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B. S.R. Hansen & Associates

Comments on the Ecological Risk Component of EPA's "Baseline Human Health and Ecological Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn, MA" dated June 2003

Prepared for

Solutia, Inc.
575 Maryville Centre Drive
St. Louis, MO 63141

and

Stauffer Management Company LLC
1800 Concord Pike, FOP3
P.O. Box 15437
Wilmington, DE 19850

Prepared by

S.R. Hansen & Associates
P.O. Box 539
Occidental, CA 95465

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1. OVERVIEW

This report presents S.R. Hansen & Associates'[1] comments on the ecological risk component of EPA's "Baseline Human Health and Ecological Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn MA", dated June 2003. In summary, we believe that EPA's ecological risk assessment (the BERA) contains certain errors and, consequently, overestimates risk due to reliance on hypothetical impacts (based on mathematical calculations) when actual observations fail to detect such impacts. The end result is that the calculated risks overestimate the severity and areal extent of the actual risks likely to be experienced by the ecological community inhabiting the Aberjona River watershed. In this report, we identify the overestimates that are made in the BERA and provide alternative assessments of the ecological risk based on a more realistic interpretation of the available data.

It should be emphasized that, based on the criteria specified in the BERA, the only substantive ecological risk in the Aberjona River watershed is associated with the potential impact of sediment-bound arsenic on benthic invertebrates and aquatic mammals and this risk is limited to a relatively small area of the watershed (i.e., the Wells G&H site in Reach 1 and the cranberry bog in Reach 2). The risks presented by all other COPCs (i.e., both organic compounds and other metals) to all other potential biological receptors (i.e., predatory fish, bottom-feeding fish, small foraging fish, waterfowl, semi-aquatic avian species, and small terrestrial mammals) are deemed to be either negligible or low in all reaches of the watershed. We concur with this conclusion that these six receptors are at negligible or low risk throughout the watershed and, consequently, our comments are primarily directed to issues related to the BERA's estimate of the risk that arsenic poses to benthic invertebrates and aquatic mammals (as represented by muskrats).

In this document, comments are provided in the following four sections. First, the conclusion that six of the eight biological receptors which were evaluated in the BERA have negligible or low risk throughout the study area is discussed. Second, the purported risk that arsenic in Reaches 1 and 2 poses to aquatic mammals (i.e., muskrats) is reviewed and critiqued. Third, the purported risk that arsenic in Reaches 1 and 2 poses to benthic invertebrates is reviewed and critiqued. Fourth, the overall risk that COPCs pose to the ecological community inhabiting the Aberjona River watershed is evaluated and summarized.

[1] CV for Dr. S.R. Hansen is attached as an appendix to this report

2. SIX OF EIGHT BIOLOGICAL RECEPTORS HAVE NEGLIGIBLE OR LOW RISK TO ALL COPCS

Using the criteria established by EPA in the BERA, it is clear that six of the eight classes of biological receptors considered in the reported assessment face negligible to low risk from all COPCs, throughout the study area. Inclusion of these receptors in summary figures (e.g., Figure E-3) incorrectly suggests a significant risk to their populations.

In EPA's risk assessment report, the criteria used in establishing a risk level for a COPC to a biological receptor is clearly explained on page 4-121 as follows:

> *"The magnitude of risk incorporates both the degree to which the endpoint is exceeded and also the proportion of the habitat affected. Since the endpoints were based on effects on populations, a reasonable probability of risk was determined to be present only when a risk was present through the majority of the organism's habitat. If the NOAEL TRV (lower effects threshold) was exceeded across most of the site, the contaminant was concluded to pose a low risk to populations. The highest risk was associated with contaminants that exceeded upper threshold effects levels based on LOAEL TRVs, and was present throughout a majority of the indicator species' habitat within the study area. If high HQs were present in only a small proportion of the habitat for the selected indicator species, the magnitude of the overall risk to the population from exposure to the COPC was considered low."*

Using these criteria, each of these COPCs was evaluated for its potential to impact each of eight classes of biological receptors – predatory fish species (represented by largemouth bass), epibenthic fish species (represented by white sucker), small foraging fish species (represented by pumpkinseed), semi-aquatic avian species (represented by green herons), aquatic mammal species (represented by muskrats), waterfowl species (represented by mallards), small mammal species using drier wetland areas (represented by short-tailed shrews), and benthic invertebrate species (considered as a group).

Based on these evaluations, EPA concluded that the only COPCs that have a potential to pose significant risk to any of the biological receptors are arsenic, chromium, copper, lead, and mercury. More detailed evaluations of the potential impacts of these metals on the biological receptors lead to the conclusion that six classes of biological receptors (i.e., predatory fish, epibenthic fish, small foraging fish, piscivorous birds, waterfowl, and small terrestrial mammals) were at negligible or low risk. This conclusion, with which we strongly concur, is made at several points in the BERA and the underlying rationale is summarized below:

> **Predatory Fish** (represented by largemouth bass) – The risk to this group of species is deemed **negligible** throughout the study area because COPC concentrations in fish collected from all reaches of the study area were lower than benchmarks which are considered indicative of impairment. The only exception was mercury. However, since the concentrations of mercury in reference fish tissues also exceeded tissue residue benchmarks, no site-related risk was deemed warranted. The BERA discussion on the risk to predatory fish can be found on pages 4-95 to 4-97 and 4-122.

Epibenthic or Bottom-Feeding Fish (represented by white sucker) – The risk to this group of species is **negligible** throughout the study area because COPC concentrations in fish collected from all reaches of the study area were lower than benchmarks which are considered indicative of impairment. The BERA discussion on the risk to epibenthic fish can be found on pages 4-95 to 4-97 and 4-122.

Small Foraging Fish (represented by pumpkin seed) – The risk to this group of species is deemed **negligible** throughout the study area because COPC concentrations in fish collected from all reaches of the study area were lower than benchmarks which are considered indicative of impairment. The BERA discussion the risk to small foraging fish can be found on pages 4-95 to 4-97 and 4-122.

Piscivorous Birds (represented by green herons) – The risk to this group of species is deemed **negligible** throughout the study area because none of the HQs (i.e., hazard quotients) for any of the COPCs were greater than the target HQ of 1 using the lower effects threshold. The BERA discussion of the risk to piscivorous birds can be found on pages 4-90 to 4-91 and 4-122.

Waterfowl (represented by mallards) – The risk to this group of species is deemed **low** throughout the study area because none of the HQs (calculated on a site-wide basis) for any of the COPCs were greater than the target HQ of 1 using the upper effects threshold. (Evaluation on a site-wide basis is considered appropriate because these species are expected to forage over wide areas.) The lower effects threshold was exceeded on a site-wide basis for chromium, mercury, and lead. However, for these metals, the upper effects level threshold was exceeded at only a few stations and, therefore, the site-wide HQ based on the upper effects thresholds for each of these metals was less than 1. This is stated clearly in the BERA on page 4-124: "The assessment of the waterfowl endpoint indicates a low risk to populations, site-wide from exposure to chromium, lead, and mercury." The BERA discussion of the risk to waterfowl can be found on pages 4-91 to 4-93 and 4-123 to 4-124.

Small Terrestrial Mammals (presented by short-tailed shrew) – The risk to this group of species is deemed between **negligible** and **low** throughout the study area. The negligible risk level applies to all COPCs except arsenic because very few (i.e., much less than a majority of stations) of the HQs for these COPCs exceed the target HQ of 1 using the lower effects threshold and no HQs exceed the upper effects threshold target. For arsenic, a **low** risk level applies because the majority of stations have HQs exceeding the HQ target of 1 using the lower effects threshold, but only a small number of stations have HQs exceeding the upper effects threshold target. This is clearly stated in the BERA on page 4-124: "Since the number of stations exceeding the upper TEL is small, the risk to small mammal populations, due to exposure to sediment arsenic is low." The BERA discussion of the risk to small terrestrial mammals can be found on pages 4-93 to 4-95 and 4-124.

<u>EPA Response to Comment Section 2</u>**:** ***Using the criteria established by EPA in the BERA, EPA concludes that six of the eight classes of biological receptors considered in the reported***

assessment face negligible to low risk from all COPCs, throughout the study area. These are summarized in Table 4-25. The same identified risks are displayed on Figure E-3, even in cases where the overall risk to the receptor was determined to be low. The inclusion of these results on Figure E-3 was not intended to imply a significant risk to these receptors. Otherwise, the reviewers have correctly summarized EPA's analysis.

3. PURPORTED IMPACTS TO AQUATIC MAMMALS

It is concluded in the BERA that aquatic mammals (represented by muskrats) are at significant risk from arsenic in Reaches 1 and 2 of the study area. It is important to note that based on the criteria established in the BERA, aquatic mammal populations are at negligible or low risk from all other COPCs throughout the entire study area. Our evaluation indicates that the risk associated with arsenic is overstated and should be ranked as low in all reaches of the study area, including Reaches 1 and 2. The fact that muskrat populations are found in all reaches of the study area, including Reach 1, demonstrates that the predicted risk is not supported by actual observations. These conclusions are discussed below.

3.1 Based on EPA's Criteria, Aquatic Mammals Face Low Risk from Other COPCs – In total, 58 COPCs were evaluated for the risk that they might pose to aquatic mammal populations in the study area. Of these, 52 chemicals (i.e., all those evaluated except for arsenic, chromium, copper, lead, mercury, and zinc) were deemed to pose negligible risk to aquatic mammal populations. The six aforementioned metals are identified as posing significant risks to aquatic mammals at various stations in Reaches 1 and 2. However, due to the relatively few stations so affected, based on the criteria established in the BERA, five of these metals (chromium, copper, lead, mercury, and zinc) are deemed to present low risk to the aquatic mammal populations inhabiting these reaches. Inclusion of any COPCs except arsenic in summary figures (e.g., Figure E-3) incorrectly suggests that they pose a significant risk to aquatic mammal populations.

3.2 Based on EPA's Criteria, Arsenic Poses Low Risk to Aquatic Mammals in Reach 2 – In the summary and conclusions of the BERA, it is stated that muskrats face a high risk from arsenic in Reaches 1 and 2. However, based on criteria established in the BERA, this conclusion is not correct for Reach 2. The upper effects threshold for arsenic is only exceeded in 4 out of the 14 stations in Reach 2 (i.e., Stations TT-30, TT-32, TT-33, and CB-03). As stated earlier, the criterion for assigning risk, as described on page 4-121 of the BERA, specifies that risk is considered "low" for a COPC if fewer than a majority of stations exceed the upper effects threshold. Therefore, since far less than a majority of stations exceed the upper threshold, arsenic should be classified as posing a low risk to aquatic mammal populations in Reach 2.

3.3 Ingestion Rates of Arsenic are Overestimated – The purported significant risk that arsenic poses to muskrats at stations in Reaches 1 and 2 is based on a food consumption model, in which consumption of plants is the principal avenue of exposure. The estimated HQ for a COPC is directly related to the value assigned as the concentration of that COPC in plant tissue. However, in the BERA, plant concentrations are not measured at each station, but rather are estimated from sediment concentrations. Assumptions used in this estimation process can lead to large errors and, consequently, lead to the designation of "significant" risk where it does not exist. A validation of the estimation process is possible by comparing actual plant tissue concentrations measured at a station with the concentrations estimated from sediment concentrations. This validation exercise is provided in Table 4-276 of the BERA and clearly demonstrates that the model overestimates the amount of arsenic in plant tissue consumed by muskrats by up to 2.76 times. For the three site stations for which data exist (i.e., Stations 18, 20, and 21), the average overestimation of plant arsenic tissue levels is 2.03 times, leading to an overestimation of the HQs by a similar amount. If the plant tissue values used in the HQ calculations are divided by a factor of 2.03 (to compensate for the over-estimate of plant concentrations), the level of risk, as illustrated in Table 1, drops to "low" in both Reaches 1 and 2. Based on the corrected HQs, only 8 out of the 20 stations in Reach 1 have HQs which are greater than 1 when the upper effects threshold for arsenic of 150 mg/kg in the sediment is used as the benchmark. In Reach 2, the risk posed by arsenic to aquatic mammals is low regardless of this correction because the number of stations exceeding the upper effects threshold was only 4 out of 14 without the correction and 1 out of 14 with the correction.

3.4 Muskrat Populations Present in all Reaches of Watershed – It is well established that muskrat populations currently inhabit all reaches of the study area. On page 4-42 of the BERA, the author states "Muskrats have been observed in the Wells G&H 38-acre wetland at the northern end of the study area (north of Salem Street), and likely occur in all of the open water habitats within the study area". No evidence is presented that these muskrat populations are suffering from arsenic poisoning and no suggestion is made in that regard. Therefore, the purported impact is, at this point, a mathematically-derived hypothesis which is not supported by actual observations on the ground or in the water.

The inconsistency between the predicted risk and the observed populations is noted in the BERA (pg 4-90). It is suggested that effects on the population may be occurring which are not observable from qualitative data and that "muskrat populations may be present on the site whether or not the conditions at a portion of the sampled stations present a risk to survival or reproduction of individuals". This position is not consistent with the stated objective of the BERA to assess risk to populations, not to individuals. Unless otherwise demonstrated, the presence of a robust population of muskrats throughout the study area indicates that risk to populations of aquatic mammals is negligible or, at worst, low.

<u>EPA Response to Comment Section 3</u>:   The BERA identifies a series of metals that may pose a risk to aquatic mammals. These metals present a low risk to aquatic mammal populations. This low risk determination takes into consideration the limited habitat area and number of sampling stations with calculated exposure exceeding lowest observed effects level for the representative mammal species. These risks are displayed on Figure E-3 and were not intended to imply significant risk to the mammal populations.

According to the criteria set out in the document, the reviewers are correct that Reach 2 should have been omitted from being considered "high" since just 4 of 14 stations exceeded the TEL. However, this conclusion is also an artifact of the way the reaches were divided. If the Cranberry Bog had been considered part of Reach 1, then 19 out of 29 stations would have had exceedences of TEL for muskrat, and the inclusion of the stations in the Cranberry Bog with those contributing to risk for muskrat would be consistent with the criteria set in the document.

EPA does not concur that the selected model for estimating exposure of mammals to ingestion of arsenic in Reaches 1 and 2 over-estimates the exposure to muskrats. EPA acknowledges the uncertainty of estimating plant tissue concentrations from sediment concentrations using uptake factors, and provided an evaluation of the magnitude of the error in Table 4-276. However, other assumptions in the model also likely contributed to uncertainty, and likely

underestimate exposure to an equal or greater degree. In particular, as noted by other reviewers, the plant tissue samples used in the model were collected from above-ground portion of the plants. Muskrats' preferred food includes the root portions of plants like cattails. Other data sets have shown that the roots typically have significantly higher concentrations of metals. In data collected just north of the study area, for cattails, the difference between roots and stem/leafs was a factor of 6. If this factor is applied in the same way as the calculation presented in Table 1 of the comments, the majority of the stations in both reaches 1 and 2 would exceed the TEL for muskrat. These arguments emphasize the uncertainty involved in the estimates of risk. However, EPA feels that reasonable assumptions have been used in calculating risk with the data available, and the evidence indicates a risk to herbivorous mammals in the upper portion of the study area associated with the ingestion of plant material.

The final point made in the comments is that the BERA acknowledges the presence of muskrat in the study area. It is standard practice in ecological risk assessment as well as in human health assessment to base conclusions of risk on reasonable models of exposure for receptors, without corresponding documentation of mortality of individuals or reduction in populations that result from these risks. The comments contend that the population of muskrat in the study area is "robust." The presence of muskrat in the watershed does not mean that the populations are unaffected. Rather, the presence of individuals in the study area indicates that either portions of the study area are not harmful to muskrat survival or may be a result of immigration from other areas supplementing reproductive rates in the study area. Either of these results would be consistent with observation of individuals in the study area, and do not result in the dismissal of the potential risk to aquatic mammals.

Table 1. Muskrat HQs for Arsenic Based on Upper Effects Threshold TEL of 150 mg/kg in Sediment

Station	Reach	BERA HQ (Plant [As] estimated from Sediment [As])	Corrected HQ (Estimated Plant [As] corrected by dividing by 2.03)
NRSE	1	1.2	<1
14	1	<1	<1
TT-22	1	<1	<1
21	1	1.2	<1
12	1	9.9	4.9
13	1	9.1	4.5
TT-28	1	5.2	2.6
WH	1	<1	<1
BW	1	8.9	4.4
15	1	1.2	<1
20	1	2	<1
WG	1	<1	<1
TT-29	1	5.2	2.6
19	1	17.4	8.6
11	1	2	<1
WW	1	<1	<1
JY	1	1	<1
18	1	5	2.5
WS	1	1.2	<1
10	1	6	3
HQ >1	**1**	**15 of 20**	**8 of 20**
TT-30	2	4.1	2
TT-31	2	<1	<1
TT-32	2	1.8	<1
CB-01	2	<1	<1
CB-04	2	<1	<1
CB-03	2	1.9	<1
CB-02	2	<1	<1
CB-06	2	<1	<1
TT-33	2	1.7	<1
16	2	<1	<1
9	2	<1	<1
AM	2	<1	<1
KF	2	<1	<1
8	2	<1	<1
HQ >1	**2**	**4 of 14**	**1 of 14**

4. PURPORTED IMPACTS TO BENTHIC INVERTEBRATES

It is concluded in the BERA that arsenic is the only COPC that poses a significant risk to benthic invertebrate communities in the study area and that this risk occurs in Reach 1, Reach 2, and portions of the Mystic Lakes. However, an evaluation of the underlying data and the decision criteria established in the BERA indicates that the risk associated with arsenic is overstated and should be ranked as "low" in all reaches of the study area, including Reach 1, Reach 2, and the Mystic Lakes. The BERA also concludes that all other COPCs pose a "negligible" to "low" risk to benthic invertebrates throughout the study site and our evaluation indicates that this conclusion is strongly supported by the available data. The rationale underlying these conclusions is discussed below.

4.1 Based on EPA's Criteria, Arsenic Poses a Low Risk to Benthic Invertebrates Throughout Study Area – In the summary and conclusions of the BERA, it is stated that benthic invertebrates face a high risk from arsenic in Reaches 1 and 2 and to some extent in the Mystic Lakes. However, based on the criteria established in the BERA, this conclusion is incorrect for all three of these locations.

> **Mystic Lakes –** For the Mystic Lakes, the upper effects threshold for arsenic is only minimally exceeded in 2 out of the 8 lake stations and, therefore, according to the decision criteria, the risk that arsenic poses to benthic invertebrates in the lakes is low. This conclusion is stated on page 5-16 of the BERA: "Based on the limited number of stations in reach 6 (2 of 8 stations) above the upper TEL, the risk to benthic invertebrates is low in this reach".
>
> **Reach 2** - The upper effects threshold for arsenic is only exceeded in 4 out of the 14 stations in Reach 2. Since clearly less than a majority of stations exceed the upper effects threshold, arsenic should be deemed to pose a low risk to benthic invertebrate communities in Reach 2.
>
> **Reach 1** - The upper effects threshold for arsenic is exceeded in 10 out of the 20 stations in Reach 1. The criterion for substantive risk requires that a majority of the stations in a reach exceed the upper effects threshold and this criterion is not met in Reach 1.

4.2 Based on EPA's Criteria, Benthic Invertebrates Face Low Risk from All Other COPCs
In total, 58 COPCs were evaluated for the risk that they might pose to benthic invertebrate communities in the study area. Of these, 52 chemicals (i.e., all those evaluated except for arsenic, chromium, copper, lead, mercury, and zinc) were deemed to pose negligible risk to benthic invertebrates. The six aforementioned metals are identified as posing significant risks to aquatic mammals at various stations in Reach 1, Reach 2, and the Mystic Lakes. However, due to the relatively few stations so affected, based on the criteria established in the BERA, five of these metals (i.e., chromium, copper, lead, mercury, and zinc) are deemed to present low risk to the benthic invertebrates inhabiting these reaches. Inclusion of any COPCs except arsenic in summary figures (e.g., Figure E-3) incorrectly suggests that they pose a significant risk to the benthic invertebrate community.

4.3 Triad Bioassay Test Results do not Support Impacts Predicted by Exceedence of the Arsenic Sediment TEL – Stations in Reaches 1 and 2 of the study area were identified in the BERA as posing a significant risk to benthic invertebrates because sediment at those stations exceeds the arsenic upper effects threshold of 220 mg/kg. In an attempt to confirm the accuracy of these predictions, bioassay tests were performed by EPA on sediment samples collected from a number of stations in Reaches 1 and 2. The accuracy of the predicted impacts would be supported if (1) the bioassay tests demonstrated that sediments containing more than 220 mg/kg of arsenic or more were toxic to the test organisms and (2) the level of toxicity increased as the concentration of arsenic in the sediments increased above the TEL. The BERA claims that the bioassay testing provides such confirmation. However, a careful evaluation of the bioassay test results indicates that the interpretation of these results in the BERA is incorrect and that, in fact, no significant toxicity is observed in any of the site samples in Reaches 1 and 2, even those with sediment arsenic concentrations greatly in excess of the purported 220 mg/kg upper effects threshold. The rationale underlying these conclusions is summarized below.

Reference Site Results Used Incorrectly - A major problem with the BERA interpretation of the toxicity test data is the manner in which the reference site results were used. Comparison against reference site results without consideration of laboratory control results is inappropriate because it tends to produce false positives. For example, in this data set, when compared to a reference site, sediments collected from four stream stations (i.e., Stations 10, 12 TT-29, and TT-30) and four wetland stations (i.e., Stations 13, 19, TT-32, and TT-33) are identified as causing reduced growth in the *C. tentans* and/or *H. azteca* tests. However, as illustrated in Table 2, only 2 of these 8 impacts (i.e., Stations 12 and 13) were identified as exhibiting reduced growth when the results from site samples were compared against the laboratory control. The purported impacts on growth for the other six sites (i.e., those detected by comparison to reference site results but not by comparison to laboratory control results) are more likely due to exceptionally high growth in the reference samples (perhaps due to high nutrient levels or favorable grain size) than to any sub-par performance in the study area samples. Interestingly, as illustrated in Table 2, Stations 12 and 13 did not have the highest arsenic concentrations of the twelve stations sampled.

Results from reference site sediment testing are more appropriately used as a means to confirm the conclusions drawn from comparisons with laboratory control sediment results, not to replace the use of the laboratory control sediment results. The results from laboratory control sediment and reference site sediment are intended to be used in a two step evaluation. In the first step, the results from site samples are compared against the results of the laboratory control to determine if any impacts may be occurring. If any impacts are identified based on this comparison with laboratory control sediments, then the second step is performed in which the results from study area samples are compared against the results from one or more reference site sediments. If no impacts are observed in this second comparison, then it is assumed that the differences observed in the first step comparison (i.e., against the laboratory control) do not indicate significant toxicity, but are rather an artifact of "natural" conditions in the study area. When this approach is taken, only two of the study area stations (i.e., Stations 12 and 13) still have reported impacts (i.e., reduced growth).

Table 2. Predicted Impacts on Test Organism Growth based on Comparison with Laboratory Control and Reference Site Results

Station	Habitat Type	[As]	Step 1 Growth Impact vs Lab Control?	Step 2 Growth Impact vs Ref Site?	Overall Assessment Growth Impact vs Lab Control + Ref Site
13	wetland	353	Y	Y	Y**
19	wetland	4250	N	Y*	N
22	wetland	13	N	N	N
TT-32	wetland	313	N	Y*	N
TT-33	wetland	221	N	Y*	N
WH	wetland	24	N	N	N
WW	wetland	4	N	N	N
10	stream	2180	N	Y*	N
12	stream	958	Y	Y	Y**
18	stream	1490	N	N	N
TT-29	stream	747	N	Y*	N
TT-30	stream	541	N	Y*	N

* Comparison with reference site results produced a false positive because no reduced growth was detected when compared with laboratory control results

** Comparison with reference site results confirms the findings made based on comparison laboratory control results

Reference Stations and Site Stations were Tested on Different Days and Results Cannot be Statistically Compared – A second and perhaps more damaging problem with the BERA interpretation of the bioassay results is the fact that the reference sites and the study area sites were tested on different days, using different cohorts of test organisms. This major failure in experimental design, which is explained below, leads to an overestimate of the number of site samples that had statistically significantly lower growth than the reference samples.

For all four of the tests which were performed on the sediment samples in the triad evaluation (i.e., the *C. tentans* acute test, the *C. tentans* chronic test, the *H. azteca* acute test, and the *H. azteca* chronic test), the samples were divided into two groups and bioassay tests were performed on each group at different times using different cohorts of test organisms. For all tests, the groups were configured as follows:

- Group 1 included all of the stream and wetland site samples plus a laboratory control
- Group 2 included all of the reference site samples, Mystic Lake samples, and a laboratory control

The results from these tests clearly demonstrate that at the end of the test period, the Group 2 control organisms weighed more than the Group 1 control organisms. This implies that the cohort of organisms used in the Group 2 tests either grew faster or started out at a larger size than the cohort of organisms used in the Group 1 tests. Therefore, the weight of the organisms from the reference sites, which were part of Group 2, would be expected to be higher than the weight of the organisms from the site samples (in Group 1) even if the quality of the sediment in the site samples and the reference samples was exactly the same. If a correction is made for this "control weight differential", the statistically significant differences in growth between reference stations and study area sites greatly diminish, if not disappear.

This point is illustrated in Table 3 for the growth results from the *C. tentans* acute bioassay tests. In the first group of sediments tested, which included all of the stream and wetland site samples, the mean control weight was 0.92 mg/individual. In the second group of sediments tested, which included the four reference sites for these habitat types, the mean control weight was 1.13 mg/individual. Based on these control values, the test organisms in the second test group were 1.23 times heavier than those in the first test group. Based on the uncorrected data, it is reported in the BERA that four wetland stations (i.e., Stations 13, 19, TT-32, and TT-33) and three stream stations (i.e., Stations 10, 12, and TT-30) had statistically significantly reduced growth when compared to the reference stations. However, when the "control weight differential" is corrected, only two of these stations (i.e., Stations 12 and 13) have statistically significantly lower growth than the designated reference stations.

This "control growth differential" was also observed in the *C. tentans* chronic test and the *H. azteca* acute tests, with values of 1.45 and 1.1, respectively.

It should be emphasized that statistically comparing the results obtained from one set of tests against those obtained from another set of tests is routinely avoided in environmental

Table 3. Growth Results for the 10-day *C. tentans* Acute Bioassay Tests Comparisons between Site Stations and Reference Stations

Sample	Habitat Type	Sample Weight (mg)	Weight of Applicable Lab Control (mg)	Control Weight Differential	Corrected Sample Weight (mg)
SA	Ref - wetland	1.40	1.13	1.23	1.14
HB	Ref - wetland	1.73	1.13	1.23	1.41
WW	wetland	1.16	0.92	1	1.16
WH	wetland	1.06	0.92	1	1.06
TT-33	wetland	**0.99***	0.92	1	0.99
TT-32	wetland	**0.89***	0.92	1	0.89
22	wetland	1.01	0.92	1	1.01
19	wetland	**0.97***	0.92	1	0.97
13	wetland	**0.55***	0.92	1	**0.55****
04-IP	Ref - stream	1.14	1.13	1.23	0.93
01-IP	Ref - stream	1.35	1.13	1.23	1.10
TT-30	stream	**0.85***	0.92	1	0.85
TT-29	stream	0.95	0.92	1	0.95
18	stream	0.90	0.92	1	0.90
12	stream	**0.67***	0.92	1	**0.67****
10	stream	**0.81***	0.92	1	0.81

* denotes site station which had statistically significantly lower weight than both applicable reference sites based on uncorrected reference weight data

** denotes site station which had statistically significantly lower weight than both applicable reference sites based on corrected reference weight data toxicology. Different cohorts of test organisms are likely to come from different genetic stocks and be in different states of health. Consequently, it is normal to observe differences in growth and reproduction between cohorts and these differences prevent meaningful comparisons between test results obtained with these different test cohorts. Not surprisingly, this phenomenon occurred in the triad study and, therefore, the results from the stream and wetland sites cannot be meaningfully compared against the reference site results. This situation makes the information in almost all of the Figures in Chapter 4 of the BERA meaningless.

Bioassay Test Results are not Consistent – Four bioassay tests were performed on each of the sediment samples collected during the 2001 triad evaluation. Two tests examined the response of *C. tentans* (a 10-day survival and growth test and a chronic life-cycle survival, growth and reproduction study) and two tests examined the response of *H. azteca* (a 10-day survival and growth test and a 42-day chronic survival, growth, and reproduction test). For each species, the results of the acute and chronic tests were not consistent and, therefore, serious doubts are raised as to the significance of the purported impacts. These inconsistencies are apparent regardless of whether the laboratory control or a reference site is used as the standard against which impacts are assessed.

For example, based on the laboratory control (see Table 4-267), the results of the 10-day *C. tentans* test identifies statistically significantly reduced growth in two samples (i.e., Stations 13 and 12) after 10-days of exposure. However, the chronic life-cycle tests show no such impact after 20-days of exposure. To conclude that the sediments from these two stations cause an impairment in organism growth in each of these samples is obviously not supported by the combined data. If growth was slightly retarded in these two samples during the first 10 days of exposure (as indicated in the 10-day test), these impacts disappeared by day 20.

This same inconsistency is even more pronounced when the results were based on comparison with reference site data (see Table 4-268). For *C. tentans*, the results of the 10-day test identify statistically significant reduced growth after 10 days of exposure in sediments from 7 stations. However, for 3 of these (i.e., Stations 10, 12 and TT-30), there is no such impact after 20-days of exposure. For H. *azteca*, the situation is even worse. The results of the 10-day test identify statistically significant reduced growth after 10 days of exposure in sediments from 4 stations (i.e., Stations 13, 19, TT-32, and TT-33), but after 28 days and 42 days of exposure there is no such impact in any of these sediments.

As illustrated in Table 4, if these inconsistencies are removed from the list of purported “hits” in Table 4-268, the calculated Toxicity Index values would decrease significantly. The highest value would be 1 and this would be assigned to only 4 of the 14 study area sites tested (i.e., Stations 13, 19, TT-33, and TT-32). It should be noted that in Table 4, these stations were assigned a TI of 1 and not 2 because the same endpoint is being detected in both the acute and the chronic tests and, therefore, should not be double counted. It should also be noted that none of these four stations exhibited consistent reduced growth when compared to the laboratory controls (see Table 4-267). In fact, only one station (i.e. Station 13) exhibited a growth impact at all and this impact was observed in the acute test but not the chronic test.

Table 4. Revision of BERA Table 4-268

Summary of Toxicity Testing Results as Compared to Corresponding Reference Samples, Wells G&H Superfund Site OU3

		C. tentans, 10-day Acute		*C. tentans*, Life Cycle Chronic				*H. azteca*, 10-day Acute		*H. azteca*, 42-day Chronic			Toxicity Index
Station	Habitat	survival	growth	survival	growth	% emerged	% hatched	survival	growth	suvival	growth	reproduction	
SA	wetland-R												0
HB	wetland-R												0
WW	wetland												0
WH	wetland												0
TT-33	wetland		p<0.05		p<0.05				p<0.05				1
TT-32	wetland		p<0.05		p<0.05				p<0.05				1
22	wetland												0
19	wetland		p<0.05		p<0.05				p<0.05				1
13	wetland		p<0.05		p<0.05				p<0.05				1
04-IP	stream-R												0
01-IP	stream-R												0
TT-30	stream		p<0.05										0
TT-29	stream												0
18	stream												0
12	stream		p<0.05										0
10	stream	p<0.05	p<0.05										0
03-IP	pond-R												0
UF	pond												0
6	pond		p<0.05										0
4	pond		p<0.05										0

shaded box indicates an acute endpoint that is not confirmed in the chronic test and should not be included in calculation of Toxic Index

patterned box indicates acute endpoints that are confirmed in chronic test, but since they reflect the same endpoint, should not be double counted in calculation of Toxic Index

Impacts Based on Comparison with Lab Control are Minor – When compared against the results of the laboratory controls (as summarized in Table 4-267) and confirmed by reference site results, few impacts were observed in the bioassay tests and those that were observed were minor. These test results lead to the prediction that benthic invertebrate communities at these stations would not be significantly impacted by exposure to the sediments and that chemical constituents of these sediments are not biologically available in toxic quantities. These conclusions are based on the following interpretation of the bioassay results and associated analytical chemistry data:

- No mortality was observed for any of the 12 study area sites from Reaches 1 and 2, even at the highest arsenic concentrations (up to 4,250 mg/kg).

- There were no consistent statistically significant reductions in growth of either test species for any of the study area sites. For *C. tentans*, sediments from two stations (i.e., Stations 12 and 13) exhibited reduced growth in test organisms after 10 days of exposure. However, exposure to these same sediments for 20 days did not produce any such effects.

- There was no demonstrated reduction in the percentage of emerging adults in the *C. tentans* chronic test in any of the samples collected from stations in Reaches 1 and 2.

- There was no demonstrated reduction in the mean number of days to adult mortality in the *C. tentans* chronic test in any of the samples collected from stations in Reaches 1 and 2. In fact, the adults exposed to sediments from these stations appeared to live longer than the adults exposed to either laboratory control sediments or reference station sediments.

- There was no demonstrated reduction in the number of eggs produced per adult in the *C. tentans* chronic test in any of the samples collected from stations in Reaches 1 and 2. In fact, the adults exposed to sediments from these stations appeared to produce more eggs than the adults exposed to laboratory control sediments.

- There was no demonstrated reduction in the number of eggs that hatched per adult in the *C. tentans* chronic test in any of the samples collected from stations in Reaches 1 and 2. In fact, the adults exposed to sediments from these stations appeared to have more eggs hatching than the adults exposed to laboratory control sediments.

- When compared to the laboratory control, samples from only 4 of the 12 stations in Reaches 1 and 2 (i.e., Stations 19, TT-32, TT-33, WH) exhibited statistically significant reductions in the percentage of successfully hatched eggs in the *C. tentans* chronic test. However, test organisms exposed to sediments from these stations had better hatching success than test organisms exposed to sediment from the designated reference station.

- When compared to the laboratory control, only one sample of the 12 collected from Reaches 1 and 2 (i.e., Station 12) exhibited a statistically significant reduction in growth in the *H. azteca* chronic test after 42 days of exposure. However, test organisms exposed to sediment from this station grew better than test organisms exposed to sediment from the designated reference station.

- When compared to the laboratory control, only one sample of the 12 collected from Reaches 1 and 2 (i.e., Station 18) exhibited a statistically significant impairment in reproduction in the *H. azteca* chronic test after 42 days of exposure. However, test organisms exposed to sediment from this station had better reproduction than test organisms exposed to the sediment from the designated reference station.

4.4 Bioassays Performed in 1995 and 1997 do not Support the Hypothesis that Exceedence of the Arsenic Sediment TEL Causes Toxicity to Benthic Invertebrates – Bioassay tests were also performed in 1995 and 1997. If interpreted correctly, the results of these tests indicate that sediments in Reaches 1 and 2 are generally not toxic, even when the arsenic concentration greatly exceeds the purported upper effects threshold for arsenic of 220 mg/kg.

In 1995, six study area samples and two reference site samples were evaluated for toxicity. The bioassay tests performed on these samples were a 10-day survival and growth test with *C. tentans* and a 10-day survival test with *H. azteca*. The *H. azteca* test did not meet control survival and was deemed a failed test. Therefore, the results from this test are not useful in evaluating impacts. The results of the *C. tentans* test are summarized in Appendix A1 of the BERA and are said to indicate growth impairments in one stream station (i.e., Station SD-16) and 2 wetland stations (i.e., Stations SD-18 and SD-19) when compared to reference site results. What is not stated in the BERA, however, is that the bioassay report in Appendix A1 concludes that the reduced growth in the stream sample "may be due to physical characteristics of the sediment rather than from contaminants". What also is not stated in the BERA is that the results from the wetland reference site are not appropriate for comparison purposes and, therefore, there is no way to determine if the wetland study area sites have reduced growth. The problem is that the very low survival (i.e., 36%) in this reference sample makes the weight data unusable. It is often seen in bioassay tests that in samples with high mortality, the surviving individuals often demonstrate higher growth rates; perhaps because the surviving individuals have less competition for food. Table 5 summarizes the results of the 1995 *C. tentans* tests along with associated sediment arsenic concentrations. It is interesting to note that the sediment arsenic concentration in a stream sample which was deemed non-toxic in the BERA comes from a station with an average arsenic concentration in the sediment of 560 mg/l as measured in 1995 and 1,437 mg/kg based on a long-term average. This value is obviously greater than the purported upper effects threshold of 220 mg/kg.

In 1997, six study area samples and two reference site samples were evaluated for toxicity. The bioassay tests performed on these samples were a 10-day survival and growth test with *C. tentans* and a 10-day survival test with *H. azteca*. The *H. azteca* test did not meet control survival and was deemed a failed test. Therefore, the results from this test are not useful in evaluating impacts. The results of the *C. tentans* test are not summarized in the BERA, but are said to indicate growth impairments in 3 of the 6 samples when compared to reference site results. What is not stated in the BERA, however, is that reduced growth is not seen in any of these samples when compared to the laboratory control. In fact, all study area samples grew faster than the

Table 5. Results for 1995 *C. tentans* Bioassay Tests and Associated Chemistry Data

	Stream 8/21/1995 SD-07	Stream 8/31/1995 SD-12	Stream 8/23/1995 SD-16	Wetland 9/7/1995 SD-18	Wetland 8/31/1995 SD-19-1	Wetland 8/21/1995 SD-19-2	Stream Ref 8/30/1995 SD-23	Wetland Ref 8/21/1995 SD-24	Lab Control
% Survival	82.5	86.2	68.6	70	70	81.1	81.2	36	70
Avg weight (mg)	0.0014*	0.0012*	0.0008*	0.0013*	0.0010*	0.0009*	0.0017*	0.0021	0.0033
1995 mean [As]	52	560	10.9	222	1940	1940	12.6	16.4	
Data set mean [As]		1437	11	721	2518		12.6	20	
1995 Growth hit									
vs Lab Cont	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**		
vs Stream Ref	**No**	**No**	**Yes**						
vs Wetland ref				**NA**	**NA**	**NA**			

NA = Cannot compare wetland stations against wetland reference site because of excessive mortality in wetland reference sample

* = Average weight of test organisms are statistically significantly less than those in the laboraotry control

laboratory control. This is illustrated in Table 6, in which the results of the 1997 *C. tentans* tests are summarized along with associated sediment arsenic concentrations. As explained above, it is inappropriate to identify any of these stations as impacted. Also of interest is the fact that the sediment arsenic concentrations in these non-toxic samples range from 62 to 2,518 mg/kg, with 4 non-toxic samples greatly exceeding the purported upper effects threshold for arsenic of 220 mg/kg.

4.5 Lack of Toxicity in Sediments Probably due to High Concentrations of Iron – As demonstrated in a series of papers written by researchers at MIT (Hemond 1995, Aurillo et al. 1994, and Senn & Hemond 2002), arsenic in the sediments of the Aberjona River watershed are primarily in the +5 oxidation state and bound to hydrous ferric oxides (HFOs). In this form, arsenic is less toxic to benthic invertebrates because (1) arsenic in the +5 oxidation state is less toxic than arsenic in the +3 oxidation state and (2) arsenic bound to HFOs is less biologically available (i.e., tightly bound to the iron complex and unlikely to either dissolve into the pore water or be liberated in the guts of those invertebrates that ingest the sediment).

