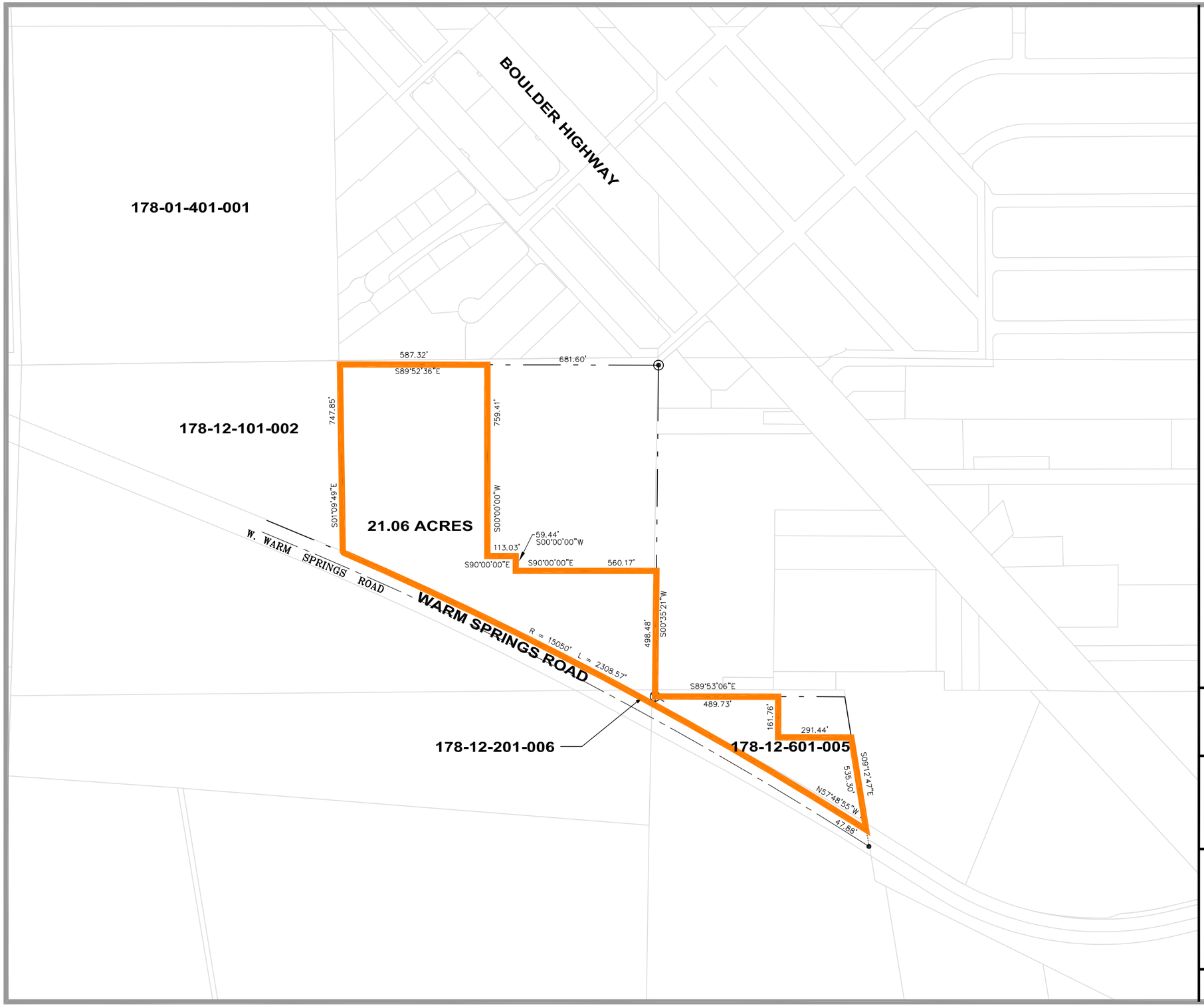
LEGAL DESCRIPTION
FOR TRONOX AREA "B"

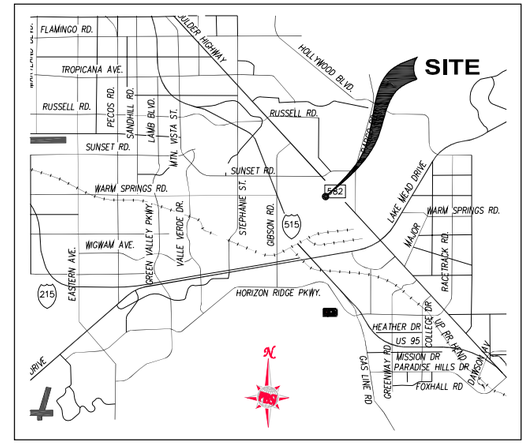
A PORTION OF SECTION 12, TOWNSHIP 22 SOUTH, RANGE 62 EAST, M.D.M., CLARK COUNTY, NEVADA, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHEAST CORNER OF THE NORTHWEST QUARTER (NW 1/4) OF SAID SECTION 12; THENCE NORTH 89°52’36” WEST, ALONG THE NORTH LINE THEREOF, 681.60 FEET TO **THE POINT OF BEGINNING**; THENCE SOUTH 00°00'00" WEST, DEPARTING SAID NORTH LINE, 759.41 FEET; THENCE SOUTH 90°00'00" EAST, 113.03 FEET; THENCE SOUTH 00°00'00" WEST, 59.44 FEET; THENCE SOUTH 90°00'00" EAST, 560.17 FEET TO THE EAST LINE OF SAID NORTHWEST QUARTER (NW 1/4); THENCE SOUTH 00°35'21" WEST, ALONG SAID EAST LINE, 498.48 FEET; THENCE SOUTH 89°53'06" EAST, DEPARTING SAID EAST LINE, 489.73 FEET; THENCE SOUTH 00°00'00" WEST, 161.76 FEET; THENCE SOUTH 89°53'06" EAST, 291.44 FEET; THENCE SOUTH 09°12'47" EAST, 371.37 FEET TO THE NORTHERLY RIGHT-OF-WAY OF WARM SPRINGS ROAD; THENCE NORTH 57°48'55" WEST, ALONG SAID RIGHT-OF-WAY, 47.88 FEET, TO THE BEGINNING OF A TANGENT CURVE CONCAVE SOUTHWESTERLY HAVING A RADIUS OF 15050.00 FEET;, THENCE, ALONG SAID CURVE TO THE LEFT THROUGH A CENTRAL ANGLE OF 8°47'20", AN ARC LENGTH OF 2308.57 FEET; THENCE NORTH 01°09'49" WEST, DEPARTING SAID RIGHT-OF-WAY, 747.85 FEET; THENCE SOUTH 89°52'36" EAST, 587.32 FEET TO THE **POINT OF BEGINNING**.

CONTAINING 917,428 SQUARE FEET (21.06 ACRES), MORE OR LESS, AS DETERMINED BY COMPUTER METHODS.

BASIS OF BEARINGS:
NORTH 88`58'43" EAST - BEING THE NORTH LINE OF THE NORTHEAST QUARTER (NE 1/4) OF SECTION 11, TOWNSHIP 22 SOUTH, RANGE 62 EAST, M.D.M., CITY OF HENDERSON, CLARK COUNTY, NEVADA AS SHOWN ON THE MAP IN BOOK 97 OF PLATS, PAGE 99, OFFICIAL RECORDS, CLARK COUNTY, NEVADA.





VICINITY MAP

N.T.S.

LEGEND

PROPERTY LINE

ASSESSORS PARCEL LINES

N

SCALE: 1"=400'

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LANDWELL
TRONOX FIGURE "B"

APN: 178-12-101-002, 178-12-201-006, & A PORTION OF 178-12-601-005

GROSS ACREAGE: 21.06± AC

SHEET 1 OF 1 DATE: 12/06/07 **PROJECT NUMBER 511729**

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ATTACHMENT C

2007 TRONOX PARCELS A/B INVESTIGATION DATA
(DATABASE ON CD)

ATTACHMENT D

JANUARY 9, 2008 ASBESTOS DATA REVIEW FOR 2007 TRONOX PARCELS A/B INVESTIGATION MEMORANDUM

Basic Environmental
COMPANY

MEMORANDUM

To: Shannon Harbour (NDEP)

From: Ranajit Sahu (BEC)

cc: Brian Rakvica (NDEP)
Jim Najima (NDEP)
Teri Copeland
Paul Black (Neptune and Co.)

Date: January 9, 2008

Subject: Asbestos Data Review for 2007 Tronox Parcels A/B Investigation, BMI Industrial Complex, Clark County, Nevada

Results of the initial Phase 2 soil investigation performed for the Tronox Parcels "A" and "B" (portions of APN Nos. 178-01-401-001, 178-12-101-002, 178-12-201-006, and 178-12-601-005) indicated the presence of both chrysotile and amphibole long (protocol) asbestos fibers. The asbestos analytical results from the initial round of sampling at the Site are presented below.

Sample ID	Long Protocol Asbestos Fibers	Mean Concentration	95% UCL Concentration	Analytical Sensitivity	Excavated?
Initial Sampling Event (Pre-Remedation)					
Amphibole					
TSB-AJ-01	0	< 2.998 E+6	< 1.106 E+7	2.998 E+6	
TSB-AJ-01-FD	0	< 2.961 E+6	< 1.093 E+7	2.961 E+6	
TSB-AJ-02	0	< 2.901 E+6	< 1.071 E+7	2.901 E+6	
TSB-AJ-03	1	2.957 E+6	1.647 E+7	2.901 E+6	Yes
TSB-AR-01	0	< 2.991 E+6	< 1.104 E+7	2.991 E+6	
TSB-AR-02	0	< 2.976 E+6	< 1.098 E+7	2.976 E+6	
TSB-AR-03	0	< 2.998 E+6	< 1.106 E+7	2.998 E+6	
TSB-AR-04	0	< 2.985 E+6	< 1.101 E+7	2.985 E+6	
TSB-AR-05	0	< 2.976 E+6	< 1.098 E+7	2.976 E+6	
TSB-AR-06	1	2.992 E+6	1.667 E+7	2.992 E+6	Yes
TSB-AR-07	0	< 2.976 E+6	< 1.098 E+7	2.976 E+6	
TSB-AR-08	4	1.188 E+7	1.655 E+7	2.976 E+6	Yes
TSB-AR-09	1	2.991 E+6	1.666 E+7	2.991 E+6	Yes
TSB-AR-10	1	2.975 E+6	1.657 E+7	2.991 E+6	Yes
TSB-AR-11	0	< 2.975 E+6	< 1.098 E+7	2.975 E+6	Yes
TSB-AR-12	1	2.998 E+6	1.670 E+7	2.998 E+6	Yes
TSB-AR-13	1	2.986 E+6	1.663 E+7	2.998 E+6	Yes
TSB-AR-14	2	5.920 E+6	2.137 E+7	2.986 E+6	Yes
TSB-BJ-01	0	< 3.205 E+6	< 1.183 E+7	2.960 E+6	Yes
TSB-BJ-02	0	< 2.959 E+6	< 1.092 E+7	3.205 E+6	Yes

Sample ID	Long Protocol Asbestos Fibers	Mean Concentration	95% UCL Concentration	Analytical Sensitivity	Excavated?
Initial Sampling Event (Pre-Remedation)					
TSB-BJ-02 FD	1	2.988 E+6	1.664 E+7	2.959 E+6	Yes
TSB-BJ-03	0	< 2.963 E+6	< 1.093 E+7	2.988 E+6	
TSB-BJ-04	0	< 2.986 E+6	< 1.102 E+7	2.963 E+6	
TSB-BJ-05	0	< 2.745 E+6	< 1.013 E+7	2.986 E+6	
TSB-BJ-06	0	< 2.978 E+6	< 1.099 E+7	2.745 E+6	
TSB-BR-01	0	< 2.762 E+6	< 1.019 E+7	2.978 E+6	
TSB-BR-02	0	< 2.991 E+6	< 1.104 E+7	2.762 E+6	
TSB-BR-03	0	< 2.988 E+6	< 1.103 E+7	2.991 E+6	
TSB-BR-04	0	< 2.958 E+6	< 1.092 E+7	2.988 E+6	
TSB-BR-05	1	2.991 E+6	1.666 E+7	2.958 E+6	Yes
TSB-BR-06	0	< 2.987 E+6	< 1.102 E+7	2.958 E+6	
Chrysotile					
TSB-AJ-01	0	< 2.998 E+6	< 1.106 E+7	2.998 E+6	
TSB-AJ-01-FD	0	< 2.961 E+6	< 1.093 E+7	2.961 E+6	
TSB-AJ-02	0	< 2.901 E+6	< 1.071 E+7	2.901 E+6	
TSB-AJ-03	2	5.913 E+6	2.135 E+7	2.901 E+6	Yes
TSB-AR-01	0	< 2.991 E+6	< 1.104 E+7	2.991 E+6	
TSB-AR-02	1	2.976 E+6	1.658 E+7	2.976 E+6	
TSB-AR-03	0	< 2.998 E+6	< 1.106 E+7	2.998 E+6	
TSB-AR-04	0	< 2.985 E+6	< 1.101 E+7	2.985 E+6	
TSB-AR-05	3	8.929 E+6	2.607 E+7	2.976 E+6	
TSB-AR-06	0	< 2.992 E+6	< 1.104 E+7	2.992 E+6	Yes
TSB-AR-07	0	< 2.976 E+6	< 1.098 E+7	2.976 E+6	
TSB-AR-08	6	1.783 E+7	2.145 E+7	2.976 E+6	Yes
TSB-AR-09	0	< 2.991 E+6	< 1.104 E+7	2.991 E+6	Yes
TSB-AR-10	0	< 2.975 E+6	< 1.098 E+7	2.975 E+6	Yes
TSB-AR-11	8	2.380 E+7	4.688 E+7	2.975 E+6	Yes
TSB-AR-12	0	< 2.998 E+6	< 1.106 E+7	2.998 E+6	Yes
TSB-AR-13	1	2.986 E+6	1.663 E+7	2.998 E+6	Yes
TSB-AR-14	2	5.920 E+6	2.137 E+7	2.960 E+6	Yes
TSB-BJ-01	19	6.090 E+7	9.512 E+7	2.960 E+6	Yes
TSB-BJ-02	5	1.480 E+7	3.447 E+7	2.959 E+6	Yes
TSB-BJ-02 FD	9	2.689 E+7	5.104 E+7	2.959 E+6	Yes
TSB-BJ-03	0	< 2.963 E+6	< 1.093 E+7	2.988 E+6	
TSB-BJ-04	0	< 2.986 E+6	< 1.102 E+7	2.963 E+6	
TSB-BJ-05	3	8.236 E+6	2.405 E+7	2.745 E+6	
TSB-BJ-06	0	< 2.978 E+6	< 1.099 E+7	2.745 E+6	
TSB-BR-01	0	< 2.762 E+6	< 1.019 E+7	2.978 E+6	
TSB-BR-02	0	< 2.991 E+6	< 1.104 E+7	2.762 E+6	
TSB-BR-03	0	< 2.988 E+6	< 1.103 E+7	2.991 E+6	
TSB-BR-04	2	5.917 E+6	2.136 E+7	2.988 E+6	
TSB-BR-05	3	8.974 E+6	2.621 E+7	2.958 E+6	Yes
TSB-BR-06	0	< 2.987 E+6	< 1.102 E+7	2.958 E+6	

Following this initial round of sampling, surface soil (4 to 6 inches) from several areas of the property, around sample locations TSB-AJ-03, TSB-AR-06, TSB-AR-08, TSB-AR-09, TSB-AR-10, TSB-AR-12, TSB-AR-13, TSB-AR-14, TSB-BJ-02, TSB-BR-05 was scraped and removed (Figure 1 [see Figure 4 of main technical memorandum]). Post-scrape samples were collected and analyzed for asbestos from 10 locations within these areas. Based on this, the original surface sample data for asbestos from these locations were removed from further evaluation and the re-sampled asbestos results were used instead. The asbestos analytical results from this second round of sampling at the Site are presented below.

Sample ID	Long Protocol Asbestos Fibers	Mean Concentration	95% UCL Concentration	Analytical Sensitivity	Excavated?
First Post-Scrape Sampling Event					
Amphibole					
TSB-AJ-03-PS	0	< 1.797 E+6	< 6.632 E+6	1.797 E+6	
TSB-AR-06-PS	0	< 2.979 E+6	< 1.099 E+7	2.979 E+6	
TSB-AR-08-PS	0	< 2.493 E+6	< 1.106 E+7	2.493 E+6	
TSB-AR-09-PS	0	< 2.980 E+6	< 1.100 E+7	2.849 E+6	
TSB-AR-10-PS	0	< 2.849 E+6	< 1.051 E+7	2.849 E+6	
TSB-AR-12-PS	0	< 2.991 E+6	< 1.104 E+7	2.849 E+6	
TSB-AR-13-PS	0	< 2.993 E+6	< 1.105 E+7	2.993 E+6	
TSB-AR-14-PS	0	< 2.921 E+6	< 1.078 E+7	2.921 E+6	
TSB-BJ-02-PS	0	< 2.998 E+6	< 1.106 E+7	2.998 E+6	
TSB-BR-05-PS	1	2.998 E+6	< 1.670 E+7	2.998 E+6	Yes
Chrysotile					
TSB-AJ-03-PS	0	< 1.797 E+6	< 6.632 E+6	1.797 E+6	
TSB-AR-06-PS	0	< 2.979 E+6	< 1.099 E+7	2.979 E+6	
TSB-AR-08-PS	0	< 2.493 E+6	< 1.106 E+7	2.493 E+6	
TSB-AR-09-PS	0	< 2.980 E+6	< 1.100 E+7	2.849 E+6	
TSB-AR-10-PS	0	< 2.849 E+6	< 1.051 E+7	2.849 E+6	
TSB-AR-12-PS	0	< 2.991 E+6	< 1.104 E+7	2.849 E+6	
TSB-AR-13-PS	0	< 2.993 E+6	< 1.105 E+7	2.993 E+6	
TSB-AR-14-PS	0	< 2.921 E+6	< 1.078 E+7	2.921 E+6	
TSB-BJ-02-PS	0	< 2.998 E+6	< 1.106 E+7	2.998 E+6	
TSB-BR-05-PS	0	< 2.998 E+6	< 1.106 E+7	2.998 E+6	Yes

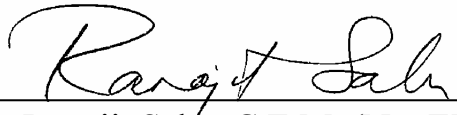
A single long amphibole asbestos fiber was detected in sample TSB-BR-05-PS during this second round of sampling. Therefore, further scraping around this location was performed. In addition, sample locations TSB-AR-11 and TSB-BJ-01 contained 8 and 19 long chrysotile asbestos fibers, respectively. Therefore, further scraping around these locations was also performed. Final samples were collected from locations TSB-BR-05, TSB-AR-11, and TSB-BJ-01 following the second and third scrapings. Figure 1 shows all areas of surface soil

that were scraped and removed. The asbestos analytical results from this final round of sampling at the Site are presented below.

Sample ID	Long Protocol Asbestos Fibers	Mean Concentration	95% UCL Concentration	Analytical Sensitivity	Excavated?
Second and Third Post-Scrape Sampling Event					
Amphibole					
TSB-BR-05-PS2	0	< 2.993 E+6	< 1.104 E+7	2.993 E+6	
TSB-AR-11-PS	0	< 2.991 E+6	< 1.104 E+7	2.991 E+6	
TSB-BJ-01-PS	0	< 2.243 E+6	< 8.277 E+6	2.243 E+6	
Chrysotile					
TSB-BR-05-PS2	0	< 2.993 E+6	< 1.104 E+7	2.993 E+6	
TSB-AR-11-PS	0	< 2.991 E+6	< 1.104 E+7	2.991 E+6	
TSB-BJ-01-PS	0	< 2.243 E+6	< 8.277 E+6	2.243 E+6	

All the asbestos laboratory reports, both pre- and post-scrape samples, are included in Attachment C-1. Asbestos risk calculations based on the final post-scrape asbestos analytical results are presented in Table 1 [see Table 5 of the main technical memorandum]. The results of the asbestos risk calculations indicate that exposures to asbestos in soil at the property should not result in adverse health effects to all future on-site receptors. Based on the results of these final sampling events, all asbestos impacted soil at the Site has been remediated.

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



January 9, 2007

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2009) Date
BRC Project Manager

ATTACHMENT D-1

ASBESTOS LABORATORY REPORTS
(ON CD)

ATTACHMENT E

DECEMBER 18, 2007 URANIUM ISOTOPE DATA REVIEW FOR 2007 TRONOX PARCELS A/B INVESTIGATION MEMORANDUM

Basic Environmental
COMPANY

MEMORANDUM

To: Shannon Harbour (NDEP)

From: Ranajit Sahu (BEC)

cc: Brian Rakvica (NDEP)
Jim Najima (NDEP)
Paul Black (Neptune and Co.)

Date: December 18, 2007

Subject: Uranium Isotope Data Review for 2007 Tronox Parcels A/B Investigation, BMI Industrial Complex, Clark County, Nevada

Results of the initial Phase 2 soil investigation performed for the Tronox Parcels "A" and "B" (Site; portions of APN Nos. 178-01-401-001, 178-12-101-002, 178-12-201-006, and 178-12-601-005) indicated that uranium isotope analytical results were biased low in comparison to the 2005 shallow soil background dataset. A comparison of the methods used for preparation and analysis of the radionuclides for both the 2005 shallow soil background dataset, and 2007 Tronox Phase 2 Parcels A/B dataset are presented below.

		Radionuclide			
Dataset	**Parameter**	Th-228, -230, 232	U-234, -235, -238	Ra-226	Ra-228
2007 Tronox A/B	Digestion Method	RICH-RC-5032 (Total Dissolution)	RICH-RC-5013 (HNO3 Leach)	--- (Gamma)	--- (Gamma)
	Analytical Method	RICH-RC-5087 (HASL 300 Th Mod)	RICH-RC-5067 (HASL 300 U Mod)	RICH-RC-5017 (EPA 901.1)	RICH-RC-5017 (EPA 901.1)
	Analysis Date	Sept/Oct 2007	Sept/Oct 2007	Sept/Oct 2007	Sept/Oct 2007
2005 Background	Digestion Method	STL-RC-0004 (Total Dissolution)	STL-RC-0004 (Total Dissolution)	--- (Gamma)	--- (Gamma)
	Analytical Method	DOE A-01-R MOD (HASL 300 Th Mod)	DOE A-01-R MOD (HASL 300 U Mod)	RICH-RC-5005 (EPA 903.1)	RICH-RC-5005 (EPA 904.0)
	Analysis Date	June 2005	June 2005	Dec 2005/ Jan 2006	Dec 2005/ Jan 2006
Comparable?		YES	NO	YES	YES

Based on this comparison, it is evident that the uranium isotope analyses are different between the background and Site datasets; whereas the thorium and radium isotope analyses are considered comparable. The primary difference between the background and Site uranium

isotope data is that the sample preparation method in the background dataset used a total dissolution method, while the Site dataset used a nitric acid preparation method.

Because of incompatibility between the two datasets, two approaches were developed to account for and correct this low bias associated with the Site uranium isotope data. The two approaches are similar, in that they both base the re-calculation of the Site uranium isotope activities on the use of the uranium metal analytical results.

Approach #1 is as follows:

1. Obtain measured results for both Site and background datasets;

2. Obtain sample-specific ratios of each uranium isotope to the uranium metal (analyzed by ICP following a nitric acid digestion) results in the background dataset;

3. Obtain summary statistics, including average, for the background isotope to uranium metal ratios;

4. Apply the isotope-specific average background ratio to the each individual measured Site uranium metal concentration to obtain a sample-specific calculated uranium isotope-specific activity; and

5. Obtain summary statistics, including the maximum calculated isotope-specific activities and use these values in the background comparison and screening-level health risk assessment in place of the previous biased low measured activities.

Approach #2 is as follows:

1. Obtain measured results for both Site and background datasets;

2. Obtain isotope-secific averages for both the Site and background datasets;

3. Obtain sample-specific ratios of each uranium isotope to the uranium metal (analyzed by ICP following a nitric acid digestion) results in both the Site and background datasets;

4. Average the sample-specific uranium isotope to the uranium metal ratios for both the Site and background datasets;

5. Obtain the ratio of the average isotope-specific Site ratios to background ratios (considered a ‘Universal Factor’);

6. Apply the Universal Factor to the measured Site uranium metal concentration to obtain a sample-specific calculated uranium isotope-specific activity; and

7. Obtain summary statistics, including the maximum calculated isotope-specific activities and use these values in the background comparison and screening-level health risk assessment in place of the previous biased low measured activities.

The calculations associated with both of these approaches are included in the attached Excel spreadsheet [on CD]. The recommended approach is Approach #1 as it provides a reasonable means to correct for the low-biased measured uranium isotope data, to obtain a Site dataset that is compatible with the shallow soil background dataset, without being overly conservative.

A comparison of the Approach #1 calculated uranium isotope activities for the Site to the shallow soils background dataset was performed using the methods discussed in the *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation*. The results of this comparison are presented in the table below.

Dataset	Parameter	Radionuclide (pCi/g)		
		Uranium-233/234	Uranium-235/236	Uranium-238
2005 Background	No. of Detects	61	54	120
	Total Samples	120	120	120
	% Detects	51%	45%	100%
	Minimum Detect	0.53	0.037	0.45
	Maximum Detect	2.84	0.21	2.37
	Median	0.58	0.041	1.02
	Mean	0.89	0.053	1.09
	Standard Deviation	0.59	0.043	0.37
2007 Tronox A/B	No. of Detects*	64	64	64
	Total Samples	64	64	64
	% Detects	100%	100%	100%
	Minimum Detect	0.82	0.050	0.81
	Maximum Detect	3.69	0.22	3.65
	Median	1.19	0.072	1.18
	Mean	1.43	0.086	1.41
	Standard Deviation	0.61	0.037	0.60
t Test	*p* Value	0.00000002	0.00000007	0.000064
	Greater than Background?	YES	YES	YES
Quantile Test	*p* Value	0.0027	NA	0.0041
	Greater than Background?	YES	NO	YES
Slippage Test	*p* Value	0.041	0.35	0.014
	Greater than Background?	NO	NO	YES
WRS Test	*p* Value	0.0000006	0.000053	0.0000020
	Greater than Background?	YES	YES	YES
Comparison Results	Greater than Background?	YES	YES	YES
	Basis	Multiple tests	Multiple tests	Multiple tests

*Number of detects for calculated activities is assumed to be the same as that for uranium metal (100%).

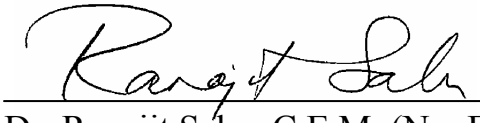
The Tronox approach to ratio up uranium isotpe concetrations is somewhat crude and may overstate the concentrations. Tronox anticipates that since Th and Ra isotopes are consistent with background, it is likely that actual uranium isotopic concentrations are also consistent with background. However, in the interest of completeing the NFAD for the Parcels A and B, Tronox is submitting the "corrected" uranium data.

Based on the comparison, the Site uranium isotope activities are considered above the shallow soil background levels. Therefore, these radionuclides should be included in the screening-level risk assessment performed for the Site. A revised Table 1 [see Table 1 of the main technical memorandum] from the *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation*, with the uranium isotopes included in the total incremental lifetime cancer risk (ILCR) estimate, using the calculated activities based on Approach #1, is attached.

The total theoretical upper-bound ILCR for future commercial/industrial receptors at the Site, with the calculated activities for the uranium isotopes included, is 4×10^{-6}. This is comparible to the theoretical upper-bound ILCR for background levels of the uranium isotopes of 3×10^{-6}. Given the proposed land use for the Site, these results indicate that future receptor exposures at the Site should not result in unacceptable carcinogenic risks.

Therefore, based on the results of the 2007 investigation, the previous data review, and the revised screening-level health risk assessment, there is no evidence to conclude that the Tronox Parcels A and B property is contaminated. In summary, BEC reiterates that an NFAD for the property is warranted.

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



December 18, 2007

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2009) Date
BRC Project Manager

ATTACHMENT F

PROBABILITY PLOTS AND BOXPLOTS
(ON CD)

Tab 2

Nevada Division of Environmental Protection (NDEP) Response to: Technical Memorandum Data Review for 2007 Tronox Parcels A/B Investigation, Dated February 11, 2008

April 8, 2008

ndep
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Jim Gibbons, Governor
Allen Biaggi, Director
Leo M. Drozdoff, P.E., Administrator

April 8, 2008

Susan Crowley
Tronox LLC
PO Box 55
Henderson, Nevada 89009

Re: **Tronox LLC (TRX)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection Response to:
Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation
Dated February 11, 2008

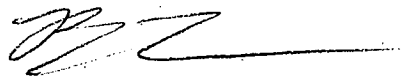
Dear Ms. Crowley,

The NDEP has received and reviewed TRX's above-identified report and finds that No Further Action (NFA) is required at this time with the following conditions:

1. TRX retains the responsibility to address any environmental impacts to groundwater beneath the property referred to as Parcels A and B. As such, additional investigation may be necessary on this property as it relates to TRX's responsibilities. TRX must be granted access to the site for activities such as well or soil boring installations or other investigative or remedial efforts.
2. The materials presented to the NDEP do not evaluate the possibility of a vapor intrusion concern from contamination in groundwater. It is anticipated that this issue will be addressed as part of the investigation of groundwater issues in the region.
3. The site soils beneath 10' below ground surface have not been evaluated to date. The property owner should note that these soils should not be disturbed without additional investigation or evaluation.
4. To limit liability, the property owner should ensure that activities at the property do not exacerbate existing, sub-surface, environmental conditions.
5. The site use is suitable for purposes of commercial or industrial use only.

Please contact the undersigned with any questions at brakvica@ndep.nv.gov or (702) 486-2850 x 247.

Sincerely,



Brian A. Rakvica, P.E.
Supervisor, Special Projects Branch
Bureau of Corrective Actions
NDEP-Las Vegas Office

BAR:s

CC: Jim Najima, NDEP, BCA, Carson City
Shannon Harbour, NDEP, BCA, Las Vegas
William J. Frey, AG's Office, Carson City
Keith Bailey, Environmental Answers, 3229 Persimmon Creek Drive, Edmond, OK 73013
Sally Bilodeau, ENSR, 1220 Avenida Acaso, Camarillo, CA 93012-8727
Barry Conaty, Akin, Gump, Strauss, Hauer & Feld, L.L.P., 1333 New Hampshire Avenue, N.W., Washington, D.C. 20036
Brenda Pohlmann, City of Henderson, PO Box 95050, Henderson, NV 89009
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Ebrahim Juma, Clark County Comprehensive Planning, PO Box 551741, Las Vegas, NV, 89155-1741
Ranajit Sahu, BRC, 311 North Story Place, Alhambra, CA 91801
Rick Kellogg, BRC, 875 West Warm Springs, Henderson, NV 89011
Mark Paris, Landwell, 875 West Warm Springs, Henderson, NV 89011
Craig Wilkinson, TIMET, PO Box 2128, Henderson, Nevada, 89009-7003
Kirk Stowers, Broadbent & Associates, 8 West Pacific Avenue, Henderson, Nevada 89015
George Crouse, Syngenta Crop Protection, Inc., 410 Swing Road, Greensboro, NC 27409
Nick Pogoncheff, PES Environmental, 1682 Novato Blvd., Suite100, Novato, CA 94947
Lee Erickson, Stauffer Management Company, P.O. Box 18890, Golden, CO 80402
Michael Bellotti, Olin Corporation, 3855 North Ocoee Street, Suite 200, Cleveland, TN 37312
Curt Richards, Olin Corporation, 3855 North Ocoee Street, Suite 200, Cleveland, TN 37312
Paul Sundberg, Montrose Chemical Corporation, 3846 Estate Drive, Stockton, California 95209
Joe Kelly, Montrose Chemical Corporation of CA, 600 Ericksen Avenue NE, Suite 380, Bainbridge Island, WA 98110

Tab 3

Basic Environmental Company (BEC) Technical Memorandum Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation BMI Industrial Complex, Clark County, Nevada

November 13, 2008

Basic Environmental
COMPANY

TECHNICAL MEMORANDUM

To: Shannon Harbour (NDEP)

From: Ranajit Sahu (BEC)

cc: Brian Rakvica (NDEP)
Jim Najima (NDEP)
Teri Copeland
Paul Black (Neptune and Co.)

Date: November 13, 2008

Subject: Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada

Introduction

The objective of this Technical Memorandum is to present the results of a screening-level indoor air health risk assessment for the Phase 2 soil gas investigation Basic Environmental Company (BEC) and Tronox performed for the Tronox Parcels "A" and "B" (portions of APN Nos. 178-01-401-001, 178-12-101-002, and 178-12-201-006 [Note: Parcel 178-12-601-005, formerly part of Tronox Parcel B, has been sold and is excluded from this analysis]). Parcels A and B will collectively be referred to as the property for the purposes of this Technical Memorandum. The property is located north of Warm Springs Road, 1/4 mile west of the intersection with Boulder Highway, in Henderson, Nevada. Figure 1 shows details of Parcels A and B and the soil gas sampling locations. The Technical Memorandum only presents the methods and results of the screening-level indoor air health risk assessment, and does not present investigation, data summary, data usabilty, or data adequacy information. This information is provided in the Nevada Division of Environmental Protection (NDEP) approved *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation* dated February 11, 2008, and the Data Validation Summary Report for the soil gas survey.

Conceptual Site Model

The conceptual site model (CSM) is used to describe relationships between chemicals and potentially exposed human receptor populations, thereby delineating the relationships between the suspected sources of chemicals identified at the property, the mechanisms by which the chemicals might be released and transported in the environment, and the means by which the

receptors could come in contact with the chemicals. The CSM provides a basis for defining data quality objectives and developing exposure scenarios.

The CSM considers current and potential future land-use conditions. Currently, the property is undeveloped. Current receptors that may use the property include on-site trespassers. Therefore, current exposures to native soils at the property are likely to be minimal. In addition, exposures to future on-site workers will be much greater than current exposures. For example, future receptors include indoor commercial workers who are assumed to be exposed to soil gas emanating from the subsurface for 250 days per year for 25 years which is much greater than any current exposures.

USEPA (1989) guidance states that potential future land use should be considered in addition to current land use when evaluating the potential for human exposure at a site. Therefore, the CSM also considers other future land-uses. For example, the CSM includes the planned use of the property for redevelopment into commercial use.

Given the planned development of the property, potential human receptors include on-site construction workers, on-site indoor commercial workers, on-site outdoor maintenance workers, and on-site visitors. Although several potential human receptors may occur on the property in the future, the screening-level health risk assessment focuses on indoor commercial workers. This receptor is considered to have the highest level of exposure at the property. Other receptors generally have lower exposures, and thus lower risk estimates. Therefore, risk estimates generated for future on-site indoor commercial workers will be protective of other potential receptors at the property.

The previous screening-level health risk assessment evaluated risks from exposure to soil. However, these exposures did not account for potential migration of VOCs from the subsurface into indoor air. In general USEPA does not recommend evaluating the indoor air exposure pathway using soil matrix data (USEPA 2002a). Because groundwater beneath a portion of the property is considered a potential VOC source area, soil gas data were recently collected. These data are further evaluated and are the focus of this screening-level indoor air health risk assessment.

Screening-Level Indoor Air Health Risk Assessment

As discussed above, the previous screening-level health risk assessment did not consider the indoor air pathway. Therefore, soil gas data were collected to specifically evaluate this potential exposure pathway at the property.

Human health risks are represented by estimated theoretical upper-bound cancer risks and non-cancer hazards derived in accordance with standard USEPA methods. The acceptable risk levels defined by USEPA for the protection of human health, and following those discussed previously with NDEP, are:

1. For non-carcinogenic compounds, the acceptable criterion is a cumulative hazard index (HI) of one or less. If the screening HI is determined to be greater than 1.0, target organ-specific HIs will be calculated for primary and secondary organs. The final risk goal will be to achieve target organ-specific non-carcinogenic HIs of less than 1.0; and

2. For known or suspected chemical and radionuclide carcinogens, the acceptable ceiling for a cumulative incremental lifetime cancer risk (ILCR) ranges from 10^{-6} to 10^{-4}. The risk goal established by the NDEP is 10^{-6}.

3. Where background levels exceed risk level goals, metals and radionuclides in property soils are targeted to have risks no greater than those associated with background conditions.

This screening-level indoor air health risk assessment follows the basic procedures outlined in USEPA *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (RAGS; USEPA 1989). Other guidance documents were also consulted for the screening-level indoor air health risk assessment.

Selection of Chemicals of Potential Concern

The broad suite of analytes sampled for was the initial list of chemicals of potential concern (COPCs) at the property. However, in order to ensure that a risk assessment focuses on those substances that contribute the greatest to the overall risk (USEPA 1989); only one procedure was used to eliminate the chemicals for quantitative evaluation in the screening-level indoor air health risk assessment: identification of chemicals that were not detected in any of the soil gas sample locations within the property. That is, all chemicals that were detected in any soil gas sample within the property was considered a COPC and evaluated in the screening-level indoor air health risk assessment. The identification of those chemicals detected in soil gas samples within the property are presented in Table 1.

Determination of Exposure Point Concentrations

A representative exposure concentration is a COPC-specific and media-specific concentration value. In risk assessment, these exposure concentrations are values incorporated into the exposure assessment equations from which potential baseline human exposures are calculated.

Due to the uncertainty associated with determining the true average concentration at a site, where direct measurements of the site average are unavailable, the USEPA recommends using the lower of the maximum detected concentration or the 95 percent upper confidence limit (UCL) as the concentration of a chemical to which an individual could be exposed over time (USEPA 1992). For the 95 percent UCL concentration approach, the 95 percent UCL is typically computed in order to represent the area-wide exposure point concentrations. The 95 percent UCL is defined as the value that, when calculated repeatedly for randomly drawn subsets of site data, equals or exceeds the true mean 95 percent of the time (USEPA 1992). The purpose for using the 95 percent UCL is to take into account the different concentrations a person may be exposed to on any given day. That is, an individual will be exposed to a range of concentrations that exist at an exposure area, from non-detect to the maximum concentration, over an entire exposure period.

The 95 percent UCL statistical calculations were performed using the computer statistical software program GISdT® (Neptune and Company 2007). The formulas for calculating the 95 percent UCL COPC concentration (as the representative exposure concentration) are presented in USEPA (1992, 2002b). The representativeness of the 95 percent UCLs for each exposure area, that is, a property-wide mean concentration is valid since concentrations of COPCs are primarily emanating from a sub-surface groundwater source, and localized 'hot spot' concentrations within the property are not expected. Therefore each measurement is assumed to be equally representative for that chemical at any point in the property and calculation of the 95 percent UCL is appropriate. The soil gas representative exposure concentrations used in this screening-level indoor air health risk assessment are presented in Table 1.

Indoor Air

The flux of COPCs from the subsurface and dispersion into indoor air were estimated using the USEPA spreadsheet-based Johnson and Ettinger model (USEPA 2004). The model is based on the vapor intrusion model published by Johnson and Ettinger (1991). The Johnson and Ettinger vapor intrusion model is a screening-level model, which incorporates both convective and diffusive mechanisms for estimating the transport of chemical vapors emanating from either subsurface soils or groundwater into indoor spaces located directly above the source of contamination. The model is constructed to calculate steady-state vapor transport (infinite source). Maximum detected VOCs concentrations in soil gas were used as representative exposure concentrations for the indoor air exposure pathway. The default physical properties and building characteristics contained in the USEPA Johnson and Ettinger model were used in

this evaluation. These values are presented in Table 2. Table 3 presents the indoor air concentrations predicted by the Johnson and Ettinger model for each of the COPCs.

Risk Assessment Methodology

The method used in the screening-level indoor air health risk assessment consists of several steps. The first step is the calculation of exposure point concentrations representative of the particular area (see above). The second step is fate and transport modeling to predict concentrations that may be present when direct measurements are not available. The third step is the exposure assessment for the various receptors present in the particular areas. The next step is to define the toxicity values for each COPC. The final step is risk characterization where theoretical upper-bound ILCRs and non-cancer HIs are calculated. The *BRC Closure Plan* (BRC, ERM, and DBSA 2007) provides a full discussion on the risk assessment methodology for the project, and used in this screening-level indoor air health risk assessment.

Table 2 presents each of the exposure parameters used in the screening-level indoor air health risk assessment. Toxicity values, when available, are published by the USEPA in the on-line Integrated Risk Information System (IRIS; USEPA 2008) and the Health Effects Assessment Summary Tables (HEAST; USEPA 1997). Unit risk factors (URFs) are chemical-specific, experimentally-derived potency values used to calculate the risk of cancer resulting from exposure to carcinogenic chemicals. A higher value implies a more potent carcinogen. Reference concentrations (RfCs) are experimentally derived "no-effect" values used to quantify the extent of adverse non-cancer health effects from exposure to chemicals. Here, a lower RfC implies a more potent toxicant. These criteria are generally developed by USEPA risk assessment work groups and listed in USEPA risk assessment guidance documents and databases. The hierarchy for selecting toxicity criteria presented in the *BRC Closure Plan* (BRC, ERM, and DBSA 2007) was used.

Uncertainty Analysis

Risk estimates are values that have uncertainties associated with them. These uncertainties, which arise at every step of a risk assessment, are evaluated to provide an indication of the uncertainty associated with a risk estimate. Risk assessments are not intended to estimate the true risk to a receptor associated with exposure to chemicals in the environment. In fact, estimating the true risk is impossible because of the variability in the exposed or potentially exposed populations. Therefore, risk assessment is a means of estimating the probability that an adverse health effect (*e.g.*, cancer, impaired reproduction) will occur in a receptor in order to assist in

decision making regarding the protection of human health. The multitude of conservative assumptions used in risk assessments guard against underestimation of risks.

Risk estimates are calculated by combining site data, assumptions about individual receptor's exposures to impacted media, and toxicity data. The uncertainties in this screening-level indoor air health risk assessment can be grouped into four main categories that correspond to these steps:

- Uncertainties in environmental sampling and analysis
- Uncertainties in fate and transport modeling
- Uncertainties in assumptions concerning exposure scenarios
- Uncertainties in toxicity data and dose-response extrapolations

Additional discussion on the uncertainties associated with the screening-level indoor air health risk assessment is provided below.

The screening-level indoor air health risk assessment for the property was based on the sampling results obtained from an soil gas investigation conducted in 2008. Errors in sampling results can arise from the field sampling, laboratory analyses, and data analyses. Errors in laboratory analysis procedures are possible, although the impacts of these sorts of errors on the risk estimates are likely to be low. The environmental sampling at the property is one source of uncertainty in the evaluation. However, the number of sampling locations and events is large and widespread, and sampling was performed using approved procedures; therefore, the sampling and analysis data is sufficient to characterize the impacts and the associated potential risks.

The amount of COPCs the body absorbs may be different from the amount of a COPC contacted. In this screening-level indoor air health risk assessment, absorption of inhaled COPCs is conservatively assumed to be 100 percent. Actual chemical and site specific values are likely less than this default value.

Toxicity criteria have not been established for many of the chemicals detected at the property. These chemicals were not quantitative evaluated in the screening-level indoor air health risk assessment. Thus, the risks presented in this assessment could be underestimated as a result.

The selection of exposure pathways is a process, often based on best professional judgement, which attempts to identify the most probable potentially harmful exposure scenarios. In a risk

assessment it is possible that risks are not calculated for all of the exposure pathways that may occur, possibly causing some underestimation of risk. In this assessment, risks were estimated for one receptor; future on-site indoor commercial workers. Risks for the most likely route of exposure to future on-site indoor commercial workers were estimated. Specifically, risks to future on-site indoor commercial workers were estimated for inhalation of indoor air. Although it is possible that other exposure routes could exist, these exposures are expected to be lower than the risks associated with the pathway considered.

Uncertainties from different sources are compounded in the screening-level indoor air health risk assessment. For example, if a person's daily intake rate for a chemical is compared to an RfC to determine potential health risks, the uncertainties in the concentration measurements, exposure assumptions, and toxicities will all be expressed in the result. Because the exposure assumptions and toxicity criteria are considered conservative, the risk estimates calculated in this screening-level indoor air health risk assessment are likely to overestimate rather than underestimate potential risks.

Screening-Level Indoor Air Health Risk Assessment Results

This screening-level indoor air health risk assessment has evaluated potential risks to human health associated with chemicals detected in soil gas at the Tronox Parcels A and B property. The calculation of chemical theoretical upper-bound ILCRs and non-cancer health effects are presented in Table 4. All calculation spreadsheets for this screening-level indoor air health risk assessment are included in Attachment A.

The total cumulative non-cancer HI for future on-site indoor commercial workers at the property is 0.01, which is below the target HI of 1.0. Therefore, because the total cumulative HI is below 1.0, the potential for adverse health effects is considered unlikely.

The theoretical upper-bound ILCR for future on-site indoor commercial workers at the property is 4×10^{-6}. The risks are primarily driven by chloroform, which contributes 95 percent of the theoretical upper-bound ILCR. Although the ILCR is above the risk goal of 1×10^{-6}, it is within the acceptable risk range from 10^{-6} to 10^{-4}. Therefore, these results indicate that future receptor exposures at the property should not result in unacceptable carcinogenic risks.

Summary

Based on the results of the 2008 soil gas investigation, this data review, and the screening-level indoor air health risk assessment, concentration levels of chemicals in soil gas at the Tronox

Parcels A and B property are not at levels of concern for human health risk for an indoor commercial scenario. In summary, BEC concludes that an NFAD for the property is further supported by these results.

