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UNITED STATES ENVIRONMENTAL PROTECTION
REGION IV
345 COURTLAND STREET. N.E.
ATLANTA, GEORGIA 30365

AUG 2 6 1993

4WD-FFB

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commanding Officer
Attn: Ms. Linda Martin - Code 1851
SOUTHNAVFACENGCOM
P.O. Box 1910010
North Charleston, South Carolina 29419-9010

Re: Review of Draft Remedial Investigation Report for Operable Unit 10; NAS Pensacola, Florida
EPA Site ID No.: FL 9170024567

Dear Ms. Martin:

The Environmental Protection Agency (EPA) has completed its review of the Draft Remedial Investigation (RI) Report for Operable Unit (OU) 10, which was received in this office on June 8, 1993. Our comments addressing the serious deficiencies in the Draft RI Report are enclosed. The Draft RI Report is incomplete in several major respects. This fact is acknowledged by the Navy in the Forward statement of the document. For this reason, as noted in General Comment #1, EPA must consider the next revision and resubmittal of this RI Report as a draft for purposes of review pursuant to the Federal Facilities Agreement. Accordingly, the Navy has failed to fulfill its obligations, under Sections VIII.G.l. (Consultationwith U.S. EPA and the State) and IX.B (Scope of Agreement) of the FFA, to submit a complete RI Report in accordance with the enforceable schedule contained in the approved FY93 Site Management Plan. A complete Draft RI Report for OU 10 must be submitted no later than 60 days from your receipt of this letter.

In the event that the Navy expects any future Primary Documents to be late or incomplete, pursuant to Section XXIV (Extensions) of the FFA, the Navy must request in writing an extension for the time needed to submit such documents to EPA, including justification for the extension. If future Primary Document8 are late or obviously incomplete and no written extensions of time have been requested by the Navy, EPA may invoke Dispute Resolution, Section XXVI of the FFA, and stipulated penalties may begin to accrue.

For a comprehensive list of the deficiencies in the Draft RI Report, see the enclosed comments. In order for the Draft RI Report to be deemed acceptable by EPA, all of the issues raised

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in the enclosed comments as well as the following highlighted deficiencies must be addressed by the Navy. The following is a summary of the most significant deficiencies noted in the document:

1. Numerous data gaps remain, particularly with regards to the nature and extent of soil contamination associated with Site 35 and, to a lesser degree, Sites 32 and 33. Without this data, it is not possible to review the RI Report, and particularly the Baseline Risk Assessment, for adequacy and completeness.

2. The analytical results for ground water and some surface water samples are suspect because of the apparent use of questionable sampling techniques and possible problems with the laboratory. The quality of the hydrogeologic information collected also is questionable because of the use of inadequate hydrogeologic testing methods.

3. The ecological risk assessment is incomplete and must be significantly revised and expanded. EPA recommends that the Navy submit an outline of this portion of the RI Report for review prior to resubmitting the full RI Report.

Please contact me at (404) 347-3016 if you have any questions regarding the above issues or any of our enclosed comments.

Sincerely Yqurs,

Allison W. Drew
Remedial Project Manager
Department of Defense Remedial Section
Federal Facilities Branch

Enclosure

cc: Ron Joyner, NAS, Pensacola
Eric Nuzie, FDEP
Paul Stoddard, Ensafe/Allen & Hoshall

TECHNICAL REVIEW AND COMMENTS
DRAFT REMEDIAL INVESTIGATION REPORT FOR OPERABLE UNIT 10
NAVAL AIR STATION (NAS) PENSACOLA
PENSACOLA, FLORIDA

GENERAL COMMENTS

1. The main objective of the remedial investigation, to characterize the nature and extent of contamination at Operable Unit (OU) 10, has not been met. Specifically, the following data gape were identified during review of the Draft RI Report:

Site 32 (Industrial Sludge Drying Beds (ISDBs)):
- Northern extent of soil contamination in the swale area
- Extent of the black, oily soil horizon encountered in boring 33S24
- Northern and westward extent of soil contamination into the wetland

Site 33 (Waste Water Treatment Ponds (WWTPs)):
- Extent of soil contamination around the former surge pond
- Presence/absence of soil contamination adjacent to the stabilization and polishing ponds

Site 35 (Miscellaneous SWMUs/sites):
- Clear identification of all miscellaneous sites (i.e. appurtenances to OU 10) and determination of presence/absence of contamination at these sites
- Presence/absence of soil contamination at the domestic sludge drying beds (east of the ISDBs), which potentially received industrial wastes
- Presence/absence of soil Contamination at the dump area east of the domestic sludge drying beds
- Presence/absence of soil contamination at the abandoned waste water treatment plant (north of the ISDBs), which potentially received industrial wastes
- Extent of soil contamination associated with the historic waste line breach
- Extent of soil contamination associated with the present surge tank
- Extent of soil contamination associated with the chlorine contact chamber area.
- Presence/absence of soil contamination at the former leaking underground waste oil storage tank
- Characterization of sediments in the North-South drainage ditch which drains the IWTP yard
- Extent of contamination from the 2,000-gallon sulfuric acid spill in 1983
- Extent of groundwater contamination in the vicinity of the old wastewater treatment plant
- Extent of contamination in the vicinity of the bilge water plant (additional soil and groundwater samples, including those which Groundwater Technology collected, are needed to fully characterize the nature and extent of contamination in this area)

Site 13 (Magazine Point Rubble Disposal)
- Characterization of actual waste materiale

The Navy has acknowledged most of the above data gaps in the Draft RI Report. The report also mentions that many of these data gaps will be addressed in the next revision of this report, once the results of a second round of sampling which was conducted during this same field event are evaluated. However, in the absence of this information, the current RI Report is incomplete and, as such, cannot be reviewed for adequacy in meeting the requirements of an RI Report. Due to the incomplete nature of the present Draft, EPA will regard the next revision of the RI Report as "Draft" rather than "Draft Final" for purposes of review and

resubmittal. Information and data which adequately addresses all of the above data gaps must be presented in the next revision of the RI Report.

2. The data necessary to address the data gaps acknowledged by the Navy was presumably collected during the second round of sampling associated with this field event. However, the following information and data is needed to address the above-mentioned data gaps which were not acknowleged by the Navy:

A. Monitoring well ES-15 contained PCE (190 ppb) and TCE (5 ppb). The adjacent recovery well screened in this same interval contained dichlorobenzene as high as 90 ppb. Monitoring wells should be installed, sampled and analyzed for TCL/TAL constituents in the vicinity of, and downgradient of, the old wastewater treatment plant (towards Pensacola Bay) in order to confirm the extent of ground water contamination in this area.

B. Additional soil and groundwater samples should be collected downgradient of the bilge water plant and analyzed for full scan TCL/TAL constituents.

3. The Draft RI Report must be revised to include an adequate definition and description of Site 35 (Miscellaneous IWTP SWMUs). This information is needed to ensure that all goals of the RI/FS are adequately addressed in the completed report. In general, Site 35 has been described as consisting of any portions of, or appurtenances to, the IWTP (exclusive of the WWTPs and the ISDBs) which potentially received or released hazardous waste or constituents. The March 1990 revision of the Community Relatione Plan (pages 14-15) contains a fairly detailed description of this site. This definition should be expanded to include some of the additional potential sources which were identified in the current Draft RI Report.

