



Minnesota Pollution Control Agency

July 20, 1995

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. David Cabiness, Code 1862
Commanding Officer
Southern Division
Naval Facilities Engineering Command
PO Box 190010
North Charleston, South Carolina 29419-9010

RE: Naval Industrial Reserve Ordnance Plant

Dear Mr. Cabiness:

The Minnesota Pollution Control Agency (MPCA) staff has reviewed, "The Feasibility Study for Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota," (FS Report), dated April 30, 1995, for Operable Unit 2 for the Naval Industrial Reserve Ordnance Plant Site (Site). The FS Report was submitted pursuant to the Federal Facility Agreement (FFA), dated March 27, 1991, between the MPCA, the U.S. Environmental Protection Agency (EPA), and the U.S. Navy (Navy).

The MPCA staff hereby rejects the FS Report and requests that the Navy rewrite and resubmit the FS Report pursuant to Attachment I to this letter. Major reasons that the MPCA staff rejects the FS Report include, but not necessarily limited to:

1. The failure of the Navy to identify an acceptable remedy for carcinogenic polyaromatic hydrocarbons, contaminants of concern at the Site;
2. The failure of the Navy to follow the EPA's National Contingency Plan by the Navy's unacceptable selection of institutional controls as a remedy for volatile organic compounds;
3. The failure of the Navy to incorporate in the FS Report soil clean-up goals established by the MPCA and EPA;

Ground Water & Solid Waste Division Site Response Section
Site Name
Category

Post-It™ brand fax transmittal memo 7571	# of pages ▶ 16
To <i>David Cabiness</i>	From <i>Dave Douglas</i>
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Mr. David Cabiness

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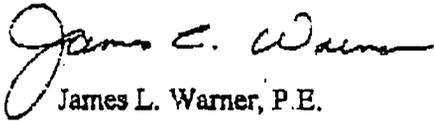
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4. The failure of the Navy to properly assess risk for the contaminants of concern in this operable unit; and
5. The failure of the Navy to follow EPA's presumptive remedy guidance in the selection of remedies for operable unit's contaminants of concern.

The MPCA staff recommends that the Navy and EPA convene a meeting at the MPCA offices to work together to rewrite the FS Report so that the FS Report will be resubmitted to the MPCA staff within 45 days of receipt of this letter as specified in the FFA.

If you have any questions regarding this letter, please contact David Douglas of my staff at (612) 296-7818.

Sincerely,



James L. Warner, P.E.
Division Manager
Ground Water and Solid Waste Division

JLW:ch

cc: Sidney Allison, Navy, Southern Division
Richard Ninesteel, Halliburton NUS Corporation
Mark Briggs, RMT, Inc.
Thomas Bloom, U.S. Environmental Protection Agency

Attachment 1

**Modifications to
"Feasibility Study for Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota"
dated April 30, 1995 for Operable Unit 2**

1. **Page 1, Section 1, Introduction, Paragraph 2:** Contrary to the Navy's statement, the objectives of the Feasibility Study (FS) Report are not to develop soil clean-up goals for the operable unit. These goals have already been identified to the Navy by the Minnesota Pollution Control Agency (MPCA) staff with the approval of the U.S. Environmental Protection Agency (EPA). This statement and all related discussion that attempts to change soil clean-up numbers already established for Operable Unit 2 (OU2) shall be removed from the FS Report.

2. **Page 8, Section 1.3, Paragraph 1:** The text states that "the concentrations of VOCs were highest in shallow layers and decreased with depth in the sandy subsurface soil." If it is true that the OU2 soils are being contaminated from the ground water underlying the site, as Navy maintains, then the shallow soils at OU2 would have lower volatile organic compound (VOC) concentrations than soils at depth. In addition, the statement that the highest concentrations of VOC were found in areas that were "consistent with locations where drums had been disposed in trenches" argues against the contention that OU3 is the source of VOC contamination at OU2.

The Navy shall change the section to resolve this discrepancy.

3. **Page 11, Section 1.3:** The report neglects to mention that carcinogenic polyaromatic hydrocarbons (cPAHs) also significantly contributed to the risk under the future land use evaluation.

