



environmental management, inc.

From: Deni Chambers, CEG, CHG
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Date: November 12, 2010

To: Shannon Harbour
Nevada Division of Environmental Protection (NDEP)

RE: Revised Work Plan to Evaluate In Situ Soil Flushing of Perchlorate-Impacted Soil,
Tronox LLC, Henderson, Nevada

This memorandum provides a response to comments received on November 8, 2010 regarding the Revised Work Plan to Evaluate In Situ Soil Flushing of Perchlorate-Impacted Soil, Tronox LLC, Henderson, Nevada (Work Plan).

Tronox acknowledges NDEP's concern regarding the schedule to demonstrate source control of the perchlorate impacted soil, as noted in the November 8, 2010 letter transmitting NDEP's comments on the Work Plan. Tronox believes that work completed by the end of 2010 will demonstrate an effective approach to achieving source control. The column studies conducted by PRIMA Environmental and reported in Appendix A of Northgate's *Revised Work Plan to Evaluate In Situ Soil Flushing of Perchlorate-Impacted Soil*, dated October 8, 2010, have demonstrated that soil flushing is an effective technology to reduce perchlorate concentrations in the vadose zone by transporting it to groundwater for treatment using the existing groundwater extraction and treatment system (GWETS). The ability to flush the perchlorate combined with the ability to remove and destroy the perchlorate are the primary elements of demonstrating source control.

The field pilot study described in the October 8th work plan and this RTC and enclosed addendum are intended to demonstrate the efficacy of the engineering design proposed for the implementation of the flushing work, which will be used to remediate vadose-zone soils containing perchlorate above Basic Comparison Levels (BCLs). Tronox recognizes that soil flushing alone may not be a cost effective strategy to remediate vadose zone perchlorate concentrations down to the level of the leaching-based Site-specific levels (LSSLs). Tronox is actively researching alternative remediation strategies to address this issue and will present the results of our evaluation to NDEP in a feasibility study of remedial alternatives.

Responses to NDEP Comments:

1. *Section 1.0, page 1, Introduction, last sentence, please describe how the*

assessment will be conducted, for example, literature review and/or laboratory testing.

Response: This sentence of the work plan has been revised to specify that the assessment will be based on a literature review.

2. *Section 1.1, page 2, Objectives, 3rd bullet, based on the column test results, TRX should additionally analyze for the following: pesticides, anions, general minerals (ammonia), metals.*

Response: Tronox agrees and notes that Table 3 of the revised work plan specifies analysis for all these constituents. The text of this bullet in Section 1.1 has been modified to clarify.

3. 1. *Section 2.2, page 4, Selected Pilot Test Conditions, TRX should expand this section to demonstrate the use of column test results to the evaluation and design of the in-situ application. NDEP has the following additional comments:*
 - a. *2nd paragraph on page, the comparison of arsenic and chromium results to currently measured on-Site values should be made via a data table including the monitoring data.*
 - b. *2nd paragraph on page, this paragraph should be expanded to include the use of column test results/findings beyond arsenic and chromium. All laboratory analytical data from the column tests should be evaluated via comparison with groundwater monitoring data and BCLs in a tabular format.*
 - c. *The NDEP notes several instances where the analytical detection limit is greater than the applicable BCL. Please evaluate and discuss in terms of impact to in-situ soil flushing.*
 - d. *The non-target analytes should also be evaluated in terms of potential impact to the existing groundwater treatment system.*

Response: A new table (Table 1) has been prepared and added to the revised work plan as requested above. As well, the text of Section 2.2 has been expanded to discuss the data in this new table, and to address each of the four issues raised above.

4. *Section 2.3, page 5, Design of Pilot Test Monitoring System, Figure 3 reference, TRX should include an additional groundwater monitoring well between PPT-MW-1 and PPT-MW-2.*

Response: The work plan text and Figure 3 have been revised to include a third downgradient monitoring well.

5. *Section 2.3, page 5, Design of Pilot Test Monitoring System, 3rd paragraph of section, NDEP remains concerned about the ability of these wells to collect infiltrating water during the test as previously indicated in the March 29, 2010 Work Plan review. Please attach the Tronox/NGEM RTCs dated May 27, 2010,*



which indicated the commitment for "active" collection of leachate samples.

Response: The RTC submitted May 27, 2010 has been added as Appendix B of the revised work plan. Tronox also notes that Section 2.4 of the work plan provided a description of the leachate collection procedures, which included active collection of leachate samples by vacuum if necessary. A reference to this has been added in Section 2.3 of the revised work plan.

6. *Section 2.4, page 5, Pilot Test Monitoring Schedule, Table 2 reference, TRX should include the EPA RCRA 13 Priority Pollutant Metals (Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Ti, and Zn) in the groundwater monitoring plan.*

Response: The subject table (now Table 3 in the revised work plan) has been updated to include analysis of all the EPA RCRA 13 Priority Pollutant Metals listed above.

7. *Section 4.0, page 10, Future Work, 2nd paragraph, TRX should note that alternative water sources will require a complete analysis of SRCs.*

Response: This paragraph of the work plan has been revised to note that alternative water sources will be analyzed for all Site Chemicals of Potential Concern.

8. *Attachment 1, Appendix A, NDEP has the following comments:*
- a. *Section 2.4.1, page 7, Addition of Water, please specify how many samples had insufficient volume for all the analyses.*
 - b. *Section 2.5, page 10, Analytical Methods, please identify the laboratories that do not have State of Nevada certification and what analytes were involved.*
 - c. *Section 2.5, page 12, Analytical Methods, Table 6 Analytical Methods, all the footnotes are not explained, please revise as necessary.*

Response: The following responses address these three items. The Final Report from PRIMA Environmental (Appendix A) has not been modified.