All screening and RI/FS sites which occupy the geographic area known as Magazine Point Peninsula must be investigated simultaneously. All sites on the Peninsula which the Parties identify as requiring an RI/FS shall become part of OU 10 and be incorporated into the single RI/FS Report to be submitted for this OU. The WWTPs and the ISDBs are already RI/FS sites. Site 35, which encompasses all remaining sitee, is currently a screening site. As agreed to at the informal dispute resolution meeting held in February 1993 and documented in the approved FY93 Site Management Plan:

> "Each screening PSC will remain as screening PSC until such time as defensible and validated Level III or IV data becomes available. Once available, the Navy will utilize such data to either prepare individual PSC assessment reports to support a No Further Remedial Action Planned (NFRAP) determination with the USEPA/FDER concurrence or immediately reclassify the site to RI/FS status.."

All data for Site 35 must therefore be collected in a timely manner which will allow the Parties to determine the status of each portion of Site 35 (RI/FS vs. screening) without delaying finalization of the RI or Feasibility Study (FS) Reports for OU 10. Simultaneous investigation of all potential sites on the Magazine Point Peninsula should prove advantageous by expediting the RI/FS process in numerous ways. For instance:

- Reduce the time required for document preparation and review by reducing the number of site-specific documents required for this geographic area
- Minimize the potential for collection of duplicative information and facilitate data evaluation efforts by assigning one contractor to collect all necessary information within a single time frame
- Facilitate the coordination of remedial actions for this geographic area where appropriate and advantageous.

4. A specific method for calculating soil clean-up goals which are protective of ground water must be proposed. Site-specific values for parameters such as Fraction of Organic Carbon (FOC) and soil partition coefficients (Kd) must be provided in order to evaluate eoil clean-up goals for contaminants of concern. Laboratory analyses and the eources of information utilized to establish these parametere must be provided. Two of models currently used by EPA to calculate soil clean-up goals are Summers and Pestan. The Navy may propose other models. However, the model selected should be deemed appropriate for site conditions by EPA before it is utilized.

5. All available analytical data (present and historical) which will facilitate completion of the RI/FS for OU 10 must be submitted in an electronic format which is compatible with EPA's Interchange File Format (IFF). For additional information on the required format for data submittal, please refer to previous EPA correspondence on thie subject, or contact Phyllis Mann at 404/347-3406.

6. Pleaee include page numbers on all tables and figures.

SPECIFIC COMMENTS

1. Forward, Paragraph 2:
The RI/BRA for Operable Unit (OU) 10 must include a complete ecological risk assessment of all on-site impacts associated with these sites. Only the impacts to on-site wetlands, and off-site impacts to Bayou Grande, Pensacola Bay, and additional wetlands, may be deferred, since these will be addressed under OUs 15-17.

2. Page i, Paragraph 1:
All relative terms, such as "low" and "elevated", must be clearly defined prior to using these terms to describe observed levels of contamination in the text.

3. Pages 2-1 through 2-3, "OU 10 Sites" and Figures 2-1 and 2-2:
Site 35 (Miscellaneous IWTP SWMUs) must be clearly defined and located in the text and corresponding figures. Include references which identify and delineate the boundaries of this site.

4. Page 2-3, Figure 2-2:
The boundaries for OU 10 and Site 13 must be clearly marked on this figure.

5. Page 2-5, Paragraph 1:
See comment #3 above.

6. Page 2-6, Paragraph 1:
The temporary industrial sludge holding pond referred to here must be located on one of the site figures.

7. Page 2-8, Paragraph 4:
Provide a listing of the specific types of contaminants identified beneath the ISDBs.

8. Page 2-9, Paragraph 3:
Provide a listing of the specific types of contaminants identified beneath the surge pond.

9. Pages 2-15 and 2-16, Table 2-2:
The depth for wells DG-1 through DG-6 is listed as unknown. However, the approximate depth of these wells is apparently known, since they are listed in the "shallow well" portion of Table 2-2. The depths of these wells should also have been determined during the recently completed well inventory. Please provide the depth for each of these wells.

10. Page 2-19, Paragraph 3:
Given the historically fluctuating nature and extent of the ground water contamination beneath OU 10, a more thorough description of this contamination must be provided. This description must be used to evaluate: (i) the impact which the recovery well system installed in 1987 may have had on ground water contamination beneath OU 10 and (ii) any relationships (or differences) between historical and present-day groundwater contamination which may facilitate design of an appropriate and effective remediation action in the future.

11. Page 2-22, Paragraph 2:
Provide the well number, sample collection date and contaminant level/ concentration for each observed occurrence of each contaminant listed here.

12. Page 2-25, Figure 2-4:
Include a symbol explaining the hatched area (i.e., does it represent the spill area?).

13. Pages 2-28 through 2-29, Section 2.3.2 and Table 2-7:

For comparative purposes, please provide the Florida Primary Drinking Water Standards (FPDWS) and the EPA Maximum Contaminant Levels (MCLs) in thio and all other text tables which present groundwater data.

14. Page 3-6, Paragraph 2:
The text here states that the depth to groundwater ranges from 0 to 4 feet, while paragraph 2 on page 3-3 states that the depth to groundwater ranges from 0 to 20 feet. Clarify this discrepancy.

15. Pages 3-11 through 3-12, Section 3.3.2:
The following comments are provided regarding this section:

A. This section is titled "Site-Specific Setting", but it actually pertains to the NAS Pensacola facility as a whole. Change the title to reflect this, and mention that a site-specific description of OU 10 is given in Section 4.4 (page 4-19).

B. In line 7 of this section, "sports" ehould be "supports".

16. Page 4-12, Figure 4-3:
Proofread the legend and correct as needed.

17. Page 4-22, Figure 4-5:
In addition to the wetlands present at OU 10, the locations of the other vegetative habitats present (pages 4-19 to 4-24), including Godfrey's Golden Aster (page 4-25), must also be shown on this or some figure.

18. Page 4-25, Section 4.4.4:
Indicate whether any other endangered, threatened, or sensitive epecies inhabit or use this site.

19. Page 4-37, Paragraph 5:
The text refers to a surface drainage swale. For clarification, please show this drainage swale on all site maps.

20. Page 5-4, Section 5.0:
When using contract laboratories, it is good practice to designate QA/QC information for duplicate samples, etc. These type samples ehould be eubmitted "blind".

21. Page 5-11, Paragraph 2:
Provide the approximate depth of the intermediate and deep borings referred to in the text, as was done for the shallow borings.

22. Page 5-14, Figure 5-5:
Provide the location of deep borehole 33S31 from which two Shelby tube eamples were collected.

23. Page 5-20, Paragraph 1:
Surface water samples for VOC analysis were not collected in accordance with the approved SAP, and the method of sample collection described is not acceptable. Surface water samples for VOC analyses must be collected ae grab samples, and should not be poured from an intermediate container. The probable impact upon the data is that VOC concentrations were lowered or possibly rendered non-detect. These surface water samples must be recollected and reanalyzed.

24. Page 5-23, Table 5-4:
Provide the installation date for the "newly installed" monitoring wells.

25. Page 5-29, Section 5.4.3:
The "PVC hand pump with a one-direction check valve" was not mentioned in the SAP. Inertial pumps are unacceptable for purging monitoring wells. Operation

of this type pump severely agitates the water column, and may have two adverse effects upon the sample. First, it may mobilize the eediment material causing it to be entrained in the sample, with the effect of raising the apparent concentrations of metals. Second, the agitation may facilitate the movement of volatile organics from the groundwater to atmosphere, with the effect of lowering the apparent concentration of volatiles, possibly below detection limits. Improper use of a bailer can also have these same effects.

26. Page 5-33, Table 5-6:
It appears that the water samples analyzed for radiological parameters were not properly preserved with HNO_3 to pH <2. Please clarify.

