



environmental management, inc.

From: Deni Chambers, C.E.G., C.Hg.
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Date: March 25, 2010

To: Shannon Harbour, P.E.
Nevada Division of Environmental Protection

RE: Response to NDEP February 24, 2010 Comments on Capture Zone Evaluation Work Plan, Tronox LLC, Henderson, Nevada

1. *Section 1.0, page 1, TRX references the EPA Guidance, A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems (EPA, 2008). NDEP has the following concerns:*

a. *EPA 2008, Step 3, 2nd bullet, please note that NDEP requests the use of well triplets for 3-point gradient solutions in lieu of well pairs wherever possible.*

Tronox Response: Tronox will perform analyses of hydraulic gradients in accordance with the EPA 2008 guidance document, including 3-point solutions where possible.

b. *EPA 2008, Step 4, 2nd bullet, NDEP refers NGEM to Figure 14 of the referenced document for capture zone width calculation in lieu of drawdown calculations. Given the prevailing hydraulic gradient across most of the site, drawdown is not a reliable indicator of capture.*

Tronox Response: Tronox will perform analyses of capture zones in accordance with the EPA 2008 guidance document, including calculation of capture zone widths as described in Figure 14 of the guidance.

2. *Section 1.1, page 1, 1st paragraph, please identify the “several other chemicals that impact groundwater quality at the Site.”*

Tronox Response: Tronox has added a list of additional constituents that impact groundwater to the text.

3. Section 2.1, NDEP has the following comments:

- a. Page 3, 1st paragraph, please specifies that wells will be abandoned in accordance with Nevada Division of Water Resources (DWR) regulations.

Tronox Response: Tronox has added reference to Nevada Division of Water Resources NAC 534 well drilling regulations.

- b. Page 3, 1st bullet, NDEP has the following comments:

- i. For clarity, NDEP requests that an overlay of groundwater elevation contours on Figure 2.

Tronox Response: Figure 2 has been revised with an overlay of shallow groundwater surface elevation contours added.

- ii. TRX states that “The wells will extend to a total depth of approximately 35-40 feet below ground surface (fbgs) and will terminate at the Qal/UMCf interface...” TRX’s Interim Groundwater Capture Evaluation and Vertical Delineation Report dated December 23, 2009 noted that perchlorate contaminated groundwater was observed at concentrations ranging from 0.24 – 556 mg/L in the Upper Muddy Creek formation (UMCf). As such, TRX should also investigate the horizontal extent of this deeper contamination and to additionally quantify this mass in the groundwater capture calculations.

Tronox Response: The purpose of these two recovery wells is to improve groundwater capture in the Qal, and this has been clarified in the text. Wells designed to investigate the extent of contamination in the UMCf are proposed in Section 2.2, Bullet 3.

- iii. Please provide justification for the locations shown on Figure 2 for the shallow wells proposed in this bullet. NDEP has noted that the perchlorate impacted groundwater further south of the barrier wall has an easterly component to the groundwater gradient. NDEP does not agree that these wells address this condition and that TRX should increase the distance between these wells and possibly include additional wells along the property boundary to better quantify (and capture, as needed) the mass of perchlorate migrating off-Site to the east.

Tronox Response: Tronox has increased the spacing between the two proposed new wells. Figure 2 has been revised to show this. Additional extraction along the eastern property boundary may be proposed in the future based on the results of the capture zone evaluation.

- c. Page 3, 6th bullet, M-48 and M-77 are not shown on Figure 2. Please include these wells on Figure 2 if possible or include and reference them as appropriate in another Figure.



Tronox Response: The wells are not located within the Interceptor well field and are therefore not shown on Figure 2. Tronox has added the two wells to Figure 1. They are shown highlighted in yellow.

- d. *Page 4, 1st bullet, TRX states that “If there are access problems or other constraints, piezometers and wells that cannot be re-established will be replaced at locations to be determined based on our assessment of accessibility.” TRX should consider locating the “replacement wells” on the basis of ability to demonstrate capture and not necessarily in the original well location (i.e. a replacement well at an existing location may not be optimal for demonstrating capture).*

Tronox Response: Tronox agrees with NDEP that all new piezometers and wells should be optimally located. The language of this bullet item has been revised to reflect this.

4. *Section 2.2, NDEP has the following comments:*

a. *1st bullet, NDEP has the following comments:*

- i. *Page 4, 2nd paragraph, NDEP is skeptical at this time about achieving these goals of confirming the barrier wall integrity and to locate any leaking portions of the barrier wall with indirect measurement using geophysical methods given the hydrogeologic complexity of the area.*

Tronox Response: Tronox understands NDEP concerns, but believes that the AquaTrack technology would be an effective tool to evaluate the integrity of the barrier wall. AquaTrack has been used successfully for at least 16 dam seepage evaluations and for other assessments with relevance to the evaluation proposed at Tronox. Tronox requests a meeting with NDEP as soon as possible to discuss the technology and its potential use for the barrier wall evaluation, so that a path forward for the evaluation can be agreed upon.

