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RESPONSES TO CTDEP's MAY 14, 1996 LETTER OF COMMENTS ON DRAFT GROUNDWATER/LEACHATE MODELING STUDY REPORT AREA A LANDFILL REMEDIAL DESIGN NAVAL SUBMARINE BASE NEW LONDON GROTON, CONNECTICUT

June 5, 1996

The first five comments of CTDEP's May 14, 1996 letter (pages 1 through 4), including the general comment (Comment No. 1) and the first four specific comments (Comments No. 2 through 5) will be addressed during a meeting to be held with CTDEP on June 11, 1996. Responses to the remaining six specific comments (Comments No. 6 through 12) are as follows:

6. Page 4-13, Section 4.5.5, Hydraulic Conductivity Along the Southern Hillside:

   Comment: The test states that the hydraulic conductivity value of 4 ft/day was selected for the model in this area based on a slug test conducted in well 4MW4S. The report implies that this value is representative of the shallow bedrock. However, this well was screened across both alluvium and bedrock. For this reason, the hydraulic conductivity specified cannot be regarded as representative of either the bedrock or alluvium and is not appropriate as an input to the model.

   Response: The bottom of the top model layer along the southern hillside was set at 10 feet below the ground surface. Due to the thin top soil and alluvium layers, both alluvium and bedrock are actually included in the top model layer along the hillside. Therefore, a bulk hydraulic conductivity value obtained from a well which is screened across alluvium and bedrock (such as 4MW4S) is required in this region. It is evident from the results of model calibration and sensitivity analysis that the hydraulic conductivity used in the model is appropriate for the portion of model along the southern hillside.

7. Page 4-13, Section 4.6, Model Applications:

   Comment: This section represents the results of the calibrated model for several diff rent scenarios, including the uncapped landfill, the capped landfill, the capped landfill under flooded conditions, etc. Each scenario is accompanied by a figure depicting the modeled groundwater elevation in each cell and a separate figure depicting the incremental difference in groundwater elevation between the modeled scenario and the previous scenario. However, not all of the scenarios are compared to the uncapped landfill, or to the capped landfill without upgradient trenching or a downgradient toe drain. For this reason, the reader is unable to determine the overall effect of any given scenario upon the groundwater flow. Such information would be useful in evaluating the overall effect of each of the different scenarios.

   In addition, a water contour map (Figure 4-34) is provided for the capped condition. This map is useful in visualizing the water table. Similar maps should be provided for each of the other simulated conditions.

Response: The purpose of the Groundwater/Leachate Modeling Study is not to investigate the performance of various landfill capping scenarios but rather to verify the performance of a previously submitted design and the impact that the potential addition of a toe drain would have on that performance. Therefore, a comparison between the current conditions and the conditions after construction of the proposed design was the focus of this report. Specific changes to the original design were also simulated to provide information for a cost-benefit analysis using the original design as the baseline. Therefore, modeling results for all the modifications were compared to the original design but not the current conditions. This approach can facilitate a more efficient cost-benefit analysis for the various design modifications which were evaluated.

8. Page 4-14, Section 4.6.1, Capped Condition:

Comment: The model simulates the effects of an upgradient interception trench which runs along a short portion of the landfill where the calibrated groundwater elevation is above the bottom of the trench. The bottom elevation of the trench is not specified. To investigate the effect of changing the bottom elevation of the trench, the model was then run with the trench elevation lowered by two feet. The bottom elevation of the trench was also unspecified in this scenario. Since this trench does not extend along the entire upgradient boundary of the landfill, it is not surprising that its ability to divert groundwater and surface water from the landfill is limited.

The model does not evaluate the presumably more realistic scenario of a trench which runs along the entire upgradient length of the landfill. This scenario should be simulated using a trench which is sufficiently deep so that the calibrated groundwater elevation is above the bottom of the trench along its entire length. Since a significant upward gradient exists between the bedrock and the overlying alluvium, consideration should be given to keying the trench into bedrock in order to intercept bedrock groundwater flow. The depth of the bottom and top of the trench should also be specified for each cell.

Response: As mentioned in the response to Comment No. 7, the main purpose of the Groundwater/Leachate Modeling Study is to evaluate and verify the performance of a previously submitted landfill cap design. The purpose and design criteria of the upgradient trench, including bottom elevations, were specified in the May 1995 100% Design Document. It is not within the scope of this modeling effort to redesign the upgradient trench.

9. Page 4-16, Section 4.6.3, Capped Condition and Toe Drain System:

Comment: The fourth paragraph states that the depth of the toe drain system is limited by the depth of the dredge spoil. Since the landfill material is present below the depth of the dredge spoil, the report concludes that it would be impossible for the toe drain to entirely dewater the landfill material. This statement appears to be predicated on the stated assumption that the dredge spoil are an impermeable boundary through which no flow is occurring. It is unlikely that this assumption is actually true. The efficacy of a toe drain which extends to greater depths, including the bedrock surface, should be evaluated.

Response: The assumption that the dredge spoil constitute an impermeable boundary is a valid one and is supported by the permeability data measured as part of the Modeling Field Investigation described in Section 2.0 of the report. As shown on Table 2-8 and in Appendix E.1, the hydraulic conductivity of six dredge spoil samples (2LMW28DS, 2LMW31DS, 2LMW32F, 2LMW32DS, 2LMW33DS, and 2LMW34DS) was measured and found to range from 1.1 10^{-7} cm/sec to 8.3 10^{-7} cm/sec.