27. Page 5-39, Paragraph 4:
In calculating the transmissivity of the surficial zone, "The aquifer thicknesses used for shallow and intermediate depth wells were calculated by subtracting the elevation of the bottom of the well from static water level elevation". This procedure is not acceptable. The surficial zone of the Sand and Gravel aquifer is composed fine grained sand. Clay beds within the zone were not reported, indicating that the sandy zone is continuous to a depth of about 40 feet. Differences in hydraulic conductivities within the aquifer exhibit the heterogeneity of the aquifer. These differences should not be interpreted to mean that the surficial zone is composed of two separate hydraulic zones. This assumption is implied if the aquifer is split for hydraulic property calculations. Ground water flow within the unconfined eurficial zone communicates freely from the upper to the basal portions of the surficial aquifer, as stated in conclusion #4 on page 6-34. A saturated aquifer thickness of approximately 35-40 feet should be assumed when calculating tranemissivity and storage values for the surficial zone.

28. Page 5-40:
The specific capacity tests results cannot be considered accurate because they were conducted while the well was being developed. As the well is developed the specific capacity will increase. Actual specific capacity will be higher once the well is developed and fine sediments are removed from around the well bore.

29. Pages 5-42 through 5-43, Paragraph 3 through end of section:
As stated in the text, the five 6-hour aquifer teste conducted at OU 10 "[did] not significantly stress [the aquifer] at discharge rates that would approach those necessary to employ an effective remedial recovery system". Inappropriate analytical methods were also used to evaluate the aquifer test data. Therefore, representative data which defines the hydraulic properties of the surficial zone have not been obtained by the specific capacity tests, the slug tests, or the short term aquifer tests. As part of the ground water remediation activities at OU 10, a pump and treat system will likely be installed. It is therefore critical that a constant rate aquifer test be conducted for a minimum of 72 hours (48 hours drawdown, 24 hours recovery) in order to obtain data which can serve as baseline data for designing the extraction system.

Before the constant rate aquifer test is conducted a step drawdown teat should be conducted to determine optimum pumping rates. At least 5 steps or pumping rates should be used to design the constant rate test.

As mentioned above, the unconfined aquifer should be continuously pumped for at least 48 hours during the pumping test. This length of time will ensure that the data collected reflects: (i) instantaneous releaee from storage in the aquifer, (ii) the secondary recharge effects in the aquifer due to gravity drainage, and (iii) the late data which represents essentially horizontal flow in the aquifer.

Several type curves have been developed for the analysis of unconfined aquifer test data. These include Boulton (1954), Neuman (1972), and Streltsova (1972). It is difficult to obtain a true match with a type curve if sufficient data has not been collected. For instance, the drawdown which was observed in observation

wells during the 6-hour pumping tests conducted ranged from 0.04 to 0.15 feet. This amount of drawdown in the observation wells is insufficient to accurately evaluate the hydraulic properties of the surficial zone, such as hydraulic conductivity and storage values.

30. Page 6-3, Paragraph 3:
The north-south drainage ditch referred to here must be clearly located on at least one, and preferably all, figures.

31. Page 6-17, Figure 6-10:
Figure 6-10 is incomplete due to the lack of groundwater contours. The text on page 6-18 states that the contours were not added "because of the small number of data points (5) and the ambiguity of the data." However, the data are not ambiguous. The only legitimate method of contouring clearly shows a potentiometric high at well GM-63 with radial flow outward toward the northwest, north and northeast.

32. Page 6-19, Paragraph 2:
The text states that the groundwater below the clay confining unit flows in an east-northeast direction. Evaluation of the groundwater elevation data indicates that the groundwater also flows in a north and northwest direction. Please make the necessary corrections.

33. Page 6-19, Paragraph 3:
Present the methodology for defining vertical hydraulic gradient calculations (i.e., vertical depth within the screened interval) for the assigned potentiometric heads.

34. Page 6-20, Table 6-2:
Insert another header above well pair GM-64/GM-63 that indicates measured water level differences between intermediate/deep wells.

35. Pages 6-29 through 6-31, "Aquifer Pumping/Recovery Tests":
When evaluating aquifer test data for the surficial zone, the analytical method must assume that the aquifer is unconfined. Why was the pumping test data for the surficial zone evaluated using analytical techniques which assume a confined aquifer, when slug test and specific capacity test data were evaluated using analytical techniques which assume an unconfined aquifer (pages 6-24 through 6-25)? It is often difficult to match the aquifer parameters precisely to the assumptions of the analyticalmethods. However, the above parameter is critical for evaluating the data accurately.

36. Page 6-35:
Slug test data alone cannot be used to design an efficient extraction system because only the aquifer medium near the well bore is stressed during the test. The hydraulic properties calculated from such data are representative of only a discrete interval in the aquifer. EPA agrees with conclusion #10, which states that aquifer test results are more reliable and representative of aquifer properties than specific capacity and slug tests. Please refer to comment #28.

37. Pages 7-6 through 7-7, Paragraph 3 and Figure 7-2:
The first sentence of this paragraph states that phenols were detected in four borings. The third sentence states that phenols were detected in 5 borings. According to Figure 7-2, phenols were detected in *six* brings. Please correct these discrepancies.

38. Page 7-12, Paragraph 3:
The text refers to "elevated" concentrations of various compound groups. It is not clear what constitutes an "elevated" concentration. Please define this term as per specific comment #2.

39. Pages 7-15 and 7-20, Tables 7-3 and 7-4:

The most recent analytical results for samples collected near the bilge water treatment plant are not consistent with either previous analytical results, or the physical description of the sample. Soil sample 33616 was analyzed for full scan TCL/TAL constituents, none of which were detected. A soil sample collected by Groundwater Technology near the same location revealed the presence of ethylbenzene, xylenes and Total Recoverable Petroleum Hydrocarbons (TRPHs). During recent field work, the area immediately north and west of the bilge water plant appeared to be the most heavily affected by the 3,000-gallon waste oil spill: "soil was highly stained, wetland surface waters were oil-laden, and a permeating odor of heavy petroleum persisted". The description of sample 33S16 also states that this location "yielded oil saturated soil below approximately 1 foot in depth." Based on this description, it would seem nearly impossible for every analytical result to be "Not Detected," particularly the analysis for PAHs and metals. Additional sampling is therefore needed in the vicinity of the bilge water plant to determine the nature and extent of the contamination from the waste oil spill. The results of all previous investigations pertaining to the Bilgewater waste oil spill area should also be presented.

40. Page 7-25, Paragraph 1:
The association of PCB's with the road must be pursued. It is very possible that this dirt road (and perhaps others at this NAS) were oiled with waste transformer oil for duet control.

41. Pages 7-48, 7-56, 7-59, 7-65, 7-71, and 7-76; Tables 7-9, 7-11, 7-12, 7-14, 7-15 and 7-16:
See comment 13.

42. Page 7-51, Paragraph 2:
The turbidity in the samples is most likely due to poor purging/sampling techniques. Each of these wells must be properly resampled, and the sample analyzed for the TCL/TAL, in order to determine the true concentration of metals in the groundwater at OU 10.

43. Page 7-62, Section 7.4.1:
1,1-dichloroethene and petroleum VOC's were detected in soil gas and temporary well samples collected from around the former ISDBs, but not in samples collected from the permanent monitoring wells installed in this area. This may be the result of poor sampling techniques (see comments 40 & 41), poor analytical work, or both. These data discrepancies must be resolved through proper resampling and analysis of the subject wells.