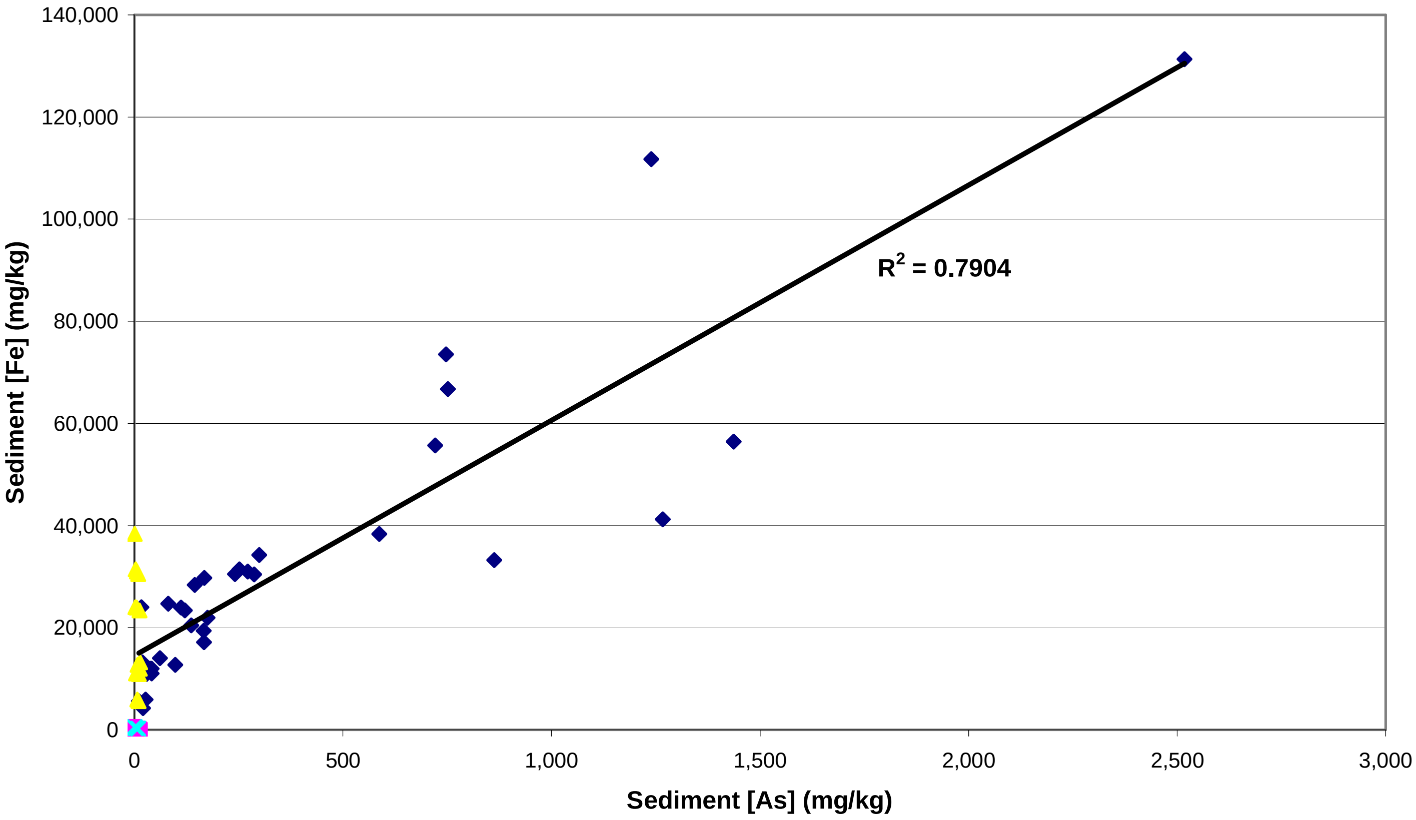
Evidence that arsenic in the sediments in Reaches 1 and 2 of the Aberjona River watershed is bound to HFOs is provided by the strong positive correlation that exists between the concentrations of arsenic and iron in sediment samples collected from these reaches over the past decade. As can be seen in Figure 1, when a linear regression is performed between the arsenic and iron sediment concentrations, there is a strong statistically significant positive correlation ($p = 0.0000$), with a correlation coefficient of 0.89 and a coefficient of determination (i.e., r^2) of 79.04%. Apparently, arsenic which entered the Aberjona River watershed was oxidized to As(V) and then became tightly bound to co-occuring hydrous ferric oxides. In depositional areas in the watershed, the HFOs settled along with the bound arsenic. Consequently, those sites that have higher sediment iron concentrations also have higher sediment arsenic concentrations. The lack of toxicity in the high iron/arsenic samples is due to the fact that the arsenic is unavailable in this iron complex to benthic invertebrates and other aquatic life.

4.6 Community Metrics do not Support Impacts Predicted by Exceedence of the Arsenic Sediment TEL - To examine the accuracy of predictions of impact based on exceedence of sediment TEL values for arsenic, an evaluation was made by EPA of the “health” of the benthic invertebrate community at each of the stations in Reaches 1 and 2 for which sediment chemistry analyses and sediment bioassay tests were performed. The accuracy of the predicted impacts based on sediment chemistry would be supported if (1) community metrics demonstrated that the benthic community was degraded at those stations which exceeded the 220 mg/kg arsenic threshold and (2) the level of degradation to the benthic community increased as the concentration of arsenic in the sediments increased. The BERA claims that the evaluation of community structure provides such confirmation. However, a careful evaluation of the community metric results indicates that the interpretation in the BERA is incorrect and that, in fact, few stations show impairment in community structure in Reaches 1 and 2, even those with sediment arsenic concentrations greatly in excess of the purported 220 mg/kg upper effects threshold. For the few stations that exhibit low diversity when compared to reference sites, there is no significant correlation with sediment arsenic concentrations. These conclusions are explained below.

Table 6. Results for 1997 *C. tentans* Bioassay Tests and Associated Chemistry Data

Sample	Habitat Type	[As] (mg/kg)	% Survival	Weight (mg/individual)	Reduced Growth vs Lab Control	Reduced Growth vs Ref Site
Lab Control			93.8	0.494		
SD-07	River	62	92.5	0.818	N	
SD-10	River	863	90	0.61	N	Y
SD-12	River	1437	83.8	0.738	N	
SD-06	Pond	74	95	0.634	N	Y
SD-18	Wetland	721	85	0.825	N	
SD-19	Wetland	2518	87.5	0.654	N	Y
FB	River Ref		63.8	1.059		
SD-25	Wetland Ref		95	1.048		

Figure 1. Arsenic as a Function of Iron in Site Sediments in Reaches 1 and 2



Community "Health" Should be Determined by Evaluating Standard Metrics – In the BERA, the health of the benthic invertebrate community at each station is summarized into a categorical metric called the "Community Index" or CI. This index includes both standard metrics of community health (i.e., # taxa, # individuals, Shannon-Weiner Index, and Pielou Index) and non-standard metrics (i.e., Community Loss Index, % Chironomids, % Oligochaetes, % Chironomids + Oligochaetes, % Dominant, and Tolerance Value of Dominant Species). How these diverse values can be summed into an overall Community Index is not explained and, therefore, the meaning of the CI is left undefined. The usual technique for assessing community "health" is to rely on the standard metrics which have been used by community ecologists for several decades and determine if, based on these metrics, any sites show lower diversity or abundance than representative reference sites.

Non-standard metrics used in the BERA to assess the "health" of the benthic invertebrate community are subjective and/or not suitable for statistical analysis and, therefore, should not be used to identify impairments. Metrics based on the percentage of chironomids and/or oligochaetes (in fact three metrics of this type are used in the BERA) are a prime example of subjectivity. The assumption is made that high levels of either of these two groups of organisms is indicative of a degraded benthic community. However, what percentage of these organisms equals impairment is never stated and, in fact, cannot be known. High percentages of these groups are to be expected in the samples collected because the selected sample locations were prime habitat for these organisms. This is acknowledged on page 4-79: "Since all of the stations sampled were selected to represent depositional areas, high abundances of Oligochaetes and Chironomids are not unexpected, since these taxa are frequently found in fine sediments". The uselessness of these metrics in evaluating impact is quickly confirmed when one of the wetland reference sites (i.e., Station SA) is shown to have a higher percentage of chironomids (i.e., 83%) than any of the 15 site stations evaluated. In fact the percent chironomids found at this reference station was more than twice that observed at any of the 15 site stations.

In addition to being subjective, three of the non-standard metrics (i.e., community loss index, percent dominance, and tolerance value of dominant species) are not suitable for statistical analysis because there is no replication within a station. For each of these metrics, the value that is indicative of impairment is not defined and differences from reference sites cannot be statistically evaluated because of the lack of replication.

The calculation of the community loss index (CLI) is another prime example of subjectivity. The CLI values for each station were determined by the comparison of the list of species observed at each site station with the list of species observed at a single reference station. For wetland and stream habitats, there were actually two reference stations and the number of species found at each of these reference stations was different. Interestingly, the reference stations selected for the CLI calculations were those with the highest number of species; thus maximizing the CLI for the site stations. Use of the other reference stations, which had fewer species, would have produced lower CLI values for the site stations. Whether these lower CLI values would have made a difference in the interpretation of the results cannot be known because the definition of a problematic CLI value is not stated.

None of the Wetland Stations in Reaches 1 or 2 Exhibited Degraded Community Structure when Compared to Reference Stations– Considering the four most commonly used metrics of community health (i.e., # taxa, # individuals, Shannon-Weiner Index, and Pielou Index), none of the seven wetland stations in Reaches 1 and 2 (i.e., Stations 13, 19, 22, TT-32, TT-33, WH, and WW) show impairment when compared against the two wetland reference sites (HB and SA). In fact, for both Shannon-Weiner Index and Pielou Index, two of the wetland sites (i.e., Stations 22 and WH) were statistically significantly more diverse than either of the reference sites.

For each metric, our conclusions were reached based on a statistical evaluation which consisted of an analysis of variance followed, if warranted, by a multiple-range test. The input data and the results of the statistical analyses are summarized in Table 7. For the "# of taxa" and the "# of individuals", the ANOVA could not detect any statistically significant differences between sites and, therefore, multiple-range tests were not deemed appropriate. For both Shannon-Weiner Index and Pielou Index, the ANOVA indicated that statistically significant differences between stations might be present. Multiple-range tests indicated that, based on these indices, two wetland sites (i.e., Station 22 and WH) were statistically significantly different from one or both reference sites. However, the results indicated that these two wetland sites were actually more diverse than the reference sites and, therefore, the community structure of these sites was not impaired.

Several of the Stream Stations in Reaches 1 or 2 Exhibited Reduced Diversity when Compared to Reference Stations, but these Reductions are not Correlated with Sediment Arsenic– Considering the four most commonly used metrics of community robustness (i.e., # taxa, # individuals, Shannon-Weiner Index, and Pielou Index), all of the five stream stations in Reaches 1 and 2 (i.e., Stations 10, 12, 18, TT-39, and TT-30) exhibit impairment when compared against the two stream reference sites (i.e., Stations 01-IP and 04-IP). In fact, for 3 of the 4 metrics (i.e., # of taxa, Shannon-Weiner Index, and Pielou Index) several of the stream sites were statistically significantly less diverse than either of the reference sites, but not because of arsenic.

For each metric, our conclusions were reached based on a statistical evaluation which consisted of an analysis of variance followed, if warranted, by a multiple-range test. The input data and the results of the statistical analyses are summarized in Table 8. For all four of the community metrics, the ANOVA indicated that statistically significant differences between stations might be present.

Multiple-range tests indicated that for the "# of organisms", there was no impairment in any of the stream stations when compared to the reference sites. One of the stream stations (i.e., Station 18) was statistically significantly different from both reference sites. However, the results indicated that this stream site had more organisms than the reference sites and, therefore, there was no impairment to community structure.

On the other hand, multiple-range tests indicated that based on the other three community metrics, each of the stream stations was less diverse than the reference sites. For "# of taxa", 3 of the 5 stream stations (i.e., Stations 10, 12, and TT-29) exhibited lower diversity that both

Table 7. Statistical Analysis of Community Metrics for Wetland Stations in Reaches 1 and 2

Station	Reach	Habitat Type	Avg # Taxa	Avg # Organisms	Shannon's Index	Pielou's Index
HB	Ref	wetland ref	18.7	439	1.33	0.400
SA	Ref	wetland ref	18.0	366	1.4	0.483
13	1	wetland	22.3	647	1.73	0.557
19	1	wetland	17.0	169	1.77	0.637
22	1	wetland	26.7	369	2.4	0.737
TT-32	2	wetland	23.7	646	1.15	0.367
TT-33	2	wetland	11.7	374	0.88	0.340
WH	1	wetland	20.0	162	2.29	0.767
WW	1	wetland	20.7	185	1.76	0.580
ANOVA p value			**0.299**	**0.289**	**0.037**	**0.033**
Pairwise Significant Differences					22 > HB	22 > HB
					22 > SA	WH > HB
					WH > HB	WH > SA

Table 8. Statistical Analysis of Community Metrics for Stream Stations in Reaches 1 and 2

Station	Reach	Habitat Type	Avg # Taxa	Avg # Organisms	Shannon's Index	Pielou's Index
01-IP	Ref	stream ref	19.7	449	1.64	0.550
04-IP	Ref	stream ref	24.3	393	2.06	0.643
10	1	stream	4.3	22.7	0.86	0.610
12	1	stream	11.0	608	0.47	0.203
18	1	stream	17.3	1583	1.01	0.353
TT-29	1	stream	11.7	1022	0.72	0.297
TT-30	2	stream	20.3	327	1.30	0.441
ANOVA p value			**0.0000**	**0.0026**	**0.0002**	**0.002**
Pairwise Significant Differences			01-IP > 10	18 > 01-IP	01-IP > 10	01-IP > 12
			01-IP > 12		01-IP > 12	01-IP > TT-29
			01-IP > TT-29		01-IP > 18	
					01-IP > TT-29	
			04-IP > 10	18 > 04-IP	04-IP > 10	04-IP > 12
			04-IP > 12		04-IP > 12	04-IP > 18
			04-IP > 18		04-IP > 18	04-IP > TT-29
			04-IP > TT-29		04-IP > TT-29	04-IP > TT-30
					04-IP > TT-30	

of the reference stations. For Shannon-Weiner Index, 4 of the 5 stream stations (i.e., Stations 10, 12, 18, and TT-29) exhibited lower diversity than both reference stations. For Pielou Index, 2 of the 5 stream stations (i.e., Stations 12 and TT-29) exhibited lower diversity than both reference stations.

For the four community metrics considered, the lower diversity observed in the stream stations is not significantly correlated with sediment arsenic concentrations. For each of the four metrics, linear regressions were performed in which the metric values for the stream stations were compared to the concentrations of arsenic measured in the sediments at these stations. The input data and the results of these regression analyses are summarized in Table 9. For three of the metrics (i.e., # of taxa, # organisms, and Pielou Index), the p-values associated with the linear regressions range from 0.377 to 0.456 and, consequently, there is very little relationship between concentrations of arsenic in the sediment and these measures of community diversity. The regression between Shannon-Weiner Index values and sediment arsenic concentrations indicated a stronger relationship ($p=0.068$), but were only marginally statistically significant since the p value exceeded the routine cut off of statistical significance of 0.05.

4.7 Crayfish do not Show Impairment – Crayfish were collected from several reaches of the study area (i.e., Reaches 1, 2, 3, 5 and a reference area) and their tissues were analyzed for COPCs. These measured concentrations were then compared to benchmarks to determine if these organisms were impaired due to harmful body burdens. As stated on page 4-71 of the BERA, the results indicated "that COPC body burdens in site crayfish are lower than those which would be associated with adverse effects" (page 4-71). This conclusion does not support the contention that benthic invertebrates are being adversely impacted in Reaches 1 and 2 of the study area.

Table 9. Correlation of Metric Results with Sediment Arsenic Concentrations for Stream Stations in Reaches 1 and 2

Station	Sediment [As] (mg/kg)	# Taxa	# Organisms	Shannon Index	Pielou Index
10	863	4.3	23	0.86	0.61
12	1437	11.0	608	0.47	0.20
18	721	17.3	1583	1.01	0.35
TT-29	747	11.7	1022	0.72	0.30
TT-30	587	20.3	327	1.30	0.44

Metric	p-Value	Correlation Coefficient r	Coefficient of Determination r^2
# Taxa	0.4559	-0.4422	19.60%
# Organisms	0.8225	-0.1399	1.96%
Shannon Index	0.0682	-0.85	72.20%
Pielou Index	0.3771	-0.5127	26.30%

<u>EPA Response to Comment Section 4</u>**: *The criterion set in the BERA for a majority of the stations within a reach was applied to wildlife receptors, and not to benthic invertebrates. This distinction is appropriate because modeled risk for wildlife receptors are based on forage areas. The endpoints selected addressed population effects, not effects on individuals. Consequently it is reasonable to set the assumption that if more than half of the stations within a reach (shrew, muskrat) exceed an exposure that is indicative of risk, that there may be sufficient habitat area affected to impact the population of animals in that portion of the study area. However, the same logic does not apply to estimating risk to benthic invertebrate populations. With benthic invertebrates, each station is equivalent to a sample community. EPA did not intend that the criteria of over 50% of the stations within the reach should be applied to benthic invertebrates.***

The risks identified by EPA's criteria were displayed on Figure E-3, even in the cases where the overall risk to the receptor was determined to be low. The inclusion of these results on Figure E-3 was not intended to imply a significant risk to these receptors. The stations identified showed evidence of impairment of benthic invertebrates through toxicity testing results, and community composition statistics. These stations also corresponded to those with the highest metals concentrations, especially arsenic.

Use of the reference sites for comparison of toxicity tests is appropriate. EPA's "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with

Freshwater Invertebrates" (Second Edition, EPA, 2000), Section 16.2, (Data Analysis) states: "In most sediment toxicity and bioaccumulation tests, test organisms are exposed to chemicals in sediment to estimate the response of the population of laboratory organisms. The organism response to these sediments is usually compared with the response to a control or reference sediment…" EPA guidance does not require the observation of an impact compared to laboratory controls, as a prerequisite for determining if there were impacts compared to reference locations. A major purpose of the laboratory controls are to establish that laboratory conditions (organism health, temperature, dissolved oxygen, ammonia concentrations), are maintained at acceptable growth levels during the test. Since the laboratory controls are based on artificial sediments, it is not uncommon to observe reduced growth of organisms in the laboratory controls, as compared to field reference. In reality, for chronic effects, the better measure of comparison for possible chronic effects is natural reference sediment.

However, the reviewers have pointed out that the experimental design was weakened by the way the samples were grouped in the lab on two different days. EPA acknowledges that the growth data of **C. tentans** *may have been influenced by the size of the organisms used on the two different beginning test days. Consequently, the EPA accepts the only stations with significant difference in* **C. tentans** *growth, as compared to laboratory controls, are stations 12 and 13, for the ten-day growth experiments. However, for stream and wetland samples, stations TT-32, 13, TT-30, 12, 18, 10 had lower growth of* **C. tentans** *as compared to laboratory controls. The three stream stations with highest arsenic concentrations (Stations 12, 18 and 10) did demonstrate the lowest growth rate of* **C. tentans***, and similarly, the four wetland stations with the highest arsenic concentrations had the lowest growth rates for* **C. tentans***, although the growth at all but 12 and 13 were not significantly different from the controls.*

Using these growth data for the 10-day **C. tentans** *tests, a consistent trend for lower growth rates on sediments with higher arsenic concentrations was observed. A plot of sediment arsenic concentration (log-transformed) versus the 10-day growth of* **C. tentans** *indicates the decreasing growth as compared with increasing arsenic concentration. This is a statistically significant relationship ($r^2 = -0.70$, $p = 0.004$, $n=15$) for wetland and stream samples alone or for all 20 samples, including the 5 lake/pond locations ($r^2 = -0.65$, $p=0.002$, $n=20$).*

This statistically significant relationship of arsenic concentration with growth of **C. tentans** *is not the sole basis of EPA's conclusion of evidence of impairment of benthic invertebrate communities associated with high concentrations of metals, including arsenic. These results were supported by other lines of evidence, discussed below and presented in the text of the BERA. The growth of* **H. azteca** *was also significantly reduced as compared to reference at stations TT-33, TT-32, 19 and 13. Growth of* **H. azteca** *was correlated to arsenic concentration in the sediment. As stated in the BERA, EPA believes these separate lines of evidence, cumulatively, indicate that there is impairment of the benthic invertebrate communities at the stations with higher metals concentrations, which is most closely associated with the concentration of arsenic.*

With regard to the 1995, and 1997 toxicity test data, EPA acknowledges that there were problems with interpreting the data for both of these rounds. This is, in part, why EPA chose to do a third and more comprehensive toxicity testing round in 2001. Due to the problems noted in interpreting the data from the earlier rounds, EPA has not put any significant weight on these test results.

EPA agrees that the predicted impacts on benthic communities associated with sediment chemistry would be supported if community metrics demonstrated that the benthic community was degraded at those stations which exceeded the 220 mg/kg arsenic threshold. However, EPA does not assume that the level of degradation to the benthic community would necessarily increase in a linear fashion as the concentration of arsenic in the sediments increased. Depending on the nature of the toxicity and resulting community response, there is no reason to assume that the response to sediment arsenic concentration of any individual community metric would necessarily be linear. As has been pointed out, there are other habitat characteristics and sediment chemistry conditions at each station (and in each sample) that could add to or ameliorate the potential toxicity of arsenic. As noted by the reviewers, the iron concentration in sediments may act to reduce, to some extent, the toxicity of arsenic to benthic invertebrates. EPA acknowledges that the toxicity of metals, including arsenic, is confounded by many variables. This contributes to the explanation of why the results of toxicity testing are as the reviewers have noted, "inconsistent." The observed variability in the response of organisms, both in the field, as shown by the benthic community analysis, and in the laboratory, reflect the variability of the response of individual organisms, and the resulting response of the community, to various levels of contaminant concentration in the sediments. As noted by the reviewers, iron concentrations in the sediment are likely a major variable in affecting the toxicity of arsenic in sediment. The correlation of iron concentration to arsenic concentrations, however, does not prove this point. As documented in the BERA, a number of metals co-vary in the sediment samples.

Community metrics used by EPA were appropriate. Many of the "standard" indices are most suitable for stream communities in riffle/run habitats. In the slow-moving, depositional environments characteristic of the samples in the river and wetlands, some of the "normal" stream metrics are not applicable. However, all of the metrics used are listed in Barbour, et. al, 1999 or Plafkin, et al. 1989 as acceptable community metrics, and most have been used in other studies of metal toxicity to evaluate similar data sets (e.g. Canfield, 1994). The only modification of these metrics was to use the tolerance of the dominant species as a simplified metric rather than Hisenhoff's Biotic Index. The metrics selected for analysis by the reviewer as "standard" are some of those least sensitive to moderate pollution or disturbance of a community. For example, number of organisms may not be sensitive to toxicity. If only the more sensitive species are impacted by sediment toxicity, this may lead to an increase in pollution-tolerant species, and no reduction in the total number of organisms present. Due to the depositional nature of the sediments, it is not surprising that high abundances of oligochaetes and chironomids are found. It has been noted in other studies that high proportions of these groups, with the relative low proportions of other taxa, are usually considered indicative of contaminated sediments (Canfield, et al., 1994). Based on these characteristics, evaluation of percent dominant and percent oligochaetes and chironomids *were reasonable, as was the use of the community loss index. The formula for the community loss index is provided in Appendix D.9.*

There are numerous ways to analyze and present benthic invertebrate community data. The current study was not designed to test for statistically significant differences between stations (with a replicate number of 3), but was intended to identify stations with several community characteristics (indicative of impairment) lower than reference, and to evaluate relationships along a gradient of contaminant concentrations. The analysis presented in the comments is selective, and the validity of the statistical approach is not supported. The statistical tests performed on the individual metrics (ANOVA followed by multiple range tests) assume normal distributions of the data, which is a condition that is not met for all of the variables (abundance and number of taxa are not normally distributed variables). However, the conclusion that stations 22 and WH are more diverse than the reference locations (Table 7) is consistent with EPA's results indicating minimal evidence of impairment or toxicity at these stations. Similarly, in the analysis of stream stations presented, although not consistent with EPA's planned analyses (and assumptions of normality not verified), the conclusions support EPA's conclusions that stations 10, 12, 18 and TT-29 show evidence of community impairment. However, EPA would disagree that the lower diversity is not correlated to sediment arsenic concentrations. Average Shannon-Wiener diversity calculated for each station is significantly correlated to log-transformed sediment concentrations for the 15 stream and wetland stations combined ($r^2 = -0.74$, $p = 0.002$, $n=15$). However, with only 7 or 8 stations, respectively, the relationship was still significant among wetland stations ($r^2 = -0.84$, $p = 0.019$, $n=7$), but was not significant for stream stations alone ($r^2 = -0.51$, $p = 0.199$, $n=8$). Output from statistical tests is included as Attachment 1 to the response to comments and will be included in the revised Wells G&H OU-3 Risk Assessment.

As EPA presented in Table 4-270, combining the results from wetland and stream sampling locations, a decrease in diversity is significantly correlated to increased sediment arsenic concentration, as were percent dominance (an acceptable measure of tolerance/intolerance, Barbour, 1999) and percent oligochaetes and chironomids (a modified, but reasonable measure of composition, Barbour, 1999) and Pielou's evenness (see results, attachment 1) . There was no significant correlation of arsenic concentration to total number of organisms or number of taxa. The lack of effect on total number of organisms is not unexpected, due to the apparent chronic effects observed in the toxicity of the sediment samples, and insensitivity of this metric to moderate toxicity or disturbance.

EPA concludes that the metrics used were standard, reasonable, and appropriate. In an attempt to simplify the presentation of multiple metrics, EPA used the calculation of a summary statistic, the CI or Community Index. With or without reliance on this metric, EPA believes that the benthic invertebrate community data consistently show lower scores for stations with higher arsenic concentrations and correlation of several metrics to increased sediment concentrations of arsenic.

EPA agrees that the benthic invertebrate data are variable. However, there are consistent trends, as documented in the BERA, and these trends in diversity, evenness, and percent dominant taxa, correlated to arsenic concentrations provide consistent, statistically significant *evidence of impairment of benthic invertebrate communities at higher concentrations of arsenic in sediment. Considering how variable the natural communities are, and how variable bioavailablity of arsenic in sediments can be, showing a statistically significant trend of several endpoints to a single contaminant is sound evidence of a relationship between community impairment and sediment arsenic concentration measured along a gradient in the field.*

EPA concurs that the BERA indicates that crayfish tissue results do not allow a conclusion of adverse effects, as a tissue residue value for crayfish was not available. However, the concentration of arsenic in tissue of crayfish on site was 11.5 times greater than at reference locations. This represented a significantly higher concentration in crayfish in reaches 1 and 2 than at reference locations (ANOVA, post-hoc comparisons, $p < 0.05$). Based on these results, EPA cannot conclude adverse effects on crayfish, however the results do not in themselves contradict the conclusion the benthic invertebrate communities are being adversely affected in Reaches 1 and 2.

Summary of benthic invertebrate endpoints:

1) *Sediment concentrations of several metals consistently exceed Severe Effect Level (SEL) values, particularly in reaches 1 & 2 for arsenic, chromium, copper, lead, mercury, and zinc, indicating potential impacts on benthic invertebrates.*
2) *Growth of* **C. tentans** *was lower than laboratory controls at stations 10, 12, 13, 18, TT-30, and TT-32. However, the impacts were statistically significant at only stations 12 and 13. No other toxicity endpoints indicated acute or chronic effects of sediment toxicity on benthic invertebrates.*
3) *EPA acknowledges that there was high variability in the results of the laboratory tests in 1995, 1997, and 2001. These apparently "inconsistent" results are not uncommon in laboratory toxicity testing when there are no acute toxic effects associated with exposure to sediments. No acute toxicity to sediment invertebrates was observed from samples collected in the study area. However, a consistent (and statistically significant) trend for lower growth rates on sediments with higher arsenic concentrations was observed.*
4) *Community metrics of benthic invertebrate populations indicated lower diversity in on-site wetland and river stations, and a significant correlation of reduced diversity with increased arsenic concentration. Other metrics, including Pielou's Evenness and percent dominant taxa also indicated lower values with higher arsenic concentrations in sediment. There was no decrease in the number of taxa or the total abundance of organisms comparing on-site stations to reference stations and no relationship of COPC concentrations to these metrics.*
5) *Crayfish tissue results do not indicate adverse effects. Concentrations of arsenic in tissue samples of crayfish from reaches 1 and 2 were higher (statistically significant), but these values were not associated with adverse effects.*

Based on these various results, EPA concludes that there is evidence that high sediment metals concentrations, particularly arsenic, may be associated with chronic impacts on benthic invertebrate communities. EPA's risk management decision will take into account the

strength of evidence of these results, as well as the severity and extent of the impacts on the ecosystem.

5. SUMMARY AND CONCLUSIONS

A thorough evaluation of the available data indicates that the BERA overestimates the risk posed by COPCs to biological receptors in the Aberjona River watershed. The available data strongly support the conclusion in the BERA that all COPCs, in all reaches of the watershed, pose negligible to low risk to predatory fish, bottom-feeding fish, small foraging fish, piscivorous birds, waterfowl, and small terrestrial mammals. On the other hand, the available data do not support the higher level of risk that the BERA assigns to aquatic mammals and benthic invertebrates. Specifically, the BERA concludes that arsenic in Reaches 1 and 2 poses a significant risk to these two groups of organisms. However, as explained in this report, risk to these two receptors is overestimated due to faulty extrapolations and misinterpretation of the available data. When these errors are corrected, the conclusion reached concerning aquatic mammal populations and benthic invertebrate communities is that they face low risk from arsenic in all reaches of the watershed (including Reaches 1 and 2) due to the fact that arsenic is bound to hydrous ferric oxides and, consequently has extremely low biological availability. These conclusions are further discussed below.

1. **BERA Concludes that all COPCs Except Arsenic Pose Negligible to Low Risk** - In the BERA, a large number of COPCs were evaluated as to the risk that they might pose to the biological community in the Aberjona River watershed. The evaluation considered the potential for impacts associated with surface water exposure and sediment exposure. In total, nine COPCs in surface water (all inorganics) and 58 COPCs in sediment (including VOCs, SVOCs, pesticides/PCBs, and inorganics) were evaluated. These evaluations considered potential impacts to a wide variety of animals represented by eight receptor classes. Of this long list of chemicals and receptor classes, it was concluded that all but six metals in sediments (i.e., arsenic, chromium, copper, lead, mercury, and zinc) posed negligible risk to all components of the biological community. In addition, of these six metals, only arsenic was identified as posing substantive risk to the biological community and this risk was limited in areal extent (i.e., to Reaches 1 and 2 of the study area) and ecological magnitude (i.e., potentially impact only two of eight receptor classes evaluated). However, careful analysis of the data, as provided in this report and summarized below, indicates that the risk associated with arsenic is overestimated in the BERA and should also be assigned a low risk to all eight receptor classes in all reaches of the study area.

2. **Risk Posed by Arsenic to Aquatic Mammals is Low –** The BERA concludes that arsenic poses a substantive risk to aquatic mammals in Reaches 1 and 2 of the study area. This risk is estimated based on a food consumption model which overestimates the concentration of arsenic in plants which are assumed to be the major food source of these species. When this overestimation is corrected, the level of risk that arsenic poses to aquatic mammals falls to "low" because less than a majority of stations in each reach

have HQs greater than 1. In addition, aquatic mammal populations are prevalent in the study area and show no signs of stress at the population level.

3. **Risk Posed by Arsenic to Benthic Invertebrates is Low –** The BERA concludes that arsenic poses a substantive risk to benthic invertebrates in Reaches 1 and 2 of the study area as well as in portions of Mystic Lakes. The primary basis for this estimated risk is a comparison of sediment arsenic concentrations with an "upper effects threshold" benchmark. The results of bioassay tests and community structure analyses are used in an attempt to confirm the benchmark-derived risk estimates. Several errors were made in the BERA in the interpretation of the data and in the design of the testing and, consequently, the risk to benthic invertebrates was overestimated. First, the criterion established for assigning risk levels was not adhered to. When properly applied, this criterion assigns low risk from arsenic to all reaches of the study area. Second, the bioassay test results indicate very minor impacts, if any, to benthic invertebrates in all of the sediment samples tested; even those sediments with arsenic concentrations greatly in excess of the purported "upper effects threshold" of 220 mg/kg. Third, the results of community structure analyses indicate that, based on standard metrics, there is no evidence that any of the wetland stations in Reaches 1 and 2 have reduced diversity or abundance. For several stream stations in these reaches, diversity is lower than that observed in reference areas, but there is no evidence that this is due to sediment arsenic concentrations. Overall, the bioassay test results and the community structure results do not confirm the level of risk predicted by the benchmark comparisons. This lack of confirmation coupled with the proper application of the criterion established in the BERA for assigning risk leads to the conclusion that arsenic in sediments in Reaches 1 and 2 poses a low risk to benthic invertebrate communities.

EPA response: EPA has responded to specific comments on the risk posed to aquatic mammals and benthic invertebrates. EPA believes that reasonable assumptions have been used in calculating risk based on sound assumptions and interpretation of the data. EPA does not believe that the BERA over-estimated the risk to aquatic mammals. Based on the dietary exposure calculations, the evidence indicates a risk to herbivorous mammals in the upper portion of the study area associated with the ingestion of plant material. EPA does not concur that the presence of muskrats in the study area is sufficient evidence to conclude that there is a lack of impairment of aquatic mammal populations.

Based on several lines of evidence in the evaluation of impacts on benthic invertebrates, EPA concludes that there is evidence that high sediment metals concentrations, particularly arsenic, may be associated with chronic impacts on benthic invertebrate communities. EPA's risk management decision will take into account the strength of evidence of these results, as well as the severity and extent of the impacts on the ecosystem.

This document has been prepared for Solutia, Inc. and Stauffer Management Company, LLC by

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Stephen. R. Hansen, Ph.D.
S.R. Hansen & Associates
P.O. Box 539
Occidential, California 95465

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S. R. HANSEN & Associates **Environmental Consulting**

STEPHEN R. HANSEN, Ph.D.
Principal

Over the past twenty-five years, Dr. Hansen has been directing research and monitoring in the areas of environmental toxicology, environmental chemistry, and community ecology. Of particular interest have been projects dealing with the prediction and mitigation of adverse impacts on natural ecosystems resulting from chemical discharge and/or physical perturbation. Performance of these projects involved the use of risk assessment techniques, toxicity identification/reduction evaluations, single and multi-species (microcosm) bioassays, field evaluations, and computer analyses.

EDUCATION:

Ph.D. (interdisciplinary ecology), University of Michigan, Ann Arbor	1974
M.S. (organic chemistry), University of Michigan, Ann Arbor	1970
B.A. (chemistry), Hunter College, New York	1964

PROFESSIONAL HISTORY:

S.R. Hansen & Associates, Occidental, CA, Principal	1987 - Present
EA Engineering, Science, and Technology, Inc. Lafayette, CA, Senior Scientist, Environmental Toxicology & Chemistry	1981-1987
United States Environmental Protection Agency Corvallis Environmental Research Laboratory, Corvallis, Oregon Research Scientist, Chemical Ecologist	1978-1981
University of Iowa, Iowa City Assistant Professor, Instructor of Zoology	1975-1980

EXPERIENCE SUMMARY:

ENVIRONMENTAL TOXICOLOGY: Designed and performed hundreds of bioassay tests to evaluate the toxicity of ambient samples of water (including surface water, stormwater runoff, and effluents) and sediment to both resident and surrogate species of fish, invertebrates, and algae. Assessed the ability of national water quality criteria, generated from a standard set of single species toxicity tests, to predict community level responses to toxic substances. Developed a mechanistic test to screen for the effects of toxicants on interspecies interactions.

Designed aquatic ecology monitoring systems to detect toxic discharges into aquatic systems. Evaluated the role played by toxic chemicals in the decline of natural populations (e.g., striped bass and salmon in the Sacramento River basin) and alterations in community structure.

TOXICITY IDENTIFICATION/REDUCTION EVALUATIONS (TI/REs): Designed and performed effluent toxicity characterization evaluations to determine if effluent limits and/or water quality objectives were being met and, therefore, if a TI/RE was necessary. These evaluations included multi-species bioassay testing, dilution modeling, and dye dispersion studies. Performed and successfully completed TI/REs on major industrial plant effluents, municipal plant effluents, sediments, and stormwater runoff samples resulting in the identification of the causative toxicants, the location of probable sources, and the evaluation of potential reduction methodologies. Participated in the development of a national-level protocol for the performance of TI/REs in industrial plants. Developed and implemented protocols for the performance of TIEs on estuarine sediments and stormwater runoff.

IMPACT & RISK ASSESSMENTS: Performed major studies to assess the impact of chemicals on the structure and functioning of natural communities. Assessed the risk associated with discharging hyper-saline water from salt ponds in and around San Francisco Bay to facilitate the conversion of these ponds to wetlands. Evaluated the impact of acid mine drainage and its constituents on salmonids in the Sacramento River System. Investigated the effects of DDTs and PCBs on marine organisms in the Southern California Bight. Determined the toxicity of bittern produced in salt pond evaporators and evaluated the potential for disposal in Northern California and in Baja Sur, Mexico. Evaluated the effects of pesticides and heavy metals on complex stream and estuarine communities. Assessed the risk to Native American populations associated with the use of wastewater treatment chemicals in North Slope, Alaska oil production facilities and their discharge into traditional fishing areas. Assessed the effects of antibiotics on nutrient uptake, competitive abilities, and population dynamics in microbial communities. Developed population and community level microcosms to simulate natural systems and to predict the impact of toxic and hazardous substances. Assessed the impact of hazardous wastes on sewage treatment processes. Determined whether wastes must be classified as hazardous, and evaluated disposal options. Evaluated the role played by toxic substances in the decline of the striped bass population in the San Francisco Bay-Delta system. Assessed the role played by selenium in producing the impacts observed in avian and aquatic populations at Kesterson Reservoir. Screened agricultural drainage waters from the San Joaquin Valley, CA for potential constituents of concern.

WATER QUALITY REGULATORY COMPLIANCE: Performed studies in support of site-specific criteria for copper, zinc, and cadmium in the Upper Sacramento River. Performed technical studies which formed the basis for the development of a site-specific water quality objective for copper in San Francisco Bay. Developed proposals for site-specific water quality-based cyanide effluent limits for two petroleum refineries in the San Francisco Bay Area. Developed a protocol for setting water quality criteria, standards, and effluent limits for the discharge of sub-surface agricultural drainage waters into receiving water bodies of California. Applied this protocol to define the research needed to set accurate effluent limits for selenium present in these agricultural waste waters. Recommended cyanide water quality standards for streams impacted by leaching processes associated with gold extraction. Developed and reviewed aquatic monitoring programs for industrial and mining clients. Evaluated wastewater treatment processes to identify the causes of TSS and toxicity problems and to determine the effectiveness of bacterial degradation.

ENVIRONMENTAL CHEMISTRY: Utilized electrochemical methods to identify the biologically available fraction of copper, zinc, cadmium, and nickel in ambient waters and effluents for use in setting site-specific water quality objectives. Developed methods to reduce the detection limit for the measurement of cyanide in ambient estuarine waters and in complex effluents. Identified diazinon as the cause of toxicity in stormwater runoff. Examined the potential of a organic chemicals to bioconcentrate in aquatic organisms. Measured the fate and effects of the insecticide Diflubenzuron in a stream community. Analyzed the role of secondary plant compounds in herbivore deterrence. Analyzed the role of insect cuticular lipids in desiccation resistance (examined the use of cuticular lipids as a key to insect species identification and systematics). Evaluated the fate and effects of selenium and cyanide in natural aquatic systems.

LITIGATION SUPPORT - Served as an expert in litigations for the following clients: (1) Stauffer Management Company concerning the impact of acid mine drainage from the Iron Mountain Mine on aquatic life in the Upper Sacramento River, (2) Ropes and Gray, Latham and Watkins, and Scadden Arps concerning the effect of DDTs and PCBs on marine life in the Southern California Bight, (3) Covington and Burling concerning when the adverse impacts of heavy metals discharged from mining operations on aquatic organisms were established in the scientific literature (4) Cargill Salt concerning the impact of a refinery waste pond on aquatic life and wildlife in the San Francisco Bay estuary, (5) City of Vallejo concerning the impact on aquatic life of exceeding effluent limits in the discharge from a wastewater treatment plant, (6) Westlands Water District concerning the discharge of subsurface agricultural drainage water to S.F. Bay and/or the Pacific Ocean, (7) Western States Petroleum Association concerning setting water quality objectives and effluent limits for selenium, (8) Unocal Oil Company concerning setting water quality objectives and effluent limits for cyanide, (9) Beveridge and Diamond concerning groundwater contamination, (10) Cargill Salt concerning the discharge of saturated brine solutions into San Francisco Bay and adjacent ponds, (11) Unocal Oil Company concerning exceedences of NPDES effluent limits for selenium, and (12) Pima County concerning setting water quality standards for effluent-dominated waterbodies.

COMMUNITY ECOLOGY: Designed and performed studies to determine the community structure of streams and lakes and to evaluate the impact of chemicals on the structure and functioning of the constituent species and functional groups. Studied the impact of mercury on clapper rails in a salt marsh community. Studied an Upper Sonoran grassland community of searching predators to determine how desiccation resistance, competition, predation, and foraging strategies influence resource utilization. Experienced in the analysis of size, age structure, spatial distribution, and resource availability for plant and animal populations. Experienced in population censusing, water chemistry measurements, habitat evaluations, and statistical analyses of multivariate data.

HYDROELECTRIC POWER: Developed input-output model for predicting effects on Sacramento River salmon population resulting from the addition of hydroelectric generation capability to Red Bluff Diversion Dam; designed and managed fisheries and hydrology field studies associated with the project. Experience in discussions and negotiations with agencies and regulatory groups. Designed and performed in-stream flow studies to assess the impacts on fisheries resources associated with water diversions from streams.

PROFESSIONAL ACTIVITIES:

Society of Environmental Toxicology and Chemistry
Water Pollution Control Federation
American Society of Testing & Materials
American Chemical Society
San Francisco Bay and Estuarine Association

PUBLICATIONS:

Love, M.S. and S.R. Hansen. 2001. Two surveys of the recreational fishery for white croaker (*Genyonemus lineatus*) on the Palos Verdes Shelf and data on DDT and PCB concentrations in white croaker from inshore waters off Palos Verdes. Submitted and accepted by CalCOFI Reports.

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Evaluation of the Potential for Reductions in Dissolved Oxygen Associated with Circulation of Saline Pond Water During the Initial Stewardship Period of Wetland Restoration. Prepared for Cargill Salt, U.S. Fish & Wildlife Service, and California Department of Fish and Game. 2003.

Evaluation of the Potential for Salinity Impacts on Bay Shrimp Associated with Circulation of Saline Pond Water During the Initial Stewardship Period of Wetland Restoration. Prepared for Cargill Salt, U.S. Fish & Wildlife Service, and California Department of Fish and Game. 2003.