The Navy shall discuss the risk associated with cPAHs in the FS Report.

4. **Page 12, Section 1.4, Paragraph 2:** Pesticides and metals above background concentrations, though not found to be contaminants of concern, were associated with site activities.

The Navy shall add this narrative to the FS Report.

5. **Page 13, Section 1.5, Remedial Technologies Section:** The EPA presumptive remedy guidance for VOCs was not written to evaluate remedies for cPAHs; however, cPAHs are contaminants of concern for OU2. Remedies other than those identified in the presumptive remedy guidance for VOCs that are more applicable to cPAHs (not just polynuclear aromatic hydrocarbons [PAHs]) shall be identified and evaluated in the FS Report beginning with Section 1.5.

6. **Page 13, Section 1.6, Feasibility Study Scope and Objectives:** Locating areas that may require remediation is not an FS objective; it is a Remedial Investigation (RI) objective. Developing soil clean-up goals is not an FS objective. The MPCA staff has already identified clean-up goals to the Navy and approved by EPA. The Navy shall remove these objectives from the FS Report.

The Navy shall evaluate remedies based on the known magnitude and extent of the contaminants of concern of OU2 and based on the soil clean-up goals identified by the MPCA staff. The Navy shall add the following objective: "To evaluate remedial alternatives for cPAHs in the soils of OU2 other than presumptive remedies for VOCs."

7. **Table 2-2: By definition, Applicable or Relevant and Appropriate Requirements (ARARs) are promulgated.** The Navy shall remove from the table and the associated discussion all requirements that the Navy has identified as "ARARs" that are not promulgated, such as those identified for thermal desorption of chlorinated hydrocarbons; however, these items may be To Be Considereds (TBCs) and should be identified as such.
8. **Table 2-4: Soil clean-up levels developed using the MPCA Soil Cleanup Model are TBCs.** Soil clean-up levels have been established for OU2. The "comments" shall be changed to reflect this.
9. **Page 26, Section 3, Remedial Action Objectives and Target Cleanup Goals:** The Navy shall develop one list of remedial action goals combining the list in this section with the list from Section 1.6.
10. **Pages 27 - 35, Sections 3.1.1, MPCA Soil Leaching Model and 3.1.2, Target Cleanup Goals for OU2 Soils - Groundwater Protection Based:** These sections shall be deleted from the FS Report and replaced with all relevant MPCA staff correspondence sent to the Navy establishing soil clean-up numbers for OU2 or by reference to such correspondence. The Navy shall list the contaminants of concern and their respective clean-up levels and shall add a discussion concerning additivity under the new Health Risk Limit (HRL) Rule which is relevant where there are multiple contaminants of concern impacting the same target organ.

The soil model makes no assertion that the OU2 soils are the sole source of ground water contamination, but indicates the likelihood that the solvents in the OU2 soil are contributing to the contamination. The model makes no assumptions about unknown leachate plumes beneath the contaminated zone in the soil. No assumptions are made about vapors moving upward through the soils, nor are any assumptions regarding perched water tables considered in the model.

It is the primary responsibility of the MPCA and EPA as regulatory agencies (not the Navy) to establish soil clean-up numbers. The MPCA staff has done this with the concurrence of the EPA and the MPCA staff has agreed to make specific changes requested by the Navy. The FS shall be used to evaluate remedies for the contaminants of concern using the soil clean-up numbers identified, not used as a forum for continuing arguments with the regulatory agencies about the numbers or the process. The Navy has not produced any new information or arguments in the FS Report that would cause the MPCA staff to either change any clean-up numbers or the process used to establish them.

11. Page 31, Section 3.1.2, Paragraph 2: The intrinsic biodegradation of trichloroethene (TCE), perchloroethylene (PCE), and other chlorinated solvents is an active area of research, with very limited amounts of data available on the biodegradation of these compounds in subsoils. Published data on the kinetics of aliphatic chlorinated solvent biodegradation in the vadose zone or ground water is largely site specific. The MPCA staff acknowledges that these published degradation rates, as applied to the Naval Industrial Reserve Ordnance Plant (NIROP) Site, are at best approximate values that are largely dependent on oxygen concentrations, bacterial consortia present, nutrient type and availability, soil type, etc. However, in the absence of site-specific microcosm degradation data that would reveal actual rates of biodegradation in these soils, it is appropriate to adopt conservative - though reasonable - rates of intrinsic biodegradation.