44. Page 7-62, Section 7.4.2:
As with the shallow groundwater samples, the turbidity in the samples is most likely due to poor purging/sampling techniques. Each of these wells must be properly resampled, and the sample analyzed for the TCL/TAL, in order to determine the true concentration of metals in the groundwater at OU 10.

45. Page 8-1, Section 8.0:
The Statement of Work for organic analyses is OLM01.1-8, 10/92. The Statement of Work for inorganic analyses is ILM03.0.

46. Page 8-6, Section 8.3:
See comment 145 above.

47. Page 9-5, Section 9.3:
For risk assessment purposes, the term "receptors" refers to humans, animals, or plante, not environmental media. Replace "Receptors" with a more appropriate term (e.g. "Media" or "Impacted Media").

(Reviewers Note: Given the incompleteness of the Draft RI Report, only a limited risk review was conducted. Section 10 was reviewed for procedural issues only; no verification of data presented or risk results was performed.)

48, Page 10-1, Paragraph 2:
The Party responsible for conducting all RI/FS activities is the Navy, not the Navy's contractor. Please make the necessary correctione here and throughout the text.

49. Page 10-2, Paragraph 1:
Provide and describe the equation used to calculate 95 percent Upper Confidence Limit (UCL) mean concentrations.

50. Page 10-2, "Guidance Documents":
Please add the following risk assessment guidance documents to this list:

> Supplemental Region IV Risk Assessment Guidance (March 26, 1991).
>
> Risk Assessment Guidance for Superfund, Volume II - Environmental Evaluation Manual, Interim Final, USEPA/OERR, EPA/540/1-89/001, March 1989.
>
> Framework for Ecolosical Risk Assessment, USEPA/Risk Assessment Forum, EPA/630/R-92/001, February 1992.

Copies of theee documents can be provided upon request.

51. Pages 10-3 through 10-9, Tables 10-1 through 10-4:
The following comments are provided regarding these tables:

A. Include the frequency of detection, range of detects, average concentration and background concentration in these initial tables summarizing the potential site contaminants of concern.

B. Non-detects must not be incorporated into the average concentrations.

C. Move the 95%UCL values to the exposure assessment section. (Note: half the detection limit should be used for non-detects in the 95%UCL calculation, but not in the initial table of site contamination),

D. Many of the values presented in these tables appear to contain more significant figures than the data would indicate is appropriate. Revise as needed.

E. Provide units for the organic data presented in Tables 10-1 and 10-2. For consistency, present the inorganic units on Table 10-4 as mg/kg rather than ppm.

F. Use the same format for both pages of Table 10-4, and for all of the tables.

52. Page 10-10, Paragraph 1:
Mention that the ecological risk assessment basically follows the same eteps as those for the human health risk assessment, but that ecological risk will be addressed in a separate section.

53. Page 10-10, "Contaminant Identification":
Please retitle thie eubeection as "Chemicals of Potential Concern." 'Chemicals of Concern" are those which contribute to a pathway that exceeds a 1E-4 risk or has an HI $\geq$1. "Chemicals of Potential Concern" are those which are carried through the risk assessment process.

54. Page 10-10, "Toxicity Assessment":
Evaluation of the predicted exposure levels relative to internal dose and toxicological responses is conducted in the "risk characterization" process. Also, the toxicity assessment does not determine acceptable levels. Delete the reference to "potency factors" or "(q_1*s)" and replace it with "cancer slope factor."

55. Page 10-11, Paragraph 3:
"Due to the highly disturbed nature of site soils, it was not possible to establish a viable site-specific background location for comparison with inorganics data." A site-specific background location does not have to be onsite (i.e., inside the site boundary). A sample collected from an undisturbed location in the vicinity of the site can still be used to establish site-specific natural background levels for inorganic constituents. Such a sample must be collected if at all possible.

56. Page 10-12, Table 10-5:
The following comments are provided regarding this table:

A. Revise this table to follow the format of Exhibit 5-7 in "Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A)."

B. The "notes" which this table indicates will be provided for lead have not been included. Please correct as needed.

57. Pages 10-14 through 10-17, Section 10.3:
The following comments are provided regarding this section:

A. The Exposure Assessment must evaluate both current and potential future exposure scenarios. Specifically, a future residential scenario must be included in this document.

B. Please divide this section into three subsections: Characterization of Exposure Setting, Identification of Exposure Pathways, and Quantification of Exposure.

C. The quantification of exposure should include exposure estimates which are expressed in terms of the mass of substance in contact with the body per unit body weight per unit time (e.g., mg chemical per kg body weight per day, mg/kg-day).

D. The 95% UCL or the maximum concentration (whichever is smaller) must be used as the exposure point concentration; it is not appropriate to use average or mean concentrations as the exposure point concentration. Also, provide the equation used for obtaining the 95% UCL.

E. EPA Region IV considers the top one foot as surface soil available for direct contact.

58. Page 10-17, Table 10-6:
The following comments are provided regarding this table:

A. Potential of exposure via fugitive dust inhalation must be considered under a typical industrial scenario.

B. Typographical error: the second bullet contains two "(" and only one ")".

59. Page 10-18, Table 10-7:
The following comments are provided regarding this table:

A. The table contents must be verified against the most recent toxicity information available. A spot check indicates numerous errors in the toxicity information presented (many inhalation slope factors are not presented, the cancer class is missing for several chemicals with slope factors, and not all chemicals with RfDs have uncertainty factors). Some of the specific deficiencies noted include:

1. Inhalation slope factor for trichloroethene: 6E-3 $(mg/kg/day)^{-1}$.

2. Oral reference dose for trichloroethene: 6E-3 mg/kg/day.

3. Oral slope factor for arsenic: 1.75 $(mg/kg/day)^{-1}$.

4. Provide inhalation slope factors for benzo(a)pyrene, 4,4'-DDT, aldrin, dieldrin, heptachlor epoxide, alpha-BHC, beta-BHC, cadmium, and chromium.

B. Each value in this table must be referenced specifically to IRIS or HEAST since these sources have different levels of EPA verification.

C. Per the Supplemental Region IV Risk Assessment Guidance, the concentration for carcinogenic PAHs must be adjusted by the toxicity equivalency factor (TEF), not the slope factor. Also, EPA does not consider pyrene and benzo(g,h,i) perylene as carcinogenic PAHs; these should not be included in the TEF approach.

D. Many of the values presented in this table contain more significant figures than the data indicates appropriate. "0.00E+00" entries must not be included in this, or any other, table.

E. Include a cancer class for all compounds with slope factors.

F. Improve the legibility and presentation of the table. Footnotes must be numbered and specified in the table (e.g., source of individual reference dose [RfD] and slope factor [SF]). Scientific notation must be used consistently throughout the table.

60. Page 10-20, Paragraph 1:
The risk management information presented here is not appropriate and should be deleted.

61. Page 10-20, Paragraph 2:
Revise to indicate that IRIS is the primary source and HEAST is a secondary source.

62. Page 10-21, Paragraph 1:
Specify the criteria used to determine that the concentration of a contaminant is "significantly above background".

63. Pages 10-21 through 10-36, Section 10.5:
Much of the information contained in this section should be moved to Section 10.3 (Exposure Assessment). The exposure assessment section should include the estimation of chemical intakes for individual pathways. Use Exhibit 9-1 in the "Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A)" as a general outline.

64. Pages 10-21 through 10-26, Section 10.5.1:
The use of average exposure point concentrations must be eliminated from the body of the report since the NCP states that risk and remedial decisions will be based on the Reasonable Maximum Exposure (RME). A central tendency risk estimate must be provided as an appendix and discussed in the uncertainties section of the risk assessment. The 95% UCL should be used as the exposure point concentration in the central tendency risk estimate, since it is the best estimate of the mean, and the exposure frequency, duration and intakes may be adjusted to reflect central tendency values. Maximum detected concentrations should be used when the 95% UCL exceeds the maximum detected concentration (see Attachment A).

