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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
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BOSTON, MASSACHUSETTS 02114-2023

March 28, 2001

Mark Evans, Remedial Project Manager
U.S. Department of the Navy
Naval Facilities Engineering Command
Northern Division
10 Industrial Highway
Code 1823, Mail Stop 82
Lester, PA 19113-2090

Re: General comments on the memorandum regarding methodology used for deriving human health risk-based preliminary remediation goals (PRGs) and cleanup goals for soil and groundwater at New London Lower Subase (February 23, 2001), the letter regarding technical rationale for calculation of alternative surface water protection criteria for New London Lower Subase (February 23, 2001), and the letter regarding technical rationale for calculation of alternative pollutant mobility criteria for New London Lower Subase (February 23, 2001)

Dear Mr. Evans:

EPA reviewed the aforementioned memorandum regarding the Navy's planned approach to determine appropriate cleanup values for soil and groundwater for the draft Feasibility Study (FS) to be reissued. I understand that the *Methodology Used for Deriving Human Health Risk-Based Preliminary Remediation Goals and Cleanup Goals for Soil and Groundwater at Lower Subase* was intended to summarize the Navy's approach for establishing Preliminary Remediation Goals (PRGs) for the Lower Subase soil and ground water and their use of these values to determine appropriate cleanup levels. The document also focused on the development of direct contact risk-based PRGs and the comparison of these values to the CT direct contact criteria for soil.

The *Technical Rationale for Calculation of Alternative Pollutant Mobility Criteria* focused on the Navy's evaluation of soil cleanup requirements from the perspective of soil to ground water transport. The Navy calculated site-specific dilution factors for contaminant migration from soil to ground water. These factors were then applied to Connecticut's Pollutant Mobility Criteria (PMC). The dilution adjusted PMCs were compared to site soils' data to determine Constituents of Concern (COCs). The dilution adjusted PMCs were also used as PRGs.

The *Technical Rationale for Calculation of Alternative Surface Water Protection Criteria* detailed the Navy's method for evaluating the need to remediate ground water based on its impacts to surface water. The Navy calculated site-specific dilution factors for use in calculating Alternative Surface Water Protection Criteria (ASWPC). The ASWPC were compared to site

groundwater data to determine COCs. The ASWPC were also developed for use as PRGs although, since no COCs were identified on this basis, there was no need to use them as such.

Overall, I am concerned that the PRG development procedures are not consistent with EPA regulations and guidance and provides incorrect information. The PRGs should be clearly derived based on the equations in RAGS Part B and sample calculations - in addition to the results tables - should be clearly presented. Additionally, it is important to select the more conservative PRG between the cancer and non-cancer PRGs to ensure overall protectiveness.

Review of the general approach to PRG development is hindered by the lack of integration among the three documents. The documents must be improved in order to clarify the final selection of clean up goals. In addition, expanding or providing explanatory or justification materials would increase the clarity and transparency of these documents in many cases. "Methodology Used for Deriving Human Health Risk-Based Preliminary Remediation Goals and Cleanup Goals for Soil and Groundwater at Lower Subase," should clearly summarize the approach used for COC selection and PRG development. It also does not clarify how different PRGs will be combined to establish cleanup levels for a contaminant. For example, lead and TPH, were identified as COCs from a Pollutant Mobility Criteria standpoint in the "Technical Rationale for Calculation of Alternative Pollutant Mobility Criteria" but the "Methodology Used for Deriving Human Health Risk-Based Preliminary Remediation Goals and Cleanup Goals for Soil and Groundwater at Lower Subase" does not summarize these findings or attempt to integrate them with the risk-based and CT Direct Exposure based PRGs.

EPA recommends combining the summary memorandum and the supporting letters into a single, well organized document. This document should clearly indicate the COC selection process (*e.g.,* use of the baseline HHRA results, comparison to PMCs and Direct Exposure Criteria (DEC) and ecological considerations. It should also concisely summarize the methods used to develop PRGs and discuss how these values will be combined to generate soil and ground water cleanup levels. This summary would be enhanced by a figure illustrating the decision process (*e.g.* a logic tree).