8a. Four of the 21 leachate samples were of insufficient volume for complete analysis – the first sample (S1) from each of the three columns, and the last sample (S8) from column RSAM-5. The first samples were collected “early” to get a perchlorate result near the start of the test, and to synchronize the sampling schedule of the three test columns. The last sample from column RSAM-5 was collected until no more leachate drained from the bottom of the column. Tables 9 through 20 of Appendix A indicate which analyses were performed on these four samples.

8b. The only laboratory that is not NDEP certified for the chemical analysis provided is Kiff Analytical of Davis, California. Kiff is NELAC certified. Kiff



provided only hexavalent chromium analysis. They were selected because of their proximity to PRIMA Environmental, which was useful in completing the hexavalent chromium analysis within the required 24-hour hold time.

8c. PRIMA reviewed Table 6 of their report, and said that the only footnote on Table 6 is the asterisk above the Lab column. This footnote is fully explained at the bottom of the table. There are two other marks on the table – a “^” above the method number of the uranium analysis, and an “*” in the hexchlorobenzene entry in the analyte list. PRIMA reports that these were originally inserted to remind the author to confirm an entry, and should have been deleted before submission.

9. *Attachment 2, Evaluation of Perchlorate Mass Distribution, NDEP has noted that this attachment discusses only perchlorate although both the column tests and the LSSL calculations (Northgate, 2010) found other chemicals that could potentially leach to groundwater. As stated above, TRX should evaluate all laboratory analytical data from the column tests in comparison with groundwater monitoring data and BCLs.*

Response: Please refer also to the response to Comment no. 3, above, and Table 1, which indicates the following chemicals were detected in the column study leachate samples at concentrations above risk-based groundwater concentrations (RBGCs):

Inorganics

- Ammonia (RSAM-5)
- Arsenic (SA-189 and RSAM-5)
- Total chromium (RSAM-5)
- Chromium-VI (RSAM-5)
- Cobalt (RSAM-5)
- Magnesium (SA-189, RSAM-6, and RSAM-5)
- Manganese (RSAM-5)
- Nitrate (RSAM-6 and RSAM-5)

Organics

- Beta-BHC (SA-189, RSAM-6, and RSAM-5)

Leaching-based, Site-specific levels (LSSLs) were calculated in the “*Revised Technical Memorandum: Calculation of Leaching-Based, Site-Specific Levels (LSSLs) for the Soil-to-Groundwater Pathway Using NDEP Guidance*,” dated September 9, 2010. Of the chemicals detected at concentrations greater than RBGCs in the leachate samples listed in Table 1, the following chemicals have been detected in soil at concentrations above the LSSLs:

Inorganics

- Arsenic
- Cobalt
- Magnesium



- Manganese

Organics

- Beta-BHC

Arsenic is being removed to the background concentration of 7.2 mg/kg within the upper 10 feet of soil, as part of the on-going soil remedial actions (Northgate 2010a, 2010b, 2010c, 2010d). At depths greater than 10 feet, arsenic is within background concentrations, as discussed in the leaching technical memorandum dated September 9, 2010.

Cobalt, magnesium, and manganese are being evaluated as part of a feasibility study requested by NDEP (NDEP 2010). In general, cobalt and manganese have leached to groundwater only in a localized area under the former manganese tailings piles, where additional remediation is planned (Northgate 2010b). Cobalt and manganese are not migrating in groundwater downgradient from this localized area, and will be evaluated further in the feasibility study. Beta-BHC has not leached to groundwater from unsaturated-zone soils, except along the western Site boundary where it has migrated from the POSSM facility, west of the Site.

The other chemicals detected in leachate samples from the column study (ammonia, nitrate, total chromium and chromium –VI) are being monitored as part of the semiannual groundwater monitoring program and are not targeted for soil flushing. If these chemicals are mobilized during the soil-flushing pilot test or during perchlorate source remediation, they will be monitored and captured by the GWETS.

References

Nevada Division of Environmental Protection (NDEP), 2010. Letter to Mr. Matt Paque, Tronox LLC, from Ms. Shannon Harbour, regarding NDEP Response to: Revised Environmental Covenants, Institutional and Engineering Control Plan, Tronox Facility, Henderson, Nevada, dated June, 9, 2010. July 30.

Northgate Environmental Management, Inc. (Northgate), 2010a. Revised Excavation Plan for Phase B Soil Remediation of RZ-B, Addendum to the Removal Action Work Plan, August 20.

Northgate, 2010b. Revised Excavation Plan for Phase B Soil Remediation of RZ-C, Addendum to the Removal Action Work Plan, September 1.

Northgate, 2010c. Revised Excavation Plan for Phase B Soil Remediation of RZ-D, Addendum to the Removal Action Work Plan, August 31.

Northgate, 2010d. Excavation Plan for Phase B Soil Remediation of RZ-E, Addendum to the Removal Action Work Plan, November 3.



Northgate. 2010e. Revised Technical Memorandum: Calculation of Leaching-Based, Site-Specific Levels (LSSLs) for the Soil-to-Groundwater Pathway Using NDEP Guidance. September 9.

Tronox LLC (Tronox). 2010. Revised Environmental Covenants, Institutional and Engineering Control Plan, Tronox Facility, Henderson Nevada. June 9.