65. Pages 10-22 through 10-23, Table 10-8:
The following comment are provided regarding this table:

A. Why are no inhalation pathways considered in this table?

B. Why are risks and hazard quotients summed by chemical class?

C. "Hazard Quotient" rather than "Hazard Index" must be used in the heading for this table. Hazard quotient is the ratio of a single substance exposure level over a specified time period to a reference dose for that substance derived from a similar exposure period. A haeard index is the sum of more than one haeard quotient for multiple substances and/or multiple exposure pathways.

D. All cancer risks, hazard indices and hazard quotients must be expressed as one significant figure only. Please correct as needed, here and throughout the document.

66. Page 10-24, Paragraph 2:
The discussion of lead criteria must be revised to reflect OSWER interim guidance on lead cleanup levels. OSWER directive 19355.4-02 sets an interim soil cleanup level for total lead at 500 to 1000 ppm protective for direct contact at residential settings. Region IV considers 500 ppm as the level of concern which may be lowered to protect groundwater.

67. Pages 10-24 through 10-26, Table 10-9 and Figure 10.1:
The following comments are provided regarding the subject table and figure:

A. Move the information presented in this table and figure to the exposure assessment section of the document.

E. Provide a description of the rationale for the parameters provided in Table 10-9.

C. The oral RfDs and SFs presented in Figure 10-1 must not be applied directly to assess dermal exposure, but converted to obtain adjusted dermal toxicity values. The conversion factors adopted by EPA Region IV are 80 percent for volatile organic compounds, 50 percent for semivolatile organic compounds and 20 percent for inorganic constituents.

68. Pages 10-27 through 10-30, Section 10.5.2
Revise this section per the comments listed above for Section 10.5.1.

69. Pages 10-36 through 10-39, Section 10.6:
The following comments are provided regarding this section:

A. The ecological risk assessment requires major revision. It must include the same general components as the human health risk assessment (i.e., contaminant identification, exposureassessment, toxicity assessment, riskcharacteritation). EPA recommends that the Navy prepare an outline of the ecological risk assessment, using the guidance documents listed in Section 10.1 (particularly the Framework document), and submit this to EPA for review prior to submitting the revised Draft RI Report. This outline should be submitted early enough to allow the Navy time to incorporate any EPA comments into the revised Draft RI Report.

The Contaminants of Concern (COCs) for ecological receptors must be identified. This section can refer to the summary tables (Tables 10-I through 10-4) in the human health assessment, but ecological COCs must be chosen with respect to ecological effects (since the COCs for ecological receptors may differ from those for human receptors). Contaminants must also be addressed for each medium, particularly focusing on contaminants in different habitat areas (e.g. sediment contaminants in the drainage ditch and in the dredge spoil area),

The contaminant migration pathways and exposure pathways must be presented and discussed in relation to the habitats and potential ecological receptors present on and near OU 10 (as presented in Section 4.4, pages 4-19 to 4-27). An evaluation of the risks to both terrestrial and aquatic receptors must be included. The terrestrial evaluation may be qualitative (i.e., comparison of

surface soil concentrations to toxicity information available in the literature for terrestrial receptors) and/or quantitative (e.g., modeling of contaminant transfer along a food chain). The risk assessment must also address potential effects on any potentially affected endangered, threatened, or otherwise sensitive species.

B. For screening purposes, surface water data must be compared to the Federal Ambient Water Quality Criteria (AWQC) (used as screening values by EPA Region IV) and the Florida Surface Water Quality Standards (SWQSs). pediment data must be compared to the Effects Range–Low and Effects Range–Median sediment value6 generated by NOM (used as sediment screening values by the EPA Region IV). Sediment data can also be compared to the sediment screening values being generated by the U.S. Navy.

C. The ecological risk assessment should emphasize the fact that the potential ecological impacts of OU 10 on Pensacola Bay and Bayou Grande will be evaluated during the RI/FS for the Bay (Site 42) and Bayou (Site 40). However, a major goal of the RI/BRA for OU 10 is to ensure that the remedial action selected prevents or limits future migration of ground water contaminants into those surface water bodies at levels that might adversely impact ecological receptors. This goal must be considered in determining the need for remedial action at OU 10.

D. Move the discussion of uncertainties to Section 10.7 (Risk Uncertainty).

E. Once comments A. through D. above are addressed, the section on recommendations for additional studies must be revised, as needed.

70. Page 10-38, Table 10–14:
This table must be revised in accordance with comment 66.B. and the following comments :

A. Check the column headings. The screening numbers given in this table appear to be the Ambient Water Quality Criteria (AWQC), not the sediment screening numbers based upon the NOM sediment values.

B. The freshwater AWQC for cadmium, trivalent chromium, and lead are hardness-dependent. Therefore, include the hardness of the surface water body in a footnote (see Appendix E) and adjust the eurface water Screening values, if needed.

C. Include the screening values for both trivalent and hexavalent chromium, since total chromium was analyzed.

71. Pages 10–43 through 10–44, Section 10.8:
Surface water data must be compared to Federal AWQCs and Florida SWQSs (see comment 66.B.). The NOM screening values pertain to sedimenta. This section must also include a summary of the risk to terrestrial ecological receptors.

72. Page 10–44 through 10–50, Section 10.9:
The following comments are provided regarding this section:

A. Change the title and contents of this section to refer to Remedial Goal Options (RGOs). Preliminary remediation goals (PRGs) are established at scoping stage for toxic substances known to be present at the site in order to provide a basis for the feasibility study consideration of all appropriate remedial alternatives which may achieve the target levels.

B. This section must contain media clean up levels for each chemical which contributes to a pathway that exceeds (i) the risk level chosen as the remediation "trigger" by the risk manager (generally 1E-4) or (ii) an HI of 1 for each scenario evaluated in the baseline risk assessment. Chemicals contributing

risk to these pathways need not be included if their individual carcinogenic risk contribution is less than 1E-6 or their noncarcinogenic HQ is less than 0.1. A table must also be provided which includes the 1E-4, 1E-5, and 1E-6 risk levels for each chemical, media and scenario (land use) and the HQ 0.1, 1 and 10 levels as well as any ARAR values (state and federal).

C. Table 10-15 is confusing; the reviewer could not locate the soil remedial goals, as described in the text and indicated by the table title. Please correct this discrepancy.

D. The MCLs on Table 10-16 must be referenced to state or federal sources. Lead and copper do not have MCLs; the values are treatment technique action levels. Many of the notes on Table 10-16 do not apply to the information presented.

73. Page 11-10, Section 11.2:
The following comments are provided regarding this page:

A. See the previous comments provided regarding the evaluation of surface water data.

B. Paragraph 3, line 7: change "r,r'-DDD" to "4,4'-DDD".

C. In addition to the summary of ecological risk related to sediment contaminants, the revised version of this report must also include a *summary* of ecological risk related to contaminated surface soils.

74. Page 12-1, 'Personal Communications':
Include the title or position of the person contacted and his/her affiliation (i.e., place of work).

75. Appendix P, "Detected Concentrations - QA/QC Samples":
The following comments are provided regarding the data contained in this appendix:

A. The data is poorly presented. The designations of many of the QA/QC samplee do not follow the proposals in the approved *SAP*, making it impossible to determine what was sampled. Label each sample in terms which clearly indicate what was being sampled. Reduce and reorganize the data in a manner which permits the maximum amount of information to be presented on each page in a clear fashion.