Memorandum to Mr. Mark Lewis (CTDEP) and Ms. Kymberlee Keckler (USEPA) Dated February 23, 2001 Regarding: "Human Health Risk-Based Preliminary Remediation Goals and Cleanup Goals for Soil and Groundwater"

The general approach taken in the development of the Preliminary Remedial Goals (PRGs) presented in this document may be acceptable. However, the text of this memorandum requires revisions to improve clarity and accuracy. Organizational issues and apparent typos made it difficult to evaluate many technical aspects of the PRG development. Comments on these issues are included below.

Overall, it appears that the intent was to provide this memorandum as the "master document" describing the development of soil and ground water cleanup values for the Lower Subase, with

the two letters on "Alternative Pollutant Mobility Criteria" and "Alternative Surface Water Protection Criteria" provided as supporting documentation. However, the integration of these three documents is not sufficient. A single document would be more appropriate. This document should provide the following:

- A clear concise summary describing how COCs will be selected (*i.e.,* review of the baseline HHRA, consideration of ecological risks, comparison to ARARs *etc.*);
- The different sources of PRGs (*i.e.,* risk-based, ecological, ARAR based *etc.*);
- A summary table of PRGs from all sources presenting the selection of the final clean up value. The text should describe the selection process for final cleanup levels (*i.e.,* how will the receptor specific risk-based PRGs be combined with ARAR-based PRGs and ecological risk-based PRGs to select a final clean-up value that is protective of both human health and the environment).

This document does not clearly define the procedures used for developing the list of COCs. Currently, Section 2 states that the COCs have been developed based on the results from the Lower Subase RI. However, in the letter to Mark Lewis about Alternative Pollutant Mobility Criteria, COCs were identified based on exceedance of the CT Pollutant Mobility Criteria. Finally, in the letter to Mark Lewis about Alternative Surface Water Protection Criteria, COCs were identified based on comparisons of groundwater concentrations to alternative surface water protection criteria. At no point were COCs identified based on comparisons to the CT Direct Exposure Criteria (CTDEC) as was done in the current version of the FS or based on any ecological risk results; yet no explanation of why these values were not used to identify COCs was included in this document. A summary of all procedures used to select COCs in all three documents should be included in this memo. Finally, justification for not selecting COCs based on comparisons to CTDEC values or ecological risk results should be added to this document.

This document does not clearly summarize the procedures used for developing the PRGs or provide a rationale for the final selection of a clean-up value. If the memo is intended to summarize the PRG development process then a summary of all procedures used to select PRGs in all three documents should be included. The development of PRGs requires site-specific data on media of potential concern, chemicals of potential concern and probable future land use. Risk-based PRGs and chemical-specific ARARs (*e.g.*, Connecticut Direct Exposure Criteria and Pollutant Mobility Criteria) are also evaluated as PRGs because they are often readily available and specify the goals that a remedial action must attain. All potential ARARs should be included in a tabular summary (RAGS Part B). The Navy should clearly identify and explain the methodology that will be used to determine which of the PRGs will be used as the final cleanup level for each media.

The use of the term PRG should be clarified and applied appropriately. At times the text seems to indicate that the CTDEC and PMC are not PRGs. For example, the third sentence in Section 3.2 reads: "The cleanup value will be the lesser value of the PRG or CTDEC." This text should

be revised to state: "The cleanup value will be the lesser value of the risk-based PRG or the CTDEC."

Text in Section 2 (*see* page 2, ¶1) and Footnote 'a' in Tables 2 through 8 indicate that the "greater of the Preliminary Remediation Goals" will be selected as the cleanup level. This text is misleading because the Navy's proposed procedure for determining cleanup levels is to select the lesser of the risk-based PRGs and then the greater of the selected risk-based PRG as compared to the CTDEC-based PRG. The use of inconsistent terminology confuses this issue. Terminology regarding PRG development should be clarified in these tables and throughout the text.

Section 2. Soil: EPA regulations at 40 C.F.R. §300.430(e)(2)(i)(A)(2) require use of 10^{-6} as the point of departure for establishing individual PRGs. In other words, a risk level of 10^{-6} is used as the starting point or initial "protectiveness" goal for determining an appropriate risk level that remedies should to attain. Although adjustments may be necessary in determining the actual remediation goal for the site, it is important to have an initial value to which adjustments can be made, particularly since the risk range covers two orders of magnitude. The point of departure represents a level from which analysis should begin, regardless of the circumstances.

