February 1, 2006

Mr. Jeff Lux, Project Manager
Tronox Worldwide, LLC
P.O. Box 268859
Oklahoma City, OK 73126-8859

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION STAFF COMMENTS ON CIMARRON'S "SITE-WIDE GROUNDWATER ASSESSMENT REVIEW" AND REFINED CONCEPTUAL SITE MODEL" (TAC No. L50954)

Dear Mr. Lux:

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the Cimarron Corporation reports, "Site-Wide Groundwater Assessment Review" and "Refined Conceptual Site Model, Cimarron Site - Crescent, Oklahoma". These reports document the available databases and the licensee's understanding of the geologic, hydrogeologic, and geochemical characteristics of the Cimarron site.

The NRC staff believes that Cimarron's discussion of its evolving conceptual site model should help to understand the hydrogeologic issues involved in identifying and evaluating potential remediation approaches. Our comments are enclosed. In addition, during our October 5 and 6, 2005, meeting with Cimarron and the Oklahoma Department of Environmental Quality, we also identified a number of "parking lot" issues. Our list of these issues is also enclosed. Cimarron should address our comments and the "parking lot" issues in the development of its conceptual site model.

If you have any questions regarding this letter, please contact me at (301) 415-6664 or by e-mail at KLK@nrc.gov.

Sincerely,

**/RA/**

Ken Kalman, Project Manager
Decommissioning Directorate
Division of Waste Management
  and Environmental Protection
Office of Nuclear Material Safety
  and Safeguards

Enclosures:
1. NRC Comments
2. Parking Lot Issues

Docket No.: 70-925
License No.: SNM-928

cc: Cimarron distribution list

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## NRC STAFF COMMENTS ON CIMARRON'S GROUND-WATER CONCEPTUAL SITE MODEL

**General Comments:**

1. Has Cimarron or its contractors developed numerical models (i.e., ground-water flow, transport, and/or geochemical simulation models) of the hydrogeologic system in Burial Area #1?

2. If there are flow and/or transport models, please identify the estimated hydraulic and transport properties of the hydrogeologic units modeled for Burial Area #1, Western Upland Area, and Western Alluvial Area. Please include an estimate of the range of typical values and explain the technical bases and analysis procedures for its estimation.

3. How was the geochemical data analyzed? Please discuss, in detail, your geochemical model(s) (e.g., MINTEQA and other software codes?) for this site.

4. Please discuss how the analytical results from your geochemical model(s) (or analyses) relate to solute transport modeling at this site. What are the major hydrochemical facies and what is the geochemical indicators for uranium mobility?

5. If you have developed numerical models of Burial Area #1, Western Upland Area, and Western Alluvial Area, please discuss your model calibration procedures. If you have not developed numerical models for these areas, discuss what calibration procedures or approaches you would propose for future confirmation of conceptual and future numerical ground-water flow and transport models.

6. How do you integrate site hydrogeologic characterization and monitoring to identify and evaluate potential remediation options? How would numerical modeling using this information assist in the decision making?

7. Please discuss the need and value of future ground-water monitoring for the identified remediation options.

8. Please discuss your analysis of the temporal and spatial variability of the uranium plume concentrations in the monitoring wells for the August 2002, and August 2004, sampling campaigns at Burial Area #1.

9. Please discuss your analysis of the historical seasonal variations in the water table elevations, total uranium concentrations, and geochemical constituents (e.g., major cations and anions dissolved in the ground water) at Burial Area #1, Western Upland Area, and Western Alluvial Area. Discuss the hydrometeorological processes which control ground-water level (water table) fluctuations (e.g., significant recharge events and Cimarron River flooding). Please compare site ground-water elevation and quality data versus river stages and total uranium and geochemistry of the surface water in the Cimarron River.

10. Please discuss the sources and magnitude of uncertainties in the conceptual site model, estimated parameters and their affect on the uncertainty in the feasibility and effectiveness of potential remediation options.

**Specific Comments:**

1. U.S. Nuclear Regulatory Commission staff has reviewed the grain-size analyses of the boreholes in Burial Area #1. Based on our analysis to date, there appears to be three soil types in the alluvial unit. These types are:

- silty-sand (SM) with little to no fine particles (–#200 sieve), and an estimated saturated hydraulic conductivity of $10^{-2}$ cm/sec;

- silty sand/ clayey sand with appreciable fine particles, and an estimated saturated hydraulic conductivity of $10^{-3}$ cm/sec (or somewhat lower); and

- clayey silt/ silty clay with greater than 50% fine particles, and an estimated saturated hydraulic conductivity lower than $10^{-6}$ cm/sec.

- There are only three soil samples with plasticity data. Plasticity data may provide an indication of geochemical retardation potential. Are there any plasticity data for soil samples beyond the three identified in the soil mechanics report which may be useful in estimating Kd's?
- Are there additional grain-size analyses for this area and for the Western Upland Area and Western Alluvial Area?

Additional information on available grain size and plasticity analyses could provide a much more detailed distribution of soil types and estimates of hydraulic conductivity and geochemical retardation. The underlining premise is that grain size and plasticity analyses can be used to condition the estimates of hydraulic conductivity and geochemical retardation.

2. Was the grain size analysis conducted by washing the samples through the #200 sieve? This information is very important since the fine particles may cling to the sand particles. The absence of washing may distort the particle size distribution by under reporting the "fine material" percentage which is thought to be the location for geochemical sorption sites.

3. What is the mineralogy of the sand, silt and clay particles? What implication does the mineralogy have on geochemical sorption and oxidation potential?