The Navy shall adopt the degradation rates and rationale previously identified by the MPCA staff.

12. Table 3-2: It is unclear to which specific entries in Dragun's *The Soil Chemistry of Hazardous Materials* that the rates that appear in Table 3-2 of the Study refer. However, a more careful analysis of the microcosm studies referenced in Dragun reveals that a number of these values are not applicable to the situation at NIROP:
 - a. Reference number 50 from Dragun (*J.T. Wilson et al. 1983. Enumeration and Characterization of Bacteria Indigenous to a Shallow Water-Table Aquifer*) states that "there was no detectable degradation of 1,2-dichloroethane, 1,1,2-trichloroethane, trichloroethylene, or tetrachloroethylene. This finding is consistent with their observed persistence in the subsurface environment."
 - b. Reference number 49 from Dragun (*B. Wilson et al. 1986. Biotransformations of Selected Alkylbenzenes and Halogenated Aliphatic Hydrocarbons in Methanogenic Aquifer Material: A Microcosm Study.*) refers to studies that were conducted on methanogenic consortia representative of sanitary landfills. There is no evidence that conditions at NIROP are methanogenic.

- c. Reference number 57 from Dragun (*G. Barrio-Lage et al. 1986. Sequential Dehalogenation of Chlorinated Ethenes*) is a study on reductive dehalogenation of solvents. Because the sandy soils at NIROP are not anaerobic, reductive dehalogenation rates are not an appropriate comparison.
- d. Reference number 38 from Dragun (*H.H. Tabak et al. 1981. Biodegradability Studies with Organic Priority Pollutant Compounds*) used settled domestic wastewater as microbial inoculum into flasks containing a synthetic medium rich in nutrients. This is not characteristic of conditions in NIROP soils.
- e. Reference number 54 from Dragun (*J. Wilson et al. 1982. Biotransformation of Selected Organic Pollutants in Ground Water.*) The microcosms prepared in this study were flooded soil samples taken above or below the water table. For one soil (pH = 4.4), the authors observed that TCE and PCE degraded at approximately one percent per week, while in another soil more representative of NIROP soils (pH = 7.8), TCE did not degrade while PCE degraded at approximately one percent per week. It was concluded that these compounds were probably degrading abiotically. No degradation was observed for 1,1-dichloroethane or 1,1,1-trichloroethane in either soil.

If the biodegradation half-life of 0.62 years (1.6 percent per week) for TCE proposed by Navy is considered, the resulting implications are clearly not credible. If the biodegradation term is reasonable, it should yield, by inserting it into the corresponding first-order rate equation, a reasonable concentration of TCE that was originally present in the soil at the site. The first order equation is represented by:

$$A_t = A_0(e^{-rt})$$

where:

A_t = concentration of TCE that exists in the soil presently. For the sake of argument, assume an approximate concentration of four parts per million (ppm) (the "true" present concentration will depend on the actual location in the soil),

A_0 = concentration of TCE that was present in the soil originally in the mid-1970s,

t = time in years, approximately 20 years.

r = rate of degradation based on half-life data, $r = \ln 2/t_{1/2}$
 $= 0.693/0.62 = 1.118 \text{ yr}^{-1}$

and solving to determine the initial concentration of TCE in soil,

$$4. = A_0(e^{-(1.118)(20)})$$

$$A_0 = 4. / (e^{-(1.118)(20)})$$

$A_0 = 2 \times 10^{10}$ ppm TCE originally in the soil.

This is an impossibility (there are 10^6 milligrams per kilograms of soil) and indicates that Navy's proposed degradation rate is very liberal.