- ii. *Page 4, 2nd paragraph, NDEP suggests that an alternative method could be to evaluate groundwater elevation maps for this area; add wells where detail is lacking between wells M-69/M-70, M-70/M-71, M-71/M-72, M-72/M-73, and M-73/M-74; and re-contour the water level data. To assist in this effort, it may be useful to at least temporarily cease injection at the recharge trenches and allow water levels to stabilize. Then TRX could collect a round of water level measurements and contour the data.*



Tronox Response: See response to comment 4.a.i above. Tronox believes that the AquaTrack method would be a more effective approach for evaluating the barrier wall integrity than water level monitoring. We request a meeting with NDEP to discuss the options and come to agreement on an approach.

- iii. *Page 5, 1st full paragraph, please specify the laboratory methods to be used. TRX should note that NDEP prefers the use of ASTM methods whenever possible.*

Tronox Response: The proposed ASTM method has been specified in the text.

- b. *Page 5, 1st bullet, please clarify the intent of the proposed pumping of the groundwater (i.e. pumped for groundwater sampling only or pumped for a longer time period) and how the long-term, historic data support this proposal.*

Tronox Response: The purpose of pumping these wells will be to extract contaminated groundwater and to monitor water levels and concentration decline over time. These data will be used as part of the groundwater model and capture zone evaluation. After an initial three month period of pumping, Tronox will submit a summary of findings to NDEP with recommendations for continued pumping of these wells, if warranted. This information has been added to the text.

- c. *Page 5, 2nd bullet, please clarify that these wells (and others as appropriate) are being constructed to be converted to extraction wells, if appropriate. Once installed, the wells should be developed, slug tested (or some other form of hydraulic testing), sampled, and converted to extraction wells (if appropriate).*

Tronox Response: The purpose of installing these wells is to further delineate the horizontal and vertical contamination in the UMCf. Construction methods for monitoring wells involve shorter screened intervals than is effective for extraction wells at the Tronox site. Data from these monitoring wells will be incorporated into the capture zone evaluation, and groundwater extraction from the UMCf may potentially be proposed based on this evaluation. If so, the extraction well locations and screened intervals will be optimally designed based on the capture zone evaluation and modeling results.

- d. *Page 5, 2nd bullet, the decision logic for the depths of the wells described in the last two paragraphs is not clear. Please clarify.*

Tronox Response: Tronox has added language to the text for clarification purposes.

- e. *Pages 5-6, 3rd bullet, NDEP has the following comments:*

- i. *Please specify whether the two UMCf wells will be advanced so that continuous cores will be available.*



Tronox Response: Sonic drilling will be used and continuous coring will be accomplished. This information has been added to the text of the work plan.

- ii. *NDEP suggests that these wells be additionally proposed as extraction wells so that if perchlorate is observed in this area, these wells can be attached to the groundwater treatment system.*

Tronox Response: The wells will be constructed appropriately such that conversion to extraction wells in the future will be possible, if warranted. Tronox proposes to install the wells 25 ft into the UMCf and use a 20 ft screened interval, with 5 ft of blank casing at the bottom.

- iii. *Please clarify if sumps will be installed in these wells.*

Tronox Response: These two wells will be constructed with 5 ft of blank casing at the bottom to serve as a sump should the wells be converted to extraction wells.

5. *Section 2.3.1, page 6, last bullet, please clarify whether the proposed wells are the same wells that were proposed in the Revised Work Plan to Evaluate Effective Groundwater Capture dated August 27, 2007.*

Tronox Response: Yes, these are those same wells.

6. *Section 2.3.2, pg 7, 2nd paragraph, NDEP requests a separate work plan for development of the model. In the response-to-comments letter requested above, please provide a date for the submittal of this model work plan.*

Tronox Response: A separate work plan for the groundwater model will be submitted on April 30, 2010.

7. *Section 3.0 and Figure 5 show the Capture Zone Evaluation report beginning in October 2010. However, some elements of the Capture Zone Evaluation report should be available, at least in draft form, prior to that date; therefore, NDEP requests data and maps for the well installations as early as possible. Please modify the schedule to reflect this request.*

Tronox Response: Tronox proposes to submit monthly status memoranda to NDEP that will summarize the previous month's field work and data results. These summaries will be submitted to NDEP by the 10th day of each month.