4. Is it possible that uranium which is possibly concentrated in the surficial soils of the partially saturated alluvial unit is being transported through the borehole annulus during infiltration and/or water table fluctuations? This local pathway should be explored to help explain some of the large values of total uranium concentrations in sands with little to no fine particles ( e.g., SM).

5. How often does the Cimarron River flood, and what is the duration and extent of the flooding? The flooding would influence the groundwater gradients and quality. Changes in the groundwater gradients would cause temporal variations in groundwater velocities, directions, and transport.

6. In Burial Area #1, the monitoring wells at the plume front have high total uranium concentrations. What are the plans for installing additional monitoring wells at the plume front? Will soil samples be collected for grain size analysis, plasticity analysis, and geochemical characterization?

7. What are the performance indicators linking the groundwater monitoring to the formulation of the conceptual site model for groundwater flow and transport?

8. What are the plans for monitoring groundwater, uranium, and other parameters in the unsaturated zone? Will soil water content, gradients, and soil water chemistry be monitored?

9. What are the plans for calibrating or adjusting the site conceptual model using monitoring data? Will the calibration include different seasons and hydrologic conditions (e.g., flooding periods)?

10. What has been done to understand the possible leaching, mobilizing, and transport of total uranium from the unsaturated zone to the underlying water-table?

11. What is the concentration of total uranium in the unsaturated zone? Discuss its influence on the total uranium concentrations in the groundwater extracted from the monitoring wells.

**PARKING LOT ISSUES**
**IDENTIFIED DURING THE OCTOBER 5 - 6, 2005 MEETINGS**
**WITH CIMARRON, ODEQ, AND NRC**

1. In the Western Alluvial Area near wells T-62 and T-64, (located at the base of the escarpment below the drainage of gully with groundwater seep 1206), is it feasible to perform a "pump and treat" remediation? Would a pilot study of a remediation procedure be feasible?

2. For Burial Area #1, the plume's extended and narrow geometry might be explained by an advective-dispersive model. The Conceptual Site Model (CSM) should reflect this postulation and build on hydrologic and transport property estimation and needs. For example, what are the soil hydraulic and transport properties of alluvial materials and the importance of Kd's conditioned (or based) on particle size distributions and geochemical analyses?

3. What is the potentiometric surfaces in the mudstone? How do mudstones relate to creation of perched water systems? How does groundwater in the mudstones relate to the groundwater flow directions and velocities within the adjoining sandstone hydrogeologic units?

4. Can groundwater monitoring data be used to estimate time-varying hydraulic gradients? Provide hydraulic conductivities estimates and groundwater flow velocities for Sandstones A, B, and C. How do these flow velocities vary with recharge in the gullies draining the uplands, and with recharge in the alluvial areas?

5. What is the vertical groundwater flow in the two mudstones? How does it affect the contaminant plumes in Burial Area #1 and Western Alluvial and Upland Areas?

6. After reviewing the chemistry of Cimarron River water and the chemistry of groundwater in the alluvial flood plain, what insights can be drawn as to areas influenced by episodic flooding by the river, as opposed to the active upward groundwater flow from Sandstone C? What can be determined as to spatial and temporal horizontal groundwater flow and vertical groundwater flow in the alluvial materials in the vicinity of Burial Area #1?

7. How can recharge and local water table fluctuations (and at time perched water tables) caused by the reservoirs, discharge in the 1206 groundwater seep area, and gullies draining to Burial Area 1 affect contaminant transport? How can this information be brought into the CSM?

8. How will the upward ground-water flow in Sandstone C impact the selection and design of remediation approaches?

9. Can the relative ages of ground water in the upland, transitional zone, and alluvium units be used to understand the dynamics of groundwater recharge, groundwater flow, and groundwater transport variabilities (e.g., determining $O^{16}/O^{18}$ ratios of the groundwater sources)?

10. What are the sources of contaminants for the Western Alluvial Area, particularly in the 1206 seep gully? How can the elevated uranium concentrations in Wells T-62 and T-64 be explained? Would a monitoring well between seep 1206 and Wells T-62 an T-64 help to identify sources and transport dynamics?

11. To develop confidence and knowledge of the CSM, additional sampling events that target geochemistry/chemistry analytes using selected monitoring wells would be beneficial. This is particularly true for the "clay unit" and alluvium in the Burial Area #1 upland, transitional area, and flood plain. One sampling event does not adequately address the temporal patterns due to recharge and flow dynamics.

12. Trend analysis for total uranium in the groundwater would help to understand the uranium plumes' behavior and the geometries and groundwater transport conditions for remediation. For example, how much uranium is in the groundwater as opposed to the porous media?

13. Can further sampling and characterization of radionuclides and groundwater dynamics, particularly the geochemistry of the porous media and groundwater, be used to better understand transport and remediation approaches (e.g., "pump and treat") in the Western Pipeline Corridor?

14. Nitrate and fluoride concentrations appear high in some areas. How do these areas compare to possible sources and contaminant releases for radionuclides discussed in the CSM?

15. Compare the significance of longitudinal dispersion to diffusion in understanding the contaminant plume's geometry and behavior in Burial Area #1.

16. Evaluate the Cimarron River stage when the five trenches in Burial Area #1 were open, uncovered, during remediation.

17. Why not discuss the impact of the Plutonium Pond, Plutonium Emergercy Pond, and Uranium Emergercy Pond on the CSM?

18. Do we need a groundwater monitoring well or wells in the drainage area near seep 1206?

19. Evaluate the recharge in the gullies draining the seep 1206 area and Burial Area #1.

20. What is the groundwater transport mechanism in the Western Alluvium?

21. Should Subarea F be declared a Phase V Area?

cc:

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