

NDEP Comment	Trust's Response:
<p><i>1. <u>Treatability Study Work Plan Soil Flushing Pilot Test Revision 3 states that the report will include the following:</u></i></p> <p><i>a. Evaluation of the effectiveness of soil flushing for reducing perchlorate mass in the vadose zone, including a comparison of the results from the high flow, reduced flow, substrate-amended and unamended test plots.</i></p> <p><i>b. Assessment of perchlorate mobilization into groundwater during system operations.</i></p> <p><i>c. Evaluation of the effects of the substrate-amended water in inducing biodegradation in the vadose zone and groundwater.</i></p> <p><i>d. A preliminary cost-benefit analysis to determine the technology's feasibility and cost effectiveness for full-scale application.</i></p> <p><i>There is no any discussion about the preliminary cost-benefit analysis (#4 above) to determine the technology's feasibility and cost effectiveness for full-scale application in this report. NDEP required that all reporting items stated in the work plan are reported in this treatability result report.</i></p>	<p>Further discussion of the treatability study results, including an evaluation of the feasibility and cost considerations of the technology, has been included in the revised report. This discussion is presented in Section 7.0.</p> <p>With respect to the preliminary cost estimates provided in the revised document, it is important to note that reliable remediation cost estimates cannot be prepared at this time since the Remedial Investigation is still underway and the detailed engineering evaluations and cost analyses of the Feasibility Study have not been completed. As such, the cost estimates provided in the revised document should be considered subject to significant revision during the Feasibility Study. These preliminary cost estimates should not be considered highly accurate remediation cost estimates.</p>
<p><i>2. Executive Summary, Paragraph 3, Page 1: "The difference in mass reduction between Test Plot 2 and Test Plot 3 is likely due at least in part to in situ biodegradation occurring in Test Plot 2." There is no post-treatment field measurement on dissolved oxygen (DO), and oxidation-reduction potential (ORP) to support this conclusion. For all future field work with groundwater NDEP requests that DO and ORP measurements be obtained and presented. Section 4.3 Baseline Soil Sampling, Page 9. soil samples collected at randomly selected depth intervals were analyzed for the following:</i></p> <p><i>a. Metals, including boron, iron, manganese, and titanium (Method SW6010B); antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, selenium, silver, and zinc (Method 6020); and mercury (Method SW7471A);</i></p> <p><i>(continued on next page)</i></p>	<p>A brief discussion of results for other analytes has been included to support the conclusions presented in the report. Specifically, discussion of results can be found in the report as follows:</p> <ul style="list-style-type: none"> <li>• Hexavalent Chromium – Sections 6.2.3, 6.6.3, and 6.7.3, for soil, pore water, and groundwater, respectively;</li> <li>• Other Metals – Sections 6.2.4 and 6.7.4;</li> <li>• Leachable Cations and Anions – Section 6.2.5;</li> <li>• Dissolved Oxygen and Oxidation Reduction Potential – Sections 6.6.4 and 6.7.5 for pore water and groundwater, respectively; and</li> <li>• Other Analytes (including cations, anions, and total organic carbon) – Sections 6.6.5 and 6.7.6 for pore water and groundwater, respectively.</li> </ul>

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<p><i>b. Hexavalent chromium (Method SW7199);                      c. Total organic carbon (Method SW9060);                      d. Soil pH (Method SW9045); and                      e. Soluble cations and anions (analysis of leachate), including calcium, magnesium, potassium, and sodium (Method SW61010B); chloride, sulfate, and nitrate (Method E300.0); chlorate (USEPA Method E300.1); and carbonate alkalinity (Method SM2320B).</i></p> <p><i>But there is no discussion about these analytic data. NDEP requires that all laboratory analytic results are discussed in the result report. In this case, arsenic, chromium, hexavalent chromium, chlorate, nitrate, sulfate and total organic carbon require at least a brief discussion of their mobilization and biodegradation.</i></p>	
<p><i>3. <u>Section 4.5.4 Microcosm Test Conclusions, Page 12 and Section 4 Results and Discussion of Appendix F UNLV Microcosm Study Report, Page 17.</u> "The biodegradation of perchlorate over time using EOS-100 and glycerol (100 times stoichiometric ratios) as the electron donors is shown in Figure 6." The cost of electron donors is counted for most of the cost for operating GWETS, so NDEP requires that more accurate dosage of electron donors is first obtained from the microcosm study in future treatability study. The field dosage of electron donors should be adjusted based on the laboratory dosage of electron donors, groundwater velocity, duration of treatability study, and number of the injections times. Please make sure that these comments are considered in the future study.</i></p>	<p>Comment noted, and will be considered in future studies.</p>