Risk Assessment Guidance for Superfund (RAGS) Part B (1991) states that the targeted total risk for carcinogenic effects should be set at 10^{-6} to solve for the risk-based PRG. The Connecticut Department of Environmental Protection Remediation Standard Regulations are derived based on the target cancer risk level of 10^{-6} for the residential and industrial/commercial risk-based direct exposure concentrations (*i.e.*, PRGs). The numbers derived and presented in Tables 2 through 8 (for Zones 1 through 7) are the risk-based PRGs based upon a point of departure of 10^{-5}, not the cleanup goals. Please recalculate the PRGs based on target cancer risk of 10^{-6}, using the same parameters that were used in the risk assessment calculations of the Remedial Investigation (RI) (Appendix I, 1998). Cleanup values can subsequently be determined based on these PRGs and site-specific factors.

If both cancer and non-cancer PRGs are computed for a contaminant, the lower PRG (*i.e.*, more conservative) of the two must be used. The last paragraph erroneously states that the cleanup value for site soil will be the *greater* of the PRG or CTDEC. Please reissue to ensure consistency with EPA guidance and regulations.

Please explain the basis for the statement that "...although CTDEC can be waived when risk-based PRGs are less than CTDEC, a value less than the CTDEC cannot be imposed as a cleanup value on a property owner..." EPA can choose to set cleanup level that are less than the CTDEC values, if appropriate to ensure the protectiveness of the remedy. Cleanup levels will be determined during risk management.

Section 3. Selection of Constituents of Concern: The first line of the second paragraph states that the IEUBK Model was used in Appendix I of the RI to evaluate lead. The Adult Model should be used for both commercial and industrial scenarios and also for adolescent trespassers.

The receptor for this model is the fetus of a woman exposed to lead in a non-residential scenario. The fetus is believed to be more sensitive than an adult to adverse effects of lead. If PRGs derived based on this model is protective of a fetus, it would also be protective of adults. To run both IEUBK and Adult Lead Models for both current and future exposure scenarios, an *arithmetic mean* concentration must be used as the exposure point concentration in the equations. Like the IEUBK, EPA recommends that 95% or more of the developing fetuses born to women exposed to lead should have blood lead levels below 10 ug/dL. Please use the Adult Lead Model to generate a site-specific lead PRG and describe what was done in the text (*see* USEPA, 1996 & 1999).

Section 3.1. Derivation of Risk-Based Preliminary Remediation Goals: The risk calculations from the RI for construction workers, full-time workers and residents were based on exposure to incidental ingestion of soil and direct dermal contact with soil at the site. Using the equation presented in this section and the calculated risk values in the RI to derive the PRGs would therefore account for ingestion and dermal contact with soil. This is the simplest method to calculate the PRGs. Although the equation is not incorrect, the equations in RAGS Part B are more appropriate to derive the PRGs because they consider the risk from ingestion of soil, inhalation of volatiles from soil, and inhalation of particulates from soil. Therefore, the PRGs should be calculated using the equations from RAGS Part B with all of the same exposure parameters as in the risk calculations of the RI. The PRGs should not be corrected by dividing by ten to consider target cancer risk level of 10^{-6} instead of 10^{-5}.

Please use the equations in RAGS Part B for the industrial scenario. Replace the equations used in the PRG memorandum with the following equations from RAGS Part B.

Commercial/industrial soil: Carcinogenic effects from soil ingestion:

$$C = \frac{TR \times BW \times AT \times 365\ \text{days/year}}{EF \times ED \times \{[SF_o \times CF \times IR_{soil}] + [SF_i \times IR_{air} \times (1/VF + 1/PEF)]\}}$$

where:

C = chemical concentration in soil (or calculated risk-based PRG) (mg/kg)
TR = target excess individual lifetime cancer risk (unitless) (default of 10^{-6})
BW = adult body weight (kg) (default of 70 kg)
AT = averaging time (year) (default of 70 years)
EF = exposure frequency (days/year) (default of 250 days/year)
ED = exposure duration (year) (default of 25 years)
SF_o = oral cancer slope factor $(\text{mg/kg-day})^{-1}$) (chemical-specific)
CF = conversion factor (kg/mg) (default of 10^{-6} kg/mg)
IR_{soil} = soil ingestion rate (mg/day) (default of 50 mg/day)
SF_i = inhalation cancer slope factor $(\text{mg/kg-day})^{-1}$) (chemical-specific)
IR_{air} = workday inhalation rate (m^3/day) (default of 20 m^3/day)
VF = soil-to-air volatilization factor (m^3/kg) (chemical-specific)
PEF = particulate emission factor (m^3/kg) (default of 4.63×10^9 m^3/kg)