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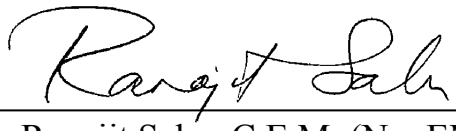
Attachments: Figure 1 – Tronox Parcels A/B Phase B Soil Gas Sample Locations
Table 1 – Chemicals of Potential Concern and Representative Exposure Concentrations in Soil Gas Table 2 – Johnson and Ettinger Model Input Parameters
Table 3 – Model Estimated Indoor Air Concentrations
Table 4 –Screening-Level Indoor Air Health Risk Assessment Results
Attachment A – Screening-Level Indoor Air Health Risk Assessment Calculation Spreadsheets (on CD)

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



November 13, 2008

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2009) Date
BRC Project Manager

FIGURE

Tronox Parcels A/B Boundary

Soil Gas Sample Locations

- Location within Parcels A/B
- Other Sample Location

BEC / Tronox Parcels A/B Data Review
BMI Common Areas, Henderson, Nevada

FIGURE 1

TRONOX PARCELS A/B
PHASE B SOIL GAS
SAMPLE LOCATIONS

Basic Environmental COMPANY

Prepared by:	Date	JOB No. 0069073
MKJ	11/03/08	FILE: GIS/BEC/TRONOX_AB/FIGURE_1.MXD

TABLES

TABLE 1
CHEMICALS OF POTENTIAL CONCERN AND REPRESENTATIVE EXPOSURE CONCENTRATIONS IN SOIL GAS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Number of Samples	Number of Detections	Frequency of Detects	Minimum DL	Maximum DL	Minimum Detection	Median[a]	Mean[a]	Maximum Detection	95% UCL	EPC
1,1,1-Trichloroethane	9	0	0%	0.15	0.17	--	0.08	0.079	--	--	--
1,1,2,2-Tetrachloroethane	9	0	0%	0.15	0.17	--	0.08	0.079	--	--	--
1,1,2-Trichloroethane	9	1	11%	0.15	0.17	0.12	0.08	0.083	0.12	0.093	0.093
1,1,2-Trichlorotrifluoroethane	9	9	100%	--	--	0.45	0.49	0.5	0.63	0.55	0.55
1,1-Dichloroethane	9	7	78%	0.15	0.16	0.11	0.41	8	27	15.6	15.6
1,1-Dichloroethene	9	2	22%	0.15	0.17	0.1	0.08	0.086	0.12	0.097	0.097
1,2,4-Trichlorobenzene	9	3	33%	0.15	0.17	0.2	0.08	0.21	0.75	0.37	0.37
1,2,4-Trimethylbenzene	9	9	100%	--	--	0.12	0.37	0.87	3.5	1.8	1.8
1,2-Dibromo-3-chloropropane	9	0	0%	0.74	0.85	--	0.39	0.4	--	--	--
1,2-Dichlorobenzene	9	0	0%	0.15	0.17	--	0.08	0.079	--	--	--
1,2-Dichloroethane	9	3	33%	0.15	0.16	0.32	0.08	0.27	1.1	0.56	0.56
1,2-Dichloropropane	9	4	44%	0.15	0.17	0.085	0.085	0.13	0.47	0.25	0.25
1,2-Dichlorotetrafluoroethane	9	5	56%	0.77	0.85	0.085	0.1	0.23	0.1	0.33	0.1
1,3,5-Trimethylbenzene	9	5	56%	0.77	0.85	0.09	0.385	0.49	1.9	0.99	0.99
1,3-Dichlorobenzene	9	3	33%	0.15	0.17	0.098	0.085	0.12	0.32	0.19	0.19
1,4-Dichlorobenzene	9	9	100%	--	--	0.31	0.84	8	43	21.1	21.1
1,4-Dioxane	9	5	56%	0.77	0.85	0.14	0.385	0.29	0.39	0.37	0.37
2-Butanone	9	9	100%	--	--	4.6	7	7.3	13	9.1	9.1
2-Hexanone	9	9	100%	--	--	0.26	0.43	0.42	0.52	0.46	0.46
2-Methoxy-2-methyl-butane	9	0	0%	0.74	0.85	--	0.39	0.4	--	--	--
4-Ethyltoluene	9	6	67%	0.77	0.85	0.11	0.385	0.41	1.5	0.77	0.77
4-Isopropyltoluene	9	7	78%	0.77	0.85	0.13	0.385	0.8	4.4	1.8	1.8
4-Methyl-2-pentanone	9	9	100%	--	--	0.14	0.29	1.3	9.2	4.2	4.2
Acetone	9	7	78%	15	24	12	18	21	50	30.9	30.9
Acrylonitrile	9	3	33%	0.77	0.85	0.11	0.385	0.31	0.12	0.40	0.12
Allyl chloride	9	1	11%	0.15	0.17	0.17	0.08	0.089	0.17	0.11	0.11
alpha-Methylstyrene	9	4	44%	0.74	0.85	0.13	0.39	1.1	7.7	3.6	3.6
Benzene	9	9	100%	--	--	1.2	1.9	1.9	2.7	2.2	2.2
Benzyl Chloride	9	0	0%	0.15	0.17	--	0.08	0.079	--	--	--
Bromodichloromethane	9	6	67%	0.16	0.17	0.098	0.18	0.22	0.67	0.38	0.38
Bromoform	9	1	11%	0.74	0.85	0.27	0.39	0.39	0.27	0.41	0.27
Bromomethane	9	1	11%	0.15	0.17	0.11	0.08	0.082	0.11	0.091	0.091
Carbon disulfide	9	7	78%	1.1	1.4	1.5	2	4.9	14	8.2	8.2

TABLE 1
CHEMICALS OF POTENTIAL CONCERN AND REPRESENTATIVE EXPOSURE CONCENTRATIONS IN SOIL GAS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Number of Samples	Number of Detections	Frequency of Detects	Minimum DL	Maximum DL	Minimum Detection	Median[a]	Mean[a]	Maximum Detection	95% UCL	EPC
Carbon tetrachloride	9	9	100%	--	--	0.25	0.39	3	11	5.8	5.8
Chlorobenzene	9	3	33%	0.15	0.17	0.16	0.08	0.12	0.31	0.18	0.18
Chloroethane	9	7	78%	0.15	0.16	0.14	0.87	3.1	11	5.9	5.9
Chloroform	9	9	100%	--	--	8.6	34	140	440	259	259
Chloromethane	9	1	11%	0.15	0.17	0.076	0.08	0.079	0.076	0.082	0.076
cis-1,2-Dichloroethene	9	2	22%	0.15	0.17	0.15	0.08	1.5	13	5.8	5.8
cis-1,3-Dichloropropene	9	0	0%	0.74	0.85	--	0.39	0.4	--	--	--
Dibromochloromethane	9	1	11%	0.15	0.17	0.12	0.08	0.084	0.12	0.094	0.094
Dichlorodifluoromethane	9	9	100%	--	--	1.8	2	2	2.1	2.1	2.1
Ethanol	9	9	100%	--	--	2.3	11	14	32	20.5	20.5
Ethyl t-butyl ether	9	0	0%	0.74	0.85	--	0.39	0.4	--	--	--
Ethylbenzene	9	7	78%	0.77	0.85	0.1	0.385	0.44	1.2	0.70	0.70
Ethylene dibromide	9	0	0%	0.15	0.17	--	0.08	0.079	--	--	--
Hexachlorobutadiene	9	5	56%	0.15	0.17	0.49	0.49	0.66	2.4	1.2	1.2
isopropyl ether	9	0	0%	0.74	0.85	--	0.39	0.4	--	--	--
Isopropylbenzene	9	3	33%	0.74	0.85	0.088	0.385	0.31	0.19	0.40	0.19
m,p-Xylene	9	8	89%	0.77	0.77	0.22	0.8	1.4	5.9	2.8	2.8
Methyl methacrylate	9	1	11%	0.74	0.85	0.42	0.39	0.4	0.42	0.41	0.41
Methyl tert butyl ether	9	6	67%	0.15	0.16	0.1	0.33	1.4	7.8	3.7	3.7
Methylene chloride	9	8	89%	0.77	0.77	0.23	0.63	1.2	3.7	2.0	2.0
Naphthalene	9	9	100%	--	--	0.42	0.83	1.2	4.2	2.1	2.1
N-Butylbenzene	9	9	100%	--	--	0.12	0.26	0.31	0.68	0.44	0.44
n-Heptane	9	6	67%	0.77	0.85	0.24	0.425	0.42	0.72	0.52	0.52
n-Octane	9	4	44%	0.77	0.85	0.23	0.385	0.49	1.5	0.86	0.86
N-Propylbenzene	9	5	56%	0.77	0.85	0.084	0.385	0.31	0.52	0.41	0.41
o-Xylene	9	7	78%	0.77	0.85	0.12	0.42	0.61	2.1	1.1	1.1
sec-Butylbenzene	9	1	11%	0.74	0.85	0.097	0.385	0.36	0.097	0.43	0.10
Styrene	9	5	56%	0.77	0.85	0.16	0.385	0.38	0.6	0.45	0.45
t-Butyl alcohol	9	9	100%	--	--	0.2	0.45	0.44	0.67	0.53	0.53
tert-Butylbenzene	9	1	11%	0.29	0.34	0.14	0.155	0.16	0.14	0.16	0.14
Tetrachloroethene	9	9	100%	--	--	1.1	5.3	7.4	30	13.8	13.8
Toluene	9	9	100%	--	--	1.2	2	4.4	19	9.8	9.8
trans-1,2-Dichloroethylene	9	0	0%	0.15	0.17	--	0.08	0.079	--	--	--

TABLE 1
CHEMICALS OF POTENTIAL CONCERN AND REPRESENTATIVE EXPOSURE CONCENTRATIONS IN SOIL GAS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Number of Samples	Number of Detections	Frequency of Detects	Minimum DL	Maximum DL	Minimum Detection	Median[a]	Mean[a]	Maximum Detection	95% UCL	EPC
trans-1,3-Dichloropropene	9	0	0%	0.74	0.85	--	0.39	0.4	--	--	--
Trichloroethene	9	9	100%	--	--	0.96	1.3	6.5	42	19.4	19.4
Trichlorofluoromethane	9	9	100%	--	--	0.95	1.1	1.1	1.4	1.2	1.2
Vinyl acetate	9	7	78%	7.7	7.8	0.99	3.5	3.4	5	4.2	4.2
Vinyl chloride	9	2	22%	0.15	0.16	0.12	0.08	0.087	0.12	0.099	0.099

Note: All units in $\mu g/m^3$.
a - Includes both detect values and non-detect values, with one-half the DL used for non-detect values.
DL = detection limit
UCL = upper confidence limit
EPC = exposure point concentration
-- = Not applicable or statistic not evaluated because all results were non-detect..

TABLE 2
JOHNSON AND ETTINGER MODEL INPUT PARAMETERS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Parameter	Value	Reference/Rationale
Depth below grade to bottom of enclosed floor space (cm)	15	Model default (slab on grade)
Average soil temperature (°C)	10	Model default
Soil gas sampling depth (cm)	200	Site-specific (five feet bgs)
Thickness of soil stratum (cm)	200	Site-specific (five feet bgs)
Soil stratum used to calculate soil vapor permeability	S	Sand
Vadose zone dry bulk density (g/cm^3)	1.66	Model default
Vadose zone total porosity (unitless)	0.375	Model default
Vadose zone water-filled porosity (unitless)	0.054	Model default
Enclosed space floor thickness (cm)	15	Model default
Soil-building pressure differential ($g/cm\text{-}s^2$)	40	Model default
Enclosed space floor length (cm)	1,000	Model default
Enclosed space floor width (cm)	1,000	Model default
Modeling Enclosed space height (cm)	244	Model default
Floor-wall seam crack width (cm)	0.1	Model default
Average vapor flow rate into building, Qsoil (L/m)	5	Model default
Indoor air exchange rate (1/hr)	0.25	Model default
Exposure duration (yrs)	25	Model default (commercial)
Exposure frequency (days/yr)	250	Model default (commercial)
Averaging time for carcinogens (yrs)	70	Model default (commercial)
Averaging time for non-carcinogens (yrs)	25	Model default (commercial)

TABLE 3
MODEL ESTIMATED INDOOR AIR CONCENTRATIONS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Predicted Indoor Air Concentration ($\mu g/m^3$)[1]
1,1,2-Trichloroethane	2.1 E-4
1,1,2-Trichlorotrifluoroethane	1.2 E-3
1,1-Dichloroethane	3.4 E-2
1,1-Dichloroethene	2.3 E-4
1,2,4-Trichlorobenzene	4.3 E-4
1,2,4-Trimethylbenzene	3.4 E-3
1,2-Dichloroethane	1.4 E-3
1,2-Dichloropropane	5.6 E-4
1,2-Dichlorotetrafluoroethane	2.2 E-4
1,3,5-Trimethylbenzene	1.9 E-3
1,3-Dichlorobenzene	3.9 E-4
1,4-Dichlorobenzene	4.4 E-2
1,4-Dioxane	9.3 E-4
2-Butanone	2.0 E-2
2-Hexanone	1.5 E-3
4-Ethyltoluene	1.8 E-3
4-Isopropyltoluene	3.3 E-3
4-Methyl-2-pentanone	9.2 E-3
Acetone	8.6 E-2
Acrylonitrile	3.3 E-4
Allyl chloride	3.0 E-4
alpha-Methylstyrene	1.3 E-2
Benzene	5.2 E-3
Bromodichloromethane	4.4 E-4
Bromoform	1.8 E-4
Bromomethane	1.9 E-4
Carbon disulfide	2.1 E-2
Carbon tetrachloride	1.3 E-2
Chlorobenzene	3.7 E-4
Chloroethane	2.1 E-2
Chloroform	6.6 E-1
Chloromethane	2.1 E-4
cis-1,2-Dichloroethene	1.2 E-2
Dibromochloromethane	7.9 E-5
Dichlorodifluoromethane	4.2 E-3
Ethanol	5.6 E-2
Ethylbenzene	1.5 E-3
Hexachlorobutadiene	2.1 E-3
Isopropylbenzene	3.8 E-4
m,p-Xylene	5.7 E-3
Methyl methacrylate	9.1 E-4
Methyl tert butyl ether	9.4 E-3
Methylene chloride	4.9 E-3
Naphthalene	3.9 E-3
N-Butylbenzene	8.1 E-4
n-Heptane	1.7 E-3
n-Octane	1.9 E-3
N-Propylbenzene	7.7 E-4
o-Xylene	2.6 E-3

TABLE 3
MODEL ESTIMATED INDOOR AIR CONCENTRATIONS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Predicted Indoor Air Concentration ($\mu g/m^3$)[1]
sec-Butylbenzene	1.8 E-4
Styrene	9.4 E-4
t-Butyl alcohol	1.3 E-3
tert-Butylbenzene	2.6 E-4
Tetrachloroethene	2.9 E-2
Toluene	3.2 E-2
Trichloroethene	4.3 E-2
Trichlorofluoromethane	2.9 E-3
Vinyl acetate	9.7 E-3
Vinyl chloride	2.6 E-4

[1] - Calculated using the J&E Model (included on CD).

TABLE 4
SCREENING-LEVEL INDOOR AIR HEALTH RISK ASSESSMENT RESULTS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA
(Page 1 of 2)

Chemical	Non-Cancer Reference Concentration (mg/kg-d)	Unit Risk Factor $(mg/kg\text{-}d)^{-1}$	J&E Predicted Conc.[a]	Non-Cancer Hazard Index	Incremental Lifetime Cancer Risk
1,1,2-Trichloroethane	1.4 E-2	1.6 E-5	2.1 E-4	0.00001	8 E-10
1,1,2-Trichlorotrifluoroetl	3.0 E+1	NA	1.2 E-3	0.00000003	NA
1,1-Dichloroethane	7.0 E-1	NA	3.4 E-2	0.00003	NA
1,1-Dichloroethene	2.0 E-1	NA	2.3 E-4	0.0000008	NA
1,2,4-Trichlorobenzene	4.0 E-3	NA	4.3 E-4	0.00007	NA
1,2,4-Trimethylbenzene	7.0 E-3	NA	3.4 E-3	0.0003	NA
1,2-Dichloroethane	4.9 E-3	2.6 E-5	1.4 E-3	0.0002	9 E-9
1,2-Dichloropropane	4.0 E-3	1.9 E-5	5.6 E-4	0.0001	3 E-9
1,2-Dichlorotetrafluoroetl	NA	NA	2.2 E-4	NA	NA
1,3,5-Trimethylbenzene	6.0 E-3	NA	1.9 E-3	0.0002	NA
1,3-Dichlorobenzene	8.0 E-3	NA	3.9 E-4	0.00003	NA
1,4-Dichlorobenzene	8.0 E-1	6.9 E-6	4.4 E-2	0.00004	7 E-8
1,4-Dioxane	NA	3.1 E-6	9.3 E-4	NA	7 E-10
2-Butanone	5.0 E+0	NA	2.0 E-2	0.000003	NA
2-Hexanone	NA	NA	1.5 E-3	NA	NA
4-Ethyltoluene	NA	NA	1.8 E-3	NA	NA
4-Isopropyltoluene	NA	NA	3.3 E-3	NA	NA
4-Methyl-2-pentanone	3.0 E+0	NA	9.2 E-3	0.000002	NA
Acetone	3.2 E+0	NA	8.6 E-2	0.00002	NA
Acrylonitrile	2.0 E-3	6.8 E-5	3.3 E-4	0.0001	6 E-9
Allyl chloride	1.0 E-3	NA	3.0 E-4	0.0002	NA
alpha-Methylstyrene	4.0 E-2	NA	1.3 E-2	0.0002	NA
Benzene	3.0 E-2	7.8 E-6	5.2 E-3	0.0001	1 E-8
Bromodichloromethane	7.0 E-2	1.8 E-5	4.4 E-4	0.000004	2 E-9
Bromoform	7.0 E-2	1.1 E-6	1.8 E-4	0.000002	5 E-11
Bromomethane	5.0 E-3	NA	1.9 E-4	0.00003	NA
Carbon disulfide	7.0 E-1	NA	2.1 E-2	0.00002	NA
Carbon tetrachloride	NA	1.5 E-5	1.3 E-2	NA	5 E-8
Chlorobenzene	5.0 E-2	NA	3.7 E-4	0.000005	NA
Chloroethane	1.0 E+1	8.3 E-7	2.1 E-2	0.000001	4 E-9
Chloroform	4.5 E-2	2.3 E-5	6.6 E-1	0.01	4 E-6
Chloromethane	9.0 E-2	NA	2.1 E-4	0.000002	NA
cis-1,2-Dichloroethene	3.5 E-2	NA	1.2 E-2	0.0002	NA
Dibromochloromethane	7.0 E-2	2.4 E-5	7.9 E-5	0.0000008	5 E-10
Dichlorodifluoromethane	2.0 E-1	NA	4.2 E-3	0.00001	NA
Ethanol	NA	NA	5.6 E-2	NA	NA
Ethylbenzene	1.0 E+0	NA	1.5 E-3	0.000001	NA
Hexachlorobutadiene	NA	2.2 E-5	2.1 E-3	NA	1 E-8
Isopropylbenzene	4.0 E-1	NA	3.8 E-4	0.0000006	NA
m,p-Xylene	1.0 E-1	NA	5.7 E-3	0.00004	NA
Methyl methacrylate	7.0 E-1	NA	9.1 E-4	0.0000009	NA
Methyl tert butyl ether	3.0 E+0	NA	9.4 E-3	0.000002	NA
Methylene chloride	NA	4.7 E-7	4.9 E-3	NA	6 E-10
Naphthalene	3.0 E-3	NA	3.9 E-3	0.0009	NA
N-Butylbenzene	1.4 E-1	NA	8.1 E-4	0.000004	NA
n-Heptane	NA	NA	1.7 E-3	NA	NA
n-Octane	NA	NA	1.9 E-3	NA	NA
N-Propylbenzene	1.4 E-1	NA	7.7 E-4	0.000004	NA
o-Xylene	1.0 E-1	NA	2.6 E-3	0.00002	NA

TABLE 4
SCREENING-LEVEL INDOOR AIR HEALTH RISK ASSESSMENT RESULTS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Non-Cancer Reference Concentration (mg/kg-d)	Unit Risk Factor $(mg/kg\text{-}d)^{-1}$	J&E Predicted Conc.[a]	Non-Cancer Hazard Index	Incremental Lifetime Cancer Risk
sec-Butylbenzene	1.4 E-1	NA	1.8 E-4	0.0000009	NA
Styrene	1.0 E+0	NA	9.4 E-4	0.0000006	NA
t-Butyl alcohol	NA	NA	1.3 E-3	NA	NA
tert-Butylbenzene	1.4 E-1	NA	2.6 E-4	0.000001	NA
Tetrachloroethene	6.0 E-1	5.9 E-6	2.9 E-2	0.00003	4 E-8
Toluene	5.0 E+0	NA	3.2 E-2	0.000004	NA
Trichloroethene	4.0 E-2	1.1 E-4	4.3 E-2	0.000004	NA
Trichlorofluoromethane	7.0 E-1	NA	2.9 E-3	0.000003	NA
Vinyl acetate	2.0 E-1	NA	9.7 E-3	0.00003	NA
Vinyl chloride	1.0 E-1	4.4 E-6	2.6 E-4	0.000002	3 E-10
			Total	0.01	4 E-6

[a]From Table 3; concentration is in $\mu g/m^3$.

NA - Toxicity criteria has not been established.

ATTACHMENT A

SCREENING-LEVEL INDOOR AIR HEALTH RISK ASSESSMENT CALCULATION SPREADSHEETS (ON CD)

Tab 4

Nevada Division of Environmental Protection (NDEP) Response to: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Dated November 13, 2008

December 22, 2008

ndep
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Jim Gibbons, Governor
Allen Biaggi, Director
Leo M. Drozdoff, P.E., Administrator

December 22, 2008

Susan Crowley (Contractor)
C/O Tronox LLC
PO Box 55
Henderson, NV 89009

Re: **Tronox LLC (TRX)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection (NDEP) Response to:
Technical Memorandum – Screening Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation
Dated November 13, 2008

Dear Ms. Crowley,

The NDEP has received and reviewed TRX's report identified above and provides comments in Attachment A. The revised report should include a fully annotated response-to-comments (RTC), a red-line strike-out version of the report, and a revised report.

Please contact the undersigned with any questions at brakvica@ndep.nv.gov or (702) 486-2850 extension 247.

Sincerely,

Brian Rakvica, P.E.
Supervisor
Bureau of Corrective Actions
Special Projects Branch
NDEP-Las Vegas Office

BAR:s

CC: Jim Najima, NDEP, BCA, Carson City
Shannon Harbour, NDEP, BCA, Las Vegas
Keith Bailey, Environmental Answers LLC, 3229 Persimmon Creek Drive, Edmond, OK 73013
Mike Skromyda, Tronox LLC, PO Box 55, Henderson, NV 89009
Barry Conaty, Holland & Hart LLP, 975 F Street, N.W. Suite 900, Washington, D.C. 20004
Brenda Pohlmann, City of Henderson, PO Box 95050, Henderson, NV 89009
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Ebrahim Juma, DAQEM, PO Box 551741, Las Vegas, NV, 89155-1741
Ranajit Sahu, BRC, 311 North Story Place, Alhambra, CA 91801
Rick Kellogg, BRC, 875 West Warm Springs, Henderson, NV 89011
Mark Paris, Landwell, 875 West Warm Springs, Henderson, NV 89011
Craig Wilkinson, TIMET, PO Box 2128, Henderson, Nevada, 89009-7003
Kirk Stowers, Broadbent & Associates, 8 West Pacific Avenue, Henderson, Nevada 89015
George Crouse, Syngenta Crop Protection, Inc., 410 Swing Road, Greensboro, NC 27409
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Lee Erickson, Stauffer Management Company, P.O. Box 18890, Golden, CO 80402
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Curt Richards, Olin Corporation, 3855 North Ocoee Street, Suite 200, Cleveland, TN 37312
Paul Sundberg, Montrose Chemical Corporation, 3846 Estate Drive, Stockton, California 95209
Joe Kelly, Montrose Chemical Corporation of CA, 600 Ericksen Avenue NE, Suite 380, Bainbridge Island, WA 98110
Paul Black, Neptune and Company, Inc., 8550 West 14th Street, Suite 100, Lakewood, CO 80215
Kelly Black, Neptune and Company, Inc., 8550 West 14th Street, Suite 100, Lakewood, CO 80215

Attachment A

1. General comments, the NDEP has the following general comments regarding the subject document:
    a. The subject document in general and the CSM in particular make no reference to the Phase 2 Investigation on Parcels A and B.
    b. Shallow soil samples have been collected at other locations at the BMI Industrial Complex and analyzed for physical properties. BRC should explore how the default Johnson and Ettinger (J&E) model values compare to the data collected either on Parcels A & B or in the general area. For the soil gas calculations particular attention should be paid to the soil moisture content.
    c. The subject document does not adequately describe the modeling work that was performed.
    d. The NDEP's review of the subject document would be aided by the addition of Section numbers.
    e. It appears that the data used in this assessment may have been reported with non-detects shown at their reporting limits rather than their detection limits. For example, for 1,1,2-TCA there are eight non-detects reported between 0.15 ug/m3 and 0.17 ug/m3. There is one detected value reported with a J flag at 0.12 ug/m3. Looking through the remainder of the dataset (beyond the nine samples used in these analyses), it appears that detects are quite often reported below the non-detect levels. This is usually an indication that the non-detects are being reported at a reporting limit rather than a method or instrument detection limit. That practice causes substantial overestimation of concentrations when the frequency of detection is low.
2. Introduction, page 1, the data validation summary report (DVSR) for the soil gas should be appropriately referenced. In addition, all referenced reports should denote their approval status.
3. Selection of Chemicals of Potential Concern, page 3, all chemicals that were not detected in soil gas at the site were eliminated from further consideration. This is an acceptable approach when it is accompanied by some consideration of whether reasonable detection limits were achieved for such chemicals. Without that information it is impossible to know if it is acceptable to eliminate those chemicals. This information may be in the DVSR that is referenced in the Introduction, if so, that is adequate, however, so additional explanation would be helpful. Please clarify.
4. Determination of Exposure Point Concentrations, pages 3 through 5
    a. Please note that the United States Environmental Protection Agency (USEPA) actually encourages that both a central tendency estimate (CTE) and a reasonable maximum estimate (RME) be used to help account for the uncertainties associated with determining risk. It is fine in this case for TRX to use only an RME, but the wording of this paragraph is a bit confusing.
    b. Indoor Air, page 4, TRX states "Maximum detected VOCs concentrations in soil gas were used as representative exposure concentrations for the indoor air exposure pathway." The J&E spreadsheet calculations used the 95 percent UCL values not the maximum. This inconsistency needs to be rectified.

   a. Page 4, 1st paragraph, in the final sentence, "non-detect" isn't quite the right term to use. NDEP suggests that TRX use the term "minimum" in place of "non-detect".
5. Uncertainty Analysis, page 5, the NDEP has the following comments:
   a. TRX states "The environmental sampling at the property is one source of uncertainty in the evaluation. However, the number of sampling locations and events is large and widespread…" Please note that nine samples within Parcels A and B would not be considered "large", however, this may be "adequate".
   b. The uncertainty analysis should discuss the fact the screening level indoor risk assessment used default values for a residential scenario while the assessment was intended for a commercial use scenario.3
6. Screening-Level Indoor Air Health Risk Assessment Results and Summary, page 7, the results of the previous screening-level health risk assessment for Parcels A and B should be mentioned in this summary. The soil gas assessment for indoor air was intended to fill a gap in that assessment. These results on their own, without combining the potentially additive risks, do not provide an adequate assessment of the potential risks to a commercial worker on this site.
7. Table 1, TRX needs to review this table for issues with significant figures.
   a. Upon close inspection, the main issue seems only to occur with trailing zeros. For example, the data are presented with two significant digits, but 8.0 is shown as 8, and .50 is shown as .5.
   b. NDEP also notes that three significant figures were reported for some medians (e.g., 1,4-Dioxane) although the reported value in the data files contains only two significant figures (0.39 in the data file and 0.385 in Table 1).
   c. Finally, another case where three significant figures were used was for the Chloroform UCL, which should clearly only have two significant figures since it is calculated from data that contain only two significant figures.
8. Table 2, the NDEP has the following comments:
   a. Please note that average soil temperature is not intended to be a default value.
      i. The average soil temperature of 10°C appears low for Las Vegas which has a mean annual temperature of approximately 20°C.
   b. Was the soil type used (sand) based on site-specific data? There are no text references in this regard.
      i. The NDEP is accepts the default soil physical properties provided the soil type is site-specific.
   c. Exposure duration, exposure frequency, and averaging time for non-carcinogens values employed are not J&E Model default values.
9. Table 4, several of the chemical names were truncated.
10. J&E Model Spreadsheets
   a. Chemical Properties Lookup Table, Vlookup Tab. References were not provided for updated information and for the chemicals added to the table.
   b. DataEnter sheets were provided even when the chemical was non-detect (ND) in all nine samples. Chemical Group 1, for example, includes input sheets1,1,1-TCA and 1,2-DCB but the chemicals were not detected.
   c. J&E model calculations were checked for one chemical from each of the four chemical groups as follows:

i. Group 1 – 1,4-DCB
ii. Group 2 – benzene
iii. Group 3 – chloroform
iv. Group 4 – PCE
v. NDEP comments are provided below for each of these compounds.

d. Group 1
   i. DataEnter 1,4-Dioxane – the CAS number appears correct but the chemical reported at I12 (spreadsheet location) is Crotonaldehyde (2-butenal)? The problem is that TRX added chemicals to the *Chemical Properties Lookup Table*; but did not sort the table (lowest to highest CAS number). Hence the VLOOKUP formula in cell I12 does not work properly in the files provided. This problem can be solved in one of two ways:
      1. Simply sort the VLOOKUP table in ascending order after adding new chemicals to the list, or
      2. Modify the formula in cell I12 as follows by adding argument FALSE (highlighted yellow):
         IF(ISERROR(MATCH(E12,CAS_No,0)),"CAS No. not found",VLOOKUP(E12,Chemical_Data,2,FALSE))
         a. By adding this argument the table need not be in ascending order.
   ii. The NDEP sorted the VLOOKUP table and the formula worked properly.
      1. This operation was performed for the VLOOKUP table for each of the four chemical groups
   iii. Various factors (*e.g.*, RfC and URF) were updated but no references for this information were provided.

e. Groups 2 through 4
   i. This set of spreadsheets contains the same error as noted above.
   ii. Various factors (*e.g.*, RfC and URF) were updated but no references for this information were provided.

Tab 5

Basic Environmental Company (BEC) Technical Memorandum Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation BMI Industrial Complex, Clark County, Nevada

BEC Response to NDEP Comments Dated December 22, 2008 on the Technical Memorandum Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Dated November 13, 2008

March 30, 2010

Basic Environmental
COMPANY

TECHNICAL MEMORANDUM

To: Shannon Harbour (NDEP)

From: Ranajit Sahu (BEC)

cc: Brian Rakvica (NDEP)
Jim Najima (NDEP)
Teri Copeland
Paul Black (Neptune and Co.)

Date: March 30, 2010

Subject: Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada

1.0 Introduction

The objective of this Technical Memorandum is to present the results of a screening-level indoor air health risk assessment for the Phase 2 soil gas investigation Basic Environmental Company (BEC) and Tronox performed for the Tronox Parcels "A" and "B" (portions of APN Nos. 178-01-401-001, 178-12-101-002, and 178-12-201-006 [Note: Parcel 178-12-601-005, formerly part of Tronox Parcel B, has been sold and is excluded from this analysis]). Parcels A and B will collectively be referred to as the property for the purposes of this Technical Memorandum. The property is located north of Warm Springs Road, 1/4 mile west of the intersection with Boulder Highway, in Henderson, Nevada. Figure 1 shows details of Parcels A and B and the soil gas sampling locations. The Technical Memorandum only presents the methods and results of the screening-level indoor air health risk assessment, and does not present investigation, data summary, data usability, or data adequacy information. This information is provided in the Nevada Division of Environmental Protection (NDEP) approved *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation* dated February 11, 2008 (BEC 2008; approved by NDEP on April 8, 2008), and the Data Validation Summary Report for the soil gas survey (Tronox 2008; approved by NDEP on October 20, 2008).

This revision of the Screening-Level Indoor Air Health Risk Assessment Technical Memorandum, Revision 1, incorporates comments received from the NDEP, dated December 22, 2008, on Revision 0 of the report, dated November 13, 2008. The NDEP comments and BRC's response to these comments are included in Attachment A. Also included in Attachment A is a redline/strikeout version of the text showing the revisions from the November 13, 2008 version of the technical memorandum.

2.0 Conceptual Site Model

The conceptual site model (CSM) is used to describe relationships between chemicals and potentially exposed human receptor populations, thereby delineating the relationships between the suspected sources of chemicals identified at the property, the mechanisms by which the chemicals might be released and transported in the environment, and the means by which the receptors could come in contact with the chemicals. The CSM provides a basis for defining data quality objectives and developing exposure scenarios.

The CSM considers current and potential future land-use conditions. Currently, the property is undeveloped. Current receptors that may use the property include on-site trespassers. Therefore, current exposures to native soils at the property are likely to be minimal. In addition, exposures to future on-site workers will be much greater than current exposures. For example, future receptors include indoor commercial workers who are assumed to be exposed to soil gas emanating from the subsurface for 250 days per year for 25 years which is much greater than any current exposures.

USEPA (1989) guidance states that potential future land use should be considered in addition to current land use when evaluating the potential for human exposure at a site. Therefore, the CSM also considers other future land-uses. For example, the CSM includes the planned use of the property for redevelopment into commercial use.

Given the planned development of the property, potential human receptors include on-site construction workers, on-site indoor commercial workers, on-site outdoor maintenance workers, and on-site visitors. Although several potential human receptors may occur on the property in the future, the screening-level health risk assessment focuses on indoor commercial workers. This receptor is considered to have the highest level of exposure at the property. Other receptors generally have lower exposures, and thus lower risk estimates. Therefore, risk estimates generated for future on-site indoor commercial workers will be protective of other potential receptors at the property.

The previous screening-level health risk assessment evaluated risks from exposure to soil. This screening-level health risk assessment is provided in the *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation* dated February 11, 2008 (BEC 2008; approved by NDEP on April 8, 2008). However, these exposures did not account for potential migration of VOCs from the subsurface into indoor air. In general USEPA does not recommend evaluating the indoor air exposure pathway using soil matrix data (USEPA 2002a). Because groundwater beneath a portion of the property is considered a potential VOC source

area, soil gas data were recently collected. These data are further evaluated and are the focus of this screening-level indoor air health risk assessment.

3.0 Screening-Level Indoor Air Health Risk Assessment

As discussed above, the previous screening-level health risk assessment did not consider the indoor air pathway. Therefore, soil gas data were collected to specifically evaluate this potential exposure pathway at the property.

Human health risks are represented by estimated theoretical upper-bound cancer risks and non-cancer hazards derived in accordance with standard USEPA methods. The acceptable risk levels defined by USEPA for the protection of human health, and following those discussed previously with NDEP, are:

1. For non-carcinogenic compounds, the acceptable criterion is a cumulative hazard index (HI) of one or less. If the screening HI is determined to be greater than 1.0, target organ-specific HIs will be calculated for primary and secondary organs. The final risk goal will be to achieve target organ-specific non-carcinogenic HIs of less than 1.0; and

2. For known or suspected chemical and radionuclide carcinogens, the acceptable ceiling for a cumulative incremental lifetime cancer risk (ILCR) ranges from 10^{-6} to 10^{-4}. The risk goal established by the NDEP is 10^{-6}.

3. Where background levels exceed risk level goals, metals and radionuclides in property soils are targeted to have risks no greater than those associated with background conditions.

This screening-level indoor air health risk assessment follows the basic procedures outlined in USEPA *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (RAGS; USEPA 1989). Other guidance documents were also consulted for the screening-level indoor air health risk assessment.

3.1 Selection of Chemicals of Potential Concern

The broad suite of analytes sampled for was the initial list of chemicals of potential concern (COPCs) at the property. However, in order to ensure that a risk assessment focuses on those substances that contribute the greatest to the overall risk (USEPA 1989); only one procedure was used to eliminate the chemicals for quantitative evaluation in the screening-level indoor air

health risk assessment: identification of chemicals that were not detected in any of the soil gas sample locations within the property.[1] That is, all chemicals that were detected in any soil gas sample within the property was considered a COPC and evaluated in the screening-level indoor air health risk assessment. The identification of those chemicals detected in soil gas samples within the property are presented in Table 1.

3.2 Determination of Exposure Point Concentrations

A representative exposure concentration is a COPC-specific and media-specific concentration value. In risk assessment, these exposure concentrations are values incorporated into the exposure assessment equations from which potential baseline human exposures are calculated. Due to the uncertainty associated with determining the true average concentration at a site, where direct measurements of the site average are unavailable, the USEPA recommends using the lower of the maximum detected concentration or the 95 percent upper confidence limit (UCL) as the concentration of a chemical to which an individual could be exposed over time (USEPA 1992). For the 95 percent UCL concentration approach, the 95 percent UCL is typically computed in order to represent the area-wide exposure point concentrations. The 95 percent UCL is defined as the value that, when calculated repeatedly for randomly drawn subsets of site data, equals or exceeds the true mean 95 percent of the time (USEPA 1992). The purpose for using the 95 percent UCL is to take into account the different concentrations a person may be exposed to on any given day. That is, an individual will be exposed to a range of concentrations that exist at an exposure area, from the minimum to the maximum concentration, over an entire exposure period.

The 95 percent UCL statistical calculations were performed using the computer statistical software program GISdT® (Neptune and Company 2009). The formulas for calculating the 95 percent UCL COPC concentration (as the representative exposure concentration) are presented in USEPA (1992, 2002b). The representativeness of the 95 percent UCLs for each exposure area, that is, a property-wide mean concentration is valid since concentrations of COPCs are primarily emanating from a sub-surface groundwater source, and localized 'hot spot' concentrations within the property are not expected. Therefore each measurement is assumed to be equally representative for that chemical at any point in the property and calculation of the

[1] For those chemicals that were not detected in any of the soil gas sample locations within the property, their detection limits were compared to shallow soil gas to indoor air vapor intrusion screening levels from USEPA (2002a), Table 2b (Generic Screening Levels and Summary Sheet; Risk = 1×10^{-5}). None had detection limits that exceeded their respective screening levels. Therefore, their exclusion should not affect the results of the evaluation.

95 percent UCL is appropriate. The soil gas representative exposure concentrations used in this screening-level indoor air health risk assessment are presented in Table 1.

3.2.1 Indoor Air

The flux of COPCs from the subsurface and dispersion into indoor air were estimated using the USEPA spreadsheet-based Johnson and Ettinger model (USEPA 2004). The model is based on the vapor intrusion model published by Johnson and Ettinger (1991). The Johnson and Ettinger vapor intrusion model is a screening-level model, which incorporates both convective and diffusive mechanisms for estimating the transport of chemical vapors emanating from either subsurface soils or groundwater into indoor spaces located directly above the source of contamination. The model is constructed to calculate steady-state vapor transport (infinite source). VOCs concentrations in soil gas used as representative exposure concentrations for the indoor air exposure pathway are presented in Table 1. Either site-specific or default physical properties and building characteristics contained in the USEPA Johnson and Ettinger model were used in this evaluation. These values are presented in Table 2. Table 3 presents the indoor air concentrations predicted by the Johnson and Ettinger model for each of the COPCs.

Where site-specific data were unavailable, the model default parameters for a sand soil were used. Parameters for a sand soil result in the most conservative indoor air estimates. Therefore, the modeling performed for the property should be considered a conservative estimate of potential indoor air risks. The modeling input parameter that considers soil moisture is the water-filled porosity, which is determined by the soil moisture content and the dry bulk density. Although there is adequate soil moisture content from the site itself, there is limited dry bulk density data for the general area; however, this information is available from the Borrow Area investigation (BRC and ERM 2007). Using an average bulk density from the Borrow Area data of 1.83 g/cm^3 and an average soil moisture content from site data of 4.92 percent results in a water-filled porosity value of 0.09. In addition, the average effective porosity (which generally equates to total porosity) for the Borrow Area investigation was 0.30. Therefore, these values (bulk density = 1.83 g/cm^3; total porosity = 0.30; water-filled porosity = 0.90) are used in the modeling effort for the property.

3.3 Risk Assessment Methodology

The method used in the screening-level indoor air health risk assessment consists of several steps. The first step is the calculation of exposure point concentrations representative of the particular area (see above). The second step is fate and transport modeling to predict concentrations that may be present when direct measurements are not available. The third step

is the exposure assessment for the various receptors present in the particular areas. The next step is to define the toxicity values for each COPC. The final step is risk characterization where theoretical upper-bound ILCRs and non-cancer HIs are calculated. The *BRC Closure Plan* (BRC, ERM, and DBSA 2007) provides a full discussion on the risk assessment methodology for the project, and used in this screening-level indoor air health risk assessment.

Table 2 presents each of the exposure parameters used in the screening-level indoor air health risk assessment. Toxicity values, when available, are published by the USEPA in the on-line Integrated Risk Information System (IRIS; USEPA 2008) and the Health Effects Assessment Summary Tables (HEAST; USEPA 1997). Unit risk factors (URFs) are chemical-specific, experimentally-derived potency values used to calculate the risk of cancer resulting from exposure to carcinogenic chemicals. A higher value implies a more potent carcinogen. Reference concentrations (RfCs) are experimentally derived "no-effect" values used to quantify the extent of adverse non-cancer health effects from exposure to chemicals. Here, a lower RfC implies a more potent toxicant. These criteria are generally developed by USEPA risk assessment work groups and listed in USEPA risk assessment guidance documents and databases. The hierarchy for selecting toxicity criteria presented in the *BRC Closure Plan* (BRC, ERM, and DBSA 2007) was used.

3.4 Uncertainty Analysis

Risk estimates are values that have uncertainties associated with them. These uncertainties, which arise at every step of a risk assessment, are evaluated to provide an indication of the uncertainty associated with a risk estimate. Risk assessments are not intended to estimate the true risk to a receptor associated with exposure to chemicals in the environment. In fact, estimating the true risk is impossible because of the variability in the exposed or potentially exposed populations. Therefore, risk assessment is a means of estimating the probability that an adverse health effect (*e.g.*, cancer, impaired reproduction) will occur in a receptor in order to assist in decision making regarding the protection of human health. The multitude of conservative assumptions used in risk assessments guard against underestimation of risks.

Risk estimates are calculated by combining site data, assumptions about individual receptor's exposures to impacted media, and toxicity data. The uncertainties in this screening-level indoor air health risk assessment can be grouped into four main categories that correspond to these steps:

- Uncertainties in environmental sampling and analysis
- Uncertainties in fate and transport modeling
- Uncertainties in assumptions concerning exposure scenarios
- Uncertainties in toxicity data and dose-response extrapolations

Additional discussion on the uncertainties associated with the screening-level indoor air health risk assessment is provided below.

The screening-level indoor air health risk assessment for the property was based on the sampling results obtained from a soil gas investigation conducted in 2008. Errors in sampling results can arise from the field sampling, laboratory analyses, and data analyses. Errors in laboratory analysis procedures are possible, although the impacts of these sorts of errors on the risk estimates are likely to be low. The environmental sampling at the property is one source of uncertainty in the evaluation. However, the sampling locations are spread across the property, and sampling was performed using approved procedures; therefore, the sampling and analysis data is sufficient to characterize the impacts and the associated potential risks.

The amount of COPCs the body absorbs may be different from the amount of a COPC contacted. In this screening-level indoor air health risk assessment, absorption of inhaled COPCs is conservatively assumed to be 100 percent. Actual chemical and site specific values are likely less than this default value.

The Johnson and Ettinger model default building characteristics assume a residential building type. However, the planned use of the property is for redevelopment into commercial use. Commercial building parameters typically result in indoor air concentrations lower than those for a residential building. For example, the recommended building air exchange rate from the California Department of Toxic Substances (DTSC; 2005) for a commercial building is 1.0 per hour versus the model default for a residential building of 0.25 per hour. This parameter alone could result in a one-fourth reduction in the indoor air concentration.

Toxicity criteria have not been established for many of the chemicals detected at the property. These chemicals were not quantitative evaluated in the screening-level indoor air health risk assessment. Thus, the risks presented in this assessment could be underestimated as a result.

The selection of exposure pathways is a process, often based on best professional judgement, which attempts to identify the most probable potentially harmful exposure scenarios. In a risk assessment it is possible that risks are not calculated for all of the exposure pathways that may

occur, possibly causing some underestimation of risk. In this assessment, risks were estimated for one receptor; future on-site indoor commercial workers. Risks for the most likely route of exposure to future on-site indoor commercial workers were estimated. Specifically, risks to future on-site indoor commercial workers were estimated for inhalation of indoor air. Although it is possible that other exposure routes could exist, these exposures are expected to be lower than the risks associated with the pathway considered.

Uncertainties from different sources are compounded in the screening-level indoor air health risk assessment. For example, if a person's daily intake rate for a chemical is compared to an RfC to determine potential health risks, the uncertainties in the concentration measurements, exposure assumptions, and toxicities will all be expressed in the result. Because the exposure assumptions and toxicity criteria are considered conservative, the risk estimates calculated in this screening-level indoor air health risk assessment are likely to overestimate rather than underestimate potential risks.

3.5 Screening-Level Indoor Air Health Risk Assessment Results

This screening-level indoor air health risk assessment has evaluated potential risks to human health associated with chemicals detected in soil gas at the Tronox Parcels A and B property. The calculation of chemical theoretical upper-bound ILCRs and non-cancer health effects are presented in Table 4. All calculation spreadsheets for this screening-level indoor air health risk assessment are included in Attachment B.

The total cumulative non-cancer HI for future on-site indoor commercial workers at the property is 0.01, which is below the target HI of 1.0. Therefore, because the total cumulative HI is below 1.0, the potential for adverse health effects is considered unlikely.

The theoretical upper-bound ILCR for future on-site indoor commercial workers at the property is 2×10^{-6}. The risks are primarily driven by chloroform, which contributes 95 percent of the theoretical upper-bound ILCR. Although the ILCR is above the risk goal of 1×10^{-6}, it is within the acceptable risk range from 10^{-6} to 10^{-4}. Therefore, these results indicate that future receptor exposures at the property should not result in unacceptable carcinogenic risks.

4.0 Summary

Based on the results of the 2008 soil gas investigation, this data review, and the screening-level indoor air health risk assessment, concentration levels of chemicals in soil gas at the Tronox Parcels A and B property are not at levels of concern for human health risk for an indoor

commercial scenario. In addition, the screening-level health risk assessment is provided in the *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation* dated February 11, 2008 (BEC 2008; approved by NDEP on April 8, 2008). Based on the results of the 2007 investigation and the 2008 screening-level health risk assessment, concentration levels of chemicals at the Tronox Parcels A and B property are not at levels of concern for human health risk for an industrial scenario. BEC concluded, and NDEP concurred, that an NFAD for the property was warranted.

A quantitative summing of the risks associated with the 2008 screening-level health risk assessment and this current screening-level indoor air health risk assessment is considered inappropriate given their differing methodologies; however, qualitatively the risks for both risk assessments combined would be less than an HI of 1.0 for non-carcinogens and the theoretical upper-bound ILCR would be within the acceptable risk range for carcinogens. Therefore, BEC concludes that an NFAD for the property is further supported by these results.

5.0 REFERENCES

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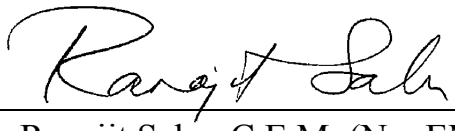
Attachments: Figure 1 – Tronox Parcels A/B Phase B Soil Gas Sample Locations
Table 1 – Chemicals of Potential Concern and Representative Exposure Concentrations in Soil Gas
Table 2 – Johnson and Ettinger Model Input Parameters
Table 3 – Model Estimated Indoor Air Concentrations
Table 4 –Screening-Level Indoor Air Health Risk Assessment Results
Attachment A – Tronox/BEC Response to Comments and Redline Version of the Text (RLSO on CD)
Attachment B – Screening-Level Indoor Air Health Risk Assessment Calculation Spreadsheets (not provided by BEC)

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



March 30, 2010

Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2011) Date
BRC Project Manager

FIGURE

Tronox Parcels A/B Boundary

Soil Gas Sample Locations

- Location within Parcels A/B
- Other Sample Location

BEC / Tronox Parcels A/B Data Review
BMI Common Areas, Henderson, Nevada

FIGURE 1

TRONOX PARCELS A/B
PHASE B SOIL GAS
SAMPLE LOCATIONS

Basic Environmental COMPANY

Prepared by:	Date	JOB No. 0069073
MKJ	03/25/10	FILE: GIS/BEC/TRONOX_AB/FIGURE_1.MXD

TABLES

TABLE 1
CHEMICALS OF POTENTIAL CONCERN AND REPRESENTATIVE EXPOSURE CONCENTRATIONS IN SOIL GAS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Number of Samples	Number of Detections	Frequency of Detects	Minimum DL	Maximum DL	Minimum Detection	Median[a]	Mean[a]	Maximum Detection	95% UCL	EPC
1,1,1-Trichloroethane	9	0	0%	0.15	0.17	--	0.080	0.079	--	--	--
1,1,2,2-Tetrachloroethane	9	0	0%	0.15	0.17	--	0.080	0.079	--	--	--
1,1,2-Trichloroethane	9	1	11%	0.15	0.17	0.12	0.080	0.083	0.12	0.093	0.093
1,1,2-Trichlorotrifluoroethane	9	9	100%	--	--	0.45	0.49	0.50	0.63	0.55	0.55
1,1-Dichloroethane	9	7	78%	0.15	0.16	0.11	0.41	8.0	27	16	16
1,1-Dichloroethene	9	2	22%	0.15	0.17	0.10	0.080	0.086	0.12	0.097	0.097
1,2,4-Trichlorobenzene	9	3	33%	0.15	0.17	0.20	0.080	0.21	0.75	0.37	0.37
1,2,4-Trimethylbenzene	9	9	100%	--	--	0.12	0.37	0.87	3.5	1.8	1.8
1,2-Dibromo-3-chloropropane	9	0	0%	0.74	0.85	--	0.39	0.4	--	--	--
1,2-Dichlorobenzene	9	0	0%	0.15	0.17	--	0.080	0.079	--	--	--
1,2-Dichloroethane	9	3	33%	0.15	0.16	0.32	0.080	0.27	1.1	0.56	0.56
1,2-Dichloropropane	9	4	44%	0.15	0.17	0.085	0.085	0.13	0.47	0.25	0.25
1,2-Dichlorotetrafluoroethane	9	5	56%	0.77	0.85	0.085	0.10	0.23	0.10	0.33	0.1
1,3,5-Trimethylbenzene	9	5	56%	0.77	0.85	0.090	0.39	0.49	1.9	0.99	0.99
1,3-Dichlorobenzene	9	3	33%	0.15	0.17	0.098	0.085	0.12	0.32	0.19	0.19
1,4-Dichlorobenzene	9	9	100%	--	--	0.31	0.84	8.0	43	21	21
1,4-Dioxane	9	5	56%	0.77	0.85	0.14	0.39	0.29	0.39	0.37	0.37
2-Butanone	9	9	100%	--	--	4.6	7.0	7.3	13	9.1	9.1
2-Hexanone	9	9	100%	--	--	0.26	0.43	0.42	0.52	0.46	0.46
2-Methoxy-2-methyl-butane	9	0	0%	0.74	0.85	--	0.39	0.40	--	--	--
4-Ethyltoluene	9	6	67%	0.77	0.85	0.11	0.39	0.41	1.5	0.77	0.77
4-Isopropyltoluene	9	7	78%	0.77	0.85	0.13	0.39	0.80	4.4	1.8	1.8
4-Methyl-2-pentanone	9	9	100%	--	--	0.14	0.29	1.3	9.2	4.2	4.2
Acetone	9	7	78%	15	24	12	18	21	50	31	31
Acrylonitrile	9	3	33%	0.77	0.85	0.11	0.39	0.31	0.12	0.40	0.12
Allyl chloride	9	1	11%	0.15	0.17	0.17	0.080	0.089	0.17	0.11	0.11
alpha-Methylstyrene	9	4	44%	0.74	0.85	0.13	0.39	1.1	7.7	3.6	3.6
Benzene	9	9	100%	--	--	1.2	1.9	1.9	2.7	2.2	2.2
Benzyl Chloride	9	0	0%	0.15	0.17	--	0.080	0.079	--	--	--
Bromodichloromethane	9	6	67%	0.16	0.17	0.098	0.18	0.22	0.67	0.38	0.38
Bromoform	9	1	11%	0.74	0.85	0.27	0.39	0.39	0.27	0.41	0.27
Bromomethane	9	1	11%	0.15	0.17	0.11	0.080	0.082	0.11	0.091	0.091
Carbon disulfide	9	7	78%	1.1	1.4	1.5	2.0	4.9	14	8.2	8.2

TABLE 1
CHEMICALS OF POTENTIAL CONCERN AND REPRESENTATIVE EXPOSURE CONCENTRATIONS IN SOIL GAS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Number of Samples	Number of Detections	Frequency of Detects	Minimum DL	Maximum DL	Minimum Detection	Median[a]	Mean[a]	Maximum Detection	95% UCL	EPC
Carbon tetrachloride	9	9	100%	--	--	0.25	0.39	3.0	11	5.8	5.8
Chlorobenzene	9	3	33%	0.15	0.17	0.16	0.080	0.12	0.31	0.18	0.18
Chloroethane	9	7	78%	0.15	0.16	0.14	0.87	3.1	11	5.9	5.9
Chloroform	9	9	100%	--	--	8.6	34	140	440	260	260
Chloromethane	9	1	11%	0.15	0.17	0.076	0.080	0.079	0.076	0.082	0.076
cis-1,2-Dichloroethene	9	2	22%	0.15	0.17	0.15	0.080	1.5	13	5.8	5.8
cis-1,3-Dichloropropene	9	0	0%	0.74	0.85	--	0.39	0.40	--	--	--
Dibromochloromethane	9	1	11%	0.15	0.17	0.12	0.080	0.084	0.12	0.094	0.094
Dichlorodifluoromethane	9	9	100%	--	--	1.8	2.0	2.0	2.1	2.1	2.1
Ethanol	9	9	100%	--	--	2.3	11	14	32	21	21
Ethyl t-butyl ether	9	0	0%	0.74	0.85	--	0.39	0.40	--	--	--
Ethylbenzene	9	7	78%	0.77	0.85	0.10	0.39	0.44	1.2	0.70	0.70
Ethylene dibromide	9	0	0%	0.15	0.17	--	0.080	0.079	--	--	--
Hexachlorobutadiene	9	5	56%	0.15	0.17	0.49	0.49	0.66	2.4	1.2	1.2
isopropyl ether	9	0	0%	0.74	0.85	--	0.39	0.40	--	--	--
Isopropylbenzene	9	3	33%	0.74	0.85	0.088	0.39	0.31	0.19	0.40	0.19
m,p-Xylene	9	8	89%	0.77	0.77	0.22	0.80	1.4	5.9	2.8	2.8
Methyl methacrylate	9	1	11%	0.74	0.85	0.42	0.39	0.40	0.42	0.41	0.41
Methyl tert butyl ether	9	6	67%	0.15	0.16	0.10	0.33	1.4	7.8	3.7	3.7
Methylene chloride	9	8	89%	0.77	0.77	0.23	0.63	1.2	3.7	2.0	2.0
Naphthalene	9	9	100%	--	--	0.42	0.83	1.2	4.2	2.1	2.1
N-Butylbenzene	9	9	100%	--	--	0.12	0.26	0.31	0.68	0.44	0.44
n-Heptane	9	6	67%	0.77	0.85	0.24	0.43	0.42	0.72	0.52	0.52
n-Octane	9	4	44%	0.77	0.85	0.23	0.39	0.49	1.5	0.86	0.86
N-Propylbenzene	9	5	56%	0.77	0.85	0.084	0.39	0.31	0.52	0.41	0.41
o-Xylene	9	7	78%	0.77	0.85	0.12	0.42	0.61	2.1	1.1	1.1
sec-Butylbenzene	9	1	11%	0.74	0.85	0.097	0.39	0.36	0.097	0.43	0.10
Styrene	9	5	56%	0.77	0.85	0.16	0.39	0.38	0.6	0.45	0.45
t-Butyl alcohol	9	9	100%	--	--	0.20	0.45	0.44	0.67	0.53	0.53
tert-Butylbenzene	9	1	11%	0.29	0.34	0.14	0.16	0.16	0.14	0.16	0.14
Tetrachloroethene	9	9	100%	--	--	1.1	5.3	7.4	30	14	14
Toluene	9	9	100%	--	--	1.2	2.0	4.4	19	9.8	9.8
trans-1,2-Dichloroethylene	9	0	0%	0.15	0.17	--	0.08	0.079	--	--	--

TABLE 1
CHEMICALS OF POTENTIAL CONCERN AND REPRESENTATIVE EXPOSURE CONCENTRATIONS IN SOIL GAS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Number of Samples	Number of Detections	Frequency of Detects	Minimum DL	Maximum DL	Minimum Detection	Median[a]	Mean[a]	Maximum Detection	95% UCL	EPC
trans-1,3-Dichloropropene	9	0	0%	0.74	0.85	--	0.39	0.40	--	--	--
Trichloroethene	9	9	100%	--	--	0.96	1.3	6.5	42	19	19
Trichlorofluoromethane	9	9	100%	--	--	0.95	1.1	1.1	1.4	1.2	1.2
Vinyl acetate	9	7	78%	7.7	7.8	0.99	3.5	3.4	5.0	4.2	4.2
Vinyl chloride	9	2	22%	0.15	0.16	0.12	0.080	0.087	0.12	0.099	0.099

Note: All units in $\mu g/m^3$.
a - Includes both detect values and non-detect values, with one-half the DL used for non-detect values.
DL = detection limit
UCL = upper confidence limit
EPC = exposure point concentration
-- = Not applicable or statistic not evaluated because all results were non-detect..