B. The legible portions of Appendix P indicate problems with the field and/or analytical work for OU 10. Following is a list of some of the particular problems noted:

- The proper type of water was apparently not used to make up field blanks.
- There is some confusion as to what matrix spike and matrix spike duplicate samples are and how they should be submitted. This apparently resulted in the submittal of many extra, unnecesary samples for analysis at great cost to the Navy.
- It appears that either the material8 used in monitoring well construction were either contaminated with low levels of pesticides, or the pesticide data is suspect.
- The permanent monitoring well data does not agree with the results of screening analyses (soil gas) or historical analytical results for OU 10. Given this lack of agreement among the data, and the sampling techniques used during the most recent round of field work, all permanent wells must be resampled and reanalyzed prior to submitting the RI Report. Shallow wells should be purged and re-sampled using low flow pumps (e.g.

peristaltic). Intermediate depth wells could be purged using a low-flow pump such as the RediFlo 11, and sampled with a peristaltic pump.

76. Appendix Q, "IRIS Database":
It is not necessary to include the IRIS database files for each chemical in an appendix. Per RAGs, Section 7.7, the main body of thio document ohould include a short description of the toxic effects of each chemical carried through the risk assessment in non-technical language. This description should include information on the effects associated with exposure to the chemical and the concentrations at which adverse effects are expected to occur in humans. If toxicity values are derived in conjunction with the regional risk assessment contact and ECAO for chemicals lacking EPA-derived values, a technical documentation/justification of the method of derivation should be prepared and included as an appendix. This explanation should include a description of the toxic effects of the chemical (e.g. information on the noncarcinogenic, carcinogenic, mutagenic, reproductive, and developmental effects).

ATTACHMENT A

United States Environmental Protection Agency

Office of Solid Waste and Emergency Response Washington, D.C. 20460

Publication 9285.7-08I May 1992

EPA

Supplemental Guidance to RAGS: Calculating the Concentration Term

Office of Emergency and Remedial Response
Hazardous Site Evaluation Division, OS-230

Intermittent Bulletin
Volume 1 Number 1

The overarching mandate of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is to protect human health and the environment from current and potential threats posed by uncontrolled releases of hazardous substance. To help met this mandate, the US. Environmental Protection Agency's (EPA's) Office of Emergency and Remedial Response has developed I human health risk assessment process as part of its remedial response program. This process is described in *Risk Assessment Guidance for Superfund: Volume I — Human Health Evaluation Manual* (RAGS/HHEM). Part A of RAGS/HHEM addresses the baseline risk assessment, and describes a general approach for estimating exposure to individuals from hazardous substance releases at Superfund sites.

This bulletin explains the concentration term in the exposure/intake equation to remedial project managers (RPMs), risk assessors, statisticians, and other personnel. This bulletin presents the general intake equation as presented in RAGS/HHEM Part A, discusses basic concepts concerning the concentration term, describes generally how to calculate the concentration term, presents examples to illustrate several important points, and, lastly, identifies where to get additional help.

THE CONCENTRATION TERM

How is the concentration term used?

RAGS/HHEM Part A presents the Superfund risk assessment process in four "steps": (1) data collection and evaluation; (2) exposure assessment; (3) toxicity assessment; and (4) risk characterization. The concentration term is calculated for use in the exposure assessment step. Highlight 1 presents the general equation Superfund uses for calculating exposure, and illustrates that the concentration term (C) is one of several parameters needed to estimate contaminant intake for an individual.

For Superfund assessments, the concentration term (C) in the intake equation is an estimate of the arithmetic average concentration for a contaminant based on I set of site sampling results. Because of the uncertainty associated with estimating the true average concentration at a site, the 95 percent upper confidence limit (UCL) of the arithmetic mean should be used for this variable. The 95 percent UCL provides reasonable confidence that the true site average will not be underestimated.

Why use an average value for the concentration term?

An estimate of average concentration is used because:

Supplemental Guidance to RAGS is a bulletin series on risk assessment of Superfund sites. These bulletins serve as supplements to *Risk Assessment Guidance for Superfund: Volume I — Human Health Evaluation Manual*. The information presented is intended as guidance to EPA and other government employees. It does not constitute rulemaking by the Agency, and may not be relied on to create a substantive or procedural right enforceable by any other person. The Government may take action that is at variance with these bulletins.

Highlight 1
GENERAL EQUATION FOR ESTIMATING EXPOSURE TO A SITE CONTAMINANT

$$I = C \times \frac{CR \times EFD}{BW} \times \frac{1}{AT}$$

where:

I = intake (i.e., the quantitative measure of exposure in RAGS/HHEM)
C = contaminant concentration
CR = contact (intake) rate
EFD = exposure frequency and duration
BW = body weight
AT = averaging time

(1) carcinogenic and chronic noncarcinogenic toxicity criteria[1] are based on lifetime average exposures; and

(2) average concentration is most representative of the concentration that would be contacted at a site over time.

For example, if you assume that an exposed individual moves randomly across an exposure area, then the spatially averaged soil concentration can be used to estimate the true average concentration contacted over time. In this example, the average concentration contacted over time would equal the spatially averaged concentration over the exposure area. While an individual may not actually exhibit a truly random pattern of movement across an exposure area, the assumption of equal time spent in different parts of the area is a simple but reasonable approach.

When should an average concentration be used?

The two types of exposure estimates now being required for Superfund risk assessments, a reasonable maximum exposure (RME) and an average, should both use an average concentration. To be protective, the overall estimate of intake (see Highlight 1) used as a basis for action at Superfund sites should be an estimate in the high end of the intake/dose distribution. One high end option is the RME used in the Superfund program. The RME, which is defined as the highest exposure that could reasonably be expected to occur for a given exposure pathway at a site, is intended to account for both uncertainty in the contaminant concentration and variability in exposure parameters (e.g., exposure frequency, averaging time). For comparative purposes, Agency guidance (U.S. EPA, *Guidance on Risk Characterization for Risk Managers and Risk Assessors*, February 26, 1992) states that an average estimate of exposure also should be presented in risk assessments. For decision-making purposes in the Superfund program, however, RME is used to estimate risk.[2]

Why use an estimate of the arithmetic mean rather than the geometric mean?

The choice of the arithmetic mean concentration as the appropriate measure for estimating exposure derives from the need to estimate an individual's long-term average exposure. Most Agency health criteria are based on the long-term average daily dose, which is simply the sum of all daily doses divided by the total number of days in the averaging period. This is the definition of an arithmetic mean. The

[1] When acute toxicity is of most concern, a long-term average concentration generally should not be used for risk assessment purposes, as the focus should be to estimate short-term, peak concentrations.

[2] For additional information on RME, see RAGS/HHEM Part A and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 55 *Federal Register* 8710, March 8, 1990.

arithmetic mean is appropriate regardless of the pattern of daily exposures over time or the type of statistical distribution that might best describe the sampling data. The geometric mean of a set of sampling results, however, bears no logical connection to the cumulative intake that would result from long-term, contact with site contaminants, and it may differ appreciably from and be much lower than the arithmetic mean. Although the geometric mean is a convenient parameter for describing central tendenaes of lognormal distributions, it is not an appropriate basis for estimating the concentration term used in Superfund exposure assessments. The following simple example may help clarify the difference between the arithmetic and geometric mean when used for an exposure assessment:

> Assume the daily exposure for a trespasser subject to random exposure at a site is 1.0, 0.01, 1.0, 0.01, 1.0, 0.01, 1.0, and 0.01 units/day over an 8-day period. Given these values, the cumulative exposure is simply their summation, or 4.04 units. Dividing this by 8 days of exposure results in an arithmetic mean of 0.505 units/day. This is the value we would want to use in a risk assessment for this individual, not the geometric mean of 0.1 units/day. Viewed another way, multiplication of the geometric mean by the number of days equals 0.8 units, considerably lower than the known cumulative exposure of 4.04 units.