NDEP Comment	Trust's Response:
<p>4. <i>Section 4.5.3 Results, page 12. The Deliverable states that "The microcosm test results show a clear increase of hardness as the experiment progressed, indicating dissolution of hardness from the soils." Hardness is a property not attributable to any single constituent. Thus, hardness is typically reported in terms of an equivalent concentration of calcium carbonate. This comment applies to Appendix F, UNLV Microcosm Study Report, page 35 (page 1285 of 1306). Please consider to use the total dissolved solids (TDS) in future report.</i></p>	<p>Comment noted. Future reports will refer to individual chemical constituents or TDS rather than hardness.</p>
<p>5. <i>Section 4.6 Infiltration Tests, Page 13. "Infiltration rates ranged from 0.10 inches per hour (in/hr) in Test Plot 2 to 1.84 in/hr in Test Plot 1, and vary across the treatability study area by well over an order of magnitude." these infiltration rates don't match them in Table of Appendix G GES Double-Ring Infiltrometer Test report, Page 2. Please explain why the different infiltration rates from the field measurements were used.</i></p>	<p>The infiltration rates reported in Appendix G are the mean of all individual measurements taken during each double ring test. Review of the test data (plotted in Figure 3 of the report) shows that in all of the double ring tests, infiltration rates decreased from high early values to a relatively constant steady-state value. The infiltration rates presented in Figure 3 and used throughout the report are time-weighted means for just the steady state portion of the tests. These values are considered to be more representative of long-term infiltration rates than the mean of all of the data. The text in Section 4.6 has been updated to present this explanation of the different infiltration rates.</p>
<p>6. <i>Section 6.1 Geology and Hydrogeology. Most of critical hydrogeology information here was referred to the Ramboll's work. A total of 20 soil borings (five per test plot) were drilled and sampled during the baseline sampling event. This represents a relatively high sampling density of one boring per 180 square feet, given that each test plot is 30 by 30 feet in plan dimension. NDEP expects much more detail geology and hydrogeology information from these soil borings. For example, why are the infiltration rates of the 4 plots so much different within about 200 ft of the distance? Do the maximum infiltration rates (for Test Plot 2 and Test Plot 3) correspond to expected values based on soil types (silty sands)?</i></p>	<p>Additional discussion of the subsurface of the test area has been incorporated into the Section 6.1 text of the revised report.</p>

NDEP Comment	Trust's Response:
<p>7. <u>Section 6.2 Baseline Soil Sampling, Page 17.</u> "These data indicate that the hexavalent chromium mass in soil in the treatability study area was relatively small and not of concern with respect to impacting GWETS or retarding the rate of in-situ biodegradation." This lumped conclusion about hexavalent chromium is not consistent with one in Appendix D. NDEP suggests more detail discussion about both chromium and hexavalent chromium of soil, pore water and groundwater of the 4 plots.</p>	<p>The discussion of both chromium and hexavalent chromium results for soil, pore water, and groundwater has been expanded in the revised report in Sections 6.2.3, 6.6.3, and 6.7.3.</p>
<p>8. <u>Section 6.2 Baseline Soil Sampling, page 17 and Appendix B Field Data Sheets.</u> The Deliverable states that "In the Treatability Study Work Plan, hexavalent chromium in the vadose zone was identified as a potential concern because hexavalent chromium compounds are water soluble and could potentially be mobilized during the treatability study". Test Plots 1 and 2 had carbon substrate added to the infiltration system and Test Plots 3 and 4 received stabilized Lake Mead water. There is no discussion of the redox environment as evidenced on the Sampling Logs that recorded low ORP values of 100+/- mV and coupled with low DO values. NDEP requests consideration of potential for mobilization of other multivalent metals that occur at the BMI Industrial Complex, e.g., arsenic, manganese, and molybdenum.</p>	<p>Discussion of dissolved oxygen and oxidation reduction potential has also been added for pore water and groundwater and is presented in Section 6.6.4 and 6.7.5, respectively. Appendix B now includes a field data summary table that tabulates the dissolved oxygen and oxidation reduction potential, as well as other field parameters, for ease of review.</p> <p>Further discussion of the treatability study results, including discussion of secondary effects, has been included in the revised report. Specifically, Section 6.7.4 has been added to discuss "Other Metals" and includes a discussion on the potential for mobilization of iron, manganese, arsenic and molybdenum.</p>
<p>9. <u>Section 6.3 Water Application Rates, Page 18.</u> The infiltration rate of Plot 2 and Plot 3 from Appendix G is 0.3 inch/hr and 1.61 in/hr, respectively, instead of 0.1 in/hr and 1.2 in/hr used as comparison here. NDEP requires a clarification for using different infiltration rates from Appendix G-GES Double-Ring Infiltration Test Report.</p>	<p>Please see response to Comment 5 above. Text has been revised in Section 4.6 to clarify selection of the infiltration rates.</p>