Applying the same reasoning to the degradation rate of 0.6 percent per week used by the MPCA staff

$$r = 0.693 / t_{1/2} = 0.693 / 1.6 = 0.433 \text{ yr}^{-1}$$

$$4. = A_0(e^{-(0.433)(20)})$$

$$A_0 = 4. / (e^{-(0.433)(20)})$$

$A_0 = 2.3 \times 10^4$ ppm TCE originally in the soil. This is a theoretically possible concentration in a soil affected by a spill, indicating that the MPCA's assumed degradation rate more accurately represents conditions at the site.

Nonetheless, in order to obtain greater clarification on biodegradation rates for these compounds, MPCA staff contacted one of the researchers named in two of the above studies (B. Wilson, EPA Kerr Laboratories, Ada, OK). Ms. Wilson agreed that the biodegradation rates adopted by the MPCA are reasonable and not overly conservative.

For these reasons, the MPCA staff rejects the rationale presented in the FS Report.

13. Page 31, Section 3.1.2, Paragraph 5: The Navy has not demonstrated that the magnitude of soil contamination in OU2 does not pose a threat to public health and the environment. Navy's claim that only a minimal amount of TCE remains in OU2 soils based on prior RI soil boring data. The MPCA staff believes that the claim of only 13 kilograms of TCE remaining in the soil is inaccurate for the following reasons:

- a. The site may not be completely characterized with respect to TCE soil concentrations. Locations with the highest concentrations of TCE are probably not represented in the data despite efforts to sample these locations during the RI.
- b. The sampling protocol was not designed to answer the question of the quantity of TCE at the site, but was intended to delineate the areas of contamination at the site. Samples showing low concentrations of TCE will affect the average in the calculation used to determine quantities at the site.

- c. Investigation of similar TCE contaminated sites at the Twin Cities Army Ammunition Plant resulted in grossly underestimating the amounts of TCE in the soils. After installation of soil vapor extraction (SVE) at these sites, it was discovered that calculations based on soil boring data underestimated total TCE mass by at least an order of magnitude. In addition, ground water contamination at these sites has decreased dramatically since SVE was installed.
- d. The fact that barrels of solvent were removed from the Site makes it more likely that locations with very high concentrations of TCE exist but may be still undefined.

The Navy shall change this narrative to reflect the above response.

14. Page 34, last paragraph: The MPCA staff concurs that there is contamination under the building; however, the statement that "OU2 soils are not a significant source of contaminants to the aquifer" does not mitigate the importance of the OU2 soils in contributing to ground water degradation at this site. As per previous comments, the fact that numerous barrels were removed from the OU2 soils must appear in any discussion of the likelihood that OU2 soils are contributing to the ground water contamination.

The Navy shall delete the statement that OU2 soils are not a significant source of contaminants to the aquifer.

15. Page 35, Section Risk-Based Soil Target Cleanup Levels: See MPCA staff responses to Sections 3.1.1 and 3.1.2.

16. Page 35, Section 3.1.2, Paragraph 1: Although migration of Dense, Nonaqueous Phase Liquid (DNAPL) from under the building (OU3) to the saturated subsoils of OU2 is possible, evidence for this phenomenon is not demonstrated nor is any modeling presented that would lend support to this claim. Also, the MPCA staff believes that if solvent were moving from under the building to OU2, the intervening soil between the building and Site A would also be contaminated.

The text makes no mention of the most likely source of soil contamination in the North 40 Area: the numerous barrels of spent solvents have been removed from disposal trenches in this area. Approximately 75 barrels have been removed to date and a new geophysical survey is being performed to identify any additional areas where barrels that may have been missed might be located. A number of the barrels observed during the removal were corroded and spilled solvents into the soil, but this is disregarded in the FS as a source of contamination in OU2 soils. Any discussions that appear in the text referring to the sources of soil contamination shall include this important information. A map which indicates the areas where barrels were removed in relation

to the areas of soil contamination shall be included in the report as well as a listing of the number of barrels recovered at each location

In addition, solvent concentrations found in the ground water are not orders of magnitude higher than the concentrations found in the OU2 soils. The MPCA staff has consistently supported and continued to advocate the concept of investigating OU3 soils for DNAPL, but do not believe DNAPL in OU3 obviates the need for remedial action in OU2 soils. The Navy shall include discussion of the removal of barrels from the site and remove statements referring to the migration of DNAPL from OU3 to OU2 without evidence that this is the case.