TABLE 2
JOHNSON AND ETTINGER MODEL INPUT PARAMETERS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Parameter	Value	Reference/Rationale
Depth below grade to bottom of enclosed floor space (cm)	15	Model default (slab on grade)
Average soil temperature (°C)	15	Model default
Soil gas sampling depth (cm)	200	Site-specific (five feet bgs)
Thickness of soil stratum (cm)	200	Site-specific (five feet bgs)
Soil stratum used to calculate soil vapor permeability	S	Sand
Vadose zone dry bulk density (g/cm^3)	1.83	Site-specific (Borrow Area data)
Vadose zone total porosity (unitless)	0.30	Site-specific (Borrow Area data)
Soil moisture content (unitless)	0.049	Site-specific
Vadose zone water-filled porosity (unitless)	0.090	Bulk density × soil moisture
Enclosed space floor thickness (cm)	15	Model default
Soil-building pressure differential ($g/cm\text{-}s^2$)	40	Model default
Enclosed space floor length (cm)	1,000	Model default
Enclosed space floor width (cm)	1,000	Model default
Modeling Enclosed space height (cm)	244	Model default
Floor-wall seam crack width (cm)	0.1	Model default
Average vapor flow rate into building, Qsoil (L/m)	5	Model default
Indoor air exchange rate (1/hr)	0.25	Model default
Exposure duration (yrs)	25	USEPA 2002
Exposure frequency (days/yr)	250	USEPA 2002
Averaging time for carcinogens (yrs)	70	USEPA 2002
Averaging time for non-carcinogens (yrs)	25	USEPA 2002

TABLE 3
MODEL ESTIMATED INDOOR AIR CONCENTRATIONS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Predicted Indoor Air Concentration ($\mu g/m^3$)[1]
1,1,2-Trichloroethane	1.1 E-4
1,1,2-Trichlorotrifluoroethane	6.4 E-4
1,1-Dichloroethane	1.8 E-2
1,1-Dichloroethene	1.3 E-4
1,2,4-Trichlorobenzene	1.9 E-4
1,2,4-Trimethylbenzene	1.7 E-3
1,2-Dichloroethane	8.0 E-4
1,2-Dichloropropane	3.0 E-4
1,2-Dichlorotetrafluoroethane	1.2 E-4
1,3,5-Trimethylbenzene	9.5 E-4
1,3-Dichlorobenzene	2.0 E-4
1,4-Dichlorobenzene	2.2 E-2
1,4-Dioxane	5.3 E-4
2-Butanone	1.1 E-2
2-Hexanone	1.0 E-3
4-Ethyltoluene	9.7 E-4
4-Isopropyltoluene	1.6 E-3
4-Methyl-2-pentanone	4.8 E-3
Acetone	5.0 E-2
Acrylonitrile	1.9 E-4
Allyl chloride	1.7 E-4
alpha-Methylstyrene	9.0 E-3
Benzene	2.8 E-3
Bromodichloromethane	2.0 E-4
Bromoform	7.5 E-5
Bromomethane	1.0 E-4
Carbon disulfide	1.2 E-2
Carbon tetrachloride	6.8 E-3
Chlorobenzene	1.9 E-4
Chloroethane	1.5 E-2
Chloroform	3.7 E-1
Chloromethane	1.3 E-4
cis-1,2-Dichloroethene	6.5 E-3
Dibromochloromethane	3.4 E-5
Dichlorodifluoromethane	2.1 E-3
Ethanol	3.4 E-2
Ethylbenzene	8.0 E-4
Hexachlorobutadiene	1.0 E-3
Isopropylbenzene	1.9 E-4
m,p-Xylene	3.0 E-3
Methyl methacrylate	4.8 E-4
Methyl tert butyl ether	5.3 E-3
Methylene chloride	2.8 E-3
Naphthalene	2.0 E-3
N-Butylbenzene	4.0 E-4
n-Heptane	1.1 E-3
n-Octane	9.9 E-4
N-Propylbenzene	3.9 E-4
o-Xylene	1.4 E-3

TABLE 3
MODEL ESTIMATED INDOOR AIR CONCENTRATIONS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Predicted Indoor Air Concentration ($\mu g/m^3$)[1]
sec-Butylbenzene	8.9 E-5
Styrene	4.9 E-4
t-Butyl alcohol	7.0 E-4
tert-Butylbenzene	1.3 E-4
Tetrachloroethene	1.5 E-2
Toluene	1.7 E-2
Trichloroethene	2.3 E-2
Trichlorofluoromethane	1.5 E-3
Vinyl acetate	5.2 E-3
Vinyl chloride	1.4 E-4

[1] - Calculated using the J&E Model (included on CD).

TABLE 4
SCREENING-LEVEL INDOOR AIR HEALTH RISK ASSESSMENT RESULTS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA
(Page 1 of 2)

Chemical	Non-Cancer Reference Concentration (mg/kg-d)	Unit Risk Factor $(mg/kg\text{-}d)^{-1}$	J&E Predicted Conc.[a]	Non-Cancer Hazard Index	Incremental Lifetime Cancer Risk
1,1,2-Trichloroethane	1.6 E-5	1.4 E-2	1.1 E-4	0.00001	4 E-10
1,1,2-Trichlorotrifluoroethane	NA	3.0 E+1	6.4 E-4	0.00000001	NA
1,1-Dichloroethane	NA	7.0 E-1	1.8 E-2	0.00002	NA
1,1-Dichloroethene	NA	2.0 E-1	1.3 E-4	0.0000004	NA
1,2,4-Trichlorobenzene	NA	4.0 E-3	1.9 E-4	0.00003	NA
1,2,4-Trimethylbenzene	NA	7.0 E-3	1.7 E-3	0.0002	NA
1,2-Dichloroethane	2.6 E-5	4.9 E-3	8.0 E-4	0.0001	5 E-9
1,2-Dichloropropane	1.9 E-5	4.0 E-3	3.0 E-4	0.0001	1 E-9
1,2-Dichlorotetrafluoroethane	NA	NA	1.2 E-4	NA	NA
1,3,5-Trimethylbenzene	NA	6.0 E-3	9.5 E-4	0.0001	NA
1,3-Dichlorobenzene	NA	8.0 E-3	2.0 E-4	0.00002	NA
1,4-Dichlorobenzene	6.9 E-6	8.0 E-1	2.2 E-2	0.00002	4 E-8
1,4-Dioxane	3.1 E-6	NA	5.3 E-4	NA	4 E-10
2-Butanone	NA	5.0 E+0	1.1 E-2	0.000001	NA
2-Hexanone	NA	NA	1.0 E-3	NA	NA
4-Ethyltoluene	NA	NA	9.7 E-4	NA	NA
4-Isopropyltoluene	NA	NA	1.6 E-3	NA	NA
4-Methyl-2-pentanone	NA	3.0 E+0	4.8 E-3	0.000001	NA
Acetone	NA	3.2 E+0	5.0 E-2	0.00001	NA
Acrylonitrile	6.8 E-5	2.0 E-3	1.9 E-4	0.0001	3 E-9
Allyl chloride	NA	1.0 E-3	1.7 E-4	0.0001	NA
alpha-Methylstyrene	NA	4.0 E-2	9.0 E-3	0.0002	NA
Benzene	7.8 E-6	3.0 E-2	2.8 E-3	0.0001	5 E-9
Bromodichloromethane	1.8 E-5	7.0 E-2	2.0 E-4	0.000002	9 E-10
Bromoform	1.1 E-6	7.0 E-2	7.5 E-5	0.000001	2 E-11
Bromomethane	NA	5.0 E-3	1.0 E-4	0.00001	NA
Carbon disulfide	NA	7.0 E-1	1.2 E-2	0.00001	NA
Carbon tetrachloride	1.5 E-5	NA	6.8 E-3	NA	2 E-8
Chlorobenzene	NA	5.0 E-2	1.9 E-4	0.000003	NA
Chloroethane	8.3 E-7	1.0 E+1	1.5 E-2	0.000001	3 E-9
Chloroform	2.3 E-5	4.5 E-2	3.7 E-1	0.01	2 E-6
Chloromethane	NA	9.0 E-2	1.3 E-4	0.000001	NA
cis-1,2-Dichloroethene	NA	3.5 E-2	6.5 E-3	0.0001	NA
Dibromochloromethane	2.4 E-5	7.0 E-2	3.4 E-5	0.0000003	2 E-10
Dichlorodifluoromethane	NA	2.0 E-1	2.1 E-3	0.00001	NA
Ethanol	NA	NA	3.4 E-2	NA	NA
Ethylbenzene	NA	1.0 E+0	8.0 E-4	0.000001	NA
Hexachlorobutadiene	2.2 E-5	NA	1.0 E-3	NA	6 E-9
Isopropylbenzene	NA	4.0 E-1	1.9 E-4	0.0000003	NA
m,p-Xylene	NA	1.0 E-1	3.0 E-3	0.00002	NA
Methyl methacrylate	NA	7.0 E-1	4.8 E-4	0.0000005	NA
Methyl tert butyl ether	NA	3.0 E+0	5.3 E-3	0.000001	NA
Methylene chloride	4.7 E-7	3.0 E+0	2.8 E-3	0.000001	3 E-10
Naphthalene	NA	3.0 E-3	2.0 E-3	0.0004	NA
N-Butylbenzene	NA	1.4 E-1	4.0 E-4	0.000002	NA
n-Heptane	NA	NA	1.1 E-3	NA	NA
n-Octane	NA	NA	9.9 E-4	NA	NA
N-Propylbenzene	NA	1.4 E-1	3.9 E-4	0.000002	NA
o-Xylene	NA	1.0 E-1	1.4 E-3	0.00001	NA

TABLE 4
SCREENING-LEVEL INDOOR AIR HEALTH RISK ASSESSMENT RESULTS
TRONOX PARCELS A/B SOIL GAS INVESTIGATION
CLARK COUNTY, NEVADA

Chemical	Non-Cancer Reference Concentration (mg/kg-d)	Unit Risk Factor $(mg/kg\text{-}d)^{-1}$	J&E Predicted Conc.[a]	Non-Cancer Hazard Index	Incremental Lifetime Cancer Risk
sec-Butylbenzene	NA	1.4 E-1	8.9 E-5	0.0000004	NA
Styrene	NA	1.0 E+0	4.9 E-4	0.0000003	NA
t-Butyl alcohol	NA	NA	7.0 E-4	NA	NA
tert-Butylbenzene	NA	1.4 E-1	1.3 E-4	0.000001	NA
Tetrachloroethene	5.9 E-6	6.0 E-1	1.5 E-2	0.00002	2 E-8
Toluene	NA	5.0 E+0	1.7 E-2	0.000002	NA
Trichloroethene	1.1 E-4	4.0 E-2	2.3 E-2	0.000002	NA
Trichlorofluoromethane	NA	7.0 E-1	1.5 E-3	0.000002	NA
Vinyl acetate	NA	2.0 E-1	5.2 E-3	0.00002	NA
Vinyl chloride	4.4 E-6	1.0 E-1	1.4 E-4	0.000001	2 E-10
			Total	0.01	2 E-6

[a]From Table 3; concentration is in $\mu g/m^3$.

NA - Toxicity criteria has not been established.

ATTACHMENT A

TRONOX/BEC RESPONSE TO COMMENTS
AND REDLINE VERSION OF THE TEXT

(RLSO VERSION ON CD)

Attachment A
Response to NDEP Comments Dated December 22, 2008 on the Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation Dated November 13, 2008

This Response to Comments has been Prepared by BEC on Behalf of Tronox

1. General comments, the NDEP has the following general comments regarding the subject document:
   a. The subject document in general and the CSM in particular make no reference to the Phase 2 Investigation on Parcels A and B.

Response: *Reference to the Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation has been provided in the revise document on pages 1 and 2. In addition, a summary of the Screening-Level Risk Assessment Results from this document has also been added on page 9.*

   b. Shallow soil samples have been collected at other locations at the BMI Industrial Complex and analyzed for physical properties. BRC should explore how the default Johnson and Ettinger (J&E) model values compare to the data collected either on Parcels A & B or in the general area. For the soil gas calculations particular attention should be paid to the soil moisture content.

Response: *The default modeling parameters for a sand soil were used. Parameters for a sand soil result in the most conservative indoor air estimates. Therefore, the modeling performed for the site should be considered a conservative estimate of potential indoor air risks. The modeling input parameter that considers soil moisture is the water-filled porosity, which is determined by the soil moisture content and the dry bulk density. Although there is adequate soil moisture content from the site itself, there is limited dry bulk density data for the general area; however, this information is available from the Borrow Area investigation. Using an average bulk density from the Borrow Area data of 1.83 g/cm3 and an average soil moisture content from site data of 4.92 percent results in a water-filled porosity value of 0.09. In addition, the average effective porosity (which generally equates to total porosity) for the Borrow Area investigation was 0.30. Therefore, these values (bulk density = 1.83; total porosity = 0.30; water-filled porosity = 0.90) have been used in the revised document.*

   c. The subject document does not adequately describe the modeling work that was performed.

Response: *Additional discussion on the model has been added on page 5.*

   d. The NDEP's review of the subject document would be aided by the addition of Section numbers.

Response: *Section numbers have been added to the revised report.*

e. It appears that the data used in this assessment may have been reported with non-detects shown at their reporting limits rather than their detection limits. For example, for 1,1,2-TCA there are eight non-detects reported between 0.15 ug/m3 and 0.17 ug/m3. There is one detected value reported with a J flag at 0.12 ug/m3. Looking through the remainder of the dataset (beyond the nine samples used in these analyses), it appears that detects are quite often reported below the non-detect levels. This is usually an indication that the non-detects are being reported at a reporting limit rather than a method or instrument detection limit. That practice causes substantial overestimation of concentrations when the frequency of detection is low.

Response: *Agreed. Because this is a screening-level evaluation, no changes have been made in response to this comment, but it is acknowledged that this adds to the conservativeness of the results of the indoor air health risk assessment.*

2. Introduction, page 1, the data validation summary report (DVSR) for the soil gas should be appropriately referenced. In addition, all referenced reports should denote their approval status.

Response: *Reference to the Tronox DVSR has been provided.*

3. Selection of Chemicals of Potential Concern, page 3, all chemicals that were not detected in soil gas at the site were eliminated from further consideration. This is an acceptable approach when it is accompanied by some consideration of whether reasonable detection limits were achieved for such chemicals. Without that information it is impossible to know if it is acceptable to eliminate those chemicals. This information may be in the DVSR that is referenced in the Introduction, if so, that is adequate, however, so additional explanation would be helpful. Please clarify.

Response: *A discussion on detection limits and their effective on the selection of chemicals of potential concern has been added as a footnote on page 4. Specifically, detection limits for chemicals eliminated as COPCs were compared to USEPA soil gas screening levels.*

4. Determination of Exposure Point Concentrations, pages 3 through 5
   a. Please note that the United States Environmental Protection Agency (USEPA) actually encourages that both a central tendency estimate (CTE) and a reasonable maximum estimate (RME) be used to help account for the uncertainties associated with determining risk. It is fine in this case for TRX to use only an RME, but the wording of this paragraph is a bit confusing.

Response: *The section in question presents a standard discussion on the use of the 95 percent UCL as the representative exposure concentration. We are unclear on what the confusion is regarding this issue.*

b. Indoor Air, page 4, TRX states "Maximum detected VOCs concentrations in soil gas were used as representative exposure concentrations for the indoor air exposure pathway." The J&E spreadsheet calculations used the 95 percent UCL values not the maximum. This inconsistency needs to be rectified.

Response: *This sentence has been revised on page 5.*

a. Page 4, 1st paragraph, in the final sentence, "non-detect" isn't quite the right term to use. NDEP suggests that TRX use the term "minimum" in place of "non-detect".

Response: *This sentence has been revised on page 4.*

5. Uncertainty Analysis, page 5, the NDEP has the following comments:
   a. TRX states "The environmental sampling at the property is one source of uncertainty in the evaluation. However, the number of sampling locations and events is large and widespread…" Please note that nine samples within Parcels A and B would not be considered "large", however, this may be "adequate".

Response: *This sentence has been revised on page 7.*

b. The uncertainty analysis should discuss the fact the screening level indoor risk assessment used default values for a residential scenario while the assessment was intended for a commercial use scenario.3

Response: *A paragraph has been added on page 7 addressing this issue.*

6. Screening-Level Indoor Air Health Risk Assessment Results and Summary, page 7, the results of the previous screening-level health risk assessment for Parcels A and B should be mentioned in this summary. The soil gas assessment for indoor air was intended to fill a gap in that assessment. These results on their own, without combining the potentially additive risks, do not provide an adequate assessment of the potential risks to a commercial worker on this site.

Response: *Because of how each of the two separate risk assessments were conducted—that is, this risk assessment uses the calculation of a 95 percent UCL and calculated risk estimates based on unit risk factors and reference concentrations, whereas, the previous risk assessment was conducted based on a ratio to screening levels approach—a summation of these separate risk results is considered inappropriate. However, a discussion on the previous results, and what these new risks mean in relation to these previous risks has been added on page 9.*

7. Table 1, TRX needs to review this table for issues with significant figures.

a. Upon close inspection, the main issue seems only to occur with trailing zeros. For example, the data are presented with two significant digits, but 8.0 is shown as 8, and .50 is shown as .5.
b. NDEP also notes that three significant figures were reported for some medians (e.g., 1,4-Dioxane) although the reported value in the data files contains only two significant figures (0.39 in the data file and 0.385 in Table 1).
c. Finally, another case where three significant figures were used was for the Chloroform UCL, which should clearly only have two significant figures since it is calculated from data that contain only two significant figures.

Response: *Because the results are generally presented to two significant figures, all values in Table 1 have been revised to two significant figures.*

8. Table 2, the NDEP has the following comments:
   a. Please note that average soil temperature is not intended to be a default value.
   i. The average soil temperature of 10°C appears low for Las Vegas which has a mean annual temperature of approximately 20°C.

Response: *According to the Fact Sheet for Correcting the Henry's Law Constant for Temperature (obtained from http://epa.gov/swerrims/riskassessment/airmodel/johnson_ettinger.htm), "For depths greater than 100 cm, the mean annual soil temperature remains relatively stable throughout the year and can be estimated from the average shallow ground water temperatures shown in Figure 1." Figure 1 indicates that the average shallow ground water temperature for Las Vegas is from 57°F to 62°F, or 13.9°C to 16.7°C. Therefore, the model has been adjusted to use an average soil temperature of 15°C.*

   b. Was the soil type used (sand) based on site-specific data? There are no text references in this regard.
   i. The NDEP is accepts the default soil physical properties provided the soil type is site-specific.

Response: *A sand soil type was selected because it provides the most conservative estimate of indoor air concentrations. However, as indicated in response to comment 1b, default values have been adjusted with site-specific values were available.*

   c. Exposure duration, exposure frequency, and averaging time for non-carcinogens values employed are not J&E Model default values.

Response: *Agreed. The reference/rationale has been changed on this table for these parameters.*

9. Table 4, several of the chemical names were truncated.

Response: *The 'Chemical' column width has been adjusted.*

10. J&E Model Spreadsheets
    a. Chemical Properties Lookup Table, Vlookup Tab. References were not provided for updated information and for the chemicals added to the table.

Response: *The chemical properties were provided from either the Hazardous Substances Databank (HSDB) website (http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB) or EPA's Water 9 v.3 software.*

    b. DataEnter sheets were provided even when the chemical was non-detect (ND) in all nine samples. Chemical Group 1, for example, includes input sheets1,1,1-TCA and 1,2-DCB but the chemicals were not detected.

Response: *The DataEnter sheets have been adjusted to only include COPCs.*

    c. J&E model calculations were checked for one chemical from each of the four chemical groups as follows:
        i. Group 1 – 1,4-DCB
        ii. Group 2 – benzene
        iii. Group 3 – chloroform
        iv. Group 4 – PCE
        v. NDEP comments are provided below for each of these compounds.
    d. Group 1
        i. DataEnter 1,4-Dioxane – the CAS number appears correct but the chemical reported at I12 (spreadsheet location) is Crotonaldehyde (2-butenal)? The problem is that TRX added chemicals to the Chemical Properties Lookup Table; but did not sort the table (lowest to highest CAS number). Hence the VLOOKUP formula in cell I12 does not work properly in the files provided. This problem can be solved in one of two ways:
            1. Simply sort the VLOOKUP table in ascending order after adding new chemicals to the list, or
            2. Modify the formula in cell I12 as follows by adding argument FALSE (highlighted yellow): IF(ISERROR(MATCH(E12,CAS_No,0)),"CAS No. not found",VLOOKUP(E12,Chemical_Data,2,FALSE))
                a. By adding this argument the table need not be in ascending order.
        ii. The NDEP sorted the VLOOKUP table and the formula worked properly.
            1. This operation was performed for the VLOOKUP table for each of the four chemical groups
        iii. Various factors (e.g., RfC and URF) were updated but no references for this information were provided.
    e. Groups 2 through 4
        i. This set of spreadsheets contains the same error as noted above.
        ii. Various factors (e.g., RfC and URF) were updated but no references for this information were provided.

Response: *The tables have been adjusted as suggested by this comment. It should be noted that this does not affect the model results as the calculations are based on lookup's off of the CAS number.*

ATTACHMENT B

SCREENING-LEVEL INDOOR AIR HEALTH RISK ASSESSMENT
CALCULATION SPREADSHEETS
(NOT PROVIDED BY BEC)

Tab 6

Nevada Division of Environmental Protection (NDEP) Response to: Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Dated November 13, 2008

May 13, 2010

May 13, 2010

Matt Paque
Tronox LLC
3301 NW 150th
Oklahoma City, OK 73134

Re: **Tronox LLC (TRX)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection (NDEP) Response to:
Technical Memorandum – Screening-Level Indoor Air health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada
Dated: March 30, 2010

Dear Mr. Paque,

The NDEP has received and reviewed TRX's above-identified Deliverable and provides comments in Attachment A. A revised Deliverable should be submitted based on the comments found in Attachment A. Please advise the NDEP **by May 27, 2010** regarding the schedule for this resubmittal. TRX should additionally provide an annotated response-to-comments letter as an appendix to the revised Deliverable.

Please contact the undersigned with any questions at sharbour@ndep.nv.gov or (702) 486-2850 extension 240.

Sincerely,

Shannon Harbour, P.E.
Staff Engineer III
Bureau of Corrective Actions
Special Projects Branch
NDEP-Las Vegas Office
Fax: 702-486-5733

SH:GL:s

EC: Jim Najima, NDEP, BCA, Carson City
Greg Lovato, NDEP, BCA, Carson City
Paul Black, Neptune and Company, Inc.
Kelly Black, Neptune and Company, Inc.
Paul Hackenberry, Hackenberry Associates LLC
Brian Rakvica, McGinley and Associates

CC: Keith Bailey, Environmental Answers LLC, 3229 Persimmon Creek Drive, Edmond, OK 73013
Susan Crowley, C/O Tronox LLC, PO Box 55, Henderson, NV 89009
Mike Skromyda, Tronox LLC, PO Box 55, Henderson, NV 89009
Michael J. Foster, Tronox LLC, P.O. Box 268859, Oklahoma City, OK 73126-8859
Deni Chambers, Northgate Environmental, 300 Frank H. Ogawa Plaza, Suite 510, Oakland, CA 94612
Barry Conaty, Holland & Hart LLP, 975 F Street, N.W. Suite 900, Washington, D.C. 20004
Brenda Pohlmann, City of Henderson, PO Box 95050, Henderson, NV 89009
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9, mail code: WST-5, 75 Hawthorne Street, San Francisco, CA 94105-3901
Ebrahim Juma, Planning Manager, Air Quality and Environmental Management, 500 S. Grand Central Pkwy, 1st floor, P.O. Box 555210, Las Vegas, NV 89155-5210
Ranajit Sahu, BRC, 311 North Story Place, Alhambra, CA 91801
Rick Kellogg, BRC, 875 West Warm Springs, Henderson, NV 89011
Mark Paris, Landwell, 875 West Warm Springs, Henderson, NV 89011
Craig Wilkinson, TIMET, PO Box 2128, Henderson, Nevada, 89009-7003
Kirk Stowers, Broadbent & Associates, 8 West Pacific Avenue, Henderson, Nevada 89015
George Crouse, Syngenta Crop Protection, Inc., 410 Swing Road, Greensboro, NC 27409
Nick Pogoncheff, PES Environmental, 1682 Novato Blvd., Suite100, Novato, CA 94947
Lee Erickson, Stauffer Management Company, P.O. Box 18890, Golden, CO 80402
Michael Bellotti, Olin Corporation, 3855 North Ocoee Street, Suite 200, Cleveland, TN 37312
Curt Richards, Olin Corporation, 3855 North Ocoee Street, Suite 200, Cleveland, TN 37312
Paul Sundberg, Montrose Chemical Corporation, 10733 Wave Crest Court, Stockton, CA 95209
Joe Kelly, Montrose Chemical Corporation of CA, 600 Ericksen Avenue NE, Suite 380, Bainbridge Island, WA 98110
Jeff Gibson, AMPAC, 3883 Howard Hughes Pkwy, Ste 700, Henderson, NV 89169
Larry Cummings, AMPAC, 3883 Howard Hughes Pkwy, Ste 700, Henderson, NV 89169

Attachment A

1. General comment, please note that the comments provided below pertain to the redline strike-out (RLSO) version of the Deliverable.
2. Page 2, Section 2.0, 4th paragraph, 1st sentence, the Tronox Risk Assessment Work Plan (and the BRC Closure Plan) describes receptors that will be considered for risk assessments performed for risk-based decision units at the Tronox facility. This list includes construction workers, outdoor workers (maintenance workers), and indoor (commercial) workers. On-site visitors will not be addressed quantitatively, although trespassers and off-site residents can be evaluated qualitatively. This should be clarified here.
3. Page 2, Section 2.0, 4th paragraph, last sentence, this sentence should clarify that the scope of this risk assessment is indoor air.
4. Page 3, Section 3.0, listed items, the listed items should match the intent of this indoor air risk assessment. For example, the 3rd listed item is irrelevant in this context and should be deleted. More generally, the listed items should recognize that this is a partial risk assessment, and that the results should be considered in concert with those presented in the previously approved (with conditions) Tronox Parcels A/B risk assessment report.
5. Page 4, Section 3.2, 1st paragraph, 8th line, please replace the discussion on what UCLs are with the text as follows: "For the 95 percent UCL concentration approach, the 95 percent UCL was computed in order to represent the area-wide exposure point concentrations. The 95 percent UCL is a statistic that quantifies the uncertainty associated with the sample mean. If randomly drawn subsets of site data are collected and the UCL is computed for each subset, the UCL will equal or exceed the true mean roughly 95 percent of the time. The purpose for using the 95 percent UCL is to derive a conservative, upper-bound estimate of the mean concentration, which takes into account the different concentrations a person may be exposed to at the Site. That is, an individual will be exposed to a range of concentrations that exist at an exposure area, from non-detect (ND) to the maximum concentration, over an entire exposure period"
6. Page 4, Section 3.2, 2nd paragraph, NDEP has the following comments:
   a. TRX should also note that this 95% UCL approach should only be applied if the data are from a single population, which has not been demonstrated and the data for chloroform indicate spatial differences (see comments on Table 1 below). Consequently, the data and hence the area, should probably be split into two sets or the maximum reported values should be used in the risk assessment instead of a UCL.
   b. TRX should also consider whether there are enough data to support a risk-based decision. Perhaps the indoor air risks should be considered in concert with the previous risks reported for other media exposures to provide multiple lines of evidence. For example, chloroform is the main driver for this risk assessment. Perhaps there are chloroform data for the other media that could be used to help explain or update the conceptual model for this site.
7. Page 4, Section 3.2, 2nd paragraph, it is not clear how detection limits were treated for calculation of UCLs. Based on some of the values reported in Table 1, it appears as though ½ the detection limit (DL) was used. Please clarify.
8. Page 4, Footnote 1, the information alluded to in this footnote should be provided in a table so that a direct comparison of DLs and risk threshold concentrations is available in the report.

9. Page 5, Section 3.2.1, last paragraph of the section, please clarify that average soil moisture content was determined using ASTM D2216. Additionally, the water-filled porosity in the above-quoted text should be corrected to read, water-filled porosity = 0.090.
10. Page 6, Section 3.3, 1st paragraph, last sentence, please update the references to the BRC Closure Plan to 2010.
11. Page 7, Section 3.4, 2nd paragraph under bullets, last sentence, it is not clear to NDEP that these statements about the sampling data being sufficient are reasonable. The chloroform data are clearly spatially distinct between the east side of Parcel B and the remainder of the data. TRX should consider a different evaluation of the data.
12. Page 7, Section 3.4, 4th paragraph under bullets, regarding the Johnson and Ettinger (J&E) modeling, NDEP is not clear why the modeling was performed assuming a residential scenario, given that a residential scenario is not consistent with the future uses of the site, or with the TRX Health Risk Assessment Work Plan. Earlier in the report (Page 2), TRX states that a commercial scenario is protective of other potential receptors but no mention is made of a residential scenario. Please clarify.
13. Page 8, Section 3.5, 3rd paragraph, last sentence, please delete this sentence as NDEP will make the determination on what are "unacceptable carcinogenic risks".
14. Page 9, Section 4.0, 2nd paragraph, TRX should present the results of both risk assessments so that the risks can be evaluated together and that the risk drivers in both cases can be considered. The conceptual site model (CSM) would then be implicitly updated and an appropriate risk management decision could be made. Please provide risk estimates from both this indoor air risk assessment and from the risk assessment previously performed for the other media exposures.
15. Table 1, NDEP provides comments as follows:
    a. NDEP notes that this table does not follow current NDEP guidance on summary tables. Half the DL appears to have been used for NDs for statistics other than the median and the mean. Please clarify.
    b. There are many detected values reported at levels that are lower than detection limits. This implies that reporting limits are used here instead of sample quantitation limits (SQLs). NDEP guidance indicates that SQLs should be reported. Please revise this table as necessary to comply with NDEP guidance.
    c. Since the data are not presented in the Deliverable, determining whether the UCL calculations are justified has been difficult. Chloroform is the chemical of primary concern (the primary risk driver for this pathway). NDEP retrieved the data from the NDEP database website (ndep.gisdt.org). The chloroform data from the NDEP database website (presented below) show that the high concentrations of chloroform are from locations SG10, SG11, and SG12, which are located on the eastern side of Parcel B, closer to known chloroform plumes. These data indicate that the population is not sufficiently homogeneous that an assumption of one population can be made; therefore, the calculation of a UCL is not appropriate because it "averages away" potential risk for decision units that are larger than exposure areas. Because the data are not indicative of one population and given the relatively few data points from the eastern side of Parcel B, the maximum concentration should be used in this screening risk assessment instead of the UCL (for all chemicals). Please note that the same spatial pattern has been observed for carbon tetrachloride. Please revise this Deliverable as necessary.

Chloroform data:

SG01	0.014
SG02	0.016
SG03	0.0086
SG04	0.0086
SG05	0.062
SG06	0.034
SG10	0.44
SG11	0.4
SG12	0.27

16. Table 2, NDEP provides the following comments:
    a. Line 7, TRX should identify "Vadose zone total porosity (unitless)" as "Gravimetric moisture content per ASTM D2216".
    b. Line 8, Reference/Rationale, the equation provided is not dimensionally correct, please refer to the equation provided herein (above).
    c. While NDEP understands that pulling the J&E worksheets together simplifies presentation, for purposes of transparency TRX should then provide the actual inputs for the J&E in Table 2 and where necessary, Table 2 should include information (including formulas where necessary) that support the derivation of some of the hard-coded inputs in the specific J&E model worksheets.
    d. The crack-to-total-area ratio (crack fraction – cell F90) is specified in the specific J&E worksheets as 400/Area of enclosed space below grade (building area – cell E90). The value of 400 is really a consequence of a 4000 cm floor-wall seam perimeter (Cell K79) and the crack radius of 0.1 cm (Cell G100). Since the basic inputs are the perimeter and the radius, these should be included explicitly in the formula for crack fraction. Please revise.
17. Attachment A, NDEP provides the following comments:
    a. Response-to-comment (RTC) # 3, the comparisons for the NDs should be given in a table, which may demonstrate that all of the DLs were less than soil gas screening criteria and could not contribute significantly to risk. Please revise as necessary.
    b. RTC # 5a, TRX has not demonstrated that the data are sufficient for decision making. Given the apparent spatial differences described above, it seems that only three samples have been taken in the area of greatest risk-based concentrations (i.e. the east side of Parcel B). Please clarify.
    c. RTC # 6, the additional text included in response to NDEP's original comment provides no useful specific information about the risk assessment performed for the other pathways. The risks should be presented so that NDEP can consider both sets of risks together with the risk drivers for both assessments identified.

Tab 7

Northgate Environmental Management, Inc. (Northgate)
Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation
BMI Industrial Complex, Clark County, Nevada

Northgate Response to NDEP's May 13, 2010 Comments on BRC's Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation
BMI Industrial Complex, Clark County, Nevada, dated March 30, 2010

June 29, 2010

northgate
environmental management, inc.

MEMORANDUM

From: Deni Chambers
Renee Kalmes, Exponent
Greg Brorby, Exponent

Date: June 29, 2010

To: Shannon Harbour, PE
Nevada Division of Environmental Protection

CC: Brian Rakvica, McGinley and Associates
Jim Najima, Nevada Division of Environmental Protection
Teri Copeland
Paul Black, Neptune and Co.

RE: Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada

1.0 INTRODUCTION

The objective of this Technical Memorandum is to present the results of a screening-level indoor air health risk assessment (HRA) for the Phase 2 soil gas investigation Basic Environmental Company (BEC) and Tronox performed for the Tronox Parcels "A" and "B" (portions of APN Nos. 178-01-401-001, 178-12-101-002, and 178-12-201-006 [Note: Parcel 178-12-601-005, formerly part of Tronox Parcel B, has been sold and is excluded from this analysis]). Parcels A and B will collectively be referred to as "the property" for the purposes of this Technical Memorandum. The property is located north of Warm Springs Road, 1/4 mile west of the intersection with Boulder Highway, in Henderson, Nevada. Figure 1 shows details of Parcels A and B and the soil gas sampling locations. The Technical Memorandum only presents the methods and results of the screening-level indoor air HRA and does not present investigation, data summary, data usability, or data adequacy information. This information is provided in the Nevada Division of Environmental Protection (NDEP) approved *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation* dated February 11, 2008 (BEC 2008; approved by NDEP on April 8, 2008), and the *Data Validation Summary Report* for the soil gas survey (Tronox 2008; approved by NDEP on October 20, 2008).

This revision of the Screening-Level Indoor Air Health Risk Assessment Memorandum, Revision 2, incorporates comments received from the NDEP, dated May 13, 2010, on Revision 1 of the report, dated March 25, 2010. The NDEP comments and BRC's response to these comments are provided separately; however, a redline/strikeout version of the text showing the revisions from the March 25, 2010 version of the technical memorandum in response to NDEP's comments is provided in Attachment A.

2.0 CONCEPTUAL SITE MODEL

The conceptual site model (CSM) is used to describe relationships between chemicals and potentially exposed human receptor populations, thereby delineating the relationships between the suspected sources of chemicals identified at the property, the mechanisms by which the chemicals might be released and transported in the environment, and the means by which the receptors could come in contact with the chemicals. The CSM provides a basis for defining data quality objectives and developing exposure scenarios.

The CSM considers current and potential future land-use conditions. Currently, the property is undeveloped; however, the planned future use of the property is for commercial purposes. Given the planned development of the property, potential human receptors include on-site construction workers, on-site indoor commercial workers, on-site outdoor maintenance workers, and on-site visitors, which is consistent with the Tronox *HRA Work Plan* (Northgate 2010) and the *BRC Closure Plan* (BRC, ERM, and DBS&A, 2009). Although several potential human receptors may occur on the property in the future, this screening-level HRA focuses on indoor commercial workers. This receptor is considered to have the highest level of exposure to volatile organic chemicals (VOCs) in indoor air at the property. Other receptors, such as site visitors, will have lower exposures, and thus lower risk estimates. Therefore, risk estimates generated for future on-site indoor commercial workers will be protective of other potential receptors at the property.

A separate screening-level HRA evaluated risks from exposure to soil at Parcels A and B. The results from that screening-level HRA are provided in the *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation* dated February 11, 2008 (BEC 2008; approved by NDEP on April 8, 2008). However, these exposures did not account for potential migration of VOCs from the subsurface into indoor air. In general, the United States Environmental Protection Agency (USEPA) does not recommend evaluating the indoor air exposure pathway using soil matrix data (USEPA 2002a). Because groundwater beneath a portion of the property is considered a potential VOC source area, soil gas data were collected. The soil gas data are the focus of this screening-level indoor air HRA.

3.0 SCREENING-LEVEL INDOOR AIR HEALTH RISK ASSESSMENT

As discussed above, the previous screening-level HRA (BEC 2008) did not consider the indoor air pathway. Therefore, soil gas data were collected to specifically evaluate this potential exposure pathway at the property.

Human health risks are represented by estimated theoretical upper-bound cancer risks and non-cancer hazards derived in accordance with standard USEPA methods. These values will be compared to the following criteria:

1. For non-carcinogenic compounds, the NDEP non-cancer risk management target is a cumulative hazard index (HI) of one or less (NDEP 2009). If the screening HI is determined to be greater than 1.0, target organ-specific HIs will be calculated for primary and secondary organs. The final risk goal will be to achieve target organ-specific non-carcinogenic HIs of less than 1.0; and
2. For most known or suspected chemical carcinogens, the NDEP point of departure is a cumulative incremental lifetime cancer risk (ILCR) of 1×10^{-6}.

This screening-level indoor air HRA follows the basic procedures outlined in USEPA's *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (RAGS Part A; USEPA 1989). Other guidance documents, including USEPA's *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)* (U.S. EPA, 2009), were also consulted for the screening-level indoor air HRA.

3.1 Selection of Chemicals of Potential Concern

As shown in Figure 1, nine soil gas samples were collected in Parcels A and B. The data for these samples, including the number of detections, detection frequency, minimum and maximum detections, minimum and maximum detection limits, mean, median, and standard deviation, are summarized in Table 1; the raw data are provided in Attachment B. Consistent with NDEP (2008) guidance, one-half the limit of detection was used in calculating the mean, median, and standard deviation; the sample quantitation limit (SQL) was used as the detection limit. For purposes of this screening-level indoor air HRA, all chemicals detected in at least one of the nine soil gas samples collected at Parcels A and B were identified as chemicals of potential concern (COPCs) at the property. For those chemicals that were not detected in any of the soil gas samples, their detection limits were compared to shallow soil gas to indoor air vapor intrusion screening levels from USEPA [2002a; Table 2c (Generic Screening Levels and Summary Sheet; Risk = 1×10^{-6}]. As shown in Table 1, none had detection limits that exceeded their respective screening levels. Therefore, their exclusion should not affect the results of the evaluation. It should be noted that screening levels have not been developed for three chemicals that were not detected in any soil gas sample (2-methoxy-2-methyl butane, ethyl t-butyl, ether, and isopropyl ether). The maximum detections limits for these chemicals were very low (0.085, 0.087, and 0.1 µg/m^3, respectively); therefore, exclusion of these chemicals also should not affect the results of the screening-level indoor air HRA.

3.2 Determination of Exposure Point Concentrations

A representative exposure point concentration is a COPC-specific and media-specific concentration value. In risk assessment, these exposure concentrations are values incorporated into the exposure assessment equations from which potential baseline human

exposures are calculated. For purposes of this screening-level indoor air HRA, the maximum detected concentration was used.

3.2.1 Indoor Air

The migration of COPCs from the subsurface and dispersion into indoor air were estimated using the USEPA spreadsheet-based Johnson and Ettinger (J&E) model (USEPA 2004a). The model is based on the vapor intrusion model published by Johnson and Ettinger (1991). The J&E model is a screening-level model, which incorporates both convective and diffusive mechanisms for estimating the transport of chemical vapors emanating from either subsurface soils or groundwater into indoor spaces located directly above the source of contamination. The model is constructed to calculate steady-state vapor transport (infinite source). The maximum detected concentrations of the COPCs in soil gas, which were used as the exposure point concentrations for the indoor air exposure pathway, are presented in Table 1. Either site-specific or default physical properties and building characteristics contained in the USEPA J&E spreadsheet model were used in this evaluation. These values are presented in Table 2. Tables 3 and 4 present the indoor air concentrations predicted by the J&E model for each of the COPCs, depending on assumptions for building air exchange rate and vapor flow rate into the building, as discussed further below.

Where site-specific data were unavailable, the model default parameters for a sand soil were used. Parameters for a sand soil result in the most conservative indoor air estimates. Therefore, the modeling performed for the property should be considered a conservative estimate of potential indoor air risks. The model input parameter that considers soil moisture is the water-filled porosity, which is determined by the gravimetric moisture content and the dry bulk density. Although there are adequate gravimetric moisture content data from the site itself (as determined using ASTM D2216), there is limited dry bulk density data for the general area; however, this information is available from the Borrow Area investigation (BRC and ERM 2007). Using an average dry bulk density from the Borrow Area data of 1.83 g/cm^3 and an average gravimetric moisture content from site data of 4.92 percent results in a water-filled porosity value of 0.09. In addition, the average effective porosity (which generally equates to total porosity) for the Borrow Area investigation was 0.30. Therefore, these values (bulk density = 1.83 g/cm^3; total porosity = 0.30; water-filled porosity = 0.090) are used in the modeling effort for the property.

With regard to building parameters, USEPA provides a recommended value for the air exchange rate for a residential building, but not a commercial building, in their J&E Model User's Guide (USEPA 2004a). The California Environmental Protection Agency (Cal-EPA) recommends a value of 1 per hour (1/hr) for commercial buildings based on the California Energy Commission's *Manual for Compliance with the 2001 Energy Efficiency Standards (for Nonresidential Buildings, High-Rise Residential Buildings and Hotels/Motels;* Cal-EPA 2005).

The Michigan Department of Environmental Quality (MDEQ) recommends a value of 2/hr. The basis for this latter value is two-fold: First, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) *Draft BSR/ASHRAE Standard 62-1989R, Ventilation for Acceptable Indoor Air Quality* suggests that system rates for total supply air in a general office will be approximately 1/hr. Second, natural ventilation, infiltration, and entrance and egress into and out of the building will increase air exchange rates above the approximate 1/hr provided by mechanical systems (Michigan Environmental Science Board 2001). To address the uncertainty in this input parameter, a range of estimated indoor air concentrations and corresponding risk estimates based on an air exchange rate of 1/hr or 2/hr were estimated (see Tables 3 and 4, respectively).

Furthermore, USEPA does not provide recommended values for floor length and width of the enclosed space. The MDEQ does provide a recommended default value for the size of a hypothetical commercial building of 4,000 square feet (ft^2) or 372 square meters (m^2; Michigan Environmental Science Board, 2001). This value is based on data provided in a 1994 U.S. Department of Energy (DOE) report entitled *Commercial Building Characteristics 1992*, which documents the results of a Commercial Buildings Energy Consumption Survey. The most recent survey was completed in 2003 and the results were presented in a 2006 report issued by the U.S. Energy Information Administration (USEIA 2006). The data presented in this report are similar to that presented in the 1994 DOE report in that the majority of commercial buildings (other than malls) are between 1,000 $feet^2$ and 5,000 $feet^2$ in size and a single story, regardless of region of the country. In addition, the reported median square footage (the metric used by MDEQ) for different categories of commercial buildings nationwide ranges from 3,000 ft^2 to 7,000 ft^2. For purposes of this screening-level indoor air HRA, a value of 2000 centimeters (cm) was assumed for both the floor length and width, which is approximately equal to the default value of 4000 ft^2 (372 m^2) recommended by MDEQ.

Finally, the vapor flow rate into a building (Q_{soil}) is a controversial input parameter in the J&E model. As originally conceived, this value was calculated using a "perimeter crack model" by Nazaroff based on various site-specific or default values related to soil vapor permeability, pressure differentials, and size of cracks; however, a wide range of values can be predicted because of the model's sensitivity to estimates of soil vapor permeability (USEPA 2004a). Consequently, EPA provides a recommended "default" value for vapor flow rate into residential buildings, but not commercial buildings, in their J&E Model User's Guide (USEPA 2004a). The recommended default value is 5 L/m, which is based on empirical data collected in residences; however, such data for commercial buildings are lacking. Cal-EPA has adopted USEPA's recommended default value for Q_{soil} for residential buildings. For commercial buildings, Cal-EPA recommends scaling the default residential value based on the size of the commercial building (e.g., if the commercial building is twice the size as the default residential building, then the Q_{soil} value is doubled; Cal-EPA 2005). To address the

uncertainty in this parameter, a range of estimated indoor air concentrations and corresponding risk estimates were estimated based on a scaled Q_{soil} value (4 × 5 L/m or 20 L/m because the default commercial building size described above is 4-times the default residential building size) as recommended by Cal-EPA and a calculated Q_{soil} based on a sand soil (see Tables 3 and 4, respectively).

3.3 Risk Assessment Methodology

The method used in the screening-level indoor air HRA consists of several steps. The first step is the determination of exposure point concentrations representative of the particular area (see above). The second step is fate and transport modeling to predict concentrations that may be present when direct measurements are not available. The third step is the exposure assessment for the various receptors present in the particular areas. The fourth step is to define the toxicity values for each COPC. The final step is risk characterization where theoretical upper-bound ILCRs and non-cancer HIs are calculated. The *BRC Closure Plan* (BRC, ERM, and DBS&A 2009) and *Tronox HRA Work Plan* (Northgate 2010) provide a full discussion on the risk assessment methodology for the project, and used in this screening-level indoor air HRA.

Table 2 presents each of the exposure parameters used in the screening-level indoor air HRA. Toxicity values, when available, are published by the USEPA in the online Integrated Risk Information System (IRIS; USEPA 2008) and the Health Effects Assessment Summary Tables (HEAST; USEPA 1997). Unit risk factors (URFs) are chemical-specific, experimentally-derived potency values used to calculate the risk of cancer resulting from exposure to carcinogenic chemicals. A higher value implies a more potent carcinogen. Reference concentrations (RfCs) are experimentally derived “no-effect” values used to quantify the extent of adverse non-cancer health effects from exposure to chemicals. Here, a lower RfC implies a more potent toxicant. These criteria are generally developed by USEPA risk assessment work groups and listed in USEPA risk assessment guidance documents and databases. The hierarchy for selecting toxicity criteria presented in the *BRC Closure Plan* (BRC, ERM, and DBSA 2009) and *Tronox HRA Work Plan* (Northgate 2010) was used, and the identified values, including the source, are presented in Tables 3 and 4.

3.4 Uncertainty Analysis

Risk estimates are values that have uncertainties associated with them. These uncertainties, which arise at every step of a risk assessment, are evaluated to provide an indication of the uncertainty associated with a risk estimate. Risk assessments are not intended to estimate the true risk to a receptor associated with exposure to chemicals in the environment. In fact, estimating the true risk is impossible because of the variability in the exposed or potentially exposed populations. Therefore, risk assessment is a means of estimating the probability that

an adverse health effect (*e.g.*, cancer, impaired reproduction) will occur in a receptor to assist in decision making regarding the protection of human health. The multitude of conservative assumptions used in risk assessments guard against underestimation of risks.

Risk estimates are calculated by combining site data, assumptions about individual receptor's exposures to impacted media, and toxicity data. The uncertainties in this screening-level indoor air HRA can be grouped into four main categories that correspond to these steps:

- Uncertainties in environmental sampling and analysis
- Uncertainties in fate and transport modeling
- Uncertainties in assumptions concerning exposure scenarios
- Uncertainties in toxicity data and dose-response extrapolations

Additional discussion on the uncertainties associated with the screening-level indoor air HRA is provided below.

The screening-level indoor air HRA for the property was based on the sampling results obtained from a soil gas investigation conducted in 2008. Errors in sampling results can arise from the field sampling, laboratory analyses, and data analyses. Errors in laboratory analysis procedures are possible, although the impacts of these sorts of errors on the risk estimates are likely to be low. The environmental sampling at the property is one source of uncertainty in the evaluation. As shown in Figure 1, the sampling locations are spread across the property, and sampling was performed using approved procedures. In addition, the maximum detected concentration was used as the exposure point concentration, which is a conservative assumption because receptors are unlikely to be exposed to the maximum concentration of all COPCs over an extended period of time.