Commercial/industrial soil: non-carcinogenic effects from soil ingestion:

$$C = \frac{THI \times BW \times AT \times 365\ days/year}{EF \times ED \times \{[1/RfD_o \times CF \times IR_{soil}] + [1/RfD_i \times IR_{air} \times (1/VF + 1/PEF)]\}}$$

where: THI = target hazard index (unitless) (default of 1)
RfD_o = oral chronic reference dose (mg/kg-day) (chemical-specific)
RfD_i = inhalation chronic reference dose (mg/kg-day) (chemical-specific)

Letter to Mr. Mark Lewis (CTDEP) Dated February 23, 2001 regarding: "Alternative Pollutant Mobility Criteria"

To justify applying the site-specific dilution factors to the pollution mobility criteria, several factors relating to the provisions of the Connecticut Remediation Standards (Section 22a-133k-2(c)(2)(E)(i)) must be addressed but have not been discussed in this letter. Specifically, the Navy must address the stipulations regarding non-aqueous phase liquids, position of the water table with respect to bedrock and the relationship between the groundwater's vertical flow velocity and horizontal flow velocity. If these stipulations cannot be met then it is not appropriate under the Connecticut regulations to derive site-specific dilution factors.

The letter does not discuss the depth of soil is being considered for remediation - soil above the seasonally low water table or soil above the seasonally high water table. The Navy should also specify the location of the soil data that was used to determine PMC-derived COCs with respect to the seasonal water tables.

The PMC modified by the dilution factors are presented in Table 5. The chemicals per zone that exceed these modified PMC are shown in Table 6. However, an actual comparison table that demonstrates these results has not been provided. A table showing the results of the comparison between the data from each zone and the PMCs modified by the zone-specific dilution factor is needed. This table should also summarize the frequency of detection, the frequency of exceedance, and present the value used for comparison.

The Navy should explicitly identify all substances detected in soil for which the State of Connecticut has not issued PMCs. The Navy should propose how these substances will be evaluated from a mobility standpoint.

The use of the term "Alternative Pollutant Mobility Criteria" does not seem to be appropriate. The phrase, as used by the State of Connecticut in the Remediation Standards, does not seem to apply to the calculation of site-specific dilution factors and the application of these dilution factors to the Pollutant Mobility Criteria. Please verify the usage of this phrase.

I note that the Contaminants of Concern in soil identified in Table 1 is dominated by constituents that typically sorb strongly onto soil particles (*i.e.,* SVOCs and metals). For this reason, an

important pathway from soil to the estuarine environment for these contaminants may be erosion, particle transport, and deposition as sediment. While the discussion of PRGs for groundwater and for soil based on mobility of COCs to groundwater is to the point, the program should take steps to ensure that the particle-transport pathway is also weighed appropriately in establishing PRGs for soils.

I look forward to working with you and the Connecticut Department of Environmental Protection toward the cleanup of the Lower Submarine Base. Please contact me at (617) 918-1385 to arrange a meeting to discuss proper PRG development for the Lower Submarine Base.

Sincerely,

Kymberlee Keckler, Remedial Project Manager
Federal Facilities Superfund Section

Attachment

cc: Mark Lewis, CTDEP, Hartford, CT
Dick Conant, NSBNL, Groton, CT
Chau Vu, USEPA, Boston, MA
Jennifer Stump, Gannett Fleming, Harrisburg, PA
Chip McLeod, EA, Newburgh, NY

ATTACHMENT A

Page	Comment

Memorandum to Mr. Mark Lewis (CTDEP) and Ms. Kymberlee Keckler (USEPA) Dated February 23, 2001 Regarding: "Human Health Risk-Based Preliminary Remediation Goals and Cleanup Goals for Soil and Groundwater"

