

October 3, 2007

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:  
*Revised Work Plan to Evaluate Effective Groundwater Capture at Tronox Extraction  
Systems, Tronox LLC, Henderson, Nevada*  
Dated August 29, 2007

Dear Ms. Crowley,

The NDEP has received and reviewed TRX's Work Plan identified above and provides comments in Attachment A. The NDEP has received and reviewed the aforementioned Deliverable and finds that the Deliverable is acceptable. Please note that the comments provided below should be reviewed and incorporated into the capture zone evaluation report. It is requested that TRX review the comments below and schedule a meeting with the NDEP by **October 31, 2007**. This meeting can be in-person or via telephone.

Please contact the undersigned with any questions at [sharbour@ndep.nv.gov](mailto:sharbour@ndep.nv.gov) or (702) 486-2850 x 240.

Sincerely,

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

SH:bar:sh

CC: Jim Najima, NDEP, BCA, Carson City  
Brian Rakvica, NDEP, BCA, Las Vegas  
Keith Bailey, Environmental Answers, 3229 Persimmon Creek Drive, Edmond, OK 73013  
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Paul Hackenberry, Hackenberry Associates, LLC, 550 W. Plumb Lane B425, Reno, Nevada 89509

### Attachment A

1. General comment: TRX interchangeably uses the terms “slurry wall” and “barrier wall” in the text and figures of the Work Plan. Please resolve this terminology in future Deliverables.
2. General comment: the NDEP did not note the reference of any standard operating procedures (SOPs) in the Work Plan. Please provide references for all applicable, approved SOPs by **October 24, 2007**. If new SOPs are needed please forward them to the NDEP as soon as possible for review.
3. General comment, please discuss if any hydraulic testing will be conducted in the wells that are proposed to be installed (e.g.: slug testing or pump testing) **at the meeting referenced in the cover letter**.
4. Section 2.1.1, Performance Evaluation, Flow Budget, the NDEP has the following comments (please note that these comments are also applicable to Appendix B):
  - a. TRX states that “The presumed upward flow of groundwater is further enhanced by the pumping upgradient of the barrier. Given this enhancement to upward flow, it would be anticipated that perchlorate mass if present within the upper portion of the Muddy would be locally influenced in the vicinity of the barrier and interceptor well field.” The first sentence starts with a presumption about upward flow and the second sentence starts with the upward flow as a “given.” Please clarify what is meant by this statement and if this refers to the unconfined portion of the Muddy Creek formation or the confined portions.
  - b. TRX states that the “Groundwater in the Muddy Creek, subsequently “dammed up” behind the groundwater barrier wall...” Please provide a cross-section of the Interceptor Well Field including the as-built dimensions of the barrier wall for a comparison of well depths versus the depth of the barrier wall and the depths of the geologic units.
  - c. TRX states that the “Groundwater flowing vertically and “daylighting” from the Muddy Creek upwards into the incised alluvial channels up-gradient from the slurry wall. The third flow element is included in the budget, since the estimates of flow from the alluvium and Muddy Creek dammed behind the barrier do not adequately account for the water being pumped at the interceptor well field. The calculations and input parameters are provided in Appendix B.” If this is truly a vertical flow component then the hydraulic conductivity used should not be the same as the horizontal hydraulic conductivity. Vertical hydraulic conductivity is typically several orders of magnitude less than horizontal hydraulic conductivity. It is suggested that TRX collect this data as part of the implementation of the Work Plan. **Please discuss this matter with the NDEP at the meeting referenced in the cover letter.**
  - d. Please consider that the existence of water dammed up behind the barrier wall and water mounded in the “dead zone” may produce a downward gradient into the Muddy Creek formation.
  - e. Please consider that the density of the water may produce a downward gradient into the Muddy Creek formation.
  - f. Please consider installing several co-located wells which are screened in the various portions of the unconfined aquifer (e.g.: the Quaternary alluvium; the transition zone; and the Tertiary Muddy Creek formation). **Please discuss this matter with the NDEP at the meeting referenced in the cover letter.**