Evaluation of the Potential for Impacts on Salmonid Migration Associated with Circulation of Saline Pond Water During the Initial Stewardship Period of Wetland Restoration. Prepared for Cargill Salt, U.S. Fish & Wildlife Service, and California Department of Fish and Game. 2003.

Evaluation of the Potential for Impacts to Aquatic Life due to the Presence of Heavy Metals in the Saline Pond Water Circulated During the Initial Stewardship Period of Wetland Restoration. Prepared for Cargill Salt, U.S. Fish & Wildlife Service, and California Department of Fish and Game. 2003.

Evaluation of the Potential for Impacts to Aquatic Life due to the Elevated Salinity of Pond Water During the Initial Stewardship Period of Wetland Restoration. Prepared for Cargill Salt, U.S. Fish & Wildlife Service, and California Department of Fish and Game. 2003.

Review of USEPA's Cobalt Toxicity Reference Value Position Paper. Prepared for the Blackbird Mine Site Group. 2002.

Evaluation of the USEPA Ambient Water Quality Criterion for Iron: Relevance and Appropriateness to the Blackbird Mine Site. Prepared for the Blackbird Mine Site Group. 2002.

Recreational Vessel Fishery for White Croaker on the Palos Verdes Shelf. Prepared for Montrose Chemical Corporation of California, Aventis CropScience, and Chris-Craft. 2000.

Evaluation of Agricultural Runoff as a Source of DDT to Predatory Animals on the Channel Islands. Prepared for Montrose Chemical Corporation of California, Aventis CropScience, and Chris-Craft. 2000.

Temporal Trends in the Concentrations of DDT and Its Metabolites in the Tissues of White Croaker Collected from the Palos Verdes Shelf. Prepared for Montrose Chemical Corporation of California, Aventis CropScience, and Chris-Craft. 2000.

Evaluation of the Sale of White Croaker in Retail Fish Markets in Southern California. Prepared for Montrose Chemical Corporation of California, Aventis CropScience, and Chris-Craft. 2000.

Evaluation of Whether Cargill Salt's Dredging Operations Increase the Bioavailability of Mercury and, Consequently, Adversely Impact California Clapper Rails. Prepared for Cargill Salt Company, Newark, California. 1999.

Evaluation of the Toxicological Significance of Exceedences of Permit Effluent Limits for Residual Chlorine and Heavy Metals. Prepared for the City of Vallejo, Vallejo, California. 1998.

Comments on an Ecological Risk Evaluation Report for the Palos Verdes Shelf. Prepared for Montrose Chemical Corporation of California. 1998.

Evaluation of the Environmental Impact of Brine Discharged to a Surface Impoundment. Prepared for Cargill Salt Company, Newark, California.

Evaluation of the Fate and Effects of Copper in the Haiwee Reservoir. Prepared for the City of Los Angeles, Department of Water and Power. 1997

Toxicity Identification Evaluation for the Marley Cooling Tower Stockton Facility. Prepared for Marley Cooling Tower Company. 1997.

Development and Application of Estuarine Sediment Toxicity Identification Evaluations. Prepared for the San Francisco Bay Regional Water Quality Control Board. 1996.

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Effluent Characterization Study for the Chevron Richmond Facility. Prepared for Chevron U.S.A., Inc. 1996.

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Stormwater Monitoring Program, Toxicity Identification Evaluation Study. Prepared for City and County of Sacramento. 1995.

San Francisco Estuary Regional Monitoring Program for Trace Substances - Aquatic Toxicity Studies. Prepared for the San Francisco Estuary Institute. 1995.

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Identification and Control of Toxicity in Storm Water Discharges to Urban Creeks. Prepared for Alameda County Urban Runoff Clean Water Program. 1994.

Evaluation of the Discharge of Bittern to the San Francisco Bay Estuary. Prepared for Cargill Salt. 1994.

Evaluation of the Effect of Nitrification on the Toxicity of the Haskell Street Wastewater Treatment Plant Effluent. Prepared for the City of El Paso. 1993.

Toxicity Identification Evaluation for the San Jose/Santa Clara Wastewater Treatment Plant. Prepared for City of San Jose, California. 1993.

Toxicity Identification Evaluation for the Unocal San Francisco Refinery. Prepared for Unocal Corporation, Rodeo, California. 1993.

Critical Review and Evaluation of the Mass Emissions Reduction Strategy for Selenium. Prepared for Western States Petroleum Association, Glendale, California. 1993

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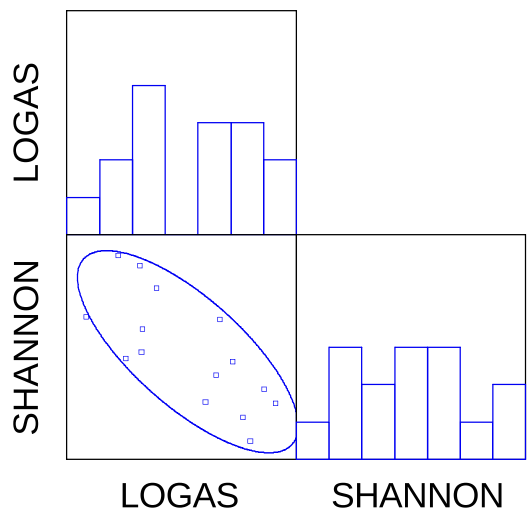
ATTACHMENT 1
EPA's Response to Comments
Statistical Output

Comparison of log-transformed arsenic concentrations to Shannon-Wiener Diversity

Data for the following results were selected according to:
(TYPE= 1) OR (TYPE= 2) (Wetland and stream stations)

Pearson correlation matrix

	LOGAS	SHANNON
LOGAS	1.000	
SHANNON	-0.736	1.000



Bartlett Chi-square statistic: 9.747 df=1 Prob= 0.002
Matrix of Bonferroni Probabilities

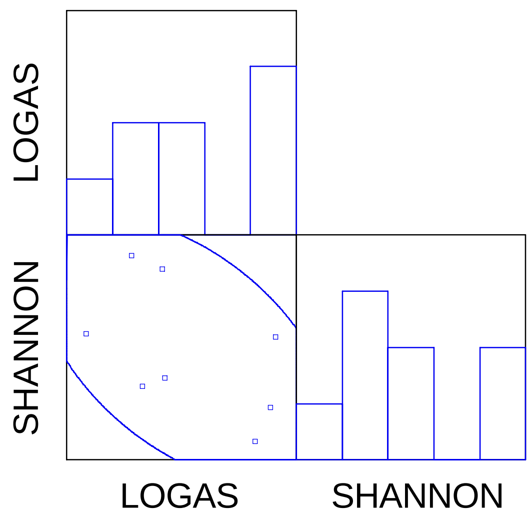
	LOGAS	SHANNON
LOGAS	0.000	
SHANNON	0.002	0.000

Number of observations: 15

Data for the following results were selected according to:
(TYPE= 1) (Stream stations, only, n=8)

Pearson correlation matrix

	LOGAS	SHANNON
LOGAS	1.000	
SHANNON	-0.508	1.000



Bartlett Chi-square statistic: 1.641 df=1 Prob= 0.200

Matrix of Bonferroni Probabilities

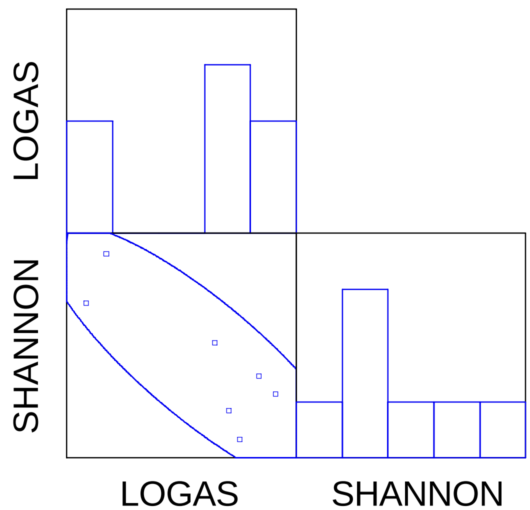
	LOGAS	SHANNON
LOGAS	0.000	
SHANNON	0.199	0.000

Number of observations: 8

Data for the following results were selected according to:
(TYPE= 2) (Wetland stations, only, n=7)

Pearson correlation matrix

	LOGAS	SHANNON
LOGAS	1.000	
SHANNON	-0.838	1.000



Bartlett Chi-square statistic: 5.445 df=1 Prob= 0.020

Matrix of Bonferroni Probabilities

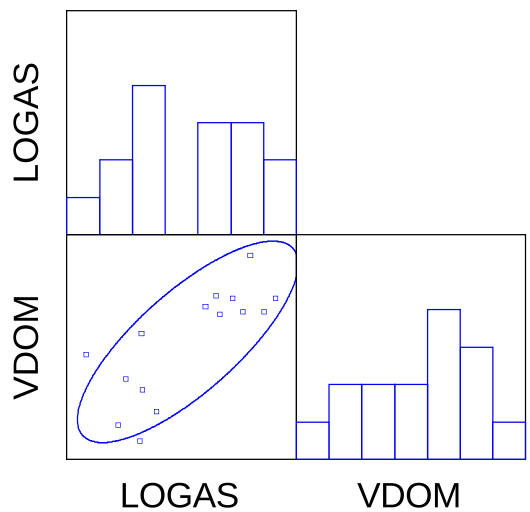
	LOGAS	SHANNON
LOGAS	0.000	
SHANNON	0.019	0.000

Number of observations: 7

Comparison of log-transformed arsenic concentrations to Percent Dominant Taxa

Data for the following results were selected according to:
(TYPE= 1) OR (TYPE= 2) (Stream and wetland stations)
Pearson correlation matrix

	LOGAS	VDOM
LOGAS	1.000	
VDOM	0.772	1.000



Bartlett Chi-square statistic: 11.337 df=1 Prob= 0.001
Matrix of Bonferroni Probabilities

	LOGAS	VDOM
LOGAS	0.000	
VDOM	0.001	0.000

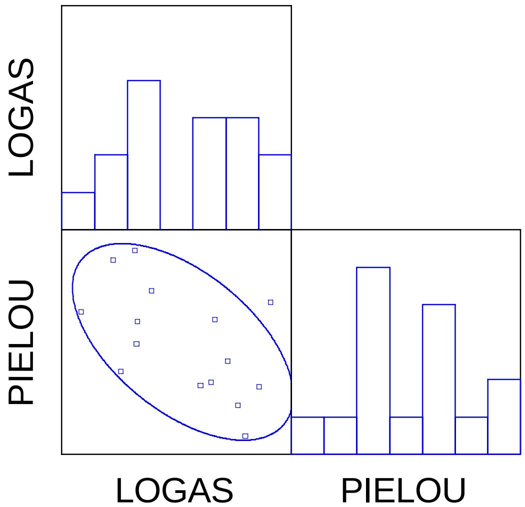
Number of observations: 15

Comparison of log-transformed arsenic concentrations to Pielou Evenness

Data for the following results were selected according to:
(TYPE= 2) OR (TYPE= 1) (Stream and wetland stations)

Pearson correlation matrix

	LOGAS	PIELOU
LOGAS	1.000	
PIELOU	-0.550	1.000



Bartlett Chi-square statistic: 4.508 df=1 Prob= 0.034
Matrix of Bonferroni Probabilities

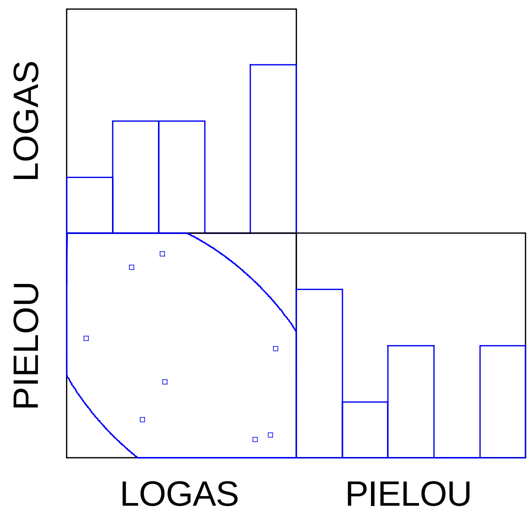
	LOGAS	PIELOU
LOGAS	0.000	
PIELOU	0.034	0.000

Number of observations: 15

Data for the following results were selected according to:
(TYPE= 1) (Wetland stations, only, n=8)

Pearson correlation matrix

	LOGAS	PIELOU
LOGAS	1.000	
PIELOU	-0.484	1.000



Bartlett Chi-square statistic: 1.470 df=1 Prob= 0.225

Matrix of Bonferroni Probabilities

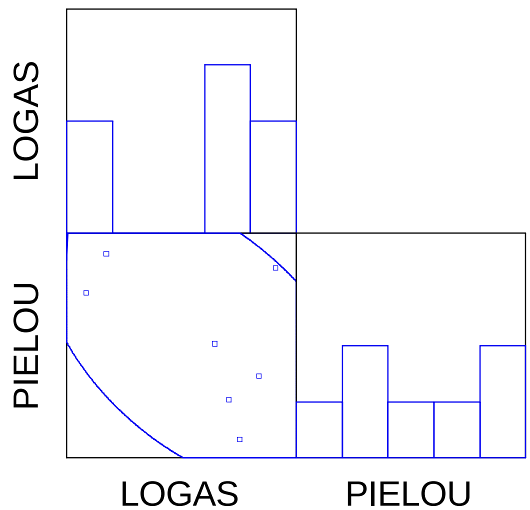
	LOGAS	PIELOU
LOGAS	0.000	
PIELOU	0.224	0.000

Number of observations: 8

Data for the following results were selected according to:
(TYPE= 2) (Stream samples, only, n=7)

Pearson correlation matrix

	LOGAS	PIELOU
LOGAS	1.000	
PIELOU	-0.503	1.000



Bartlett Chi-square statistic: 1.310 df=1 Prob= 0.252

Matrix of Bonferroni Probabilities

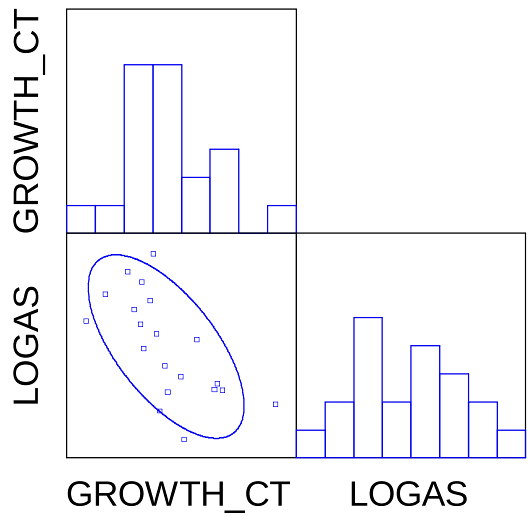
	LOGAS	PIELOU
LOGAS	0.000	
PIELOU	0.250	0.000

Number of observations: 7

Comparison of log-transformed arsenic concentrations to 10-day growth of *C. tentans*

Pearson correlation matrix

	GROWTH_CT	LOGAS
GROWTH_CT	1.000	
LOGAS	-0.645	1.000



Bartlett Chi-square statistic: 9.414 df=1 Prob= 0.002

Matrix of Bonferroni Probabilities

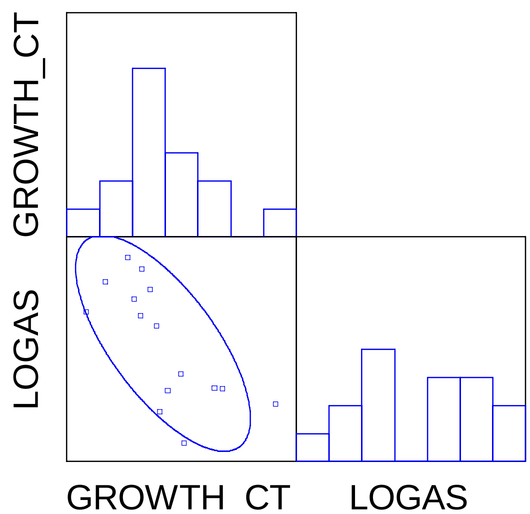
	GROWTH_CT	LOGAS
GROWTH_CT	0.000	
LOGAS	0.002	0.000

Number of observations: 20
(Includes pond samples)

Data for the following results were selected according to:
(TYPE= 1) OR (TYPE= 2) (stream and wetland, only)

Pearson correlation matrix

	GROWTH_CT	LOGAS
GROWTH_CT	1.000	
LOGAS	-0.698	1.000



Bartlett Chi-square statistic: 8.342 df=1 Prob= 0.004

Matrix of Bonferroni Probabilities

	GROWTH_CT	LOGAS
GROWTH_CT	0.000	
LOGAS	0.004	0.000

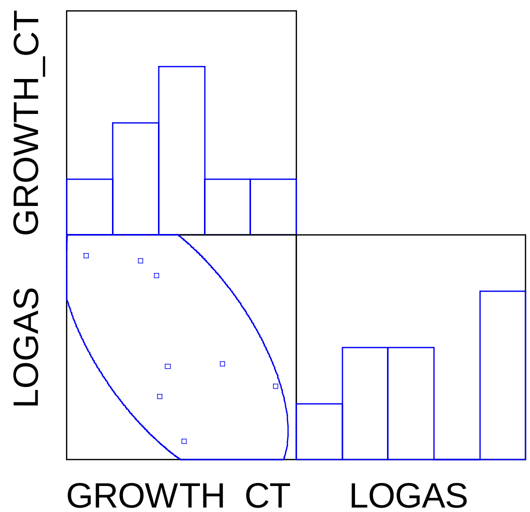
Number of observations: 15

Comparison of log-transformed arsenic concentrations to 10-day growth of *C. tentans* (stream and wetland stations, separately)

Data for the following results were selected according to:
(TYPE= 1) (Wetland stations, only, n=8)

Pearson correlation matrix

	GROWTH_CT	LOGAS
GROWTH_CT	1.000	
LOGAS	-0.619	1.000



Bartlett Chi-square statistic: 2.658 df=1 Prob= 0.103

Matrix of Bonferroni Probabilities

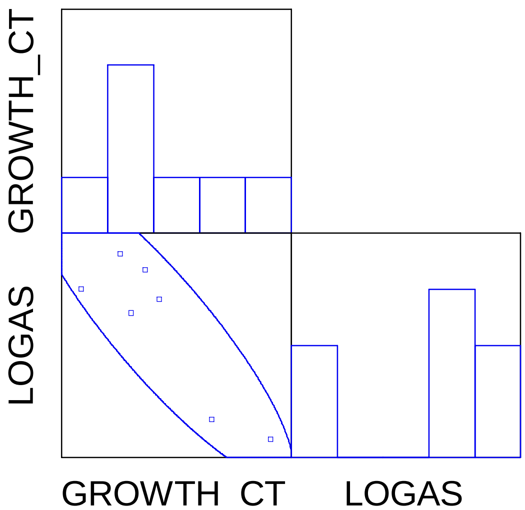
	GROWTH_CT	LOGAS
GROWTH_CT	0.000	
LOGAS	0.102	0.000

Number of observations: 8

Data for the following results were selected according to:
(TYPE= 2) (Stream Stations, only, n=7)

Pearson correlation matrix

	GROWTH_CT	LOGAS
GROWTH_CT	1.000	
LOGAS	-0.883	1.000



Bartlett Chi-square statistic: 6.808 df=1 Prob= 0.009

Matrix of Bonferroni Probabilities

	GROWTH_CT	LOGAS
GROWTH_CT	0.000	
LOGAS	0.008	0.000

Number of observations: 7

C. Solutia, Inc., Stauffer Management Company, LLC, and legal counsels Hush & Eppenberger, and Ropes & Gray

COMMENTS SUBMITTED BY
STAUFFER MANAGEMENT COMPANY LLC AND SOLUTIA, INC. ON BASELINE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT REPORT, WELLS G&H SUPERFUND SITE, ABERJONA RIVER STUDY, OPERABLE UNIT 3, WOBURN, MA
USEPA REGION 1

By:

PAUL B. GALVANI
THOMAS H. HANNIGAN, JR.
ROPES & GRAY LLP
One International Place
Boston, MA 02110
Telephone: (617) 951-7000

ROBERT F. WILKINSON
HUSCH & EPPENBERGER, LLC
190 Carondelet Plaza, Suite 600
St. Louis, MO 63105
Telephone: (314) 480-1500

Date: October 14, 2003

I. <u>INTRODUCTION</u>

These comments are submitted to the United States Environmental Protection Agency ("EPA") by Stauffer Management Company LLC ("SMC") and Solutia, Inc. ("Solutia" for itself and as attorney-in-fact for Monsanto Company (now known as Pharmacia Corporation)), (collectively with SMC, the "Commenters"), in response to the request for public comments issued by EPA with respect to its Baseline Human Health and Ecological Risk Assessment Report, Wells G&H Superfund Site, Aberjona River Study, Operable Unit 3, Woburn, MA, USEPA Region 1 (the "Report").

For the reasons set forth below, as well as in the concurrent reports prepared by Gradient Corporation ("Gradient") and Dr. Stephen R. Hansen, both the human health risk and ecological risk assessments suffer from several fundamental flaws, including: (i) the use of exposure scenarios that are unrealistic and unsupportable; (ii) the findings of unacceptable "risks" premised upon non-existing and unrealistic future uses; (iii) the use of overly conservative sediment ingestion rates for children and adults; (iv) the use of exposure point concentrations that overestimate risks at the Wells G&H and Cranberry Bog locations; (v) the improper design and interpretation of bioassay test results and community structure analyses used in assessing risk to the benthic invertebrate community; and (vi) the use of inappropriately high arsenic ingestion rates in the aquatic mammal food consumption model. The impact of these flaws is compounded by the EPA's improper refusal to allow public access to materials relied upon by EPA and its contractors. In view of these shortcomings, any decision to take anything other than "no action" based upon this Report would be arbitrary and capricious.

EPA Response: Please see responses to specific comments below.

II. THE REPORT'S EXPOSURE SCENARIOS ARE UNREALISTIC AND UNSUPPORTABLE

A. Current Exposure Scenarios

EPA's human health risk assessment report alleges current unacceptable risks at two locations – a non-cancer health risk at WH and non-cancer and cancer risks at CB-03. The supposed risks, however, are predicated on untenable exposure scenarios, entailing repeated visits to inhospitable sites where wading into and ingestion of sediment are assumed to occur. EPA's use of several, manifestly unrealistic exposure parameters, such as the frequency of exposure and the rate of sediment ingestion, results in findings that grossly overestimate the actual risk likely to be experienced by the local population. The use of more realistic exposure assumptions results in risks that fall comfortably within EPA's range of acceptable risks.

Included among the unrealistic exposure assumptions in the Report are the following:

- EPA assumes that a person will go wading in the Wells G&H wetland and come into contact with and ingest sediments containing arsenic (at the highest levels in the data set used) a minimum of 26 days per year, every year – for no fewer than 30 years – starting at age 1. This assumption is made despite the fact that the area is adjacent to a live shooting range, overrun with phragmites, cattails (rising over eight feet in height) and other thick vegetation (including vines and brambles), often flooded, underlain by soft peat sediments up to 30 feet thick that in many places will not support the weight of a human (child or adult),[1] and, during the

[1] Thus suggesting that, after the first visit, additional visits would be unlikely (or, at the very least, much less intrusive).

summer months (when the wading activity presumably would occur), teeming with mosquitos and the most dense undergrowth of the year.[2] The EPA's scenario also assumes that a child – again, starting at age 1 – will be allowed to wander off through the burrs and thorns in search of mud and then ingest sediment every single day that the child visits the site, for a period of six years. There is no conceivable way that anyone – let alone a one- or two-year old child – will be exposed to surface water or sediment with anywhere near the frequency or duration assumed by the EPA. Without such assumptions, there is no unacceptable risk.

- As for the Cranberry Bog location, which is an equally inhospitable environment, the Report goes even further and assumes that a child is allowed, starting at age 1, to wade – indeed, be physically guided to the mud, because it would be extremely difficult to get there on her own – no fewer than 104 days each year (again, for 30 years, starting at age 1), each time ingesting arsenic-containing sediment. Such an assumption is unreasonable and unsupportable.

- The Report fails to acknowledge that the frequency with which a person actually leaves a trail, boardwalk or pier to go wading into and ingest sediment – if at all – certainly will be far less than the frequency with which he or she visits the site.

A more detailed analysis of the unrealistic exposure scenarios employed in the Report is set forth in the Gradient report, filed herewith. That report also shows that the use of more

[2] It is impossible to reconcile the forbidding nature of the setting at which the alleged risks are found with the EPA's description (at page 1-9 of the Report) of the area as one featuring "prolonged and intimate contact with water and a significant risk of ingestion."

realistic exposure (though still conservative) assumptions leads to calculated risks that fall well within EPA's range of acceptable risk levels. For example, unlike the Report's assumption that a child, starting at age 1, would wade in sediment at the Cranberry Bog for four days each week, six months per year, Gradient utilizes an estimate of six days/year of wading into and ingesting sediment – itself highly unlikely. Moreover, for current risks in the Wells G&H wetland – which if anything is even less desirable for wading than the Cranberry Bog – Gradient employed an exposure frequency of four such events every year for thirty years.

EPA Response: All the samples applied to the human health risk assessment were thoroughly investigated by the Agency and risk assessors and considered reasonably accessible. The Wells G&H wetland and Cranberry Bog are areas that are well utilized by the surrounding neighborhoods and the community as a whole. The Wells G&H wetland has been reported by residents as an area that is used daily for nature walks, and recently, has been periodically utilized as a paint ball range by community children. During each visit to these areas, adults and children were observed utilizing these areas (e.g., walking dogs, playing in groups, sliding down the embankments). This site-specific information supports the use of the current 26 day/year exposure frequency (1 day per week for the warmest 6 months of the year) during which contact with contaminated media may occur. In addition, children and adults are naturally attracted to the edge of wetlands and surface water to observe the environment. Samples located in areas overgrown with reeds, vines, brambles or with excessively soft sediments, and considered not accessible, were not quantitatively evaluated for human exposures.

The Cranberry Bog wetland is used as a play area by local children. It is surrounded by residences, making it plausible that young children living in these residences may contact sediments and soils in areas adjacent to their yards. No fencing is in place to prevent a child from wandering from their yard into the wetland, which in some locations is a distance of as little as 5 to 10 feet. Therefore, for the Cranberry Bog, it is not unreasonable to assume an exposure frequency approaching one used in a residential setting. Activities reported and observed as occurring include fishing, catching frogs and insects and playing games (such as capture the flag or hide-and-go-seek). A bridge has been built to connect the eastern and western sides of the wetland to allow greater access by individuals utilizing this area recreationally. The community performs cleanup of these areas on a regular basis, which includes trash removal in the interior wetland areas. These activities may all result in contact with the wetland media.

Given the proximity of the wetlands to residential and future recreational properties, the evaluation estimated risks associated with childhood and adult exposures for a combined

duration of 30 years, as prescribed by EPA guidance. For this evaluation, it is assumed that 6 of those years are during childhood and 24 years are during adulthood. Since childhood exposures may in fact occur for longer than 6 years, a young child (age 1 to 6) was selected for evaluation to capture the reasonable maximum childhood risk that may occur during a 6 year childhood exposure duration.

Exposure frequencies used in Gradient's deterministic risk calculations are not sufficiently protective of reasonable maximum exposures that are occurring or may occur in the future at these stations. These areas are currently utilized by the community at a higher frequency than would be accounted for by an exposure frequency of 4 to 6 days/year. Future plans to develop these areas into more attractive and more highly utilized recreational spaces would only serve to increase the frequency with which individuals visit the site and contact impacted media.

According to EPA guidance, the maximum detected concentration of a contaminant is used as the reasonable maximum exposure point concentration if a calculated UCL exceeds the maximum detected concentration. It is acknowledged that the reasonable maximum EPC used at a small number of stations is uncertain due to one or a small number of elevated arsenic detects compared to the remainder of the data set. This uncertainty is specifically applicable to stations WH, CB-03 and 13/TT-27. During public presentations, this uncertainty was acknowledged, and the public was informed that the risk estimated for these stations was largely attributable to elevated arsenic levels in one or a small number of samples. This information will be added to the text of the risk assessment, with the locations of the highest arsenic levels identified. EPA will be using ProUCL version 3.0 for revisions to the draft report. Its use may result in a more accurate estimate of exposure point concentrations for these stations.

B. Future Exposure Scenarios

EPA also has calculated human health risk predicated on a speculative future use of City of Woburn property in the Wells G&H wetland. Specifically, it presupposes that the City's Redevelopment Authority will build a boardwalk into the wetland, enticing more people to visit. It then triples to 78 (from the assumption that current users will visit the site 26 times per year) the number of times the exposed visitor wades in the mud. Of course, this assumption presupposes that the visitor, including the toddler, will be allowed to leave the security of the hypothetical new walkway for the insecurity of the mud on each and every visit.

One cannot escape the fact that much of the area included as part of the Report's analysis of future land-use conditions – a wetland that is in many places inaccessible, and in any event overrun by thick vegetation – is inhospitable. Portions are submerged in water, rendering it impassable, and pools of stagnant water on the side of the path attract mosquitoes. The thick growth covering the wetland provides no indication that anyone has even tried to go through it to enter the mud. When compounded by the fact that the wetland is located immediately adjacent to a live shooting range, the desirability of a nature trail, walkway or pier extending into these areas is particularly unreasonable. To make matters worse, however, EPA assumes, without basis, that further exposures will treble, from 26 to 78 times a year!

The Report's reliance upon the draft proposal prepared by the Woburn Redevelopment Authority ("WRA") as a basis for its future-use analysis is misplaced. None of the numerous proposals mentioned by the WRA has been approved. Indeed, the WRA recently announced its plans to seek an extension on the deadline for submitting final redevelopment plans to the EPA and suggested that the WRA intends to reconsider reusing portions of the 38-acre, municipally-owned wetland for nature trails and other public uses.[3] Moreover, Joseph LeMay, the EPA Remedial Project Manager, is on the panel involved in generating the draft proposals. It is inappropriate for the EPA to boot-strap the conclusions it reaches in the Report by relying upon speculative uses – unsupported by objective, scientific survey data – that EPA officials themselves have been involved in generating, and which the City itself is considering abandoning. Exposure scenarios used in human health risk assessments must be realistic, which EPA's are not.

[3] "Wells G&H/Aberjona Study Area – City Seeks Extension For Grant to Direct Re-Use of Plan," Woburn Daily Times Chronicle, August 25, 2003.

EPA Response: It is acknowledged that children and adults would be unlikely to leave a hypothetical boardwalk each time the study area is visited. However, without the boardwalk being fenced and the exact construction details not available, it would be remiss to assume a lesser degree of exposure. This evaluation is intended to evaluate future uses proposed by the City of Woburn as described in the report. If the City of Woburn elected not to construct a pier or boardwalk, or design a pier or boardwalk to minimize exposures to sediments, then EPA may need to re-evaluate the future risks associated with NT-2 or NT-3. If the City of Woburn decided to construct a boardwalk or pier into the wetlands and unacceptable risks remained under the NT-2 or NT-3 exposure scenarios, then cleanup alternatives would need to be considered for the area to reduce those risks. The RPM for the Site, Joseph F. LeMay, is not a panel member of the advisory committee under the Superfund Redevelopment Iniative Grant. Mr. LeMay does periodically coordinate with the City of Woburn, WRA, and advisory panel regarding the status of the Site.

C. The Exposure Scenarios Were Predetermined

As more fully set forth in the Gradient report, the exposure scenarios utilized by EPA's risk assessors with regard to the two areas where theoretical current usage allegedly indicates a potential risk to human health are simply unreasonable and unsupportable, and not based on any objective evidence. In fact, EPA's representative has stated that the scenarios and assumptions related thereto resulted from negotiations between the Agency and the Massachusetts Department of Environmental Protection ("DEP"). The Report and the administrative record, however, are devoid of evidence reflecting (i) who was involved in these negotiations and what relevant qualifications they possess; (ii) how and when the negotiations transpired; (iii) what were the considerations; (iv) who made the final determinations; and (v) the bases for those conclusions.[4] As a result of this failure alone, the exposure scenarios contained in the Report cannot be defended. In fact, they are not only unsupported by the record, they are contrary to it. There is no evidence that the sites are being used with a frequency anywhere close to what EPA has assumed.

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[4] By letter to EPA's Enforcement Counsel dated April 18, 2003, representatives of SMC and Solutia requested precisely this information, but the EPA has declined to make it available. This and other failures to respond to numerous information requests are discussed more fully infra.

The predetermined nature of the exposure scenarios is further suggested by EPA's "5-Year Review Report" for the Wells G&H Superfund Site, dated August 4, 1999. In that Report, the EPA indicated that "[d]ata from March 1998 provides the remainder of the information needed to complete a risk assessment of the Aberjona River from Route 128 in Woburn to Sandy Beach at the Upper Mystic Lake in Winchester" (emphasis added). This makes plain that, as of 1998, the EPA already had all of the information it needed in order to prepare the risk assessment. However, EPA took additional samples (including at WH and CB-03, where they now claim an unacceptable risk exists), and did not issue this latest Report until 2003, four years after it was said to be ready for completion.[5]

EPA Response: EPA and the State consider the exposure scenarios reasonable and appropriate. Please see EPA's specific responses to your client's contractor, Gradient Corporation, comments. Regarding the second part of the comment, as additional information becomes available, it is reasonable and appropriate to incorporate this information into a baseline risk assessment. In 2001, EPA discussed the preliminary analytical results of data collected along the Aberjona River with Stauffer Management Company and Solutia, Inc. In early 2002, EPA provided Stauffer Management Company and Solutia, Inc., with hard copies and electronic copies of the data collected along the Aberjona River.

III. THE SEDIMENT INGESTION RATES USED BY THE REPORT ARE OVERLY-CONSERVATIVE

The Report's use of sediment ingestion rates of 200 mg/day for children and 100 mg/day for adults is overly conservative. Those values were based upon a 1994 Region I Guidance. Studies performed since that time (and described more fully in Appendix A to the Gradient report) reflect that the average and high-end soil ingestion rates are much lower than the values used in the Report. Moreover, EPA's 1997 Exposure Factors Handbook recommends soil

[5] EPA's refusal to provide public access to this and other information utilized by the EPA and its contractors is discussed more fully infra.

ingestion rates half the amount of those used in the Report: 100 mg/day for children and 50 mg/day for adults.[6]

EPA Response: The child and adult soil ingestion values recommended in the 1997 Exposure Factors Handbook represent central estimate values and are appropriate for use in a central tendency evaluation. The Exposure Factors Handbook does not recommend upper percentile values for use with a reasonable maximum scenario. Therefore, EPA Region I values, recommended for use in a reasonable maximum scenario, were selected for use. These values are consistent with ingestion rates recommended by MADEP and, as stated in the Exposure Factors handbook, are within the range of ingestion estimates from published studies. The central tendency ingestion rates utilized are the same as those recommended in the Exposure Factors Handbook for use in a central tendency evaluation.

IV. THE EXPOSURE POINT CONCENTRATIONS AND RISK CALCULATIONS USED AT STATIONS WH AND CB-03 OVERESTIMATE THE RISKS AT THOSE LOCATIONS

Also as discussed more fully in Gradient's report, the exposure point concentration ("EPC") used at station WH is heavily influenced by a single sample with a high arsenic concentration. Indeed, of the 12 total samples used at that station, 11 revealed arsenic concentrations in the range of 4.7 to 424 mg/kg, far below the EPC for that station ultimately used by the EPA (1900 mg/kg). The twelfth sample, however, had a concentration of 3230 mg/kg, which heavily influenced the EPC. Similarly, at station CB-03 in the Cranberry Bog, the Report used a maximum concentration of 1410 mg/kg as the EPC. The sediment concentrations in the other CB-03 samples were substantially lower, however, ranging from just 9.1 to 510

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[6] In addition, and as discussed more fully in Appendix B to the Gradient report, the arsenic toxicity factor used by EPA in the Report is overly conservative and results in an overestimation of the cancer risk from exposure to arsenic in sediment. In fact, estimated arsenic exposures along the Aberjona River are less than the arsenic exposures permitted in drinking water at the maximum contaminant level ("MCL") of 10 µg/L, the level designed to be health protective.

mg/kg. Thus, a person at that station will be exposed to concentrations far less than 1410 mg/kg, the EPC used in the Report.

The EPA used its software program, ProUCL, to calculate the EPC for these stations. This software statistically characterizes data sets and calculates upper confidence limits ("UCLs") on the mean concentration. Recent analyses by researchers at the University of Florida and GeoSyntec Consultants call the recommendations of EPA's ProUCL program into question, particularly as they relate to the arsenic data sets at the WH and CB-03 stations. These analyses, which include an evaluation specific to highly skewed data sets (included as Appendix C to the Gradient report), indicate that the ProUCL recommendation may be biased high, and that other UCL estimation methods which provide conservative estimates of the UCLs are still substantially lower than those developed by EPA.

EPA Response: EPA acknowledges that the reasonable maximum EPC used at a small number of stations may be uncertain due to one or a small number of elevated arsenic detects compared to the remainder of the data set. This uncertainty is specifically applicable to stations WH (sample SD-12-01-ME; 3230 mg/kg), CB-03 (sample CB-03-11; 1410 mg/kg), and 13/TT-27 (samples SD-13-01-FW and SD-13-02-FW; 4210 mg/kg and 2480 mg/kg, respectively). During public presentations, this uncertainty was acknowledged, and the public was informed that the risk estimated for these stations was largely attributable to elevated arsenic levels in one or a small number of samples. This information will be added to the text of the risk assessment, with the locations of the highest arsenic levels identified. In addition, EPA recently released version 3.0 of the ProUCL calculation software (version 2.1 was used for the draft report). ProUCL version 3.0 is being used in revisions to the draft report. Its use may result in a more accurate estimate of exposure point concentrations for these stations.

Finally, it is unclear why the Report ignored the central tendency ("CT") human health risk analysis that it performed for surface water, sediment and surface soil, in favor of the so-called "Reasonable Maximum Exposure" ("RME") cases. Indeed, the ultimate risks that the EPA found utilizing the CT approach at a number of locations were substantially lower than the

RME cases. The EPA nevertheless opted to base its conclusions on the worst-case scenarios. Simply put, use of the RME in this case is unsupported by the factual record.

EPA Response: The human health risk assessment has evaluated and documented the risk at all human health exposure stations for both the central tendency (CT) and reasonable maximum exposure (RME) scenarios. Table 5-1 provides an overall risk summary table for the exposure stations, showing the CT as well as RME estimated risks. These risk calculations, along with site-specific considerations, will be factored into risk management decisions for the study area. The purpose of the Executive Summary is to provide a concise overview of the results of the risk assessment. Therefore, only the areas with estimated CT and RME risks exceeding regulatory guidelines and major risk contributors for those areas have been included.

V. <u>THE EPA IMPROPERLY HAS REFUSED TO ALLOW PUBLIC ACCESS TO INFORMATION UTILIZED BY THE EPA AND ITS CONTRACTORS</u>

Commenters are hindered in their ability to respond to the assumptions, calculations and conclusions in the Report because of EPA's refusal to provide to the public access to all information cited in the Report. Indeed, notwithstanding numerous requests from the Commenters during the past three years for access to the information, the EPA repeatedly has refused to make the information available, invoking an indefensible claim of "deliberative process privilege." Thus, in preparing the Report, the EPA and its contractors have been able to view and rely upon materials to which the public has been denied access.[7]

EPA Response: Summaries of the analytical results of the 1995 and 1997 sampling were presented in the Foster Wheeler Data Compendium (1995) and the Metcalf & Eddy

[7] Page 2-33 of the Report claims that "results from the 1995 and 1997 investigations [are] presented in Appendix A.1 and A.2 (Foster Wheeler, 1996; M&E, 1998)," but no "results" are provided. In fact, the actual conclusions of Foster Wheeler and Metcalf & Eddy concerning risk assessments are not set forth anywhere in the Appendices. In addition, the database provided by EPA fails to include some of the samples that EPA used in their exposure areas (specifically, at stations 13/TT-27 and NT-1).

Supplemental Data Compendium (1998) which have been included in Appendices A.1 and A.2, respectively. The risk conclusions resulting from the 1995, 1997, and 2000, 2001, and 2002 data were presented in the March/May 2003 Wells G&H OU-3 Risk Assessment Report. As stated on page 3-4 of the report text (Volume I), station 13/TT-27 consisted of samples from stations 13 and TT-27 combined and station NT-1 consisted of samples collected from stations BW, WG, TT-29, 19, and sample SD-12-01-ME combined. The analytical data from these combined stations is presented in the data base by separate stations or samples.