17. Page 36, Section 3.2.1, Paragraph 2: Evaluating "driving" exposure pathways may be consistent with EPA's current soil screening guidelines; however, the guideline's present methodology to determine the acceptable residual soil level, not a soil pore gas concentration.

The Navy shall change the narrative to reflect the above response.

18. Page 36, Section 3.2.1, Paragraph 3 and Table 3-4 on Page 37: The risk-based concentrations do correspond approximately to HQ=1 or ECR=E-5.

The Navy shall change the narrative to reflect the above response.

19. Pages 36 to 38, Section 3.2.1: Documentation and/or rationale for an attenuation coefficient of 0.0016 is lacking. Since this value represents a change from previous work RMT should have: 1) sought prior input and approval from the MPCA, and 2) provided documentation on the rationale of why 0.0016 is a more appropriate value for the NIROP Site than the previously utilized value (i.e., 0.01).

The report states on page 38, "This number is the ratio of the indoor concentration to the soil pore gas concentration, estimated based on studies conducted with the conservative gas, radon (Little, et al., 1992)." This is very misleading and misrepresents the cited reference. The 0.0016 value is based on the mean indoor radon concentration in the living space of single-family dwellings (as reported by Nero et al.) and an estimated mean radon concentration in soil pores as reported by Nazaroff et al. This generic value was derived as part of an analogy to demonstrate the potential importance of subsurface transport of volatiles into buildings. The MPCA staff do not believe that the authors intended it to be utilized in the manner proposed by Navy. The authors clearly state that the attenuation coefficient varied widely across the housing stock and indicate that the range of reasonable values vary over two or three orders of magnitude. This is not surprising since transport models have been found sensitive to a variety of site-specific parameters such as soil permeability and soil porosity. Climate has also been shown to influence soil gas transport.

The 0.0016 value is based on nationwide data and an estimated average may not be applicable to the NIROP Site. The cited reference provides equations which could have easily been utilized with site-specific information to calculate a more appropriate value.

The Navy shall change the narrative to reflect the above response.

20. Page 38, Section 3.2, Paragraph 2: Adjusting Preliminary Remediation Goals (PRG) for Additivity: The report shall note: 1) the risk from exposure to ground water should be summed with those from soil. Ground water and soil are often dealt with separately. This is one reason why the MPCA staff has utilized an individual target HQ of 0.2; and 2) the carcinogens TCE and PCE also have noncarcinogenic effects.

The Navy shall change the narrative to reflect the above response.

21. Page 39, Section 3.2, Noncarcinogenic Effects: The statements following the second and third bullets appear contradictory concerning concentrations of ethylbenzene exceeding PRG/10 level.

The Navy shall resolve this inconsistency.

22. Page 40, Section 3.2.2, Paragraph 1: The text states: "Of the exposure routes based on direct human contact (that is, compositional concentrations), the ingestion route of exposure was calculated in the Baseline Risk Assessment to pose the highest risk compared to inhalation and dermal adsorption. For this reason, the ingestion route is the most sensitive, and the PRGs based on the ingestion route are the lowest concentrations, and are the most protective." This is incorrect. Dermal adsorption was not evaluated in the Baseline Risk Assessment. For nonvolatile contaminants (e.g., cPAHs) the dermal pathway can result in a higher exposure than incidental ingestion. The MPCA staff understands that there was previous agreement that dermal adsorption would not be incorporated into the clean-up values. However, the Navy shall change the narrative to clearly state that inability to incorporate the dermal pathway is part of the uncertainty and would result in an under estimation of risk posed by the residual levels.

23. Pages 44 - 47, Section 3.2.2, Additivity: Since cPAHs are also carcinogenic, the additivity screening shall include TCE, PCE and cPAHs combined.

The Navy shall change the screening to reflect the additivity as described above.