The J&E model relies on a series of assumptions regarding site soils and building characteristics. In this assessment, soil physical parameter data for this site or nearby sites were used as available; otherwise, characteristics associated with "sand" were conservatively assumed. Because the site has not yet been developed, assumptions had to be made regarding the type and size of future buildings. For purposes of this screening-level assessment, a range of indoor air concentrations and corresponding risks were estimated based on a range of values for building air exchange rate and vapor flow rate into the building to address some of the uncertainty in these model input parameters.

The indoor commercial worker is the only scenario quantitatively evaluated in this screening-level indoor air HRA. NDEP default assumptions were used for exposure frequency (250 days per year) and duration (25 years; NDEP 2009), which are consistent with USEPA assumptions for a reasonable maximum exposure (RME) scenario (USEPA 2002b). Other receptors, such as site visitors, would not be expected to be at the site as frequently or for as

long a period of time; therefore, conclusions regarding indoor commercial workers will be protective of other potential receptors at the property.

One of the largest sources of uncertainty in any risk assessment is the limited understanding of toxicity to humans who are exposed to the low concentrations that are generally encountered in the environment. The majority of the available toxicity data are from animal studies; these data are extrapolated using mathematical models or multiple uncertainty factors to predict what might occur in humans. Sources of conservatism in the toxicity criteria used in this screening-level indoor air HRA include:

- The use of conservative methods and assumptions to extrapolate from high-dose animal studies to predict the possible response in humans at exposure levels far below those administered to animals;
- The assumption that chemicals considered to be carcinogens do not have thresholds (i.e., for all doses greater than zero, some risk is assumed to be present); and
- The fact that epidemiological studies (i.e., human exposure studies) are limited and are not generally considered in a quantitative manner in deriving toxicity values.

In aggregate, these assumptions lead to overestimates of risk, such that the actual risk is unlikely to be higher than the estimated risk, but could be considerably lower and, in fact, could be zero. It should be noted, however, that toxicity criteria have not been established for many of the chemicals detected at the property. These chemicals were not quantitatively evaluated in the screening-level indoor air HRA. Thus, the risks presented in this assessment could be underestimated as a result.

In summary, uncertainties from different sources are compounded in this screening-level indoor air HRA. For example, if a person's daily intake rate for a chemical is compared to an RfC to determine potential health risks, the uncertainties in the concentration measurements, exposure assumptions, and toxicities will all be expressed in the result. Because the exposure assumptions and toxicity criteria are considered conservative, the risk estimates calculated in this screening-level indoor air HRA are likely to overestimate rather than underestimate potential risks.

3.5 Screening-Level Indoor Air Health Risk Assessment Results

This screening-level indoor air HRA has evaluated potential risks to human health associated with chemicals detected in soil gas at the Tronox Parcels A and B property. The theoretical upper-bound ILCRs and non-cancer health effects for the COPCs are presented in Tables 3 (assuming more conservative values for air exchange rate and vapor flow into the building) and

4 (assuming less conservative values for these same parameters). All calculation spreadsheets for this screening-level indoor air HRA are included in Attachment C.

The total cumulative non-cancer HI for future on-site indoor commercial workers at the property ranges from 0.0008 to 0.002. The largest contributor to the cumulative HI is chloroform. The HI values are well below NDEP's target HI of 1.0.

The theoretical upper-bound ILCR for future on-site indoor commercial workers at the property ranges from 5×10^{-7} to 1×10^{-6}. The risks are primarily driven by chloroform, which contributes approximately 90 percent of the theoretical upper-bound ILCR. These values are equal to or below NDEP's point of departure of 1×10^{-6}. It should be noted that chloroform was not detected in any of the 64 soil samples collected at the property (BEC, 2008). The apparent source of chloroform and other chemicals detected in soil gas is impacted groundwater located south and west (upgradient) of Parcels A and B.[1]

4.0 SUMMARY OF SCREENING-LEVEL SOIL HEALTH RISK ASSESSMENT

As stated previously, the results of the screening-level HRA for COPCs in soil at Parcels A and B are presented in the *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation*, dated February 11, 2008 (BEC, 2008). These results are briefly summarized herein so that the results from both the soil and soil gas assessments can be considered in concert. The COPCs identified in soil were evaluated in three groups, i.e., chemicals (other than asbestos), radionuclides, and asbestos. For chemicals and radionuclides, ILCRs and HIs were estimated based on the maximum detected concentration and the USEPA Region 9 industrial preliminary remediation goals (PRGs) for chemicals (USEPA 2004b) and the USEPA industrial PRGs for radionuclides (U.S. EPA, 2007). For asbestos, the estimated risk for death from lung cancer or mesothelioma was estimated according to USEPA's (and subsequently NDEP's) asbestos risk assessment guidance (U.S. EPA, 2003). The results of the screening-level soil HRA can be summarized as follows:

- **Chemicals (other than asbestos):** The total cumulative non-cancer HI for future commercial/industrial receptors at the property is 0.27. The largest contributor to the cumulative HI is lead. The total theoretical upper-bound ILCR for future commercial/industrial receptors at the property for non-radionuclides is 1×10^{-6}. The largest contributors to the cumulative ILCR are dioxins/furans, alpha-BHC and polycyclic aromatic hydrocarbons (PAHs).

[1] A draft figure showing chloroform concentrations in soil gas and groundwater was provided as part of the Site-Wide Data meeting with NDEP on February 5, 2010. The presence of VOCs in soil gas and groundwater will be evaluated as part of the site-wide soil gas report for the Tronox facility.

- **Radionuclides:** The total theoretical upper-bound ILCR for future commercial/industrial receptors at the property for radionuclides is 3×10^{-6}. The largest contributor to the cumulative ILCR is uranium-238.

- **Asbestos:** The estimated risks for death from lung cancer or mesothelioma for asbestos exposures to outdoor maintenance worker receptors were below 1×10^{-6}. For construction workers, the best estimate and upper bound concentrations of asbestos range from 1×10^{-7} (best estimate) to 8×10^{-7} (upper bound estimate) for chrysotile fibers, and from zero (best estimate) to 5×10^{-6} (upper bound estimate) for amphibole fibers (no long amphibole structures have been detected at the property).

5.0 SUMMARY

This technical memorandum presents the results of a screening-level indoor air HRA for COPCs in soil gas at Parcels A and B. All chemicals detected in soil gas were identified as COPCs, regardless of detected concentration or detection frequency. The maximum detected concentration was used as the exposure point concentration. USEPA's J&E model was used to estimate indoor air concentrations for indoor commercial workers and associated non-cancer HIs and ILCRs. The estimated cumulative HI ranged from 0.0008 to 0.002, depending on the assumptions for air exchange rate and vapor flow into a building, and was driven primarily by chloroform. The cumulative ILCRs ranged from 5×10^{-7} to 1×10^{-6}, and were also driven by chloroform. The apparent source of chloroform and other chemicals detected in soil gas is impacted groundwater located south and west (upgradient) of Parcels A and B.

The results of a separate screening-level HRA for chemicals detected in soil at Parcels A and B were also summarized so that the results from both screening-level HRAs can be considered in concert. All chemicals detected in soil above background concentrations were identified as COPCs. As with the soil gas assessment, the maximum detected concentration was used as the exposure point concentration to evaluate both commercial/industrial workers and construction workers. The estimated cumulative HI was 0.27 and was driven by lead. The estimated cumulative ILCR for non-radionculides was 1×10^{-6}, and was driven by dioxins/furans, alpha-BHC and PAHs. For radionuclides, the estimated cumulative ILCR was 3×10^{-6}, and was driven by uranium-238. Finally, the best estimates of risk associated with exposure to asbestos were below 1×10^{-6} whereas the upper-bound estimates ranged from 8×10^{-7} (chrysotile fibers) to 5×10^{-6} (amphibole fibers). It should be noted that chloroform was not detected in any of the 64 soil samples collected at the property.

Figure

Tables

Attachments

5.0 REFERENCES

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Figure

Figure origin: BEC / Tronox Parcels A/B Data Review, BMI Common Areas, Henderson, Nevada, March 25, 2010

SHEET NUMBER:	FIGURE NUMBER:
X	1

TRONOX PARCELS A/B
PHASE B SOIL GAS
SAMPLE LOCATIONS
Tronox Facility
Henderson, Nevada

SCALE:	DATE:	PROJECT NUMBER:
AS NOTED	06/29/10	2027.02

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Tables

TABLE 1
Parcel A/B Soil Gas Data Results Summary

Chemical	Sample Count	Detection Count	Frequency of Detections	Minimum DL (µg/m^3)	Maximum DL (µg/m^3)	Minimum Detection (µg/m^3)	Maximum Detection (µg/m^3)	Median (µg/m^3)	Mean (µg/m^3)	Standard Deviation	Location of Max Detection	Target Shallow Soil Gas to Indoor Air Concentration (µg/m^3)[1]	Count of DLs > Target Soil Gas Concentration
1,1,1-Trichloroethane	9	0	0%	0.074	0.085	-	-	0.039	0.0398	-	-	2.2E+04	0
1,1,2,2-Tetrachloroethane	9	0	0%	0.094	0.11	-	-	0.0495	0.0505	-	-	4.2E-01	0
1,1,2-Trichloroethane	9	1	11%	0.074	0.085	0.12	0.12	0.039	0.0486	-	SG05B-05	1.5E+00	0
1,1,2-Trichlorotrifluoroethane	9	9	100%	-	-	0.45	0.63	0.49	0.503	0.0559	SG12B-05	3.0E+05	-
1,1-Dichloroethane	9	7	78%	0.077	0.078	0.11	27	0.41	7.96	11.3	SG01B-05	5.0E+03	0
1,1-Dichloroethene	9	2	22%	0.077	0.085	0.1	0.12	0.0405	0.0554	0.0141	SG02B-05	2.0E+03	0
1,2,4-Trichlorobenzene	9	3	33%	0.11	0.13	0.2	0.75	0.06	0.201	0.275	SG02B-05	2.0E+03	0
1,2,4-Trimethylbenzene	9	9	100%	-	-	0.12	3.5	0.37	0.868	1.18	SG03B-05	6.0E+01	-
1,2-Dibromo-3-chloropropane	9	0	0%	0.11	0.13	-	-	0.06	0.0606	-	-	2.0E+00	0
1,2-Dichlorobenzene	9	0	0%	0.097	0.11	-	-	0.05	0.0521	-	-	2.0E+03	0
1,2-Dichloroethane	9	3	33%	0.074	0.081	0.32	1.1	0.039	0.249	0.396	SG05B-05	9.4E-01	0
1,2-Dichloropropane	9	4	44%	0.077	0.085	0.085	0.47	0.0425	0.109	0.185	SG05B-05	4.0E+01	0
1,2-Dichlorotetrafluoroethane	9	5	56%	0.077	0.085	0.085	0.1	0.085	0.0703	0.00709	SG11B-05	NA	-
1,3,5-Trimethylbenzene	9	5	56%	0.092	0.1	0.09	1.9	0.09	0.33	0.77	SG03B-05	6.0E+01	0
1,3-Dichlorobenzene	9	3	33%	0.095	0.11	0.098	0.32	0.055	0.1	0.112	SG12B-05	1.1E+03	0
1,4-Dichlorobenzene	9	9	100%	-	-	0.31	43	0.84	7.96	14.2	SG05B-05	8.0E+03	-
1,4-Dioxane	9	5	56%	0.093	0.1	0.14	0.39	0.14	0.133	0.107	SG03B-05	NA	-
2-Butanone	9	9	100%	-	-	4.6	13	7	7.33	2.45	SG03B-05	1.0E+04	-
2-Hexanone	9	9	100%	-	-	0.26	0.52	0.43	0.419	0.0703	SG06B-05	NA	-
2-Methoxy-2-methyl-butane	9	0	0%	0.074	0.085	-	-	0.039	0.0398	-	-	NA	-
4-Ethyltoluene	9	6	67%	0.087	0.097	0.11	1.5	0.11	0.288	0.551	SG03B-05	NA	-
4-Isopropyltoluene	9	7	78%	0.1	0.11	0.13	4.4	0.18	0.724	1.55	SG06B-05	NA	-
4-Methyl-2-pentanone	9	9	100%	-	-	0.14	9.2	0.29	1.26	2.98	SG06B-05	8.0E+02	-
Acetone	9	7	78%	0.11	0.11	12	50	18	19.2	13	SG11B-05	3.5E+03	0
Acrylonitrile	9	3	33%	0.11	0.12	0.11	0.12	0.06	0.0767	0.00577	SG03B-05	3.6E-01	0
Allyl chloride	9	1	11%	0.074	0.085	0.17	0.17	0.039	0.0541	-	SG05B-05	NA	-
alpha-Methylstyrene	9	4	44%	0.11	0.12	0.13	7.7	0.06	0.961	3.74	SG12B-05	NA	-
Benzene	9	9	100%	-	-	1.2	2.7	1.9	1.88	0.529	SG03B-05	3.1E+00	-
Benzyl Chloride	9	0	0%	0.13	0.15	-	-	0.065	0.0683	-	-	5.0E-01	0
Bromodichloromethane	9	6	67%	0.081	0.085	0.098	0.67	0.18	0.203	0.205	SG12B-05	1.4E+00	0
Bromoform	9	1	11%	0.11	0.13	0.27	0.27	0.06	0.0839	-	SG06B-05	2.2E+01	0
Bromomethane	9	1	11%	0.074	0.085	0.11	0.11	0.039	0.0475	-	SG03B-05	5.0E+01	0
Carbon disulfide	9	7	78%	0.18	0.18	1.5	14	2	4.8	5.51	SG10B-05	7.0E+03	0
Carbon tetrachloride	9	9	100%	-	-	0.25	11	0.39	2.99	4.14	SG11B-05	1.6E+00	-
Chlorobenzene	9	3	33%	0.075	0.087	0.16	0.31	0.0415	0.098	0.0839	SG12B-05	6.0E+02	0
Chloroethane	9	7	78%	0.077	0.078	0.14	11	0.87	3.1	4.28	SG01B-05	1.0E+05	0
Chloroform	9	9	100%	-	-	8.6	440	34	139	179	SG10B-05	1.1E+00	-
Chloromethane	9	1	11%	0.077	0.085	0.076	0.076	0.0405	0.0441	-	SG11B-05	2.4E+01	0
cis-1,2-Dichloroethene	9	2	22%	0.074	0.085	0.15	13	0.041	1.49	9.09	SG04B-05	3.5E+02	0
trans-1,3-Dichloropropene	9	0	0%	0.076	0.088	-	-	0.0405	0.0412	-	-	NA	-
Dibromochloromethane	9	1	11%	0.1	0.12	0.12	0.12	0.055	0.0617	-	SG01B-05	1.0E+00	0
Dichlorodifluoromethane	9	9	100%	-	-	1.8	2.1	2	2.01	0.0928	SG10B-05	2.0E+03	-
Ethanol	9	9	100%	-	-	2.3	32	11	13.9	10.6	SG12B-05	NA	-
Ethyl t-butyl ether	9	0	0%	0.075	0.087	-	-	0.0395	0.0405	-	-	NA	-
Ethylbenzene	9	7	78%	0.095	0.11	0.1	1.2	0.21	0.358	0.379	SG03B-05	2.2E+01	0
Ethylene dibromide	9	0	0%	0.079	0.092	-	-	0.042	0.0428	-	-	1.1E-01	0
Hexachlorobutadiene	9	5	56%	0.14	0.15	0.49	2.4	0.49	0.654	0.76	SG04B-05	1.1E+00	0
isopropyl ether	9	0	0%	0.087	0.1	-	-	0.0455	0.0467	-	-	NA	-

TABLE 1
Parcel A/B Soil Gas Data Results Summary

Chemical	Sample Count	Detection Count	Frequency of Detections	Minimum DL (µg/m^3)	Maximum DL (µg/m^3)	Minimum Detection (µg/m^3)	Maximum Detection (µg/m^3)	Median (µg/m^3)	Mean (µg/m^3)	Standard Deviation	Location of Max Detection	Target Shallow Soil Gas to Indoor Air Concentration (µg/m^3)[1]	Count of DLs > Target Soil Gas Concentration
Isopropylbenzene	9	3	33%	0.082	0.095	0.088	0.19	0.0475	0.074	0.0522	SG03B-05	4.0E+03	0
m,p-Xylene	9	8	89%	0.2	0.2	0.22	5.9	0.8	1.36	1.85	SG03B-05	7.0E+04	0
Methyl methacrylate	9	1	11%	0.11	0.13	0.42	0.42	0.06	0.1	-	SG05B-05	7.0E+03	0
Methyl tert butyl ether	9	6	67%	0.077	0.082	0.1	7.8	0.33	1.4	2.98	SG11B-05	3.0E+04	0
Methylene chloride	9	8	89%	0.077	0.077	0.23	3.7	0.63	1.13	1.31	SG01B-05	5.2E+01	0
Naphthalene	9	9	100%	-	-	0.42	4.2	0.83	1.2	1.16	SG06B-05	3.0E+01	-
N-Butylbenzene	9	9	100%	-	-	0.12	0.68	0.26	0.311	0.197	SG06B-05	1.4E+03	-
n-Heptane	9	6	67%	0.098	0.11	0.24	0.72	0.25	0.301	0.198	SG05B-05	NA	-
n-Octane	9	4	44%	0.077	0.085	0.23	1.5	0.0425	0.284	0.61	SG06B-05	NA	-
N-Propylbenzene	9	5	56%	0.08	0.088	0.084	0.52	0.084	0.153	0.173	SG03B-05	1.4E+03	0
o-Xylene	9	7	78%	0.096	0.11	0.12	2.1	0.4	0.534	0.672	SG03B-05	7.0E+04	0
sec-Butylbenzene	9	1	11%	0.085	0.099	0.097	0.097	0.045	0.0516	-	SG03B-05	1.4E+03	0
Styrene	9	5	56%	0.12	0.13	0.16	0.6	0.16	0.224	0.162	SG10B-05	1.0E+04	0
t-Butyl alcohol	9	9	100%	-	-	0.20	0.67	0.45	0.44	0.14	SG11B-05	NA	-
tert-Butylbenzene	9	1	11%	0.074	0.085	0.14	0.14	0.04	0.05	-	SG12B-05	1.4E+03	0
Tetrachloroethene	9	9	100%	-	-	1.10	30	5.30	7.40	8.8	SG05B-05	8.1E+00	-
Toluene	9	9	100%	-	-	1.20	19	2.00	4.41	5.7	SG05B-05	4.0E+03	-
trans-1,2-Dichloroethylene	9	0	0%	0.074	0.085	-	-	0.04	0.04	-	-	7.0E+02	0
trans-1,3-Dichloropropene	9	0	0%	0.093	0.11	-	-	0.05	0.05	-	-	NA	-
Trichloroethene	9	9	100%	-	-	0.96	42	1.3	6.5	13	SG04B-05	2.2E-01	-
Trichlorofluoromethane	9	9	100%	-	-	0.95	1.4	1.1	1.1	0.15	SG12B-05	7.0E+03	-
Vinyl acetate	9	7	78%	0.25	0.25	0.99	5	2.9	2.6	1.4	SG11B-05	2.0E+03	0
Vinyl chloride	9	2	22%	0.074	0.082	0.12	0.12	0.039	0.057	0	SG01B-05	2.8E+00	0

Notes:

1 - Shallow soil gas to indoor air vapor intrusion screening levels from USEPA (2002a), Table 2c (Generic Screening Levels and Summary Sheet; Risk - 1 x 10^{-6})

DL=Detection Limit

ug/m3=micrograms per cubic meter

TABLE 2
Johnson and Ettinger Model Input Parameters

Parameter	Value	Reference/Rationale
Depth below grade to bottom of enclosed floor space (cm)	15	Model default (slab on grade)
Soil gas sampling depth (cm)	150	Site-specific (five feet below ground surface [bgs])
Average soil temperature (°C)	17	Site-specific (Figure 8, USEPA 2004, p. 48)[1]
Thickness of soil stratum (cm) A	150	Site-specific (five feet bgs)
Thickness of soil stratum (cm) B	0	No stratum B; used single stratum model
Thickness of soil stratum (cm) C	0	No stratum C; used single stratum model
Soil stratum used to calculate soil vapor permeability	S	Sand
Vadose zone dry bulk density (g/cm^3)	1.83	Site-specific (Borrow Area data)
Vadose zone total porosity (unitless)	0.30	Site-specific (Borrow Area data)
Vadose zone water-filled porosity (unitless)	0.090	(Dry bulk density/water density) × soil moisture content[2]
Stratum B soil parameters	blank	No stratum B; used single stratum model
Stratum C soil parameters	blank	No stratum C; used single stratum model
Enclosed space floor thickness (cm)	10	Model default
Soil-building pressure differential ($g/cm\text{-}s^2$)	40	Model default
Enclosed space floor length (cm)	2,000	MDEQ - commericial (2001)
Enclosed space floor width (cm)	2,000	MDEQ - commericial (2001)
Modeling Enclosed space height (cm)	244	Model default
Floor-wall seam crack width (cm)	0.1	Model default
Indoor air exchange rate (1/hr)	1 or 2	Cal-EPA (2005) or MDEQ (2001)
Average vapor flow rate into building, Qsoil (L/m)	20 or Calculated	Model default or calculated (Eq. 15, USEPA 2004, p. 22)
Averaging time for carcinogens (yrs)	70	USEPA 2002b
Averaging time for non-carcinogens (yrs)	25	USEPA 2002b
Exposure duration (yrs)	25	USEPA 2002b
Exposure frequency (days/yr)	250	USEPA 2002b

Notes:
1 - This value is essentially the same as the average air temperatue of 19 °C in Boulder City, NV (www.weatherbase.com)
2 - Where soil moisture content=gravimetric moisture content per ASTM D2216; site-specific value=0.049

TABLE 3
Screening-Level Indoor Air Health Risk Assessment Results
(Qsoil-20 L/m and ER=1/h)

Chemical	J&E Predicted Indoor Air Conc. ($\mu g/m^3$)	Unit Risk Factor $(\mu g/m^3)^{-1}$	Key	Non-Cancer Reference Concentration (mg/m^3)	Key	Incremental Lifetime Cancer Risk	Non-Cancer Hazard Index
1,1,2-Trichloroethane	4.5 E-5	1.6 E-5	I	NA		2.E-10	NA
1,1,2-Trichlorotrifluoroethane	2.4 E-4	NA		3.0 E+1	H	NA	5 E-9
1,1-Dichloroethane	9.8 E-3	1.6 E-6	CA	NA		4.E-09	NA
1,1-Dichloroethene	5.0 E-5	NA		2.0 E-1	I	NA	2 E-7
1,2,4-Trichlorobenzene	1.3 E-4	NA		2.0 E-3	P	NA	5 E-5
1,2,4-Trimethylbenzene	1.1 E-3	NA		7.0 E-3	P	NA	1 E-4
1,2-Dichloroethane	5.0 E-4	2.6 E-5	I	2.4 E+0	A	3.E-09	1 E-7
1,2-Dichloropropane	1.8 E-4	1.0 E-5	CA	4.0 E-3	I	4.E-10	3 E-5
1,2-Dichlorotetrafluoroethane	3.7 E-5	NA		NA		NA	NA
1,3,5-Trimethylbenzene	5.9 E-4	NA		6.0 E-3	P	NA	7 E-5
1,3-Dichlorobenzene	1.1 E-4	NA		NA		NA	NA
1,4-Dichlorobenzene	1.5 E-2	1.1 E-5	CA	8.0 E-1	I	4.E-08	1 E-5
1,4-Dioxane	1.7 E-4	7.7 E-6	CA	3.6 E+0	A	3.E-10	3 E-8
2-Butanone	5.0 E-3	NA		5.0 E+0	I	NA	7 E-7
2-Hexanone	3.4 E-4	NA		3.0 E-2	I	NA	8 E-6
4-Ethyltoluene	6.1 E-4	NA		NA		NA	NA
4-Isopropyltoluene	1.3 E-3	NA		NA		NA	NA
4-Methyl-2-pentanone	3.4 E-3	NA		3.0 E+0	I	NA	8 E-7
Acetone	2.5 E-2	NA		3.1 E+1	A	NA	6 E-7
Acrylonitrile	6.0 E-5	6.8 E-5	I	2.0 E-3	I	1.E-09	2 E-5
Allyl chloride	8.3 E-5	6.0 E-6	C	1.0 E-3	I	1.E-10	6 E-5
alpha-Methylstyrene	5.7 E-3	NA		NA		NA	NA
Benzene	1.1 E-3	7.8 E-6	I	3.0 E-2	I	2.E-09	3 E-5
Bromodichloromethane	1.2 E-4	3.7 E-5	C	NA		1.E-09	NA
Bromoform	2.6 E-5	1.1 E-6	I	NA		7.E-12	NA
Bromomethane	3.9 E-5	NA		5.0 E-3	I	NA	5 E-6
Carbon disulfide	6.4 E-3	NA		7.0 E-1	I	NA	6 E-6
Carbon tetrachloride	4.1 E-3	6.0 E-6	I	1.0 E-1	I	6.E-09	3 E-5
Chlorobenzene	1.1 E-4	NA		5.0 E-2	P	NA	2 E-6
Chloroethane	8.2 E-3	NA		1.0 E+1	I	NA	6 E-7
Chloroform	2.0 E-1	2.3 E-5	I	9.8 E-2	A	1.E-06	1 E-3
Chloromethane	3.9 E-5	1.8 E-6	H	9.0 E-2	I	2.E-11	3 E-7
cis-1,2-Dichloroethene	4.7 E-3	NA		NA		NA	NA
Dibromochloromethane	1.5 E-5	2.7 E-5	CA	NA		1.E-10	NA
Dichlorodifluoromethane	7.0 E-4	NA		2.0 E-1	H	NA	2 E-6
Ethanol	1.6 E-2	NA		NA		NA	NA
Ethylbenzene	4.4 E-4	2.5 E-6	CA	1.0 E+0	I	3.E-10	3 E-7
Hexachlorobutadiene	7.1 E-4	2.2 E-5	I	NA		4.E-09	NA
Isopropylbenzene	6.3 E-5	NA		4.0 E-1	I	NA	1 E-7
m,p-Xylene	2.2 E-3	NA		7.0 E-1	CA	NA	2 E-6
Methyl methacrylate	1.6 E-4	NA		7.0 E-1	I	NA	2 E-7
Methyl tert butyl ether	3.5 E-3	2.6 E-7	CA	3.0 E+0	I	2.E-10	8 E-7
Methylene chloride	1.6 E-3	4.7 E-7	I	1.1 E+0	A	2.E-10	1 E-6
Naphthalene	1.3 E-3	3.4 E-5	CA	3.0 E-3	I	1.E-08	3 E-4
N-Butylbenzene	2.0 E-4	NA		NA		NA	NA
n-Heptane	4.7 E-4	NA		NA		NA	NA
n-Octane	5.5 E-4	NA		NA		NA	NA
N-Propylbenzene	1.6 E-4	NA		1.0 E+0	X	NA	1 E-7
o-Xylene	8.5 E-4	NA		7.0 E-1	CA	NA	8 E-7

TABLE 3
Screening-Level Indoor Air Health Risk Assessment Results
(Qsoil-20 L/m and ER=1/h)

Chemical	J&E Predicted Indoor Air Conc. ($\mu g/m^3$)	Unit Risk Factor $(\mu g/m^3)^{-1}$	Key	Non-Cancer Reference Concentration (mg/m^3)	Key	Incremental Lifetime Cancer Risk	Non-Cancer Hazard Index
sec-Butylbenzene	2.9 E-5	NA		NA		NA	NA
Styrene	2.1 E-4	NA		1.0 E+0	I	NA	1 E-7
t-Butyl alcohol	2.8 E-4	NA		NA		NA	NA
tert-Butylbenzene	4.2 E-5	NA		NA		NA	NA
Tetrachloroethene	1.1 E-2	5.9 E-6	CA	2.7 E-1	A	2.E-08	3 E-5
Toluene	7.7 E-3	NA		5.0 E+0	I	NA	1 E-6
Trichloroethene	1.6 E-2	2.0 E-6	CA	NA		8.E-09	NA
Trichlorofluoromethane	5.7 E-4	NA		7.0 E-1	H	NA	6 E-7
Vinyl acetate	2.0 E-3	NA		2.0 E-1	I	NA	7 E-6
Vinyl chloride	5.5 E-5	4.4 E-6	I	1.0 E-1	I	6.E-11	4 E-7
	Total					1.E-06	2 E-3

Notes:
NA=Toxicity criterion has not been established.
ER=Indoor air exchange rate
Qsoil=Average vapor flow rate

Key:
I=IRIS - Accessed June 2010 (http://www.epa.gov/iris/)
CA=CalEPA - Accessed June 2010 (http://oehha.ca.gov/risk/chemicalDB/index.asp)
P=PPRTV - as cited in NDEP BCLs table (2009) or
the EPA RSLs table (2010) (http://www.epa.gov/region9/superfund/prg/index.html)
X=PPRTV Appendix A - as cited in EPA RSLs table (2010)
A=ATSDR - as cited in NDEP BCLs table (2009) or in the EPA RSLs table (2010)
H=HEAST - as cited in NDEP BCLs table (2009) or in the EPA RSLs table (2010)

Units:
$\mu g/m^3$=micrograms per cubic meter
mg/m^3=milligrams per cubic meter

TABLE 4
Screening-Level Indoor Air Health Risk Assessment Results
(Qsoil=calculated and ER=2/h)

Chemical	J&E Predicted Indoor Air Conc. ($\mu g/m^3$)	Unit Risk Factor $(\mu g/m^3)^{-1}$	Key	Non-Cancer Reference Concentration (mg/m^3)	Key	Incremental Lifetime Cancer Risk	Non-Cancer Hazard Index
1,1,2-Trichloroethane	1.7 E-5	1.6 E-5	I	NA		7.E-11	NA
1,1,2-Trichlorotrifluoroethane	9.1 E-5	NA		3.0 E+1	H	NA	2 E-9
1,1-Dichloroethane	3.8 E-3	1.6 E-6	CA	NA		1.E-09	NA
1,1-Dichloroethene	1.9 E-5	NA		2.0 E-1	I	NA	6 E-8
1,2,4-Trichlorobenzene	5.8 E-5	NA		2.0 E-3	P	NA	2 E-5
1,2,4-Trimethylbenzene	4.4 E-4	NA		7.0 E-3	P	NA	4 E-5
1,2-Dichloroethane	1.8 E-4	2.6 E-5	I	2.4 E+0	A	1.E-09	5 E-8
1,2-Dichloropropane	6.8 E-5	1.0 E-5	CA	4.0 E-3	I	2.E-10	1 E-5
1,2-Dichlorotetrafluoroethane	1.4 E-5	NA		NA		NA	NA
1,3,5-Trimethylbenzene	2.4 E-4	NA		6.0 E-3	P	NA	3 E-5
1,3-Dichlorobenzene	4.3 E-5	NA		NA		NA	NA
1,4-Dichlorobenzene	5.8 E-3	1.1 E-5	CA	8.0 E-1	I	2.E-08	5 E-6
1,4-Dioxane	6.4 E-5	7.7 E-6	CA	3.6 E+0	A	1.E-10	1 E-8
2-Butanone	1.9 E-3	NA		5.0 E+0	I	NA	3 E-7
2-Hexanone	1.1 E-4	NA		3.0 E-2	I	NA	3 E-6
4-Ethyltoluene	2.3 E-4	NA		NA		NA	NA
4-Isopropyltoluene	5.2 E-4	NA		NA		NA	NA
4-Methyl-2-pentanone	1.3 E-3	NA		3.0 E+0	I	NA	3 E-7
Acetone	9.0 E-3	NA		3.1 E+1	A	NA	2 E-7
Acrylonitrile	2.1 E-5	6.8 E-5	I	2.0 E-3	I	4.E-10	7 E-6
Allyl chloride	3.0 E-5	6.0 E-6	C	1.0 E-3	I	4.E-11	2 E-5
alpha-Methylstyrene	1.8 E-3	NA		NA		NA	NA
Benzene	4.2 E-4	7.8 E-6	I	3.0 E-2	I	8.E-10	9 E-6
Bromodichloromethane	5.2 E-5	3.7 E-5	C	NA		5.E-10	NA
Bromoform	1.2 E-5	1.1 E-6	I	NA		3.E-12	NA
Bromomethane	1.5 E-5	NA		5.0 E-3	I	NA	2 E-6
Carbon disulfide	2.3 E-3	NA		7.0 E-1	I	NA	2 E-6
Carbon tetrachloride	1.6 E-3	6.0 E-6	I	1.0 E-1	I	2.E-09	1 E-5
Chlorobenzene	4.3 E-5	NA		5.0 E-2	P	NA	6 E-7
Chloroethane	2.6 E-3	NA		1.0 E+1	I	NA	2 E-7
Chloroform	7.3 E-2	2.3 E-5	I	9.8 E-2	A	4.E-07	5 E-4
Chloromethane	1.4 E-5	1.8 E-6	H	9.0 E-2	I	6.E-12	1 E-7
cis-1,2-Dichloroethene	1.8 E-3	NA		NA		NA	NA
Dibromochloromethane	6.7 E-6	2.7 E-5	CA	NA		4.E-11	NA
Dichlorodifluoromethane	2.8 E-4	NA		2.0 E-1	H	NA	1 E-6
Ethanol	5.8 E-3	NA		NA		NA	NA
Ethylbenzene	1.7 E-4	2.5 E-6	CA	1.0 E+0	I	1.E-10	1 E-7
Hexachlorobutadiene	2.9 E-4	2.2 E-5	I	NA		2.E-09	NA
Isopropylbenzene	2.5 E-5	NA		4.0 E-1	I	NA	4 E-8
m,p-Xylene	8.5 E-4	NA		7.0 E-1	CA	NA	8 E-7
Methyl methacrylate	6.0 E-5	NA		7.0 E-1	I	NA	6 E-8
Methyl tert butyl ether	1.3 E-3	2.6 E-7	CA	3.0 E+0	I	8.E-11	3 E-7
Methylene chloride	6.1 E-4	4.7 E-7	I	1.1 E+0	A	7.E-11	4 E-7
Naphthalene	5.2 E-4	3.4 E-5	CA	3.0 E-3	I	4.E-09	1 E-4
N-Butylbenzene	8.2 E-5	NA		NA		NA	NA

TABLE 4
Screening-Level Indoor Air Health Risk Assessment Results
(Qsoil=calculated and ER=2/h)

Chemical	J&E Predicted Indoor Air Conc. ($\mu g/m^3$)	Unit Risk Factor $(\mu g/m^3)^{-1}$	Key	Non-Cancer Reference Concentration (mg/m^3)	Key	Incremental Lifetime Cancer Risk	Non-Cancer Hazard Index
n-Heptane	1.5 E-4	NA		NA		NA	NA
n-Octane	2.1 E-4	NA		NA		NA	NA
N-Propylbenzene	6.5 E-5	NA		1.0 E+0	X	NA	4 E-8
o-Xylene	3.2 E-4	NA		7.0 E-1	CA	NA	3 E-7
sec-Butylbenzene	1.2 E-5	NA		NA		NA	NA
Styrene	8.2 E-5	NA		1.0 E+0	I	NA	6 E-8
t-Butyl alcohol	1.1 E-4	NA		NA		NA	NA
tert-Butylbenzene	1.7 E-5	NA		NA		NA	NA
Tetrachloroethene	4.1 E-3	5.9 E-6	CA	2.7 E-1	A	6.E-09	1 E-5
Toluene	2.9 E-3	NA		5.0 E+0	I	NA	4 E-7
Trichloroethene	6.1 E-3	2.0 E-6	CA	NA		3.E-09	NA
Trichlorofluoromethane	2.1 E-4	NA		7.0 E-1	H	NA	2 E-7
Vinyl acetate	7.6 E-4	NA		2.0 E-1	I	NA	3 E-6
Vinyl chloride	2.0 E-5	4.4 E-6	I	1.0 E-1	I	2.E-11	1 E-7
	Total					**5.E-07**	**8 E-4**

Notes:
NA=Toxicity criterion has not been established.
ER=Indoor air exchange rate
Qsoil=Average vapor flow rate

Key:
I=IRIS - Accessed June 2010 (http://www.epa.gov/iris/)
CA=CalEPA - Accessed June 2010 (http://oehha.ca.gov/risk/chemicalDB/index.asp)
P=PPRTV - as cited in NDEP BCLs table (2009) or
the EPA RSLs table (2010) (http://www.epa.gov/region9/superfund/prg/index.html)
X=PPRTV Appendix A - as cited in EPA RSLs table (2010)
A=ATSDR - as cited in NDEP BCLs table (2009) or in the EPA RSLs table (2010)
H=HEAST - as cited in NDEP BCLs table (2009) or in the EPA RSLs table (2010)

Units:
$\mu g/m^3$=micrograms per cubic meter
mg/m^3=milligrams per cubic meter

Attachment A

Redline Version of the Text (on CD)

Attachment B

Soil Gas Data for Parcels A and B (on CD)

Attachment C

Screening-Level Indoor Air Health Risk Assessment Calculation Spreadsheets (on CD)

northgate

environmental management, inc.

From: Deni Chambers
Renee Kalmes, Exponent
Greg Brorby, Exponent

Date: June 29, 2010

To: Shannon Harbour, PE
Nevada Division of Environmental Protection

RE: Response to Nevada Division of Environmental Protection's May 13, 2010 Comments on BRC's *Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada*, dated March 30, 2010

Responses to Comments

1. *General comment, please note that the comments provided below pertain to the redline strike-out (RLSO) version of the Deliverable.*

   Response: Comment noted.

2. *Page 2, Section 2.0, 4th paragraph, 1st sentence, the Tronox Risk Assessment Work Plan (and the BRC Closure Plan) describes receptors that will be considered for risk assessments performed for risk-based decision units at the Tronox facility. This list includes construction workers, outdoor workers (maintenance workers), and indoor (commercial) workers. On-site visitors will not be addressed quantitatively, although trespassers and off-site residents can be evaluated qualitatively. This should be clarified here.*

   Response: The text of Section 2.0 has been revised to clarify the receptors that will be considered for risk assessments performed at the Tronox facility in general and for receptors evaluated in the screening-level indoor air HRA in particular (p. 2).

3. *Page 2, Section 2.0, 4th paragraph, last sentence, this sentence should clarify that the scope of this risk assessment is indoor air.*

   Response: The text of Section 2.0 has been revised to clarify that the scope of this risk assessment is indoor air (p. 2).

4. *Page 3, Section 3.0, listed items, the listed items should match the intent of this indoor air risk assessment. For example, the 3rd listed item is irrelevant in this context and should be deleted. More generally, the listed items should recognize that this is a partial risk assessment, and that the results should be considered in concert with those presented in the previously approved (with conditions) Tronox Parcels A/B risk assessment report.*

Response: The text of Section 3.0 has been revised such that the listed items are relevant to this risk assessment (pp. 2-3). In addition a new section has been added (what is now Section 4.0) that summarizes the results of the screening-level HRA for soil (pp. 9-10) and the results of both assessments are discussed in the Summary section (now Section 5.0, p. 10).

5. *Page 4, Section 3.2, 1st paragraph, 8th line, please replace the discussion on what UCLs are with the text as follows: "For the 95 percent UCL concentration approach, the 95 percent UCL was computed in order to represent the area-wide exposure point concentrations. The 95 percent UCL is a statistic that quantifies the uncertainty associated with the sample mean. If randomly drawn subsets of site data are collected and the UCL is computed for each subset, the UCL will equal or exceed the true mean roughly 95 percent of the time. The purpose for using the 95 percent UCL is to derive a conservative, upper-bound estimate of the mean concentration, which takes into account the different concentrations a person may be exposed to at the Site. That is, an individual will be exposed to a range of concentrations that exist at an exposure area, from non-detect (ND) to the maximum concentration, over an entire exposure period"*

   Response: Section 3.2 has been revised to indicate that maximum detected concentrations were used as exposure point concentrations (p. 4); therefore, the suggested text regarding 95 percent UCLs was no longer relevant and thus not added to this section of the document.

6. *Page 4, Section 3.2, 2nd paragraph, NDEP has the following comments:*
   a. *TRX should also note that this 95% UCL approach should only be applied if the data are from a single population, which has not been demonstrated and the data for chloroform indicate spatial differences (see comments on Table 1 below). Consequently, the data and hence the area, should probably be split into two sets or the maximum reported values should be used in the risk assessment instead of a UCL.*
   b. *TRX should also consider whether there are enough data to support a risk-based decision. Perhaps the indoor air risks should be considered in concert with the previous risks reported for other media exposures to provide multiple lines of evidence. For example, chloroform is the main driver for this risk assessment. Perhaps there are chloroform data for the other media that could be used to help explain or update the conceptual model for this site.*

   Response: (a) see response to Comment No. 5.
   (b) A new section has been added (what is now Section 4.0) that summarizes the results of the screening-level HRA for soil (pp. 9-10) and the results of both assessments are discussed in the Summary section (now Section 5.0, p. 10). As noted in revised document, chloroform was not detected in any of the 64 soil samples collected at the property. The apparent source of chloroform and other chemicals in soil gas is impacted groundwater south and west (upgradient) of Parcels A and B.

7. *Page 4, Section 3.2, 2nd paragraph, it is not clear how detection limits were treated for calculation of UCLs. Based on some of the values reported in Table 1, it appears as though ½ the detection limit (DL) was used. Please clarify.*

   Response: This comment is no longer relevant because 95 percent UCLs were not calculated; however, the text of Section 3.1 was revised to clarify that, consistent with NDEP guidance, one-half the detection limit was used to calculate the mean, median, and standard deviations presented in Table 1 (p. 3).

8. *Page 4, Footnote 1, the information alluded to in this footnote should be provided in a table so that a direct comparison of DLs and risk threshold concentrations is available in the report.*

   Response: A column has been added to Table 1 that provides the U.S. EPA indoor air screening levels referenced in the text to allow for a direct comparison to the detection limits also provided in the table. A second column was added that indicates the number of detection limits exceeding the screening value for each chemical. The chemicals eliminated from further evaluation based on this comparison are discussed in 3.1 (p. 3).

9. *Page 5, Section 3.2.1, last paragraph of the section, please clarify that average soil moisture content was determined using ASTM D2216. Additionally, the water-filled porosity in the above-quoted text should be corrected to read, water-filled porosity = 0.090.*

   Response: The text of Section 3.2.1 has been revised to indicate that soil moisture content was determined using ASTM D2216, and the typographical error has been corrected (pp. 4-5).

10. *Page 6, Section 3.3, 1st paragraph, last sentence, please update the references to the BRC Closure Plan to 2010.*

    Response: It is our understanding that the 2010 version of the BRC Closure Plan has not been finalized; therefore, the 2009 document is the most recent version available. Section 3.3. has been revised to update the reference to the 2009 BRC Closure Plan (p. 6).

11. *Page 7, Section 3.4, 2nd paragraph under bullets, last sentence, it is not clear to NDEP that these statements about the sampling data being sufficient are reasonable. The chloroform data are clearly spatially distinct between the east side of Parcel B and the remainder of the data. TRX should consider a different evaluation of the data.*

    Response: The text of Section 3.4 (as well as other sections in the document) has been revised to indicate that the maximum detected concentration was used as the exposure point concentrations (p. 7).

12. *Page 7, Section 3.4, 4th paragraph under bullets, regarding the Johnson and Ettinger (J&E) modeling, NDEP is not clear why the modeling was performed assuming a residential scenario, given that a residential scenario is not consistent with the future*

uses of the site, or with the TRX Health Risk Assessment Work Plan. Earlier in the report (Page 2), TRX states that a commercial scenario is protective of other potential receptors but no mention is made of a residential scenario. Please clarify.

Response: The text of Section 3.4 (as well as other sections in the document) has been revised to indicate that the J&E model was used to evaluate a commercial, rather than residential, scenario (p. 8). Revised calculation spreadsheets are provided in Attachment A that document the use of commercial exposure and modeling assumptions (also see response to Comment 16).

13. *Page 8, Section 3.5, 3rd paragraph, last sentence, please delete this sentence as NDEP will make the determination on what are "unacceptable carcinogenic risks".*

    Response: The text of Section 3.5 has been revised to note that the estimated excess cancer risks are equal to or below NDEP's point of departure of 1×10^{-6} (p. 9).

14. *Page 9, Section 4.0, 2nd paragraph, TRX should present the results of both risk assessments so that the risks can be evaluated together and that the risk drivers in both cases can be considered. The conceptual site model (CSM) would then be implicitly updated and an appropriate risk management decision could be made. Please provide risk estimates from both this indoor air risk assessment and from the risk assessment previously performed for the other media exposures.*

    Response: A new section has been added (what is now Section 4.0) that summarizes the results of the screening-level HRA for soil (pp. 9-10) and the results of both assessments are discussed in the Summary section (now Section 5.0, pp. 10-11).

15. *Table 1, NDEP provides comments as follows:*
    a. *NDEP notes that this table does not follow current NDEP guidance on summary tables. Half the DL appears to have been used for NDs for statistics other than the median and the mean. Please clarify.*
    b. *There are many detected values reported at levels that are lower than detection limits. This implies that reporting limits are used here instead of sample quantitation limits (SQLs). NDEP guidance indicates that SQLs should be reported. Please revise this table as necessary to comply with NDEP guidance.*
    c. *Since the data are not presented in the Deliverable, determining whether the UCL calculations are justified has been difficult. Chloroform is the chemical of primary concern (the primary risk driver for this pathway). NDEP retrieved the data from the NDEP database website (ndep.gisdt.org). The chloroform data from the NDEP database website (presented below) show that the high concentrations of chloroform are from locations SG10, SG11, and SG12, which are located on the eastern side of Parcel B, closer to known chloroform plumes. These data indicate that the population is not sufficiently homogeneous that an assumption of one population can be made; therefore, the calculation of a UCL is not appropriate because it "averages away" potential risk for decision units that are larger than exposure areas. Because the data are not indicative of one population and given the relatively few data points from the eastern side of Parcel B, the maximum concentration should be used in this screening risk assessment instead of the UCL (for all chemicals). Please note that the same*

spatial pattern has been observed for carbon tetrachloride. Please revise this Deliverable as necessary.

Chloroform data:

SG01	0.014
SG02	0.016
SG03	0.0086
SG04	0.0086
SG05	0.062
SG06	0.034
SG10	0.44
SG11	0.4
SG12	0.27

Response: (a) Table 1 has been revised to be consistent with NDEP guidance. It should be noted that the mean, median, and standard deviation were estimated assuming one-half the detection limit for non-detect values, which is also consistent with NDEP guidance.
(b) Table 1 has been updated such the detection limits are based on sample quantitation limits (SQLs).
(c) As stated previously, the maximum detected concentration was used as the exposure point concentration rather than the 95 percent UCL.

16. *Table 2, NDEP provides the following comments:*
    a. *Line 7, TRX should identify "Vadose zone total porosity (unitless)" as "Gravimetric moisture content per ASTM D2216".*
    b. *Line 8, Reference/Rationale, the equation provided is not dimensionally correct, please refer to the equation provided herein (above).*
    c. *While NDEP understands that pulling the J&E worksheets together simplifies presentation, for purposes of transparency TRX should then provide the actual inputs for the J&E in Table 2 and where necessary, Table 2 should include information (including formulas where necessary) that support the derivation of some of the hard-coded inputs in the specific J&E model worksheets.*
    d. *The crack-to-total-area ratio (crack fraction – cell F90) is specified in the specific J&E worksheets as 400/Area of enclosed space below grade (building area – cell E90). The value of 400 is really a consequence of a 4000 cm floor-wall seam perimeter (Cell K79) and the crack radius of 0.1 cm (Cell G100). Since the basic inputs are the perimeter and the radius, these should be included explicitly in the formula for crack fraction. Please revise.*

Response: (a) Line 8 (not 7) of Table 2 has been moved to a footnote for Line 9, where "Soil moisture content" has been replaced with "Gravimetric moisture content per ASTM D2216."
(b) Line 9 of Table 2 has been updated so that the equation provided under Reference/Rationale is dimensionally correct.
(c) The J&E Modeling spreadsheet used in this assessment is included in Attachment B. This is the "advanced" soil gas spreadsheet as opposed to the "screening" spreadsheet used previously. All of the non-chemical-specific input values are shown on the "Data Entry Sheet" worksheet and are provided in Table 2. Unlike the "screening" version of the spreadsheet, the "advanced" version does not

include any additional “hard-coded” input values. Instead, all values are calculated from the input parameters shown on the “Data Entry Sheet” worksheet or in Table 2.
(d) See the response to (c) above.

17. *Attachment A, NDEP provides the following comments:*
    a. *Response-to-comment (RTC) # 3, the comparisons for the NDs should be given in a table, which may demonstrate that all of the DLs were less than soil gas screening criteria and could not contribute significantly to risk. Please revise as necessary.*
    b. *RTC # 5a, TRX has not demonstrated that the data are sufficient for decision making. Given the apparent spatial differences described above, it seems that only three samples have been taken in the area of greatest risk-based concentrations (i.e. the east side of Parcel B). Please clarify.*
    c. *RTC # 6, the additional text included in response to NDEP’s original comment provides no useful specific information about the risk assessment performed for the other pathways. The risks should be presented so that NDEP can consider both sets of risks together with the risk drivers for both assessments identified.*

    Response: (a) The U.S. EPA soil screening levels have been added to Table 1.
    (b) The maximum detected concentration was used as the exposure point concentration rather than the 95 percent UCL. This is conservative assumption given that it is unlikely that receptor will be exposed to the maximum concentrations of all COPCs over an extended period of time.
    (c) A new section has been added (what is now Section 4.0) that summarizes the results of the screening-level HRA for soil (pp. 9-10) and the results of both assessments are discussed in the Summary section (now Section 5.0, pp. 10-11).

Tab 8

Nevada Division of Environmental Protection (NDEP) Response to: Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation And Errata Tronox LLC, Henderson, Nevada, Dated June 29, 2010

August 31, 2010

ndep
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Jim Gibbons, Governor
Allen Biaggi, Director
Leo M. Drozdoff, P.E., Administrator

August 31, 2010

Matt Paque
Tronox LLC
PO BOX 268859
Oklahoma City, OK 73134

Re: **Tronox LLC (TRX)**
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection (NDEP) Response to:
Revised Technical Memorandum: Screening-Level Indoor Air Health Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Tronox LLC, Henderson, Nevada
Dated: June 29, 2010

And

Errata to Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Tronox LLC, Henderson Nevada: NDEP Facility ID # 000539

Dear Mr. Paque,

The NDEP has received and reviewed TRX's above-identified Deliverable and provides comments in Attachment A. A revised Deliverable should be submitted **by September 21, 2010** based on the comments found in Attachment A. TRX should additionally provide an annotated response-to-comments letter as part of the revised Deliverable.

Please contact the undersigned with any questions at sharbour@ndep.nv.gov or 775-687-9332.