Even if the dredge spoil is not completely impermeable, the hydraulic gradient and groundwater flow within that layer is dominantly vertical, with or without a toe drain. Therefore, a toe drain extending below the top of the dredge spoil would still not dewater the landfill material any lower

than that elevation at the edge of the landfill cap. A toe drain extending to the bedrock surface, as suggested by CTDEP, would also penetrate the dredge spoil and intercept the significant and relatively uncontaminated groundwater flow in the underlying alluvium layer. This is unnecessary and might also create a pathway for contaminated groundwater migration into the lower aquifer.

10. Page 4-23,Table 4-4, Loading From Landfilled Mass:

Comment: This table states that the mass flux of iron from the uncapped landfill material to the wetland is 330 grams per year. This does not appear to be a reasonable estimate of the amount of iron entering the wetland from the approximately 12 acres landfill. One would expect a considerably greater amount of iron to be flowing from the landfill to the wetland each year. Mass flux estimates for other contaminants are of similar magnitude and would appear to be unreasonably low. This suggests that the model is not useful for estimating contaminant concentrations or mass flux. For this reason, the model should not be relied upon to predict specific leachate groundwater concentrations generated under various scenarios.

The report also states that if the leachate were collected in a toe drain system, the collected leachate would meet drinking water standards an would require no treatment. It should be noted that drinking water standards are not relevant in determining whether treatment would be required prior to discharging the collected leachate. Requirements for treatment are determined on a case-by-case basis using the Federal and State Water Quality Criteria. In many cases, effluent limitations are considerably more strict than drinking water standards. Since the landfill is discharging directly to the wetland, the aquatic toxicity criteria would be applied with no dilution or attenuation.

Response: Table 4-4 only accounts for vertical infiltration through the unsaturated landfill material. The total contaminant mass loadings through groundwater discharge into the wetland are listed in Tables 4-3 and 4-5. Table 4-5 combines select information previously listed in Tables 4-3 and 4-4.

In this study the MODFLOW groundwater modeling results were only used to calculate the groundwater flow rate from the landfill into the wetland. Simple and conservative mass loading calculations were then performed using the equations described in Section 4.7 to determine the worst case mass loading rates. No contaminant fate and transport modeling was conducted to predict leachate concentrations as implied by the comment. Therefore, it is very easy to verify all the calculations which lead to the mass loading results which are summarized in Tables 4-3 through 4-5.

Using iron as an example, a groundwater concentration of 32 mg/L and a K_d value of 402 L/kg throughout the entire landfill area were used in the calculation. Both the groundwater concentration and the K_d value used in the calculation are representative of the iron conditions and are supported by site-specific measurements (see Appendix D.5). The calculated iron mass loading rate into the landfill under existing conditions is about 597 grams per year (see Tables 4-3 and 4-5).

The Groundwater/Leachate Modeling Study Report is not intended to be a risk assessment report. Therefore, no evaluation was conducted to determine probable wetland water quality criteria or potential toe drain leachate discharge standards. Furthermore, even if a toe drain is required, the discharge location of the collected leachate has not yet been selected and would probably be outside of the wetland. The well-established drinking water standards were simply used for comparison with the conservatively estimated leachate concentrations to provide preliminary quantitative information for the cost-benefit analysis of the need for a toe drain and associated treatment system.

11. Page 4-26, Section 4.8, Summary of Modeling Results:

Comment: The report states that adding a toe drain will increase the hydraulic gradient and flow velocity from the landfill to the wetland. This would cause the discharge from the landfill to the wetland to increase from 3,080 ft^3/day to 10,700 ft^3/day. A toe drain would be expected to depress the water table and thus increase the hydraulic gradient. However, a finite amount of water would be expected to enter the landfill via infiltration from the surface or groundwater inflow from upgradient. This amount of water represents all the water that is available to flow between the landfill and the wetland. Since adding a toe drain would not be expected to add to the available supply of water in the landfill, it does not appear reasonable to conclude that adding a toe drain would increase the total flow between the landfill and the wetland.

Response: Although the annual precipitation is relatively constant, a toe drain would depress the groundwater table along the hillside which would increase the capacity of the upgradient soil to retain precipitation. ~~will increase~~ Therefore, the upgradient surface infiltration and groundwater recharge may increase with a toe drain in place. It is difficult to accurately estimate the actual amount of the increase. However, it is expected that, if a landfill cap featuring a toe drain was installed, the groundwater flow to the wetland would first increase to the estimated maximum of 10,700 ft^3/day range (based on the constant-head boundary assumption) immediately after construction and then eventually decrease to a lower long-term equilibrium flow rate between 3,080 and 10,700 ft^3/day. The text of Section 4.8 will be expanded to include this discussion.

12. Page 6-1, Section 6.1, Conceptual Design of the Toe Drain:

Comment: The text here describe a treatment system which would consist of a bag filtration system for removing suspended solids, followed by a liquid-phase granular activated carbon system for removal of organics. The report does not discuss metal removal. In the experience of the Department, metals pretreatment is generally required in most groundwater extraction and treatment systems to prevent fouling. Metals pretreatment may also be required to comply with effluent limitations.

Response: The Navy agrees that many groundwater treatment systems require removal of metals and suspended solids either to prevent fouling of downstream unit processes (typically air stripping and/or granular activated carbon adsorption) or to meet discharge limitations. However, for the Area A landfill the expected metal concentrations in the groundwater which would be collected by a toe drain system, as reported on Table 4-5 (page 4-24) are sufficiently low that no such pretreatment step is required and that a bag filter system is expected to be adequate for the removal of suspended solids ahead of the liquid-phase granular activated carbon (GAC) adsorption system.

Operating experience with many groundwater and wastewater treatment system has also shown that liquid-phase GAC systems featuring backwash capability can provide significant removal of suspended solids through filtration and of low concentrations of dissolved metals through adsorption without negative impact on their ability to remove dissolved organic contaminants.