p. 1, §1.0	The second sentence of the first paragraph states: "...This memorandum discusses the methodology that will be used to derive risk-based cleanup values for soil Preliminary Remediation Goal (PRGs) as well as the approach that will be used to determine appropriate soil cleanup values for soil, considering both risk-based PRGs and Connecticut Direct-Exposure Criteria (CTDEC)...." Clearer wording would be: "This memorandum discusses the methodology that will be used to derive risk-based Preliminary Remediation Goals (PRGs) for soil as well as the approach that will be used to determine appropriate soil cleanup values, considering both risk-based PRGs and Connecticut Direct-Exposure Criteria (CTDEC)." Please also discuss on the Connecticut PMC based PRGs and the ecological risk-based PRGs.
p. 2, §2.0	The second paragraph indicates that the clean-up levels for soil will be based on a comparison of risk-based PRGs and CTDEC for each of the COCs. Please discuss how soil to groundwater PMC will be used to determine clean-up levels.
p. 2, § 2.0	The sentence immediately preceding Section 2.1 indicates that the CTDEC can be used as default cleanup values, and although CTDEC can be waived when risk-based PRGs have a greater value than CTDEC, a value less than the CTDEC cannot be imposed as a cleanup value on a property owner. Please cite the State and Federal regulations that are the basis for this statement.
p. 3, §3.2	The fifth sentence in this paragraph should be revised to read: "The risk-based PRGs for two polycyclic aromatic hydrocarbons (benzo[a]pyrene and dibenz[a,h]anthracene) and arsenic **are lower values than** the CTDEC-**based PRGs** for residential receptors (Residential Direct Exposure Criteria)."
p. 3, §4.0	The final sentence on this page should be modified to read: "The Pollutant Mobility Criteria, as adjusted by the site-specific dilution factors, will be used in conjunction with the HHRA results, and the ecological risk considerations, to identify COCs for soil remediation in the Final Feasibility Study Report for the Lower Subase."
Tables 2-8	Table 2 through Table 8 list Direct Exposure Criteria (DEC) for substances that are not listed in Connecticut's Remediation Standards [*e.g.*, dibenz(a,h)anthracene

and indeno(1,2,3-cd)pyrene]. Please provide justification for the RDEC and IDEC values provided.

Footnote (a) in Table 2 through Table 8 indicates that the "greater of the Preliminary Remediation Goals is bolded." Even though none of the COCs listed have both carcinogenic and non-carcinogenic risk-based PRGs, this text is misleading because the Navy's proposed procedure for determining cleanup levels is to select the lesser of the risk-based PRGs and then the greater of the selected risk-based PRG and the CTDEC-based PRG. The lesser value should be selected in both cases.

Table 5 — The number 1.00E-04 is listed under the heading "Non-Carcinogen." This appears to be an error. Please clarify the source or meaning of this number.

Letter to Mr. Mark Lewis (CTDEP) dated February 23, 2001 regarding: "Alternative Pollutant Mobility Criteria"

p. 2 — The formula for the dilution factor (DF) incorrectly has the variable L (release length) in the numerator of the second term. This variable should be in the denominator.

p. 2 — The second paragraph on page 2 indicates that the hydraulic conductivity for Zone 3 was determined to be 1.7 ft/day (presumably during the Phase II RI). The text states that the value is unrealistically low and consequently, the next lowest infiltration dilution factor (Zone 2) will be used instead. Please provide a clear statement to the effect that a higher volume flux is used in order to be conservative.

p. 2 — Site-Specific Dilution Factors: The memo cites the Connecticut regulations that stipulate an approach to calculation of the background adjustment in the absence of background data. The method uses half the "minimum detection limit" instead of background concentrations for inorganics. This deserves some elaboration, both on the rationale behind the guidance and on the Navy's interpretation in the present context. In particular, please specify what is meant by "minimum detection limit." Is this the minimum actually achieved by the laboratories used in site investigations to date? Or, is this a hypothetical minimum that might be achieved under ideal circumstances? This issue is particularly germane to the inorganics issues at the site because detection limits achieved in practice for arsenic (to choose the most significant example, as arsenic was identified as a COC for every Lower Subase zone) are strongly dependent upon the laboratory chosen and the diligence with which they work to achieve target detection levels.

p. 2 In the discussion regarding background values in the third paragraph on page 2, The Navy states that site-specific data for background inorganic constituents are not available at Lower Subase, then proposes using a value of one-half the minimum detection limit for the subject substance for the background concentration. This is not a conservative assumption and for some constituents, for example for arsenic, which has been identified as a COC in all zones and is typically found in groundwater in this region, this assumption may result in rejecting a PRG that should be retained. The intent of the background adjustment term in the site-specific dilution factor equation is to account for concentrations already in the groundwater before the impacts from the source in question. If the groundwater upgradient from the source already contains concentrations of the constituent in question then this would impact the results such that the calculated dilution factors would be lower and the zone-specific PMC would be lower. Therefore, it is important to use site-specific upgradient (*i.e.,* background) values in the calculation of the dilution factors and in the determination of the zone-specific PMCs. The Navy should address this data gap using site-specific data.