Sincerely,

Shannon Harbour, P.E.
Staff Engineer III
Bureau of Corrective Actions
Special Projects Branch
NDEP-Carson City Office
Fax: 775-687-8335

SH:gl:sh

EC: Jim Najima, Bureau of Corrective Actions, NDEP
Greg Lovato, Bureau of Corrective Actions, NDEP

Brenda Pohlmann, City of Henderson
Mitch Kaplan, U.S. Environmental Protection Agency, Region 9
Mike Skromyda, Tronox LLC
Michael J. Foster, Tronox LLC
Keith Bailey, Environmental Answers LLC
Susan Crowley, Tronox LLC (Contractor)
Deni Chambers, Northgate Environmental
Brian Rakvica, McGinley and Associates
Joe McGinley, McGinley & Associates
Barry Conaty, Holland & Hart LLP
Ranajit Sahu, BRC
Rick Kellogg, BRC
Lee Farris, BRC
Mark Paris, Landwell
Craig Wilkinson, TIMET
Kirk Stowers, Broadbent & Associates
Victoria Tyson, Tyson Contracting
George Crouse, Syngenta Crop Protection, Inc.
Nick Pogoncheff, PES Environmental
Lee Erickson, Stauffer Management Company
Michael Bellotti, Olin Corporation
Curt Richards, Olin Corporation
Paul Sundberg, Montrose Chemical Corporation
Joe Kelly, Montrose Chemical Corporation of CA
Jeff Gibson, AMPAC
Larry Cummings, AMPAC
Ebrahim Juma , Clean Water Team
Joe Leedy, Clean Water Team
Kathryn Hoffmann, Clean Water Team
Paul Hackenberry, Hackenberry Associates, LLC
Paul Black, Neptune and Company, Inc.
Kelly Black, Neptune and Company, Inc.
Teri Copeland, Neptune and Company, Inc.
Kurt Fehling, The Fehling Group, LLC
Joanne Otani

CC: Susan Crowley, C/O Tronox LLC, PO Box 55, Henderson, NV 89009
Lee Farris, BRC, 875 W. Warm Springs Road, Henderson, NV 89011
Lee Erickson, Stauffer Management Company

Attachment A

1. General comment, NDEP has noted that previous versions of the subject Deliverable were reviewed in late 2008 and in April 2010. NDEP acknowledges that, in general, most of the previous comments have been addressed; however, there are some cases that the way in which the comments have been addressed has raised new issues. General and specific comments are provided below. Note that the comments on the text pertain to the redline strike-out version.
2. General comment, TRX should note that not all of the electronic files were delivered on the CD included with the report. For future submittals, TRX should make sure that all electronic files are included with the Deliverable CD.
3. General comment, the following are elements of a risk assessment that are required in NDEP guidance that were not included in the Deliverable and should be included in the revised version. (Please note that several of these elements were also purposed in the health risk assessment (HRA) work plan and Chapter 9 of the BRC Closure Plan:
   a. Electronic copies of the laboratory reports. NDEP acknowledges that these laboratory reports are included in the data validation summary report (DVSR) but TRX should electronically provide either the DVSR or the laboratory reports in this HRA Deliverable. Additionally, the laboratory and the analytical methods used should be identified with the data or with the laboratory reports. For example, presumably TO-15 and TO-15 SIM were used and clarification is needed.
   b. A summary of the data validation that is reported in the DVSR to verify that the data are of sufficient quality from the laboratory.
   c. A data usability evaluation to demonstrate that the data are usable for the decision to be made.
   d. Plots of the data (including spatial plots) as part of exploratory data analysis (potentially focused on the primary contributors to the risk assessment results).
   e. A data quality assessment to demonstrate that enough data have been collected to support the decisions to be made.
4. Johnson & Ettinger (J&E) model, NDEP has the following comments:
   a. NDEP notes that several input parameters to the J&E model were changed from the previous version of this Deliverable with no explanation for the changes. Please clarify why the following values were changed and the rationale for the new value (Note: the values ***not in*** parentheses are the values from Table 2 in the current version of the report while those ***in*** parentheses are the values from Table 2 in the previous revision of the report):
      i. Average soil temperature (deg C): 17 (15)
      ii. Soil gas sampling depth (cm): 150 (200)
      iii. Thickness of soil stratum (cm): 150 (200)
      iv. Enclosed space floor thickness (cm): 10 (15)
      v. Enclosed space floor length (cm): 2000 (1000)
      vi. Enclosed space floor width (cm): 2000 (1000)
      vii. Average vapor flow rate into building (L/m): 20 (5)
      viii. Indoor air exchange rate (1/hr): 1 or 2 (0.25)

b. The following is a list of chemicals and the toxicological surrogates identified by NDEP to be used to obtain necessary toxicological values needed for the J&E model:

Chemical	Surrogate
1,2-Dichlorotetrafluoroethane	See Attachment B
1,3-Dichlorobenzene	1,2-Dichlorobenzene
4-Ethyltoluene	Isopropylbenzene (Cumene)
4-Isopropyltoluene	Isopropylbenzene (Cumene)
alpha-Methylstyrene	Styrene
cis-1,2-Dichloroethene	trans-1,2-Dichloroethylene
Ethanol	See Attachment B
N-Butylbenzene	Isopropylbenzene (Cumene)
n-Heptane	See Attachment B
n-Octane	See Attachment B
sec-Butylbenzene	Isopropylbenzene (Cumene)
t-Butyl alcohol	sec-Butyl Alcohol
tert-Butylbenzene	Isopropylbenzene (Cumene)

5. Page 1, Section 1.0, 11th line, NDEP has observed that a data summary, data usability and data adequacy are not presented. Please see above general comments for further details.
6. Page 3, Section 3.0, 2nd listed item, please clarify what is meant by the qualifier "most" in the sentence "For most known or suspected chemical carcinogens, the NDEP point of departure is a cumulative incremental lifetime cancer risk of 1x10-6" as this is not consistent with the approved TRX HRA work plan.
7. Page 4, Section 3.1, please clarify why a screening target of 1/10th BCL is not used for COPC selection to account for possible additive effects for chemicals that were not detected. Please discuss any differences that occur between the two screening methods. TRX should provide justification for not using the 1/10th BCL method if still applicable.
8. Page 5, Section 3.2, last sentence, please provide the appropriate reference for the use of the maximum concentration instead of the 95% UCL for this risk assessment.
9. Page 6, Section 3.2.1, 7th line from top of page, TRX references Table 2; however, even though the parameter Qsoil is an input for one of the scenarios modeled in J&E, this value is not provided in Table 2.
10. Page 6, Section 3.2.1, 1st full paragraph on page, 2nd sentence, this is the 1st instance where use of parameters for a sand soil has been described as conservative. NDEP understands the intent is to compare to different soil types; however, the alluvium at this site is essentially sand. Therefore, the parameter for sand is not conservative for this site; instead is should be considered "representative". Please revise.
11. Page 7, Section 3.2.1, 2nd full paragraph, 3rd line, please provide a reference for "Nazaroff".
12. Page 8, Section 3.3, 1st paragraph, last sentence, this sentence is unclear. Please revise "The *BRC Closure Plan* (BRC, ERM, and DBS&A 20072009) and *Tronox HRA Work Plan* (Northgate 2010) provides a full discussion on the risk assessment methodology for the project, and used in this screening-level indoor air HRA" to "The *BRC Closure Plan* (BRC, ERM, and DBS&A 20072009) and *Tronox HRA Work Plan* (Northgate 2010) provide a full discussion of the risk assessment methodology for the project and are used as the basis for this screening-level indoor air HRA".

13. Page 8, Section 3.3, 2nd paragraph, last sentence, NDEP requires more complete references to the Tronox HRA WP and/or the BRC Closure Plan Chapter 9. In this case, please provide reference to hierarchy used.
14. Page 9, Section 3.4, paragraph below sentence below bullets, last sentence, this sentence does not follow from the rest of this paragraph. The paragraph is about uncertainty related to sampling and analysis. This sentence is about uncertainty associated with use of the maximum concentration. A new paragraph is needed along with a comment on the uncertainty associated with a maximum concentration (statistics this far in the tail are always very uncertain). Please revise as necessary.
15. Page 11, Section 3.4, 3rd line on page, please clarify how the risk could be zero at this Site or any Site.
16. Section 3.5, results are now presented for both risk assessments performed for this site. If these 2 risk assessments had been performed within the context of a single risk assessment, then these risks would have been added across media to present cumulative risk. If they are added, then the ICLR is 2x10-6. Tronox should acknowledge this and discuss the results as appropriate.
17. Page 12, Section 4.0, 1st bullet, NDEP rejects the notion that the largest contributor to the cumulative HI is lead. Lead should not be included in a HI calculation, but should be evaluated separately. NDEP acknowledges that inclusion of lead in the HI calculation in the previous risk assessment report occurred; however, NDEP provided comments in a January 17, 2008 Part 2 Response letter that were intended to be considered for future risk assessments. Comment 7 of the January 17, 2010 letter addressed this issue. Whereas NDEP acknowledges that Tronox is referencing this previous work, NDEP does not want the issue to be perpetuated in future Deliverables, including this Deliverable; therefore, the HI as presented needs to be provided better context.
18. Page 13, asbestos bullet. This bullet first indicates that the estimated asbestos risks are less than $1x10^{-6}$; however, later in the bullet TRX acknowledges that the upper bound estimate for amphibole is 5x10-6. Please clarify.
19. RTC #17.b (previous RTC # 5.a), the previous comment stands as it has not been demonstrated that the data are sufficient for decision making. Given the apparent spatial differences described above, it seems that only 3 samples have been taken in the area of greatest risk-based concentrations (the east side of Parcel B). Use of the maximum concentration might be acceptable for the risk assessment, but misses the point of trying to understand how the data impact the conceptual site model (CSM). It appears that the concentrations of chloroform in these 3 samples (440, 40, 270 ppb) are much greater than those for the other 6 samples (14, 16, 8.6, 8.6, 62, 34). These 3 samples are co-located. There is a clear spatial pattern in the data. Please provide a figure, and please describe in the context of nature and extent, and in the context of the CSM.

Attachment B

NDEP is providing this attachment to identify recommended screening reference concentrations (RfCs) for n-heptane, n-octane, ethanol, and 1,2-dichlorotetrafluoroethane that have been detected in soil gas at the Tronox facility. These chemicals do not have inhalation RfCs derived by the USEPA in the IRIS database or in other EPA-recommended databases (USEPA, 2003). Accordingly, we have located noncancer inhalation criteria from other reliable sources or have identified an appropriate toxicological surrogate as the basis for RfCs for these chemicals. The bases for the recommended RfCs are provided herein. It is noted that these RfCs should be considered as conservative "screening" level RfCs and that, if warranted, additional analysis may be conducted by NDEP or the Companies.

n-Heptane

Neither USEPA (2010a, 2010b, 1997), ATSDR (2009) or other EPA-recommended sources (USEPA, 2003) have an RfC for n-heptane; however, the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) provides an oral reference dose (RfD) for n-heptane which is based on an inhalation toxicity study. The TPHCWG extrapolated rodent inhalation data to derive an oral RfD. They started with a USEPA RfC for n-hexane of 0.2 mg/m^3,[1] converted it to an RfD of 0.06 mg/kg-day using standard conversion factors and metabolic data that support their conclusion that n-heptane is 38 times less toxic than n-hexane and calculated an oral RfD for n-heptane of 2 mg/kg-day (0.06 mg/kg-day x 38 = 2.28 mg/kg-day; rounded down to 2 mg/kg-day) (TPHCWG, 1997). The RfD was converted back to an RfC by assuming an inhalation rate of 20 m^3/day and a body weight of 70 kg. This results in a screening level RfC of 7 mg/m^3 for n-heptane. This RfC is consistent with simply multiplying the original USEPA n-hexane RfC by 38.

n-Octane

Neither USEPA (2010a, 2010b, 1997), ATSDR (2009) or other EPA-recommended sources (USEPA, 2003) have an RfC for n-octane; however, the TPHCWG provides an RfC of 18.4 mg/m^3 for the C5 – C8 alkane and cycloalkane compounds, which includes n-octane (TPHCWG, 1997). This RfC is based upon a no observed adverse effect level (NOAEL) from two lifetime studies (one rat, one mouse) that used a commercial mixture of hexane. Accordingly, the TPHCWG RfC for C5 – C8 alkane and cycloalkane compounds of 18.4 mg/m^3 is identified as a screening level RfC for n-octane.

Ethanol

Toxicity criteria for ethanol were not found in the USEPA or ATSDR databases (USEPA, 2010a. 2010b. 1997; ATSDR, 2009); however, the California Environmental Protection Agency (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA) has reviewed the toxicity of ethanol in their draft report entitled, "Potential Health Risks of Ethanol in Gasoline" (CalEPA, 1999). Based upon a review of the vast database for ethanol toxicity, CalEPA derived

[1] This was the USEPA RfC for n-hexane at that time. USEPA has since revised the RfC for n-hexane upward to 0.7 mg/m^3 (USEPA, 2010).

a draft RfC of 100 mg/m^3 (CalEPA, 1999), which is recommended as a screening RfC for ethanol.

1, 2-Dichlorotetrafluoroethane

Neither USEPA (2010a, 2010b, 1997), ATSDR (2009) or other EPA-recommended sources (USEPA, 2003) have identified an RfC for 1,2-dichlorotetrafluoroethane; however, 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113) is structurally similar and does have a USEPA RfC of 30 mg/m^3 available from HEAST (USEPA, 1997). The difference between the two chemical structures is that 1, 2-Dichlorotetrafluoroethane has four fluorine and two chlorine atoms while Freon 113 has three fluorine and three chlorine atoms. While there is this difference in chemical structure, it was determined that Freon 113 is a reasonable toxicological surrogate. Accordingly, the screening RfC recommended for 1, 2-dichlorotetrafluorethane is 30 mg/m^3.

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Tab 9

Nevada Division of Environmental Protection (NDEP) Meeting Minutes regarding the Tech Memo of Parcels A/B Indoor Air Health Risk Assessment

September 7, 2010

DRAFT

Meeting Minutes

Project: Tronox (TRX)
Location: Conference Call
Time and Date: 4:00 PM, Tuesday, September 7, 2010
In Attendance: NDEP – Shannon Harbour
MGA – Brian Rakvica (for NDEP)
Neptune – Paul Black (for NDEP)
Hackenberry Assoc. – Paul Hackenberry (for NDEP)
Northgate – Deni Chambers (for TRX)
Exponent – Reneé Kalmes, Greg Brorby (for TRX)

CC: Jim Najima (NDEP), Greg Lovato (NDEP), Susan Crowley (for TRX), Keith Bailey (for TRX), Matt Paque (TRX)

1. The meeting was held to discuss NDEP's comment letter dated August 31, 2010 regarding the Tech Memo of Parcels A/B Indoor Air Health Risk Assessment.
2. No discussion on comments #1, 2, 4.b, 10, and 12.
3. Comments #7, 14, 15, 16, and 19, NDEP will confer internally and respond back to TRX. **ACTION ITEM.**
4. Comment #3 and 5, Data usability (DU): NDEP and Exponent discussed the following:
   a. NDEP explained that the previously-submitted Tech Memo for the soil at Parcels A/B was acceptable as a screening-level risk assessment because asbestos was the only COPC. Additionally, the confirmation sampling data showed that all sampled chemicals were less than the approved screening levels. This was also approved in 2008. The indoor air component is being submitted 2 years later.
   b. Exponent requested a process going forward for DU.
   c. The DVSR for the soil gas sampling as been submitted and approved by NDEP.
   d. TRX has not submitted a formal data usability evaluation for this data.
   e. NDEP and TRX discussed whether TRX should submit a Site-wide soil gas DU study or a risk assessment-specific DU study. Results from nine soil gas samples are available for Parcels A/B.
   f. NDEP noted that the DU evaluation for Parcels A/B should be submitted separately. **ACTION ITEM.**
   g. NDEP will look at the BRC Parcel 4A HRA and forward to TRX if the data usability was approved. **ACTION ITEM.**
5. Comment #4.a, Table 2, NDEP commented that the values in this Table were different than the original submittal and requested an explanation.
   a. Exponent stated that the listed parameters were changed because of discussions with NDEP, the model "default" was wrong, and/or were based on previous NDEP comments. Additionally, Exponent stated that text was added to the tech memo describing each of these parameters.
   b. NDEP stated that this comment was only looking for the Table to address why the changes were made.
6. Comment #6, Exponent stated that "most" accounted for the fact that dioxins/furans are not regulated using a cumulative incremental lifetime cancer risk of $1x10^{-6}$. NDEP requested that the text clarify this.

7. Comment #8, Exponent stated that the maximum concentration was used in place of the 95% UCL due to NDEP direction in prior comments. NDEP noted that TRX should include the reference to the basis for this.
8. Comment #9, Exponent stated that Q_{soil} was calculated 2 ways:
   a. CalEPA calculation based on EPA default value for a house, which is scaled up based on difference in size of buildings.
   b. Model calculation based on other parameters.
9. Comment #11, Exponent stated that the Nazaroff reference comes from the EPA reference in the document. Exponent believes this is the appropriate reference since the EPA document is the one that was used not the actual Nazaroff article.
10. Comment #13, NDEP clarified that TRX should provide either the calculations used in this Section or the equation numbers from the BRC document referenced.
11. Comment #17, Exponent stated that the document will be revised as requested.
12. Comment #18, Exponent clarified how the values presented were for different receptors (maintenance worker, construction worker) and are appropriate.

Tab 10

Northgate Environmental Management, Inc. (Northgate) Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation BMI Industrial Complex, Clark County, Nevada

Northgate Response to Comments re: Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada, dated June 29, 2010. 2010

November 12, 2010

northgate
environmental management, inc.

MEMORANDUM

From: Deni Chambers
Renee Kalmes, Exponent
Greg Brorby, Exponent

Date: November 12, 2010

To: Shannon Harbour, PE
Nevada Division of Environmental Protection

CC: Brian Rakvica, McGinley and Associates
Jim Najima, Nevada Division of Environmental Protection
Teri Copeland
Paul Black, Neptune and Co.

RE: Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada

1.0 INTRODUCTION

The objective of this Technical Memorandum is to present the results of a screening-level indoor air health risk assessment (HRA) for the Phase B Source Area Soil Gas Investigation that Basic Environmental Company (BEC) and Tronox performed for the Tronox Parcels "A" and "B" (portions of APN Nos. 178-01-401-001, 178-12-101-002, and 178-12-201-006 [Note: Parcel 178-12-601-005, formerly part of Tronox Parcel B, has been sold and is excluded from this analysis]). Parcels A/B will collectively be referred to as "the property" for the purposes of this Technical Memorandum. The property is located north of Warm Springs Road, 1/4 mile west of the intersection with Boulder Highway, in Henderson, Nevada. Figure 1 shows details of Parcels A/B and the soil gas sampling locations. The Technical Memorandum presents a summary of the data included in this assessment, including results of the *Data Validation Summary Report Phase B Source Area Investigation Soil Gas Survey* (ENSR 2008a; approved by the Nevada Division of Environmental Protection [NDEP] on October 20, 2008) and data usability evaluation, as well as the methods and results of the screening-level indoor air HRA. This Technical Memorandum also provides a brief summary of the *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation* dated February 11, 2008 (BEC 2008; approved by NDEP on April 8, 2008).

This revision of the Screening-Level Indoor Air Health Risk Assessment Memorandum, Revision 3, incorporates comments received from the NDEP, dated August 31, 2010, on Revision 2 of the report, dated June 29, 2010, along with clarifying comments received from NDEP during a September 7, 2010 teleconference (September 7, 2010 meeting minutes). The NDEP comments and BRC's response to the August 31, 2010 comments are provided

separately; however, a redline/strikeout version of the text showing the revisions from the June 29, 2010 version of the Technical Memorandum in response to NDEP's comments is provided in Attachment A.[1]

2.0 CONCEPTUAL SITE MODEL

The conceptual site model (CSM) is used to describe relationships between chemicals and potentially exposed human receptor populations, thereby delineating the relationships between the suspected sources of chemicals identified at the property, the mechanisms by which the chemicals might be released and transported in the environment, and the means by which the receptors could come in contact with the chemicals. The CSM provides a basis for defining data quality objectives and developing exposure scenarios.

The CSM considers current and potential future land-use conditions. Currently, the property is undeveloped; however, the planned future use of the property is for commercial purposes. Given the planned development of the property, potential human receptors include on-site construction workers, on-site indoor commercial workers, on-site outdoor maintenance workers, and on-site visitors, which is consistent with the Tronox *HRA Work Plan* (Northgate 2010) . Although several potential human receptors may occur on the property in the future, this screening-level HRA focuses on indoor commercial workers. This receptor is considered to have the highest level of exposure to volatile organic chemicals (VOCs) in indoor air at the property. Other receptors, such as site visitors, will have lower exposures, and thus lower risk estimates. Therefore, risk estimates generated for future on-site indoor commercial workers will be protective of other potential receptors at the property.

A separate screening-level HRA evaluated risks from exposure to soil at Parcels A/B. The results from that screening-level HRA are provided in the *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation* dated February 11, 2008 (BEC 2008; approved by NDEP on April 8, 2008). However, these exposures did not account for potential migration of VOCs from the subsurface into indoor air. In general, the United States Environmental Protection Agency (USEPA) does not recommend evaluating the indoor air exposure pathway using soil matrix data (USEPA 2002a). Because groundwater beneath a portion of the property is considered a potential VOC source area, soil gas data were collected. The soil gas data are the focus of this screening-level indoor air HRA. It should be noted that the pending site-wide soil gas risk assessment will more fully discuss the site-wide

[1] Revisions made to correct typographical or minor grammatical errors are not shown in the redline/strikeout version to facilitate readability of the document.

conceptual model, including potential groundwater and soil sources and the impact of these sources on the measured soil gas concentrations, including data collected in Parcels A/B.

3.0 SCREENING-LEVEL INDOOR AIR HEALTH RISK ASSESSMENT

As discussed in Section 2.0, the previous screening-level HRA for Parcels A/B (BEC 2008) did not consider the indoor air pathway. Therefore, soil gas data were collected at several locations throughout Parcels A/B to specifically evaluate this potential exposure pathway at the property.

Human health risks are represented by estimated theoretical upper-bound cancer risks and non-cancer hazards derived in accordance with standard USEPA methods. These values will be compared to the following criteria:

1. For non-carcinogenic compounds, the NDEP non-cancer risk management target is a cumulative hazard index (HI) of one or less (NDEP 2009). If the screening HI is determined to be greater than 1.0, target organ-specific HIs will be calculated for primary and secondary organs. The final risk goal will be to achieve target organ-specific non-carcinogenic HIs of less than 1.0; and
2. For most known or suspected chemical carcinogens, the NDEP point of departure is a cumulative incremental lifetime cancer risk (ILCR) of 1×10^{-6}.[2]

This screening-level indoor air HRA follows the basic procedures outlined in USEPA's *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (RAGS Part A; USEPA 1989). Other guidance documents, including USEPA's *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)* (U.S. EPA, 2009), were also consulted for the screening-level indoor air HRA.

3.1 Data Review and Evaluation

Soil gas samples were collected in Parcels A/B as part of the Phase B Source Area Soil Gas Investigation. The details of the soil gas sampling are provided in the *Phase B Source Area Investigation Soil Gas Survey Work Plan* (Soil Gas Work Plan; ENSR 2008b). Briefly, sample locations were based on the *Phase A Source Area Investigation Results* (ENSR 2007), which identified the presence of several VOCs in soil and/or groundwater at the Tronox site. According to the Soil Gas Work Plan, soil gas samples were collected to evaluate VOCs from a groundwater source (Parcels A/B) or to investigate Nevada Auto Parts as a potential VOC

[2] There are exceptions to this general rule, including dioxins/furans and asbestos, each of which is evaluated separately from other carcinogenic chemicals (Northgate 2010).

source (Parcel B). All of the soil gas samples in Parcels A/B were collected at 5 feet below ground surface (bgs), and analyzed for VOCs according to EPA Method TO15.

The soil gas data, including those from Parcels A/B, have been validated as documented in the *Revised Data Validation Summary Report [DVSR], Phase B Source Area Investigation Soil Gas Survey, Tronox LLC Facility, Henderson, Nevada*, (ENSR 2008a; approved by NDEP on October 20, 2008). An electronic copy of the DVSR for the soil gas data, including laboratory reports, is provided in Attachment D. A data usability evaluation for the soil gas samples collected in Parcels A/B is provided in Attachment E. This evaluation was conducted in accordance with USEPA and NDEP guidance. As discussed further in the attachment, a small number of data points were found to be qualified based on method blank and quantitation issues, but were deemed acceptable. Based on this evaluation, all Data Usability requirements were met and all Parcel A/B soil gas data were deemed to be usable for risk assessment purposes.

3.2 Selection of Chemicals of Potential Concern

As shown in Figure 1, nine soil gas samples were collected in Parcels A/B. The validated data for these samples, including the number of detections, detection frequency, minimum and maximum detections, minimum and maximum detection limits, mean, median, and standard deviation, are summarized in Table 1; the raw data are provided in Attachment B. Consistent with NDEP (2008) guidance, one-half the limit of detection was used in calculating the mean, median, and standard deviation; the sample quantitation limit (SQL) was used as the detection limit. For purposes of this screening-level indoor air HRA, all chemicals detected in at least one of the nine soil gas samples collected at Parcels A/B were identified as chemicals of potential concern (COPCs) at the property.

For those chemicals that were not detected in any of the soil gas samples, their detection limits were compared to shallow soil gas to indoor air vapor intrusion screening levels from USEPA [2002a; Table 2c (Generic Screening Levels and Summary Sheet; Risk = 1×10^{-6}], which are based on a residential scenario assuming a soil gas to indoor air attenuation factor (alpha) of 0.1. These levels are considered sufficiently conservative for purposes of evaluating detection limits (as opposed to $1/10^{th}$ the screening level) for the following reasons. First, future use of Parcels A/B will be commercial rather than residential. Second, USEPA provides screening levels for both shallow and deep soil gas. "Shallow" soil gas is defined as soil gas samples collected just below the foundation to depths less than 5 feet below the foundation, whereas "deep" soil gas is defined as soil gas samples collected from just above the groundwater table or from depths greater than 5 feet below the foundation. For deep soil gas, the generic screening levels are based on an alpha of 0.01, resulting in screening levels that are a factor of

10 higher than those for shallow soil gas. Because soil gas samples in Parcels A/B were collected at 5 feet bgs, comparison to either the shallow soil gas or deep soil gas screening levels may be justifiable, and the shallow soil screening levels were used to be conservative. As shown in Table 1, none of the chemicals that were not detected in any of the soil gas samples had detection limits that exceeded their respective screening levels. Therefore, their exclusion should not affect the results of the evaluation. It should be noted that screening levels have not been developed for three chemicals that were not detected in any soil gas sample (2-methoxy-2-methyl butane, ethyl t-butyl, ether, and isopropyl ether). The maximum detections limits for these chemicals were very low (0.085, 0.087, and 0.1 µg/m^3, respectively); therefore, exclusion of these chemicals also should not affect the results of the screening-level indoor air HRA.

3.3 Determination of Exposure Point Concentrations

A representative exposure point concentration is a COPC-specific and media-specific concentration value. In risk assessment, these exposure concentrations are values incorporated into the exposure assessment equations from which potential baseline human exposures are calculated. In general, U.S. EPA (1992) recommends using the 95th upper confidence limit (UCL) of the arithmetic mean concentration for purposes of estimating reasonable maximum or upper-end exposures. However, as discussed further in Section 3.5, not all soil gas data appear to be from a single population. Therefore, for purposes of this screening-level indoor air HRA, the maximum detected concentration was used, which is consistent with NDEP's comments to previous versions of this Technical Memorandum.

3.3.1 Indoor Air

The migration of COPCs from the subsurface and dispersion into indoor air were estimated using the USEPA spreadsheet-based Johnson and Ettinger (J&E) model (USEPA 2004a). The model is based on the vapor intrusion model published by Johnson and Ettinger (1991). The J&E model is a screening-level model, which incorporates both convective and diffusive mechanisms for estimating the transport of chemical vapors emanating from either subsurface soils or groundwater into indoor spaces located directly above the source of contamination. The model is constructed to calculate steady-state vapor transport (infinite source). The maximum detected concentrations of the COPCs in soil gas, which were used as the exposure point concentrations for the indoor air exposure pathway, are presented in Table 1. Either site-specific or default physical properties and building characteristics contained in the USEPA J&E spreadsheet model were used in this evaluation. These values are presented in Table 2. Tables 3 and 4 present the indoor air concentrations predicted by the J&E model for

each of the COPCs, depending on assumptions for building air exchange rate and vapor flow rate into the building, as discussed further below.

Where site-specific data were unavailable, the model default parameters for a sand soil were used. Parameters for a sand soil result in the most conservative indoor air estimates. The model input parameter that considers soil moisture is the water-filled porosity, which is determined by the gravimetric moisture content and the dry bulk density. Although there are adequate gravimetric moisture content data from the site itself (as determined using ASTM D2216), there is limited dry bulk density data for the general area; however, this information is available from the Borrow Area investigation (BRC and ERM 2007). Using an average dry bulk density from the Borrow Area data of 1.83 g/cm^3 and an average gravimetric moisture content from site data of 4.92 percent results in a water-filled porosity value of 0.09. In addition, the average effective porosity (which generally equates to total porosity) for the Borrow Area investigation was 0.30. Therefore, these values (bulk density = 1.83 g/cm^3; total porosity = 0.30; water-filled porosity = 0.090) are used in the modeling effort for the property.

With regard to building parameters, USEPA provides a recommended value for the air exchange rate for a residential building, but not a commercial building, in their J&E Model User's Guide (USEPA 2004a). The California Environmental Protection Agency (Cal-EPA) recommends a value of 1 per hour (1/hr) for commercial buildings based on the California Energy Commission's *Manual for Compliance with the 2001 Energy Efficiency Standards (for Nonresidential Buildings, High-Rise Residential Buildings and Hotels/Motels;* Cal-EPA 2005). The Michigan Department of Environmental Quality (MDEQ) recommends a value of 2/hr. The basis for this latter value is two-fold: First, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) *Draft BSR/ASHRAE Standard 62-1989R, Ventilation for Acceptable Indoor Air Quality* suggests that system rates for total supply air in a general office will be approximately 1/hr. Second, natural ventilation, infiltration, and entrance and egress into and out of the building will increase air exchange rates above the approximate 1/hr provided by mechanical systems (Michigan Environmental Science Board 2001). To address the uncertainty in this input parameter, a range of estimated indoor air concentrations and corresponding risk estimates based on an air exchange rate of 1/hr or 2/hr were estimated (see Tables 3 and 4, respectively).

Furthermore, USEPA does not provide recommended values for floor length and width of the enclosed space. The MDEQ does provide a recommended default value for the size of a hypothetical commercial building of 4,000 square feet (ft^2) or 372 square meters (m^2; Michigan Environmental Science Board, 2001). This value is based on data provided in a 1994 U.S. Department of Energy (DOE) report entitled *Commercial Building Characteristics 1992*, which documents the results of a Commercial Buildings Energy Consumption Survey. The most

recent survey was completed in 2003 and the results were presented in a 2006 report issued by the U.S. Energy Information Administration (USEIA 2006). The data presented in this report are similar to that presented in the 1994 DOE report in that the majority of commercial buildings (other than malls) are between 1,000 feet^2 and 5,000 feet^2 in size and a single story, regardless of region of the country. In addition, the reported median square footage (the metric used by MDEQ) for different categories of commercial buildings nationwide ranges from 3,000 ft^2 to 7,000 ft^2. For purposes of this screening-level indoor air HRA, a value of 2000 centimeters (cm) was assumed for both the floor length and width, which is approximately equal to the default value of 4000 ft^2 (372 m^2) recommended by MDEQ.

Finally, the vapor flow rate into a building (Q_{soil}) is a controversial input parameter in the J&E model. As originally conceived, this value was calculated using a "perimeter crack model" by Nazaroff based on various site-specific or default values related to soil vapor permeability, pressure differentials, and size of cracks; however, a wide range of values can be predicted because of the model's sensitivity to estimates of soil vapor permeability (USEPA 2004a). Consequently, EPA provides a recommended "default" value for vapor flow rate into residential buildings, but not commercial buildings, in their J&E Model User's Guide (USEPA 2004a). The recommended default value is 5 L/m, which is based on empirical data collected in residences; however, such data for commercial buildings are lacking. Cal-EPA has adopted USEPA's recommended default value for Q_{soil} for residential buildings. For commercial buildings, Cal-EPA recommends scaling the default residential value based on the size of the commercial building (e.g., if the commercial building is twice the size as the default residential building, then the Q_{soil} value is doubled; Cal-EPA 2005). To address the uncertainty in this parameter, a range of estimated indoor air concentrations and corresponding risk estimates were estimated based on a scaled Q_{soil} value (4 × 5 L/m or 20 L/m because the default commercial building size described above is 4-times the default residential building size) as recommended by Cal-EPA and a calculated Q_{soil} based on a sand soil (see Tables 3 and 4, respectively).

3.4 Risk Assessment Methodology

The method used in the screening-level indoor air HRA consists of several steps. The first step is the determination of exposure point concentrations representative of the particular area (see above). The second step is fate and transport modeling to predict concentrations that may be present when direct measurements are not available. The third step is the exposure assessment for the various receptors present in the particular areas. The fourth step is to define the toxicity values for each COPC. The final step is risk characterization where theoretical upper-bound ILCRs and non-cancer HIs are calculated. The *Tronox HRA Work Plan* (Northgate 2010) provides a full discussion on the risk assessment methodology for the

project, and is used as the basis for this screening-level indoor air HRA. Specifically, the procedures outlined in the following sections of the *Tronox HRA Work Plan* were followed in this assessment:

- Section 3.3.3 regarding the evaluation of indoor air
- Section 4.2.1 regarding the estimation of inhalation exposure (Equation 9, assuming the entire 8-hour workday is spent indoors)
- Section 5.0 regarding hierarchy for selecting toxicity criteria
- Section 6.0 regarding the estimation of excess cancer risks (Equations 16 and 17) and noncancer hazard indexes (Equations 22 and 23) and assessment of uncertainty.

Table 2 presents each of the exposure parameters used in the screening-level indoor air HRA. Toxicity values, when available, are published by the USEPA in the online Integrated Risk Information System (IRIS; USEPA 2010) and the Health Effects Assessment Summary Tables (HEAST; USEPA 1997). Unit risk factors (URFs) are chemical-specific, experimentally-derived potency values used to calculate the risk of cancer resulting from exposure to carcinogenic chemicals. A higher value implies a more potent carcinogen. Reference concentrations (RfCs) are experimentally derived "no-effect" values used to quantify the extent of adverse non-cancer health effects from exposure to chemicals. Here, a lower RfC implies a more potent toxicant. These criteria are generally developed by USEPA risk assessment work groups and listed in USEPA risk assessment guidance documents and databases. The identified values, including the source, are presented in Tables 3 and 4.

3.5 Uncertainty Analysis

Risk estimates are values that have uncertainties associated with them. These uncertainties, which arise at every step of a risk assessment, are evaluated to provide an indication of the uncertainty associated with a risk estimate. Risk assessments are not intended to estimate the true risk to a receptor associated with exposure to chemicals in the environment. In fact, estimating the true risk is impossible because of the variability in the exposed or potentially exposed populations. Therefore, risk assessment is a means of estimating the probability that an adverse health effect (*e.g.*, cancer, impaired reproduction) will occur in a receptor to assist in decision making regarding the protection of human health. The multitude of conservative assumptions used in risk assessments guard against underestimation of risks.

Risk estimates are calculated by combining site data, assumptions about individual receptor's exposures to impacted media, and toxicity data. The uncertainties in this screening-level indoor air HRA can be grouped into four main categories that correspond to these steps:

- Uncertainties in environmental sampling and analysis
- Uncertainties in fate and transport modeling
- Uncertainties in assumptions concerning exposure scenarios
- Uncertainties in toxicity data and dose-response extrapolations

Additional discussion on the uncertainties associated with the screening-level indoor air HRA is provided below.

The screening-level indoor air HRA for the property was based on the sampling results obtained from a soil gas investigation conducted in 2008. Errors in sampling results can arise from the field sampling, laboratory analyses, and data analyses. Errors in laboratory analysis procedures are possible, although the impacts of these sorts of errors on the risk estimates are likely to be low. The environmental sampling at the property is one source of uncertainty in the evaluation. As shown in Figure 1, the sampling locations are spread across the property, and sampling was performed using approved procedures.

The maximum detected concentration was used as the exposure point concentration, which is generally considered to be a conservative assumption because receptors are unlikely to be exposed to the maximum concentration of all COPCs over an extended period of time. As discussed further in Section 3.6, chloroform contributed almost exclusively to the non-cancer hazard index and cancer risk estimates. Of the nine soil gas samples collected in Parcels A/B, the highest concentrations of chloroform were detected in three samples adjacent to one another in Parcel B and the concentrations detected in these samples were much higher than the chloroform concentrations detected in the other six samples. Further, the three highest detected concentrations were relatively similar (440, 400, and 270 micrograms per cubic meter [$\mu g/m^3$]), suggesting that the maximum chloroform concentration may be reasonably representative of chloroform concentrations in soil gas in this area of Parcel B.

Figure 2 presents the chloroform results for soil gas and groundwater. As shown, soil gas locations were placed at the farthest down-gradient property boundary, while other locations were spread randomly throughout the Parcels. Some soil gas locations were co-located near groundwater monitoring wells. Higher soil-gas concentrations were detected in Parcel B where higher concentrations of chloroform in groundwater were also detected. Additionally, chloroform was detected in groundwater at a monitoring well located directly up-gradient from Parcel B (MW23) at higher concentrations than those reported in Parcels A/B. Up-gradient groundwater concentrations likely contribute to the measured soil gas concentrations in Parcel B. Finally, based on the soil gas sampling locations, and considering these locations in

context of the entire site-wide investigation, the sample results are deemed representative to evaluate Parcel A/B soil gas conditions.

The J&E model relies on a series of assumptions regarding site soils and building characteristics. In this assessment, soil physical parameter data for this site or nearby sites were used as available; otherwise, characteristics associated with "sand" were conservatively assumed. Because the site has not yet been developed, assumptions had to be made regarding the type and size of future buildings. For purposes of this screening-level assessment, a range of indoor air concentrations and corresponding risks were estimated based on a range of values for building air exchange rate and vapor flow rate into the building to address some of the uncertainty in these model input parameters.

The indoor commercial worker is the only scenario quantitatively evaluated in this screening-level indoor air HRA. NDEP default assumptions were used for exposure frequency (250 days per year) and duration (25 years; NDEP 2009), which are consistent with USEPA assumptions for a reasonable maximum exposure (RME) scenario (USEPA 2002b). Other receptors, such as site visitors, would not be expected to be at the site as frequently or for as long a period of time; therefore, conclusions regarding indoor commercial workers will be protective of other potential receptors at the property.

One of the largest sources of uncertainty in any risk assessment is the limited understanding of toxicity to humans who are exposed to the low concentrations that are generally encountered in the environment. The majority of the available toxicity data are from animal studies; these data are extrapolated using mathematical models or multiple uncertainty factors to predict what might occur in humans. Sources of conservatism in the toxicity criteria used in this screening-level indoor air HRA include:

- The use of conservative methods and assumptions to extrapolate from high-dose animal studies to predict the possible response in humans at exposure levels far below those administered to animals;
- The assumption that chemicals considered to be carcinogens do not have thresholds (i.e., for all doses greater than zero, some risk is assumed to be present); and
- The fact that epidemiological studies (i.e., human exposure studies) are limited and are not generally considered in a quantitative manner in deriving toxicity values.

In aggregate, these assumptions lead to overestimates of risk, such that the actual risk is unlikely to be higher than the estimated risk, but could be considerably lower. It should be noted, however, that toxicity criteria have not been established for many of the chemicals

detected at the property. These chemicals were not quantitatively evaluated in the screening-level indoor air HRA. Thus, the risks presented in this assessment could be underestimated as a result.

In summary, uncertainties from different sources are compounded in this screening-level indoor air HRA. For example, if a person's daily intake rate for a chemical is compared to an RfC to determine potential health risks, the uncertainties in the concentration measurements, exposure assumptions, and toxicities will all be expressed in the result. Because the exposure assumptions and toxicity criteria are considered conservative, the risk estimates calculated in this screening-level indoor air HRA are likely to overestimate rather than underestimate potential risks.

3.6 Screening-Level Indoor Air Health Risk Assessment Results

This screening-level indoor air HRA has evaluated potential risks to human health associated with chemicals detected in soil gas at the Tronox Parcels A/B property. The theoretical upper-bound ILCRs and non-cancer health effects for the COPCs are presented in Tables 3 (assuming more conservative values for air exchange rate and vapor flow into the building) and 4 (assuming less conservative values for these same parameters). All calculation spreadsheets for this screening-level indoor air HRA are included in Attachment C.

The total cumulative non-cancer HI for future on-site indoor commercial workers at the property ranges from 0.0008 to 0.002. The largest contributor to the cumulative HI is chloroform. The HI values are well below NDEP's target HI of 1.0.

The theoretical upper-bound ILCR for future on-site indoor commercial workers at the property ranges from 5×10^{-7} to 1×10^{-6}. The risks are primarily driven by chloroform, which contributes approximately 90 percent of the theoretical upper-bound ILCR. These values are equal to or below NDEP's point of departure of 1×10^{-6}. It should be noted that chloroform was not detected in any of the 64 soil samples collected at the property (BEC, 2008). The apparent source of chloroform and other chemicals detected in soil gas is impacted groundwater located south and west (upgradient) of Parcels A/B.[3]

[3] A draft figure showing chloroform concentrations in soil gas and groundwater was provided as part of the Site-Wide Data meeting with NDEP on February 5, 2010. The presence of VOCs in soil gas and groundwater will be evaluated as part of the site-wide soil gas report for the Tronox facility.

4.0 SUMMARY OF SCREENING-LEVEL SOIL HEALTH RISK ASSESSMENT

As stated previously, the results of the screening-level HRA for COPCs in soil at Parcels A/B are presented in the *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation*, dated February 11, 2008 (BEC, 2008). These results are briefly summarized herein so that the results from both the soil and soil gas assessments can be considered in concert. The COPCs identified in soil were evaluated in three groups, i.e., chemicals (other than asbestos), radionuclides, and asbestos. For chemicals and radionuclides, ILCRs and HIs were estimated based on the maximum detected concentration and the USEPA Region 9 industrial preliminary remediation goals (PRGs) for chemicals (USEPA 2004b) and the USEPA industrial PRGs for radionuclides (U.S. EPA, 2007). For asbestos, the estimated risk for death from lung cancer or mesothelioma was estimated according to USEPA's (and subsequently NDEP's) asbestos risk assessment guidance (U.S. EPA, 2003). The results of the screening-level soil HRA can be summarized as follows:

- **Chemicals (other than asbestos):** The total cumulative non-cancer HI for future commercial/industrial receptors at the property is 0.10.[4] The largest contributor to the cumulative HI is total chromium. The total theoretical upper-bound ILCR for future commercial/industrial receptors at the property for non-radionuclides is 1×10^{-6}. The largest contributors to the cumulative ILCR are dioxins/furans, alpha-BHC and polycyclic aromatic hydrocarbons (PAHs).

- **Radionuclides:** The total theoretical upper-bound ILCR for future commercial/industrial receptors at the property for radionuclides is 3×10^{-6}. The largest contributor to the cumulative ILCR is uranium-238.

- **Asbestos:** The estimated risks for death from lung cancer or mesothelioma for asbestos exposures to outdoor maintenance worker receptors were below 1×10^{-6}. For construction workers, the best estimate and upper bound concentrations of asbestos range from 1×10^{-7} (best estimate) to 8×10^{-7} (upper bound estimate) for chrysotile fibers, and from zero (best estimate) to 5×10^{-6} (upper bound estimate) for amphibole fibers (no long amphibole structures have been detected at the property).

[4] The total cumulative non-cancer HI reported in the cited document is 0.27; however, that value included lead. Because lead is evaluated separately from other noncarcinogens, the portion of the HI attributed to lead (0.17) was subtracted from the reported total HI of 0.27, resulting in an adjusted total HI of 0.10.

5.0 SUMMARY

This Technical Memorandum presents the results of a screening-level indoor air HRA for COPCs in soil gas at Parcels A/B. All chemicals detected in soil gas were identified as COPCs, regardless of detected concentration or detection frequency. Consistent with NDEP's comments to previous versions of this Technical Memorandum, the maximum detected concentration was used as the exposure point concentration. USEPA's J&E model was used to estimate indoor air concentrations for indoor commercial workers and associated non-cancer HIs and ILCRs. The estimated cumulative HI ranged from 0.0008 to 0.002, depending on the assumptions for air exchange rate and vapor flow into a building, and was driven primarily by chloroform. The cumulative ILCRs ranged from 5×10^{-7} to 1×10^{-6}, and were also driven by chloroform. The apparent source of chloroform and other chemicals detected in soil gas is impacted groundwater located south and west (upgradient) of Parcels A/B.

The results of a separate screening-level HRA for chemicals detected in soil at Parcels A/B were also summarized so that the results from both screening-level HRAs can be considered in concert. All chemicals detected in soil above background concentrations were identified as COPCs. As with the soil gas assessment, the maximum detected concentration was used as the exposure point concentration to evaluate both commercial/industrial workers and construction workers. The estimated cumulative HI was 0.10 and was driven by total chromium. The estimated cumulative ILCR for non-radionculides was 1×10^{-6}, and was driven by dioxins/furans, alpha-BHC and PAHs. For radionuclides, the estimated cumulative ILCR was 3×10^{-6}, and was driven by uranium-238. Finally, the best estimates of risk associated with exposure to asbestos were below 1×10^{-6} whereas the upper-bound estimates ranged from 8×10^{-7} (chrysotile fibers) to 5×10^{-6} (amphibole fibers). It should be noted that chloroform was not detected in any of the 64 soil samples collected at the property.