VI. ECOLOGICAL RISK ASSESSMENT POINTS

The ecological risk assessment portion of the Report identified heightened "risk" – ascribed to elevated levels of arsenic – primarily to muskrats and benthos. Notably, the elevated risk was limited to Reach 1, the Wells G&H site. With respect to muskrats, though, the "significant" risk in Reach 1 is primarily based upon a food consumption model, in which consumption of plants is deemed to be the principal avenue of exposure. However, assumptions used in this estimation process can lead to substantial errors and, consequently, a finding of "significant" risk where it does not exist. More importantly, the finding of a hypothetical risk to muskrats is itself belied by the Report's own observation that the muskrat population currently inhabits all reaches of the study area. No evidence is presented that the muskrat population is suffering from arsenic, and no suggestion is made in that regard. The alleged impact is, at best, a mathematically-derived hypothesis that is unsupported by actual observation on the ground or in the water. Simply put, the risk associated with arsenic is overstated by the Report and should be ranked as low in all reaches of the study area.[8]

EPA Response: EPA used commonly accepted modeling methods of exposure estimation for the dietary exposure of muskrats, using reasonable assumptions. These issues are discussed more fully in the responses to the comments from Dr. Stephen R. Hansen, submitted herewith. It is standard practice in ecological risk assessment as well as human health risk assessment to

[8] These issues are discussed more fully in the report of Dr. Stephen R. Hansen, submitted herewith.

base conclusions of risk on reasonable models of exposure for receptors, without corresponding documentation of mortality of individuals or reduction in populations that result from these risks. The presence of muskrat in the watershed does not mean that the populations are unaffected. Rather, the presence of individuals in the study area indicates that either portions of the study area are not harmful to muskrat survival or may be a result of immigration from other areas supplementing reproductive rates in the study area. Either of these results would be consistent with observation of individuals in the study area, and do not result in the dismissal of the potential risk to aquatic mammals.

With respect to benthic invertebrates, EPA's determination of "significant" risk in Reach 1 is primarily based on the exceedence of an "upper effects threshold" concentration of arsenic in sediment samples collected from within the reach. However, available data indicate that this threshold is set too low because it overestimates the bioavailability of arsenic. In addition, the results of bioassay tests and community analyses do not support the assigned risk levels. Bioassay tests demonstrate that benthic invertebrates survive, grow, and reproduce in samples which greatly exceed the selected threshold concentration. Community analyses demonstrate that benthic invertebrate communities found at sites which exceed the threshold concentration are as diverse and abundant as those found in reference areas. Based on the weight of evidence, the benthic invertebrate community in Reach 1 should be assigned a "low" risk from arsenic in the sediments.

EPA Response: Based on several lines of evidence in the evaluation of impacts on benthic invertebrates, EPA concludes that there is evidence that high sediment metals concentrations, particularly arsenic, may be associated with chronic impacts on benthic invertebrate communities. These issues are discussed more fully in the responses to the comments from Dr. Stephen R. Hansen, submitted herewith. EPA's risk management decision will take into account the strength of evidence of these results, as well as the severity and extent of the impacts on the ecosystem.

VII. <u>SPECIFIC COMMENTS ON TEXT</u>

In addition to the general comments outlined above, SMC and Solutia provide the following specific comments, organized by page number:

E-3: The Report should explain the basis for using "[o]nly those sediment samples collected from beneath two feet or less of standing water . . . in the quantitative evaluation."

***EPA Response:** As stated in EPA guidance, data from "surficial, near-shore sediments should be used" (USEPA, 1989). The use of sediment data from areas where the surface water depth is two feet or less meets this criterion, especially when considering childhood exposures. Adult may be exposed to sediments located in areas where the water depth is greater than 2 feet. However, it is anticipated that these sediments will not remain adhered to the skin to any significant extent but will wash off by the time the adult surfaces from the water. Sediment samples collected from areas where the surface water depth was greater than two feet were collected for and utilized in the ecological risk assessment. These samples are not considered applicable for use in the human health risk assessment.*

E-3: The Report should indicate the basis by which the EPA assigned the "highest," "typical" or "lowest" exposure potential (e.g., what measured proximity to nearby residences qualified it as "highest exposure potential," and what factor(s) were used to conclude that a location was "partially isolated" or "industrial" such that a determination of "lowest exposure potential" was found).

***EPA Response:** Site-specific information gathered during site visits, along with professional judgment, was used to qualitatively determine stations assigned "high", "typical", and "low" exposure potential. Current land use as well as the potential for future land use change or development (e.g., zoning and surrounding land use) was also factored into the decision.*

E-3: The Report should specify the basis for the assumption that future land use for stations NR, 22/TT-22, WG, WH and AS will increase as a result of future development. Similarly, the Report fails to provide the basis for the assumption that the physical barriers limiting current access to stations 13/TT-27, JY, WW and TT-31 will be removed.

***EPA Response:** Future plans by the City of Woburn include development of the Wells G&H wetland, including stations NR, 22/TT-22, WG and WH, into a passive recreational space. The evaluation of the NR stations is intended to evaluate future uses proposed by the City of Woburn as described in the report. Station AS is located in an area that may be further developed for residential use by the expansion of condominiums located in the vicinity of this station. The future exposure frequency used for stations 13/TT-27, JY, WW and TT-31 factors in that the land to the south of this area, with current controlled access, may become developed for recreational purposes along with the removal of access restrictions. Should this occur, these stations would also become available for public recreational use with access occurring through the currently controlled property. Since the sampling locations are in areas considered accessible by humans (e.g., close to shore and in shallow water), contact with impacted media may occur. An exposure frequency of 78 days per year is sufficiently*

protective and not unreasonably conservative considering the land to the south of this station is currently being considered for development as an ice skating facility which would bring families, including young children, to this area.

E-5: The Report should indicate the relevance, if any, to the risk assessment of comprehensive surface water data to be collected from ten surface water gauging and monitoring stations along the entire Aberjona River.

EPA Response: The comprehensive surface water data collected south of Route 128 will be evaluated in the revised Wells G&H OU-3Risk Assessment Report. The surface water data collected to the north of Route 128 will be incorporated into the baseline risk assessment being conducted for the study area north of Route 128. The baseline risk assessment being conducted for the area north of Route 128 will be released with the Comprehensive RI.

Table E-1: Because all of the exposure scenarios set forth on Table E-1 relate to either current or future waders, the Report should describe precisely the type of wading activity contemplated, as well as the location and temporal duration of such activity under these assumed scenarios. Are the theoretical waders standing perfectly still in the wetlands? At precisely the point of highest concentration of sediment concentration? For how long?

EPA Response: The exposure assessment of the baseline human health risk assessment explains the activities may occur while wading exposures are being incurred. The exposure frequencies and exposure durations are also provided. To characterize exposure point concentrations (EPCs), the upper confidence limit (UCL) on the arithmetic mean is used. This calculated value represents an estimate of the typical concentration a receptor may contact while moving about the station. For a small number of contaminants, the UCL exceeded the maximum detected value and the maximum detected value was used as the EPC. EPA acknowledged that the reasonable maximum EPC used in this case may be uncertain due to one or a small number of elevated detects compared to the remainder of the data set for that compound. ProUCL version 3.0 is being used in revisions to the draft report. Its use may result on a more accurate estimation of exposure point concentrations for these stations.

1-1: The Report states that the EPA intends to incorporate the final risk assessment into a comprehensive remedial investigation ("RI"), documenting all the data collected along the Aberjona River and Halls Brook Holding Area to the Mystic Lakes and explaining "the nature and extent of contaminants and their fate and transport mechanisms." The relationship between the RI and the Multi-Source Groundwater Response Plan ("MSGWRP") is unclear (i.e., has the MSGWRP been abandoned, superseded, or modified by the forthcoming RI?). The EPA should include in its analysis all of the potential sources of arsenic identified by the Commenters in previous communications to the EPA.

EPA Response: The MSGRP is an RI/FS, which incorporates Groundwater Surface Water Investigation Plan (GSIP) data collected by the Industri-Plex Settlers under the Industri-Plex Consent Decree, as well as other data collected/obtained to support the MSGRP RI/FS. One aspect of the GSIP is the "evaluation of the potential for future, off-site migration of metals through the surface water pathway". The surface water pathway immediately downstream of the Industri-Plex is the Halls Brook Holding Area and Aberjona River. The Comprehensive RI Report referred to in these responses is the MSGRP RI, and will further explain nature and extent and fate and transport.

1-2: It is unclear from the description of the Aberjona River study area provided in the Report whether the area matches up geographically with the MSGWRP study area. If the EPA has drawn different geographical boundaries around these respective study areas, the Report should provide the basis for that decision.

EPA Response: The Comprehensive RI (MSGRP) will further explain nature and extent and fate and transport.

1-3: The Report should set forth the basis for the exclusion of tributaries to the Aberjona River and uplands within their respective sub-watersheds from the study area boundaries. To the extent that aerial photographs of the Wells G&H superfund site for years prior to 1938 exist, they should be considered.

EPA Response: The Comprehensive RI Report will further explain nature and extent and fate and transport. The RI Report will consider all the existing information, including EPA's historical aerial photographic analyses.

1-5: Reference is made to a 1986 report prepared by Planning Research Corporation (PRC). The Report should set forth the purpose(s) and conclusion(s) of those evaluations, as well as the purpose(s) and conclusion(s) of the risk assessment completed by Ebasco Corporation in 1988.

EPA Response: This information is documented in the Wells G&H Superfund Site Administrative Record, which supported the 1989 Wells G&H ROD.

1-6: The Report should indicate the status of negotiations and clean-up of the Olympia Nominee Trust property.

EPA Response: The report is a baseline risk assessment, and is not intended to provide a status of enforcement negotiations. Status of enforcement negotiations should be directed to EPA enforcement counsel.

1-7: The Report improperly identifies certain of the settling defendants at the Industri-Plex Superfund Site. Solutia, Inc. is not "formerly Monsanto", and SMC is not "formerly Stauffer Chemical." Pharmacia Corporation is the former Monsanto Company; Solutia, Inc. was spun off from Monsanto Company in 1997 and Monsanto Company eventually changed its name to Pharmacia Corporation.

EPA Response: Noted.

1-7: The Report improperly characterizes the remedy under the Industri-Plex Consent Decree. The interim groundwater remedy regarding hot spot treatment related only to benzene and toluene, and the groundwater/surface water investigation plan was to investigate <u>potential</u> for <u>future off-site</u> migration. Thus, the Consent Decree did not address, and was not intended to address, the issue of alleged historical releases and discharges along the river upon which EPA focuses in the current risk assessment and apparently in the forthcoming RI.

EPA Response: The purpose of the Groundwater/ Surface water investigation plan is outlined in Appendix H of the 1989 Industri-Plex Consent Decree. The Report was a baseline risk assessment from Route 128 to the Mystic Lakes. The Comprehensive RI Report will further explain nature and extent and fate and transport.

1-7: The Report fails to explain the basis for simply incorporating the MSGWRP data into the RI for the Aberjona River. The basis for mentioning the MSGWRP only under the sub-heading describing the Industri-Plex Superfund Site should also be set forth.

EPA Response: The Report was a baseline risk assessment between Route 128 to Mystic Lakes. The Comprehensive RI Report will further explain nature and extent and fate and transport.

1-8: It is unclear why a discussion of various MIT studies – which were conducted along the <u>entire</u> length of the Aberjona River – is found under the sub-heading describing the Industri-Plex Superfund Site. Indeed, there is no basis at all to tie these studies to the Industri-Plex site alone, when there is a plethora of other potential contributors to environmental conditions along the Aberjona River watershed (by way of example only, owner/operators of historic and current landfills for Woburn, railroad owners and operators, tanneries along the watershed, and any entities that have applied pesticides or herbicides in the area).

EPA Response: The MIT studies were mentioned in the text in the context of the samples that were collected at Halls Brook holding area, which is part of the Industri-Plex Site. The Comprehensive RI Report will further explain nature and extent and fate and transport.

1-9: The Report should explain the basis for the EPA's conclusion that "prolonged and intimate contact with water and a significant risk of ingestion" by way of wading exist in those portions of the River identified in the risk assessment.

EPA Response: The text referred to in the comment is part of the MADEP definition of Class B waters. As stated earlier in the text on page 1-9, the Aberjona River is classified by the Commonwealth as a Massachusetts Class B surface water.

1-10: The Report purports to rely upon information set forth in the "Upper Mystic Lake Watershed Urban Runoff Project Main Report," prepared in 1982 by the Department of Environmental Quality Engineering ("DEQE"), but fails to set forth the conclusions reached by the DEQE therein.

EPA Response: The Comprehensive RI Report will further explain nature and extent and fate and transport.

1-16: Included among the general objectives of the Aberjona River Study is the identification of sampling locations "where COPC concentrations in environmental media do and do not appear to pose potential risk to human and ecological receptors, based upon conservative exposure and toxicity assumptions." The Report should clarify what is meant by "conservative exposure and toxicity assumptions" and explain precisely how the EPA derived such assumptions.

EPA Response: Exposure scenarios and exposure and toxicity assumptions are explained in the Report, as well as EPA's responses to public comments (see responses to your contractor's Gradient Corporation and Hansen comments, as well as responses to ASC's comments).

2-1: The statement that site investigation activities were begun in 1995 is incorrect. EPA has been aware of and investigating the Wells G&H Superfund Site and related areas since at least the 1980s.

EPA Response: Site investigation activities from which analytical data was used to evaluate human health and ecological risk in the Wells G&H March/May 2003 Risk Assessment were begun in 1995.

2-11 and 2-12: The Report indicates that stations WH-01 through -10 and WW-01 through -12 in the eastern and western portions of the Wells G&H wetlands were not sampled until the 2000/2001 sampling round. The Report should indicate the reason(s) why those locations were not sampled or evaluated in the prior sampling rounds and investigations of the River. Similarly, an explanation should be provided as to why samples were not taken at locations CB-03-01 through -12 (the cranberry bog north of stations 9 and 16) prior to the 2000/2001 sampling round.

EPA Response: Stations WH, WW, and CB03-01 through 12 were not selected until 2000/2001. In 1995, sampling locations were selected in areas that were anticipated to be most impacted by potential contamination. In 1997, sampling locations were selected in depositional areas to fill data gaps. Subsequent to 1997, sampling was primarily focused on collecting additional samples for use in the Human Health Risk Assessment. Samples collected after 1997 that could be used to evaluate ecological risk were also included in the Ecological Risk Assessment.

2-15, 2-16, and 2-18: In its discussion of the 1995 sampling round, the Report notes that sediment samples were collected "where undisturbed sediment existed from a depth of 0-6 inches." The Report should explain the basis for this decision (i.e., why EPA did not take samples from locations deeper than six inches – particularly where page E-3 of the report notes that sediment samples collected from "two feet or less of standing water were used" in the quantitative evaluation – and why it did not differentiate among the depths within the zero to six inch range). The same questions should be answered with respect to the 1997, 1999, and 2000/2001 sampling rounds.

EPA Response: Samples were collected at a depth of 0-6 inches, since this depth of sediments is most likely to have exposure to ecological receptors. Incidental sediment ingestion of waterfowl, mammals and fish would be only in the top few inches of sediment. Even assuming scouring events could remove the top few inches of sediment, exposing underlying sediments to the surface, EPA considers 0-6 inches as a reasonable estimate of likely exposure of ecological receptors. It is standard practice to sample benthic invertebrate communities at a depth of 0-6 inches, since this is usually the depth of greatest biological activity. Exposure pathways for normal ecological exposure were not identified for deep contamination, therefore these were not considered significant and were not included in the BERA.

For a human health risk assessment, data from "surficial, near-shore sediments should be used" (USEPA, 1989). The use of 0-6 inch sediment data from areas where the surface water depth is two feet or less meets this criterion, especially when considering childhood exposures. Adult may be exposed to 0-6 inch sediments located in areas where the water depth is greater than 2 feet. However, it is anticipated that these sediments will not remain adhered to the skin to any significant extent but will wash off by the time the adult surfaces from the water. Sediment samples collected from areas where the surface water depth was greater than two feet are not are not considered applicable for use in the human health risk assessment.

2-34: The Report should identify the reference samples used by the EPA for comparing levels of inorganics detected in the river and lake samples.

EPA Response*: *The habitat for each of the reference samples is presented in Tables 2-1 and 2-2. Table 2-14 presents analytical data for the eleven reference samples referred to in the surface water table presented on pages 2-34 through 2-36 of the text.

2-38: The EPA should address the fate and transport implications of the facts that (i) above-average chromium concentrations were detected in the "Wildwood area", and (ii) the maximum concentration of lead was detected "near the rifle range."

EPA Response*: *Fate and transport will be addressed in the Comprehensive RI Report.

2-52 et seq.: An incomplete contaminant fate and transport analysis should not be included in the risk assessment.

EPA Response: Fate and transport will be addressed in the Comprehensive RI Report.

2-62: The Report fails to set forth the basis for the conclusion that "[c]ontamination of matrices within the Aberjona River Study has occurred most likely from past industrial disposal practices."[9] For example, it is entirely unclear how or why the EPA has concluded, at the current time, that the alleged matrix contamination is not the result of proximate sources or other historic activity such as aerial application of herbicides and pesticides, urban water runoff, and the like.

EPA Response: Fate and transport will be addressed in the Comprehensive RI Report.

VIII. CONCLUSION

It is well established under CERCLA that the EPA is acting at its own risk if it makes a response action decision that is "arbitrary or capricious or otherwise not in accordance with law." 42 U.S.C. § 9613(j). Indeed, EPA action will be set aside as arbitrary and capricious if the

9 Page 2-63 of the Report similarly sets forth the contention – without providing the basis therefor – that "[c]ontamination of matrices within the Aberjona River Study area has occurred

Agency has “entirely failed to consider an important aspect of [a] problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.” Motor Vehicles Mfrs. Ass’n of U.S. v. State Farm Mut. Ins. Co., 463 U.S. 29, 43 (1983). In view of the flaws with the Report outlined above (and detailed more fully in the reports submitted by Gradient and Dr. Hansen), it is clear that any remedial action, other than no action, taken in reliance upon the Report would be arbitrary and capricious.

Respectfully submitted,

_/s/ Paul B. Galvani_________________
Paul B. Galvani
Thomas H. Hannigan, Jr.
ROPES & GRAY LLP
One International Place
Boston, Massachusetts 02110-2624
Tel. (617) 951-7000
Attorneys for SMC

_/s/ Robert F. Wilkinson _________
Robert F. Wilkinson
HUSCH & EPPENBERGER, LLC
190 Carondelet Plaza, Suite 600
St. Louis, MO 63105
Tel. (314) 480-1500
Attorneys for Solutia, Inc.

in the past as a result of disposal practices, most likely from upgradient NPL and/or industrial sites.”

D. Aberjona Study Coalition

October 10, 2003

Mr. Joseph F. LeMay P.E.
Remedial Project Manager
Office of Site Remediation & Restoration
Suite 1100 (HBO)
1 Congress Street
Boston, MA 02114-2023

Dear Mr. LeMay,

In April of 2002 we received a telephone call from Mayor John Curran asking us if we would be interested in acting as a citizens advisory group for the upcoming Environmental Protection Agency (EPA) study of the Aberjona Watershed. In July of 2002 we invited you and members of your group to speak at the Woburn Neighborhood Association meeting regarding the Watershed Study. It was after that meeting the idea to establish the Aberjona Study Coalition was born.

Over the past eighteen months we have established a coalition consisting of six community groups that represent over 225,000 residents who border the Aberjona Watershed. Our first task was to hire a technical advisor who is an expert in the many environmental sciences and would act as our interpreter to translate the many complex reports that will be issued over the next few years as result of the EPA Aberjona Watershed Study.

The first of the complex reports "Baseline Human Health and Ecological Risk Assessment Report" was released in two parts during the spring and summer of 2003. This report is the foundation of all of the reports that will be issued from the EPA over the next few years. If the assumptions are not correct in the baseline report it could have a lasting effect on all of the decisions that will be made. With this in mind when searching for a technical advisor we chose Cambridge Environmental, Inc.

Attached, and as a joint effort of the Aberjona Study Coalition, Inc. and its technical advisor Cambridge Environmental, Inc. are our comments on the Baseline Human Health and Ecological Risk Assessment for Operable Unit 3 of the Wells G&H Superfund Site.

As stated in the text of the comments; by necessity, our comments are in part incomplete, in that we expect to receive, and then comment on, additional information from the EPA by way of response to some of the preliminary comments presented here. We reserve the right to provide further comment to the EPA on issues for which information is currently incomplete. We also will comment in the future on issues tied to information to be provided by EPA in subsequent reports (e.g. the fate and transport analysis that EPA intends to provide in the Remedial Investigation report for the site).

Thank you for giving us the vehicle in which to voice our comments and concerns, we look forward to your response.

Sincerely,

Linda A. Raymond, Treasurer
Aberjona Study Coalition, Inc.

Cc:
Anna Mayor, DEP Project Manger Superfund Section

Comments on the

Baseline Human Health and Ecological Risk Assessment
Wells G&H Superfund Site
Operable Unit 3
Woburn, Massachusetts

Prepared on behalf of the

Aberjona Study Coalition

by

Stephen Zemba, Richard Lester, Laura Green, Sarah Armstrong, and Shailesh Sahay
Cambridge Environmental Inc.

John Durant
Tufts University

and

Bonnie Potocki
Eco-Solutions, Inc.

October 10, 2003

Introduction and Summary

The Cambridge Environmental Inc. team was selected by the Aberjona Study Coalition (ASC), a stakeholder in the U.S. Environmental Protection Agency's (EPA) investigation of chemical contamination of the Aberjona River, to provide technical assistance in evaluating the results of EPA's work. The ASC represents a broad group of citizens – more than 225,000 residents in Woburn, Winchester, Wilmington, Medford, and Arlington, Massachusetts – who have diverse and long-standing interests in the Aberjona River and surrounding areas. The ASC has three goals with respect to EPA's efforts:

- to ensure that the investigation is technically sound;
- to ensure that the investigation is complete; and, most importantly
- to ensure that the investigation is adequately protective of human health and the environment.

Our review of the EPA's *Baseline Human Health and Ecological Risk Assessment* (hereinafter "the Risk Assessment") for Operable Unit 3 of the Wells G&H Superfund Site (the "Site") indicates that EPA has satisfied some, but not all, of the ASC's goals. In general, the Risk Assessment is technically sound, *i.e.*, the methods are consistent with U.S. EPA guidance and procedures, and the calculations set forth are mathematically correct. However, significant data gaps exist. It is not clear that enough data have been generated and analyzed to support the Record of Decision that must be developed for the Site. Moreover, the Risk Assessment does not adequately characterize potential risks to human health, and therefore may not represent a health-protective analysis.

Many of our concerns about the Risk Assessment can be addressed through presentation of additional information and the collection and/or analysis of additional data. In what follows, we offer specific suggestions for changes and additions to supplement the Risk Assessment.

Our comments are presented in four categories:

- General comments on the Risk Assessment and Site investigation;
- Major comments on the human health risk assessment;
- Major comments on the ecological risk assessment; and
- Minor comments.

By necessity, our comments are in part incomplete, in that we expect to receive, and then comment on, additional information from EPA by way of response to some of the preliminary comments presented here. We reserve the right to provide further comment to EPA on issues for which information is currently incomplete. We also will comment in the future on issues tied to information to be provided by EPA in subsequent reports (*e.g.*, the fate and transport analysis that EPA intends to provide in the Remedial Investigation report for this site).

General Comments on the Risk Assessment and Site Investigation

EPA should facilitate access to the Risk Assessment and future documents through electronic media

The Risk Assessment comprises six thick binders of material, including many color figures. We would expect that the costs of producing a large number of hard-copy reports are prohibitive, and hence distribution of such hard-copy report must be limited. Public access through libraries is necessary and appropriate, but it limits the ability of individuals to review documents (*e.g.*, many people work during the majority of the hours that libraries are open, materials get lost and damaged, *etc*.).

Distribution of electronic media, however, provides a cost-effective means of providing wider access to documents. We commend EPA's effort in making the document available on its web site. In the future, we also encourage EPA to distribute reports on CD-ROM, since the on-line dynamic links require considerable navigation time. The need to wait for linked sections, tables, and figures to download and display limits both the utility and the accessibility of the on-line document. A CD-ROM version would facilitate report access and navigation. Thus, we recommend that EPA plan for CD-ROM dissemination of future reports.

EPA Response: This suggestion will be considered for future deliverables.

Report format

Generally, the Risk Assessment report is well organized. However, many tables are long and cumbersome, and many portions of the appendices are difficult to navigate or even to find, due to a lack of page-numbering. Figures in the report were generally quite helpful and illustrative, *e.g.*, the use of color overlays on black-and-white aerial photographs. We recommend the incorporation of more summary tables (*e.g.*, summary tables of risk, as described in detail below). Also use of a single, sequential, page-numbering system would help to identify specific locations in the document, especially in the volumes of tables and appendices.

EPA Response: A risk summary table is provided in Section 5 (Table 5-1). The summary table presents cumulative risk by receptor for each exposure station.

The EPA Sampling program has not covered all of the contaminated areas

Over the past decade, a large body of research has been published on the fate and transport of pollutants in the Aberjona watershed. Much of this research has been conducted by investigators from the Massachusetts Institute of Technology (MIT) as part of a project funded by the Superfund Basic Research Program at the National Institute of Environmental Health Sciences (NIEHS). A significant thrust of this research has been on contamination by metals, particularly arsenic (As), chromium (Cr), and lead (Pb), in the watershed. The MIT data show that these elements are present in the sediments in many parts of the watershed at concentrations significantly elevated above background. For example, Knox (1991) analyzed 27 surface (0-20 cm) sediment samples collected along the thalweg (*i.e.*, the deepest part) of the main stem of the Aberjona. Of these, 21 were collected south of Route 128/95. The results show that As, Cr, and Pb concentrations are elevated in sediment deposition areas all along the length of the river. In over half of the samples, arsenic concentrations were >10 ppm, and in 9 out of 21 samples the levels were >100 ppm.

Moreover, MIT investigators have reported that the more deeply buried sediments in the Wells G&H wetland area and Upper Mystic Lake also contain significantly elevated levels of metals -- indeed, the highest levels of As, Pb, and Cr found in the watershed were reported in these areas. Spliethoff and Hemond (1996) discovered very high levels of As (>1,500 ppm), Cr (>8,000 ppm) and Pb (>2,500 ppm) in sediment 20-60 cm below the sediment-water interface at the bottom of Upper Mystic Lake. Zeeb (1996) reported As levels in excess of 6,000 ppm at a depth of 50 cm in a peat core collected between the Aberjona River and the former well H structure.

The EPA study has not utilized any of the MIT data or any other historical sediment data in its analysis. This omission undermines the comprehensiveness of the report.

Several points should be considered.

1. It would have been prudent for EPA to have used the historical sediment sampling results to inform their sampling strategy. For example, historical hotspots in the river should have been mapped and re-sampled as part of the EPA effort. If the original findings were confirmed, areas around the hotspots (both immediately upstream and downstream and near the shores) should have been sampled to determine the extent of contamination.

EPA Response: In preparing the sampling design, EPA did consider areas that were previously sampled by other parties where historical results indicated elevated concentrations of metals, as well as other historical information, such as the location and operation of previous facilities within the study area. EPA's sampling strategy also considered field reconnaissance information to focus the sampling on areas of greatest deposition (i.e., areas expected to contain the highest contaminant levels), areas that represented a variety of typical ecological habitats (i.e., pond, wetland, stream, floodplain, lake, etc.), and areas that represented potential human activity (fishing, wading, swimming, etc.). In addition, EPA has recently conducted sediment core (0 to 4 feet) sampling along various reaches of the river to characterize the vertical deposition of contamination. The results from these samples will be used in the nature and extent portion of the comprehensive Remedial Investigation (RI) and in the revised OU3 risk assessment. Where appropriate, MIT information may be qualitatively applied and referenced in the RI.

2. The EPA study is regarded as the basis for the Human Health and Ecological Risk Assessment and the Record of Decision. Historical data could be used as a consistency

check to assess sampling uncertainties. For example, the Risk Assessment includes only limited numbers of samples in many of the reaches downstream of the Wells G&H Site. The limited data used in the Risk Assessment should be compared with the wider body of historical data, in order to gauge the representativeness of the Risk Assessment samples. By not including a comprehensive assessment of all available and reliable data, EPA is ignoring a valuable source of information.

EPA Response: The historical samples were not necessarily collected or analyzed using the same methods and procedures as those employed for the current data, nor were the historical data validated in accordance with EPA data validation procedures. This would likely result in possible uncertainties when comparing different data sets. However, where appropriate, the historical data sets will be qualitatively applied and referenced in the RI.

3. The sites in the study area where the very highest levels of metals contamination have been reported are not considered in the Risk Assessment. While we recognize that humans are rarely exposed to peat deposits at the Wells G&H wetland or to sediments in the deepest parts of Upper Mystic Lake, it is possible that the contamination in these areas could be having significant ecological impacts. For the sake of being complete and thorough, EPA should acknowledge the presence of the high levels of contamination in these areas, and at the very least justify omission of these data from the Ecological Risk Assessment.

EPA Response: The revised Wells G&H OU-3 Risk Assessment will evaluate the sediment core data for human exposures that may occur as part of a potential future dredging scenario. The comprehensive RI will further discuss nature and extent as well as fate and transport mechanism. As for the Baseline Ecological Risk Assessment (BERA), exposure pathways for normal ecological exposure were not identified for deep contamination, therefore these were not considered significant and were not included in the BERA.

4. The focus of the Risk Assessment on the quality of near-shore and surficial sediments does not take into account the potential effects of sediment scouring (*e.g.*, as caused by floods and possible dredging activities), which could serve both to mobilize contaminants and to expose or bring deeper layers to the surface. Better knowledge of sediment contamination at depth (particularly in sediment deposition areas along the river) is required to evaluate potential future risk scenarios and risk management options. Core sampling and analysis is also consistent with the important goal of defining the extent and nature of contamination, even if the contamination is likely to remain in place.

EPA Response: Sediment core (0 to 4 feet) sampling has been conducted recently along various reaches of the study area to generally characterize the vertical extent of contamination. The results from these samples will be used in the nature and extent portion of the comprehensive RI and in the revised Wells G&H OU-3 Risk Assessment.

Fate-and-transport considerations

The EPA report does not explicitly consider the consequences of chemical transformation and transport in the watershed. Importantly, As, a redox-sensitive element, can be remobilized from sediments under certain conditions — for example, when dissolved oxygen levels become very low, such as at the bottom of stratified lakes in the summer. Senn and Hemond (2002) observed that As is remobilized from the sediments of Upper Mystic Lake when both oxygen and nitrate are depleted in the bottom waters. Dissolved As levels as high as about 15 ppm were measured. Similarly high levels of dissolved As (~27 ppm) in Upper Mystic Lake were reported in an earlier study by Spliethoff and co-workers (1995). These elevated levels of dissolved As should be recognized by EPA in their study, and should be evaluated in the context of the ecological risk assessment.

EPA Response: EPA acknowledges that chemical transformation and transport of arsenic in the watershed is an important fate and transport issue which will be discussed in the RI. EPA recently conducted an 18-month surface water sampling program at 10 stations spaced throughout the study area that included monthly base-flow and selected storm flow samples. The results of these surface water samples will be evaluated further for ecological risks in the revised Wells G&H OU-3 Risk Assessment.

Soils Outside of the Delineated 100-Year Flood Plain Should be Sampled

Another issue worthy of attention is flooding, and the possibility that flood waters may transport metals-contaminated sediments to over-bank areas. The "100-year flood plain" is inaccurate, since areas outside of the 100-year flood plain (as presently defined) are known to flood considerably more regularly. These areas are possibly subject to transport and deposition of contaminants from the Aberjona. For example, a grassy area adjacent to the parking lot of the International Family Church, located at 620 Washington Street in Winchester, routinely floods (McKinney, 2003). This area, however, is depicted as being outside the 100-year flood plain on Figure 2-6 of the Risk Assessment. Many residences in the neighborhood near the International Family Church are subject to periodic basement flooding.

Significant flooding events have occurred in October 1996, June 1998, March 2001 (CDM, 2003), and as recently as October 2, 2003 (Winchester Star, 2003) Photographs posted by the U.S. Geological survey during the March 2001 flooding event appear at http://ma.water.usgs.gov/floods/flood032001_img.htm. These photographs are indicative of recurrent flooding problems that have developed in the Aberjona watershed that are not adequately characterized by the flood plain delineation. All locations that flood are of potential concern in the Risk Assessment from the standpoint of contaminant transport and deposition. Ginn Field, a town recreational facility, has been inundated (CDM, 2003). Residents of Wickham Road, approximately 1,500 feet to the east of the Upper Mystic Lake and well outside of the current 100-year flood plain delineation, have experienced recurring flooding problems (Winchester Star, 2003).

Given limited time and resources, we have not been able to develop a comprehensive list of all flood-prone locations not accounted for in the Risk Assessment, but we believe that such areas might be extensive. Flooding problems have plagued the Aberjona River watershed in recent years, and the flood plain delineation is known to be out-of-date. In fact, the Massachusetts Department of Environmental Management (DEM) is presently updating the flood plain delineation (DEM, 2003). We suggest that EPA consult with DEM to identify unaccounted areas subject to flooding, and that EPA conduct additional sampling as appropriate to characterize additional areas possibly influenced by Site-related contamination. If updated flood plain information cannot be generated in the time frame of EPA's investigation, we recommend that EPA move forward with other aspects of the investigation, but then return to this issue when the updated flood plain delineation becomes available.

Moreover, the six soil sampling stations included in the Risk Assessment are not adequate to characterize flood plain soils because of potentially differing land uses. The Risk Assessment is predicated on recreational land use scenarios. The extensive nature of flooding may be affecting a wide variety of land uses, including residential areas.

EPA Response: Soil contaminant levels in residential yards and recreational spaces, present as a result of flooding events, are expected to be lower than those present in soils on the river banks or sediments within the streambed as demonstrated by soil sample results from several floodplain areas along the river, such as Davidson Park, Kraft Foods, Danielson Park, the Cranberry Bog, and station WS/WSS. The extrapolation of the recreational risk calculations to a residential scenario indicates that risk above regulatory guidelines would not be present at these residences. This extrapolation assumes that the measured contaminant levels would be present in the residential yards. This issue will be discussed and documented more fully in the revised Wells G&H OU-3 Risk Assessment. The revised Wells G&H OU-3 Risk Assessment will also use storm event surface water to determine the risk to residents who contact this medium during flooding events. Additional details regarding the floodplain sampling strategy can be found in responses provided in the next section (Major Comments on the Human Health Risk Assessment).

Major Comments on the Human Health Risk Assessment

Risk estimates require more complete presentation

Figure E-1 of the Risk Assessment depicts a very limited number of areas that "present current and/or future risks to human health." The implication of the figure is that all *other* areas on the map do *not* present any such risks. But this implication is inappropriate. Not noted on the figure is that a judgement has apparently already been made by EPA as to what levels of risk are acceptable for this site. In particular, the judgement appears to be that any incremental, site-related risks of cancer up to 100 in 1,000,000 (or 1×10^{-4}) are acceptably small, and present "no risk." But, as is well known, EPA has applied criteria that are 10 or 100 times more stringent at other sites – that is, EPA has determined that site-related risks of cancer may be no more than 10 in 1,000,000 or even no more than 1 in 1,000,000. Separate from whether one does or does not agree with such judgements (please see the next point below), it is entirely inappropriate to be making these judgements within the context of a Baseline Risk Assessment. The Risk Assessment should, by definition, assess risk: it is elsewhere, in full consideration of the many dimensions of risk *management*, that one judges what levels of risk are acceptably small.

EPA Response: The sampling strategy EPA employed targeted areas representing the greatest potential risk due to the deposition and accumulation of contaminants. The human health risk assessment has evaluated and documented the risk at all human health exposure stations, including those where the estimated risk is within or below regulatory guidelines. Table 5-1 provides an overall risk summary table for the exposure stations. These risk calculations, along with site-specific considerations, will be factored into risk management decisions for the study area prior to finalizing the Record of Decision. The purpose of the Executive Summary is to provide a concise overview of the results of the risk assessment. Therefore, only the areas with estimated risks exceeding regulatory guidelines and major risk contributors for those areas have been included.

EPA should present better and more informative summaries of the risks as they are assessed, separate from judgements as to "acceptability" or lack thereof. Figure E-1 should be re-labeled to reflect the *specific risk criteria* exceeded at various locations (*i.e.*, a non-cancer hazard index of 1 and an incremental cancer risk of 1×10^{-4}). Figures similar to Figure E-1, but based on the more stringent criteria of incremental cancer risk levels of 1×10^{-6} and 1×10^{-5}, should be added to the report. A figure depicting hazard indices that round to 1 should also be added (the current Figure E-1 shows locations with hazard indices that round to 2 or greater). Moreover, numerical summary tables of the overall risk estimates at each sampling station should be clearly and prominently presented in the document. At present, the reader must sift through several long and detailed tables in Volume III of the report to extract the various receptor-specific risk estimates that contribute to the total incremental cancer risk estimates, since, for example, the child and adult risk estimates are presented separately. Simplified summary tables of total incremental cancer risk estimates (adult plus child) for the present and future case are needed to provide readers with ready access to comparative risk estimates at the various sampling stations.

EPA Response: The text of the Executive Summary states that Figure E-1 summarizes those stations where risks exceed regulatory guidelines. This information will be added as a footnote to Figure ES-1. Figure ES-1 is summarizing cumulative risk at stations with target organ HIs greater than 1, not 2. The total HI may exceed 1 without the HI, segregated by target organ, exceeding 1. Table 5-1 in the Summary and Conclusions section summarize cumulative risks for all exposure stations.

Tables 1a and 1b, shown below, are examples of potential risk summary tables, based on our reproduction of a portion of EPA's risk calculations for potential exposure to arsenic (As) in sediments and soils. Note that the values in Tables 1a and 1b do not include risk estimates for all chemicals of concern in sediments and soils, nor do they include exposure pathways that evaluate other environmental media (surface water and fish). These values can easily be included in the location-specific risk totals.[1]

Table 1a Risk estimates due to exposure to arsenic (As) in sediment
Reasonable Maximum Exposure Scenario

Exposure Point	Current Risks		Future Risks	
	Lifetime Incremental Cancer Risk	Child Hazard Index	Lifetime Incremental Cancer Risk	Child Hazard Index
Station 01	1.E-06	2.E-02	1.E-06	2.E-02
Station 03	**2.E-05**	3.E-01	**2.E-05**	3.E-01
Station 05	5.E-06	8.E-02	5.E-06	8.E-02
Station 07/DP	**1.E-05**	3.E-01	**1.E-05**	3.E-01
Station 08	5.E-06	9.E-02	5.E-06	9.E-02
Station 09	6.E-06	1.E-01	6.E-06	1.E-01
Station 13/TT-27	NA	NA	**8.E-04**	**1.E+01**
Station 14	4.E-06	8.E-02	9.E-06	2.E-01
Station 16/TT-33	**4.E-05**	8.E-01	**4.E-05**	8.E-01
Station 22/TT-22	4.E-06	6.E-02	**1.E-05**	2.E-01
Station AM	7.E-06	1.E-01	7.E-06	1.E-01
Station AS	7.E-06	1.E-01	**2.E-05**	4.E-01
Station CB-01	**1.E-05**	2.E-01	**1.E-05**	2.E-01
Station CB-02	**1.E-05**	2.E-01	**1.E-05**	2.E-01
Station CB-03	**3.E-04**	**6.E+00**	**3.E-04**	**6.E+00**
Station CB-04	**6.E-05**	**1.E+00**	**6.E-05**	**1.E+00**

[1] Since arsenic in sediments and soils contributes the substantial majority of total risk estimates at most locations, the values in Tables 1a and 1b are fairly representative of total risk estimates.

Station CB-06	**3.E-05**	6.E-01	**3.E-05**	6.E-01
Station CB-07	**1.E-05**	2.E-01	**1.E-05**	2.E-01
Station JY	NA	NA	**7.E-05**	**1.E+00**
Station KF	**1.E-05**	2.E-01	**1.E-05**	2.E-01
Station LP	**3.E-05**	5.E-01	**3.E-05**	5.E-01
Station NR	**1.E-05**	2.E-01	**3.E-05**	4.E-01
Station NT-1	NA	NA	**5.E-04**	**8.E+00**
Station NT-2	NA	NA	**2.E-04**	**3.E+00**
Station NT-3	NA	NA	**9.E-05**	**2.E+00**
Station TT-30	**7.E-05**	**1.E+00**	**7.E-05**	**1.E+00**
Station TT-31	NA	NA	6.E-06	1.E-01
Station WG	**2.E-05**	3.E-01	**5.E-05**	8.E-01
Station WH	**1.E-04**	**2.E+00**	**3.E-04**	**6.E+00**
Station WS/WSS	**6.E-05**	**1.E+00**	**6.E-05**	**1.E+00**
Station WW	NA	NA	9.E-06	2.E-01

Table 1b Risk estimates due to exposure to arsenic in soil
Reasonable Maximum Exposure Scenario

Exposure Point	Current Risks		Future Risks	
	Lifetime Incremental Cancer Risk	Child Hazard Index	Lifetime Incremental Cancer Risk	Child Hazard Index
Station 07/DP	**1.E-05**	2.E-01	**1.E-05**	2.E-01
Station CB-05	**2.E-05**	4.E-01	**2.E-05**	4.E-01
Station DA	**4.E-05**	**1.E+00**	**6.E-05**	**1.E+00**
Station KF	**1.E-05**	3.E-01	**1.E-05**	3.E-01
Station NR	**1.E-05**	4.E-01	**4.E-05**	7.E-01
Station WS/WSS	3.E-06	7.E-02	4.E-06	7.E-02

The incremental cancer risk estimates in Tables 1a and 1b represent the sum of the values for the child and adult receptors. Risk estimates are highlighted in Tables 1a and 1b as follows. Boldface highlighting is used to indicate incremental cancer risk estimates equal to or greater than 1×10^{-5} and hazard indices equal to or greater than 1. Risk estimates that are additionally underlined equal or exceed an incremental cancer risk of 1×10^{-4} and/or have hazard indices that round to values of 2 or higher.