Secondly, the ratio of one-half the minimum detection limit to the ground-water protection criterion would not be used to represent "background" but instead it would be used to represent the fraction the groundwater protection criteria are reduced because of background. This text should be clarified.

p. 2 In the discussion regarding background values in the third paragraph on page 2, the Navy states: "...For volatile and semivolatile organic substances, pesticides, and polychorinated biphenyls which do not occur naturally, background was assumed to be zero...." The intent of the background adjustment term in the site-specific dilution factor equation is to account for concentrations already in the groundwater before the impacts from the source in question. If the groundwater upgradient from the source already contains concentrations of the chemicals of concern then this would impact the results such that the calculated dilution factors would be lower and the zone-specific PMC would be lower. Therefore, it is important to use site-specific upgradient (*i.e.,* background) values in the calculation of the dilution factors and in the determination of the zone-specific PMCs. The Navy should address this data gap using site-specific data.

Table 1 The variable "L" has been assigned a value of 175 feet for each of the seven zones of the lower subase. The Navy states in the notes to Table 1 that this corresponds to roughly half the width of the Lower Subase perpendicular to the Thames River. However, no justification is provided for the use of this value. Another logical value would be 350 feet or the width of the Lower Subase perpendicular to the Thames River. Is this adjustment intended to correct for cover by buildings and pavement that reduce infiltration? Please justify use of the selected value.

Table 1 The formula given in the notes for the unadjusted dilution rate is erroneously listed as:

Unadjusted dilution factor = 1 + (KiD/IL) x (background adjustment)

The editorial correction of this formula should be as follows:

Unadjusted dilution factor = 1 + (KiD/IL)

Table 2 The heading for the third column in this table is not correct. It should be "½ Detection Limit (μg/L)." Note also that the units in this table are incorrectly listed as g/L whereas they should be μg/L.

Table 2 The notes for Table 2 erroneously list the formula for the background adjustment used by the Navy as:

Background adjustment = 1 – ([detection limit]/Ground-Water Protection Criteria)

The formula used by the Navy for background adjustment should be as follows:

Background adjustment = 1 – ([½ Detection Limit]/[Ground-Water Protection Criterion])

Table 2 The Ground-Water Protection Criteria listed in Table 2 is not correct for "VOC, SVOC." The Table lists a value of "1" but the Ground-Water Protection criteria depend on the specific organic under consideration.

Table 2 The table labels should be consistent with the equations listed in the text. For example, the last column in Table 2 labeled "Background Adjust" appears to correspond to the term $1\text{-}F_{adj}$. It would be helpful if a clear link between table entries and the notation in the text were made.

Table 3 Table 3 is supposed to list the zone-specific and chemical-specific dilution factors. The table represents a matrix whose elements should be the product of the zone-specific unadjusted dilution rates shown in Table 1 and the chemical-specific background adjustment factors shown in Table 2. All values listed in Table 3 are in error and must be corrected. This error does not appear to have affected the final results because the final results in Table 5 appear correct.

Table 5 The value for phenanthrene in Zone 1 is not correct. The PMC for phenanthrene is the same as that for pyrene (4 μg/Kg). The adjusted PMC should be the same as that for pyrene.

Table 5 Carbazole, chrysene, dibenz(a,h)anthracene and indeno(1,2,3-cd)pyrene do not have Connecticut PMC. Where did the numbers in Table 5 come from for these four parameters? Section 22a-133k-2(d) discusses how to handle substances that do not have PMC listed in the Remediation Standards. The Navy should discuss this point and justify any proposed PMC.