24. Page 47, Section 3.2.2, Paragraph 1: Change "Area B" at the end of the statement to "Area E."

25. Page 47, Section 3.2.3, Paragraph 2: The Navy shall identify how it determined that the cPAHs in Area D are not related to site activities.

26. Page 49, Section 3.4, Paragraph 3: The Navy shall change the narrative to indicate that the depth to ground water at OU2 is approximately 20 feet.
27. Page 49, Section 3.2, Paragraph 1: The Navy shall delete New England urban background levels from the FS Report as they are not applicable at NIROP.
28. Page 49, Section 3.3, Paragraph 2: The Navy shall identify methods that can verify soil pore gas clean-up levels.
29. Page 49, Section 3.3, Paragraph 3: The Navy shall change the narrative to discuss the dermal absorption pathway and direct dermal toxicity for cPAHs.
30. Page 52, Section 4.1, No-Action Alternative (Alternative 1): The Navy shall change the description of this alternative to include monitoring of the soil and ground water for the next 20 years. Site monitoring is necessary for all remedies in order to detect any changes in site conditions and verify that the remedy implemented continues to be protective of public health, welfare, and the environment after the cleanup is completed. The cost of site monitoring for all remedies evaluated shall be identified in the FS Report.
31. Page 53, Section 4.2, Paragraph 1: The Navy shall proceed with the remediation of OU2 soils for VOCs under the residential land use scenario, which is consistent with the approach taken in the remediation of OU1.

The statutory requirements of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) clearly state that applying permanent land use restrictions through institutional controls instead of a remedy is an unacceptable alternative. "Institutional controls may be used during the conduct of the RI/FS and implementation of the remedial action and, where necessary, as a component of the completed remedy. The use of institutional controls shall not substitute for active response measures." (40 CFR §300.430 (a) (iii) (D). (Also see the MPCA staff response for Page 118, Section 6.6, paragraph 3.)

The Navy shall delete all narratives related to institutional controls for VOCs for OU2 soils from the FS Report.

32. Page 56, Section 4.3.2, Paragraph 2: The Navy has not demonstrated the extent to which ground water is contaminating soil at NIROP. Because soils at the site are in contact with the contaminated ground water, some recontamination of the lowest soils immediately in contact with the ground water is possible for a time. However, the MPCA staff maintain that OU2 soils are contributing to ground water contamination at the site based upon information from the RI and from removal actions.

Accordingly, the minimum remedial requirement entails the "removal, treatment, or containment or some combination of the three of all contaminated soils which act as a source of further groundwater pollution." (Minnesota R. pt. 7060.0910, subp. 3 C).

For these reasons, the MPCA staff rejects this rationale. Lacking evidence in support of these arguments, the Navy shall delete this argument from the FS Report.

33. Page 56, Section 4.3.2, last paragraph: The argument that OU2 soils are not the source of ground water contamination has been previously addressed. Data collected from the RI shows that, while there is a local area of elevated VOC in soil next to the ground water, there is also a broad area of contamination in the mid-depth vadose soils of higher concentration that appears generally separated from the lower contaminated soils. The MPCA staff believes that the most reasonable explanation for the contamination found in the mid-depth soils is due to the barrels found at the site and is a continuing source of ground water contamination. It is feasible that the lowest levels of soil contamination may be due to VOCs emanating from the ground water, but the claim that all of the contamination in the OU2 soils is from ground water is not supported by the data.

The Navy shall delete statements referring to OU2 soil contamination being due to ground water alone.

34. Page 62, Section 4.3.5, Enhanced Bioremediation of cPAHs using SVE: The Navy shall delete this section from the FS Report and further discussion of this remedy. The Navy has not presented sufficient technical information in the FS Report for further consideration of this alternative. No sites are identified where this alternative has been used, much less been successful in meeting remedial objectives. (See further response to this section below.)

35. Page 62, Section 4.3.5: The Navy has not demonstrated the biodegradation of PAHs at NIROP. Biodegradation of PAH is generally restricted to the lower molecular weight compounds, including naphthalene, phenanthrene, and anthracene, although mineralization of a few higher molecular weight compounds including fluoranthene and pyrene has occasionally been demonstrated. As a rule, the higher the molecular weight of the PAH, the more recalcitrant it is to biodegradation, although the extent of high molecular weight PAH biodegradation is very site specific. Additional factors include the age of the PAH contamination, nutrient concentrations, microorganisms present, and the degree of PAH adsorption to the soil.