UCL AS AN ESTIMATE OF THE AVERAGE CONCENTRATION

What is a 95 percent UCL?

The 95 percent UCL of a mean is defined as a value that, when calculated repeatedly for randomly drawn subsets of site data, equals or exceeds the true mean 95 percent of the time. Although the 95 percent UCL of the mean provides a conservative estimate of the average (or mean) concentration, it should not be confused with a 95th percentile of site concentration data (as shown in Highlight 2).

Why use the UCL as the average concentration?

Statistical confidence limits are the classical tool for addressing uncertainties of a distribution average. The 95 percent UCL of the arithmetic mean concentration is used as the average concentration because it is not possible to know the true mean. The 95 percent UCL therefore accounts for uncertainties due to limited sampling data at Superfund sites. As sampling data become less Limited at a site, uncertainties decrease, the UCL moves closer to the true mean, and exposure evaluations using either the mean or the UCL produce similar results. This concept is illustrated in Highlight 2.

Should a value other than the 95 percent UCL be used for the concentration?

A value other than the 95 percent UCL can be used provided the risk assessor can document that high coverage of the true population mean occurs (i.e., the value equals or exceeds the true population mean with high probability). For exposure areas with limited amounts of data or extreme variability in measured or modeled data, the UCL can be greater than the highest measured or modeled concentration. In these cases, if additional data cannot practicably be obtained, the highest measured or modeled value could be used as the concentration term. Note, however, that the true mean still may be higher than this maximum value (i.e., the 95 percent UCL indicates a higher mean is possible), especially if the most contaminated portion of the site has not been sampled.

CALCULATING THE UCL

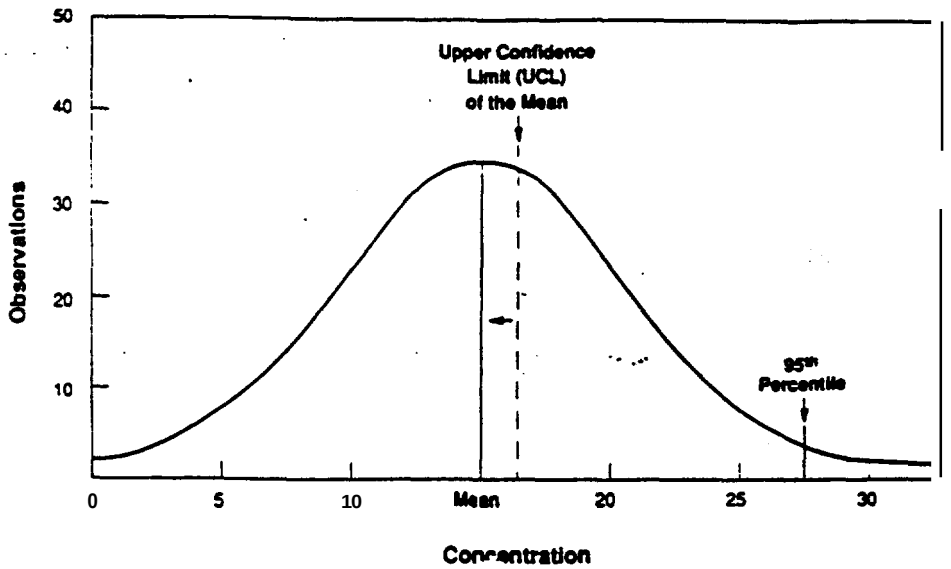
How many samples are necessary to calculate the 95 percent UCL?

Sampling data from Superfund sites have shown that data sets with fewer than 10 samples per exposure area provide poor estimates of the mean concentration (i.e., there is a large difference between the sample mean and the 95 percent UCL), while data sets with 10 to 20 samples per exposure area provide somewhat better estimates of the mean, and data sets with 20 to 30 samples provide fairly consistent estimates of the mean (Le., the 95 percent UCL is close to the sample mean). Remember that, in general, the UCL approaches the true mean as more samples are included in the calculation.

Should the data be transformed?

EPA's experience shows that most large or "complete' environmental contaminant data sets

Highlight 2
COMPARISON OF UCL AND 95" PERCENTILE



AS sample size increases, the UCL of the mean moves closer to the true mean, while the 95th percentile of the distribution remains at the upper end of the distribution.

from soil sampling are lognormally distributed rather than normally distributed (see Highlights 3 and 4 for illustrations of lognormal and normal distributions). In most cases, it is reasonable to assume that Superfund soil sampling data are lognormally distributed. Because transformation is a necessary step in calculating the UCL of the arithmetic mean for a lognormal distribution, the data should be transformed by using the natural logarithm function (i.e., calculate ln(x), where x is the value from the data set). However, in cases where there is a question about the distribution of the data set, a statistical test should be used to identify the best distributional assumption for the data set. The W-test (Gilbert 1987) is one statistical method that can be used to determine if a data set is consistent with a normal or lognormal distriiution. In all cases, it is valuable to plot the data to better understand the contaminant distribution at the site.

How do you calculate the UCL for a lognormal distribution?

To calculate the 95 percent UCL of the arithmetic mean for a lognormally distributed data set, first transform the data using the natural logarithm function as discussed previously (i.e., calculate ln(x)). After transforming the data, determine the 95 percent UCL for the data set by completing the following four steps:

(1) Calculate the arithmetic mean of the transformed data (which is also the log of the geometric mean);

(2) Calculate the *standard* deviation of the transformed data;

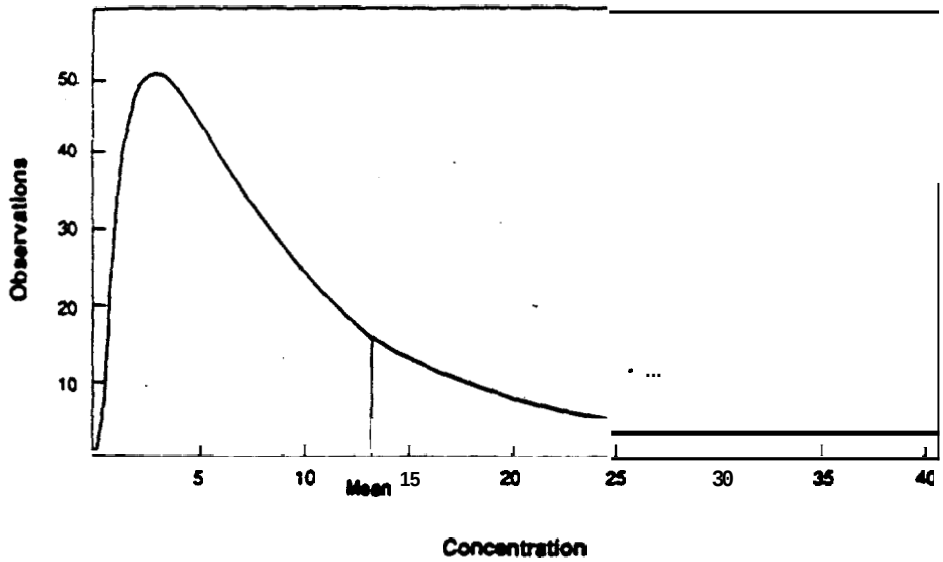
(3) Determine the H-statistic (e.g., see Gilbert 1987); and

(4) Calculate the UCL using the equation shown in Highlight 5.