Note that a figure depicting sampling locations with hazard indices greater than or equal to 1 would include five additional sampling stations beyond those shown in Figure E-1 (sediment stations CB-04, JY, TT-30, and WS/WSS, and soil sampling station DA).

EPA Response: This information is presented in the report in Table 5-1. Table 5-1 highlights exposure stations where cancer risks exceed $1x10^{-4}$ and target organ HIs exceed 1. However, the cumulative cancer and noncancer risks are presented for all exposure stations. Please note that a cumulative HI may exceed 1 without target organ HIs exceeding 1.

An incremental lifetime cancer risk of 1×10^{-4} is not necessarily a valid criterion for acceptable, site-related risk

The upper-limit of acceptable, incremental, site-related, lifetime cancer risks under the Massachusetts Contingency Plan (MCP) is 1×10^{-5}, not 1×10^{-4}. If the Aberjona River Study had been conducted under the auspices of the Massachusetts Contingency Plan (MCP), a number of additional sampling stations depicted in Figure E-1 would be deemed to present a potentially significant risk to human health. Based on our recalculations of EPA's work, *more than two-thirds of the sediment sampling stations* (23 of 31 stations; please see Table 1a) and all but one of the soil sampling stations (please see Table 1b) present risks that are greater than or equal to an incremental cancer risk of 1×10^{-5}.

Some consideration of the nature of contamination is important with respect to EPA's risk management criteria. EPA considers incremental cancer risks ranging from 1×10^{-6} to 1×10^{-4} as ambiguous in the sense that they may or may not merit remedial action. EPA can choose to pursue a "no action" alternative for incremental cancer risk levels within the 1×10^{-6} to 1×10^{-4} range. EPA can also choose to act on risks within this range. The choice to act or not to act is a case-by-case decision that depends on many factors. In the case of the Aberjona River Study, there may be compelling reasons to pursue remedial actions at incremental cancer risk levels more stringent than 1×10^{-4}. First, arsenic – the contaminant that dominates the cancer risk estimates – has been *definitively* shown to cause cancer in humans exposed *at environmental levels*. Indeed, among the 90 or so established human carcinogens – and the hundreds of rodent carcinogens that are presumed by EPA to be human carcinogens, even absent human data – arsenic is unique in being demonstrably carcinogenic in people who drink elevated amounts in water (and receive elevated doses in foods). It is curious that EPA has demanded strict risk criteria at many other sites contaminated only by chemicals known to cause cancer in rodents, not humans: yet here in Woburn, at a site dominated by risks from arsenic, the most lenient of risk criteria seem already to have been chosen. Second, as we discuss in the next comment, the risk estimates are based on an exposure assessment that incorporates a lesser degree of conservatism than is found in many other EPA risk assessments, and may not be protective of all future uses. Third, given the infamous reputation of the Wells G&H and Industri-Plex sites, citizens within the Aberjona watershed have lived with higher degrees of publicity, concerns, stigma, and fears than have neighbors of many other Superfund sites.

EPA Response: The human health risk assessment has evaluated and documented the risk at all human health exposure stations, including those where the estimated risk is

within or below regulatory guidelines. These risk calculations, along with site-specific considerations, will be factored into risk management decisions for the study area. EPA is working closely with DEP to develop a remedy that DEP agrees is consistent with the goals of the state regulations. EPA will continue its public relations activities with the communities regarding risk communication, cleanup alternatives, and cleanup solutions. It is anticipated that the next public meeting will occur after the completion of the comprehensive Remedial Investigation Report. Regarding the selection of exposure assumptions, please refer to the following comment response.

The Risk Assessment's emphasis on realism runs counter to conservative risk assessment tradition, and is inappropriate for future land use considerations

The Risk Assessment evaluates potential exposure to contaminants on the basis of the characteristics of individual sampling stations. For current land use, EPA does not calculate risks at seven of its thirty-one sampling stations because the locations are inaccessible. Qualitative judgment was used to assign exposure frequencies of 26, 52, 78, and 104 days per year to contaminants in sediments and soils at each of the other twenty-four sampling stations.

At face value, EPA's assumptions on exposure frequency seem reasonable for *current* land use. For future use scenarios, however, the differentiation among land uses is not as justifiable, and in our opinion should be abandoned. Substantial changes in land use have occurred in the Aberjona watershed, are likely to continue to occur, and cannot be anticipated in detail. For example, EPA judges the highest potential exposure intensity to occur in the former Cranberry Bog area for both current and future land use. If this risk assessment had been conducted at some point in the past when the cranberry bogs were still operating (and walking trails were nonexistent), it is likely that EPA would have considered the potential exposure intensity in the former Cranberry Bog area to be considerably lower than is now in fact the case.

Hence, we do not find it appropriate to make extensive assumptions concerning future land use in a risk assessment that is designed to be hypothetical in nature. Rather, we recommend that EPA adopt more uniform reasonable worst-case assumptions in addressing future land use. For example, in assessing recreational exposure to contaminated sediments and soils, the assumed high-end exposure frequency of 104 days per year should be applied to all locations unless there are compelling reasons for considering restrictions to access into the indefinite future. As described in the following comment, the unknowable nature of future land use strongly suggests that EPA consider additional exposure routes.

EPA Response: Future land use assumptions were selected to be adequately protective of exposures that may occur within a recreational space. Generally, stations were

evaluated with a future exposure frequency of 78 days per year. The future exposure frequency of 26 days per year was only applied to a small number of stations where future land use is assumed to remain the same as current land use, due to their location further into the wetland or abutting Route 93 (station AM). This exposure frequency is adequately protective of recreational exposures in undeveloped areas. The 104 days per year exposure frequency was utilized for areas where residences were close to the station, in some cases, immediately abutting the area. Using an exposure frequency of 104 days per year for areas not near residences would likely overestimate the risk associated with future recreational exposures at these stations.

Additional exposure pathways and scenarios should be considered

EPA's Risk Assessment focuses only on exposure to contaminants that might occur during recreational activities. While we agree that recreational use is the most plausible means of potential contaminant exposure under current land use, other scenarios are possible. Unfortunately, in some cases, the data to determine the viability of these pathways are not available.

The Aberjona River watershed has undergone many changes since the time that the 100-year flood plain was delineated. As noted above, the recent history of flooding along the Aberjona suggests that the flood plain definition is out –of date, and raises the possibility of contaminant transport to areas beyond the 100-year flood plain during flooding events. EPA has not collected sufficient data to evaluate whether flooding has increased the concentrations of river-related contaminants in upland soils. For example, the backyards of many residences line the western shores of the Upper and Lower Mystic Lakes. Is it possible that flooding has brought contaminants to these areas? If so, what are the concentrations of contaminants in these soils? We note that residential exposure assumptions assume a significantly higher degree of potential exposure than that considered in the Risk Assessment's recreational use scenarios, and hence even a modest increase in contaminant concentrations in soil could reflect potentially significant risks to human health.

Consider the portion of the International Family Church property (620 Washington Street, Winchester) that periodically floods. EPA has not sampled soils in this area, so there is no way to tell if contaminants have been deposited in soils during flooding events. The church runs an elementary school (nursery school through 8th grade). Children generally do not play in the grassy area subject to flooding, since it is located adjacent to a well-utilized parking area; however, the area is occasionally used for picnics and volleyball games (McKinney, 2003). Since this area has not been sampled, risk estimates cannot be determined.

Similarly, the Winchester playing fields built atop the culverted river (shown at the bottom of Risk Assessment Figure 2-8) have also been subject to flooding (CDM, 2003; Winchester Star, 2003), and hence may be receiving potential deposition of contaminants mobilized in flood waters. This area is potentially important, since athletic recreational exposure may be more intense and frequent than exposures considered by EPA. For example, in an athletic exposure scenario, it might be appropriate to assume a higher degree of dermal adherence of soil. Again however, no data have been collected in this regard.

More generally, it is conceivable that river-related contaminants have migrated to residential soils through flooding events. If so, a complete residential exposure pathway may *currently* exist. For example, consider Risk Assessment Figure 2-8, which depicts the course of the Aberjona just to the north of Winchester center. Several homes are located in or near the 100-year flood plain delineation in Winchester at the point where the Aberjona River is culverted beneath the playing field area (at the bottom portion of Figure 2-8, along the river's eastern bank). In addition, the 100-year flood plain delineation, as superimposed on the aerial photograph in Figure 2-8, goes through or near a number of the housing units on the Aberjona's western bank.[2]

If residential soils have been affected by river-related contaminants through flooding, then the residential exposure pathway is complete under current land use conditions. In this case, the nature of the risk assessment would change, since a higher degree of potential exposure to contaminants must be considered.

In addition, a broader view of future residential use should be considered in the Risk Assessment. There are already some residential properties that overlap the existing delineation of the 100-year flood plain, which is widely believed to be undersized. Barring permanent land use restrictions, additional residential properties could be constructed closer to the river in the future. EPA should carefully consider land use all along the Aberjona River, to identify areas where new homes might be constructed, even if the likelihood of residential development is small. These areas should be considered for residential use in future-case risk calculations, since the purpose of future land use consideration is meant to be hypothetical and encompassing in nature: fundamentally, the Risk Assessment should be health protective under reasonably foreseeable conditions.

Residential exposure scenarios should also consider the possibility of vegetable gardening. In residential areas already subject to flooding, ingestion of homegrown vegetables raised in contaminant-affected soils may already represent a complete exposure pathway. As lands in and near the flood plain become redeveloped, new residential areas could provide opportunities for gardening. It is also conceivable that lands in the flood plain might be developed as community gardens to make use of land that cannot be used for building. In addition, the Site-specific soil-to-plant uptake factors provided in Risk Assessment Table 4-27 for arsenic and lead are substantially higher than literature-based reference values. The average Site-specific uptake factor of 0.4 for arsenic indicates that plants are capable of assimilating arsenic from the sediments. Developed for the ecological risk assessment, the Site-specific uptake factors are not necessarily applicable to consumable vegetables, but the elevated values do suggest that

[2] Presumably, these housing units were not built in the 100-year flood plain without mitigating measures (*e.g.*, filling of low-lying areas). This again illustrates the out-of-date nature of the 100-year flood plain delineation.

arsenic may be available for uptake, and that vegetables raised in Site-contaminated soils could contain elevated arsenic concentrations. Hence, in addition to identifying and collecting data from soils that may be subject to flooding, potential dietary intake of arsenic should also be considered via the consumption of home-grown vegetables.

Finally, the Risk Assessment should assess risks to construction workers who may work in contaminated areas where future excavation and building is plausible. A construction worker can receive more intense exposure to contaminants over periods of limited duration, introducing the possibility of potential subchronic and acute risks to health.

EPA Response: Soil contaminant levels present in residential yards and recreational spaces as a result of flooding events are expected to be lower than those present in soils on the river banks or sediments within the streambed as demonstrated by soil sample results from several floodplain areas along the river, such as Davidson Park, Kraft Foods, Danielson Park, the Cranberry Bog, and station WS/WSS. The extrapolation of the recreational risk calculations to a residential scenario indicates that risk above regulatory guidelines would not be present at these residences. This extrapolation assumes that the measured contaminant levels would be present in the residential yards. This issue will be discussed and documented more fully in the revised Wells G&H OU-3 Risk Assessment. Note that the dermal adherence factor used for the recreational scenario, selected for the adherence of wet soil, is also protective of residential and athletic exposures. The revised Wells G&H OU-3 Risk Assessment will also use storm event surface water data to determine the risk to residents who contact this medium during flooding events. To address an excavation scenario, sediment core samples, up to 4 feet in depth, have been collected from 13 locations along various reaches of the study area in 2003 where elevated concentrations of metals have been observed. These samples, which generally characterize the vertical deposition of contamination, will be evaluated for a dredging scenario, as well as for potential ecological impact. This evaluation will determine whether risk above regulatory guidelines is indicated for workers who may contact contaminated sediments during dredging or ecological receptors that may be in contact with this material. This information will also be presented in the revised Wells G&H OU-3 Risk Assessment.

The data screening procedure is arbitrary and uncertainties should be assessed

EPA chose to include only sediment samples collected within two feet of the water surface within the human health risk assessment calculations. This choice was presumably governed by the nature of the available data, which were not necessarily collected for use in a human health risk assessment. The assumption seems reasonable for current land use in most of the study area. However, it seems inappropriate for Sandy Beach (sampling station 01), which is operated by the Division of Urban Parks and Recreation as a public swimming area. Many individuals will walk out to depths greater than two feet prior to swimming, especially when first entering the water. Application of the two-foot screening criterion eliminates some of the most contaminated samples found at the Sandy Beach sampling location, and hence may serve to underestimate risks to public health.

We recommend that EPA reconsider its two-foot screening criterion at the Sandy Beach location and consider all of the samples. In addition, as a sensitivity study, we also recommend that EPA test the implications of the two-foot screening criterion at the other sampling locations in the study area. For example, application of the screening criteria at sampling station TT-30 eliminates three of the available samples, reducing data consideration to a single sample. Twenty-one other areas are not considered at all in the human health risk calculations because all samples are eliminated. Sensitivity calculations should be developed that consider all of the available samples. These sensitivity calculations should be added to the uncertainty section. If there are other areas for which samples are eliminated from consideration that might significantly increase risk estimates if included in calculations, EPA should make a more critical examination of land use in the area to determine if the risk estimates are protective of human health under all plausible conditions.

EPA Response: As stated in EPA guidance, data from "surficial, near-shore sediments should be used" (USEPA, 1989). The use of sediment data from areas where the surface water depth is two feet or less meets this criterion, especially when considering childhood exposures. Adults may be exposed to sediments located in areas where the water depth is greater than two feet. However, it is anticipated that these sediments will not remain adhered to the skin to any significant extent but will wash off by the time the adult surfaces from the water. Sediment samples collected from areas where the surface water depth was greater than two feet were collected for and utilized in the ecological risk assessment. These samples are not considered applicable for use in the human health risk assessment.

Data coverage is inadequate

Considerable holes exist in the spatial coverage of data used in the human health risk assessment. There are several areas that have not been sampled adequately. As described in other comments, sampling of soils subject to flooding has not been sufficient. Since it is widely known that the 100-year flood plain delineation is out of date, its boundaries should not be used as a principal factor in determining soil sampling locations. Rather, EPA should consult in detail with local officials and especially individuals knowledgeable with conditions in the river. For example, the Mystic River Watershed Association (MyRWA) has conducted a detailed shoreline investigation of the Aberjona River. We recommend that EPA convene an *ad hoc* panel of individuals to discuss areas affected by flooding and develop a systematic approach to identifying and sampling flood-impacted soils. Work currently being done by the Massachusetts Department of Environmental Management to update the flood plain delineation may be useful for this purpose.

Sampling should be considered both within the current, inaccurate 100-year flood plain delineation and in areas that flood that may not be covered by the current delineation. We have not identified all such areas; however, as examples we list four areas that are prone to flooding:

- The playing fields located east of the Mystic Valley Parkway, just downstream of sampling station 5 should be sampled, since they are depicted within the current delineation, and are subject to recurrent flooding.

- There is a bike trail that runs north from Davidson Park, past the International Family Church property. There is a considerable gap in sampling between Davidson Park and sampling station 08 that is easily accessed (due to the presence of the bike path). We recommend further sampling be conducted in this area.

- The Kraft Foods property and wooded areas to the south were flooded in March 2001. These areas are depicted in Figure 2-6 as a relatively large area within the current 100-year flood plain delineation that has not been sampled at all (the KF and 08 sampling stations focused on sediments). We recommend soil sampling in this area to check for contaminants that might have been deposited during flooding events,

- Similarly, there are residences south of sampling location 08 (Risk Assessment Figure 2-6) that appear to have yards that intrude into the 100-year flood plain delineation. These yards should be sampled for the presence of river-related contaminants. Given the inaccuracy of the flood plain definition, it would be prudent to identify and sample the yards of other homes in this area that might have experienced flooding.

Additionally, there are at least three areas that have not been adequately sampled to characterize sediment contamination. Risk Assessment Figure 2-8 indicates only two samples along the one-half mile stretch of the Aberjona River to the north of its culverting in Winchester center. Similarly, Risk Assessment Figure 2-5 indicates an even longer stretch of river that is currently characterized by a single sample. Also, public parkland extends along the entire western shorelines of the Upper and Lower Mystic Lakes. Appropriately, EPA sampled the Sandy Beach location, but with the exception of six samples collected in deep water (and hence not used in the human health risk assessment), there have been no samples taken along the western shorelines south of Sandy Beach that cover a distance of significantly more than a mile. There appear to have been no samples collected in the vicinity of the Winchester Boat Club, a facility used for sailing and other activities. Given the nature of sailing, it is reasonable to assume that individuals will contact sediments on an occasional basis, often in water deeper than two feet. Similarly, sediments along the privately-owned eastern shorelines of the Upper and Lower Mystic Lakes have not been sampled. By not sampling along the shorelines, EPA may be missing some areas of historical contamination that deposited and accumulated over many years. The degree of this contamination may not be well-represented by the sampling at Sandy Beach, which has probably received large amounts of uncontaminated sands from outside of the watershed to enhance its use as a public recreation area.

Even at locations that have been sampled, spatial coverage is at times inadequate because the two-foot screening criterion eliminates available data from use in the human health risk assessment. In fact, some of the sampled locations have no data suitable for use in the Risk Assessment, and hence no health risk calculations were developed for them. As a specific example, Reach 4, which includes Judkins Pond and Mill Pond, has no sediment samples under less than two feet of water, and hence no associated risk calculations. The supplemental Risk Assessment Table C.1-1 indicates 21 sampling stations for which no human health risk calculations have been performed (sampling locations 02, 04, 06, 10, 11, 12, 15, 18, 19, 20, 21, AO, BW, LF, LM, MP, TT-28, TT-29, TT-32, LF, and UM).

EPA Response: EPA consulted with municipal officals regarding areas frequently flooded and used for recreational purposes. EPA's sampling strategy targeted areas representing the greatest potential risk due to the depositional patterns and potential to accumulate contaminants. Areas with the highest concentrations of contaminants were primarily found in Reach 1 and portions of Reach 2 (e.g., the former cranberry bog), which exhibited potential risks to human health. High concentrations were not found downstream of these areas along the river, and consequently, these areas did not exhibit excessive risks to human health. These locations demonstrated contaminant levels corresponding to risk below regulatory guidelines. Therefore, it may be inferred that other depositional areas within Winchester, downstream of or in proximity to those that were sampled, would also demonstrate levels of contaminants corresponding to risk below regulatory guidelines. This approach also allowed EPA to focus their resources on the most highly contaminated areas and to further assess human health risks.

As stated previously, soil contaminant levels present in residential yards and recreational spaces as a result of flooding events are expected to be lower than those present in soils on the river banks or sediments within the streambed. An example of this was demonstrated by soil samples collected from the floodplain area of Davidson Park, Kraft Foods, Danielson Park, the Cranberry Bog, and station WS/WSS. The extrapolation of the recreational risk calculations to a residential scenario indicates that risk above regulatory guidelines would not be present at these residences. This extrapolation assumes that the measured contaminant levels would be present in the residential yards. This issue will be discussed and documented more fully in the revised Wells G&H OU-3 Risk Assessment. The revised Wells G&H OU-3 Risk Assessment will also use storm event surface water data to determine the risk to residents who contact this medium during flooding events.

The sampling stations not included for quantitative risk evaluation have been justified as to their exclusion. The stations excluded are: (1) located far from the shoreline; (2) in greater than 2 feet of surface water; and/or (3) in areas with access obstacles present (e.g., steep banks, soft organic deposits). These samples are not considered applicable for use in the human health risk assessment.

Exposure assumptions

In general, EPA's exposure assumptions are developed in a manner consistent with Superfund risk assessment guidance. However, the mix of exposure assumptions employed by EPA in this Assessment is not highly protective of human health, especially when considered in the context of baseline human health risk assessments for other sites.

While it is generally not possible to confirm or evaluate site-specific exposure assumptions, it may be possible to gauge the appropriateness of the assumptions made for the recreational swimming pathway at Sandy Beach on the Upper Mystic Lake (EPA sampling station 01). EPA's reasonable maximum exposure profile assumes swimming occurs thirty-nine days per year (three times a week during the thirteen summer months), and that the swimmer is in the water for an hour during each swimming day. These assumptions seem reasonable, but it is quite possible that there are significant numbers of children who swim more frequently (*e.g.*, children who attend day camps or take swimming lessons) and/or spend more time in the water. In this case, however, EPA does not need to rely solely on default assumptions and professional judgment, but can instead seek information to reduce the uncertainty of the exposure estimates. We recommend that EPA consult with officials and lifeguards who have worked at Sandy Beach to determine appropriate assumptions for evaluating reasonable maximum exposure to surface water.

In evaluating potential exposure to contaminants in sediments and soils, EPA incorporates a factor of 0.5 in its sediment/soil ingestion pathway to reflect the assumption that not all of a person's daily contact with soil is likely to occur in contaminated Site areas. This factor (labeled ET in equations) seems arbitrary, is not taken from default guidance or recommendations, and may be inappropriate. Places such as the Cranberry Bog area may be utilized on a daily basis by people who jog or walk their dogs. In such cases, these areas may afford the predominant source of access to exposed soils. Reducing the potential level of exposure by 50% through the ET factor, while already assuming limited exposure frequency ranging from 26 to 104 days per year, seems less than health-protective. We recommend that the ET factor be dropped from the calculations.

Also, we note that the assumptions used to evaluate dermal exposure to contaminants in sediments have been taken from an interim guidance document labeled "Review Draft – For Public Comment" (EPA, 2001). Use of this document as guidance that has not been finalized should be clearly noted in the text of the Risk Assessment. It is possible that changes will be made in the guidance document's recommendations based on response to public comment. It should be noted that the mix of exposure assumptions suggested in the draft dermal guidance is not highly protective of human health, especially when considered in the context of baseline human health risk assessments, which are generally meant to be highly protective. In estimating reasonable maximum exposure levels, it is appropriate to combine upper-end and best-estimate values. Key factors, however, are usually assigned higher-than-average values to ensure that upper-end exposure estimates are generated.

In particular, an aspect that concerns us is the dermal adherence factor (DAF), or the rate at soil or sediment is assumed to stick to the skin. EPA's (2001) draft recommendations are based on "best estimate" values, and not upper-end estimates. The suggested values of 0.20 mg/cm^2 and 0.07 mg/cm^2 are not very high compared with similar values used in regulatory contexts. For example, the Massachusetts DEP performed a critical evaluation of dermal adherence data. DEP (2001) notes a large amount of sediment tends to adhere to the skin of children playing in sediments, with measurements indicating more than 20 mg/cm^2 of sediment sticking to their skin. Not all of this sediment is in direct contact with the skin layer, however, and absorption of contaminants from the soil layer is limited. Based upon consideration of this factor, DEP recommends the use of a 1 mg/cm^2 DAF for sediment. For recreational exposure to soils, DEP's default recommendation for a DAF for an adult is the same as that used by EPA (0.07 mg/cm^2), but DEP recommends a somewhat higher DAF for a child (0.35 mg/cm^2 *v.* 0.2 mg/cm^2).

Because (1) the Massachusetts DEP has carefully considered the topic of dermal adherence, (2) the Aberjona River is located in Massachusetts, and hence deserves similar regulatory considerations as other properties in the Commonwealth, and (3) DEP's recommended values are more health protective than those used by EPA, we recommend that EPA adopt the following dermal adherence factors:

- for evaluating potential exposure to sediments (both adults and children), 1 mg/cm^2; and
- for evaluating potential exposure to soils, 0.35 mg/cm^2 for children and 0.07 mg/cm^2 for adults.

EPA Response: Information obtained from the MDC and the town Parks and Recreation Department on swimming at Sandy Beach indicates that the exposure assumptions are appropriate for the activities occurring. Exposures to a child attending one-week of swimming class for up to six weeks during the summer would be accounted for by the exposure frequency of 39 days per year.

The Fraction Ingested (FI) term has been used to account for the portion of dose that it is anticipated an individual would incur in upland or background locations. It is likely that an individual would spend a portion of their day in their yard or in other unimpacted areas. The FI term is a standard term described in EPA risk assessment guidance.

The "Supplemental Guidance for Dermal Risk Assessment" document will be noted in the references section as being "Interim-Review Draft for Public Comment".

The intent of the reasonable maximum exposure (RME) scenario is to evaluate the maximum exposure that is reasonably expected to occur at a site. The RME scenario is constructed by combining some maximum or near maximum exposure values with others left at their mean values. In doing so, exposures are modeled that are

reasonably anticipated to occur. Exposures of a higher frequency or intensity may occasionally occur, but should not serve as the basis for remedial actions at a site.

It is acknowledged that EPA and DEP differ in some of their recommended exposure assumptions. There are cases in which EPA assumptions are more conservative (e.g., soil ingestion rates) and cases, as pointed out, that DEP assumptions are more conservative. Because each method is more conservative in some areas than others, the final assessment result of both the EPA and DEP methods is roughly equivalent. EPA is working closely with DEP to develop a remedy that DEP agrees is consistent with the goals of the state regulations.

Assumptions regarding the fish ingestion pathway are not justified

The risk assessment assumptions for the fish ingestion pathway are not consistent with Superfund guidance. The risk assessment calculations assume that an adult ingests 5 g/day or 13 g/day, respectively, in the central tendency and reasonable maximum exposure calculations. However, the U.S. EPA's exposure factors handbook recommends higher fish ingestion rates of 8 g/day (mean) and 25 g/day (95^{th} percentile) for freshwater recreational fishers (U.S. EPA, 1997a). We recommend that the ingestion rates be raised to these values or even higher ones. For example, the U.S. EPA default recommendation for consumption of locally-caught fish is 54 g/day, a value that roughly equates to two half-pound servings per week (U.S. EPA, 1991). Thus, the fish ingestion rates in the Risk Assessment do not reflect high levels of fish consumption. The current U.S. EPA's reasonable maximum exposure rate of 13 g/day corresponds to less than a pound of fish per month.

Also, the assumption that only half of the fish are caught in the Aberjona study area should be eliminated. The assumption is based on professional judgement and an incorrect interpretation of information in the U.S. EPA's (1997a) Exposure Factors Handbook. The fish ingestion rates in the Exposure Factors Handbook are intended to represent consumption rates of recreationally-caught fish, and not total fish consumption rates, as erroneously discussed in the Risk Assessment (p. 3-32). There is discussion of total and recreational fish consumption in U.S. EPA (1997a), but it is irrelevant to the recommended consumption rates. Table 10-63 of U.S. EPA (1997a) provides a comparison of the intake rate of all fish and the portion recreationally-caught. Interestingly, the 50^{th} and 95^{th} percentile consumption rates of recreational fish alone, 11 g/day and 39 g/day respectively, are higher than the values used in the Risk Assessment.

The Risk Assessment provides very little information about local fishing habits. As a default, health protective assumption, it is reasonable to believe that there are individuals who fish frequently in the Mystic Lakes and perhaps other parts of the Aberjona Watershed, and that these individuals use the watershed as their prime source of recreational fishing. This is especially the case for the Upper and Lower Mystic Lakes, which are accessible from many public and private points.

More work needs to be done by EPA to investigate and characterize recreational fishing habits in the study area in order to justify any site-specific assumptions. The information provided in the Risk Assessment is scant and non-descriptive. The Risk Assessment (p. 3-1) mentions that Board of Health officials in Woburn and Winchester were contacted for information about local fishing habits, but little information is provided about these discussions and their use in characterizing the fish ingestion pathway (save for the belief on the part of health officials that local populations are not consuming eel and crayfish from the study area). Davidson Park, Leonard Pool, and the Upper Mystic Lake were identified as areas that might be fished by recreational anglers (p. 3-15). No specific reasons for focusing on these three areas are provided in the Risk Assessment. Why, for example, was the Lower Mystic Lake not included? A recent fishing report for the Lower Mystic Lake supplies the following anecdotal information (see http://www.wmi.org/bassfish/reports/95294.htm):

> Excellent action in Lower Mystic Lake at dusk on 9/17. Caught six LMB in the pads at the southwest corner of the Lower Lake between 6:15 and 7:30. Three were in excess of 3lbs, with one weighing in just over 4. All taken on a Yamamoto twin tailed hula grub in watermelon. Four taken by hopping it across the pads and letting it drop in the openings, one in the channel where Mill Brook flows into the lake, and one on the outside edge of the pads. Tons of bait started jumping just as it was getting too dark to fish. Tried a perch pattern floating rap just before leaving, but no takers.

Barring the development of site-specific information, EPA should revise its fish pathway assumptions in a health protective manner, as described above. In addition to the fish ingestion rates used for adults, EPA should also reconsider its fish ingestion rates for children. Also, the assumption that fish are caught by older children may be a reasonable one, but younger children may well consume fish caught and prepared by their parents. Thus, the use of a 31 kg body weight for children in exposure calculations is not necessarily justified, and we recommend that the default body weight of 15 kg for a young child be used in the calculations.

EPA Response: The fish ingestion rates selected for use are based on recreational fishing data gathered in the New England area. Other recreational fish ingestion rates are provided in the Exposure Factors Handbook, but are appropriate for other areas of the country. Since the study area is in New England, fish ingestion rates derived for the New England region have been applied.

As noted, FI term of 50% has been used to account for the likelihood that anglers will utilize other surface water bodies in the area for fishing. This is a reasonable assumption since there are a number of other attractive fishing spots in the area, and information from local anglers indicates that multiple surface water bodies are utilized for recreational fishing. Table 10-63 was used to derive age-specific fish ingestion rates. Ingestion rates in that table are higher than those assumed in this report since other regions of the country are included in the analysis.

Fillet data obtained from fish collected throughout the study area were evaluated. No particular areas were targeted or excluded. Fish collected from the Lower Mystic Lake were included in the analysis. Local officials could not provide site-specific information relative to the frequency and intensity of fish ingestion exposures. Therefore, data collected and provided in the Exposure Factors Handbook relative to ingestion rates were utilized.

Based on age-specific ingestion rates showing that young children ingest less fish than older children, it is equally conservative to evaluate an older child or a young child. This is not the case for soil ingestion pathway since young children are assumed to ingest more soil than an older child. Since the older child is more likely to be fishing and the evaluation is equally conservative, the older child was selected for evaluation.

Risk sensitivity calculations

As suggested above, we recommend a few key changes to the assumptions used by EPA in the evaluation of sediments and soils in the Risk Assessment. Specifically, we recommend (i) the elimination of the exposure time factor of 0.5 used in the sediment/soil ingestion calculations, (ii) the adoption of an upper-end exposure frequency of 104 days of contact per year with contaminated soil and sediment for all locations under future land use consideration, and (iii) more health protective assumptions on the rate at which sediment and soil are assumed to adhere to skin. To appreciate the combined effect of these assumptions on the location-specific risk estimates, please see Tables 2a and 2b below, which provide revised risk estimates for potential exposure to arsenic in sediments and soils. Risk estimates are highlighted according to the same conventions as those in Tables 1a and 1b. Note that the Table 2 estimates maintain all of EPA's other assumptions, including limited bioavailability of arsenic via the soil ingestion pathway, and that the Table 2 estimates do not account for all other chemicals in sediments/soils, nor for pathways other than exposure to sediments and soils. Even so, the Table 2 estimates indicate a much larger number of sampling locations that do not meet the upper limits of EPA's risk management criteria. In particular, 23 of the 31 of the sediment sampling locations (Table 2a) and 2 of the 6 soil sampling locations (Table 2b) are projected to have incremental cancer risks equal to or exceeding 1×10^{-4} and/or a total (non-cancer) hazard index equal to or exceeding 1. If the incremental cancer risk threshold criterion is lowered to 1×10^{-5}, consistent with standard Massachusetts policy, then all 31 of the 31 sampling stations fail to meet target criteria for risks to health that are acceptably small.

EPA Response: Please see responses to specific comments above relative to the issues of the FI term, exposure frequencies, and dermal adherence factors. The calculations presented below have not been reviewed for accuracy since they do not represent current or future exposures that may reasonably occur within the study area.

Table 2a Sensitivity calculations for exposure to arsenic in sediment
Reasonable Maximum Exposure Scenario

Exposure Point	Modified Current Risks		Modified Future Risks	
	Lifetime Incremental Cancer Risk	Child Hazard Index	Lifetime Incremental Cancer Risk	Child Hazard Index
Station 01	7.E-06	8.E-02	**1.E-05**	1.E-01
Station 03	**1.E-04**	**1.E+00**	**1.E-04**	**2.E+00**
Station 05	**3.E-05**	3.E-01	**4.E-05**	4.E-01
Station 07/DP	**9.E-05**	**1.E+00**	**1.E-04**	**1.E+00**
Station 08	**3.E-05**	4.E-01	**4.E-05**	5.E-01
Station 09	**4.E-05**	4.E-01	**5.E-05**	6.E-01
Station 13/TT-27	NA	NA	**6.E-03**	**7.E+01**
Station 14	**3.E-05**	3.E-01	**1.E-04**	**1.E+00**
Station 16/TT-33	**3.E-04**	**3.E+00**	**4.E-04**	**4.E+00**
Station 22/TT-22	**2.E-05**	3.E-01	**9.E-05**	**1.E+00**
Station AM	**4.E-05**	5.E-01	**2.E-04**	**2.E+00**
Station AS	**4.E-05**	5.E-01	**2.E-04**	**2.E+00**
Station CB-01	**9.E-05**	**1.E+00**	**9.E-05**	**1.E+00**
Station CB-02	**7.E-05**	8.E-01	**8.E-05**	9.E-01
Station CB-03	**2.E-03**	2.E+01	**2.E-03**	**2.E+01**
Station CB-04	**4.E-04**	**4.E+00**	**4.E-04**	**4.E+00**
Station CB-06	**2.E-04**	**2.E+00**	**2.E-04**	**2.E+00**
Station CB-07	**8.E-05**	9.E-01	**3.E-04**	**4.E+00**
Station JY	NA	NA	**6.E-04**	**7.E+00**
Station KF	**6.E-05**	7.E-01	**8.E-05**	9.E-01
Station LP	**2.E-04**	**2.E+00**	**2.E-04**	**3.E+00**
Station NR	**8.E-05**	9.E-01	**3.E-04**	**4.E+00**
Station NT-1	NA	NA	**4.E-03**	**4.E+01**
Station NT-2	NA	NA	**1.E-03**	**1.E+01**
Station NT-3	NA	NA	**8.E-04**	**9.E+00**
Station TT-30	**4.E-04**	**5.E+00**	**2.E-03**	**2.E+01**
Station TT-31	NA	NA	**5.E-05**	5.E-01
Station WG	**1.E-04**	**1.E+00**	**4.E-04**	**5.E+00**
Station WH	**7.E-04**	**8.E+00**	**3.E-03**	**3.E+01**
Station WS/WSS	**3.E-04**	**4.E+00**	**4.E-04**	**4.E+00**
Station WW	NA	NA	**7.E-05**	9.E-01

Table 2b Sensitivity calculations for exposure to arsenic in soil

Exposure Point	Modified Current Risks		Modified Future Risks	
	Lifetime Incremental Cancer Risk	Child Hazard Index	Lifetime Incremental Cancer Risk	Child Hazard Index
Station 07/DP	**3.E-05**	6.E-01	**4.E-05**	8.E-01
Station CB-05	**5.E-05**	**1.E+00**	**6.E-05**	**1.E+00**
Station DA	**<u>1.E-04</u>**	**<u>2.E+00</u>**	**<u>2.E-04</u>**	**<u>3.E+00</u>**
Station KF	**3.E-05**	6.E-01	**4.E-05**	8.E-01
Station NR	**4.E-05**	8.E-01	**<u>2.E-04</u>**	**<u>3.E+00</u>**
Station WS/WSS	9.E-06	2.E-01	9.E-06	2.E-01

Hexavalent chromium data

Chromium (Cr) may exist in either of two valence states: as hexavalent Cr (Cr VI), which is an established human carcinogen, or as trivalent Cr (Cr III), which is an essential nutrient with little toxicity. In aquatic systems, there is a tendency to find hexavalent chromium dissolved in water samples and trivalent chromium bound in sediments. This generality is not absolute, however, and both forms of chromium can be found in environmental media under various conditions of oxidation or reduction.

Total chromium analysis methods do not distinguish between the hexavalent and trivalent forms, but a separate method is available to quantify the hexavalent portion. The analysis method for hexavalent chromium was used by EPA on surface water samples and some sediment/soil samples. Hexavalent chromium was detected at anomalously high levels in some sediment sample analyses. EPA checked the quality assurance procedures on these samples and found them to be flawed, and hence rejected the use of the sampling results. Because of the complexities of the inter-conversions between the two valence states of Cr, more testing should be performed to characterize the nature and extent of hexavalent chromium concentrations in sediments and soils.

EPA *estimates* hexavalent chromium concentrations in sediment samples based on information *inferred* from an ion chromatography study (Risk Assessment, p. 3-17). Because it rejected its own data, EPA has no direct measurements of hexavalent chromium in sediments. Given the existence of a published test method for hexavalent chromium, the lack of direct measurements is a serious shortcoming that should be remedied through additional sample analyses.

Better knowledge of hexavalent chromium is important because it, like As, is a carcinogen. It also is known to cause allergic contact dermatitis (ACD), which can result from one-time contact with sufficient concentrations of hexavalent chromium in soils or sediments. We recommend that an assessment of ACD be added to the Risk Assessment upon collection of direct sampling data (as described above). As a possible benchmark, the Massachusetts DEP has established a 170 mg/kg guideline for ACD (DEP, 1998).

EPA Response: Direct hexavalent chromium measurements via ion chromatography are available for the study area. The rejection of some hexavalent chromium data was due to possible matrix interferences that may have biased the data. Ion chromatography methods were later employed and the hexavalent chromium data was determined to be acceptable and reliable. Hexavalent chromium results were non-detect except for the results at location SD-WW-06 (17.3 mg/kg) where the total chromium level was 13,400 mg/kg. Because sampling via ion chromatography was not performed at all locations, hexavalent chromium data were estimated using the available ion chromatography results for those sampling locations without sample-specific hexavalent chromium results. Since hexavalent chromium was not detected at a level approaching the DEP ACD guideline, it is not necessary to include this information in the report.

Major Comments on the Ecological Risk Assessment

Previous work on ecological risk assessment should be review and incorporated

As mentioned in the general discussion of sampling data, the Aberjona watershed is a well-studied area, and considerable information on potential ecological risks is available outside of EPA's remedial investigation. EPA should devote effort to integrating and assimilating this information, either using it directly if possible or comparing previous findings to their own.

By its mandate under the Superfund program, EPA's Risk Assessment focuses on chemical contamination, specifically the various lists of metals and organic compounds on the priority pollutant lists. Ecological threats to the Aberjona River watershed, however, are not limited to the pollutants considered in the Risk Assessment. The Aberjona River is listed as an impaired stream (pending confirmation) for reasons of un-ionized ammonia, organic enrichment/low dissolved oxygen, and pathogens (DEP, 1999). The chemical contaminants of interest to the Superfund program are likely influenced by these basic water quality issues that potentially complicate the ecological risk evaluation. Individual chemicals cannot necessarily be examined in isolation. The ecological risk assessment should discuss, and to the extent possible, consider interactions between overall water quality parameters and the chemical contaminants of interest to the Superfund program.

DEP conducted a benthic macroinvertebrate survey as part of its Water Quality Assessment for the Boston Harbor watershed (DEP, 1999). The sampling station located in the Aberjona was determined to have the lowest total metric score of the fourteen stations examined. EPA should review this finding to determine whether their results are consistent with those of DEP.

Also, ecological risks within the Aberjona watershed were the subject of a recent Ph.D. dissertation (Rogers, 1998). EPA should review this study for a number of reasons, and consider the relevance of its methods and information. It was conducted directly within the Aberjona watershed, and considers the integrated effects of all factors that affect the urban watershed. The methods developed in Rogers (1998) are worthy of consideration as a framework for a more comprehensive ecological risk assessment, as they integrate chemical contamination with other relevant determinants of watershed health. The data presented, along with an extensive bibliography, offer potentially valuable information that can be used to enhance the ecological risk assessment. Also, the analysis and conclusions of Rogers (1998) provide a point of comparison for EPA's ecological risk assessment and findings.

EPA Response: EPA has utilized other studies to prepare the BERA, to develop the problem formulation and to interpret the results. However, data collected to estimate risk, in particular, need to be part of a comprehensive study, and address specific assessment and measurement endpoints presented in the BERA. The conclusion of risk in the BERA would not be altered, for example, by the data collected by DEP in 1999 with one station within the study area. In addition to her Ph.D. thesis, Catriona Rogers has co-authored recent papers (Rogers et al., 2002). EPA acknowledges the work done by Rogers and others in documenting the physical, chemical, and biological conditions in the complex Aberjona River system. EPA can, and has used, the works of other professional scientists to develop the study design and problem formulation for the site, as well as compare results. However, the calculation of risk must be based upon data collected by EPA or with oversight by EPA, utilizing EPA methods and subjected to EPA data validation methods.