Available studies on PAH biodegradation *in-situ* demonstrate that biotransformation of carcinogenic PAH (cPAH) varies widely. Conditions and levels of contaminants are different for each site, and it is essential to perform treatability studies in the laboratory to evaluate biodegradation rates of these compounds. (Bioremediation of Soil Contaminated with Polyaromatic Hydrocarbons [PAHs]: A Review, 1993. S. Wilson and K. Jones). Further, provided that *in-situ* or on-site biotransformation of cPAHs is

occurring, the extent of that biodegradation may well not reach human health risk clean-up levels. Even under optimal laboratory shake flask conditions or bioreactors (Ellis et al., 1991. *Bioremediation of a Creosote Contaminated Site*) cPAH removal ranges from 7 to 40 percent, depending on the type of PAH present in the soil.

The MPCA staff rejects soil vacuum extraction as a remedy for cPAHs. The Navy shall delete Section 4.3.5 and all related appendices and narrative.

36. Page 65, Section 4.3.5, Paragraph 1: The assertion that first order biodegradation rates will hold *in-situ* until risk based clean-up numbers are attained is addressed in the response to Paragraph 3.
37. Page 65, Section 4.3.5, Paragraph 2: Two and three ring PAHs are not carcinogenic PAHs.

The Navy shall change the narrative to reflect the above response.

38. Page 65, Section 4.3.5, Paragraph 3: The conclusion reached in the FS that cPAHs will intrinsically biodegrade to concentrations that no longer pose a human health risk is unsubstantiated. Although Park *et al.* found rates for the biodegradation of PAH in soil, it is important to note that: 1) the contamination was freshly added to the soil system, making it more available for biodegradation, 2) PAH concentrations were not alluded to in the study, 3) it is improbable that these biodegradation rates proceed indefinitely to low concentrations of PAH in soil via first order kinetics. For example, the Luthy et al., review (referenced on page 63, paragraph 3: Luthy et al., 1994. *Remediating Tar-Contaminated Soils at Manufactured Gas Plant Sites*) states that studies "indicate that mass transfer limitations can exist even in well-mixed systems where aqueous phase diffusional resistances are minimal . . . this is inferred from the extent of biodegradation approaching a limiting value, after which there is little change in PAH content in the soil matrix." In addition, ". . . studies of biological treatment of PAHs in liquid cultures and solid matrices associated with manufactured gas plant site soils have indicated that a range of 2- through 6-ring PAHs may biodegrade when present in aqueous solution, but removal from a solid matrix is less predictable and, generally, much less efficient." Other references also allude to these difficulties even when attempting active bioremediation of PAHs through bioreactors. Therefore, the proposal that cPAHs in OU2 soils will intrinsically biodegrade to below risk-based clean-up numbers is not adequately supported. The Navy shall verify the proposed biodegradation rates through laboratory treatability studies. Finally, the Navy's assumptions of *in-situ* PAH biodegradation are predicated on the enhanced delivery of oxygen through the operation of a SVE system at the site. For these reasons, the MPCA staff rejects this rationale.

Therefore, in the FS Report the Navy shall evaluate the alternatives of: 1) excavating and landfilling the PAH contaminated soils and 2) thermally treating only the PAH contaminated soils as part of the treatment train as per the criteria used to evaluate the other remedial alternatives.

39. Page 66, Section 4.3.5, Paragraph 3: The Navy shall change "ammonia" to "N" or "nitrogen."
40. Appendix I: In Appendix I, 1 ppm is used as a cPAH clean-up value. However, in Table 3-6, 470 ppm is used as the clean-up value.

The Navy shall resolve this discrepancy.