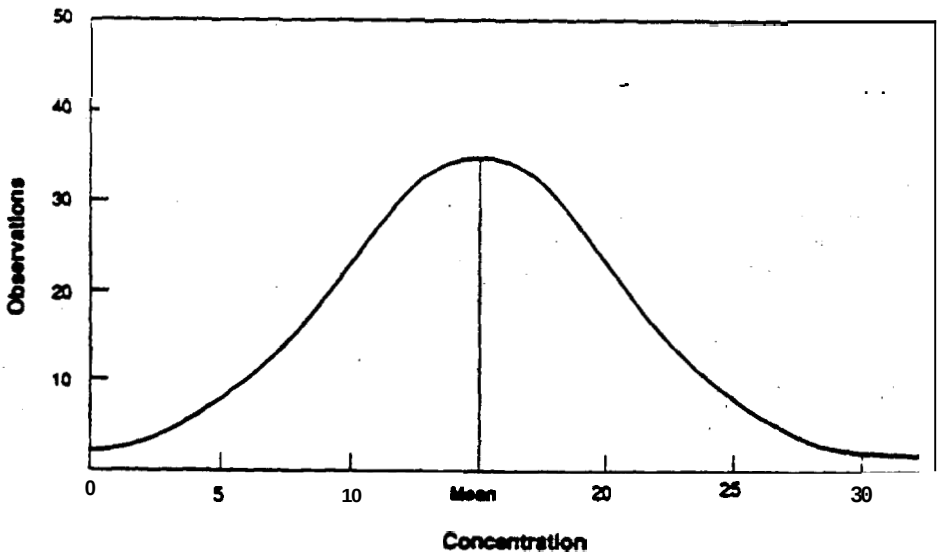
How do you calculate the UCL for a normal distribution?

If a statistical test supports the assumption that the data set is normally distributed, calculate the 95 percent UCL by completing the following four steps:

Highlight 3
EXAMPLE OF A LOGNORMAL DISTRIBUTION



Highlight 4
EXAMPLE OF A NORMAL DISTRIBUTION



Highlight 5
CALCULATING THE UCL OF THE *ARITHMETIC* MEAN. FOR A LOGNORMAL DISTRIBUTION

$$UCL = e^{(\bar{x} + 0.5s^2 + sH/\sqrt{n-1})}$$

where:

UCL	=	upper confidence limit
e	=	constant (base of the natural log, equal to 2718)
$\bar{x}$	=	mean of the transformed data
s	=	standard deviation of the transformed data
H	=	H-statistic (e.g., from table published in Gilbert 1987)
n	=	number of samples

Highlight 6
CALCULATING THE UCL OF THE ARITHMETIC MEAN FOR A NORMAL DISTRIBUTION

$$UCL = \bar{x} + t(s/\sqrt{n})$$

where:

UCL	=	upper confidence limit
$\bar{x}$	=	mean of the untransformed data
s	=	standard deviation of the untransformed data
t	=	Student-t statistic (e.g., from table published in Gilbert 1987)
n	=	number of samples

(1) Calculate the arithmetic mean of the untransformed data;

(2) Calculate the standard deviation of the untransformed data;

(3) Determine the one-tailed t-statistic (e.g., see Gilbert 1987); and

(4) Calculate the UCL using the equation presented in Highlight 6.

Use caution when applying normal distribution calculations if there is a possibility that heavily contaminated portions of the site have not been adequately sampled. In such cases, a UCL from normal distribution calculations could fall below the true mean, even if a Limited data set at a site appears normally distributed.

EXAMPLES

The examples shown in Highlights 7 aad 8 address the exposure scenario where an individual at a Superfund site has qual opportunity to contact soil in any sector of the contaminated area over time. Even though the examples address only soil exposures, the UCL approach is applicable to all exposure pathways. Guidance and examples for other exposure pathway will be presented in forthcoming bulletins.

Highlight 7 presents a simple data set and provides a stepwise demonstration of transforming the data — assuming a lognormal distribution — and calculating the UCL. Highlight 8 uses the same data set to show the difference between the UCLs that would result from assuming normal and lognormal distribution of the data. These

Highlight 7

EXAMPLE OF DATA TRANSFORMATION AND CALCULATION OF UCL

This example shows the calculation of a 95 percent UCL of the arithmetic mean concentration for chromium in soil at a Superfund site. This example is applicable only to a scenario in which a spatially random exposure pattern is assumed. The concentrations of chromium obtained from random sampling in soil at this site (in mg/kg) are 10, 13, 20, 36, 41, 59, 67, 110, 110, 136, 140, 160, 200, 230, and 1300. Using these data, the following steps are taken to calculate a concentration term for the intake equation:

(1) Plot the data and inspect the graph. (You may need the help of a statistician for this part [as well as other parts] of the calculation of the UCL.) The plot (not shown, but similar to Highlight 3) shows a skew to the right, consistent with a lognormal distribution.

(2) Transform the data by taking the natural log of the values (i.e., determine $\ln(x)$). For this data set, the transformed values are: 2.30, 2.56, 3.00, 3.58, 3.71, 4.08, 4.20, 4.70, 4.70, 4.91, 4.94, 5.08, 5.30, 5.44, and 7.17.

(3) Apply the UCL equation in Highlight 5, where:

$\bar{x} = 4.38$
$s = 1.25$
$H = 3.163$ (based on 95 percent)
$n = 15$

The resulting 95 percent UCL of the arithmetic mean is thus found to $\text{quale}^{(6.218)}$, or 502 mg/kg.

Highlight 8

COMPARING UCLS OF THE ARITHMETIC MEAN ASSUMING DIFFERENT DISTRIBUTIONS

In this example, the data presented in Highlight 7 are used to demonstrate the difference in the UCL that be seen if the normal distribution approach were inappropriately applied to this data set (i.e., if, in this example, a normal distribution is assumed).

ASSUMED DISTRIBUTION	Normal	Lognormal
TEST STATISTIC:	Student-t	H-statistic
95 PERCENT UCL (mg/kg):	325	502

examples demonstrate the importance of using the correct assumptions.

WHERE CAN I GET MORE HELP?

Additional information on Superfund's policy and approach to calculating the concentration term and estimating exposures at waste sites *can* be obtained in:

- U.S. EPA, *Risk Assessment Guidance for Superfund: Volume I — Human Health Evaluation Manual (PanA)*, EPA/540/1-89/002, December 1989.
- U.S. EPA, *Guidance for Data Useability in Risk Assessment*, EPA/540/G-90/008 (OSWER Directive 9285.7-05), October 1990.
- U.S. EPA, *Risk Assessment Guidance for Superfund (Part A — Baseline Risk Assessment) Supplemental Guidance/ Standard Exposure Factors*, OSWER Directive 9285.6-03, May 1991.

Useful statistical guidance can be found in many standard textbooks, including: . .

- Gilbert, RO, *Statistical Methods fa Environmental Pollution Monitoring*, Van Nostrand Reinhold, New York, New York, 1987.

Questions or comments concerning the concentration term *can* be directed to:

- Toxics Integration Branch
  Office of Emergency and Remedial Response
  401 M Street SW
  Washington, DC 20460
  Phone: 202-260-9486

EPA staff can obtain additional copies of this bulletin by calling EPA's Center for Environmental Research Information at FTS 684-7562 (513-569-7652). Others can obtain copies by contacting NTIS at 800-336-4700 (703-487-4650 in the Washington, DC area).

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