- b. The model states “Perchlorate concentration data for key well positions do not appear to indicate complete ARF capture is being achieved. The results of this analysis are not consistent with the results of the particle tracking exercise described above, which indicated that all particle pathways end at extraction well locations, and that “complete capture” is achieved.”
  - c. The Model also states “Additional modeling efforts beyond those described herein, pending the discovery of significantly different data, may include expanding the model to three dimensions (e.g., simulating interaction between Qal and MCf or the Muddy Creek transition zone). Also, calibration of the current solute transport model may be warranted in the case of modified project objectives (e.g., more precise evaluation of mass removal efficiency is deemed necessary).
  - d. Another noted limitation of the model was stated as “Given the large hydraulic conductivity contrast between the Qal and MCf, groundwater flow and solute transport are inferred to be largely dominant in the alluvium. However, some degree of communication is presumed to occur.”
8. Section 2.2.1, Performance Evaluation, Overlapping Cones of Depression, TRX states that “Overlapping cones of depression are evident from data collected from adjacent piezometers and monitoring wells, indicating that the well field has developed a capture zone sufficient to encompass the width of the plume in this area.” Please note that drawdown does not equal capture. The NDEP suggests that it would be more accurate to state “Overlapping cones of depression are evident from data collected from adjacent piezometers and monitoring wells, indicating that the well field has developed an area of drawdown sufficient to encompass the width of the plume in this area.”
9. Table 1, the NDEP requests that TRX prepare and submit cross-sections which present the proposed locations and depths of the new wells relative to existing wells, geologic units and saturated thicknesses. Please provide this at the meeting referenced in the cover letter.
10. Appendix A, the NDEP has the following comments:
- a. Response to comment (RTC) 12, the NDEP has the following comments:
    - i. The NDEP acknowledges TRX’s RTC but please note that the RTC does not rebut the implication that dilution could also be a factor in the concentration decline.
    - ii. In Section 2.1.1 Performance Evaluation, Flow Budget, TRX states that “The slurry wall, installed in 2001, has dramatically improved groundwater capture. Current capture rates of about 65 gpm are double those before the wall was installed.” Please reconcile the above-statement with RTC 12.
    - iii. Additionally see comments above for Section 2.1.1.
  - b. RTC 14, TRX proposes to “mine” wells M-70 and M-71 by pumping contaminated groundwater from the “dead zone” north of the barrier wall allowing the injected Lake Mead water to “migrate further into this area and assist in lowering the groundwater concentrations via flushing or dilution. In Section 2.1.3, TRX proposes to pump wells M-70 and M-71 and monitor the perchlorate concentration over time to “demonstrate the slurry wall is continuous and does not leak significantly along its length”. The NDEP does not understand that if TRX is expecting the infiltration of Lake Mead water into this area, thereby reducing the contaminant concentrations, how pumping M-70 and M-71 will demonstrate the integrity of the barrier wall.

Please explain if the injection of Lake Mead water will be halted during these pump tests. Please clarify. **This matter must be discussed at the meeting requested in the cover letter.**

11. Appendix B, the NDEP has the following comments:
  - a. Table B-1, as noted previously, the NDEP does not agree with the use of a horizontal hydraulic conductivity to calculated vertical flow.
  - b. Table B-2, the NDEP noted that the electronic version provided with the original document included a duplicate of Table B-1 instead of Table B-2. Please provide a corrected electronic version of this Work Plan to the NDEP by **October 24, 2007**.
12. Appendix C, the NDEP has the following comments:
  - a. TRX states that "... Lake Mead water containing very low concentrations of total chromium and perchlorate has moved a sufficient distance in the groundwater to a monitor well..." Please quantify what is meant by "very low concentrations of total chromium and perchlorate" and "sufficient distance".
  - b. In Table C-1, TRX reports groundwater velocities ranging from 1.1 ft/d to 12.3 ft/d. Please discuss if separate groundwater velocities should be calculated for the alluvium, alluvial channels, and the inter-channel areas.
  - c. The NDEP requests that the seepage velocity be calculated using hydraulic parameters for comparison. It is requested that TRX also collect physical parameter data in applicable geologic units during the implementation of this Work Plan (e.g.: dry bulk density, specific gravity, etc.). **Please discuss this matter with the NDEP at the meeting referenced in the cover letter.**