Figure

Tables

Attachments

5.0 REFERENCES

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Figures

Figure origin: BEC / Tronox Parcels A/B Data Review, BMI Common Areas, Henderson, Nevada, March 25, 2010

SHEET NUMBER:	FIGURE NUMBER:
X	1

TRONOX PARCELS A/B
PHASE B SOIL GAS
SAMPLE LOCATIONS
Tronox Facility
Henderson, Nevada

SCALE:	DATE:	PROJECT NUMBER:
AS NOTED	06/29/10	2027.02

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environmental management, inc.
TRONOX
www.ngem.com

DESIGNED BY:	REVISIONS			
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CHECKED BY:				
EK				
APPROVED BY:				
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Legend

- Tronox Parcels A-B Boundary
- Groundwater Sampling Location
- Soil Gas Sampling Location

Soil Gas concentration in ug/m^3 (micrograms per cubic meter)
Groundwater concentraion in ug/l (micrograms per liter)

FIGURE NUMBER:
2
SHEET NUMBER:
1

PARCEL A & B CHLOROFORM RESULTS IN SOIL GAS AND GROUNDWATER

Tronox LLC
Henderson, Nevada

SCALE:	DATE:	PROJECT NUMBER:
1 in = 500 ft	11/03/10	2027.06.T50

DESIGNED BY:	REVISIONS			
	NO.:	DESCRIPTION:	DATE:	BY:
DRAWN BY: NGEM				
CHECKED BY: NGEM				
APPROVED BY: NGEM				

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TRONOX
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Tables

TABLE 1
Parcel A/B Soil Gas Data Results Summary

Chemical	Sample Count	Detection Count	Frequency of Detections	Minimum DL (µg/m^3)	Maximum DL (µg/m^3)	Minimum Detection (µg/m^3)	Maximum Detection (µg/m^3)	Median (µg/m^3)	Mean (µg/m^3)	Standard Deviation	Location of Max Detection	Target Shallow Soil Gas to Indoor Air Concentration (µg/m^3)[1]	Count of DLs > Target Soil Gas Concentration
1,1,1-Trichloroethane	9	0	0%	0.074	0.085	-	-	0.039	0.0398	-	-	2.2E+04	0
1,1,2,2-Tetrachloroethane	9	0	0%	0.094	0.11	-	-	0.0495	0.0505	-	-	4.2E-01	0
1,1,2-Trichloroethane	9	1	11%	0.074	0.085	0.12	0.12	0.039	0.0486	-	SG05B-05	1.5E+00	0
1,1,2-Trichlorotrifluoroethane	9	9	100%	-	-	0.45	0.63	0.49	0.503	0.0559	SG12B-05	3.0E+05	-
1,1-Dichloroethane	9	7	78%	0.077	0.078	0.11	27	0.41	7.96	11.3	SG01B-05	5.0E+03	0
1,1-Dichloroethene	9	2	22%	0.077	0.085	0.1	0.12	0.0405	0.0554	0.0141	SG02B-05	2.0E+03	0
1,2,4-Trichlorobenzene	9	3	33%	0.11	0.13	0.2	0.75	0.06	0.201	0.275	SG02B-05	2.0E+03	0
1,2,4-Trimethylbenzene	9	9	100%	-	-	0.12	3.5	0.37	0.868	1.18	SG03B-05	6.0E+01	-
1,2-Dibromo-3-chloropropane	9	0	0%	0.11	0.13	-	-	0.06	0.0606	-	-	2.0E+00	0
1,2-Dichlorobenzene	9	0	0%	0.097	0.11	-	-	0.05	0.0521	-	-	2.0E+03	0
1,2-Dichloroethane	9	3	33%	0.074	0.081	0.32	1.1	0.039	0.249	0.396	SG05B-05	9.4E-01	0
1,2-Dichloropropane	9	4	44%	0.077	0.085	0.085	0.47	0.0425	0.109	0.185	SG05B-05	4.0E+01	0
1,2-Dichlorotetrafluoroethane	9	5	56%	0.077	0.085	0.085	0.1	0.085	0.0703	0.00709	SG11B-05	NA	-
1,3,5-Trimethylbenzene	9	5	56%	0.092	0.1	0.09	1.9	0.09	0.33	0.77	SG03B-05	6.0E+01	0
1,3-Dichlorobenzene	9	3	33%	0.095	0.11	0.098	0.32	0.055	0.1	0.112	SG12B-05	1.1E+03	0
1,4-Dichlorobenzene	9	9	100%	-	-	0.31	43	0.84	7.96	14.2	SG05B-05	8.0E+03	-
1,4-Dioxane	9	5	56%	0.093	0.1	0.14	0.39	0.14	0.133	0.107	SG03B-05	NA	-
2-Butanone	9	9	100%	-	-	4.6	13	7	7.33	2.45	SG03B-05	1.0E+04	-
2-Hexanone	9	9	100%	-	-	0.26	0.52	0.43	0.419	0.0703	SG06B-05	NA	-
2-Methoxy-2-methyl-butane	9	0	0%	0.074	0.085	-	-	0.039	0.0398	-	-	NA	-
4-Ethyltoluene	9	6	67%	0.087	0.097	0.11	1.5	0.11	0.288	0.551	SG03B-05	NA	-
4-Isopropyltoluene	9	7	78%	0.1	0.11	0.13	4.4	0.18	0.724	1.55	SG06B-05	NA	-
4-Methyl-2-pentanone	9	9	100%	-	-	0.14	9.2	0.29	1.26	2.98	SG06B-05	8.0E+02	-
Acetone	9	7	78%	0.11	0.11	12	50	18	19.2	13	SG11B-05	3.5E+03	0
Acrylonitrile	9	3	33%	0.11	0.12	0.11	0.12	0.06	0.0767	0.00577	SG03B-05	3.6E-01	0
Allyl chloride	9	1	11%	0.074	0.085	0.17	0.17	0.039	0.0541	-	SG05B-05	NA	-
alpha-Methylstyrene	9	4	44%	0.11	0.12	0.13	7.7	0.06	0.961	3.74	SG12B-05	NA	-
Benzene	9	9	100%	-	-	1.2	2.7	1.9	1.88	0.529	SG03B-05	3.1E+00	-
Benzyl Chloride	9	0	0%	0.13	0.15	-	-	0.065	0.0683	-	-	5.0E-01	0
Bromodichloromethane	9	6	67%	0.081	0.085	0.098	0.67	0.18	0.203	0.205	SG12B-05	1.4E+00	0
Bromoform	9	1	11%	0.11	0.13	0.27	0.27	0.06	0.0839	-	SG06B-05	2.2E+01	0
Bromomethane	9	1	11%	0.074	0.085	0.11	0.11	0.039	0.0475	-	SG03B-05	5.0E+01	0
Carbon disulfide	9	7	78%	0.18	0.18	1.5	14	2	4.8	5.51	SG10B-05	7.0E+03	0
Carbon tetrachloride	9	9	100%	-	-	0.25	11	0.39	2.99	4.14	SG11B-05	1.6E+00	-
Chlorobenzene	9	3	33%	0.075	0.087	0.16	0.31	0.0415	0.098	0.0839	SG12B-05	6.0E+02	0
Chloroethane	9	7	78%	0.077	0.078	0.14	11	0.87	3.1	4.28	SG01B-05	1.0E+05	0
Chloroform	9	9	100%	-	-	8.6	440	34	139	179	SG10B-05	1.1E+00	-
Chloromethane	9	1	11%	0.077	0.085	0.076	0.076	0.0405	0.0441	-	SG11B-05	2.4E+01	0
cis-1,2-Dichloroethene	9	2	22%	0.074	0.085	0.15	13	0.041	1.49	9.09	SG04B-05	3.5E+02	0
trans-1,3-Dichloropropene	9	0	0%	0.076	0.088	-	-	0.0405	0.0412	-	-	NA	-
Dibromochloromethane	9	1	11%	0.1	0.12	0.12	0.12	0.055	0.0617	-	SG01B-05	1.0E+00	0
Dichlorodifluoromethane	9	9	100%	-	-	1.8	2.1	2	2.01	0.0928	SG10B-05	2.0E+03	-
Ethanol	9	9	100%	-	-	2.3	32	11	13.9	10.6	SG12B-05	NA	-
Ethyl t-butyl ether	9	0	0%	0.075	0.087	-	-	0.0395	0.0405	-	-	NA	-
Ethylbenzene	9	7	78%	0.095	0.11	0.1	1.2	0.21	0.358	0.379	SG03B-05	2.2E+01	0
Ethylene dibromide	9	0	0%	0.079	0.092	-	-	0.042	0.0428	-	-	1.1E-01	0
Hexachlorobutadiene	9	5	56%	0.14	0.15	0.49	2.4	0.49	0.654	0.76	SG04B-05	1.1E+00	0
isopropyl ether	9	0	0%	0.087	0.1	-	-	0.0455	0.0467	-	-	NA	-

TABLE 1
Parcel A/B Soil Gas Data Results Summary

Chemical	Sample Count	Detection Count	Frequency of Detections	Minimum DL (µg/m^3)	Maximum DL (µg/m^3)	Minimum Detection (µg/m^3)	Maximum Detection (µg/m^3)	Median (µg/m^3)	Mean (µg/m^3)	Standard Deviation	Location of Max Detection	Target Shallow Soil Gas to Indoor Air Concentration (µg/m^3)[1]	Count of DLs > Target Soil Gas Concentration
Isopropylbenzene	9	3	33%	0.082	0.095	0.088	0.19	0.0475	0.074	0.0522	SG03B-05	4.0E+03	0
m,p-Xylene	9	8	89%	0.2	0.2	0.22	5.9	0.8	1.36	1.85	SG03B-05	7.0E+04	0
Methyl methacrylate	9	1	11%	0.11	0.13	0.42	0.42	0.06	0.1	-	SG05B-05	7.0E+03	0
Methyl tert butyl ether	9	6	67%	0.077	0.082	0.1	7.8	0.33	1.4	2.98	SG11B-05	3.0E+04	0
Methylene chloride	9	8	89%	0.077	0.077	0.23	3.7	0.63	1.13	1.31	SG01B-05	5.2E+01	0
Naphthalene	9	9	100%	-	-	0.42	4.2	0.83	1.2	1.16	SG06B-05	3.0E+01	-
N-Butylbenzene	9	9	100%	-	-	0.12	0.68	0.26	0.311	0.197	SG06B-05	1.4E+03	-
n-Heptane	9	6	67%	0.098	0.11	0.24	0.72	0.25	0.301	0.198	SG05B-05	NA	-
n-Octane	9	4	44%	0.077	0.085	0.23	1.5	0.0425	0.284	0.61	SG06B-05	NA	-
N-Propylbenzene	9	5	56%	0.08	0.088	0.084	0.52	0.084	0.153	0.173	SG03B-05	1.4E+03	0
o-Xylene	9	7	78%	0.096	0.11	0.12	2.1	0.4	0.534	0.672	SG03B-05	7.0E+04	0
sec-Butylbenzene	9	1	11%	0.085	0.099	0.097	0.097	0.045	0.0516	-	SG03B-05	1.4E+03	0
Styrene	9	5	56%	0.12	0.13	0.16	0.6	0.16	0.224	0.162	SG10B-05	1.0E+04	0
t-Butyl alcohol	9	9	100%	-	-	0.20	0.67	0.45	0.44	0.14	SG11B-05	NA	-
tert-Butylbenzene	9	1	11%	0.074	0.085	0.14	0.14	0.04	0.05	-	SG12B-05	1.4E+03	0
Tetrachloroethene	9	9	100%	-	-	1.10	30	5.30	7.40	8.8	SG05B-05	8.1E+00	-
Toluene	9	9	100%	-	-	1.20	19	2.00	4.41	5.7	SG05B-05	4.0E+03	-
trans-1,2-Dichloroethylene	9	0	0%	0.074	0.085	-	-	0.04	0.04	-	-	7.0E+02	0
trans-1,3-Dichloropropene	9	0	0%	0.093	0.11	-	-	0.05	0.05	-	-	NA	-
Trichloroethene	9	9	100%	-	-	0.96	42	1.3	6.5	13	SG04B-05	2.2E-01	-
Trichlorofluoromethane	9	9	100%	-	-	0.95	1.4	1.1	1.1	0.15	SG12B-05	7.0E+03	-
Vinyl acetate	9	7	78%	0.25	0.25	0.99	5	2.9	2.6	1.4	SG11B-05	2.0E+03	0
Vinyl chloride	9	2	22%	0.074	0.082	0.12	0.12	0.039	0.057	0	SG01B-05	2.8E+00	0

Notes:

1 - Shallow soil gas to indoor air vapor intrusion screening levels from USEPA (2002a), Table 2c (Generic Screening Levels and Summary Sheet; Risk - 1 x 10^{-6})

DL=Detection Limit

ug/m3=micrograms per cubic meter

TABLE 2
Johnson and Ettinger Model Input Parameters

Parameter	Value	Reference/Rationale
Depth below grade to bottom of enclosed floor space (cm)	15	Model default (slab on grade)
Soil gas sampling depth (cm)	150	Site-specific (five feet below ground surface [bgs])
Average soil temperature (°C)	17	Site-specific (Figure 8, USEPA 2004, p. 48)[1]
Thickness of soil stratum (cm) A	150	Site-specific (five feet bgs)
Thickness of soil stratum (cm) B	0	No stratum B; used single stratum model
Thickness of soil stratum (cm) C	0	No stratum C; used single stratum model
Soil stratum used to calculate soil vapor permeability	S	Sand
Vadose zone dry bulk density (g/cm^3)	1.83	Site-specific (Borrow Area data)
Vadose zone total porosity (unitless)	0.30	Site-specific (Borrow Area data)
Vadose zone water-filled porosity (unitless)	0.090	(Dry bulk density/water density) × soil moisture content[2]
Stratum B soil parameters	blank	No stratum B; used single stratum model
Stratum C soil parameters	blank	No stratum C; used single stratum model
Enclosed space floor thickness (cm)	10	Model default
Soil-building pressure differential ($g/cm\text{-}s^2$)	40	Model default
Enclosed space floor length (cm)	2,000	MDEQ - commericial (2001)
Enclosed space floor width (cm)	2,000	MDEQ - commericial (2001)
Modeling Enclosed space height (cm)	244	Model default
Floor-wall seam crack width (cm)	0.1	Model default
Indoor air exchange rate (1/hr)	1 or 2	Cal-EPA (2005) or MDEQ (2001)
Average vapor flow rate into building, Qsoil (L/m)	20 or Calculated	Model default or calculated (Eq. 15, USEPA 2004, p. 22)
Averaging time for carcinogens (yrs)	70	USEPA 2002b
Averaging time for non-carcinogens (yrs)	25	USEPA 2002b
Exposure duration (yrs)	25	USEPA 2002b
Exposure frequency (days/yr)	250	USEPA 2002b

Notes:
1 - This value is essentially the same as the average air temperatue of 19 °C in Boulder City, NV (www.weatherbase.com)
2 - Where soil moisture content=gravimetric moisture content per ASTM D2216; site-specific value=0.049

TABLE 3
Screening-Level Indoor Air Health Risk Assessment Results
(Qsoil-20 L/m and ER=1/h)

Chemical	J&E Predicted Indoor Air Conc. ($\mu g/m^3$)	Unit Risk Factor $(\mu g/m^3)^{-1}$	Key	Non-Cancer Reference Concentration (mg/m^3)	Key	Incremental Lifetime Cancer Risk	Non-Cancer Hazard Index
1,1,2-Trichloroethane	4.5 E-5	1.6 E-5	I	NA		2 E-10	NA
1,1,2-Trichlorotrifluoroethane	2.4 E-4	NA		3.0 E+1	H	NA	5 E-9
1,1-Dichloroethane	9.8 E-3	1.6 E-6	CA	NA		4 E-9	NA
1,1-Dichloroethene	5.0 E-5	NA		2.0 E-1	I	NA	2 E-7
1,2,4-Trichlorobenzene	1.3 E-4	NA		2.0 E-3	P	NA	5 E-5
1,2,4-Trimethylbenzene	1.1 E-3	NA		7.0 E-3	P	NA	1 E-4
1,2-Dichloroethane	5.0 E-4	2.6 E-5	I	2.4 E+0	A	3 E-9	1 E-7
1,2-Dichloropropane	1.8 E-4	1.0 E-5	CA	4.0 E-3	I	4 E-10	3 E-5
1,2-Dichlorotetrafluoroethane	3.7 E-5	NA		3.0 E+1	S	NA	9 E-10
1,3,5-Trimethylbenzene	5.9 E-4	NA		6.0 E-3	P	NA	7 E-5
1,3-Dichlorobenzene	1.1 E-4	NA		2.0 E-1	S	NA	4 E-7
1,4-Dichlorobenzene	1.5 E-2	1.1 E-5	CA	8.0 E-1	I	4 E-8	1 E-5
1,4-Dioxane	1.7 E-4	7.7 E-6	CA	3.6 E+0	A	3 E-10	3 E-8
2-Butanone	5.0 E-3	NA		5.0 E+0	I	NA	7 E-7
2-Hexanone	3.4 E-4	NA		3.0 E-2	I	NA	8 E-6
4-Ethyltoluene	6.1 E-4	NA		4.0 E-1	S	NA	1 E-6
4-Isopropyltoluene	1.3 E-3	NA		4.0 E-1	S	NA	2 E-6
4-Methyl-2-pentanone	3.4 E-3	NA		3.0 E+0	I	NA	8 E-7
Acetone	2.5 E-2	NA		3.1 E+1	A	NA	6 E-7
Acrylonitrile	6.0 E-5	6.8 E-5	I	2.0 E-3	I	1 E-9	2 E-5
Allyl chloride	8.3 E-5	6.0 E-6	CA	1.0 E-3	I	1 E-10	6 E-5
alpha-Methylstyrene	5.7 E-3	NA		1.0 E+0	S	NA	4 E-6
Benzene	1.1 E-3	7.8 E-6	I	3.0 E-2	I	2 E-9	3 E-5
Bromodichloromethane	1.2 E-4	3.7 E-5	CA	NA		1 E-9	NA
Bromoform	2.6 E-5	1.1 E-6	I	NA		7 E-12	NA
Bromomethane	3.9 E-5	NA		5.0 E-3	I	NA	5 E-6
Carbon disulfide	6.4 E-3	NA		7.0 E-1	I	NA	6 E-6
Carbon tetrachloride	4.1 E-3	6.0 E-6	I	1.0 E-1	I	6 E-9	3 E-5
Chlorobenzene	1.1 E-4	NA		5.0 E-2	P	NA	2 E-6
Chloroethane	8.2 E-3	NA		1.0 E+1	I	NA	6 E-7
Chloroform	2.0 E-1	2.3 E-5	I	9.8 E-2	A	1 E-6	1 E-3
Chloromethane	3.9 E-5	1.8 E-6	H	9.0 E-2	I	2 E-11	3 E-7
cis-1,2-Dichloroethene	4.7 E-3	NA		6.0 E-2	S	NA	5 E-5
Dibromochloromethane	1.5 E-5	2.7 E-5	CA	NA		1 E-10	NA
Dichlorodifluoromethane	7.0 E-4	NA		2.0 E-1	H	NA	2 E-6
Ethanol	1.6 E-2	NA		1.0 E+2	S	NA	1 E-7
Ethylbenzene	4.4 E-4	2.5 E-6	CA	1.0 E+0	I	3 E-10	3 E-7
Hexachlorobutadiene	7.1 E-4	2.2 E-5	I	NA		4 E-9	NA
Isopropylbenzene	6.3 E-5	NA		4.0 E-1	I	NA	1 E-7
m,p-Xylene	2.2 E-3	NA		7.0 E-1	CA	NA	2 E-6
Methyl methacrylate	1.6 E-4	NA		7.0 E-1	I	NA	2 E-7
Methyl tert butyl ether	3.5 E-3	2.6 E-7	CA	3.0 E+0	I	2 E-10	8 E-7
Methylene chloride	1.6 E-3	4.7 E-7	I	1.1 E+0	A	2 E-10	1 E-6
Naphthalene	1.3 E-3	3.4 E-5	CA	3.0 E-3	I	1 E-8	3 E-4
N-Butylbenzene	2.0 E-4	NA		4.0 E-1	S	NA	3 E-7
n-Heptane	4.7 E-4	NA		7.0 E+0	S	NA	5 E-8
n-Octane	5.5 E-4	NA		1.8 E+1	S	NA	2 E-8
N-Propylbenzene	1.6 E-4	NA		1.0 E+0	X	NA	1 E-7
o-Xylene	8.5 E-4	NA		7.0 E-1	CA	NA	8 E-7

TABLE 3
Screening-Level Indoor Air Health Risk Assessment Results
(Qsoil-20 L/m and ER=1/h)

Chemical	J&E Predicted Indoor Air Conc. ($\mu g/m^3$)	Unit Risk Factor $(\mu g/m^3)^{-1}$	Key	Non-Cancer Reference Concentration (mg/m^3)	Key	Incremental Lifetime Cancer Risk	Non-Cancer Hazard Index
sec-Butylbenzene	2.9 E-5	NA		4.0 E-1	S	NA	5 E-8
Styrene	2.1 E-4	NA		1.0 E+0	I	NA	1 E-7
t-Butyl alcohol	2.8 E-4	NA		3.0 E+1	S	NA	6 E-9
tert-Butylbenzene	4.2 E-5	NA		4.0 E-1	S	NA	7 E-8
Tetrachloroethene	1.1 E-2	5.9 E-6	CA	2.7 E-1	A	2 E-8	3 E-5
Toluene	7.7 E-3	NA		5.0 E+0	I	NA	1 E-6
Trichloroethene	1.6 E-2	2.0 E-6	CA	NA		8 E-9	NA
Trichlorofluoromethane	5.7 E-4	NA		7.0 E-1	H	NA	6 E-7
Vinyl acetate	2.0 E-3	NA		2.0 E-1	I	NA	7 E-6
Vinyl chloride	5.5 E-5	4.4 E-6	I	1.0 E-1	I	6 E-11	4 E-7
	Total					1E-06	2E-03

Notes:
NA=Toxcity value not established.
ER=Indoor air exchange rate
Qsoil=Average vapor flow rate

Key:
I=IRIS - Accessed June 2010 (http://www.epa.gov/iris/)
CA=CalEPA - Accessed June 2010 (http://oehha.ca.gov/risk/chemicalDB/index.asp)
P=PPRTV - as cited in NDEP BCLs table (2009) or
the EPA RSLs table (2010) (http://www.epa.gov/region9/superfund/prg/index.html)
X=PPRTV Appendix A - as cited in EPA RSLs table (2010)
A=ATSDR - as cited in NDEP BCLs table (2009) or in the EPA RSLs table (2010)
H=HEAST - as cited in NDEP BCLs table (2009) or in the EPA RSLs table (2010)
S=Surrogate toxicity criterion provided by NDEP (Personal communication [electronic mail message] from Shannon Harbor, NDEP, to Susan Crowley (Contractor), Tronox LLC, dated August 20, 2010, or Letter from Shannon Harbour, NDEP, to Matt Paque, Tronox, dated August 31, 2010).

Units:
$\mu g/m^3$=micrograms per cubic meter
mg/m^3=milligrams per cubic meter

TABLE 4
Screening-Level Indoor Air Health Risk Assessment Results
(Qsoil=calculated and ER=2/h)

Chemical	J&E Predicted Indoor Air Conc. ($\mu g/m^3$)	Unit Risk Factor $(\mu g/m^3)^{-1}$	Key	Non-Cancer Reference Concentration (mg/m^3)	Key	Incremental Lifetime Cancer Risk	Non-Cancer Hazard Index
1,1,2-Trichloroethane	1.7 E-5	1.6 E-5	I	NA		7 E-11	NA
1,1,2-Trichlorotrifluoroethane	9.1 E-5	NA		3.0 E+1	H	NA	2 E-9
1,1-Dichloroethane	3.8 E-3	1.6 E-6	CA	NA		1 E-9	NA
1,1-Dichloroethene	1.9 E-5	NA		2.0 E-1	I	NA	6 E-8
1,2,4-Trichlorobenzene	5.8 E-5	NA		2.0 E-3	P	NA	2 E-5
1,2,4-Trimethylbenzene	4.4 E-4	NA		7.0 E-3	P	NA	4 E-5
1,2-Dichloroethane	1.8 E-4	2.6 E-5	I	2.4 E+0	A	1 E-9	5 E-8
1,2-Dichloropropane	6.8 E-5	1.0 E-5	CA	4.0 E-3	I	2 E-10	1 E-5
1,2-Dichlorotetrafluoroethane	1.4 E-5	NA		3.0 E+1	S	NA	3 E-10
1,3,5-Trimethylbenzene	2.4 E-4	NA		6.0 E-3	P	NA	3 E-5
1,3-Dichlorobenzene	4.3 E-5	NA		2.0 E-1	S	NA	1 E-7
1,4-Dichlorobenzene	5.8 E-3	1.1 E-5	CA	8.0 E-1	I	2 E-8	5 E-6
1,4-Dioxane	6.4 E-5	7.7 E-6	CA	3.6 E+0	A	1 E-10	1 E-8
2-Butanone	1.9 E-3	NA		5.0 E+0	I	NA	3 E-7
2-Hexanone	1.1 E-4	NA		3.0 E-2	I	NA	3 E-6
4-Ethyltoluene	2.3 E-4	NA		4.0 E-1	S	NA	4 E-7
4-Isopropyltoluene	5.2 E-4	NA		4.0 E-1	S	NA	9 E-7
4-Methyl-2-pentanone	1.3 E-3	NA		3.0 E+0	I	NA	3 E-7
Acetone	9.0 E-3	NA		3.1 E+1	A	NA	2 E-7
Acrylonitrile	2.1 E-5	6.8 E-5	I	2.0 E-3	I	4 E-10	7 E-6
Allyl chloride	3.0 E-5	6.0 E-6	CA	1.0 E-3	I	4 E-11	2 E-5
alpha-Methylstyrene	1.8 E-3	NA		1.0 E+0	S	NA	1 E-6
Benzene	4.2 E-4	7.8 E-6	I	3.0 E-2	I	8 E-10	9 E-6
Bromodichloromethane	5.2 E-5	3.7 E-5	CA	NA		5 E-10	NA
Bromoform	1.2 E-5	1.1 E-6	I	NA		3 E-12	NA
Bromomethane	1.5 E-5	NA		5.0 E-3	I	NA	2 E-6
Carbon disulfide	2.3 E-3	NA		7.0 E-1	I	NA	2 E-6
Carbon tetrachloride	1.6 E-3	6.0 E-6	I	1.0 E-1	I	2 E-9	1 E-5
Chlorobenzene	4.3 E-5	NA		5.0 E-2	P	NA	6 E-7
Chloroethane	2.6 E-3	NA		1.0 E+1	I	NA	2 E-7
Chloroform	7.3 E-2	2.3 E-5	I	9.8 E-2	A	4 E-7	5 E-4
Chloromethane	1.4 E-5	1.8 E-6	H	9.0 E-2	I	6 E-12	1 E-7
cis-1,2-Dichloroethene	1.8 E-3	NA		6.0 E-2	S	NA	2 E-5
Dibromochloromethane	6.7 E-6	2.7 E-5	CA	NA		4 E-11	NA
Dichlorodifluoromethane	2.8 E-4	NA		2.0 E-1	H	NA	1 E-6
Ethanol	5.8 E-3	NA		1.0 E+2	S	NA	4 E-8
Ethylbenzene	1.7 E-4	2.5 E-6	CA	1.0 E+0	I	1 E-10	1 E-7
Hexachlorobutadiene	2.9 E-4	2.2 E-5	I	NA		2 E-9	NA
Isopropylbenzene	2.5 E-5	NA		4.0 E-1	I	NA	4 E-8
m,p-Xylene	8.5 E-4	NA		7.0 E-1	CA	NA	8 E-7
Methyl methacrylate	6.0 E-5	NA		7.0 E-1	I	NA	6 E-8
Methyl tert butyl ether	1.3 E-3	2.6 E-7	CA	3.0 E+0	I	8 E-11	3 E-7
Methylene chloride	6.1 E-4	4.7 E-7	I	1.1 E+0	A	7 E-11	4 E-7
Naphthalene	5.2 E-4	3.4 E-5	CA	3.0 E-3	I	4 E-9	1 E-4
N-Butylbenzene	8.2 E-5	NA		4.0 E-1	S	NA	1 E-7
n-Heptane	1.5 E-4	NA		7.0 E+0	S	NA	2 E-8

TABLE 4
Screening-Level Indoor Air Health Risk Assessment Results
(Qsoil=calculated and ER=2/h)

Chemical	J&E Predicted Indoor Air Conc. ($\mu g/m^3$)	Unit Risk Factor $(\mu g/m^3)^{-1}$	Key	Non-Cancer Reference Concentration (mg/m^3)	Key	Incremental Lifetime Cancer Risk	Non-Cancer Hazard Index
n-Octane	2.1 E-4	NA		1.8 E+1	S	NA	8 E-9
N-Propylbenzene	6.5 E-5	NA		1.0 E+0	X	NA	4 E-8
o-Xylene	3.2 E-4	NA		7.0 E-1	CA	NA	3 E-7
sec-Butylbenzene	1.2 E-5	NA		4.0 E-1	S	NA	2 E-8
Styrene	8.2 E-5	NA		1.0 E+0	I	NA	6 E-8
t-Butyl alcohol	1.1 E-4	NA		3.0 E+1	S	NA	2 E-9
tert-Butylbenzene	1.7 E-5	NA		4.0 E-1	S	NA	3 E-8
Tetrachloroethene	4.1 E-3	5.9 E-6	CA	2.7 E-1	A	6 E-9	1 E-5
Toluene	2.9 E-3	NA		5.0 E+0	I	NA	4 E-7
Trichloroethene	6.1 E-3	2.0 E-6	CA	NA		3 E-9	NA
Trichlorofluoromethane	2.1 E-4	NA		7.0 E-1	H	NA	2 E-7
Vinyl acetate	7.6 E-4	NA		2.0 E-1	I	NA	3 E-6
Vinyl chloride	2.0 E-5	4.4 E-6	I	1.0 E-1	I	2 E-11	1 E-7
	Total					**5 E-7**	**8 E-4**

Notes:
NA=Toxicity criterion has not been established.
ER=Indoor air exchange rate
Qsoil=Average vapor flow rate

Key:
I=IRIS - Accessed June 2010 (http://www.epa.gov/iris/)
CA=CalEPA - Accessed June 2010 (http://oehha.ca.gov/risk/chemicalDB/index.asp)
P=PPRTV - as cited in NDEP BCLs table (2009) or
the EPA RSLs table (2010) (http://www.epa.gov/region9/superfund/prg/index.html)
X=PPRTV Appendix A - as cited in EPA RSLs table (2010)
A=ATSDR - as cited in NDEP BCLs table (2009) or in the EPA RSLs table (2010)
H=HEAST - as cited in NDEP BCLs table (2009) or in the EPA RSLs table (2010)
S=Surrogate toxicity criterion provided by NDEP (Personal communication [electronic mail message] from Shannon Harbor, NDEP, to Susan Crowley (Contractor), Tronox LLC, dated August 20, 2010, or Letter from Shannon Harbour, NDEP, to Matt Paque, Tronox, dated August 31, 2010).

Units:
$\mu g/m^3$=micrograms per cubic meter
mg/m^3=milligrams per cubic meter

Attachment A

Redline Version of the Text (on CD)

Attachment B

Soil Gas Data for Parcels A and B (on CD)

Attachment C

Screening-Level Indoor Air Health Risk Assessment Calculation Spreadsheets (on CD)

Attachment D

Soil Gas DVSR
(on CD)

Attachment E

Data Usability Evaluation

Attachment E: Data Usability Evaluation

The primary objective of the data usability evaluation is to identify appropriate data for use in the risk assessment. Evaluation of the analytical data for Parcels A/B, in terms of usability for this assessment, was conducted in accordance with the criteria presented in the *Guidance for Data Usability in Risk Assessment (Parts A and B)* (U.S. EPA, 1992a,b) and the *NDEP Supplemental Guidance for Assessing Data Usability for Environmental Investigations at the BMI Facility in Henderson, NV* (NDEP, 2010). These criteria include:

- Site data report content
- Documentation
- Data sources
- Analytical methods and detection limits
- Data review
- Data quality indicators (DQIs): precision, accuracy, representativeness, comparability, and completeness (PARCC).

The site-wide soil gas HRA will include a discussion of the data usability for all soil gas samples collected as part of the Phase B Source Area Soil Gas Investigation. As requested by NDEP, this data usability evaluation is limited to the nine soil gas samples located in Parcels A/B. A summary of the data analysis relevant to usability criteria for risk assessment are provided in Table E-1.

Table E-1: Data Usability Evaluation for Soil Gas Samples in Parcels A/B

Data Usability Criteria	Evaluation Results
Reports	All soil gas site characterization data in Parcels A/B were reviewed. Data are presented in the Revised Data Validation Summary Report (DVSR; Appendix D). Soil gas samples were collected from May 7 through May 29, 2008. Validation of laboratory data was completed by August 19, 2008 and a draft DVSR was submitted to NDEP on August 25, 2008. NDEP provided comments to the DVSR on September 18, 2008 and September 30, 2008; Tronox provided responses to NDEP comments on September 29, 2008 with a revised DVSR submitted on October 13, 2008; which was approved by NDEP on October 20, 2008. The DVSR and accompanying lab reports were considered complete for HRA purposes.
Documentation	Parcels A/B include nine soil gas sample locations (five locations in Parcel A and four locations in Parcel B) and represents a small subset of the entire Phase B Source Area Soil Gas Investigation. The placement of the site-wide sample locations (including Parcels A/B) were based on review of Phase A soil data (ENSR 2007) and historical groundwater data collected from prior investigations (Hargis and Associates 2008). All reviewed reports provide adequate information regarding sample results related to location and sampling procedures.
Data Sources	All analytical data for the soil gas samples were provided. Soil gas locations were placed at the property boundary, while other locations were spread randomly throughout the Parcels. Some soil gas locations were co-located near groundwater monitoring wells. Based on placement, and considering the context of Parcels A/B soil gas data within the entire site-wide investigation, the sample results were deemed representative to evaluate Parcel A/B soil gas conditions.
Analytical Method and Detection Limits	Soil gas samples were analyzed for VOCs using EPA Method TO-15. This method is adequate to characterize VOCs in soil gas. All helium tracer gas analyses utilized modified EPA Method 3C. Method detection limits were confirmed to be adequate for risk assessment applications.
Data Review	The quality of the analytical results was reviewed by Renee Kalmes CIH and Greg Brorby DABT of Exponent. The data review included review of: • Agreement of analyses conducted with chain-of-custody (COC) requests • Data package completeness • Holding times • Initial and continuing calibrations

	• Method blanks/canister blanks • Surrogate spike recoveries • Internal standard results • Laboratory control sample (LCS) results • Field duplicate results • Laboratory duplicate results • Quantitation limits and sample results
Data Quality Indicators	Based on the LCS results, field and laboratory duplicate results, surrogate spike recoveries and canister blanks, precision and accuracy were deemed acceptable. Representativeness of the data was deemed acceptable as soil gas sampling included site-wide locations and locations biased to accommodate groundwater locations with higher VOC concentrations. The only data quality indicators associated with Parcels A/B soil gas data were based on method blank contamination (acetone, methylene chloride, vinyl acetate, carbon disulfide) and quantitation problems for acetone in which two samples were qualified as J+ (See Table E-2). In all cases, the qualified data were deemed acceptable for risk assessmen purposes.

The specific information that Exponent reviewed as part of the data usability evaluation is discussed below.

As part of the soil gas DVSR, individual validation memoranda were developed for batches of soil gas samples. Appendix C of the DVSR presents these documents. Exponent reviewed the following ENSR validation memoranda that contained data for the relevant Parcel A/B soil gas data:

- Validation Memo TH539to15wwb for SG-01, SG-02, SG-03, SG-04, SG-05
- Validation Memo TH537to15wwb for SG-06
- Validation Memo TH536to15wwb for SG-10, SG-11 and SG-12

ELEMENTS REVIEWED

Sample data were reviewed for the following elements as reported in the validation memoranda for the relevant Parcels A/B data:

- Agreement of analyses conducted with COC requests
- Data package completeness
- Holding times

- Initial and continuing calibrations
- Method blanks/canister blanks
- Surrogate spike recoveries
- Internal standard results
- LCS results
- Field duplicate results
- Laboratory duplicate results
- Quantitation limits and sample results

DISCUSSION

Agreement of Analyses Conducted with COC Requests

No discrepancies were noted.

Data Package Completeness

The data packages were complete as received.

Holding Times

The samples were analyzed within the method-specified holding time.

Initial and Continuing Calibrations

The percent relative standard deviations (%RSDs), and the response factors (RFs) of all target compounds were within the quality control (QC) acceptance criteria for the initial and continuing calibrations associated with the sample analyses.

Method Blanks/Canister Blanks

Selected target compounds were detected in several laboratory method blanks associated with the sample analyses. The presence of blank contamination indicates that false positives may exist for these compounds in the associated samples. Action levels (ALs) were established at 10× the concentration detected in the laboratory method blank for the common laboratory contaminants acetone and 2-butanone, and at 5× the concentration detected in the method blank for the remaining compounds. Sample results were qualified as follows:

- If the sample result was < the sample quantitation limit (SQL) and < the AL, the result was reported as not detected (U) at the SQL.

- If the sample result was > SQL but < AL, the result was reported as not detected (U) at the reported concentration.
- If the sample result was > AL, the result was not qualified.

Target compounds were not detected in the canister blanks.

The samples were collected in canisters verified as clean by the laboratory through routine checks of ten percent of the canisters cleaned.

Surrogate Spike Recoveries

Surrogate percent recoveries (%Rs) met the QC acceptance criteria for all samples in this data set.

Internal Standard Results

All internal standard recoveries met the QC acceptance criteria.

LCS Results

The LCS %Rs met the QC acceptance limits of 70-130% for all sample analyses.

Field Duplicate Results

Duplicates were obtained on select samples within each validation report group and each validation report lists the relative percent difference (RPD) of the detected compounds. No Parcels A/B data were qualified due to field duplication issues.

Laboratory Duplicate Results

Laboratory duplicate analyses were performed on select samples within the three data validation group reports. The RPDs for all target compounds in the duplicate samples met the QC acceptance criteria.

Quantitation Limits and Sample Results

All samples were analyzed at minor dilutions due to the requirement to pressurize the canisters prior to analysis. Sample results and SQLs were adjusted accordingly.

In addition, all samples required additional dilution due to target compound concentrations that exceeded the calibration range. All dilution factors associated with Parcel A/B reported results are tabulated below.

Sample ID	Dilution Factors
SG01B-05	1.7
SG02B-05	1.7
SG03B-05	1.61
SG04B-05	1.53
SG05B-05	1.63
SG06B-05	1.54
SG10B-05	1.55, 7.75
SG11B-05	1.47, 14.7
SG12B-05	1.54, 7.7

The laboratory combined the results from multiple runs to ensure that all results were within the calibration range, and non-detect results were reported at the lowest possible reporting limit. The laboratory did not adjust the reporting limits for the additional analytical dilutions.

The laboratory appended an "M" qualifier to selected results to indicate possible matrix interference due to elution of non-target compounds, leading to a potential high bias in the results. Associated results less than the reporting limit were already flagged with a "J" to indicate an estimated result; in these cases, the "M" qualifier was removed and the "J" qualifier was retained. If the associated result was greater than the reporting limit, the "M" qualifier was replaced with "J+" during validation to indicate an estimated value with possible high bias.

CONCLUSION

Evaluation of the analytical data for Parcels A/B, in terms of usability for the risk assessment, was conducted in accordance with U.S. EPA and NDEP guidance. A small number of data points were found to be qualified based on method blank and quantitation issues but were deemed acceptable. Based on the evaluation, all Data Usability requirements were met and all Parcel A/B soil gas data were deemed to be usable for risk assessment purposes.

REFERENCES

Nevada Division of Environmental Protection (NDEP). 2010. Supplemental Guidance for Assessing Data Usability for Environmental Investigations at the BMI Facility in Henderson, NV. September 1.

U.S. Environmental Protection Agency (U.S. EPA). 1992a. Guidance for Data Usability in Risk Assessment. Part A. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09A. PB92-963356. April.

U.S. Environmental Protection Agency (U.S. EPA). 1992b. Guidance for Data Usability in Risk Assessment. Part B. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09B. PB92-963362. May.

Table E-2
Summary of Data Qualifications for Parcel A/B Data

Qualifications based on blank contamination (b) (from Table E-4 of the soil gas DVSR)

Sample ID	SDG	Method	Matrix	Analyte	Result	Qualifiers	Units	Reason	Batch ID	MB_Result	Dilution Factor	QL
SG06B-05	P0801507	TO-15	GS	Methylene chloride	0.77	U	ug/m3	b	MS16052708	0.076	1.54	0.77
SG10B-05	P0801483	TO-15	GS	Vinylacetate	7.8	U	ug/m3	b	MS13052708	0.40	1.55	7.8
SG10B-05	P0801483	TO-15	GS	Acetone	24	U	ug/m3	b	MS13052708	1.8	1.55	7.8
SG11B-05	P0801483	TO-15	GS	Carbon disulfide	1.4	U	ug/m3	b	MS13052708	0.29	1.47	0.74
SG12B-05	P0801483	TO-15	GS	Vinylacetate	7.7	U	ug/m3	b	MS13052708	0.40	1.54	7.7
SG12B-05	P0801483	TO-15	GS	Carbon disulfide	1.1	U	ug/m3	b	MS13052708	0.29	1.54	0.77
SG12B-05	P0801483	TO-15	GS	Acetone	15	U	ug/m3	b	MS13052708	1.8	1.54	7.7

Qualification based on quantitation problems (q) (from Table D-7 of the soil gas DVSR)

Sample ID	SDG	Method	Matrix	Analyte	Result	Qualifiers	Units	Reason
SG01B-05	P0801656	TO-15	GS	Acetone	33	J+	ug/m3	q
SG04B-05	P0801656	TO-15	GS	Acetone	12	J+	ug/m3	q

northgate
environmental management, inc.

From: Deni Chambers
Renee Kalmes, Exponent
Greg Brorby, Exponent
Date: November 12, 2010

To: Shannon Harbour, PE
Nevada Division of Environmental Protection

CC: Brian Rakvica, McGinley and Associates
Jim Najima, Nevada Division of Environmental Protection
Teri Copeland
Paul Black, Neptune and Co.

RE: Response to Comments re: Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada

1. *General comment, NDEP has noted that previous versions of the subject Deliverable were reviewed in late 2008 and in April 2010. NDEP acknowledges that, in general, most of the previous comments have been addressed; however, there are some cases that the way in which the comments have been addressed has raised new issues. General and specific comments are provided below. Note that the comments on the text pertain to the redline strike-out version.*

   Response: Comment noted.

2. *General comment, TRX should note that not all of the electronic files were delivered on the CD included with the report. For future submittals, TRX should make sure that all electronic files are included with the Deliverable CD.*

   Response: Comment noted.

3. *General comment, the following are elements of a risk assessment that are required in NDEP guidance that were not included in the Deliverable and should be included in the revised version. (Please note that several of these elements were also purposed in the health risk assessment (HRA) work plan and Chapter 9 of the BRC Closure Plan:*
   a. *Electronic copies of the laboratory reports. NDEP acknowledges that these laboratory reports are included in the data validation summary report (DVSR) but TRX should electronically provide either the DVSR or the laboratory reports in this HRA Deliverable. Additionally, the laboratory and the analytical methods used should be identified with the data or with the laboratory reports. For example, presumably TO-15 and TO-15 SIM were used and clarification is needed.*
   b. *A summary of the data validation that is reported in the DVSR to verify that the data are of sufficient quality from the laboratory.*

c. *A data usability evaluation to demonstrate that the data are usable for the decision to be made.*
d. *Plots of the data (including spatial plots) as part of exploratory data analysis (potentially focused on the primary contributors to the risk assessment results).*
e. *A data quality assessment to demonstrate that enough data have been collected to support the decisions to be made.*

Response: (a) An electronic copy of the DVSR for the soil gas data, including the laboratory reports, has been included as Appendix D of the revised document. (b) A summary of the data validation that is reported in the DVSR has been added to the revised document as Appendix E. (c) A data usability evaluation for the relevant Parcels A/B soil gas data has been added to the revised document (Appendix E). It should be noted that the pending Site-wide soil gas report will provide a data usability evaluation for all soil gas data (including Parcels A/B). NDEP requested a separate data usability evaluation be conducted for Parcels A/B rather than as part of the site-side assessment (NDEP September 7, 2010 meeting minutes). (d) Data plots have not been submitted. Rather the soil gas results for chloroform, the primary contributor to the incremental lifetime cancer risk (ILCR) estimates, are shown on a new figure (Figure 2). (e) The text of what is now Section 3.5 has been revised to include a qualitative discussion of the sufficiency of the soil gas data collected in Parcels A/B to support decision-making (p._). A quantitative data quality assessment will be included in the pending site-wide soil gas HRA for the soil gas dataset as a whole, including the samples in Parcels A/B.

4. *Johnson & Ettinger (J&E) model, NDEP has the following comments:*
   a. *NDEP notes that several input parameters to the J&E model were changed from the previous version of this Deliverable with no explanation for the changes. Please clarify why the following values were changed and the rationale for the new value (Note: the values **not in** parentheses are the values from Table 2 in the current version of the report while those **in** parentheses are the values from Table 2 in the previous revision of the report):*
      i. *Average soil temperature (deg C): 17 (15)*
      ii. *Soil gas sampling depth (cm): 150 (200)*
      iii. *Thickness of soil stratum (cm): 150 (200)*
      iv. *Enclosed space floor thickness (cm): 10 (15)*
      v. *Enclosed space floor length (cm): 2000 (1000)*
      vi. *Enclosed space floor width (cm): 2000 (1000)*
      vii. *Average vapor flow rate into building (L/m): 20 (5)*
      viii. *Indoor air exchange rate (1/hr): 1 or 2 (0.25)*

b. The following is a list of chemicals and the toxicological surrogates identified by NDEP to be used to obtain necessary toxicological values needed for the J&E model:

Chemical	Surrogate
1,2-Dichlorotetrafluoroethane	See Attachment B
1,3-Dichlorobenzene	1,2-Dichlorobenzene
4-Ethyltoluene	Isopropylbenzene (Cumene)
4-Isopropyltoluene	Isopropylbenzene (Cumene)
alpha-Methylstyrene	Styrene
cis-1,2-Dichloroethene	trans-1,2-Dichloroethylene
Ethanol	See Attachment B
N-Butylbenzene	Isopropylbenzene (Cumene)
n-Heptane	See Attachment B
n-Octane	See Attachment B
sec-Butylbenzene	Isopropylbenzene (Cumene)
t-Butyl alcohol	sec-Butyl Alcohol
tert-Butylbenzene	Isopropylbenzene (Cumene)

Response: (a)

(i) The previous value of 15°C was cited as a model default value; however, according to United States Environmental Protection Agency (USEPA) guidance,[1] there is no default value for this parameter. Instead, USEPA recommends that the groundwater temperature, as shown in Figure 8 of the guidance, be used as a surrogate. As such, the currently recommended value of 17°C is based on that guidance, as indicated in Table 2. Further, because previous comments from NDEP suggested that surface air temperature may be a better surrogate for soil temperature, Tronox notes in a footnote to Table 2 that the average surface air temperature reported for nearby Boulder City is 19°C, which is essentially the same as the value of 17°C used in the assessment.

(ii) The previous value of 200 cm was incorrect, i.e., as noted in the original table, soil gas samples were collected at 5 feet below ground surface; however, 200 cm is not equivalent to 5 feet. Therefore, the correct value of 150 cm was used.

(iii) See response to (ii)

(iv) The previous value of 15 cm was cited as a model default value; however, according to EPA guidance, the default value is 10 cm; therefore, the correct value was used.

(v) As noted in NDEP's comments to earlier versions of the document, it did not make sense that the vapor intrusion modeling was based on a residential scenario when the future use of the site is expected to be commercial. Therefore, building-specific input parameters, such as enclosed space floor length, were modified to reflect a commercial scenario. The basis for these

[1] U.S. Environmental Protection Agency (USEPA). 2004a. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. Office of Emergency and Remedial Response. Washington, DC.

input values was noted in Table 2 and further described in what is now Section 3.3.1 of the document.

(vi) See response to (v)

(vii) See response to (v)

(viii) See response to (v)

(b) The toxicity values for the identified surrogates are incorporated into the revised document.

5. *Page 1, Section 1.0, 11th line, NDEP has observed that a data summary, data usability and data adequacy are not presented. Please see above general comments for further details.*

Response: See response to Comment 3.

6. *Page 3, Section 3.0, 2nd listed item, please clarify what is meant by the qualifier "most" in the sentence "For most known or suspected chemical carcinogens, the NDEP point of departure is a cumulative incremental lifetime cancer risk of 1x10-6" as this is not consistent with the approved TRX HRA work plan.*

Response: A footnote has been added in the revised document that notes that dioxin and asbestos are examples of known or suspected chemical carcinogens that are not consistent with the general NDEP point of departure of an incremental lifetime cancer risk of $1x10^{-6}$ (p. _).

7. *Page 4, Section 3.1, please clarify why a screening target of 1/10th BCL is not used for COPC selection to account for possible additive effects for chemicals that were not detected. Please discuss any differences that occur between the two screening methods. TRX should provide justification for not using the 1/10th BCL method if still applicable.*

Response: As noted in what is now Section 3.2 of the document, all chemicals detected in soil gas were identified as chemicals of potential concern (COPCs). As also noted in Section 3.2, for chemicals that were not detected in any of the samples, the detection limits were compared to shallow soil gas to indoor air vapor intrusion screening levels from USEPA. These screening levels are based on an excess cancer risk of 1×10^{-6} or a noncancer hazard index of 1 for a residential scenario assuming a generic soil gas to indoor air attenuation factor (alpha) of 0.1. These screening values are considered sufficiently conservative for purposes of evaluating detection limits (as opposed to $1/10^{th}$ of the screening values) for the following reasons. First, future use of Parcels A/B will be commercial rather than residential. Second, USEPA provides screening levels for both shallow and deep soil gas. "Shallow" soil gas is defined as soil gas samples collected just below the foundation to depths less than 5 feet below the foundation, whereas "deep" soil gas is defined as soil gas samples collected from just above the groundwater table or from depths greater than 5 feet below the foundation. For deep soil gas, the generic screening levels are based on an alpha of 0.01, resulting in screening levels that are a factor of 10 higher than those for shallow soil gas. Because soil gas samples in Parcels A/B were collected at 5 feet below ground surface (bgs), comparison to either the shallow soil gas or deep soil gas screening levels may be justifiable, and the shallow soil

screening levels were used to be conservative. As noted in Table 1 and in Section 3.2, none of these chemicals had detection limits that exceeded these generic screening levels and, therefore, were not identified as COPCs. Additional text has been added to Section 3.2 to clarify this rationale (p. _).

8. *Page 5, Section 3.2, last sentence, please provide the appropriate reference for the use of the maximum concentration instead of the 95% UCL for this risk assessment.*

   Response: Based on further discussions with NDEP on September 7, 2010, the text of what is now Section 3.3 has been modified to state that the maximum detected concentration was used as the exposure point concentration consistent with NDEP's comments on a previous version of the technical memorandum (p. _).

9. *Page 6, Section 3.2.1, 7th line from top of page, TRX references Table 2; however, even though the parameter Qsoil is an input for one of the scenarios modeled in J&E, this value is not provided in Table 2.*

   Response: Table 2 is intended to provide values for parameters "input" into the model by the user, as opposed to intermediate values that are calculated by the model. As noted in what is now Section 3.3.1, two values were used for the average vapor flow rate into the building (Qsoil). The source of the first value, 20 liters per minute (L/min), is described in Section 3.3.1. The second value is calculated by the model, as also described in Section 3.3.1. No change was made to the technical memorandum in response to this comment.

10. *Page 6, Section 3.2.1, 1st full paragraph on page, 2nd sentence, this is the 1st instance where use of parameters for a sand soil has been described as conservative. NDEP understands the intent is to compare to different soil types; however, the alluvium at this site is essentially sand. Therefore, the parameter for sand is not conservative for this site; instead is should be considered "representative". Please revise.*

    Response: The sentence has been deleted (p. 4)

11. *Page 7, Section 3.2.1, 2nd full paragraph, 3rd line, please provide a reference for "Nazaroff".*

    Response: As noted at the end of this sentence, the information provided is from USEPA guidance and not from the primary article authored by Nazaroff. The primary reference is provided in the USEPA guidance document. No change was made to the technical memorandum in response to this comment.

12. *Page 8, Section 3.3, 1st paragraph, last sentence, this sentence is unclear. Please revise "The BRC Closure Plan (BRC, ERM, and DBS&A 20072009) and Tronox HRA Work Plan (Northgate 2010) provides a full discussion on the risk assessment methodology for the project, and used in this screening-level indoor air HRA" to "The BRC Closure Plan (BRC, ERM, and DBS&A 20072009) and Tronox HRA Work Plan (Northgate 2010) provide a full discussion of the risk assessment methodology for the project and are used as the basis for this screening-level indoor air HRA".*

Response: What is now Section 3.4 has been revised as requested (p. 6).

13. *Page 8, Section 3.3, 2nd paragraph, last sentence, NDEP requires more complete references to the Tronox HRA WP and/or the BRC Closure Plan Chapter 9. In this case, please provide reference to hierarchy used.*

    Response: Based on further discussions with NDEP on September 7, 2010, it is our understanding that this comment actually pertains to the 1st paragraph of Section 3.3. The text has been revised to specifically identify the sections of the *Tronox HRA Work Plan* relied upon in this screening-level indoor air evaluation (p. _).

14. *Page 9, Section 3.4, paragraph below sentence below bullets, last sentence, this sentence does not follow from the rest of this paragraph. The paragraph is about uncertainty related to sampling and analysis. This sentence is about uncertainty associated with use of the maximum concentration. A new paragraph is needed along with a comment on the uncertainty associated with a maximum concentration (statistics this far in the tail are always very uncertain). Please revise as necessary.*

    Response: What is now Section 3.5 has been revised as requested (p. 8).

15. *Page 11, Section 3.4, 3rd line on page, please clarify how the risk could be zero at this Site or any Site.*

    Response: As discussed with NDEP on September 7, 2010, this statement is based on the fact that cancer risk estimates are generally based on low-dose extrapolations from high-dose animal studies. These extrapolations are done in a manner to not underestimate risk and, as a result, the risk may be overestimated or even zero. Nonetheless, what is now Section 3.5 has been revised to remove this language. Similar language is commonly used in risk assessment evaluations (p._).

16. *Page 11, Section 3.5, results are now presented for both risk assessments performed for this site. If these 2 risk assessments had been performed within the context of a single risk assessment, then these risks would have been added across media to present cumulative risk. If they are added, then the ICLR is 2x10-6. Tronox should acknowledge this and discuss the results as appropriate.*

    Response: Based on discussions with NDEP on September 7, 2010, we are still awaiting additional guidance to be provided by NDEP to address this issue. However, we believe that the previous version of the technical memorandum provided the information necessary for risk management decisions. Therefore, no change was made to the technical memorandum in response to this comment.