EPA acknowledges that general water quality and physical habitat conditions have important influences on habitat quality and health of ecological communities. Ambient water quality parameters (pH, temperature, conductivity, dissolved oxygen and hardness) were measured at each surface water station during the data collection in 1995, and additional data were collected at the stations sampled for the triad study in 2001. In addition, EPA has continued to collect detailed surface water data throughout the watershed that will be incorporated into the comprehensive RI report. Consideration of the influence of both chemical and non-chemical stressors is incorporated into EPA's risk assessment methodology. The influence of non-chemical stressors, such as sediment grain size, organic carbon content, and oxygen depletion is considered in the interpretation of the benthic invertebrate community results.

Selection of sediment sampling locations

A detailed rationale for the selection of sediment sampling stations is not provided. Some reaches are more sparsely sampled than others, and it is not clear that sampling adequately characterizes the nature and extent of contamination. Specifically, the ecological risk assessment should address the following issues:

- In Section 2.1.1.1 (page 2-4), a description of how sediment sampling locations were selected should be added.

- In Section 2.1.2.1 (page 2-16), the report states that sediment samples from a depth of 0 to 6 inches were collected. However, EPA does not justify its decision not to sample at lower depths. Because the ecological impact of deep sediment contamination could be significant, EPA should justify its decision. In addition, the ecological risk assessment should provide sediment core description profiles.

- In the same section (Section 2.1.2.1, page 2-17), a description of how sediment bioassay locations were selected should be added.

EPA Response: Sampling locations were selected in 1995 in areas that were anticipated to be most impacted by potential contamination (the Wells G&H Wetland). In 1997, sampling locations were selected in depositional areas to fill data gaps. Subsequent to 1997, sampling was primarily focused on collecting additional samples for the Human Health Risk Assessment. Samples collected after 1997 that could be used to evaluate ecological risk were also included in the Ecological Risk Assessment. Sediment core description profiles for the 2003 core samples will be provided in the comprehensive RI Report.

Samples were collected at a depth of 0-6 inches, since this depth of sediments is most likely to have exposure to ecological receptors. Incidental sediment ingestion of waterfowl, mammals and fish would be only in the top few inches of sediment. Even assuming scouring events could remove the top few inches of sediment, exposing underlying sediments to the surface, EPA considers 0-6 inches as a reasonable estimate of likely exposure of ecological receptors. It is standard practice to sample benthic invertebrate communities at a depth of 0-6 inches, since this is usually the depth of greatest biological activity. Exposure pathways for normal ecological exposure were not identified for deep contamination, therefore these were not considered significant and were not included in the BERA.

Sediment bioassay locations were selected based on the following criteria: all locations were previously sampled for sediment chemistry and used for exposures for other receptors. All locations were depositional, where the highest levels of contamination were expected. Locations were selected to represent replicates of each of the three major habitats (pond, stream, wetland). Based on results of previous sediment sampling and earlier bioassays, stations from each habitat were stratified (if possible), to represent stations with the high concentrations of COPCs including arsenic, chromium, or lead and/or showed toxicity in earlier bioassays.

Data gaps in ecological risk assessment sampling

Data gaps exist for ecological risk assessment sampling. For example, the numbers of crayfish collected from various reaches are quite limited. Only two samples were collected from reaches 1 and 2, three from reach 3, one from reach 5, and no samples at all from reaches 4 and 6. These are extremely small crayfish datasets for reaches that measure at least 100 feet each in length. Additionally, there is no figure showing where the crayfish sampling occurred within each reach. If additional samples cannot be collected, the results of the analyses should be supplemented with modeling based on biota sediment bioaccumulation factors to estimate tissue concentrations in crayfish. The crayfish tissue data that were collected could be used to verify the results of the modeling.

The average concentration of contaminants in crayfish is used to assess risk in each reach. Although this provides a best estimate of risk, due to the limited nature of the data, it would be more conservative and more protective of the environment to use the maximum detected concentrations.

Although no crayfish samples were collected from reaches 4 and 6, dietary exposures associated with ingestion of crayfish were calculated for these areas using data from reaches 3 and 5. Using crayfish body burden data from another reach to represent potential crayfish body burdens in reaches 4 and 6 does not provide useful information that can aid in making a risk management decision.

EPA response: EPA acknowledges that there is uncertainty associated with using a limited number of crayfish samples to estimate exposure of mallards and muskrat to COPCs through dietary intake of invertebrate tissue. However, using literature values for BCFs also has associated uncertainty, and does not necessarily improve the estimate of risk. Where appropriate, EPA prefers applying site-specific data to the risk assessment. Also, it could be counter-argued that the application of maximum values over estimate risks making conclusions of risks highly conservative and difficult to defend. EPA believes that the limited data set for crayfish tissue was used in an appropriate and consistent manner to estimate risk on site. It should also be noted that the proportion of the diet contributed by COPCs in crayfish tissue was only a major factor for mallards (67% of diet invertebrates), whereas only 10% of the muskrat diet was based on invertebrate tissue. Shrew dietary composition was based on BCFs, and not on the crayfish data.

Reference locations are inappropriate

Reference locations selected by the U.S. EPA to evaluate background (local) conditions are potentially inappropriate. Horn Pond is one of the least contaminated ponds in the area, but may still have been contaminated by historical tanning industry activity. The reference location upstream of the Wells G&H site is downstream of the Industri-Plex site, a potential source of sediment contamination. A cursory examination of data from the reference locations indicates levels of contamination that may exceed true background levels. Figure 2-21 of the Risk Assessment shows that arsenic concentrations at five Industri-Plex surface water sampling locations (SW-01, SW-02, SW-03, SW-04, and SW-12) range from 1.1 to 15.7 μg/l. Concentrations at three locations in Wilmington (SW-23, SW-24, and SW-27) range from non-detect to 3.2 μg/l.

These results seem high relative to the published USGS range, which has a 75th percentile value for arsenic of 3 μg/l.

Concentrations of some contaminants in sediment reference samples also appear to be somewhat elevated. According to Figure 2-23, the concentrations of PAHs at SD-03, SD-04, SD-12, and SD-25 range from 4.4 mg/kg to 57 mg/kg. While not extremely high, these concentrations of PAHs are indicative that sediment in the reference areas have been affected by the surrounding urban environment. If DEP's 90th percentile background levels for individual PAHs in natural soil (DEP, 2002) are summed, the total is approximately 27 mg/kg. The concentrations of PAHs in some reference sediment samples thus exceed this level of PAHs.

Similarly, chromium concentrations in some reference sediment sampling locations are higher than DEP's 30 mg/kg 90th percentile background concentration for chromium. Chromium concentrations indicated on Figure 2-24 at locations SD-02-IP, SD-04-IP, and SD-24 range from 198 mg/kg to 512 mg/kg.

On selecting reference locations, EPA should address and discuss the larger philosophic issue of what constitutes an appropriate reference location for the Aberjona watershed. The entire watershed and its surroundings have been affected historically by similar industrial activities. One can view reference locations as attempting to (1) distinguish specific sources from a larger industrialized area (*i.e.*, the Industri-Plex and Wells G&H sites *v.* the area-wide diffuse contributions of the tanning industry and other industrial actitivies) or (2) identify a similar habitat that has been largely free of the general industrial activity that has affected the Aberjona watershed. In this context, EPA should explicitly discuss the philosophy used to identify and select reference locations.

EPA Response: EPA spent a considerable effort in screening and selecting reference locations. There were four main criteria for selection of reference locations. The first was that their locations would ensure that they were not exposed to site-related contaminants. The second was that they were reasonably undisturbed, as evidenced by a lack of physical disturbance of the sediment or vegetation, and not obviously impacted from any known pollution sources. The third was that they were similar to (in terms of vegetative composition, hydrology and general characteristics of sediment composition) and representative of one of the three main habitat types sampled on site (pond, stream or wetland). And lastly, the reference locations were selected to be reasonably close to the site area. EPA believes these criteria are reasonable, and the reference locations are consistent with the criteria. As much as possible, reference locations were selected within the Aberjona River watershed, and if not, located close by. As this area is largely urban, it was anticipated that the reference locations could include media (sediment, surface water or tissue from biota) with low levels of potential contaminants. The approach included using locations assumed to be outside of the influence of site-related contamination. The reference locations included samples that have normal concentrations of contaminants found in urban water sheds, including low levels of PAHs and metals. The reference locations were used in an appropriate

manner. They were not used to screen out contaminants, but only as comparison to local habitat conditions, outside of the influence of contaminants detected on site.

Ecological toxicity data should be more completely documented

Risk Assessment Tables 4-142 through 4-145 compile the specific toxicologic data and benchmarks used in the ecological risk assessment. The values and cited references, however, do not match those discussed in the short toxicity profiles provided in the Risk Assessment text (Section 4.2.1). We recommend that the toxicity profiles be refined to include discussion and selection of the specific values used in the risk assessment calculations. Some relevant information might already be contained in the referenced footnotes to Tables 4-142 to 4-145, which we could not locate in the Risk Assessment document.

Also, EPA should cite the primary references of ecotoxicological data. Most of the citations provided are secondary references, *i.e.*, publications in which others have assembled and reviewed multiple data sources from the literature. In cases where the review publications are recent and specifically targeted to the species considered in the risk assessment, secondary referencing is potentially acceptable, although it is more reflective of a screening-level analysis. Referencing publications such as the Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles, however, is inappropriate. The ATSDR profiles are largely geared toward human health and do not provide the critical review needed to examine ecological endpoints. At a minimum, we recommend that EPA document the specific rationale for selecting values from ATSDR toxicological profiles and similar secondary review publications.

In general, it appears that EPA has used chronic toxicity values when available, focusing mostly on mortality and reproductive health effects. Occasionally, sub-chronic or shorter term values are used (*e.g.*, the value of 9 mg/kg-d used for chromium for the muskrat and shrew).[1] Given the chronic design focus of the ecological risk assessment, we recommend that EPA avoid the use of non-chronic values when possible, and provide detailed documentation when the use of non-chronic values is unavoidable. The use of safety factors should also be considered in conjunction with less-than-chronic data.

EPA Response: The purpose of Section 4.2.1 was to give an overview of the nature of the toxicity of the wide spectrum of contaminants detected on site. This section was prepared prior to the identification of the COPCs contributing the major risk to ecological receptors. It was not the purpose of this section to identify specific toxicity

[1] The chromium value serves as a good example of a case in which greater documentation is needed. The value of 9 mg/kg-d apparently is selected from Table 2-2 of ATSDR's toxicological profile for chromium. Further on in Table 2-2, lower (and hence more protective) values of 3.5 mg/kg-d and 0.46 mg/kg-d are provided from other studies that were longer in duration (and hence more chronic in nature) than the study that yielded 9 mg/kg-d. Given these data, EPA should explain their rationale in choosing the 9 mg/kg-d value.

reference values for individual receptors to each compound. The last page of Tables 142-145 were omitted in printing the BERA. This page gives citations for the footnotes. EPA will include the last page of these tables in the revised Wells G&H OU-3 Risk Assessment.

For specific compounds, when standard ecological references failed to provide a toxicity value for a similar wildlife receptor species, EPA consulted the Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles. These profiles utilize a variety of data, and frequently use rodents in laboratory toxicity tests. For the major contaminants of concern in the watershed, which included metals, only 2 values (cobalt and silver) were used from ATSDR for avian species. It was determined by EPA to be preferable to use a documented value from ATSDR from a laboratory toxicity study cited in this database, than to list the value as not available and assume there was no risk from exposure to the specific COPC. For the mammals, EPA considered using a TRV from a rodent in a laboratory study as a reasonable reference value, when other wildlife values were not available.

The primary sources for each of the toxicity reference values used are from sources readily obtained through electronic databases available on-line. As stated in the text (BERA, Section 4.3.2.1, page 4-60), TRVs were selected which were associated with chronic exposures (i.e., long duration exposures) and no adverse effects (NOAELs - no observed adverse effect levels), relating to reproduction or mortality, preferentially. The value of 9 mg/kg-day for chromium, specifically questioned in the comment, was selected as it was a reproductive end-point for chromium III. No chronic, NOAEL reproductive endpoints were presented in ATDSR for chromium III. The alternative value, referenced in Sample (1996) was 2,737 mg/kg (reproductive), and was not selected, as other values from ATDSR for reproductive effects in rodents ranged from 2 mg/kg to 32 mg/kg for LOAEL values, which were not consistent with the high TRV cited by Sample (1996).

Habitat identification and sampling stations

There are no figures in the ecological risk assessment showing the types of habitat that occur in the study area and their locations. In addition, the text of the report (page 4-52) indicates that sampling stations can represent an area of habitat from a few square feet to 20,000 square feet, but there is no indication of which stations represent a small area and which represent a much larger area. It is difficult to determine whether the sampling stations are given sufficient weight in the Risk Assessment without knowing the size and location of the area they represent, as well as the habitats they encompass.

EPA Response: Section 4.2.2.1 of the BERA describes the habitats included in the study. The general habitat type is characterized for each sampling station in Table 4-32. The location of each sampling station is then shown on Figures 2-1 through 2-20. The aerial photographs of the basemaps in Figures 2-3 to 2-20 depict the habitat (open water, river channel, emergent wetland or deciduous forested habitat). Detailed descriptions of habitat conditions at the 20 stations for Triad sampling are provided in

Appendix D.1 to D.3. EPA believes that there are sufficient data presented to review the document and interpret risk at the site.

Plant uptake factors were generally applied to all reaches

Plant uptake factors based on a small number of plant samples were applied to plants in all areas considered in the ecological risk assessment. Six plant samples were collected from stations in the 38-acre wetland of reach 1. Plant tissue data are not available for the other 5 reaches. Because the plant species present may vary, and because sediment chemistry may not be the same at all locations, it may not be correct to use generic plant uptake factors for all reaches. U.S. EPA screening guidance (1997b) recommends using a plant uptake factor of 1 in the absence of site-specific information. Using average plant uptake values derived from another reach to represent potential plant tissue concentrations for the other five reaches will not provide useful information that can aid in making a risk management decision.

EPA Response: EPA's (1997) guidance is for screening and in cases when no data is available. Although the data set is not large, EPA did collect site-specific data for concentrations of COPCs in plant tissue. Data were collected in the reach with the highest observed contaminant concentrations, and the potentially largest area of habitat for herbivores (Reach 1). Utilizing these data for the other reaches is a reasonable estimate of plant uptake, and the uncertainty in these extrapolations was discussed in the BERA. Utilizing an uptake factor of one for all plant tissue would result in an overly conservative assumption.

Data usage in food-chain pathways

Although the EPA collected media-specific data for the ecological risk assessment, EPA did not necessarily collect the most appropriate data. For example, in evaluating potential dietary risks to the muskrat, EPA sampled cattails, the muskrat's primary food item. Instead of sampling the roots and basal portions of the plants eaten by muskrats (as stated on page 4-38), however, EPA chose to sample the stems and leaves of the cattails.

Further, the risk evaluation for the muskrat population was conducted on a station-by-station basis. However, the size of each station is not indicated. Thus it is unclear whether the station size was appropriate for evaluating the muskrat population.

EPA Response: Samples of plant tissue were collected to estimate dietary exposure of both muskrat and mallard in food-chain models. It is correct that EPA collected above-ground portions of plants for plant tissue analysis. This was done in part to allow these values to be used as estimates for mallard consumption as well, for which it would not be generally appropriate to use root portions of the plant. As is true for most food-chain modeling, the best available data were used as an estimate in the models. EPA acknowledges that the utilization of stem/leaf samples likely underestimated dietary exposure of muskrat to metal COPCs. However plant tissue concentrations were not measured at each station, but rather estimated from sediment concentrations.

Evaluation of the potential error in this estimate of plant tissue concentrations for sediment concentrations and BCFs, is provided in Table 4-276 of the BERA. There is uncertainty involved in each assumption, and EPA attempted to use the data in a consistent and reasonable manner.

Formal surveys of flora and fauna

No formal surveys of fauna and flora were conducted throughout the study area. Wildlife use of the study area is based only on limited field observations. A formal survey, performed by a wildlife biologist, would determine the presence or absence of species in parts of the study area. Without such a survey, it is possible that the ecological risk assessment missed key receptors or did not characterize areas that may be important to wildlife.

EPA Response: Although no formal survey of flora and fauna were conducted, habitats were qualitatively surveyed during several site visits on numerous dates by qualified biologists. In 1985, the USEPA conducted an evaluation of the wetlands near Wells G&H to determine the extent and type of wetlands in the study area (PRC, 1986). In both 1995 and 1997, USEPA, USF&WS, and NOAA biologists were extensively involved in qualitative field surveys, biological sampling, and reference site selection. The qualitative assessments provided an adequate characterization of the major flora and fauna present or potentially present based on habitat conditions. It was the opinion of EPA and the other reviewing resource agencies (USFWS, DEP, NOAA), that the characterization and qualitative description of the site from the early surveys were sufficient to develop a sound site conceptual model and problem formulation. More recently, in preparation of the revised BERA, the majority of the sampling stations were re-visited by teams of biologists from EPA, USFWS and DEP to confirm the habitat conditions and suitability of each station to represent each of the wildlife receptors, and also to select the sampling locations for the triad sampling. In addition, Habitat Assessment Field data sheets were completed (Appendix C) for each of the triad sampling locations. EPA believes that the site was adequately characterized for the purposes of the BERA. It is neither a practical expectation nor necessarily a goal of a risk assessment to provide quantitative data on all flora and fauna in a resource area.

In addition, quantitative surveys are very unlikely to detect population effects in highly mobile animals such as the muskrat and mallard. The results of the BERA identified probable effects (i.e. chronic impacts) on reproduction. For the BERA, the assessment population was operationally defined to be the population within study area (Aberjona River Basin, south of Route 128). The population is regulated by births and deaths (which may be affected by site conditions) as well as immigration and emigration of individuals from adjacent areas. Severe effects on a receptor could remove individuals from the assessment population, or decrease reproductive rates and cause the study area to serve a sink for the regional population. In this case, lower reproduction rates within the study area might be compensated by an increase in immigration. The

resulting subtle impacts on population density within the study area would not likely be detected using standard field survey methods.

Relative bioavailability of arsenic in ecological receptors

The relative bioavailability of arsenic found in the site-specific study in Appendix C.9 is not appropriate for all ecological receptors. The site-specific study is based on absorption in swine. Pigs, however, are omnivores with different digestive physiology than the muskrat and the shrew. Pigs have acidic stomachs and long intestines, while muskrats are herbivores with alkaline stomachs. The shrew is a carnivore with an acidic stomach but a much shorter intestine than the pig. These biological differences may result in different rates of arsenic uptake among the species.

EPA Response: EPA acknowledges that the bioavailability of arsenic calculated in the swine study is not appropriate for all ecological receptors. The value derived for pigs (50%) was used to adjust only the small contribution to the diet of muskrat contributed by incidental sediment ingestion. The bioavailability of arsenic was not applied to other ecological receptors in the BERA. Specifically, the incidental sediment ingestion factor for muskrat utilized in the BERA was 3.3% (Table 4-28). The contribution of incidental sediment to total dietary exposure ranged from 3.4 % (Station 16) to 8.1 % (Station 13 and BW) for muskrat (Tables 4-146 to 4-192). EPA considers the application of this site-specific bioavailability data to be reasonable and appropriate.

Amphibians and reptiles

Amphibians and reptiles are not considered in the ecological risk assessment, despite the fact that they were commonly found in the study area. Bullfrog tadpoles, for example, were frequently found in shallow waters. The Risk Assessment states that there are limited data on the toxicological effects of chemicals of potential concern on these organisms. It would be possible, however, to do at least a screening analysis using tests such as FETAX (frog embryo teratogenesis assay – Xenopus) tests.

EPA Response: EPA acknowledges that amphibians and reptiles were not utilized as receptors in the BERA, and it is discussed in the BERA (Section 4.2.3.2) that selection of receptor species/communities is a complex decision process with input from a number of concerned parties. It is not possible to use all potential receptors in a risk assessment, and the collective professional judgment in designing the problem formulation was that, with the available tests and toxicity reference values, an assessment endpoint for amphibians and reptiles was not as valuable as the other endpoints selected. Utilization of FETAX tests was considered. However, literature suggesting expected teratogenic effects of metals from exposure to sediments was lacking and questions about the variability of the tests were also raised. The other issue with FETAX testing is that it most reliably addresses concentrations of contaminants in surface water. In the BERA, the main exposure route (highest media concentrations) for amphibians was likely to be sediment.

Exposure parameters for the heron

The ecological risk assessment states that the great blue heron has a foraging distance of 2 to 15 miles, corresponding to the size of the study area (7 miles). Therefore, the entire study area is used as the foraging range for the heron. Although this is a reasonable estimate of heron exposure; it would be more conservative and more protective of the heron to assume the heron has a foraging distance of only 2 miles, perhaps focused on a more contaminated portion of the river. The heron will forage near its nest; hence, nesting sites should be identified, and the foraging area should be defined based on nesting sites.

Further, the ecological risk assessment excludes sediment stations under more than three feet of water when evaluating heron exposure to sediment. This may be reasonable; however, no justification is provided for this threshold depth criterion. This threshold does not appear in EPA's wildlife exposure factor handbook (U.S. EPA, 1993). EPA should provide the basis for this assumption.

EPA Response: The receptor species modeled in the BERA was a green heron. Little information on the foraging distance of this species was found. Making the assumption that the foraging distance would be similar to a great blue heron may have overestimated the foraging range of the heron. Even under the highly conservative scenario of maximum exposure for heron (using maximum observed fish, invertebrate and sediment concentrations site-wide) the only COPC for heron above 1.0 was for iron (Table 4-194). The risk calculations would not have indicated risk, even using the most conservative assumptions, and appear to be protective of the receptor.

Natural history references for the green heron used the term "shallow" water to describe the depth of water the bird will forage for small fish or invertebrate prey. EPA used a reasonable assumption of "shallow" to mean 2-3' of water. Changing this assumption would alter the stations selected for incidental sediment ingestion, and would have little effect on the results of the BERA risk calculations, since the majority of the dietary exposure for the diet is from ingestion of animal prey.

Exposure parameters for the mallard

As for the heron, only sediment samples beneath less than three feet of water were used to evaluate exposure of mallard ducks to sediment. The justification and references for this threshold should be elucidated.

Many species of ducks live on Mystic Lake for at least a portion of the year. Because it is the largest open water body in the Aberjona River watershed, exposures for mallards in Mystic Lake should be calculated separately. Sediment sampling location SD-02-01 was used to evaluate exposure of a muskrat to sediment, but was not used to evaluate mallard exposure.

EPA Response: Mallards are dabbling ducks. Water depth for feeding and brooding is typically listed as 1 up to 3 feet deep (Johnson, et al., 1987). Up to 2.0 to 2.5 may be more typical for mallards; however, since water levels may vary, EPA considered less than 3 feet a reasonable estimate of forage depth for a dabbling duck.

Mallard use of Mystic Lakes was included in the site-wide model. Based on the depth, sediment sample SD-02-01 should have been used for mallard exposure calculation, and was an error in Table 4-32. The sitewide model was re-calculated with this sample; Tables E.1-51, E.1.52, 4-198 and 4-199 were revised (attached) and will be included in the revised Wells G&H OU-3 Risk Assessment. Table 4-197, which summarized HQs for mallard, did not require revision, as none of the HQs, rounded to whole numbers, differed from the previously reported values.

Shrew

The Risk Assessment should provide information about the size of the area (acreage) that is suitable shrew habitat in each reach of the Aberjona River. The Risk Assessment should also describe the size of the area that is represented by each station used to estimate the shrew's exposure. Information should also be provided as to how many soil or sediment samples were used within each reach to calculate sediment and dietary exposure to the shrew.

EPA Response: Sampling locations not inundated with water were considered potential shrew habitat. Sampling stations within these locations were applied to the shrew habitat. The size of each station can be estimated by identifying the stations/samples used for characterizing exposures for shrew and estimating the areas represented by these samples in Figures 2-3 to 2-20. Shrew risk was not calculated by reach, but by station. The stations/samples used in each reach to calculate exposure to shrew are shown in Table 4-32.

Eels

Eels were caught in the fish survey but were not used in the Risk Assessment. Though eels are a key species in the study area, no justification is provided for the exclusion of eels from the study. Eels have a higher lipid content than the white sucker, a species that was considered in the study, and could therefore contain higher concentrations of lipophilic chemicals. The eel should replace the white sucker in the Risk Assessment. Eels should additionally be used in the small fish tissue data used to calculate dietary fish exposure for the heron.

EPA Response: There were 17 white sucker samples in the Aberjona River study area as compared to 5 eel samples (all from reach 6). White sucker was selected as a reasonable receptor to evaluate potential tissue residue effects, since more data were available and more tissue residue values were available from similar species. Although eels may have higher lipid content, metals, are not lipophilic, and do not generally bioaccummulate through the food web. Eel samples were not used in the small fish

tissue data used to calculate dietary exposure to heron, since the 5 samples were all greater than 17 cm, and recorded as "large fish."

Fish body burden study and fish community

The Risk Assessment performed a fish body burden study to determine whether fish within the study area carry a greater body burden of chemicals than fish in reference bodies of water. However, due to the small sample size of fish in the reference area, fish data should also be compared to the fish data collected by the Massachusetts DEP's Fish Toxics Program.

Because benchmarks are not available for some chemicals of concern, and because the ecological effects of exceeding the benchmarks are not well-defined, another measurement endpoint should be used to evaluate the potential effect of chemicals on the fish populations in the Aberjona River and Mystic Lake. This endpoint should be an assessment of the fish community to evaluate the biological integrity of the Aberjona River. One such endpoint could be the Index of Biotic Integrity, which is an aggregation of 12 biological metrics that are based on the fish community's taxonomic and trophic composition and the abundance and condition of fish. These metrics assess the species richness component of diversity and the health of resident taxonomic groupings and habitat guilds of fish. Two of the metrics assess the community composition in terms of tolerant or intolerant species. Fish protocols are described in U.S. EPA (1999).

Further, recreational fishers in the Mystic Lakes have reported seeing spots on fish caught in the lakes. (MyRWA, 2003). The ecological risk assessment should investigate the presence of diseases or tumors in the fish.

EPA Response: EPA used two evaluations for fish. One was a comparison to tissue residue benchmarks, and a second was a comparison to reference values. The comparison to reference values was useful, particularly in the cases where tissue residue benchmarks were not available. For the main contaminants of concern in the Study Area, these analyses did not indicate elevated tissue levels in fish. There is no evidence of magnification of arsenic in aquatic food chains (Eisler, 2000), and no evidence in EPA's study for elevated concentrations of metals in fish tissue collected on site. Consequently, EPA determined no additional studies were necessary.

As part of the fish survey observations were recorded on the condition of the fish, including the presence of spots or tumors. These data are presented in Appendix A, Section 5. Among the fish collected, one white sucker collected in Reach 5, was observed to have subdermal black spots. Three fish (brown bullhead) with tumors were collected from Davidson Pond.

Crayfish

Crayfish are mobile, epibenthic organisms, not sessile, infaunal benthic invertebrates. Therefore, concentrations of chemicals in crayfish tissue should not be used to represent potential levels of chemicals in the tissues of infaunal benthic organisms such as midges and amphipods (page 4-66). This measurement endpoint should not be used as an indicator for the sustainability of the benthic invertebrate community.

EPA Response: EPA believes the use of the crayfish data to model dietary uptake was a reasonable estimate for the invertebrate tissue concentrations in diets of muskrat, mallard and heron. Crayfish are a normal invertebrate food source for the modeled receptors. Where appropriate, EPA prefers applying site-specific data to the risk assessment.

Summary tables

Summary tables that show individual samples and the calculated exposure point concentrations for all media for all indicator wildlife species should be provided. Because such tables are not included in the ecological risk assessment, it is impossible to check some of the calculations.

EPA Response: The individual samples and the calculated exposure concentration were presented in the BERA. Sediment and surface water concentrations calculated for each scenario are presented in Tables 4-7 to 4-15 and Tables 4-33 through 4-101. Tissue concentrations for plants were calculated based on the sediment concentration (noted in tables, above) multiplied by an uptake factor. Fish and crayfish tissue concentrations were used in the models either by reach or for site-wide concentrations. The site-wide concentrations used in the heron and mallard models for fish and crayfish are summarized in Tables 4-25 and 4-26. The concentrations of COPCs by reach are not presented in a Table for small fish and crayfish. However, in addition to the summary tables by media noted above, each value for each medium for each receptor is presented for each model in Appendix E.1. The concentration from each medium utilized for each receptor for each scenario is not readily presented in "Summary Tables." All values used in the calculations are presented in Appendix E.1.

Minor Comments

- The Risk Assessment does not clearly show the locations of biota sampling. Also, data usage in the ecological risk assessment is not well documented. For example, fish sampling results are provided, but the Risk Assessment does not indicate what samples were used to derive exposure point concentrations.

EPA Response: As described in the report, fish samples were collected by US Fish and Wildlife Service and EPA at each reach along the Aberjona River and Mystic Lakes. Large fish samples were collected from Reaches 3 – 6; small fish samples were collected from Reaches 1 – 6; and crayfish were collected from Reaches 1- 3 and 5. Further descriptions of the fish sampling locations are attached and will be included in the revised Wells G&H OU-3 Risk Assessment. Benthic invertebrate samples were collected as part of the sediment triad sampling effort. The locations of the triad sediment samples are illustrated on Figures 2-1, 2-3 and 2-4 and denoted by "TR" and

the color pink. Plant tissue samples were presented in the tables. The plant tissue samples were collected near sediment stations 18, 20 and 21 and reference station 23.

In addition, Table 4-23 lists the sample group for each biological tissue (crayfish and fish) used for each exposure calculation. Sitewide average and maximum concentrations of crayfish and small fish tissues are presented in Tables 4-25 and 4-26, respectively. The data for individual samples are presented in Appendix A (Sections 5.0 and 6.0).

- In the ecological risk assessment (section 2.1.2.3), the depth of each surface water sample is not cited in the analysis. The Risk Assessment should specify whether water samples were collected at the surface or at depths greater than 2 feet.

EPA Response: According to Appendix A.1 (the Foster Wheeler Compendium), surface water samples were collected in accordance with the protocols outlined in the FW 1995 Field Operations Plan. According to the field notes, samples were collected within the water column at varying depths based on the depth of the water column. This is consistent with typical surface water sampling field protocols of sample collection at a depth from the bottom of 60% of the water column.

- It would be useful to present a second version of Figure 2-25 on a logarithmic scale to show the concentrations of each of the metals.

EPA Response: At this time, EPA will not be producing an additional version of Figure 2-25.

- On page 4-58, justification should be provided for the worm uptake factor of 0.5 used for antimony, beryllium, cobalt, silver, thallium, and vanadium. In the absence of site-specific information, U.S. EPA (1997b) recommends the use of an uptake factor of 1.

EPA Response: A value of 1 is recommended for screening-level risk calculations, and is very conservative for metals. As noted in the footnotes of the shrew models in the BERA, uptake values (UFs) values for arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, and zinc were based on regression analyses of literature derived soil-biota uptake data provided in Sample et al. (1998); uptake factors for aluminum, barium and iron were taken from Beyer and Stafford (1993). Sample (1998) also provides UFs (90^{th} percentile UF for data from Oak Ridge Reservation, Appendix C.1 of Sample 1998) for beryllium (1.18), cobalt (0.29), silver (15) and vanadium (0.09). No values for UFs were available for antimony or thallium in Sample 1998. Shrew models were re-calculated using a UF of 1.0 rather than 0.5 in the earthworm model for antimony and thallium, and using the Sample 1998 values for beryllium, cobalt, silver and vanadium. These results are shown in the attached revision of Table 4-245, and will be included in the revised Wells G&H OU-3 Risk Assessment. Re-calculating the shrew models using the higher UF values for Be and

Ag, resulted in all HQ values all remaining below 1.0. Although a few stations had higher HQs for antimony using a UF of 1.0, no other notable changes resulted from these recalculated results. The BERA documented the high uncertainty associated with the estimates used in the shrew model; these suggested changes in UFs for the shrew model do not change the conclusions of the BERA.

- Based on examination of other maps, the legend on the bottom of Figure 2-7 appears to cover a school. While it may not affect the risk assessment calculations, it does obscure the location of an elementary school (the Muraco School), a land use characteristic that might interest some readers.

EPA Response: At this time, EPA will not be amending Figure 2-7.

- There are a number of tributaries to the Aberjona River that are not depicted in the baseline maps. Sampling station TT31 appears to be located on an unnamed tributary that flows from the east and joins the Aberjona just north of the Cranberry Bog area. Further to the south, Sweetwater Brook enters the Aberjona in the vicinity of the Kraft Foods facility (under which it is culverted). Risk Assessment maps such as Figures E-1, E-2, E-3, and 2-2 should be updated to show these tributaries.

EPA Response: At this time, EPA will not be amending Figures E-1, E-2, E-3 and 2-2.

- The 100-year flood plain delineation does not correspond to the physical stream pictures depicted in Figure 2-4. It appears that there has been a distortion in coordinate scaling, the result of which is most easily seen at the top of Figure 2-4, where the 100-year flood plain delineation does not line up with the unnamed tributary. It also appears that the flood plain delineation is somewhat shifted with respect to the borders of the Cranberry Bog area.

EPA Response: The 100 year flood plain was obtained from Massachusetts GIS, and scaled on the figures in a best fit capacity. At this time, EPA will not be amending Figure 2-4.

- Major MWRA sewer mains run along the Aberjona and interact with it, particularly during flooding events. Consideration of these sewer mains may be relevant within the fate and transport assessment that will be developed in the Remedial Investigation report.

EPA Response: Your comment is acknowledged. Subsurface utilities such as the MWRA sanitary sewer mains mentioned in the comment will be considered in the comprehensive RI.

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EPA Response to ASC Comments
EPA New/ Revised Ecological Tables

1) Description of Fish Sampling Locations Table;
2) Table E.1 – 51 Average Exposure Calculations for Mallard (Site-Wide);
3) Table E.1 – 52 Maximum Exposure Calculations for Mallard (site Wide);
4) Table 4-198 Average Exposure Case Hazard Quotients for Mallard (Site-Wide);
5) Table 4-199 Maximum Exposure Case Hazard Quotients for Mallard (Site-Wide);
6) Table 4-245 Revised Hazard Quotient Summary for Shrew; and
7) Table 4-32 Applicability of Sediment Samples to Exposure Scenarios for Indicator Species.

DESCRIPTION OF FISH SAMPLING LOCATIONS

WELLS G&H SUPERFUND SITE OU3

Reach	Location of Fish Samples	Species Collected	Number of Individuals
Reach 1	North of Olympia Ave	white sucker	18
	nr	brown bullhead	1
	nr	pumpkinseed	7
Reach 2	Near Station 8	white sucker	9
	North of Washington Circle	white sucker	4
	North of Washington Circle	redfin pickerel	2
Reach 3	South of Swanton Road	largemouth bass	4
	Davidson Pond and south of pond	white sucker	5
	Davidson Pond	yellow perch	5
	Davidson Pond	brown bullhead	5
	nr	pumpkinseed	19
Reach 4	Judkins Pond	largemouth bass	5
	Judkins Pond	white sucker	8
	Judkins Pond	pumpkinseed	15
Reach 5	nr	white sucker	3
	nr	pumpkinseed	21
	Everett	largemouth bass	2
	North or guaging station	largemouth bass	2
	nr	white sucker	3
	Near guaging station	white sucker	4
	nr	largemouth bass	1
	nr	white sucker	1
	Above bridge at Mystic Valley Parkway	largemouth bass	2
Reach 6	Upper Mystic Lake	largemouth bass	4
	Upper Mystic Lake	pumpkinseed	21
	Upper Mystic Lake	brown bullhead	1
	Upper Mystic Lake	carp	5
	Upper Mystic Lake	eel	5
Reach 7 (Reference)	Wright's Pond	largemouth bass	10
	Wright's Pond	pumpkinseed	20
	Wright's Pond	eel	8
	Wright's Pond	brown bullhead	11