41. Page 82, Additional Design Data Requirements, Paragraph 2: The Navy shall submit a drawing showing the areas cited for Figure 4-6. Figure 4-6 is not the drawing referred to in this paragraph. The Navy shall identify what clean-up number assumptions were used to compute the 450,000 cubic yards of soil. The Navy shall show how additivity of multiple contaminants (e.g., under the HRL Rule) was used in this calculation and, if not used, shall recompile the volume of soil requiring remediation.
42. Page 86, Section 5.1, Alternative 1 - No Additional Action: What does the Navy mean when it says that "...[h]owever, these current exposure pathways, evaluated in the Risk Assessment conducted during RI activities, did not exceed Minnesota threshold values for unacceptable risk..."? This statement seems at odds with the rest of this section.
43. Page 87, Section 5.2, Alternative 2 - Institutional Controls: The MPCA staff rejects this alternative. See response to Page 53, Section 4.2, paragraph 1.
44. Page 90, Section 5.3, Alternative 3 - Soil Vacuum Extraction: The MPCA staff accepts this alternative for the treatment of VOCs; however, the staff rejects this alternative for cPAHs because the Navy has not provided information substantiating its claims that this alternative remediates cPAHs. Therefore, as a remedy for both VOCs and cPAHs, the MPCA staff rejects this alternative. The Navy shall identify alternatives and evaluate remedies that remediate cPAHs. The MPCA staff remains open to consideration of remedies that treat both VOCs and cPAHs and to a treatment train concept for remediating these categories of contaminants. (See discussion on Page 5, Section 2 of the document entitled, "Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites With Volatile Organic Compounds in Soils," dated September 1993 (EPA Directive 9355.0-48FS).

45. Page 93, Section 5.3.1, Paragraph 2: See MPCA response to Page 56, Section 4.3.2, Paragraph 2.

While ground water will affect the soils in contact with it at OU2, recontamination of the entire soil column due to contaminants in the ground water is very unlikely. In addition, many other sites proceed with SVE without recontamination of the soil. The Navy shall delete from the narrative language that soils will become recontaminated by ground water.

46. Page 106, Section 5.5.1, Paragraph 2: The statement that "excavation and incineration will also prevent any further deterioration of ground water quality at the NIROP, which would be due to leaching of additional constituents from the soil" is at odds with the claim elsewhere in the report that OU2 soils are not contributing to the ground water contamination.

The Navy shall change the narrative to resolve this inconsistency.

47. Figure 6-1, Comparison of Alternatives for OU2: The Navy shall modify this figure to compare all of the selection criteria for each remedy, not just the three shown.

48. Page 114, Section 6.3.1, Paragraph 2: The Navy shall amend the statement, "once ground water under OU2 has reached the target cleanup goals, natural volatilization of VOCs and biodegradation of PAHs in soil will lower their concentrations to levels which are protective of human health and the environment" to reflect that this prediction has been made without treatability studies or other site specific evidence to support these claims.

49. Appendix G: Calculations presented here conclude that 3.6 tons per year of VOC will be removed by SVE from OU2 soils. This is inconsistent with the assertions that only 13 kilograms VOC remain in OU2 soils.

How do the calculations regarding total soil volumes and effectiveness of SVE at OU2 relate or take into consideration the risk-based clean-up levels for VOCs in Table 3-6?

50. Page 118, Section 6.6, Summary: The MPCA staff rejects the Institutional Controls Alternative for VOCs (see previous discussion regarding Page 53, Section 4.2, Paragraph 1).

In addition, the existing ground water pump-and-treat system does not substitute for actual ground water restoration which is required under Minn. R. pt. 7060.0910.

51. Figure 5-2: Institutional Controls: The MPCA staff believes that an implemented remedy is considered permanent when it allows for unrestricted use of all land and natural resources impacted by the contaminants.

The narrative shall change the figure to reflect the above response.

52. Appendix H: See MPCA staff response for Page 65, Section 4.3.5, Paragraph 3.

The volume of soil impacted by cPAHs is not quantified in the FS Report. This information is essential for making remedial decisions concerning PAH impacted soil at the site. For example, a small volume of soil might be economically landfilled, while a larger amount of soil may not.

The Navy shall quantify the volume of soil impacted by cPAHs.