17. *Page 12, Section 4.0, 1st bullet, NDEP rejects the notion that the largest contributor to the cumulative HI is lead. Lead should not be included in a HI calculation, but should be evaluated separately. NDEP acknowledges that inclusion of lead in the HI calculation in the previous risk assessment report occurred; however, NDEP provided comments in a January 17, 2008 Part 2 Response letter that were intended*

to be considered for future risk assessments. Comment 7 of the January 17, 2010 letter addressed this issue. Whereas NDEP acknowledges that Tronox is referencing this previous work, NDEP does not want the issue to be perpetuated in future Deliverables, including this Deliverable; therefore, the HI as presented needs to be provided better context.

Response: The hazard index has been changed to exclude lead; however, a footnote has been added to indicate that lead was included in the original hazard index reported in the cited document (p. 10).

18. *Page 13, asbestos bullet. This bullet first indicates that the estimated asbestos risks are less than $1x10^{-6}$; however, later in the bullet TRX acknowledges that the upper bound estimate for amphibole is 5x10-6. Please clarify.*

    Response: As discussed with NDEP on September 7, 2010, the first sentence in this bullet refers to maintenance workers and the latter sentences of this bullet refer to construction workers. No change was made to the technical memorandum in response to this comment.

19. *RTC #17.b (previous RTC # 5.a), the previous comment stands as it has not been demonstrated that the data are sufficient for decision making. Given the apparent spatial differences described above, it seems that only 3 samples have been taken in the area of greatest risk-based concentrations (the east side of Parcel B). Use of the maximum concentration might be acceptable for the risk assessment, but misses the point of trying to understand how the data impact the conceptual site model (CSM). It appears that the concentrations of chloroform in these 3 samples (440, 400, 270 ppb) are much greater than those for the other 6 samples (14, 16, 8.6, 8.6, 62, 34). These 3 samples are co-located. There is a clear spatial pattern in the data. Please provide a figure, and please describe in the context of nature and extent, and in the context of the CSM.*

    Response: What is now Section 3.4 has been revised in response to this comment. The discussion includes reference to a new Figure 2 that presents the chloroform results for soil gas and groundwater in Parcels A/B. Additionally, as previously indicated, the pending site-wide soil gas assessment will more fully discuss the site-wide conceptual model including potential groundwater and soil sources and the impact of these sources on the measured soil gas concentrations, including data collected in Parcels A/B (p. _).

Tab 11

Nevada Division of Environmental Protection (NDEP) Response to: Revised Tech Memo: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation Tronox LLC, Henderson, Nevada, Dated November 12, 2010

May 23, 2011

ndep
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

STATE OF NEVADA
Department of Conservation & Natural Resources
DIVISION OF ENVIRONMENTAL PROTECTION

Brian Sandoval, Governor
Leo M. Drozdoff, P.E., Director
Colleen Cripps, Ph.D., Administrator

May 23, 2011

Jay A. Steinberg
Nevada Environmental Response Trust
35 East Wacker Drive, Suite 1550
Chicago, IL 60601

Re: **Tronox LLC (TRX) Facility**
Nevada Environmental Response Trust (Trust) Property
NDEP Facility ID #H-000539
Nevada Division of Environmental Protection (NDEP) Response to:
Revised Tech Memo: Screening Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Tronox LLC, Henderson, Nevada
Dated: November 12, 2010

Dear Mr. Steinberg,

The NDEP has received and reviewed the above-identified Deliverable prepared and submitted by TRX and provides comments in Attachment A. Please advise NDEP **by June 13, 2011** whether the Trust will be providing a revised Deliverable based on the comments found in Attachment A. Please contact the undersigned with any questions at sharbour@ndep.nv.gov or 775-687-9332.

Sincerely,

Shannon Harbour, P.E.
Staff Engineer III
Bureau of Corrective Actions
Special Projects Branch
NDEP-Carson City Office
Fax: 775-687-8335

SH:wk:sh

EC: Jim Najima, Bureau of Corrective Actions, NDEP
Greg Lovato, Bureau of Corrective Actions, NDEP
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Carolyn Tanner, AG's Office
Brenda Pohlmann, City of Henderson
Stephen Tyahla, U.S. Environmental Protection Agency, Region 9
Charles K. Hauser, Esq., Southern Nevada Water Authority
Peggy Reofer, Southern Nevada Water Authority

Marcia Scully, Metropolitan Water District of Southern California
Mickey Chaudhuri, Metropolitan Water District of Southern California
John R. McNeill, Central Arizona Water Conservation District
Andrew Steinberg, Nevada Environmental Response Trust
Tanya O'Neill, Foley & Lardner LLP
Allan Delorme, ENVIRON
Mark Travers, ENVIRON
Mike Skromyda, Tronox LLC
Matt Paque, Tronox LLC
Deni Chambers, Northgate Environmental
Brian Rakvica, McGinley and Associates
Joe McGinley, McGinley & Associates
Barry Conaty, Holland & Hart LLP
Ranajit Sahu, BRC
Rick Kellogg, BRC
Lee Farris, BRC
Mark Paris, Landwell
Craig Wilkinson, TIMET
Kirk Stowers, Broadbent & Associates
Victoria Tyson, Tyson Contracting
George Crouse, Syngenta Crop Protection, Inc.
Nick Pogoncheff, PES Environmental
Lee Erickson, Stauffer Management Company
Michael Bellotti, Olin Corporation
Curt Richards, Olin Corporation
Paul Sundberg, Montrose Chemical Corporation
Joe Kelly, Montrose Chemical Corporation of CA
Jeff Gibson, AMPAC
Larry Cummings, AMPAC
Ebrahim Juma , Clean Water Team
Joe Leedy, Clean Water Team
Kathryn Hoffmann, Clean Water Team
Paul Black, Neptune and Company, Inc.
Kelly Black, Neptune and Company, Inc.
Mike Balshi, Neptune and Company, Inc.

CC: Lee Farris, BRC, 875 W. Warm Springs Road, Henderson, NV 89011
Lee Erickson, Stauffer Management Company

Attachment A

1. General comment, NDEP has noted that this technical memorandum does not discuss the sampling design used for the data that were collected and presented. Please reference the appropriate document where this information can be found.
2. Response to Comment (RTC) 4.a.iv and Table 2, this RTC indicates that the appropriate reference for the enclosed space floor thickness parameter is EPA guidance. However, Table 2 indicates that the reference is "model default". Please revise for consistency.
3. RTC 3.d, NDEP comment 3.d requested that the data be displayed spatially as is noted in NDEP guidance for risk assessment. Spatial data plots have not been provided for any COPC other than chloroform and rationale for this has not been given. The RTC simply states that the requested spatial plots have not been submitted. NDEP understands that chloroform is one of the more pervasive compounds; however, other compounds have been shown to dominate the vapor intrusion pathway (e.g. naphthalene). The downgradient soil vapor intrusion study should be reviewed to assist in the selection of compounds other than chloroform for spatial data plots.
4. RTC 4.b, this RTC includes a table of chemicals and toxicological surrogates; however, this table could not be located within the main document. Please include this table in the main document as appropriate.
5. RTC 5, the last paragraph in the current Section 3.3.1 describes QSoil as an input to the J&E model. If it is an input, then please include it in Table 2. If not, then it should be labeled as an intermediate value. Please revise as necessary.
6. RTC 14, the redline additions to the document reference a groundwater well MW23, that seems to appear as M-23 on Figure 2. Please clarify that this is the same well as there are MW and M series wells associated with the Site. Additionally, please revise the document as necessary for consistency.
7. RTC 16, as requested in this RTC, NDEP is clarifying that cumulative risk be presented in this document.
8. Attachment E, NDEP provides the following comments:
   a. NDEP issued guidance for blank contamination based on EPA's revision to the National Functional Guidelines in 2009. This guidance is referenced in the September 2010 revision that is included in the references in Appendix E. TRX did not follow the most recent NDEP guidance on blank contamination. Please revise the Deliverable accordingly.
   b. Table E-2, please include footnotes that explain the reason codes and qualifiers.

Tab 12

Nevada Division of Environmental Protection (NDEP) Meeting Minutes regarding NERT's questions on the parcels soil gas issues

February 21, 2013

FINAL

Meeting Minutes

Project:	Nevada Environmental Response Trust (NERT)
Location:	Conference Call
Time and Date:	11:30 AM, February 21, 2013

In Attendance:

NDEP:	Shannon Harbour, Weiquan Dong
MGA:	Brian Rakvica (for NDEP)
TFG:	Kurt Fehling (for NDEP)
Neptune:	Paul Black (for NDEP)
Hackenberry:	Paul Hackenberry (for NDEP)
ENVIRON:	John Pekala, Lynne Haroun, Chris Stubbs, Chris Ritchie, Alan DeLorme (for NERT)

The purpose of the meeting is to discuss NERT's questions on the parcels soil gas issues.

1. NERT noted that they are trying to close out the sale parcels ASAP.
2. Discuss comments from the NDEP's January 29, 2013 letter and May 23, 2011 letter.
3. Helium as a Tracer (NDEP Comment #7c): Issue: ENVIRON would like to understand NDEP's rationale for using a liquid tracer, as opposed to helium.
    a. NERT prefers helium as leak checks can be done in the field and can be quantitative.
    b. NERT notes they have had problems with interference with liquid tracers.
    c. NDEP noted problems with helium at other sites (break thru) and that the comment is only a recommendation for NERT's consideration and the results will dictate the appropriateness.
    d. NERT will be prepared to use liquid tracers if the helium is a problem.
    e. All agreed.
4. Practical Quantitation Limits (PQLs) (NDEP Comment #8): Issue: Identification of "risk-based" PQLs.
    a. Work plan didn't include the PQLs proposed to be used.
    b. Other PQLs were based upon indoor air RSLs.
    c. Laboratories state this is difficult and would require a significant air volume to attain.
    d. NERT proposes to derive PQLs based upon an attenuation factor (AF) applied to the indoor air RSLs. Preliminarily this is a 2E-4 AF. NERT would propose to multiply this by 10 to address the issue of multiple contaminants.
    e. NDEP is ok with this so long as NERT believes the data will be usable for its intended purpose.
5. Parcels A and B: Issues:
    a. (1) Confirm that existing soil gas data for Parcels A and B is sufficient;
        i. NDEP has not had an opportunity to review this prior to the call.
        ii. NERT will summarize the data and send to NDEP for review and comment.
    b. (2) Discuss Comment #8 (re: blank contamination) in NDEP's May 23, 2011 Response to: Revised Technical Memorandum – Screening-Level Indoor Air

Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation. Dated November 12, 2010.

i. In the future, blank contamination will be addressed by NERT but would propose to not reopen historic data.
ii. NDEP noted that the existing guidance allows this so long as it is addressed in the uncertainty analysis.
iii. All agreed.

c. Additional comment, NERT notes that Exponent and NGEM prepared the previous HRA. NERT proposes to prepare an addendum to the existing HRA and provide the needed information to address the outstanding comments.
    i. NDEP concurs and just noted that to the extent possible provide the historic documents in electronic format that are referenced.

6. Update from previous calls.
    a. Soils for Parcels C-H, evaluate as combined data set with maximum concentrations or evaluate as a sub-set.
        i. This is done, in QC and will be delivered to NDEP soon.
        ii. Expedited review requested as this affects the HRA development.

Tab 13

ENVIRON International Corporation (ENVIRON) Response to NDEP Comments on Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada, dated November 12, 2010

May 3, 2013

May 3, 2013

Mr. Weiquan Dong, PE
Bureau of Corrective Actions, Special Projects Branch
Nevada Division of Environmental Protection
2030 E. Flamingo Rd., Suite 230
Las Vegas, Nevada 89119

Re: Response to NDEP Comments on *Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada,* dated November 12, 2010.

Dear Mr. Dong:

On behalf of the Nevada Environmental Response Trust (the Trust), this technical memorandum has been prepared to respond to Nevada Division of Environmental Protection's (NDEP) May 23, 2011 comments (NDEP 2011) on the *Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation* (the Indoor Air HRA) (Northgate Environmental Management, Inc. [Northgate] 2010b). This technical memorandum also addresses comments received from NDEP during a conference call on February 21, 2013 (NDEP 2013b) and in a March 6, 2013 e-mail (NDEP 2013c). As discussed with NDEP during the February 21, 2013 call, all NDEP comments are addressed in this memorandum and the November 12, 2010 Indoor Air HRA will not be revised.

To facilitate the review of information provided in this memorandum, the following related reports and information have been provided in Attachments A through C.

- Attachment A: Chronological Listing of Select Documents for Parcels A and B (lists all previous versions of the Parcels A and B vapor intrusion risk assessments, NDEP comments, and other related reports);
- Attachment B: *Phase B Source Area Investigation Soil Gas Survey Work Plan* (ENSR Corporation [ENSR] 2008); and
- Attachment C: *Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation* (includes the November 12, 2010 Response to Comments) (Northgate 2010b).

RESPONSE TO COMMENTS

NDEP's May 23, 2011 letter included comments on the Indoor Air HRA (Comments #1 and 8 below) and comments on Northgate's responses to NDEP comments, which were included as Attachment A of the Indoor Air HRA (Comments #2 - 7, below).

1. General comment, NDEP has noted that this technical memorandum does not discuss the sampling design used for the data that were collected and presented. Please reference the appropriate document where this information can be found.

   The Phase B Source Area Investigation Soil Gas Survey Work Plan *(ENSR 2008) presents the soil gas sampling design, including collection methods, analytical testing, and reporting. This document is provided as Attachment B of this memorandum.*

2. (Northgate's) Response to Comment (RTC) 4.a.iv and Table 2, this RTC indicates that the appropriate reference for the enclosed space floor thickness parameter is EPA guidance. However, Table 2 indicates that the reference is "model default". Please revise for consistency.

   The enclosed space floor thickness parameter is a model default value as provided in U.S. Environmental Protection Agency (USEPA) guidance (2004). Table 2 of the Indoor Air HRA has been revised for consistency and is presented as Table 1 of this memorandum.

3. (Northgate's) RTC 3.d, NDEP comment 3.d requested that the data be displayed spatially as is noted in NDEP guidance for risk assessment. Spatial data plots have not been provided for any COPC other than chloroform and rationale for this has not been given. The RTC simply states that the requested spatial plots have not been submitted. NDEP understands that chloroform is one of the more pervasive compounds; however, other compounds have been shown to dominate the vapor intrusion pathway (e.g. naphthalene). The downgradient soil vapor intrusion study should be reviewed to assist in the selection of compounds other than chloroform for spatial data plots.

   ENVIRON International Corporation (ENVIRON) reviewed the results of the vapor intrusion health risk assessments (HRAs) for Parcels A and B (Northgate 2010b) and for upgradient Parcels C and D (Northgate 2010c). In addition, vapor intrusion risks estimated based on groundwater data were considered. Based on this review, soil gas and groundwater results for benzene; 1,4-dichlorobenzene; and naphthalene were considered for spatial presentation (in addition to chloroform). Chloroform (over 90 percent) and 1,4-dichlorobenzene (3 percent) were the primary contributors to the total cancer risk, and naphthalene (over 13 percent), in addition to chloroform (over 60 percent), were the primary contributors to the total noncancer hazard index (HI) for the vapor intrusion pathway based on the risk results estimated using the soil gas data. Additionally, benzene was selected because in 2008, detected groundwater concentrations exceeded its groundwater risk-based concentration (RBC). (The RBC represents the benzene concentration corresponding to a cancer risk of one in a million [1×10^{-6}]). Although initially identified for presentation, naphthalene was ultimately not presented because it was not detected in 2008 in wells located in or near Parcels A or B.

   Figure 1 presents the soil gas and groundwater concentrations for benzene, 1,4-dichlorobenzene, and chloroform for locations within or near Parcels A and B.[1] Groundwater concentrations from 2008 were selected for presentation to correspond to the year in which the soil gas samples were collected. The groundwater results are the maximum concentrations from the Phase B groundwater investigation (Northgate 2010a). In addition, results are shown for wells located on or near Parcels A and B that were sampled in 2008 by the former Montrose Chemical Corporation of California and by Stauffer Management Company LLC/Syngenta Crop Protection, Inc. facilities and current Olin Corporation (Olin) facility. These results were obtained from the NDEP regional database.[2] In addition, figures developed by Hargis & Associates (2012) depicting groundwater concentrations of chloroform, benzene, and 1,4-dichlorobenzene for upgradient and in-parcel areas are provided in Attachment D.

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[1] Additional chemicals were not identified for spatial presentation because (1) spatial distributions of the most frequently detected chemicals (i.e., other chlorobenzenes) are similar to those for benzene and 1,4-dichlorobenzene, (2) few wells in Parcels A and B have been sampled for VOCs, and (3) the detection frequencies for most VOCs were very low.

[2] The NDEP regional database is available at: http://ndep.neptuneinc.org/ndep_gisdt/home/index.xml.

Our review of soil gas and groundwater data presented on Figure 1 indicates the following:

- *Benzene was detected at elevated concentrations in three wells (MC-50, MC-62, and MC-114, at concentrations of 1,100; 2,400; and 700 micrograms per liter [µg/L], respectively), while in the remaining wells, benzene was either not detected or detected at low concentrations (from less than detection limits to 6 µg/L). In soil gas, benzene was detected at low concentrations at all locations (from 1.2 to 2.7 micrograms per cubic meter [µg/m^3]). In particular, the benzene concentration was 2.4 µg/m^3 in the soil gas sample co-located with the maximum groundwater concentration of 2,400 µg/L.*

- *The highest soil gas and groundwater chloroform concentrations were detected in the eastern parcel areas (eastern side and former portion of Parcel B, and former Parcel I). The maximum chloroform groundwater and soil gas concentrations were 390 µg/L (M-95) and 1,100 µg/m^3 (SG09), respectively. For comparison, the maximum chloroform groundwater and soil gas concentrations within Parcels A and B were 34 µg/L (M-44) and 440 µg/m^3 (SG-10), respectively.*

- *1,4-Dichlorobenzene was either not detected or detected at low concentrations at all groundwater (less than 59 µg/L) and soil gas (less than 43 µg/m^3) sampling locations.*

4. (Northgate's) RTC 4.b, this RTC includes a table of chemicals and toxicological surrogates; however, this table could not be located within the main document. Please include this table in the main document as appropriate.

   The table of chemicals and toxicological surrogates from the November 12, 2010 Response to Comments is presented in Table 2 of this memorandum.

5. (Northgate's) RTC 5, the last paragraph in the current Section 3.3.1 describes QSoil as an input to the J&E model. If it is an input, then please include it in Table 2. If not, then it should be labeled as an intermediate value. Please revise as necessary.

   The vapor flow rate into a building (Q_{soil}) is an input parameter to the Johnson and Ettinger (J&E) model for calculating the indoor air concentrations as shown in Table 3 of the Indoor Air HRA and is also an intermediate value used in the model to calculate indoor air concentrations, as shown in Table 4 of the Indoor Air HRA. Two different values for Q_{soil} were used to provide a range of estimated indoor air concentrations and corresponding risk estimates to address the uncertainty in this parameter, as described in the last paragraph of Section 3.3 of the Indoor Air HRA. Table 2 of the Indoor Air HRA has been revised to reflect this information and is presented as Table 1 of this memorandum.

6. (Northgate's) RTC 14, the redline additions to the document reference a groundwater well MW23, that seems to appear as M-23 on Figure 2. Please clarify that this is the same well as there are MW and M series wells associated with the Site. Additionally, please revise the document as necessary for consistency.

   Groundwater well MW23, referenced in Section 3.5 in the last paragraph on page 9 of the Indoor Air HRA, is the same as M-23 shown on Figure 2 of the Indoor Air HRA. The correct name of this well is M-23. This well is also presented on Figures 1 and 2 of this memorandum.[3]

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[3] Figure 2 of this memorandum presents the shallow groundwater and soil gas locations within and near Parcels A and B. In preparing this memorandum, ENVIRON reviewed the data for these locations, with results from many of the locations used in the analyses presented in this memorandum. (See for example, Figure 3 and Tables.) The specific data used for each analysis is identified in the text or on the appropriate table and/or figure.

7. (Northgate's) RTC 16, as requested in this RTC, NDEP is clarifying that cumulative risk be presented in this document.

   ENVIRON noted a few minor errors in the Indoor Air HRA when preparing the response to this comment that affect the cumulative risk calculation. The original and corrected text is provided below:

   - *Indoor Air HRA, Section 4.0: Originally stated in the first bullet on page 12, "the largest contributors to the cumulative [incremental lifetime cancer risk (ILCR)] are dioxins/furans, alpha-BHC, and polycyclic aromatic hydrocarbons (PAHs)" for non-radionuclide chemicals other than asbestos. The correct list of non-radionuclide chemicals other than asbestos that are the largest contributors to the cumulative ILCR are: dioxins/furans, beta-BHC, benzo(a)pyrene, and hexachlorobenzene.*
   - *Indoor Air HRA, Section 4.0: Originally stated in the last bullet on page 12, "for construction workers, the best estimate and upper bound concentrations of asbestos range from 1×10^{-7} (best estimate) to 8×10^{-7} (upper bound estimate) for chryostile fibers." The correct upper bound estimate for chryostile fibers is 3×10^{-7}.*

   As requested by NDEP, ENVIRON calculated the cumulative non-cancer HI and cancer risk (see Table 3 of this memorandum).[4] For commercial/industrial workers, the cumulative HI[5] for the vapor intrusion and soil-related pathways is 0.10, and the cumulative cancer risk for chemical carcinogens and radionuclides combined for these same pathways is 5.1×10^{-6}.

8. Attachment E, NDEP provides the following comments:

   a. NDEP issued guidance for blank contamination based on EPA's revision to the National Functional Guidelines in 2009. This guidance is referenced in the September 2010 revision that is included in the references in Appendix E. TRX did not follow the most recent NDEP guidance on blank contamination. Please revise the Deliverable accordingly.

      As noted in NDEP's current guidance on blank contamination (NDEP 2012) and discussed during the February 21, 2013 call (NDEP 2013b), the 2012 blank contamination guidance applies only to data collected after June 2011. Given the data presented in this report were collected prior to June 2011 (specifically, the soil gas data were collected in 2008), it was agreed that the guidance does not apply. However, NDEP's 2012 guidance states that uncertainties in the risk results associated with use of the older guidance for addressing blanks should be discussed. The following paragraph taken from the Indoor Air HRA discusses the validated 2008 soil gas results impacted by blank contamination. Additional discussion is then provided in the paragraph "Additional ENVIRON Discussion."

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[4] For cumulative risk, ENVIRON understands that NDEP is requesting that the estimated cancer risks for chemical and radiological contaminants for the soil-related and inhalation pathways be summed and that asbestos risks be presented separately. For the noncancer HI, the estimated HQs for all chemical COPCs are summed for the soil-related and inhalation pathways.

[5] The total HI of 0.27 for all soil-related pathways and COPCs reported by Basic Environmental Company (BEC) (2008) incorrectly included lead. The portion of the HI attributed to lead (0.17) has been subtracted from the HI of 0.27, resulting in an adjusted HI of 0.10. It is noted that the maximum detected concentration of lead in soils in Parcels A and B combined is 136 milligrams per kilogram (mg/kg), less than its industrial soil Basic Comparison Level of 800 mg/kg (NDEP 2013d).

Blank Contamination *(summarized from Attachments D and E in the Northgate 2010 Indoor Air HRA):*

". . . in general, laboratory and field blanks were free of contamination at significant levels. Table E-4 [in the Indoor Air HRA presented in Table 4 of this memorandum] lists the sample results [in Parcels A and B] that were qualified based on contamination in laboratory method blanks. Target compounds were not detected in the canister blanks."

ENVIRON notes that seven sample results were qualified (U) due to blank contamination based on the presence of low levels of the common laboratory contaminants methylene chloride and acetone as well as trace levels of carbon disulfide and vinyl acetate in the method blanks. The majority of these were based on the presence of acetone. Two sample results were qualified (J+) due to quantitation problems and the acetone results may be biased high. As stated in the Data Usability Evaluation in Attachment E of the Indoor Air HRA, "… in all cases, the qualified data were deemed acceptable for risk assessment purposes."

Additional ENVIRON Discussion: Comparison of Potential Differences between Blank Contamination Approaches

ENVIRON's review of the 2008 soil gas sampling results indicated that (1) only seven samples were qualified due to blank contamination and (2) all chemicals with blank contamination were also reported as detected in at least one sample for which blank contamination was not identified. Thus, no detected analyte was eliminated as a possible chemical of potential concern (COPC) simply on the basis of blank contamination; further, reported concentrations in the qualified (J+) contaminated samples were biased high. Thus, use of the former approach for addressing blanks would have had minimal to no impact on the risk assessment results.

b. Table E-2, please include footnotes that explain the reason codes and qualifiers.

Footnotes for the reason codes and qualifiers have been added to Table E-2 (included as Table 4 of this memorandum).

ADDITIONAL DATA ANALYSIS

Additional data analysis for Parcels A and B was requested by NDEP during a conference call on February 21, 2013 (NDEP 2013b) and in a March 6, 2013 e-mail (NDEP 2013c). The requested analyses and responses are provided below.

A1. Cross plots (scatter plots) should be done for the new and combined data sets.

ENVIRON understands that NDEP is requesting a cross plot similar to Table 9 of Northgate (2010c), which presented a plot of the chloroform 2008 soil gas and 2008/2009 groundwater concentrations for co-located soil gas and groundwater samples across the entire Nevada Environmental Response Trust Site (Site). (We note that only 2008 groundwater data were used for 2008 co-located soil gas samples in and near Parcels A and B, except for three locations where 2008 groundwater data were not available and 2006 and 2010 data were used instead. The most recent groundwater data [2008, 2009, and 2011] were used for 2013 co-located soil gas samples in and near Parcels A and B).

As shown on Figure 2 of this memorandum, four co-located 2008 soil gas and shallow groundwater sampling locations within Parcels A and B (SG01 and PC-40, SG04 and H-49A, SG05 and MC-62, and SG06 and PC-37) were identified with results for volatile organic compounds (VOCs); an additional 11 locations were identified near Parcels A and B (E-SG-2 and

MC-3, E-SG-3 and AA-BW-04A, E-SG-9 and M-23, SG07 and M-95, SG14 and M-48, SG16 and MC-45, SG17 and MC-97, SG19 and M-7B, SG24 and M-99, SG90 and M-98, and SG91 and M-100).[6] *These 2008 and 2013 soil gas data were plotted and a linear regression model applied, as shown on Figure 3. Pearson's correlation coefficient (r of 0.87) indicates a strong positive correlation between groundwater and soil gas concentrations in and near Parcels A and B, providing further evidence to support the conceptual site model that groundwater is the source of chloroform in soil gas.*

A second cross plot for only "new" (2013) soil gas data is not presented (as requested by NDEP) because "new" soil gas samples have not been collected in Parcels A and B since 2008, apart from the three nearby 2013 soil gas samples, which were included as nearby sample locations in Figure 3 of this memorandum.

A2. Compare groundwater VOC concentrations used for the Site-Wide Soil Gas Human Health Risk Assessment with most recent groundwater sample results for the same wells.

For clarification, ENVIRON notes that the groundwater results were not "used" for estimating risks in the Site-Wide Soil Gas Human Health Risk Assessment (Site-Wide HHRA) (Northgate 2010c). Northgate presented groundwater concentrations for chloroform, carbon tetrachloride, and trichloroethylene (TCE) in Figures 5, 6, and 7, respectively, of the Site-Wide HHRA. Northgate's selection of chemicals for presentation was based on the risk results for the entire Site, and not specifically on the risk results for Parcels A and B. As shown on Figures 6 and 7 of the Site-Wide HHRA, carbon tetrachloride and TCE concentrations in Parcels A and B groundwater were either below detection limits or detected at low concentrations only slightly exceeding detection limits. The areas of higher carbon tetrachloride and TCE concentrations are located south of Parcels A and B, along the western boundary of the Site, and for TCE, also in the central portion of the Site. Given the very low concentrations of carbon tetrachloride and TCE (and the observation that they contributed less than 1 percent of the total cancer risk in Parcels A and B), the requested comparison is presented for chloroform only. [7]

ENVIRON searched NDEP's regional database for chloroform results in shallow groundwater wells sampled within or near Parcels A and B, as presented in Table 5 of this memorandum. The 2008/2009 chloroform concentrations presented on Figure 5 of the Site-Wide HHRA (Northgate 2010c) are highlighted gray in Table 5, while the most recent groundwater results are shown in ***bold*** *font. Eight shallow wells within Parcel A, 3 wells within Parcel B, and 15 wells near Parcels A and B were identified with chloroform results. Well locations are shown on Figure 1 of this memorandum. For most wells, more recent sampling data were not available, as Tronox, and now the Trust, have not sampled for VOCs since 2008. For the 3 wells (H-49A, H-56A, and MC 53) included in the Site-Wide HHRA for which more recent data are available, chloroform concentrations remain approximately the same or show a general downward trend as compared with the 2008/2009 sampling results.*

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[6] A middle-water bearing zone well, MC-MW-32, was previously misidentified as a shallow well in the *Soil Gas Investigation and Human Health Risk Assessment Work Plan for Parcels C, D, F, G, and H* (ENVIRON 2013). Although co-located with soil gas sample, E-SG-1, this well was not included in the cross plot presented in Figure 3.

[7] In addition to chloroform, historical and recent groundwater results for benzene and 1,4-dichlorobenzene are discussed and displayed spatially in the response to comment #3 and in Attachment D. Similar to the results for chloroform, the groundwater concentrations for these chemicals generally show decreasing concentration trends from 2008 to 2012.

A3. Calculate risk for the new soil gas samples and compare with risk calculations for the earlier data set.

This requested analysis is not presented because "new" soil gas samples were not collected in Parcels A and B.[8] Specifically, the only available data set for soil gas in these two parcels was collected in 2008 (Northgate 2010b).

A4. Calculate risk using the groundwater VOC concentrations and compare with risk associated with the soil gas.

The maximum 2008 groundwater concentrations were used to estimate risks for the vapor intrusion pathway at 23 locations in and near Parcels A and B. Specifically, hazard quotients (HQs) and cancer risks were estimated for the three primary risk contributors (chloroform, benzene, and 1,4-dichlorobenzene) identified in the response to Comment #3 above. The methodology and assumptions presented in the Soil Gas Investigation and Human Health Risk Assessment Work Plan for Parcels C, D, F, G, and H *(ENVIRON 2013) were used for these calculations, using a parcel-specific depth to groundwater (for Parcels A and B) of 35 feet (ft). The results are presented in Table 6 of this memorandum.*

A comparison of the risk estimates based on 2008 groundwater results with those estimated based on 2008 soil gas results indicates the following:

- *For benzene, the cancer risks and HQs estimated using the groundwater data are approximately 3000-fold higher than cancer risks and HQs estimated using soil gas results based on one set of co-located groundwater and soil gas samples at the location of the maximum groundwater concentration. (As described in response to Comment #3 and in Attachment D, benzene was not detected in groundwater and was detected at low concentrations in soil gas in the remaining co-located samples). While the predicted risks using the detected groundwater concentrations are substantially higher than the predicted risks using the soil gas data, this finding is not unexpected given what is known about the aerobic biodegradation of petroleum hydrocarbons (including benzene) in vadose zone soils and literature studies reporting that biodegradation can significantly reduce the potential for vapor intrusion for this class of compounds. When oxygen supply from the atmosphere is sufficient, petroleum hydrocarbons (including benzene) in the vadose zone can be rapidly biodegraded by microorganisms that are naturally present in soil, resulting in substantial attenuation over relatively short distances (USEPA 2012, 2013). This biodegradation is not accounted for in the J&E model such that the predicted indoor air concentrations (and associated risks) of petroleum hydrocarbons can be substantially overestimated. For this reason, the benzene soil gas data is considered to provide the better estimate of potential risk for the vapor intrusion pathway.*

- *For chloroform, the cancer risks and HQs estimated using the groundwater data were approximately 2- to 3-fold higher than those estimated using the soil gas concentrations at the two locations with the highest soil gas and groundwater concentrations. (The two highest groundwater concentrations were 130 and 390 µg/L, at M-23 and M-95, both outside of Parcels A and B; co-located soil gas concentrations were 98 and 430 µg/m^3, respectively.) At all other locations with co-located samples, groundwater concentrations were low (less than or equal to 3 µg/L), and estimated risks based on the groundwater data were approximately 1- to 12-fold less than those estimated using the soil gas data.*

[8] NDEP confirmed that additional soil gas samples did not need to be collected in Parcels A and B in the March 7, 2013 e-mail from Weiquan Dong of NDEP to John Pekala of ENVIRON.

- *For 1,4-dichlorobenzene, the cancer risks and HQs estimated using the groundwater data were on average, 6-fold higher than those estimated using soil gas measurements (although a wide range of ratios was exhibited.*

In summary, the comparisons are consistent with expectations. Chloroform is recalcitrant to biodegradation and the risks estimated using soil gas or groundwater results are relatively consistent. For benzene, risks estimated using the groundwater data are substantially overestimated, which is not unexpected given that the J&E model does not account for biodegradation. 1,4-Dichlorobenzene is not expected to biodegrade readily (but is expected to be less recalcitrant to biodegradation than chloroform). The finding that the ratio of risks estimated based on groundwater to risks estimated based on soil gas data are highest for benzene, followed by 1,4-dichlorobenzene, and then chloroform is consistent with the expected rate of degradation of these chemicals in the vadose zone.

SUMMARY

This section summarizes the results of risk assessments conducted for Parcels A and B indoor air (Northgate 2010b, as supplemented by information presented in this memorandum) and soils (BEC 2008). The soil risk assessment was previously reported in *Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation* (Soil HRA). The risk estimates for soils were based on soil samples collected from 0 and 10 ft below ground surface (bgs) in 2007 and the risk estimates for indoor air were based on 5-ft bgs soil gas samples collected in 2008.

As presented in Table 3 of this memorandum, the cumulative HI for commercial/industrial workers for soil-related and indoor air pathways is 0.10, well below the health benchmark of 1, indicating little potential for adverse noncancer health effects. The estimated cumulative cancer risk for these pathways ranges from 4.4×10^{-6} to 5.1×10^{-6}, depending on the value of Q_{soil} used for estimating risks for the vapor intrusion pathway, well within USEPA's target risk range of 1×10^{-6} to 1×10^{-4}. The primary contributors to cancer risk for the soil-related pathways are dioxins/furans, beta-BHC, benzo(a)pyrene, hexachlorobenzene, uranium-233/234, uranium-235/236, and uranium-238; for indoor air, the primary contributor to cancer risk is chloroform.

The Soil HRA (BEC 2008) also included best and upperbound estimates of potential risks from asbestos exposures for construction workers, future maintenance workers, and current/future on-site trespassers. For the future maintenance worker and current/future on-site trespasser, the estimated asbestos cancer risks were well below 1×10^{-6}. For construction workers, the best estimate and upper bound risk estimates for asbestos ranged from 1.5×10^{-7} to 5.4×10^{-6} for the different asbestos fibers.

Based on the Parcel A and B soil investigation data and the results of the Soil HRA, NDEP issued a No Further Action (NFA) letter for soils in the 0 to 10 ft depth interval (NDEP 2008). This memorandum has responded to NDEP comments on the Indoor Air HRA. With NDEP approval of the Indoor Air HRA, the environmental investigation and risk assessment work for Parcels A and B will be complete. Given the high priority for completing this work, we would appreciate your prompt

review and approval of the Indoor Air HRA. Upon approval, the Trust will request that NDEP issue a NFA letter for Parcel A/B soils less than 10 ft bgs, including vapor intrusion.

Sincerely,

John M. Pekala, PG
Senior Manager
Nevada CEM #2347, expires 9/20/2014

Allan J. DeLorme, PE
Managing Principal

Attachments (see list below)

cc: BMI Compliance Coordinator, NDEP, BCA, Las Vegas
Brian Rakvica, McGinley and Associates, Las Vegas
NDEP c/o McGinley and Associates, Reno

ec: Shannon Harbour, NDEP
JD Dotchin, NDEP
Greg Lovato, NDEP
Stephen Tyahla, USEPA
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Lee Farris, Landwell
Ranajit Sahu, BMI
Joe Kelly, Montrose
Paul Sundberg, Montrose
Curt Richards, Olin
Jay Gear, Olin
Ed Modiano, *de maximis, inc.*
Chuck Elmendorf, Stauffer
Nick Pogoncheff, Stauffer
George Crouse, Syngenta
David Hadzinski, TIMET
Kirk Stowers, Broadbent & Associates (for TIMET)
Victoria Tyson, Tyson Contracting (for TIMET)
Enoe Marcum, WAPA

Tables

Figures

Attachments

References

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Tables

TABLE 1
Johnson and Ettinger Model Input Parameters (former Table 2 of the Indoor Air HRA)

Parameter	Value	Reference/Rationale
Depth below grade to bottom of enclosed floor space (cm)	15	Model default (slab on grade) (USEPA 2004)
Soil gas sampling depth (cm)	150	Site-specific (five feet below ground surface [bgs])
Average soil temperature (°C)	17	Site-specific (Figure 8, USEPA 2004, p. 48). The average shallow groundwater temperature in the Henderson, Nevada area.
Thickness of soil stratum (cm) A	150	Site-specific (five feet bgs)
Thickness of soil stratum (cm) B	0	No stratum B; used single stratum model
Thickness of soil stratum (cm) C	0	No stratum C; used single stratum model
Soil stratum used to calculate soil vapor permeability	S	Sand
Vadose zone dry bulk density (g/cm^3)	1.83	Site-specific (Borrow Area data)
Vadose zone total porosity (unitless)	0.30	Site-specific (Borrow Area data)
Vadose zone water-filled porosity (unitless)	0.090	(Dry bulk density/water density) × soil moisture content [1]
Stratum B soil parameters	blank	No stratum B; used single stratum model
Stratum C soil parameters	blank	No stratum C; used single stratum model
Enclosed space floor thickness (cm)	10	Model default (USEPA 2004)
Soil-building pressure differential, ($g/cm\text{-}s^2$)	40	Model default (USEPA 2004)
Enclosed space floor length (cm)	2,000	MDEQ - commericial (2001)
Enclosed space floor width (cm)	2,000	MDEQ - commericial (2001)
Modeling Enclosed space height (cm)	244	Model default (USEPA 2004)[2]
Floor-wall seam crack width (cm)	0.1	Model default (USEPA 2004)
Indoor air exchange rate (1/hr)	1 or 2	Cal-EPA (2005) or MDEQ (2001)
Average vapor flow rate into building, Qsoil, (L/m) - Table 3 Results	20	Model default (Cal-EPA 2005)
Average vapor flow rate into building, Qsoil, (L/m) - Table 4 Results	Calculated	Intermediate value (Eq. 15, USEPA 2004, p. 22)[3]
Averaging time for carcinogens (yrs)	70	USEPA 2002
Averaging time for non-carcinogens (yrs)	25	USEPA 2002
Exposure duration (yrs)	25	USEPA 2002
Exposure frequency (days/yr)	250	USEPA 2002

Notes:
1 - Where soil moisture content=gravimetric moisture content per ASTM D2216; site-specific value=0.049
2 - This value is the model default for residential buildings since there is no model default for commercial buildings (USEPA 2004).
3 - This is a calculated value of 10 L/min.

TABLE 2
Toxicological Surrogates for Toxicity Values

Chemical	Surrogate
1,2-Dichlorotetrafluoroethane	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
1,3-Dichlorobenzene	1,2-Dichlorobenzene
4-Ethyltoluene	Isopropylbenzene (Cumene)
4-Isopropyltoluene	Isopropylbenzene (Cumene)
alpha-Methylstyrene	Styrene
cis-1,2-Dichloroethene	trans-1,2-Dichloroethene
Ethanol[a]	See footnote a
N-Butylbenzene	Isopropylbenzene (Cumene)
n-Heptane	n-Hexane
n-Octane	C5 - C8 alkane and cycloalkane compounds
sec-Butylbenzene	Isopropylbenzene (Cumene)
t-Butyl alcohol	sec-Butyl Alcohol
tert-Butylbenzene	Isopropylbenzene (Cumene)

Notes:

[a] California Environmental Protection Agency derived a draft reference concentration for ethanol based on ethanol toxicity data as provided in Attachment B of NDEP (2010).

References:

Nevada Division of Environmental Protection (NDEP), 2010. NDEP Response to Revised Technical Memorandum: Screening-Level Indoor Air Health Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Tronox LLC, Henderson, Nevada, Dated: June 29, 2010. August 31.

TABLE 3
Cumulative Risk for Vapor Intrusion and Soil-Related Pathways

Receptor[a]	Commercial/Industrial Worker				Construction Worker	Future Maintenance Worker	Current/Future On-Site Trespasser
Media	Soil	Indoor Air[b]	Indoor Air[c]	Cumulative HI and Cancer Risk[d]	Soil[e]	Soil[e]	Soil[e]
Total Non-Cancer HI	0.10	0.002	0.0008	**0.10**			
Total Cancer Risk	3.9E-06	1.2E-06	4.5E-07	**5.1E-06**			
Estimated Chrysotile Risk - Best Estimate[f]					1.5E-07	2.6E-09	7.0E-11
Estimated Chrysotile Risk - Upper Bound[g]					2.6E-07	4.6E-09	1.2E-10
Estimated Amphibole Risk - Best Estimate[f]					0.0E+00	0.0E+00	0.0E+00
Estimated Amphibole Risk - Upper Bound[g]					5.4E-06	9.7E-08	2.6E-09

Notes:
BEC = Basic Environmental Company
Cal/EPA = California Environmental Protection Agency
ER = Indoor air exchange rate
HI = Hazard index
L/min = Liters per minute
Q_{soil} = Average vapor flow rate
UCL = Upper confidence limit

[a] Gray shading indicates that the pathway was not evaluated in the screening-level health risk assessment. The indoor air pathway was only evaluated for the commercial/industrial worker.
[b] The indoor air concentrations were estimated based on a scaled Q_{soil} value of 4 × 5 L/min or 20 L/min to account for the default commercial building size and an ER of 1 per hour as recommended by Cal/EPA (2011).
[c] The indoor air concentrations were estimated based on a calculated Q_{soil} value and an ER of 2 per hour as recommended by Michigan Environmental Science Board (2001).
[d] The indoor air cancer risk and HI were based on a scaled Q_{soil} value of 20 L/min and an ER of 1 per hour as described in footnote b.
[e] The estimated risks for asbestos were presented as reported in BEC (2008).
[f] The best estimate was based on the pooled analytical sensitivity multiplied by the number of asbestos fibers found.
[g] The upper bound was based on the 95% UCL of the Poisson distribution.

References:
Basic Environmental Company (BEC). 2008. Technical Memorandum – Data Review for 2007 Tronox Parcels A/B Investigation, BMI Industrial Complex, Clark County, Nevada, Revision 1. February 11.
California Environmental Protection Agency (Cal/EPA). 2011. Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance). October.
Michigan Environmental Science Board. 2001. Evaluation of the Michigan Department of Environmental Quality's Generic Groundwater and Soil Volatilization to Indoor Air Inhalation Criteria. (A Science Report to Governor John Engler). Michigan Environmental Science Board, Lansing, MI.

TABLE 4
Summary of Data Qualifiers for Parcel A/B Data (former Table E-2 of the Indoor Air HRA)

Sample ID	SDG	Method	Matrix	Analyte	Result	Qualifiers	Units	Reason	Batch ID	Method Blank Result	Dilution Factor	SQL
Qualifications based on blank contamination (b) (from Table E-4 of the soil gas DVSR)												
SG06B-05	P0801507	TO-15	GS	Methylene chloride	0.77	U	µg/m^3	b	MS16052708	0.076	1.54	0.77
SG10B-05	P0801483	TO-15	GS	Vinyl acetate	7.8	U	µg/m^3	b	MS13052708	0.40	1.55	7.8
SG10B-05	P0801483	TO-15	GS	Acetone	24	U	µg/m^3	b	MS13052708	1.8	1.55	7.8
SG11B-05	P0801483	TO-15	GS	Carbon disulfide	1.4	U	µg/m^3	b	MS13052708	0.29	1.47	0.74
SG12B-05	P0801483	TO-15	GS	Vinyl acetate	7.7	U	µg/m^3	b	MS13052708	0.40	1.54	7.7
SG12B-05	P0801483	TO-15	GS	Carbon disulfide	1.1	U	µg/m^3	b	MS13052708	0.29	1.54	0.77
SG12B-05	P0801483	TO-15	GS	Acetone	15	U	µg/m^3	b	MS13052708	1.8	1.54	7.7
Qualification based on quantitation problems (q) (from Table D-7 of the soil gas DVSR)												
SG01B-05	P0801656	TO-15	GS	Acetone	33	J+	µg/m^3	q				
SG04B-05	P0801656	TO-15	GS	Acetone	12	J+	µg/m^3	q				

Notes:
- GS = Soil gas
- SDG = Sample delivery group
- SQL = Sample quantitation limit
- µg/m^3 = micrograms per cubic meter

Reason codes:
- b = Qualified due to blank contamination
- q = Qualified due to quantitation problem

Qualifiers:
- U = The analyte was analyzed for, but was not detected above the sample reporting limit
- J+ = The result is an estimated quantity and the result may be biased high

TABLE 5

Historical and Recent Chloroform Concentrations in Shallow Groundwater[a]

Parcel	Well ID	Date Sampled[b]	Chloroform (µg/L)[b]
Parcel A	H-48	9/1/1981	900
		10/14/1981	400
		11/10/1981	300
		2/9/1982	ND
		4/13/1982	300
		6/23/1982	ND
		8/16/1982	ND
		10/19/1982	400
		12/6/1982	ND
		2/14/1983	200
		2/29/1984	1000
		6/19/2008	**<1**
	H-49A	9/16/2004	10
		11/30/2004	6.0
		2/22/2005	<5.0
		5/24/2005	<5.0
		9/23/2005	7.6
		10/25/2005	7.0
		2/2/2006	<5.0
		4/25/2006	<5.0
		7/25/2006	<5.0
		11/30/2006	<0.33
		1/18/2007	3.4
		4/17/2007	2.3
		7/11/2007	2.0
		11/14/2007	3.2
		1/30/2008	<0.33
		4/3/2008	<0.33
		4/3/2008	<0.33
		6/24/2008	3.0
		7/11/2008	<0.33
		11/5/2008	2.0
		1/19/2009	<0.33
		4/15/2009	<0.33
		4/20/2010	1.4
		4/4/2011	**0.97**
	H-56A	9/16/2004	ND
		2/22/2005	<5.0
		5/24/2005	<5.0
		9/23/2005	<5.0
		10/25/2005	<5.0
		1/31/2006	<5.0
		4/25/2006	<5.0
		7/19/2006	1.1
		7/25/2006	<5.0
		11/30/2006	<0.33J
		1/17/2007	<0.33
		4/18/2007	<0.33
		4/18/2007	<0.33
		7/11/2007	<0.33
		11/14/2007	<0.33
		1/30/2008	<0.33
		4/3/2008	<0.33
		7/11/2008	<0.33
		11/5/2008	<0.33
		1/19/2009	<0.33
		4/15/2009	<0.33
		4/19/2010	2.0

TABLE 5

Historical and Recent Chloroform Concentrations in Shallow Groundwater[a]

Parcel	Well ID	Date Sampled[b]	Chloroform (µg/L)[b]
Parcel A (Continued)	H-56A (Continued)	7/28/2010	2.0
		4/4/2011	**1.8**
	H-58A	9/16/2004	ND
		2/22/2005	<5.0
		5/24/2005	<5.0
		9/23/2005	9.6
		10/25/2005	17
		2/2/2006	7.7
		4/25/2006	4.9
		7/25/2006	16
		11/30/2006	<0.33
		1/18/2007	4.3
		4/18/2007	4.6
		7/11/2007	6.6
		11/14/2007	5.6
		1/30/2008	9.7
		1/30/2008	9.0
		4/3/2008	8.6
		7/11/2008	4.8
		11/5/2008	2.4
		1/19/2009	2.0
		4/15/2009	<0.33
		4/19/2010	2.2
		4/4/2011	**5.2**
	MC-62	1/25/2005	3.4
		4/19/2005	2.8
		10/27/2005	4.3
		2/1/2006	68
		4/27/2006	8
		7/27/2006	4.6
		6/23/2008	**2.3J**
	MC-65	**6/20/2008**	**8.3**
	MC-66	6/20/2008	5.2
		6/20/2008	**5.3**
	PC-40	12/17/1998	<5.0
		5/26/2000	<5.0
		12/1/2006	4J
		6/18/2008	**1.6**
Parcel B	M-44	**6/24/2008**	**34**
	PC-37	**6/20/2008**	**2.0**
	PC-72	**6/23/2008**	**29**
Relevant Nearby Locations for Parcels A and B	M-23	**6/25/2008**	**130**
	M-48	12/6/2006	99
		7/9/2008	**180**
	M-94	**6/23/2008**	**50**
	M-95	12/4/2006	350
		6/27/2008	**390**
	M-96	**7/9/2008**	**28**
	MC-09R	7/24/2009	7.9
		5/19/2010	4.3
		4/22/2011	6.5
		4/30/2012	**0.94J**
	MC-45	1/17/1986	ND
		2/19/1986	ND
		7/15/1986	ND
		12/6/2006	3.0J
		6/25/2008	**3.0**
	MC-47	1/25/2005	1.7
		4/19/2005	1.9

TABLE 5

Historical and Recent Chloroform Concentrations in Shallow Groundwater[a]

Parcel	Well ID	Date Sampled[b]	Chloroform (µg/L)[b]
	MC-47 (Continued)	10/26/2005	4.5
		1/31/2006	4.3
		4/26/2006	16
		7/26/2006	4.9
		11/29/2006	2
		1/17/2007	2.7
		4/18/2007	3.6
		7/13/2007	11
		12/20/2007	8
		1/29/2008	12
		1/29/2008	13
		4/9/2008	8.1
		4/9/2008	7.5
		7/10/2008	7.2
		11/7/2008	8.2
		1/20/2009	11.0
		4/13/2009	5.9
		4/20/2010	10.0
		4/5/2011	13.0
		4/11/2012	**8.4**
	MC-48	1/15/1986	ND
		2/20/1986	ND
		7/15/1986	ND
		3/31/2004	13
		6/29/2004	8.1
		9/28/2004	1.4
		1/25/2005	1
		4/19/2005	1.8
		10/26/2005	2.1
		2/1/2006	14
		4/26/2006	31
		7/26/2006	6.4
		11/29/2006	<0.33J
		1/24/2007	2.3
		4/18/2007	9.3
		7/13/2007	14
		12/20/2007	4.5
		12/20/2007	4.4
		1/29/2008	57
		4/9/2008	7.9
		7/10/2008	2.2
		11/7/2008	<0.33
		1/20/2009	<0.33
		4/13/2009	<0.33
		4/21/2010	2.7
		4/5/2011	4.2
		4/11/2012	**0.4**
	MC-49	1/16/1986	2100
		2/20/1986	1000.0
		7/15/1986	1600
		4/1/2004	<5
		6/29/2004	1
		9/28/2004	5.3
		1/26/2005	5.1
		4/19/2005	4.6
		10/27/2005	13
		10/27/2005	13

TABLE 5

Historical and Recent Chloroform Concentrations in Shallow Groundwater[a]

Parcel	Well ID	Date Sampled[b]	Chloroform (µg/L)[b]
Relevant Nearby Locations for Parcels A and B (Continued)	MC-49 (Continued)	2/2/2006	<10
		2/2/2006	<10
		4/27/2006	39
		4/27/2006	37
		7/27/2006	9.1
		7/27/2006	9.2
		12/4/2006	2.2
		12/4/2006	440J
		1/19/2007	2.2
		4/19/2007	6.7
		7/13/2007	12
		7/13/2007	13
		12/20/2007	3.5
		1/29/2008	55
		4/9/2008	5.2
		7/10/2008	<0.33
		11/6/2008	<0.33
		1/20/2009	<0.33
		4/13/2009	<0.33
		4/21/2010	1.6
		4/5/2011	2.5
		4/12/2012	**<2.0**
	MC-50	4/1/2004	55
		6/29/2004	25
		9/29/2004	9.3
		1/26/2005	4.7
		4/20/2005	3.4
		10/27/2005	<0.5
		2/1/2006	270
		4/26/2006	6.3
		7/27/2006	3.1
		11/29/2006	<0.33
		1/18/2007	4
		4/18/2007	15
		7/16/2007	6.2
		12/21/2007	<0.66
		1/29/2008	<1.3
		4/9/2008	7.6
		7/10/2008	5
		7/10/2008	4.2
		11/6/2008	3.2
		1/21/2009	3.4
		4/13/2009	2.9
		4/21/2010	3.2
		4/6/2011	15
		4/11/2012	**2.6**
	MC-53	4/1/2004	9.0
		6/29/2004	31
		9/28/2004	220
		1/26/2005	30
		4/20/2005	15
		10/26/2005	17
		2/1/2006	2.7
		4/26/2006	300
		7/26/2006	25
		12/4/2006	4.0

TABLE 5

Historical and Recent Chloroform Concentrations in Shallow Groundwater[a]

Parcel	Well ID	Date Sampled[b]	Chloroform (µg/L)[b]
Relevant Nearby Locations for Parcels A and B (Continued)	MC-53 (Continued)	1/17/2007	6.6
		4/18/2007	9.6
		7/16/2007	8.1
		12/21/2007	5.1
		1/29/2008	10
		4/9/2008	36
		6/25/2008	13
		7/10/2008	11
		11/6/2008	7.3
		1/21/2009	9.3
		4/14/2009	7.1
		4/21/2010	5.0
		4/6/2011	14.0
		4/11/2012	**1.3**
	MC-94	**10/7/2009**	**5.4**
	MC-113	11/7/2008	2.6
		1/22/2009	2
		4/14/2009	2.6
		4/22/2010	3
		4/6/2011	5.7
		4/12/2012	**0.59**
	MC-114	11/7/2008	37.0
		1/22/2009	<3.3
		4/14/2009	16.0
		4/22/2010	5.4
		4/6/2011	22.0
		4/12/2012	**3.5**

Notes:
< = sample not detected
µg/L = micrograms per liter
J = the associated value is an estimated quantity
ND = sample not detected and detection limit not available

[a] ENVIRON identified these wells using NDEP's Regional Database available at http://ndep.neptuneinc.org/ndep_gisdt/home/index.xml, the Data Validation Summary Reports for the Phase A Investigation (ENSR 2007) and the Phase B Groundwater Investigation (Northgate 2010a).