nr = not recorded

	Mean Concentrations Compound	C Sediment (mg/Kg)	C Water (mg/L)	C Animal (mg/Kg)	C Plant (mg/Kg)	TRV mg/Kg day	DOSE animal	DOSE plant	DOSE food (a+p)	DOSE soil/ sediment	DOSE water	Total Dose	HQ animal	HQ plant	HQ soil/ sediment	HQ water	*TOTAL HQ*	% HQ animal	% HQ plant	% HQ soil/ sediment	% HQ water
	Volatile Organics																				
	2-Butanone	0.03813542	0.0025			12.1	0	0	0	3.5866E-05	0.0000725	1.08E-04	0.00E+00	0.00E+00	2.96E-06	5.99E-06	*8.96E-06*	0	0	0.33097319	0.66902681
	Acetone	0.38235455	0.0025			1700.0	0	0	0	0.0003596	0.0000725	4.32E-04	0.00E+00	0.00E+00	2.12E-07	4.26E-08	*2.54E-07*	0	0	0.83221649	0.16778351
	cis-1,2-Dichloroethene	0.09539474	0.00090625			3114.0	0	0	0	8.9719E-05	2.62813E-05	1.16E-04	0.00E+00	0.00E+00	2.88E-08	8.44E-09	*3.73E-08*	0	0	0.7734375	0.2265625
	Tetrachloroethene	0.03662281	0.00059375			14.0	0	0	0	3.4444E-05	1.72188E-05	5.17E-05	0.00E+00	0.00E+00	2.46E-06	1.23E-06	*3.69E-06*	0	0	0.66670699	0.33329301
	Trichloroethene	0.05412931	0.0006875			7.0	0	0	0	5.0909E-05	1.99375E-05	7.08E-05	0.00E+00	0.00E+00	7.27E-06	2.85E-06	*1.01E-05*	0	0	0.7185802	0.2814198
	Semivolatile Organics																				
	2-Methylnaphthalene	0.20403968	0.0025			143.70	0	0	0	0.0001919	0.0000725	2.64E-04	0.00E+00	0.00E+00	1.34E-06	5.05E-07	*1.84E-06*	0	0	0.72579355	0.27420645
	Acenaphthylene	0.19961905	0.0025			133.30	0	0	0	0.00018774	0.0000725	2.60E-04	0.00E+00	0.00E+00	1.41E-06	5.44E-07	*1.95E-06*	0	0	0.72141284	0.27858716
	Anthracene	0.25782031	0.0025			1000.00	0	0	0	0.00024248	0.0000725	3.15E-04	0.00E+00	0.00E+00	2.42E-07	7.25E-08	*3.15E-07*	0	0	0.76982666	0.23017334
	Benzo(a)anthracene	0.84743243	0.0025			1.30	0	0	0	0.00079701	0.0000725	8.70E-04	0.00E+00	0.00E+00	6.13E-04	5.58E-05	*6.69E-04*	0	0	0.91661972	0.08338028
	Benzo(a)pyrene	0.89654167	0.0025		0.14	1.30	0	0.010606922	0.010606922	0.0008432	0.0000725	1.15E-02	0.00E+00	8.16E-03	6.49E-04	5.58E-05	*8.86E-03*	0	0.92053044	0.07317758	0.00629197
	Benzo(b)fluoranthene	1.4623875	0.0025		0.11	1.30	0	0.008297522	0.008297522	0.00137538	0.0000725	9.75E-03	0.00E+00	6.38E-03	1.06E-03	5.58E-05	*7.50E-03*	0	0.85142982	0.14113077	0.00743941
	Benzo(g,h,i)perylene	0.52961765	0.0025			133.30	0	0	0	0.00049811	0.0000725	5.71E-04	0.00E+00	0.00E+00	3.74E-06	5.44E-07	*4.28E-06*	0	0	0.87294197	0.12705803
	Benzo(k)fluoranthene	1.05876014	0.0025		0.21	1.30	0	0.015711377	0.015711377	0.00099576	0.0000725	1.68E-02	0.00E+00	1.21E-02	7.66E-04	5.58E-05	*1.29E-02*	0	0.93633571	0.05934358	0.00432071
	Carbazole	0.24666667	0			133.30	0	0	0	0.00023199	0	2.32E-04	0.00E+00	0.00E+00	1.74E-06	0.00E+00	*1.74E-06*	0	0	1	0
	Chrysene	1.06212	0.0025		0.12	1.30	0	0.009237821	0.009237821	0.00099892	0.0000725	1.03E-02	0.00E+00	7.11E-03	7.68E-04	5.58E-05	*7.93E-03*	0	0.89607154	0.09689593	0.00703252
	Dibenz(a,h)anthracene	0.26682308	0.0025			1.30	0	0	0	0.00025095	0.0000725	3.23E-04	0.00E+00	0.00E+00	1.93E-04	5.58E-05	*2.49E-04*	0	0	0.77585207	0.22414793
	Dibenzofuran	0.26323913	0.0025			133.30	0	0	0	0.00024758	0.0000725	3.20E-04	0.00E+00	0.00E+00	1.86E-06	5.44E-07	*2.40E-06*	0	0	0.77349158	0.22650842
	Fluoranthene	1.8244125	0.0025		0.09	125.00	0	0.006427178	0.006427178	0.00171586	0.0000725	8.22E-03	0.00E+00	5.14E-05	1.37E-05	5.80E-07	*6.57E-05*	0	0.78231979	0.20885547	0.00882474
	Fluorene	0.2211875	0.0025			125.00	0	0	0	0.00020803	0.0000725	2.81E-04	0.00E+00	0.00E+00	1.66E-06	5.80E-07	*2.24E-06*	0	0	0.74155771	0.25844229
	Indeno(1,2,3-cd)pyrene	0.57054225	0.0025		0.24	1.30	0	0.017911737	0.017911737	0.00053659	0.0000725	1.85E-02	0.00E+00	1.38E-02	4.13E-04	5.58E-05	*1.42E-02*	0	0.96711298	0.02897251	0.00391451
	Naphthalene	0.25289844	0.0025			140.00	0	0	0	0.00023785	0.0000725	3.10E-04	0.00E+00	0.00E+00	1.70E-06	5.18E-07	*2.22E-06*	0	0	0.76639352	0.23360648
	N-nitrosodiphenylamine	0.28046939	0.0025			150.00	0	0	0	0.00026378	0.0000725	3.36E-04	0.00E+00	0.00E+00	1.76E-06	4.83E-07	*2.24E-06*	0	0	0.78440679	0.21559321
	Phenanthrene	0.88542254	0.0025		0.24	133.30	0	0.017770225	0.017770225	0.00083274	0.0000725	1.87E-02	0.00E+00	1.33E-04	6.25E-06	5.44E-07	*1.40E-04*	0	0.95152785	0.04459005	0.0038821
	Pyrene	1.47772152	0.0025		0.09	133.30	0	0.006751452	0.006751452	0.0013898	0.0000725	8.21E-03	0.00E+00	5.06E-05	1.04E-05	5.44E-07	*6.16E-05*	0	0.82196958	0.16920375	0.00882666
	Pesticides and PCBs																				
	4,4'-DDD	0.02559	0.00005	0.0024	1.32E-03	8.50	0.00019635	9.85799E-05	0.000294933	2.4067E-05	0.00000145	3.20E-04	2.31E-05	1.16E-05	2.83E-06	1.71E-07	*3.77E-05*	0.61274069	0.30762949	0.07510493	0.00452488
	4,4'-DDE	0.0165019	0.00005	0.0050	7.17E-04	1.90	0.00040563	5.34308E-05	0.000459064	1.552E-05	0.00000145	4.76E-04	2.13E-04	2.81E-05	8.17E-06	7.63E-07	*2.51E-04*	0.85210971	0.1122415	0.03260279	0.003046
	4,4'-DDT	0.00526704	0.00005	0.0012	8.46E-04	0.00	9.4258E-05	6.30795E-05	0.000157337	4.9537E-06	0.00000145	1.64E-04	3.37E-02	2.25E-02	1.77E-03	5.18E-04	*5.85E-02*	0.57565134	0.38524015	0.03025304	0.00885547
	Aldrin	0.00134413	0.000025	0.0003		0.20	2.3157E-05	0	2.31572E-05	1.2642E-06	0.000000725	2.51E-05	1.16E-04	0.00E+00	6.32E-06	3.63E-06	*1.26E-04*	0.92089709	0	0.05027171	0.02883119
	alpha-Chlordane	0.01127078	2.3653E-05	0.0009	1.15E-03	2.14	7.563E-05	8.60133E-05	0.000161643	1.06E-05	6.85934E-07	1.73E-04	3.53E-05	4.02E-05	4.95E-06	3.21E-07	*8.08E-05*	0.43734612	0.49738963	0.06129769	0.00396656
	Aroclor 1248	0.06297429	0.0005	0.0026		0.98	0.00021427	0	0.000214268	5.9227E-05	0.0000145	2.88E-04	2.19E-04	0.00E+00	6.04E-05	1.48E-05	*2.94E-04*	0.74399817	0	0.20565378	0.05034805
	Aroclor 1254	0.147685	0.0005	0.0157		1.50	0.00127746	0	0.001277465	0.0001389	0.0000145	1.43E-03	8.52E-04	0.00E+00	9.26E-05	9.67E-06	*9.54E-04*	0.89279349	0	0.09707276	0.01013375
	Aroclor 1260	0.18944722	0.0005	0.0258	1.18E-02	0.35	0.00210247	0.000882276	0.002984748	0.00017818	0.0000145	3.18E-03	6.09E-03	2.56E-03	5.16E-04	4.20E-05	*9.21E-03*	0.66169102	0.27767019	0.05607535	0.00456345
	beta-BHC	0.00136868	0.000025	0.0003		4.00	2.2699E-05	0	2.26992E-05	1.2872E-06	0.000000725	2.47E-05	5.67E-06	0.00E+00	3.22E-07	1.81E-07	*6.18E-06*	0.9185704	0	0.05209093	0.02933867
	delta-BHC	0.00187629	0.000025	0.0003		1.60	2.1732E-05	0	2.17322E-05	1.7647E-06	0.000000725	2.42E-05	1.36E-05	0.00E+00	1.10E-06	4.53E-07	*1.51E-05*	0.89721452	0	0.07285379	0.02993169
	Endosulfan I	0.00456514	0.000025	0.0004	7.51E-04	10.00	3.1046E-05	5.60179E-05	8.70639E-05	4.2935E-06	0.000000725	9.21E-05	3.10E-06	5.60E-06	4.29E-07	7.25E-08	*9.21E-06*	0.33715406	0.60834565	0.04662691	0.00787338
	Endosulfan Sulfate	0.00225836	0.00005	0.0008		10.00	6.2092E-05	0	6.20919E-05	2.124E-06	0.00000145	6.57E-05	6.21E-06	0.00E+00	2.12E-07	1.45E-07	*6.57E-06*	0.94557314	0	0.03234538	0.02208148
	Endrin Aldehyde	0.00289641	0.00005	0.0020	8.90E-04	0.30	0.00016643	6.63744E-05	0.000232801	2.7241E-06	0.00000145	2.37E-04	5.55E-04	2.21E-04	9.08E-06	4.83E-06	*7.90E-04*	0.70229581	0.28009023	0.01149517	0.00611879
	gamma-Chlordane	0.0147596	2.3612E-05	0.0004	1.42E-03	2.14	3.2471E-05	0.000105642	0.000138114	1.3881E-05	6.84742E-07	1.53E-04	1.52E-05	4.94E-05	6.49E-06	3.20E-07	*7.13E-05*	0.21267411	0.69192257	0.09091849	0.00448483
	Inorganics																				
	Aluminum	10317.8846	0.25301176	50.0063	1.72E+02	109.70	4.07210895	12.80647515	16.8785841	9.70397048	0.007337341	2.66E+01	3.71E-02	1.17E-01	8.85E-02	6.69E-05	*2.42E-01*	0.153145	0.48162945	0.3649496	0.00027594
	Antimony	6.14997908	0.00067941	0.0484		0.13	0.00394364	0	0.003943638	0.00578406	1.97029E-05	9.75E-03	3.15E-02	0.00E+00	4.63E-02	1.58E-04	*7.80E-02*	0.40458372	0	0.59339492	0.00202135
	Arsenic	278.399038	0.01390588	2.2175	14.67	5.14	0.18057546	1.094184487	1.274759947	0.2618343	0.000403271	1.54E+00	3.51E-02	2.13E-01	5.09E-02	7.85E-05	*2.99E-01*	0.11748585	0.71189737	0.1703544	0.00026238
	Barium	86.9161538	0.03672059	10.1813	8.48	208.00	0.82907955	0.631975536	1.461055086	0.08174464	0.001064897	1.54E+00	3.99E-03	3.04E-03	3.93E-04	5.12E-06	*7.42E-03*	0.5370157	0.40934647	0.05294806	0.00068976
	Beryllium	0.67926561	5.1412E-05	0.0054		0.66	0.00043719	0	0.000437192	0.00063885	1.49094E-06	1.08E-03	6.62E-04	0.00E+00	9.68E-04	2.26E-06	*1.63E-03*	0.40573456	0	0.59288178	0.00138366
	Cadmium	6.25545962	0.00029629	0.0701	0.67	1.45	0.00570605	0.049969298	0.055675352	0.00588326	8.59253E-06	6.16E-02	3.94E-03	3.45E-02	4.06E-03	5.93E-06	*4.25E-02*	0.09268009	0.81162201	0.09555834	0.00013956
X	Chromium	1210.01154	0.01258941	1.1325	22.61	1.00	0.09222174	1.686142846	1.778364586	1.13801585	0.000365093	2.92E+00	9.22E-02	1.69E+00	1.14E+00	3.65E-04	*2.92E+00*	0.03161803	0.57809049	0.39016631	0.00012517
	Cobalt	14.6549615	0.000905	0.4388	1.30	5.00	0.03572829	0.097058015	0.132786305	0.01378299	2.6245E-05	1.47E-01	7.15E-03	1.94E-02	2.76E-03	5.25E-06	*2.93E-02*	0.24372017	0.66208027	0.09402054	0.00017903
	Copper	388.702885	0.01178529	49.6688	19.69	47.00	4.04462565	1.468005909	5.512631559	0.36557506	0.000341774	5.88E+00	8.61E-02	3.12E-02	7.78E-03	7.27E-06	*1.25E-01*	0.68803136	0.24972252	0.06218798	5.8139E-05
	Cyanide	1.02849398	0.0025	0.2394		68.70	0.01949279	0	0.019492785	0.0009673	0.0000725	2.05E-02	2.84E-04	0.00E+00	1.41E-05	1.06E-06	*2.99E-04*	0.94935861	0	0.04711042	0.00353097
X	Iron	26458.8077	1.56129412	345.0313	2190.25	3.19	28.0965848	163.3229148	191.4194996	24.8845086	0.045277529	2.16E+02	8.81E+00	5.12E+01	7.80E+00	1.42E-02	*6.78E+01*	0.12986678	0.75490388	0.11502006	0.00020928
X	Lead	341.711731	0.00738706	0.7778	31.16	1.13	0.06333883	2.32371827	2.387057097	0.32137988	0.000214225	2.71E+00	5.61E-02	2.06E+00	2.84E-01	1.90E-04	*2.40E+00*	0.0233839	0.8578876	0.11864942	7.9089E-05
	Manganese	453.4175	0.4224	98.9250	255.69	977.00	8.0556606	19.06600674	27.12166734	0.42643916	0.0122496	2.76E+01	8.25E-03	1.95E-02	4.36E-04	1.25E-05	*2.82E-02*	0.2922916	0.69179102	0.01547292	0.00044446
X	Mercury	2.40031441	0.00014506	0.0092	0.08	0.01	0.00074816	0.006269881	0.007018037	0.0022575	4.20671E-06	9.28E-03	1.17E-01	9.80E-01	3.53E-01	6.57E-04	*1.45E+00*	0.08062257	0.67565266	0.24327144	0.00045332
	Nickel	21.6891923	0.00207	0.0846	0.56	77.40	0.00688609	0.041780761	0.048666855	0.02039869	0.00006003	6.91E-02	8.90E-05	5.40E-04	2.64E-04	7.76E-07	*8.93E-04*	0.09961717	0.60441832	0.29509609	0.00086842
	Selenium	3.23378906	0.00079412	0.4069	0.28	0.40	0.03313265	0.020719722	0.053852367	0.00304138	2.30294E-05	5.69E-02	8.28E-02	5.18E-02	7.60E-03	5.76E-05	*1.42E-01*	0.58212443	0.36403542	0.05343554	0.00040462
	Silver	0.5480786	0.00032235	0.0323		181.20	0.00263127	0	0.002631272	0.00051547	9.34823E-06	3.16E-03	1.45E-05	0.00E+00	2.84E-06	5.16E-08	*1.74E-05*	0.83371306	0	0.16332497	0.00296197
	Thallium	1.35540964	0.00082059	0.0825		0.07	0.00671814	0	0.00671814	0.00127476	2.37971E-05	8.02E-03	9.08E-02	0.00E+00	1.72E-02	3.22E-04	*1.08E-01*	0.83801816	0	0.15901341	0.00296844
	Vanadium	43.7275	0.00138162	0.1467	1.52	11.40	0.01194724	0.113457409	0.125404648	0.04112571	4.00669E-05	1.67E-01	1.05E-03	9.95E-03	3.61E-03	3.51E-06	*1.46E-02*	0.07172485	0.68113776	0.24689685	0.00024054
	Zinc	1191.42077	0.07170294	25.3938	46.12	14.50	2.06786385	3.439285228	5.507149078	1.12053123	0.002079385	6.63E+00	1.43E-01	2.37E-01	7.73E-02	1.43E-04	*4.57E-01*	0.31190631	0.51876469	0.16901536	0.00031364

	Maximum Concentrations Compound	C Sediment (mg/Kg)	C Water (mg/L)	C Animal (mg/Kg)	C Plant (mg/Kg)	TRV mg/Kg day	DOSE animal	DOSE plant	DOSE food (a+p)	DOSE soil/ sediment	DOSE water	Total Dose	HQ animal	HQ plant	HQ soil/ sediment	HQ water	*TOTAL HQ*	% HQ animal	% HQ plant	% HQ soil/ sediment	% HQ water
	Volatile Organics																				
	2-Butanone	0.05963899	0.0025			12.10	0	0	0	5.609E-05	0.0000725	1.29E-04	0.00E+00	0.00E+00	4.64E-06	5.99E-06	*1.06E-05*	0	0	0.43619459	0.56380541
	Acetone	1.0706758	0.0025			1700.00	0	0	0	0.00100697	0.0000725	1.08E-03	0.00E+00	0.00E+00	5.92E-07	4.26E-08	*6.35E-07*	0	0	0.93283745	0.06716255
	cis-1,2-Dichloroethene	0.19625028	0.00203555			3114.00	0	0	0	0.00018457	5.9031E-05	2.44E-04	0.00E+00	0.00E+00	5.93E-08	1.90E-08	*7.82E-08*	0	0	0.75767665	0.24232335
	Tetrachloroethene	0.041	0.0010024			14.00	0	0	0	3.8561E-05	2.90695E-05	6.76E-05	0.00E+00	0.00E+00	2.75E-06	2.08E-06	*4.83E-06*	0	0	0.57016851	0.42983149
	Trichloroethene	0.20574648	0.00124582			7.00	0	0	0	0.0001935	3.61287E-05	2.30E-04	0.00E+00	0.00E+00	2.76E-05	5.16E-06	*3.28E-05*	0	0	0.84266777	0.15733223
	Semivolatile Organics																				
	2-Methylnaphthalene	0.22	0.0025			143.70	0	0	0	0.00020691	0.0000725	2.79E-04	0.00E+00	0.00E+00	1.44E-06	5.05E-07	*1.94E-06*	0	0	0.74052468	0.25947532
	Acenaphthylene	0.25887043	0.0025			133.30	0	0	0	0.00024347	0.0000725	3.16E-04	0.00E+00	0.00E+00	1.83E-06	5.44E-07	*2.37E-06*	0	0	0.77054612	0.22945388
	Anthracene	0.3193702	0.0025			1000.00	0	0	0	0.00030037	0.0000725	3.73E-04	0.00E+00	0.00E+00	3.00E-07	7.25E-08	*3.73E-07*	0	0	0.80556105	0.19443895
	Benzo(a)anthracene	1.31752298	0.0025			1.30	0	0	0	0.00123913	0.0000725	1.31E-03	0.00E+00	0.00E+00	9.53E-04	5.58E-05	*1.01E-03*	0	0	0.94472528	0.05527472
	Benzo(a)pyrene	1.41399308	0.0025		0.22	1.30	0	0.016728853	0.016728853	0.00132986	0.0000725	1.81E-02	0.00E+00	1.29E-02	1.02E-03	5.58E-05	*1.39E-02*	0	0.9226549	0.07334647	0.00399863
	Benzo(b)fluoranthene	2.19347211	0.0025		0.17	1.30	0	0.012445663	0.012445663	0.00206296	0.0000725	1.46E-02	0.00E+00	9.57E-03	1.59E-03	5.58E-05	*1.12E-02*	0	0.85354623	0.14148158	0.00497218
	Benzo(g,h,i)perylene	0.81632165	0.0025			133.30	0	0	0	0.00076775	0.0000725	8.40E-04	0.00E+00	0.00E+00	5.76E-06	5.44E-07	*6.30E-06*	0	0	0.91371621	0.08628379
	Benzo(k)fluoranthene	1.25929539	0.0025		0.25	1.30	0	0.018687203	0.018687203	0.00118437	0.0000725	1.99E-02	0.00E+00	1.44E-02	9.11E-04	5.58E-05	*1.53E-02*	0	0.9369804	0.05938443	0.00363517
	Carbazole	0.28170509	0			133.30	0	0	0	0.00026494	0	2.65E-04	0.00E+00	0.00E+00	1.99E-06	0.00E+00	*1.99E-06*	0	0	1	0
	Chrysene	1.5941169	0.0025		0.19	1.30	0	0.01386488	0.01386488	0.00149927	0.0000725	1.54E-02	0.00E+00	1.07E-02	1.15E-03	5.58E-05	*1.19E-02*	0	0.89817951	0.09712388	0.00469662
	Dibenz(a,h)anthracene	0.40317515	0.0025			1.30	0	0	0	0.00037919	0.0000725	4.52E-04	0.00E+00	0.00E+00	2.92E-04	5.58E-05	*3.47E-04*	0	0	0.83949035	0.16050965
	Dibenzofuran	0.35065129	0.0025			133.30	0	0	0	0.00032979	0.0000725	4.02E-04	0.00E+00	0.00E+00	2.47E-06	5.44E-07	*3.02E-06*	0	0	0.81978065	0.18021935
	Fluoranthene	2.88615891	0.0025		0.14	125.00	0	0.010167578	0.010167578	0.00271443	0.0000725	1.30E-02	0.00E+00	8.13E-05	2.17E-05	5.80E-07	*1.04E-04*	0	0.78486779	0.2095357	0.00559651
	Fluorene	0.25752406	0.0025			125.00	0	0	0	0.0002422	0.0000725	3.15E-04	0.00E+00	0.00E+00	1.94E-06	5.80E-07	*2.52E-06*	0	0	0.76962287	0.23037713
	Indeno(1,2,3-cd)pyrene	0.67752082	0.0025		0.29	1.30	0	0.021270247	0.021270247	0.00063721	0.0000725	2.20E-02	0.00E+00	1.64E-02	4.90E-04	5.58E-05	*1.69E-02*	0	0.96771111	0.02899043	0.00329846
	Naphthalene	0.40766936	0.00199454			140.00	0	0	0	0.00038341	5.78416E-05	4.41E-04	0.00E+00	0.00E+00	2.74E-06	4.13E-07	*3.15E-06*	0	0	0.86891556	0.13108444
	N-nitrosodiphenylamine	0.35725709	0.0025			150.00	0	0	0	0.000336	0.0000725	4.09E-04	0.00E+00	0.00E+00	2.24E-06	4.83E-07	*2.72E-06*	0	0	0.82252155	0.17747845
	Phenanthrene	1.49074606	0.0025		0.40	133.30	0	0.029918927	0.029918927	0.00140205	0.0000725	3.14E-02	0.00E+00	2.24E-04	1.05E-05	5.44E-07	*2.36E-04*	0	0.95303015	0.04466045	0.0023094
	Pyrene	1.97472323	0.0025		0.12	133.30	0	0.009022166	0.009022166	0.00185723	0.0000725	1.10E-02	0.00E+00	6.77E-05	1.39E-05	5.44E-07	*8.22E-05*	0	0.82379966	0.16958048	0.00661986
	Pesticides and PCBs																				
	4,4'-DDD	0.04049519	0.00005	0.0033	2.09E-03	8.50	0.00027099	0.000155999	0.000426991	3.8086E-05	0.00000145	4.67E-04	3.19E-05	1.84E-05	4.48E-06	1.71E-07	*5.49E-05*	0.58087143	0.33438375	0.08163674	0.00310807
	4,4-DDE	0.02358317	0.00005	0.0069	1.02E-03	1.90	0.00055831	7.63589E-05	0.000634665	2.218E-05	0.00000145	6.58E-04	2.94E-04	4.02E-05	1.17E-05	7.63E-07	*3.46E-04*	0.84810926	0.11599501	0.03369307	0.00220266
	4,4'-DDT	0.00694553	0.00005	0.0015	1.12E-03	0.00	0.00012353	8.31814E-05	0.000206709	6.5323E-06	0.00000145	2.15E-04	4.41E-02	2.97E-02	2.33E-03	5.18E-04	*7.67E-02*	0.57537228	0.38744745	0.03042638	0.0067539
	Aldrin	0.00250521	0.000025	0.0003		0.20	2.537E-05	0	2.53702E-05	2.3561E-06	0.000000725	2.85E-05	1.27E-04	0.00E+00	1.18E-05	3.63E-06	*1.42E-04*	0.89170472	0	0.08281318	0.0254821
	alpha-Chlordane	0.01604988	2.6005E-05	0.0012	1.64E-03	2.14	0.00010054	0.000122485	0.000223028	1.5095E-05	7.54138E-07	2.39E-04	4.70E-05	5.72E-05	7.05E-06	3.52E-07	*1.12E-04*	0.42089925	0.51275273	0.06319102	0.00315701
	Aroclor 1248	0.08700417	0.0005	0.0032		0.98	0.00026344	0	0.00026344	8.1827E-05	0.0000145	3.60E-04	2.69E-04	0.00E+00	8.35E-05	1.48E-05	*3.67E-04*	0.73225091	0	0.22744528	0.04030381
	Aroclor 1254	0.29067332	0.0005	0.0204		1.50	0.0016601	0	0.001660103	0.00027338	0.0000145	1.95E-03	1.11E-03	0.00E+00	1.82E-04	9.67E-06	*1.30E-03*	0.85221713	0	0.14033927	0.0074436
	Aroclor 1260	0.32611143	0.0005	0.0337	2.04E-02	0.35	0.0027414	0.001518735	0.004260131	0.00030671	0.0000145	4.58E-03	7.95E-03	4.40E-03	8.89E-04	4.20E-05	*1.33E-02*	0.59838309	0.3315047	0.0669472	0.00316501
	beta-BHC	0.00169937	0.000025	0.0004		4.00	2.8827E-05	0	2.88265E-05	1.5983E-06	0.000000725	3.11E-05	7.21E-06	0.00E+00	4.00E-07	1.81E-07	*7.79E-06*	0.92541673	0	0.05130863	0.02327464
	delta-BHC	0.00368965	0.000025	0.0003		1.60	2.6718E-05	0	2.67175E-05	3.4701E-06	0.000000725	3.09E-05	1.67E-05	0.00E+00	2.17E-06	4.53E-07	*1.93E-05*	0.86429125	0	0.11225557	0.02345318
	Endosulfan I	0.0086487	0.000025	0.0005	1.42E-03	10.00	4.4747E-05	0.000106126	0.000150873	8.1341E-06	0.000000725	1.60E-04	4.47E-06	1.06E-05	8.13E-07	7.25E-08	*1.60E-05*	0.2801376	0.66440032	0.05092324	0.00453884
	Endosulfan Sulfate	0.0021	0.00005	0.0010		10.00	8.0678E-05	0	8.06782E-05	1.9751E-06	0.00000145	8.41E-05	8.07E-06	0.00E+00	1.98E-07	1.45E-07	*8.41E-06*	0.95927564	0	0.02348364	0.01724072
	Endrin Aldehyde	0.00356366	0.00005	0.0027	1.10E-03	0.30	0.00022199	8.16653E-05	0.000303658	3.3516E-06	0.00000145	3.08E-04	7.40E-04	2.72E-04	1.12E-05	4.83E-06	*1.03E-03*	0.71968205	0.26475152	0.01086566	0.00470077
	gamma-Chlordane	0.05254032	2.6035E-05	0.0006	5.04E-03	2.14	4.8078E-05	0.00037606	0.000424138	4.9414E-05	7.55028E-07	4.74E-04	2.25E-05	1.76E-04	2.31E-05	3.53E-07	*2.22E-04*	0.10136456	0.79286171	0.10418187	0.00159186
	Inorganics																				
	Aluminum	11152.0826	0.54203338	59.1894	1.86E+02	109.70	4.81990969	13.841875	18.66178469	10.4885337	0.015718968	2.92E+01	4.39E-02	1.26E-01	9.56E-02	1.43E-04	*2.66E-01*	0.16525761	0.47458881	0.35961463	0.00053895
	Antimony	7.73323824	0.00096957	0.0516		0.13	0.00419997	0	0.004199967	0.00727311	2.81176E-05	1.15E-02	3.36E-02	0.00E+00	5.82E-02	2.25E-04	*9.20E-02*	0.36517658	0	0.63237867	0.00244476
	Arsenic	360.890159	0.026428	3.0890	19.02	5.14	0.2515426	1.418397189	1.669939787	0.33941719	0.000766412	2.01E+00	4.89E-02	2.76E-01	6.60E-02	1.49E-04	*3.91E-01*	0.12513789	0.70562693	0.16885391	0.00038128
	Barium	89.1385086	0.04105479	13.2536	8.69	208.00	1.0792698	0.648134487	1.727404283	0.08383477	0.001190589	1.81E+00	5.19E-03	3.12E-03	4.03E-04	5.72E-06	*8.71E-03*	0.59548231	0.35760532	0.04625546	0.0006569
	Beryllium	0.74131255	8.7842E-05	0.0062		0.66	0.00050128	0	0.000501281	0.0006972	2.54743E-06	1.20E-03	7.60E-04	0.00E+00	1.06E-03	3.86E-06	*1.82E-03*	0.41737473	0	0.58050424	0.00212103
	Cadmium	6.91594149	0.00093994	0.1367	0.74	1.45	0.01112868	0.0552453	0.066373979	0.00650444	2.72583E-05	7.29E-02	7.67E-03	3.81E-02	4.49E-03	1.88E-05	*5.03E-02*	0.15264488	0.757764	0.08921723	0.00037388
X	Chromium	1675.30704	0.02016543	1.6250	31.31	1.00	0.1323288	2.334528966	2.466857765	1.57562627	0.000584797	4.04E+00	1.32E-01	2.33E+00	1.58E+00	5.85E-04	*4.04E+00*	0.03272979	0.57741509	0.38971047	0.00014464
	Cobalt	16.3621449	0.00153257	0.5353	1.45	5.00	0.04359198	0.108364481	0.151956464	0.0153886	4.44446E-05	1.67E-01	8.72E-03	2.17E-02	3.08E-03	8.89E-06	*3.35E-02*	0.26042244	0.64737918	0.09193287	0.00026552
	Copper	445.265332	0.03907888	57.4012	22.55	47.00	4.67429667	1.681624101	6.355920773	0.41877205	0.001133287	6.78E+00	9.95E-02	3.58E-02	8.91E-03	2.41E-05	*1.44E-01*	0.68984897	0.24817994	0.06180384	0.00016725
	Cyanide	1.50673635	0.0025	0.2611		68.70	0.0212629	0	0.021262905	0.00141709	0.0000725	2.28E-02	3.10E-04	0.00E+00	2.06E-05	1.06E-06	*3.31E-04*	0.93453088	0	0.06228266	0.00318646
X	Iron	30190.559	2.32642302	463.3638	2499.17	3.19	37.7326385	186.3579851	224.0906235	28.3942207	0.067466268	2.53E+02	1.18E+01	5.84E+01	8.90E+00	2.11E-02	*7.92E+01*	0.14940524	0.73789856	0.11242907	0.00026714
X	Lead	385.394401	0.02631843	1.0509	35.15	1.13	0.08557515	2.620770465	2.706345613	0.36246343	0.000763234	3.07E+00	7.57E-02	2.32E+00	3.21E-01	6.75E-04	*2.72E+00*	0.02787852	0.85379011	0.11808272	0.00024865
	Manganese	531.78196	0.50794141	121.8323	299.88	977.00	9.92104808	22.36119788	32.28224597	0.50014093	0.014730301	3.28E+01	1.02E-02	2.29E-02	5.12E-04	1.51E-05	*3.36E-02*	0.30249756	0.68180376	0.01524954	0.00044913
X	Mercury	3.33368988	0.00035585	0.0128	0.12	0.01	0.00104246	0.008707959	0.009750421	0.00313534	1.03197E-05	1.29E-02	1.63E-01	1.36E+00	4.90E-01	1.61E-03	*2.02E+00*	0.08083565	0.67524093	0.2431232	0.00080022
	Nickel	23.9652522	0.00254262	0.1027	0.62	77.40	0.00836427	0.046165227	0.054529494	0.02253932	7.3736E-05	7.71E-02	1.08E-04	5.96E-04	2.91E-04	9.53E-07	*9.97E-04*	0.10842612	0.59844051	0.29217753	0.00095584
	Selenium	3.71343745	0.00083155	0.4778	0.32	0.40	0.03890697	0.023792953	0.062699927	0.00349249	2.4115E-05	6.62E-02	9.73E-02	5.95E-02	8.73E-03	6.03E-05	*1.66E-01*	0.58757193	0.35932044	0.05274345	0.00036418
	Silver	0.71842753	0.00035684	0.0505		181.20	0.00410871	0	0.00410871	0.00067568	1.03482E-05	4.79E-03	2.27E-05	0.00E+00	3.73E-06	5.71E-08	*2.65E-05*	0.85692043	0	0.14092133	0.00215825
	Thallium	1.64146786	0.00084048	0.1502		0.07	0.01222932	0	0.012229322	0.0015438	2.43738E-05	1.38E-02	1.65E-01	0.00E+00	2.09E-02	3.29E-04	*1.86E-01*	0.88634356	0	0.1118899	0.00176654
	Vanadium	46.8347829	0.0020127	0.1875	1.63	11.40	0.01526496	0.12151971	0.136784667	0.04404811	5.83682E-05	1.81E-01	1.34E-03	1.07E-02	3.86E-03	5.12E-06	*1.59E-02*	0.08438753	0.67178362	0.24350618	0.00032267
	Zinc	1321.28804	0.2243946	27.8736	51.15	14.50	2.26980206	3.814174273	6.083976332	1.2426714	0.006507443	7.33E+00	1.57E-01	2.63E-01	8.57E-02	4.49E-04	*5.06E-01*	0.30952598	0.52012731	0.16945931	0.0008874

TABLE 4-198
AVERAGE EXPOSURE CASE HAZARD QUOTIENTS FOR MALLARD (SITE-WIDE)

WELLS G&H SUPERFUND SITE OU3

	COPC	Total Dose (mg/kg-day)	TRV (mg/kg-day)	Total HQ	Percent Animal HQ	Percent Plant HQ	Percent Surface Sediment HQ	Percent Surface Water HQ
	Volatile Organics							
	2-Butanone	0.00011	12.1	<0.1	0.0	0.0	33	66.9
	Acetone	0.00043	1700	<0.1	0.0	0.0	83	16.8
	cis-1,2-Dichloroethene	0.00012	3114	<0.1	0.0	0.0	77	22.7
	Tetrachloroethene	0.00005	14.00	<0.1	0.0	0.0	67	33.3
	Trichloroethene	0.00007	7.00	<0.1	0.0	0.0	72	28.1
	HAZARD INDEX			*0.000023*	*0.0*	*0.0*	*56*	*0.4*
	Semivolatile Organics							
	2-Methylnaphthalene	0.0003	143.7	<0.1	0.0	0.0	73	27.4
	Acenaphthylene	0.0003	133.3	<0.1	0.0	0.0	72	27.9
	Anthracene	0.0003	1000	<0.1	0.0	0.0	77	23.0
	Benzo(a)anthracene	0.001	1.30	<0.1	0.0	0.0	92	8.3
	Benzo(a)pyrene	0.01	1.30	<0.1	0.0	92.1	7.3	0.6
	Benzo(b)fluoranthene	0.01	1.30	<0.1	0.0	85.1	14.1	0.7
	Benzo(g,h,i)perylene	0.001	133.3	<0.1	0.0	0.0	87	12.7
	Benzo(k)fluoranthene	0.02	1.30	<0.1	0.0	93.6	5.9	0.4
	Carbazole	0.0002	133.3	<0.1	0.0	0.0	100	0.0
	Chrysene	0.01	1.30	<0.1	0.0	89.6	9.7	0.7
	Dibenz(a,h)anthracene	0.0003	1.30	<0.1	0.0	0.0	78	22.4
	Dibenzofuran	0.0003	133.3	<0.1	0.0	0.0	77	22.7
	Fluoranthene	0.01	125.0	<0.1	0.0	78.2	20.9	0.9
	Fluorene	0.0003	125.0	<0.1	0.0	0.0	74	25.8
	Indeno(1,2,3-cd)pyrene	0.02	1.30	<0.1	0.0	96.7	2.9	0.4
	Naphthalene	0.0003	140.0	<0.1	0.0	0.0	77	23.4
	N-nitrosodiphenylamine	0.0003	150	<0.1	0.0	0.0	78	21.6
	Phenanthrene	0.02	133.3	<0.1	0.0	95.2	4.5	0.4
	Pyrene	0.01	133.3	<0.1	0.0	82.2	16.9	0.9
	HAZARD INDEX			*0.05*	*0.0*	*90.7*	*8.6*	*0.8*
	Pesticides and PCBs							
	4,4'-DDD	0.00032	8.50	<0.1	61.3	30.8	7.5	0.5
	4,4'-DDE	0.00048	1.90	<0.1	85.2	11.2	3.3	0.3
	4,4'-DDT	0.00016	0.003	<0.1	57.6	38.5	3.0	0.9
	Aldrin	0.00003	0.20	<0.1	92.1	0.0	5.0	2.9
	alpha-Chlordane	0.00017	2.14	<0.1	43.7	49.7	6.1	0.4
	Aroclor 1248	0.00029	0.98	<0.1	74.4	0.0	21	5.0
	Aroclor 1260	0.0032	0.35	<0.1	66.2	27.8	5.6	0.5
	beta-BHC	0.00002	4.00	<0.1	91.9	0.0	5	2.9
	delta-BHC	0.00002	1.60	<0.1	89.7	0.0	7	3.0
	Endosulfan I	0.00009	10.0	<0.1	33.7	60.8	4.7	0.8
	Endosulfan Sulfate	0.00007	10.0	<0.1	94.6	0.0	3.2	2.2
	Endrin Aldehyde	0.00024	0.30	<0.1	70.2	28.0	1.1	0.6
	gamma-Chlordane	0.00015	2.14	<0.1	21.3	69.2	9.1	0.4
	HAZARD INDEX			*0.07*	*59.5*	*36.2*	*3.5*	*0.8*
	Inorganics							
	Aluminum	26.6	110	0.24	15.3	48.2	36.5	0.0
	Antimony	0.01	0.13	<0.1	40.5	0.0	59	0.2
	Arsenic	1.54	5.14	0.30	11.7	71.2	17.0	0.0
	Barium	1.54	208	<0.1	53.7	40.9	5.3	0.1
	Beryllium	0.00	0.66	<0.1	40.6	0.0	59	0.1
	Cadmium	0.06	1.45	<0.1	9.3	81.2	9.6	0.0
X	Chromium	2.92	1.00	**2.92**	3.2	57.8	39.0	0.0
	Cobalt	0.15	5.00	<0.1	24.4	66.2	9.4	0.0
	Copper	5.88	47.0	0.13	68.8	25.0	6.2	0.0
	Cyanide	0.02	68.7	<0.1	94.9	0.0	4.7	0.4
X	Iron	216	3.19	**67.8**	13.0	75.5	11.5	0.0
X	Lead	2.71	1.13	**2.40**	2.3	85.8	11.9	0.0
	Manganese	27.56	977	<0.1	29.2	69.2	1.5	0.0
X	Mercury	0.01	0.01	**1.45**	8.1	67.6	24.3	0.0
	Nickel	0.07	77.4	<0.1	10.0	60.4	29.5	0.1
	Selenium	0.06	0.40	0.14	58.2	36.4	5.3	0.0
	Silver	0.00	181	<0.1	83.4	0.0	16.3	0.3
	Thallium	0.01	0.07	0.11	83.8	0.0	15.9	0.3
	Vanadium	0.17	11.4	<0.1	7.2	68.1	24.7	0.0
	Zinc	6.6	14.5	0.46	31.2	51.9	16.9	0.0
	HAZARD INDEX			*76.16*	*12.6*	*74.4*	*13.0*	*0.02*

NOTES:
HQ = Hazard quotient
TRV = Toxicity Reference Value
X = Indicates a COPC with a HQ >= 1.
0.0 = Indicates COPC was not detected in medium, or that the detected concentration was low, contributing less than 0.05% of the Total HQ.
Total Dose = Sum of exposure from ingestion of food (plant and animal), sediment, and water.

TABLE 4-199
MAXIMUM EXPOSURE CASE HAZARD QUOTIENTS FOR MALLARD (SITE-WIDE)

WELLS G&H SUPERFUND SITE OU3

	COPC	Total Dose (mg/kg-day)	TRV (mg/kg-day)	Total HQ	Percent Animal HQ	Percent Plant HQ	Percent Surface Sediment HQ	Percent Surface Water HQ
	Volatile Organics							
	2-Butanone	0.0001	12.1	<0.1	0.0	0.0	44	56.4
	Acetone	0.0011	1700	<0.1	0.0	0.0	93	6.7
	cis-1,2-Dichloroethene	0.0002	3114	<0.1	0.0	0.0	76	24.2
	Tetrachloroethene	0.0001	14.00	<0.1	0.0	0.0	57	43.0
	Trichloroethene	0.0002	7.00	<0.1	0.0	0.0	84	15.7
	HAZARD INDEX			*0.00005*	*0.0*	*0.0*	*73*	*27.1*
	Semivolatile Organics							
	2-Methylnaphthalene	0.000	143.7	<0.1	0.0	0.0	74	25.9
	Acenaphthylene	0.0003	133.3	<0.1	0.0	0.0	77	22.9
	Anthracene	0.000	1000	<0.1	0.0	0.0	81	19.4
	Benzo(a)anthracene	0.001	1.30	<0.1	0.0	0.0	94	5.5
	Benzo(a)pyrene	0.018	1.30	<0.1	0.0	92.3	7.3	0.4
	Benzo(b)fluoranthene	0.015	1.30	<0.1	0.0	85.4	14.1	0.5
	Benzo(g,h,i)perylene	0.001	133.3	<0.1	0.0	0.0	91	8.6
	Benzo(k)fluoranthene	0.020	1.30	<0.1	0.0	93.7	5.9	0.4
	Carbazole	0.000	133.3	<0.1	0.0	0.0	100	0.0
	Chrysene	0.015	1.30	<0.1	0.0	89.8	9.7	0.5
	Dibenz(a,h)anthracene	0.000	1.30	<0.1	0.0	0.0	84	16.1
	Dibenzofuran	0.000	133.3	<0.1	0.0	0.0	82	18.0
	Fluoranthene	0.013	125.0	<0.1	0.0	78.5	21.0	0.6
	Fluorene	0.000	125.0	<0.1	0.0	0.0	77	23.0
	Indeno(1,2,3-cd)pyrene	0.022	1.30	<0.1	0.0	96.8	2.9	0.3
	Naphthalene	0.000	140.0	<0.1	0.0	0.0	87	13.1
	N-nitrosodiphenylamine	0.000	150	<0.1	0.0	0.0	82	17.7
	Phenanthrene	0.031	133.3	<0.1	0.0	95.3	4.5	0.2
	Pyrene	0.011	133.3	<0.1	0.0	82.4	17.0	0.7
	HAZARD INDEX			*0.07*	*0.0*	*90.3*	*9.1*	*0.6*
	Pesticides and PCBs							
	4,4'-DDD	0.0005	8.50	<0.1	58.1	33.4	8.2	0.3
	4,4-DDE	0.0007	1.90	<0.1	84.8	11.6	3.4	0.2
	4,4'-DDT	0.0002	0.003	<0.1	57.5	38.7	3.0	0.7
	Aldrin	0.00003	0.20	<0.1	89.2	0.0	8.3	2.5
	alpha-Chlordane	0.0002	2.14	<0.1	42.1	51.3	6.3	0.3
	Aroclor 1248	0.0004	0.98	<0.1	73.2	0.0	23	4.0
	Aroclor 1260	0.0046	0.35	<0.1	59.8	33.2	6.7	0.3
	beta-BHC	0.00003	4.00	<0.1	92.5	0.0	5	2.3
	delta-BHC	0.00003	1.60	<0.1	86.4	0.0	11	2.3
	Endosulfan I	0.0002	10.0	<0.1	28.0	66.4	5.1	0.5
	Endosulfan Sulfate	0.0001	10.0	<0.1	95.9	0.0	2.3	1.7
	Endrin Aldehyde	0.0003	0.30	<0.1	72.0	26.5	1.1	0.5
	gamma-Chlordane	0.0005	2.14	<0.1	10.1	79.3	10.4	0.2
	HAZARD INDEX			*0.09*	*58.5*	*37.1*	*3.8*	*0.6*
	Inorganics							
	Aluminum	29.2	110	0.3	16.5	47.5	36.0	0.1
	Antimony	0.01	0.13	<0.1	36.5	0.0	63	0.2
	Arsenic	2.01	5.14	0.4	12.5	70.6	16.9	0.0
	Barium	1.81	208	<0.1	59.5	35.8	4.6	0.1
	Beryllium	0.001	0.66	<0.1	41.7	0.0	58	0.2
	Cadmium	0.07	1.45	<0.1	15.3	75.8	8.9	0.0
X	Chromium	4.04	1.00	**4.0**	3.3	57.7	39.0	0.0
	Cobalt	0.17	5.00	<0.1	26.0	64.7	9.2	0.0
	Copper	6.78	47.0	0.1	69.0	24.8	6.2	0.0
	Cyanide	0.02	68.7	<0.1	93.5	0.0	6.2	0.3
X	Iron	253	3.19	**79.2**	14.9	73.8	11.2	0.0
X	Lead	3.07	1.13	**2.7**	2.8	85.4	11.8	0.0
	Manganese	32.8	977	<0.1	30.2	68.2	1.5	0.0
X	Mercury	0.01	0.01	**2.0**	8.1	67.5	24.3	0.1
	Nickel	0.08	77.4	<0.1	10.8	59.8	29.2	0.1
	Selenium	0.07	0.40	0.2	58.8	35.9	5.3	0.0
	Silver	0.00	181	<0.1	85.7	0.0	14.1	0.2
	Thallium	0.01	0.07	0.2	88.6	0.0	11.2	0.2
	Vanadium	0.18	11.4	<0.1	8.4	67.2	24.4	0.0
	Zinc	7.3	14.5	0.5	31.0	52.0	16.9	0.1
	HAZARD INDEX			*89.8*	*14.3*	*72.7*	*13.0*	*0.0*

NOTES:
HQ = Hazard quotient
TRV = Toxicity Reference Value
X = Indicates a COPC with a HQ >= 1.
0.0 = Indicates COPC was not detected in medium, or that the detected concentration was low, contributing less than 0.05% of the Total HQ.
Total Dose = Sum of exposure from ingestion of food (plant and animal), sediment, and water.