Letter to Mr. Mark Lewis (CTDEP) Dated February 23, 2001 regarding: "Alternative Surface Water Protection Criteria"

p. 1, §1.0 The memo states, "... with the exception of some polycyclic hydrocarbons, all ground-water concentrations were below SWPC." Please discuss whether the dilution factors that are discussed subsequently were applied.

p. 2, §1.0 The first sentence on this page states: "...Guidance provided by CTDEP refers to standard estuarine Waste Load Allocation guidance (U.S. EPA, 1990)...." Please clarify the reference for the State guidance that refers to the EPA document.

p. 6, §2.0 The text under the heading "Ground-Water Waste Loadings" indicates that the Navy is using Section 22a-133k-2(c)(2)(E)(ii) of the Connecticut Remediation Standards to calculate the daily average discharge from the ground-water plume to the Thames River. Please clarify what relevance this Section has to the calculation. Please clarify this point and discuss exactly how the daily average discharges were calculated.

p. 6, §2.0 The estimation of contaminant fluxes to the estuary is very much dependent upon sound estimates of the volume flux of groundwater that discharges to the Thames River system. This, in turn, is based upon estimates of the hydraulic gradient across each zone and the hydraulic conductivity appropriate to each zone. While the horizontal gradients can be estimated with some confidence, based on water levels in monitoring wells scattered across the Lower Subase, the appropriate conductivities are difficult to estimate. Aquifer materials are usually highly heterogeneous, so that a limited number of slug tests and/or grain-size analyses may not be a statistically valid sample of the distribution. Furthermore, even if the distribution of conductivities were known quite well, it is not obvious how to choose the appropriate "representative" value for a particular zone (*i.e.*, what "apparent" conductivity captures the overall flow of groundwater at the scale of a zone?). Steps should be taken to ensure that the estimates of the volume flux of groundwater discharging to the estuary from site are well constrained, or at least "conservative" (*i.e.*, likely to be an overestimate). When the approach is documented in detail, the description should include a table showing the sources of data used (*e.g.*, slug tests, grain-size analyses, pumping tests, laboratory measurements on core samples, *etc.*), the number of conductivity analyses available, the minimum and maximum values for each zone, and the average

value (the averaging *method* adopted should also be explicitly described). Such a table will provide important perspective on the credibility of the conductivities invoked for the flux calculations. Given the difficulty of estimating the appropriate hydraulic conductivity to use in these calculations, it would be prudent to perform some independent checks on the plausibility of the estimated fluxes. One approach that should be considered is to look at the water balance for the groundwater basin as a whole. In particular, since the base occupies a fairly well defined drainage (*e.g.*, bounded by topographic divides on the north and east), the total groundwater discharge to the estuary from the basin can be estimated easily from the surface area, average annual precipitation, and reasonable estimates of surface runoff and evapotranspiration (based on estimates of vegetation types, building and pavement cover, *etc.*). While it would still be difficult to apportion the overall water flux to the various zones of the Lower Subase, this approach should yield an independent check on the estimated volume flux of groundwater to the estuary. The gross water balance might be accurate to within a factor of two or so, while the hydraulic conductivity estimates necessary for the approach outlined may be valid only within an order of magnitude, if that.

§2.1 In the second equation on page 7, it appears as if the multiplication sign should be a division sign, such that the dilution factor is defined as the total flow divided by the sum of the plume discharges. Please check and revise as necessary.

§3 In the first equation, the parameter DF is defined as a "zone-specific dilution factor;" however, this appears to be a dilution factor used for the entire base. Please delete the term "zone-specific."

Table 2 Table 2 footnotes define ASWPC as "Ambient Surface Water Protection Criteria." This footnote should read "Alternative Surface Water Protection Criteria."

Table 2 Table 2 lists two different sets of contaminant concentrations that differ by more than two orders of magnitude. The first are the average groundwater concentrations (C_{plume}) and the second are the expected concentrations after dilution in the Thames(C). Evaluating whether the loading impacts of site groundwater on surface water exceed the levels allowed by the Connecticut Remediation Standards requires comparison between the C_{plume} and the ASWPC. These columns are not adjacent to each other in the table. In fact, the numbers adjacent to the ASWPC in the table are the expected concentrations after dilution in the Thames (C). These numbers are not at all comparable and their proximity in the table is misleading. A few of the groundwater concentrations (C_{plume}) are less than a factor of two lower than the ASWPC. As such, the nature of the models used and the assumptions inherent in them require careful scrutiny.

REFERENCES

USEPA, 1996. Recommendations of the Technical Review Workgroup (TRW) for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. December 1996.

USEPA, 1999. Frequently Asked Questions (FAQs) on the Adult Lead Model. Guidance Document. April 1999.