[b] Sample results highlighted gray were presented in the Site-Wide Soil Gas HRA (Northgate 2010c) and bolded sample results represent the most recent chloroform sample results.

References:

ENSR Corporation (ENSR), 2007. Phase A Source Area Investigation Results Report, Tronox LLC Facility, Henderson, Nevada, September. NDEP approved the Report November 30, 2007 and Appendix G – Data Validation Summary Report (DVSR) December 17, 2007.

Northgate Environmental Management, Inc. (Northgate), 2010a. Revised Data Validation Summary Report, Phase B Investigation Groundwater, Tronox LLC, Henderson, Nevada. April 7. NDEP approved April 14, 2010.

Northgate, 2010c. Site-Wide Soil Gas Human Health Risk Assessment, Tronox LLC, Henderson, Nevada. November 22. Not reviewed by NDEP.

TABLE 6
Cancer Risks Estimated Using Soil Gas and Groundwater Results from Co-located Samples

Chemical	Groundwater							Soil Gas						Ratio of Cancer Risk[c]	Ratio of Hazard Quotient[d]
	Well ID[a]	Sample Location Relative to Parcels A and B	Sample Date	Maximum Concentration (µg/L)[b]	RBC (µg/L)	Cancer Risk	Hazard Quotient	Soil Gas Boring	Sample Date	Maximum Concentration (µg/m^3)	RBC (µg/m^3)	Cancer Risk	Hazard Quotient		
Benzene	H-48	Within Parcel A	6/19/2008	3	420	6.0E-09	7.1E-05	--	--	--	--	--	--	--	--
	MC-49	Near Parcels A/B	1/29/2008	6	420	1.4E-08	1.7E-04	--	--	--	--	--	--	--	--
	MC-47	Near Parcels A/B	11/7/2008	4	420	8.8E-09	1.1E-04	--	--	--	--	--	--	--	--
	MC-50	Near Parcels A/B	1/29/2008	1100	420	2.6E-06	3.1E-02	--	--	--	--	--	--	--	--
	MC-62	**Within Parcel A**	**6/23/2008**	**2400**	**420**	**5.7E-06**	**6.8E-02**	**SG05**	**5/29/2008**	**2**	**6197**	**1.9E-09**	**2.2E-05**	**3.1E+03**	**3.1E+03**
	MC-114	Near Parcels A/B	11/7/2008	700	420	1.7E-06	2.0E-02	--	--	--	--	--	--	--	--
Chloroform	**H-49A**	**Within Parcel A**	**6/24/2008**	**3**	**176**	**1.7E-08**	**2.1E-05**	**SG04**	**5/29/2008**	**9**	**1861**	**2.2E-08**	**2.7E-05**	**7.8E-01**	**7.8E-01**
	H-58A	Within Parcel A	1/30/2008	10	176	5.5E-08	6.9E-05	--	--	--	--	--	--	--	--
	M-23	**Near Parcels A/B**	**6/25/2008**	**130**	**176**	**7.4E-07**	**9.2E-04**	**E-SG-9**	**3/8/2013**	**98**	**1861**	**2.5E-07**	**3.1E-04**	**3.0E+00**	**3.0E+00**
	M-44	Within Parcel B	6/24/2008	34	176	1.9E-07	2.4E-04	--	--	--	--	--	--	--	--
	M-94	Near Parcels A/B	6/23/2008	50	176	2.8E-07	3.5E-04	--	--	--	--	--	--	--	--
	M-95	**Near Parcels A/B**	**6/27/2008**	**390**	**176**	**2.2E-06**	**2.8E-03**	**SG07**	**5/17/2008**	**430**	**1861**	**1.1E-06**	**1.4E-03**	**2.0E+00**	**2.0E+00**
	M-96	Near Parcels A/B	7/9/2008	28	176	1.6E-07	2.0E-04	--	--	--	--	--	--	--	--
	MC-45	**Near Parcels A/B**	**6/24/2008**	**3**	**176**	**1.7E-08**	**2.1E-05**	**SG16**	**5/18/2008**	**84**	**1861**	**2.1E-07**	**2.7E-04**	**7.9E-02**	**7.9E-02**
	MC-47	Near Parcels A/B	1/29/2008	13	176	7.4E-08	9.2E-05	--	--	--	--	--	--	--	--
	MC-48	Near Parcels A/B	1/29/2008	57	176	3.2E-07	4.0E-04	--	--	--	--	--	--	--	--
	MC-49	Near Parcels A/B	1/29/2008	55	176	3.1E-07	3.9E-04	--	--	--	--	--	--	--	--
	MC-50	Near Parcels A/B	4/9/2008	8	176	4.3E-08	5.4E-05	--	--	--	--	--	--	--	--
	MC-53	Near Parcels A/B	4/9/2008	36	176	2.0E-07	2.5E-04	--	--	--	--	--	--	--	--
	MC-62	**Within Parcel A**	**6/23/2008**	**2**	**176**	**1.3E-08**	**1.6E-05**	**SG05**	**5/29/2008**	**62**	**1861**	**1.6E-07**	**2.0E-04**	**8.3E-02**	**8.3E-02**
	MC-65	Within Parcel A	6/20/2008	8	176	4.7E-08	5.9E-05	--	--	--	--	--	--	--	--
	MC-66	Within Parcel A	6/20/2008	5	176	3.0E-08	3.7E-05	--	--	--	--	--	--	--	--
	MC-113	Near Parcels A/B	11/7/2008	3	176	1.5E-08	1.8E-05	--	--	--	--	--	--	--	--
	MC-114	Near Parcels A/B	11/7/2008	37	176	2.1E-07	2.6E-04	--	--	--	--	--	--	--	--
	PC-37	**Within Parcel B**	**11/5/2008**	**2**	**176**	**1.1E-08**	**1.4E-05**	**SG06**	**5/20/2008**	**34**	**1861**	**8.7E-08**	**1.1E-04**	**1.3E-01**	**1.3E-01**
	PC-40	**Within Parcel A**	**6/18/2008**	**2**	**176**	**9.1E-09**	**1.1E-05**	**SG01**	**5/29/2008**	**14**	**1861**	**3.6E-08**	**4.4E-05**	**2.5E-01**	**2.5E-01**
	PC-72	Within Parcel B	6/23/2008	29	176	1.6E-07	2.0E-04	--	--	--	--	--	--	--	--

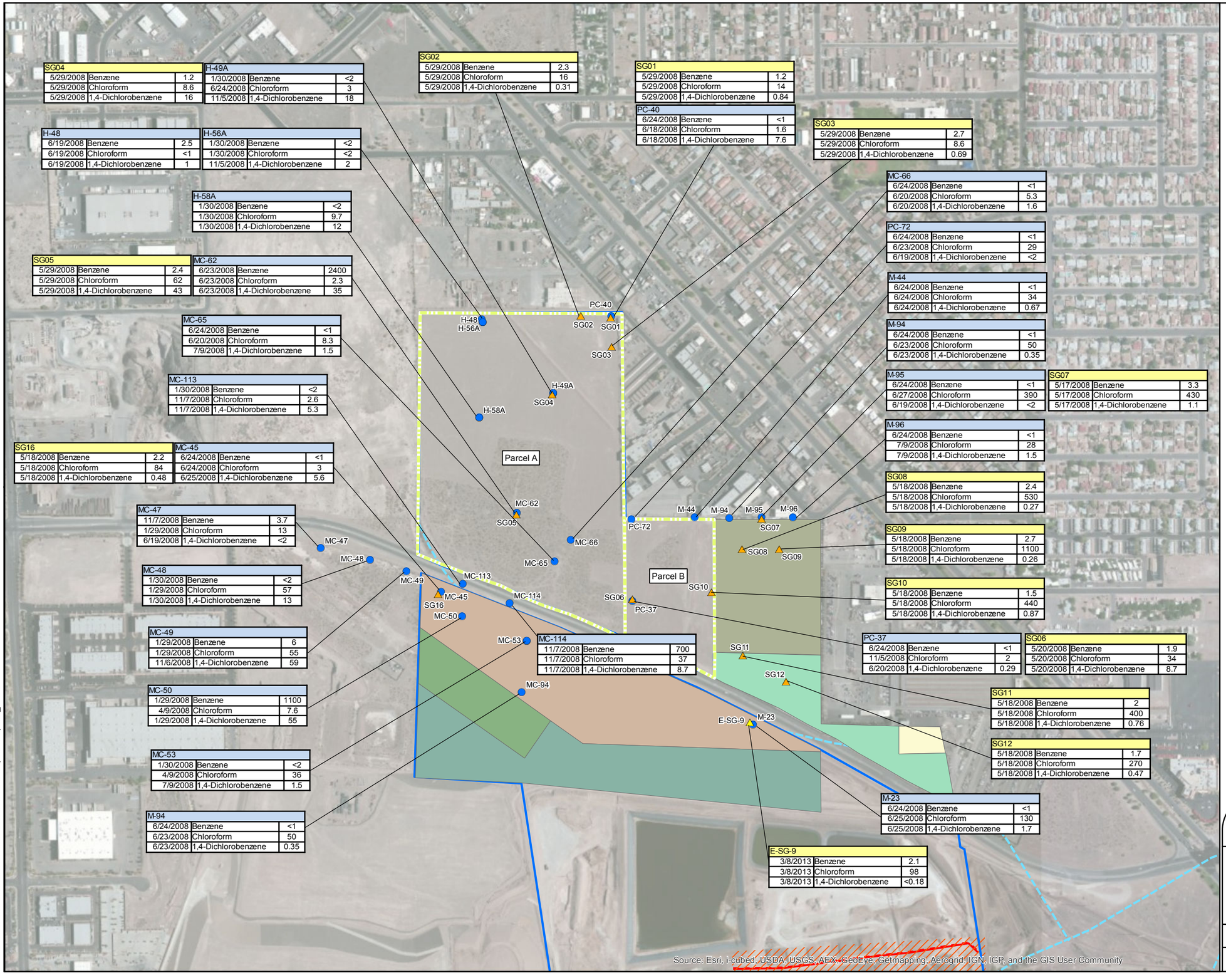
TABLE 6
Cancer Risks Estimated Using Soil Gas and Groundwater Results from Co-located Samples

Chemical	Groundwater							Soil Gas						Ratio of Cancer Risk[c]	Ratio of Hazard Quotient[d]
	Well ID[a]	Sample Location Relative to Parcels A and B	Sample Date	Maximum Concentration (µg/L)[b]	RBC (µg/L)	Cancer Risk	Hazard Quotient	Soil Gas Boring	Sample Date	Maximum Concentration (µg/m^3)	RBC (µg/m^3)	Cancer Risk	Hazard Quotient		
1,4-Dichlorobenzene	H-48	Within Parcel A	6/19/2008	1	933	1.1E-09	3.4E-07	--	--	--	--	--	--	--	--
	H-49A	**Within Parcel A**	**11/5/2008**	**18**	**933**	**1.9E-08**	**6.1E-06**	**SG04**	**5/29/2008**	**16**	**5290**	**1.5E-08**	**4.7E-06**	**1.3E+00**	**1.3E+00**
	H-56A	Within Parcel A	11/5/2008	2	933	2.1E-09	6.8E-07	--	--	--	--	--	--	--	--
	H-58A	Within Parcel A	1/30/2008	12	933	1.3E-08	4.1E-06	--	--	--	--	--	--	--	--
	M-23	**Near Parcels A/B**	**6/25/2008**	**2**	**933**	**1.8E-09**	**5.8E-07**	**E-SG-9**	**3/8/2013**	**<0.18**	**5290**	**1.7E-10**	**5.3E-08**	**1.1E+01**	**1.1E+01**
	M-44	Within Parcel B	6/24/2008	1	933	7.2E-10	2.3E-07	--	--	--	--	--	--	--	--
	M-94	Near Parcels A/B	6/23/2008	0.35	933	3.7E-10	1.2E-07	--	--	--	--	--	--	--	--
	M-96	Near Parcels A/B	7/9/2008	2	933	1.6E-09	5.1E-07	--	--	--	--	--	--	--	--
	MC-45	**Near Parcels A/B**	**6/25/2008**	**6**	**933**	**6.0E-09**	**1.9E-06**	**SG16**	**5/18/2008**	**0.5**	**5290**	**4.4E-10**	**1.4E-07**	**1.4E+01**	**1.4E+01**
	MC-48	Near Parcels A/B	1/30/2008	13	933	1.4E-08	4.4E-06	--	--	--	--	--	--	--	--
	MC-49	Near Parcels A/B	11/6/2008	59	933	6.3E-08	2.0E-05	--	--	--	--	--	--	--	--
	MC-50	Near Parcels A/B	1/29/2008	55	933	5.9E-08	1.9E-05	--	--	--	--	--	--	--	--
	MC-53	Near Parcels A/B	7/9/2008	2	933	1.6E-09	5.1E-07	--	--	--	--	--	--	--	--
	MC-62	**Within Parcel A**	**6/23/2008**	**35**	**933**	**3.7E-08**	**1.2E-05**	**SG05**	**5/29/2008**	**43**	**5290**	**4.0E-08**	**1.3E-05**	**9.4E-01**	**9.4E-01**
	MC-65	Within Parcel A	7/9/2008	2	933	1.6E-09	5.1E-07	--	--	--	--	--	--	--	--
	MC-66	Within Parcel A	6/20/2008	2	933	1.7E-09	5.5E-07	--	--	--	--	--	--	--	--
	MC-113	Near Parcels A/B	11/7/2008	5	933	5.7E-09	1.8E-06	--	--	--	--	--	--	--	--
	MC-114	Near Parcels A/B	11/7/2008	9	933	9.3E-09	3.0E-06	--	--	--	--	--	--	--	--
	PC-37	**Within Parcel B**	**6/20/2008**	**0.29**	**933**	**3.1E-10**	**9.9E-08**	**SG06**	**5/20/2008**	**9**	**5290**	**8.1E-09**	**2.6E-06**	**3.9E-02**	**3.9E-02**
	PC-40	**Within Parcel A**	**6/18/2008**	**8**	**933**	**8.1E-09**	**2.6E-06**	**SG01**	**5/29/2008**	**1**	**5290**	**7.8E-10**	**2.5E-07**	**1.0E+01**	**1.0E+01**

Notes:
-- = no value
µg/L= micrograms per liter
µg/m^3 = micrograms per cubic meter
RBC = risk-based concentration

[a] Only groundwater wells with detected concentrations are shown. Bolded sample results indicate groundwater wells are collocated with a 2008 or 2013 soil gas sample.
[b] Sample results highlighted gray indicate that the maximum concentration exceeds its risk-based concentration.
[c] This value represents the ratio of cancer risk calculated from groundwater to cancer risk calculated from soil gas.
[d] This value represents the ratio of the hazard quotient calculated from groundwater to the hazard quotient calculated from soil gas.

Figures



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Legend

- 2008 Phase B Soil Gas Location (µg/m³)
- 2013 Soil Gas Location (µg/m³)
- Shallow Groundwater Well (µg/L)
- Study Area
- Former portion of Parcel B
- Parcel C
- Parcel D
- Parcel E
- Former Parcel I
- Former Parcel J
- Ditches
- Interceptor Well Field
- Groundwater Barrier Wall

NOTE:
Data boxes highlighted blue indicate groundwater data in µg/L and databoxes highlighted yellow indicate soil gas data in µg/m³.

N

0 300 600

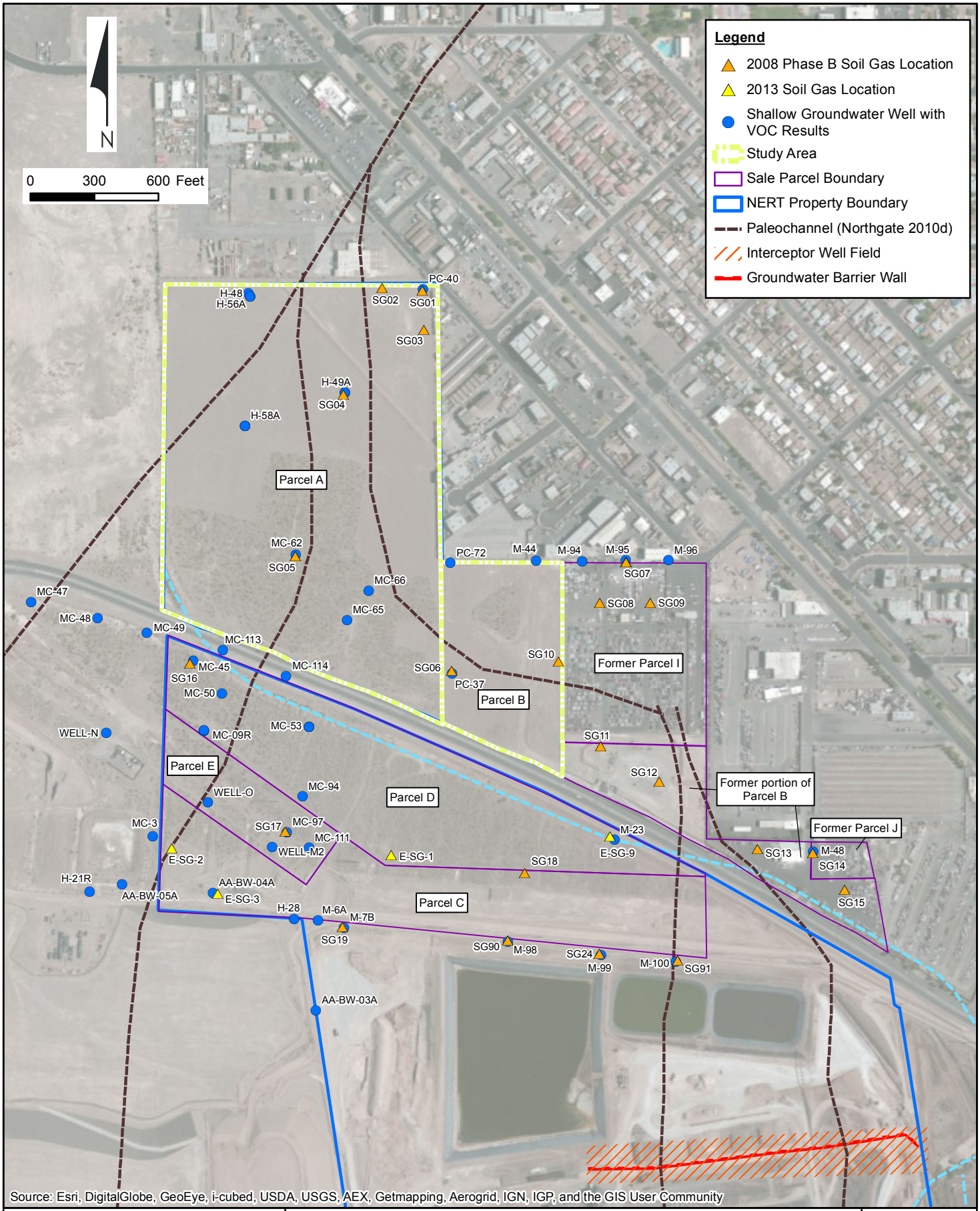
SCALE IN FEET

ENVIRON

Soil Gas & Shallow Groundwater Results for Benzene, Chloroform, & 1,4-Dichlorobenzene

Nevada Environmental Response Trust Site
Henderson, Nevada

Date:	Contract Number:		Figure
04/26/13	21-32100GA		1
Drafter: RS	Approved:	Revised:	



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

ENVIRON

Soil Gas & Shallow Groundwater Well Sampling Locations

Nevada Environmental Response Trust Site, Henderson, Nevada

Figure **2**

Drafter:	RS	Date:	4/16/13	Contract Number:	21-32100GA	Approved:	Revised:

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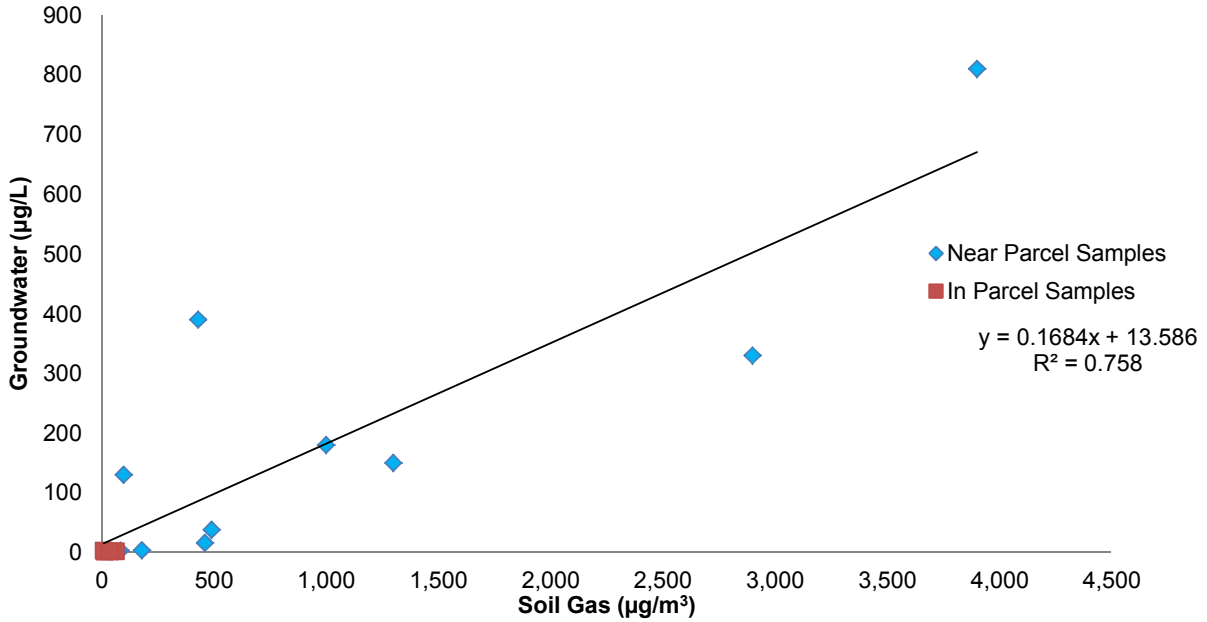
FIGURE 3
Comparison of Chloroform Concentrations in Soil Gas and Shallow Groundwater in Co-located Locations Within and Near Parcels A and B

Location Group	Soil Gas			Groundwater		
	Boring ID	Sample Date	Chloroform ($\mu g/m^3$)	Well ID	Sample Date	Chloroform ($\mu g/L$)
Parcel A	SG01	5/29/2008	14	PC-40	6/18/2008	1.6
	SG04	5/29/2008	8.6	H-49A	6/24/2008	3
	SG05	5/29/2008	62	MC-62	6/23/2008	2.3
Parcel B	SG06	5/20/2008	34	PC-37	6/20/2008	2
Near Parcels A/B	E-SG-2	3/7/2013	460	MC-3	5/27/2009	16
	E-SG-3	3/7/2013	2900	AA-BW-04A	10/20/2011	330
	E-SG-9	3/8/2013	98	M-23	6/25/2008	130
	SG07	5/17/2008	430	M-95	6/27/2008	390
	SG14	5/20/2008	1000	M-48	7/9/2008	180
	SG16	5/18/2008	84	MC-45	6/25/2008	3
	SG17	5/18/2008	180	MC-97	6/25/2008	3.8
	SG19	5/28/2008	70	M-7B	6/26/2008	2.1
	SG24	5/28/2008	1300	M-99	5/6/2010	150
	SG90	5/28/2008	3900	M-98	11/30/2006	810
	SG91	5/21/2008	490	M-100	12/4/2006	38



Attachment A

Chronological Listing of Select Documents for Parcels A and B

Attachment A

Chronological Listing of Select Parcel A and B Documents

Date	Document Title	Revision
November 13, 2008	**Basic Environmental Company (BEC**), 2008. Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, November 13, 2008.	Revision 0
December 22, 2008	**Nevada Division of Environmental Protection (NDEP)**, 2008. NDEP Response to: Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Dated November 13, 2008. December 22, 2008.	Revision 0
March 30, 2010	**BEC**, 2010. Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, March 30, 2010.	Revision 1
May 13, 2010	**NDEP**, 2010. NDEP Response to: Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, BMI Industrial Complex, Clark County, Nevada, Dated March 30, 2010. May 13.	Revision 1
June 29, 2010	**Northgate Environmental Management, Inc. (Northgate)**, 2010. Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation. June 29, 2010.	Revision 2
August 31, 2010	**NDEP**, 2010. NDEP Response to: Revised Technical Memorandum: Screening-Level Indoor Air Health Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation And Errata, Tronox LLC, Henderson, Nevada, Dated: June 29, 2010 August 31, 2010.	Revision 2
September 7, 2010	**NDEP**, 2010. Meeting Minutes regarding the Tech Memo of Parcels A/B Indoor Air Health Risk Assessment. September 7.	Revision 2
November 12, 2010	**Northgate**, 2010. Response to Comments re: Revised Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Dated June 29, 2010. November 12, 2010.	Revision 3
November 12, 2010	**Northgate**, 2010. Revised Technical Memorandum – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation. November 12, 2010.	Revision 3
May 23, 2011	**NDEP**, 2011. NDEP Response to: Revised Tech Memo – Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation, Tronox LLC, Henderson, Nevada, Dated: November 12, 2010.	Revision 3

Attachment B

Phase B Source Area Investigation
Soil Gas Survey Work Plan
Tronox LLC Facility Henderson, Nevada
March 2008

(Provided electronically or on CD separately)

Attachment C

Revised Technical Memorandum: Screening-Level Indoor Air Health Risk Assessment for the 2008 Tronox Parcels A/B Soil Gas Investigation
BMI Industrial Complex, Clark County, Nevada
November 12, 2010

(Provided in Tab 10, Indoor Air HRA, November 12, 2010)

Attachment D

Shallow Groundwater Results for Benzene, 1,4-Dichlorobenzene, and Chloroform

Attachment D

Shallow Groundwater Results for Benzene, 1,4-Dichlorobenzene, and Chloroform

Figures

This attachment presents figures developed by Hargis & Associates (H+A) (2012) depicting groundwater concentrations of benzene, chloroform, and 1,4-dichlorobenzene for areas within and upgradient of Parcels A and B (H+A Figures 6, 8, and 10, included in this Attachment). The figures provide information on upgradient sources and current concentrations of these chemicals in groundwater on the adjacent Olin Corporation (Olin) property.

In 2008, benzene was detected in monitoring well MC-62 (within Parcel A) at a concentration of 2,400 micrograms per liter (µg/L) and in two upgradient Parcel D monitoring wells (MC-50 and MC-114) at concentrations of 1,100 and 700 µg/l, respectively (see Figure 1 of this memorandum). The 2008 benzene concentrations in all other nearby wells ranged from less than the detection limit (typically 1 or 2 µg/L to a maximum detected concentration of 6 µg/L. Historical monitoring data from 2005 and 2006 for MC-62 indicate that benzene was either not detected or detected at a lower concentration (maximum detected concentration of 180 µg/L). MC-62 has not been sampled since 2008. However, Olin/Stauffer Management Company, LLC/Syngenta Crop Protection LLC/Montrose Chemical Corporation of California (OSSM) monitor their groundwater treatment system transect wells for volatile organic compounds (VOCs) on a quarterly basis (*de maximis*, *inc.* 2012). Well MC-50, which is located directly upgradient of well MC-62 and along the same paleochannel as well MC-62 (see Figure 2 of this memorandum), is considered to be a good indicator of anticipated concentrations in monitoring well MC-62. Benzene concentrations detected in monitoring well MC-50 have decreased since 2008 to levels below 50 µg/L in 2012, as shown on the H+A Figure 6 included in this Attachment. Concentrations for other upgradient VOCs originating on the Olin property show similar spatial distributions and decreasing concentration trends as those for benzene. Figure 10 from H+A for 1,4-dichlorobenzene is provided in this Attachment as an additional example. Similar to benzene, a comparison of the 2012 1,4-dichlorobenzene concentrations in

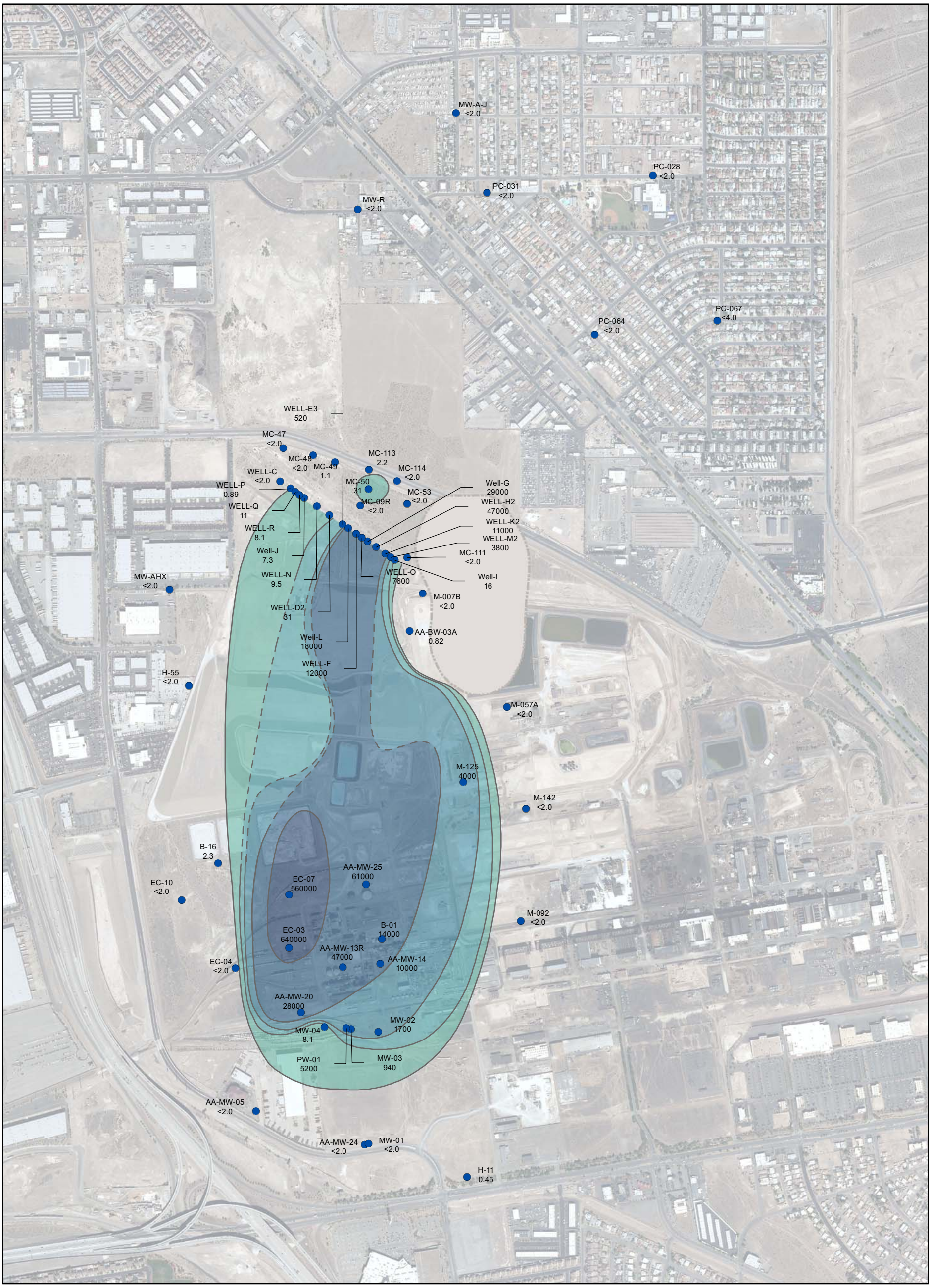
wells to the north of the OSSM treatment system with the 2008 concentrations (see Figure 1 of this memorandum) shows that concentrations in 2012 are less than those measured in 2008.

Overall, the groundwater results suggest that historically, elevated concentrations of benzene and related chemicals (specifically, chlorobenzenes) have been elevated in monitoring wells near the paleochannel and downgradient of the OSSM groundwater treatment system. A comparison of groundwater concentrations in these wells in 2008 with concentrations measured in 2012 indicates that concentrations of benzene and related compounds have decreased substantially. The 2012 benzene concentration of 31 µg/L in upgradient monitoring well MC-50 is well below the risk-based concentration of 420 µg/L (see Table 6 of this memorandum) for the vapor intrusion pathway.

References

de maximis, inc., 2012. Quarterly Operations Report, Groundwater Treatment System, Henderson, Nevada, Third Quarter 2012. November 14. Under NDEP review.

Hargis & Associates, Inc. (H+A), 2012. 2012 Comprehensive Groundwater Data Evaluation Report, Former Montrose and Stauffer Facilities and Current Olin Facility, Henderson, Nevada. August 16. NDEP commented January 22, 2013.



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EXPLANATION

BENZENE CONCENTRATION (ug/l)
EPA METHOD: 8260B

- 5 (BCL, MCL) - 99
- 100 - 999
- 1,000 - 9,999
- 10,000 - 99,999
- 100,000 - 999,999

Boundary of concentration zone is dashed where inferred, queried where uncertain

H-11 0.45 — MONITOR WELL IDENTIFIER; CONCENTRATION IN MICROGRAMS PER LITER; SECOND QUARTER 2012

< — LESS THAN; COMPOUND WAS NOT DETECTED AT OR ABOVE THE REPORTED DETECTION LIMIT

ug/l — MICROGRAMS PER LITER

AREA OF UNCERTAIN SHALLOW ZONE SATURATION

N

0 500 1,000
Feet

Note:
While additional data may be available from other BMI area companies, these maps were prepared based on water quality data generated by the OSSM companies in 2012.

2012 COMPREHENSIVE DATA EVALUATION
MONTROSE, STAUFFER AND OLIN SITES
HENDERSON, NEVADA

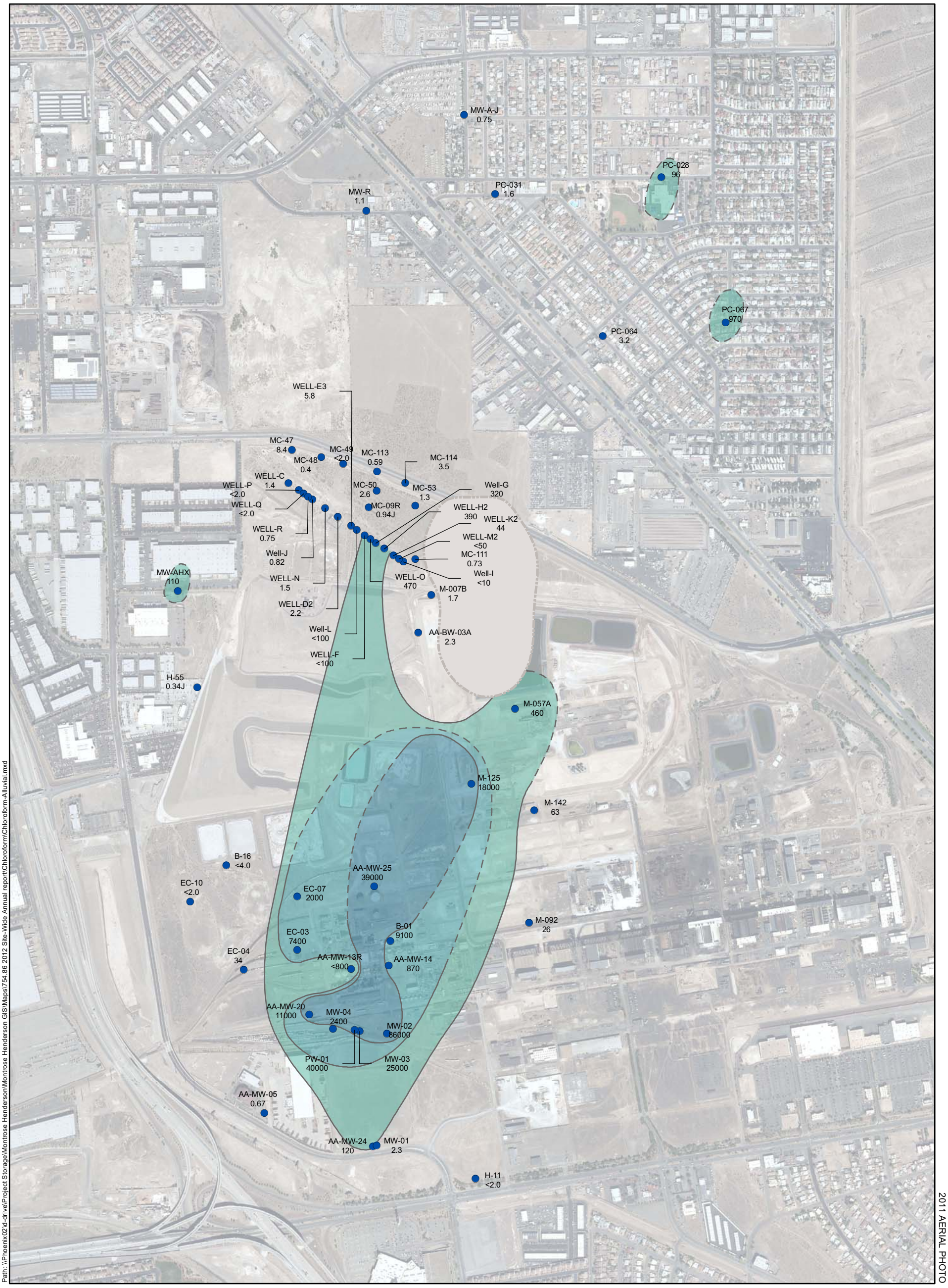
BENZENE
SHALLOW ZONE
SECOND QUARTER 2012

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY / ENGINEERING

7/23/2012

FIGURE 6

PREP BY DAT REV BY BRW RPT NO 754.86



EXPLANATION

CHLOROFORM CONCENTRATION (ug/l)
EPA METHOD: 8260B

- 80 (TTHM MCL) - 999
- 1,000 - 9,999
- 10,000 - 99,999

Boundary of concentration zone is dashed where inferred, queried where uncertain.

H-11 MONITOR WELL IDENTIFIER
<2.0 CONCENTRATION IN MICROGRAMS PER LITER SECOND QUARTER 2012

<	LESS THAN; COMPOUND WAS NOT DETECTED AT OR ABOVE THE REPORTED DETECTION LIMIT
ug/l	MICROGRAMS PER LITER
TTHM	TOTAL TRIHALOMETHANES (BROMODICHLOROMETHANE + BROMOFORM + CHLOROFORM + DIBROMOCHLOROMETHANE)
J	THE ASSOCIATED VALUE IS AN ESTIMATED QUANTITY.
	AREA OF UNCERTAIN SHALLOW ZONE SATURATION

N

0 500 1,000
Feet

Note:
BCL = 0.193 ug/l

While additional data may be available from other BMI area companies, these maps were prepared based on water quality data generated by the OSSM companies in 2012.

2012 COMPREHENSIVE DATA EVALUATION
MONTROSE, STAUFFER AND OLIN SITES
HENDERSON, NEVADA

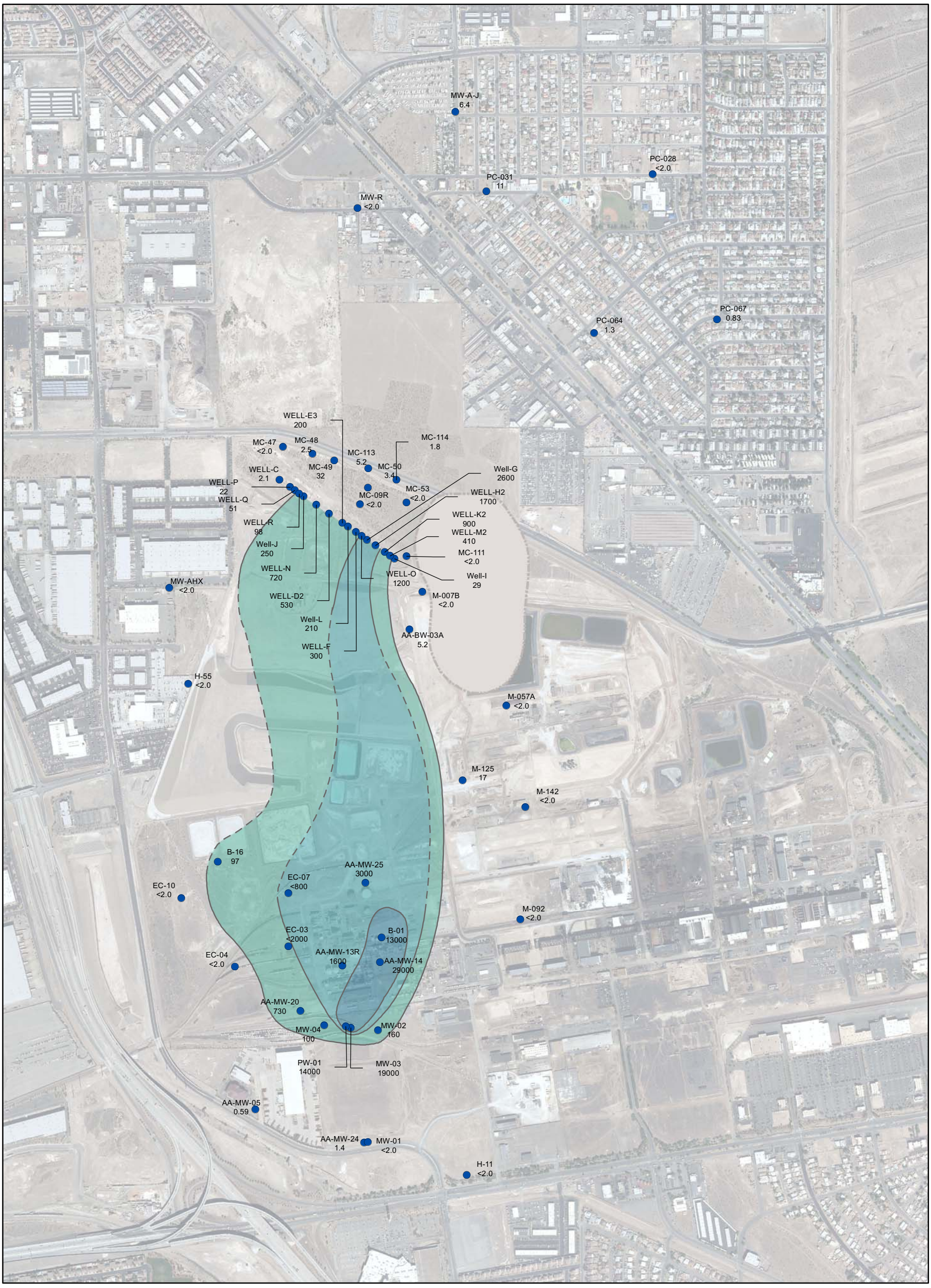
CHLOROFORM
SHALLOW ZONE
SECOND QUARTER 2012

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY / ENGINEERING

8/14/2012

FIGURE 8

PREP BY DAT REV BY BRW RPT NO 754.86



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EXPLANATION

1,4-DICHLOROBENZENE CONCENTRATION (ug/l)
EPA METHOD: 8260B

- 75 (BCL, MCL) - 999
- 1,000 - 9,999
- 10,000 - 99,999

Boundary of concentration zone is dashed where inferred, queried where uncertain

H-11 <2.0 — MONITOR WELL IDENTIFIER; CONCENTRATION IN MICROGRAMS PER LITER SECOND QUARTER 2012

< — LESS THAN; COMPOUND WAS NOT DETECTED AT OR ABOVE THE REPORTED DETECTION LIMIT

ug/l — MICROGRAMS PER LITER

AREA OF UNCERTAIN SHALLOW ZONE SATURATION

N

0 500 1,000
Feet

Note:
While additional data may be available from other BMI area companies, these maps were prepared based on water quality data generated by the OSSM companies in 2012.

2012 COMPREHENSIVE DATA EVALUATION
MONTROSE, STAUFFER AND OLIN SITES
HENDERSON, NEVADA

1,4-DICHLOROBENZENE
SHALLOW ZONE
SECOND QUARTER 2012

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY / ENGINEERING

7/23/2012

FIGURE 10

PREP BY DAT REV BY BRW RPT NO 754.86

Tab 14

Conference Call re: Response to Comments Parcels A&B Soil Gas Health Risk Assessment, Meeting Minutes

July 26, 2013

Conference Call re: Response to Comments Parcels A&B Soil Gas Health Risk Assessment
Meeting Minutes
July 26, 2013

Attendees: Weiquan Dong, NDEP; James Dotchin, NDEP; Paul Hackenberry, Hackenberry & Associates; Lynne Haroun, ENVIRON; Chris Stubbs, ENVIRON; Allan DeLorme, ENVIRON

A conference call was held on July 26, 2013 to discuss comments/questions from Hackenberry & Associates (Hackenberry) in response to a request from Weiquan Dong of NDEP on June 13, 2013. Below is a summary of the items discussed on the call.

1) **Comment: Need to redo the soil gas HRA**
   ENVIRON explained that the most current revision of the Parcel A&B Soil Gas Health Risk Assessment (HRA), developed by Northgate Environmental Management (NGEM, 2010), had been discussed with NDEP at the planning stages of this effort. NDEP had agreed at that time that the most cost-effective and efficient path forward would be to use the Northgate HRA as a basis for the current health risk analysis for Parcels A&B, with ENVIRON to supply a technical memorandum to supplement the HRA and respond to NDEP comments (dated May 23, 2011). ENVIRON indicated that responding to this comment with a rewrite and resubmittal of the HRA at this point would result in further delay and costs. NDEP and Hackenberry agreed that, instead of a rewrite and resubmittal of the HRA, that ENVIRON would provide a consolidated set of the relevant documents for Parcels A&B in a single deliverable which includes the Northgate HRA, ENVIRON Technical Memorandum (2013), NDEP comment letters, responses to comments, and all associated correspondence.

2) **Comment: Need to present additional groundwater data collected by OSSM at upgradient off-site locations**
   ENVIRON discussed with NDEP and Hackenberry the fact that the data being requested would not result in a material difference in the estimated risk of vapor intrusion at Parcel A&B due to: 1) the OSSM groundwater plume is contained at the site boundary by its extraction and treatment system; and 2) on-site soil gas data is more representative of actual conditions pursuant to evaluating vapor intrusion risk. Based on this discussion, NDEP and Hackenberry agreed that presentation of additional data from the OSSM site was not required.

3) **Use of different soil property parameters in the groundwater versus soil gas Johnson & Ettinger (J&E) modeling**
   Hackenberry indicated that in order to independently verify the J&E modeling results, it needed ENVIRON to provide two example J&E spreadsheets, showing intermediate steps, for the soil gas modeling results. ENVIRON will provide the example calculations for the top two risk drivers in soil gas (chloroform and 1,2-dichlorobenzene). Example spreadsheets for the groundwater modeling results have already been provided. Hackenberry also questioned why different soil properties were used for each media. ENVIRON explained that in conducting J&E modeling for

VOCs in groundwater it used updated site-specific information regarding soil properties that differed somewhat from those used by Northgate in its HRA. ENVIRON will conduct a screening-level sensitivity analysis showing the effect on risk from groundwater of using the updated soil properties.

4) **Detections of helium in soil gas samples**

Hackenberry asked about the detections of helium tracer in soil gas samples during sample collection activities at the site. ENVIRON verified that helium tracer was not detected in any of the soil gas samples collected at the site.