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RE: Technical Memorandum: Evaluation of Recharge at the Tronox Trenches, Henderson, Nevada

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INTRODUCTION

Northgate Environmental Management, Inc. (Northgate) presents this memorandum on behalf of Tronox LLC (Tronox) as a preliminary analysis to evaluate whether the groundwater recharge trenches that were partially removed from the Tronox Henderson site (Site) during remediation operations in Remediation Zone (RZ) D should be restored to resume recharging Lake Mead water to the alluvial aquifer. This recharge system consisted of two parallel trenches, each 600-feet long, 3-feet wide, and 5-feet deep, constructed 50-feet apart, approximately 150 feet downgradient of the Interceptor Well Field (IWF). During remediation in mid-September 2010 nearly all portions of the trenches were removed or damaged.

When originally constructed in 1987, the purpose of the recharge trenches was to re-inject treated groundwater from the on-Site IWF. The IWF extraction wells are part of the groundwater mitigation program for chromium (Kerr-McGee, 1985), as specified in the 1986 Consent Order (NDEP, 1986). The recharge trenches have been renovated twice since their installation because of clogging: once in 1994 and again in 2008. After perchlorate was discovered in the Las Vegas Wash in 1997, Tronox constructed pond GW-11 to receive the treated groundwater and stopped injecting treated groundwater into the recharge trenches. At that time, Tronox switched to injecting Lake Mead water (which contains less than 0.005 mg/L of perchlorate) and continued to do so until the recent soil remediation operations. Based on Northgate's review of the 1986 Consent Order and the 2001 and 2005 Administrative Orders of Consent between Kerr-McGee and NDEP, there do not appear to be any regulatory requirements for continuing this recharge.

The estimated cost for replacing the damaged trenches is approximately $150,000. In addition to these initial replacement costs, the recharge operations contribute to ongoing operation and

maintenance (O&M) costs associated with supplying the Lake Mead water and maintaining the trenches. As discussed below, the original purposes for the recharge trenches are no longer applicable to Site conditions, and recharge through these trenches does not appear to provide any other benefits. Therefore, given the costs to reconstruct the trenches and that recharge in other areas of the site as part of the flushing program (Northgate, 2010a) may be more beneficial, we recommend not reconstructing the trenches at this time.

EVALUATION OF RECHARGE TRENCHES

The original purpose of the recharge trenches was for the disposal of treated groundwater. Although this practice ceased in 1997, restoring the trenches for potential future groundwater disposal could provide the benefit of allowing more groundwater to be extracted and still be within the capacity of the groundwater extraction and treatment system (GWETS). However, recharging treated groundwater in areas other than the trenches may provide the added benefit of flushing leachable chemicals from the vadose zone.

Another reason historically provided for recharging Lake Mead water is that it "maintained a hydraulic barrier" to the Tronox source area perchlorate plume (NDEP Fact Sheet, 2008) and improved capture at areas upgradient to the IWF. However, in October 2001, Tronox installed a bentonite-slurry barrier wall upgradient of the trenches and immediately downgradient of the extraction wells to enhance capture of groundwater in the IWF (ENSR, 2005). This barrier wall has eliminated the need for an additional hydraulic barrier in this area.

Differences in groundwater flow with and without recharge were evaluated using the Tronox three-dimensional flow model (Northgate, 2010b). Based on this evaluation, the differences in groundwater flow are relatively minor, and these differences should not significantly affect cleanup. The results indicate there is not a significant difference in modeled "particle" flow paths and travel times in the Quaternary alluvium (Qal) between the trenches and the Athens Road Well Field (AWF) when comparing the scenarios with and without recharge to the trench. The modeling also indicates only minor differences in particle transport upward from the Upper Muddy Creek formation (UMCf) into the Qal with and without recharge.

The groundwater mound that is present around the trenches with recharge is absent without recharge, and its absence eliminates a small area of very slow groundwater flow (dead zone) with relatively high perchlorate concentrations that is located between the barrier wall and trenches. The elimination of this dead zone may allow for more effective groundwater flow, and hence perchlorate transport, out of this area. On the other hand, perchlorate concentrations in the vicinity of the trenches may increase without recharge due to the absence of dilution water. Neither of these potential effects appears to have a significant impact on overall perchlorate transport to the AWF.

CONCLUSIONS AND RECOMMENDATIONS

Based on this analysis, recharge into the trenches does not appear to provide any significant benefit and has significant associated costs. Northgate proposes to defer reinjection while continuing to evaluate water level and chemical concentration data related to recharge cessation. Steady-state water level measurements in the vicinity of the trench under "no-recharge" conditions can be used to validate the modeled flow results. Both Tronox well data and data for wells on the neighboring POSSM and TIMET sites in the vicinity of the trenches can be monitored to assess concentration changes without recharge.

In addition to this further data evaluation, Northgate strongly recommends development of a Site-wide approach to remediating vadose zone soils and optimizing groundwater cleanup prior to making a decision regarding reinstallation of the trenches.

REFERENCES

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