NDEP Comment	Trust's Response:
<p>10. <u>Section 6.5 Pore Water Sampling</u>. Provide calculations to support the statement that application of 5 to 10 pore volumes may be enough to achieve up to 98% mass reduction. NDEP would like to see the mass reductions in terms of dimensional time (e.g., days, weeks, months) as well as dimensionless time (i.e., pore values).</p>	<p>Additional discussion of the treatability study results, including an evaluation of mass reduction as a function of the number of pore volumes and time, is presented in the revised report as Section 7.1. Table 7 summarizes the time and pore volumes required to achieve 90% reduction in perchlorate concentration.</p>
<p>11. <u>Table 3 Water Application Data</u>. The pore volume calculation assumes 30% porosity. The infiltration rates from the field double-ring infiltration test confirm big difference among 4 plots, this assumption is invalid. As a result, the number of pore volume in this table is not correct, too. NDEP requires re-calculating the number of pore volume using the plot specific data.</p>	<p>Collecting plot-specific porosity data was not included in the NDEP-approved Work Plan and was not performed as part of this study. However, the assumed porosity value of 0.30 used in the draft version of the text has been updated to 0.35 based on review of the limited site-specific porosity data available for the alluvium, which ranges from 0.319 to 0.404 with a mean of 0.358.</p>
<p>12. <u>The time duration of Figure 7 (Flushing Volume vs. Time Photos) and Figure 9 (Pore Water Perchlorate vs. Time Plots) is different</u>. NDEP suggests that Figures 7, 8, and 9 plots use the same duration.</p>	<p>The time scales in Figure 7 have been changed to match the other time-series plots.</p>
<p>13. <u>Table 3 (Water Application Data) shows that the total water volume used for flushing Plot 3 is 2,357,148 gallons but Figure 3 shows that the perchlorate concentration of Plot 3 reached less than 10 microgram/l in 50 days and close to zero in about 75 days. Figure 7 shows that Plot 3 was flushed about 150 days, which means that about half water applied to Plot 3 is unnecessary. There was less water used for flushing Plot 2 and the electron donor was added 2.5 weeks before terminating flushing. There was almost no change of the perchlorate concentration of Plot 2 pore water during last 2.5 weeks in Table 5 (Summary of Analytical Results: Pore Water Samples), which means</u>  (continued on next page)</p>	<p>Further discussion of the treatability study results has been added to the report throughout Section 6, including the addition of Section 6.5 – Tracer Study and generation of a new Section 7.0 that further analyzes pore volumes and mass removal. The Trust notes that several of the items noted in this comment (for example, total porosity, effective porosity, grain size) were not included in the NDEP-approved work plan.</p>

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<p><i>that most mass change from Plot 2 was caused by the flushing. If that is the case, the conclusion of "The difference in mass reduction between Test Plot 2 and Test Plot 3 is likely due at least in part to in situ biodegradation occurring in Test Plot 2" made in the Executive Summary may not be correct. NDEP requires more detail analysis of all data including soil physical property, particle size, dye movement and more accurate number of total porosity, effective porosity, perchlorate baseline mass and pore volume water that is needed to flush 90% of the flushable perchlorate mass change in the vadose zone caused by the soil flushing and the biodegradation.</i></p>	
<p><i>14. <u>Figure 10</u>. The figure is Pore Water TDS vs. Time Plots; however, two of the plots are labeled Perchlorate. Please correct the labels.</i></p>	<p>The axis labels in Figure 10 have been revised to read "TDS."</p>
<p><i>15. <u>Appendix A Boring Logs</u>. There is no discussion in the text with regards to the PID readings and potential for impact, if any. Please add some discussion on the PID readings.</i></p>	<p>VOC analysis was not included in the NDEP-approved Work Plan. PID readings were only collected during drilling operations for health and safety reasons. As such, it is not possible to provide any meaningful discussion or conclusion regarding these field observations.</p>
<p><i>16. <u>Appendix B Field Data Sheets</u>. Field data sheet for Well TT-TP4-M3 indicates pump depth as "27?" and noted that the pump is dedicated. Review of MW construction diagrams do not indicate status of dedicated pumps. Additionally, the report tables do not present construction well detail summary. Where is the information for the depth of the dedicated pumps? It should be noted that subsequent field data sheets indicate pump is set at 30. Please clarify in the reversion.</i></p>	<p>A well construction summary table indicating depth of pump intake has been added to Appendix A.</p>
<p><i>17. <u>Appendix F UNLV Microcosm Study Report, Section 5.0 Conclusions and Recommendations</u>. This section provides conclusions but makes no specific recommendations. Please clarify in reversion.</i></p>	<p>The title of the Section 5.0 of the UNLV report has been revised to read "Conclusions."</p>

NDEP Comment	Trust's Response:
<p>18. <u>Appendix F UNLV Microcosm Study Report</u>. <i>It appears that the field duplicate samples for hexavalent chromium (Test America) and the soil samples associated with UNLV's microcosm study were reported on a dry weight basis. Were pre- and post-flushing perchlorate concentrations in soil reported by Test America on a dry or wet weight basis? Please clarify in the reversion.</i></p>	<p>The Test America soil results are reported on a dry weight basis and text in Section 4.3 has been updated to include this information.</p>
Minor Corrections/Editorial:	Trust's Response:
<p>19. <u>Editorial Corrections</u>. <i>Section 3.3 Pore Water Sampling, first paragraph, last sentence the sentence states, "...and stored in an ice chest cooled with water ice pending shipment to the...". Should the statement read "ice water"?</i> <i>Section 4.7.3 Reduced-Flow Test Plots, third sentence: There is an apparent typographic error in the statement "...spaced 18-inches apart were attached to either side of the manifold."</i></p>	<p>Section 3.3: The word "water" has been deleted.                      Section 4.7.3: The phrase "either side of" has been deleted.</p>