TABLE 4-245 REVISED
HAZARD QUOTIENT SUMMARY FOR SHREW[1]
MAXIMUM EXPOSURE CASE WITH REVISED UPTAKE FACTORS [2]
WELLS G&H SUPERFUND SITE OU3

Station	Habitat Type	Aberjona River Reach	COPC HAZARD QUOTIENT																				
			Benzo(b) fluoranthene	Benzo(k) fluoranthene	Aroclor 1254	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Cyanide	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium
	Wetland	Reference[3]				5		2								77								6
20	Wetland	1				11	2	16			1	1				148	1							7
21	Wetland	1				7		13			1	3				95			4					5
22/TT-22	Wetland	1				4	94	3								31	29							3
BW	Wetland	1				8	18	142				1				506	1		3				2	6
CB-01	Wetland	2				6		3								63								6
CB-02	Wetland	2				2		3								23								2
CB-03	Wetland	2				4		67			1					217								4
CB-04	Wetland	2				4	1	13								150								4
CB-05	Wetland	2				2		3								39								2
CB-06	Wetland	2				3	1	7			2					55								5
DA	River	2				4		10								125								2
NRSE	Wetland	1				3		11								82			1					2
JY	Wetland	1			5	5	3	19			1					130								4
NRSO	River	1				3		11								97								2
KFSO	River	2				2		3								58								2
WSS	Wetland	1				4										37								2
WG	Wetland	1				6	4	14				1				98								4
WH	Wetland	1				5	8	21			1					198	2							6
WS	Riparian	1				4	1	12								126								3
% of OU3 stations (non-reference) with HQ>1					5	100	47	95	0	0	32	21	0	0	0	100	21	0	16	0	0	0	5	100

1. Only COPCs having one or more station with HQ>1 are presented.
2. HQs were calculated using 95% UCL values for surface water and sediment data. Where 95% UCLs could not be calculated (number of samples <4), maximum station values were used.
3. Reference stations include 24, HB, and SA.
4. A blank cell indicates that the HQ <1.0

TABLE 4-32
APPLICABILITY OF SEDIMENT SAMPLES TO EXPOSURE SCENARIOS FOR INDICATOR SPECIES

WELLS G&H SUPERFUND SITE OU3

Station	Reach	Habitat	Sample ID	Date Sampled	Standing Water Depth (ft)	Applicability of Samples/Stations to Ecological Exposures[1]					Notes
						Muskrat	Heron	Mallard	Shrew	Invertebrates	
01	6	lake	SD-01-01-FW	8/15/1995	1.0	x	x	x		x	
			SD-01-02-FW	8/15/1995	4.0	x				x	
			SD-01-03-FW	8/15/1995	1.0	x	x	x		x	
			SD-01-04-FW	8/15/1995	4.0	x				x	
			SD-01-05-FW	8/15/1995	1.0	x	x	x		x	
			SD-01-06-FW	8/15/1995	5.0	x				x	
			SD-01-06-ME	11/12/1997	7.0					x	
			SD-01-07-FW	8/15/1995	6.0					x	
			SD-01-07-ME	11/12/1997	8.0					x	
			SD-01-08-FW	8/15/1995	1.0	x	x	x		x	
			SD-01-09-FW	8/15/1995	5.0	x				x	
			SD-01-10-FW	8/15/1995	6.0					x	
02	6	lake	SD-02-01-FW	8/16/1995	1.5	x		x		x	
			SD-02-01-ME	11/13/1997	5.0	x				x	
			SD-02-02-FW	8/16/1995	4.9	x				x	
			SD-02-02-ME	11/13/1997	7.0					x	
			SD-02-03-FW	8/16/1995	1.0 or 3.3	x	x	x		x	
03	6	lake	SD-03-01-FW	8/16/1995	1.6	x	x	x		x	
			SD-03-02-FW	8/16/1995	2.5	x	x	x		x	
			SD-03-02-ME	11/13/1997	1.5	x	x	x		x	
			SD-03-03-FW	8/16/1995	0.3	x	x	x		x	
04	6	lake	SD-04-01-FW	8/17/1995	4.9	x				x	
			SD-04-02-FW	8/17/1995	4.9	x				x	
			SD-04-02-ME	11/14/1997	7.0					x	
			SD-04-03-FW	8/17/1995	3.3	x				x	
			SD-04-03-ME	11/14/1997	7.0					x	
			SD-AO-01	7/18/2000	4.7	x				x	
			SD-AO-02	7/18/2000	4.4	x				x	
			SD-AO-03	7/18/2000	4.5	x				x	
			SD-AO-03-TR	6/27/2001	5.0	x				x	
			SD-AO-04	7/18/2000	6.3					x	
			SD-AO-05	7/18/2000	5.5					x	
05	5	river	SD-05-01-FW	8/17/1995	1.0	x	x	x		x	
			SD-05-02-FW	8/17/1995	N/A	x	x	x		x	
			SD-05-03-FW	8/17/1995	2.0	x	x	x		x	
			SD-05-03-ME	11/13/1997	3.0	x	x	x		x	
06	4	lake	SD-06-01-FW	8/18/1995	3.3	x				x	
			SD-06-02-FW	8/18/1995	3.3	x				x	
			SD-06-03-FW	8/18/1995	3.3	x				x	
			SD-06-03-ME	11/18/1997	4.0	x				x	
			SD-06-03-TR	6/26/2001	3.8	x				x	
			SD-JP-01	7/10/2000	4.0	x				x	
07	3	lake	SD-07-01-FW	8/18/1995	NA	x				x	
			SD-07-02-FW	8/21/1995	5.0	x				x	
			SD-07-02-ME	11/20/1997	3.4	x				x	
			SD-07-03-FW	8/21/1995	NA	x				x	
			SD-07-04-FW	8/29/1995	NA	x				x	
			SD-07-05-FW	8/21/1995	2.0	x	x	x		x	
			SD-07-05-ME	11/20/1997	1.2	x	x	x		x	
			SD-07-06-FW	8/21/1995	4.0	x				x	
			SD-07-07-FW	8/21/1995	1.5	x	x	x		x	
			SD-07-08-FW	8/21/1995	1.5	x	x	x		x	
			SD-07-09-FW	8/21/1995	1.0	x	x	x		x	
			SD-07-10-FW	8/21/1995	1.0	x	x	x		x	
			SD-07-10-ME	11/19/1997	2.0	x	x	x		x	

TABLE 4-32
APPLICABILITY OF SEDIMENT SAMPLES TO EXPOSURE SCENARIOS FOR INDICATOR SPECIES

WELLS G&H SUPERFUND SITE OU3

Station	Reach	Habitat	Sample ID	Date Sampled	Standing Water Depth (ft)	Applicability of Samples/Stations to Ecological Exposures[1]					Notes
						Muskrat	Heron	Mallard	Shrew	Invertebrates	
08	2	river	SD-08-01-FW	8/21/1995	1.0	x	x	x		x	
			SD-08-02-FW	8/21/1995	1.5	x	x	x		x	
			SD-08-03-FW	8/21/1995	1.5	x	x	x		x	
09	2	river	SD-09-01-FW	8/22/1995	1.0	x	x	x		x	
			SD-09-02-FW	8/22/1995	NA	x	x	x		x	
			SD-09-03-FW	8/22/1995	0.5	x	x	x		x	
			SD-09-04-FW	8/22/1995	1.0	x	x	x		x	
			SD-09-05-FW	8/22/1995	1.0	x	x	x		x	
			SD-09-06-FW	8/22/1995	1.5	x	x	x		x	
			SD-09-07-FW	8/22/1995	2.0	x	x	x		x	
			SD-09-08-FW	8/22/1995	2.0	x	x	x		x	
			SD-09-09-FW	8/22/1995	0.5	x	x	x		x	
			SD-09-10-FW	8/22/1995	0.5	x	x	x		x	
10	1	river	SD-10-01-FW	8/23/1995	2.0	x	x	x		x	
			SD-10-01-ME	11/19/1997	2.0	x	x	x		x	
			SD-10-02-FW	8/23/1995	NA	x	x	x		x	
			SD-10-02-ME	11/19/1997	2.0	x	x	x		x	
			SD-10-02-TR	6/22/2001	1.4	x	x	x		x	
			SD-10-03-FW	8/23/1995	1.5	x	x	x		x	
11	1	river	SD-11-01-ME	11/14/1997	0.5	x	x	x		x	
			SD-11-02-FW	8/24/1995	2.0 or 2.5	x	x	x		x	
			SD-11-03-FW	8/24/1995	2.0 or 2.5	x	x	x		x	
12	1	river	SD-12-01-FW	8/31/1995	1.0	x	x	x		x	
			SD-12-02-FW	8/31/1995	NA	x	x	x		x	
			SD-12-03-FW	8/31/1995	0.5	x	x	x		x	
			SD-12-03-ME	11/20/1997	5.0	x	x	x		x	
			SD-12-03-TR	6/19/2001	4.5	x	x	x		x	
13	1	wetland	SD-13-01-FW	9/1/1995	0.3	x	x	x		x	
			SD-13-01-ME	11/17/1997	2.0	x	x	x		x	
			SD-13-01-TR	6/22/2001	0.3	x	x	x		x	
			SD-13-02-FW	9/1/1995	0.3	x	x	x		x	
			SD-13-03-FW	9/1/1995	0.0	x	x	x		x	
			SD-13-03-ME	11/17/1997	2.0	x	x	x		x	
14	1	river	SD-14-01-FW	9/5/1995	1.0	x				x	
			SD-14-02-FW	9/5/1995	1.0	x				x	
			SD-14-03-FW	9/5/1995	1.5	x				x	
15	1	wetland	SD-15-01-FW	9/5/1995	0.5	x	x	x		x	
			SD-15-01-ME	11/17/1997	2.5	x	x	x		x	
			SD-15-02-FW	9/5/1995	0.5	x	x	x		x	
			SD-15-03-FW	9/5/1995	0.5	x	x	x		x	
16	2	river	SD-16-01-FW	8/29/1995	NA	x	x	x		x	
			SD-16-02-FW	8/23/1995	1.0	x	x	x		x	
			SD-16-03-FW	8/23/1995	1.5	x	x	x		x	
18	1	river	SD-18-01-FW	8/29/1995	NA	x	x	x		x	
			SD-18-02-FW	9/7/1995	0.2	x	x	x		x	
			SD-18-02-ME	11/18/1997	0.5	x	x	x		x	
			SD-18-02-TR	6/21/2001	1.1	x	x	x		x	
			SD-18-03-FW	9/7/1995	0.4	x	x	x		x	
			SD-18-03-ME	11/18/1997	0.3	x	x	x		x	
			SD-11-01-FW	8/24/1995	2.0	x	x	x		x	
19	1	wetland	SD-19-01-FW	8/31/1995	0.0	x	x	x		x	
			SD-19-01-TR	6/19/2001	0.8	x	x	x		x	
			SD-19-02-FW	8/31/1995	0.0	x	x	x		x	
			SD-19-03-FW	8/31/1995	0.0	x	x	x		x	
20	1	wetland	SD-20-01-FW	9/7/1995	0.0	x	x	x	x	x	
			SD-20-01-ME	11/17/1997	2.0	x	x	x		x	
			SD-20-02-FW	9/7/1995	0.0	x	x	x	x	x	
			SD-20-03-FW	9/7/1995	0.0	x	x	x	x	x	

TABLE 4-32
APPLICABILITY OF SEDIMENT SAMPLES TO EXPOSURE SCENARIOS FOR INDICATOR SPECIES

WELLS G&H SUPERFUND SITE OU3

Station	Reach	Habitat	Sample ID	Date Sampled	Standing Water Depth (ft)	Applicability of Samples/Stations to Ecological Exposures[1]					Notes
						Muskrat	Heron	Mallard	Shrew	Invertebrates	
21	1	wetland	SD-21-01-FW	9/8/1995	0.0	x	x	x	x	x	
			SD-21-01-ME	11/14/1997	1.0	x	x	x	x	x	
			SD-21-02-FW	9/8/1995	0.0	x	x	x	x	x	
			SD-21-03-FW	9/8/1995	0.0	x	x	x	x	x	
22/TT-22	1	wetland	SD-22-01-FW	9/8/1995	0.0				x	x	
			SD-22-01-TR	6/18/2001	0.2				x	x	
			SD-22-02-FW	9/8/1995	0.0				x	x	
			SD-22-02-ME	11/12/1997	0.0				x	x	
			SD-22-03-FW	9/8/1995	0.0				x	x	
			SD-TT-22-01	2/7/2001	0.5				x	x	
			SD-TT-22-02	2/7/2001	0.5				x	x	
			SD-TT-22-03	2/7/2001	1.0				x	x	
AM	2	river	SD-AM-01	7/10/2000	1.0	x	x	x		x	(a)
AS	3	river	SD-AS-01	7/10/2000	1.0	x	x	x		x	(a)
			SD-AS-02	7/10/2000	1.5	x	x	x		x	(a)
BW	1	wetland	SD-BW-01	7/17/2002	0.0	x	x	x	x	x	
			SD-BW-02	7/17/2002	0.0	x	x	x	x	x	
			SD-BW-03	7/17/2002	0.0	x	x	x	x	x	
			SD-BW-04	7/17/2002	0.0	x	x	x	x	x	
			SD-BW-05	7/17/2002	0.0	x	x	x	x	x	
			SD-12-01-ME	11/20/1997	1.0	x	x	x	x	x	
CB-01	2	wetland	SD-CB-01-01	2/9/2001	0.5	x	x	x	x	x	(a)
			SD-CB-01-02	2/9/2001	0.5	x	x	x	x	x	(a)
			SD-CB-01-03	2/9/2001	0.3	x	x	x	x	x	(a)
			SD-CB-01-04	2/9/2001	0.3	x	x	x	x	x	(a)
			SD-CB-01-05	2/9/2001	0.7	x	x	x	x	x	(a)
			SD-CB-01-06	2/9/2001	0.2	x	x	x	x	x	(a)
			SD-CB-01-07	2/9/2001	0.5	x	x	x	x	x	(a)
			SD-CB-01-08	2/9/2001	0.7	x	x	x	x	x	(a)
			SD-CB-01-09	2/9/2001	0.5	x	x	x	x	x	(a)
			SD-CB-01-10	2/9/2001	0.3	x	x	x	x	x	(a)
CB-02	2	wetland	SD-CB-02-01	2/8/2001	0.5	x	x	x	x	x	(a)
			SD-CB-02-02	2/8/2001	0.5	x	x	x	x	x	(a)
			SD-CB-02-03	2/8/2001	0.5	x	x	x	x	x	(a)
			SD-CB-02-04	2/8/2001	0.5	x	x	x	x	x	(a)
			SD-CB-02-05	2/8/2001	0.5	x	x	x	x	x	(a)
			SD-CB-02-06	2/8/2001	0.7	x	x	x	x	x	(a)
			SD-CB-02-07	2/8/2001	0.8	x	x	x	x	x	(a)
			SD-CB-02-08	2/8/2001	0.9	x	x	x	x	x	(a)
			SD-CB-02-09	2/8/2001	0.9	x	x	x	x	x	(a)
			SD-CB-02-10	2/8/2001	1.2	x	x	x	x	x	(a)
CB-03	2	wetland	SD-CB-03-01	2/9/2001	0.7	x	x	x	x	x	(a)
			SD-CB-03-02	2/9/2001	1.0	x	x	x	x	x	(a)
			SD-CB-03-03	2/9/2001	1.2	x	x	x	x	x	(a)
			SD-CB-03-04	2/8/2001	1.0	x	x	x	x	x	(a)
			SD-CB-03-05	2/8/2001	0.7	x	x	x	x	x	(a)
			SD-CB-03-06	2/8/2001	0.3	x	x	x	x	x	(a)
			SD-CB-03-07	2/8/2001	0.7	x	x	x	x	x	(a)
			SD-CB-03-08	2/8/2001	0.5	x	x	x	x	x	(a)
			SD-CB-03-09	2/8/2001	0.5	x	x	x	x	x	(a)
			SD-CB-03-10	2/8/2001	0.5	x	x	x	x	x	(a)
			SD-CB-03-11	2/8/2001	0.3	x	x	x	x	x	(a)
			SD-CB-03-12	2/8/2001	0.7	x	x	x	x	x	(a)

TABLE 4-32
APPLICABILITY OF SEDIMENT SAMPLES TO EXPOSURE SCENARIOS FOR INDICATOR SPECIES

WELLS G&H SUPERFUND SITE OU3

Station	Reach	Habitat	Sample ID	Date Sampled	Standing Water Depth (ft)	Applicability of Samples/Stations to Ecological Exposures[1]					Notes
						Muskrat	Heron	Mallard	Shrew	Invertebrates	
CB-04	2	wetland	SD-CB-04-01	7/11/2002	< 1.0	x	x	x	x	x	(a)
			SD-CB-04-02	7/11/2002	0.0	x	x	x	x	x	(a)
			SD-CB-04-03	7/11/2002	0.0	x	x	x	x	x	(a)
			SD-CB-04-04	7/11/2002	0.0	x	x	x	x	x	(a)
			SD-CB-04-05	7/11/2002	< 1.0	x	x	x	x	x	(a)
			SD-CB-04-06	7/11/2002	0.0	x	x	x	x	x	(a)
			SD-CB-04-07	7/11/2002	0.0	x	x	x	x	x	(a)
			SD-CB-04-08	7/11/2002	< 1.0	x	x	x	x	x	(a)
			SD-CB-04-09	7/11/2002	< 1.0	x	x	x	x	x	(a)
			SD-CB-04-10	7/11/2002	< 1.0	x	x	x	x	x	(a)
CB-05	2	riparian	SO-CB-05-01	7/11/2002	0.0				x		(a)
			SO-CB-05-02	7/11/2002	0.0				x		(a)
			SO-CB-05-03	7/11/2002	0.0				x		(a)
			SO-CB-05-04	7/11/2002	0.0				x		(a)
			SO-CB-05-05	7/11/2002	0.0				x		(a)
			SO-CB-05-06	7/11/2002	0.0				x		(a)
			SO-CB-05-07	7/11/2002	0.0				x		(a)
			SO-CB-05-08	7/11/2002	0.0				x		(a)
			SO-CB-05-09	7/11/2002	0.0				x		(a)
			SO-CB-05-10	7/11/2002	0.0				x		(a)
CB-06	2	wetland	SD-CB-06-01	7/11/2002	< 0.5	x		x	x	x	(a)
			SD-CB-06-02	7/11/2002	< 1.0	x		x	x	x	(a)
			SD-CB-06-03	7/11/2002	< 1.0	x		x	x	x	(a)
			SD-CB-06-04	7/11/2002	< 1.0	x		x	x	x	(a)
			SD-CB-06-05	7/11/2002	0.0	x		x	x	x	(a)
			SD-CB-06-06	7/11/2002	< 1.0	x		x	x	x	(a)
			SD-CB-06-07	7/11/2002	< 0.5	x		x	x	x	(a)
			SD-CB-06-08	7/11/2002	< 1.0	x		x	x	x	(a)
			SD-CB-06-09	7/11/2002	< 0.5	x		x	x	x	(a)
			SD-CB-06-10	7/11/2002	0.0	x		x	x	x	(a)
DA	2	riparian	SO-DA-01	7/11/2002	0.0				x		(a)
			SO-DA-02	7/11/2002	0.0				x		(a)
			SO-DA-03	7/11/2002	0.0				x		(a)
			SO-DA-04	7/11/2002	0.0				x		(a)
			SO-DA-05	7/11/2002	0.0				x		(a)
NRSE	1	wetland	SD-NR-01	9/4/2002	0.1	x		x	x	x	(a)
			SD-NR-02	9/4/2002	0.1	x		x	x	x	(a)
			SD-NR-03	9/4/2002	0.0	x		x	x	x	(a)
			SD-NR-04	9/4/2002	0.0	x		x	x	x	(a)
			SD-NR-05	9/4/2002	0.1	x		x	x	x	(a)
JY	1	wetland	SD-JY-06	7/18/2002	0.0	x		x	x	x	(a)
			SD-JY-07	7/18/2002	0.0	x		x	x	x	(a)
			SD-JY-08	7/18/2002	0.0	x		x	x	x	(a)
			SD-JY-09	7/18/2002	0.0	x		x	x	x	(a)
			SD-JY-10	7/18/2002	0.0	x		x	x	x	(a)
			SD-JY-11	7/18/2002	0.0	x		x	x	x	(a)
			SD-JY-12	7/18/2002	0.0	x		x	x	x	(a)
			SD-JY-13	7/18/2002	0.0	x		x	x	x	(a)
			SD-JY-14	7/18/2002	0.0	x		x	x	x	(a)
			SD-JY-15	7/18/2002	0.0	x		x	x	x	(a)
NRSO	1	riparian	SO-NR-16	9/4/2002	0.0				x		(a)
			SO-NR-17	9/4/2002	0.0				x		(a)
			SO-NR-18	9/4/2002	0.0				x		(a)
			SO-NR-19	9/4/2002	0.0				x		(a)
			SO-NR-20	9/4/2002	0.0				x		(a)

TABLE 4-32
APPLICABILITY OF SEDIMENT SAMPLES TO EXPOSURE SCENARIOS FOR INDICATOR SPECIES

WELLS G&H SUPERFUND SITE OU3

Station	Reach	Habitat	Sample ID	Date Sampled	Standing Water Depth (ft)	Applicability of Samples/Stations to Ecological Exposures[1]					Notes
						Muskrat	Heron	Mallard	Shrew	Invertebrates	
KFSE	2	river	SD-KF-01	9/4/2002	0.3	x	x	x		x	(a)
			SD-KF-02	9/4/2002	0.3	x	x	x		x	(a)
			SD-KF-03	9/4/2002	0.3	x	x	x		x	(a)
			SD-KF-04	9/4/2002	0.2	x	x	x		x	(a)
			SD-KF-05	9/4/2002	0.3	x	x	x		x	(a)
			SD-KF-06	9/4/2002	0.5	x	x	x		x	(a)
			SD-KF-07	9/4/2002	0.0	x	x	x		x	(a)
			SD-KF-08	9/4/2002	0.2	x	x	x		x	(a)
			SD-KF-09	9/4/2002	0.8	x	x	x		x	(a)
			SD-KF-10	9/4/2002	0.3	x	x	x		x	(a)
KFSO	2	riparian	SO-KF-01	9/4/2002	0.0				x		(a)
			SO-KF-02	9/4/2002	0.0				x		(a)
			SO-KF-03	9/4/2002	0.0				x		(a)
			SO-KF-04	9/4/2002	0.0				x		(a)
			SO-KF-05	9/4/2002	0.0				x		(a)
			SO-KF-06	9/4/2002	0.0				x		(a)
			SO-KF-07	9/4/2002	0.0				x		(a)
			SO-KF-08	9/4/2002	0.0				x		(a)
			SO-KF-09	9/4/2002	0.0				x		(a)
			SO-KF-10	9/4/2002	0.0				x		(a)
LF	6	lake	SD-LF-01	7/17/2000	5.2					x	(a)
			SD-LF-02	7/17/2000	6.8					x	(a)
LM	6	lake	SD-LM-01	7/17/2000	75.0					x	(a)
			SD-LM-02	7/17/2000	37.0					x	(a)
			SD-LM-03	7/17/2000	52.0					x	(a)
LP	3	river	SD-LP-01	7/12/2002	1.5	x	x	x		x	(a)
			SD-LP-02	7/12/2002	1.0	x	x	x		x	(a)
			SD-LP-03	7/12/2002	1.5	x	x	x		x	(a)
			SD-LP-04	7/12/2002	1.0	x	x	x		x	(a)
			SD-LP-05	7/12/2002	2.0	x	x	x		x	(a)
			SD-LP-06	7/12/2002	1.0	x	x	x		x	(a)
			SD-LP-07	7/12/2002	1.5	x	x	x		x	(a)
			SD-LP-08	7/12/2002	2.0	x	x	x		x	(a)
			SD-LP-09	7/12/2002	0.0	x	x	x		x	(a)
			SD-LP-10	7/12/2002	0.3	x	x	x		x	(a)
			SD-LP-11	9/13/2002	0.1	x	x	x		x	(a)
			SD-LP-12	9/13/2002	0.0	x	x	x		x	(a)
			SD-LP-13	9/13/2002	0.0	x	x	x		x	(a)
			SD-LP-14	9/13/2002	0.0	x	x	x		x	(a)
			SD-LP-15	9/13/2002	0.0	x	x	x		x	(a)
MP	4	lake	SD-MP-01	7/10/2000	2.2			x		x	(a)
			SD-MP-02	7/10/2000	2.0			x		x	(a)
WSS	1	riparian	SO-SS-01	7/12/2002	0.0				x		(a)
			SO-SS-02	7/12/2002	0.0				x		(a)
			SO-SS-03	7/12/2002	0.0				x		(a)
			SO-SS-04	7/12/2002	0.0				x		(a)
			SO-SS-05	7/12/2002	0.0				x		(a)
TT-28	1	river	SD-TT-28-01	2/7/2001	1.0	x	x	x		x	(a)
			SD-TT-28-02	2/7/2001	1.0	x	x	x		x	(a)
			SD-TT-28-03	2/7/2001	1.0	x	x	x		x	(a)
TT-29	1	river	SD-TT-29-01	2/12/2001	2.0	x	x	x		x	(b)
			SD-TT-29-02	2/12/2001	1.5	x	x	x		x	(b)
			SD-TT-29-03	2/12/2001	1.5	x	x	x		x	(b)
			SD-TT-29-03-TR	6/19/2001	1.0	x	x	x		x	(b)
TT-30	2	river	SD-TT-30-01	2/12/2001	0.5	x	x	x		x	
			SD-TT-30-01-TR	6/22/2001	0.6	x	x	x		x	
			SD-TT-30-02	2/12/2001	0.5	x	x	x		x	
			SD-TT-30-03	2/12/2001	0.5	x	x	x		x	

TABLE 4-32
APPLICABILITY OF SEDIMENT SAMPLES TO EXPOSURE SCENARIOS FOR INDICATOR SPECIES

WELLS G&H SUPERFUND SITE OU3

Station	Reach	Habitat	Sample ID	Date Sampled	Standing Water Depth (ft)	Applicability of Samples/Stations to Ecological Exposures[1]					Notes
						Muskrat	Heron	Mallard	Shrew	Invertebrates	
TT-31	2	wetland	SD-TT-31-01	2/12/2001	0.3	x		x		x	(a)
			SD-TT-31-02	2/12/2001	0.8	x		x		x	(a)
			SD-TT-31-03	2/12/2001	0.5	x		x		x	(a)
TT-32	2	river	SD-TT-32-01	2/9/2001	0.8	x	x	x		x	(a)
			SD-TT-32-02	2/9/2001	0.5	x	x	x		x	(a)
			SD-TT-32-02-TR	6/20/2001	0.6	x	x	x		x	(a)
			SD-TT-32-03	2/9/2001	0.3	x	x	x		x	(a)
TT-33	2	river	SD-TT-33-01	2/8/2001	0.3	x	x	x		x	
			SD-TT-33-02	2/8/2001	0.5	x	x	x		x	
			SD-TT-33-02-TR	6/20/2001	0.5	x	x	x		x	
			SD-TT-33-03	2/8/2001	0.3	x	x	x		x	
UF	6	lake	SD-UF-01	7/18/2000	4.5	x				x	
			SD-UF-02	7/18/2000	5.6					x	
			SD-UF-02-TR	6/27/2001	7.1					x	
			SD-UF-03	7/18/2000	3.7	x				x	
UM	6	lake	SD-UM-01	7/17/2000	85.0					x	(a)
			SD-UM-02	7/17/2000	78.0					x	(a)
			SD-UM-03	7/17/2000	52.0					x	(a)
WG	1	wetland	SD-WG-01	7/13/2000	0.3	x		x	x	x	
			SD-WG-02	7/13/2000	0.2	x		x	x	x	
			SD-WG-03	7/13/2000	0.0	x		x	x	x	
			SD-WG-04	7/13/2000	0.0	x		x	x	x	
			SD-WG-05	7/13/2000	0.3	x		x	x	x	
			SD-WG-06	7/13/2000	0.3	x		x	x	x	
			SD-WG-07	7/13/2000	0.2	x		x	x	x	
			SD-WG-08	7/13/2000	0.2	x		x	x	x	
			SD-WG-09	7/13/2000	0.0	x		x	x	x	
			SD-WG-10	7/13/2000	0.2	x		x	x	x	
			SD-WG-11	7/13/2000	0.0	x		x	x	x	
			SD-WG-12	7/13/2000	0.2	x		x	x	x	
			SD-WG-13	7/13/2000	0.0	x		x	x	x	
			SD-WG-14	7/13/2000	0.0	x		x	x	x	
			SD-WG-15	7/13/2000	0.2	x		x	x	x	
			SD-WG-16	7/13/2000	0.0	x		x	x	x	
			SD-WG-17	7/13/2000	0.0	x		x	x	x	
			SD-WG-18	7/13/2000	0.0	x		x	x	x	
			SD-WG-19	7/13/2000	0.0	x		x	x	x	
			SD-WG-20	7/13/2000	0.0	x		x	x	x	
			SD-19-01-ME	11/19/1997	0.3	x		x	x	x	
WH	1	wetland	SD-WH-01	7/12/2000	0.2	x		x	x	x	
			SD-WH-02	7/12/2000	0.3	x		x	x	x	
			SD-WH-03	7/12/2000	0.2	x		x	x	x	
			SD-WH-04	7/12/2000	0.3	x		x	x	x	
			SD-WH-05	7/12/2000	0.2	x		x	x	x	
			SD-WH-06	7/12/2000	0.2	x		x	x	x	
			SD-WH-07	7/12/2000	0.1	x		x	x	x	
			SD-WH-07-TR	6/18/2001	1.2	x		x	x	x	
			SD-WH-08	7/12/2000	0.2	x		x	x	x	
			SD-WH-09	7/12/2000	0.3	x		x	x	x	
			SD-WH-10	7/12/2000	0.3	x		x	x	x	

TABLE 4-32
APPLICABILITY OF SEDIMENT SAMPLES TO EXPOSURE SCENARIOS FOR INDICATOR SPECIES

WELLS G&H SUPERFUND SITE OU3

Station	Reach	Habitat	Sample ID	Date Sampled	Standing Water Depth (ft)	Applicability of Samples/Stations to Ecological Exposures[1]					Notes
						Muskrat	Heron	Mallard	Shrew	Invertebrates	
WS	1	river	SD-WS-01	7/11/2000	0.3	x	x	x	x	x	(a)
			SD-WS-02	7/11/2000	0.2	x	x	x	x	x	(a)
			SD-WS-03	7/11/2000	0.1	x	x	x	x	x	(a)
			SD-WS-04	7/11/2000	0.2	x	x	x	x	x	(a)
			SD-WS-05	7/11/2000	0.2	x	x	x	x	x	(a)
			SD-WS-06	7/11/2000	0.2	x	x	x	x	x	(a)
			SD-WS-07	7/11/2000	0.3	x	x	x	x	x	(a)
			SD-WS-08	7/11/2000	0.2	x	x	x	x	x	(a)
			SD-WS-09	7/11/2000	0.1	x	x	x	x	x	(a)
			SD-WS-10	7/11/2000	0.2	x	x	x	x	x	(a)
WW	1	wetland	SD-WW-01	11/28/2000		x		x		x	(c)
			SD-WW-02	11/28/2000		x		x		x	(c)
			SD-WW-03	11/28/2000		x		x		x	(c)
			SD-WW-04	11/28/2000		x		x		x	(c)
			SD-WW-05	11/28/2000		x		x		x	(c)
			SD-WW-06	11/28/2000		x		x		x	(c)
			SD-WW-06-TR	6/21/2001	0.8	x		x		x	(c)
			SD-WW-07	11/28/2000		x		x		x	(c)
			SD-WW-08	11/28/2000		x		x		x	(c)
			SD-WW-08	2/6/2001		x		x		x	(c)
			SD-WW-09	11/28/2000		x		x		x	(c)
			SD-WW-10	11/28/2000		x		x		x	(c)
			SD-WW-11	11/28/2000		x		x		x	(c)
			SD-WW-12	11/28/2000		x		x		x	(c)
REFERENCE											
01I		river	SD-01-00-IP	6/21/1999	0.3	x	x	x		x	
			SD-01-00-IP-TR	6/25/2001	0.3	x	x	x		x	
02I		pond	SD-02-00-IP	6/21/1999	2.0	x	x	x		x	
03I		pond	SD-03-00-IP	6/18/1999	9.2					x	
			SD-03-00-IP-TR	6/25/2001	13.0					x	
04I		river	SD-04-00-IP	6/17/1999	NA	x	x	x		x	
			SD-04-00-IP-TR	6/26/2001	0.4	x	x	x		x	
12I		river	SD-12-00-IP	6/17/1999	0.3	x	x	x		x	
23		river	SD-23-01-FW	8/30/1995	NA	x	x	x		x	
			SD-23-02-FW	8/30/1995	1.5	x	x	x		x	
			SD-23-03-FW	8/30/1995	1.0	x	x	x		x	
24		wetland	SD-24-01-FW	8/30/1995	0.7	x	x	x	x	x	
			SD-24-02-FW	8/30/1995	1.0	x	x	x	x	x	
			SD-24-03-FW	8/30/1995	NA	x	x	x	x	x	
			SD-24-03-ME	11/12/1997	1.0	x	x	x	x	x	
25		lake	SD-25-01-FW	9/11/1995	3.5	x	x	x		x	
			SD-25-02-FW	9/11/1995	4.0	x	x	x		x	
			SD-25-02-ME	11/18/1997	NA	x	x	x		x	
			SD-25-03-FW	9/11/1995	3.0	x	x	x		x	
26		lake	SD-26-01-FW	9/11/1995	3.0	x	x	x		x	
			SD-26-02-FW	9/11/1995	2.5	x	x	x		x	
			SD-26-03-FW	9/11/1995	2.5	x	x	x		x	
27		river	SD-27-01-FW	9/12/1995	2.5	x	x	x		x	
			SD-27-02-FW	9/12/1995	1.5	x	x	x		x	
			SD-27-03-FW	9/12/1995	1.5	x	x	x		x	
HB		wetland	SD-HB-00-TR	6/26/2001	0.8	x	x	x	x	x	
SA		wetland	SD-SA-01-TR	6/25/2001	0.7	x	x	x	x	x	

(a) Data includes Inorganics only
(b) Data includes Acetone and Inorganics only
(c) <1 ft water (most WW <6" water)

E. City of Woburn

Comments on Baseline Human Health Risk Assessment

Wells G & H Superfund Site

Aberjona River Study

Operable Unit 3

Woburn, Massachusetts

Anne Marie Desmariais, Tufts University

For the Technical Outreach Services to Communities (TOSC) prorram

This review of the Aberjona River Study Baseline Human Health Risk Assessment was conducted by the Civil and Environmental Engineering Department at Tufts University on behalf of the City of Woburn City Council in order to provide comments regarding the appropriateness of the study and its compliance with EPA Superfund Risk Assessment Guidelines.

This review is limited to the Baseline Human Health Risk Assessment, and focuses on the methodology and conclusions. This review did not evaluate the completeness or validity of the data used in the Risk Assessment.

The Wells G & H Human Health Risk Assessment used data from multiple sampling rounds conducted between 1995 and 2002. The Wells G & H area has been the subject of intense study since the early 1980's. This Risk Assessment, which was done by Metcalf & Eddy for EPA Region 1, focused on the Aberjona River from Route 128 to the Mystic Lakes, and included sediment, surface water, and some upland soils in its sampling and analysis program. It also evaluated fish tissue, and considered eating some fish from the Aberjona River and the Mystic Lakes as exposure pathways. The Wells G & H Superfund site is included within the boundaries of the Study Area, which does not include the Industriplex Superfund site, north of Route 128.

The purpose of Risk Assessment under Superfund, which is the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is to determine if a site that has been contaminated by release or disposal of hazardous wastes presents an unacceptable risk to human health, human welfare, or the environment. The Human Health Risk Assessment should not be used to attempt to determine if specific individuals who live in the City of Woburn are at risk of becoming ill as a result of living near the Study Area. The Risk Assessment uses hypothetical scenarios, which describe the types of contacts that people may have with contaminated environmental media, either under the current conditions present at the site, or under future conditions. In this case, the future scenarios presumed that a park or some other area where recreation was encouraged would be present on portions of the site in the future. If this were to be the case, there would be more opportunities for contact with contaminated water and sediment.

The purpose of Risk Assessment is to determine if the risks under the conditions assumed by the risk assessor are higher than levels determined to be acceptable based on the Superfund guidance. The Risk Assessment looks at risk of getting cancer and at risk of getting other illnesses, such as kidney disease, immune dysfunction, reproductive disorders, and other non-cancer effects. Each type of risk is evaluated separately, and is based on calculations of exposures, or doses, of chemicals that the hypothetical persons would incur. These exposures are compared to toxicity values that are derived from studies on the effects of each chemical found at the site. The comparisons allow the risk assessor to characterize the risk from each chemical related to each type of exposure. This Risk Assessment evaluated exposures to chemicals in some upland soils near the River, sediment, and surface water, as well as in fish, to people who wade in the River, swim in the Mystic Lakes and certain parts of the River, and play or walk in the flood plain. The Risk Assessment used conservative assumptions that hypothetical people were exposed to contaminants by ingesting small amounts of sediment, soil, and surface water, eating fish, and primarily from contacting surface water, soil, and sediment with their skin.

The Risk Assessment used different exposure factors for different sections of the River. These factors were conservative, but within reasonable expectations for some individuals. By using conservative factors, the Risk Assessment has greater validity, because if there is no unacceptable risk with conservative factors, risk managers will have a lot more confidence in the outcome. If under reasonable worst cases, such as an older child or teenager playing in the River nearly every day in the summer, the risks are all below the limits of concern, then it is easier for risk managers to decide that no additional studies or no remedial action is needed. If a Risk Assessment does not use reasonable worst case scenarios, it is difficult to reach decisions about possible cleanup because there will always be nagging questions about whether some individuals who are exposed to the contaminated environment are at a higher risk that the Risk Assessment indicated.

The Risk Assessment assumed that for the worst case, a person swims or wades in the River 104 days per year, for 24 years for adults and six years for children, in the most accessible portions of the river. For less accessible areas, the Risk Assessment assumed that people went into the River 26 times per year, or twice a week during the summer, between late May and Labor Day. Although the argument could be made that EPA's consultant should have used the same conservative factor, 104 days per year, or approximately every day between the middle of May and Labor Day, using more conservative exposure factors would not change the overall conclusion of the Risk Assessment, although it would identify additional areas of the River that presented unacceptable risk.

EPA Response*:* ***Generally, stations were evaluated with a future exposure frequency of 78 days per year. This exposure frequency is adequately protective of recreational exposures in undeveloped areas (i.e., not in close physical proximity to residences). The exposure frequency of 26 days per year was only applied to a small number of stations where future land use is assumed to remain the same as current land use, due to their location further into the wetland or abutting Route 93 (station AM). The 104 days per year exposure frequency was utilized for areas where residences were close to the station, in some cases, immediately abutting the area. Using an exposure frequency of 104 days per year for areas not near residences would likely overestimate the risk associated with these stations.***

The methods used for this Risk Assessment were appropriate and consistent with Superfund Guidance. The study included a large number of samples and sampling rounds. In some cases, the data were not complete because some sampling locations were not included on all rounds. However, the overall data set used for the Risk Assessment include adequate data for the evaluations and analyses that were performed. It is likely that slightly different conclusions about risk would be reached if there were additional data points. However, the overall conclusion of the Risk Assessment would not change.

EPA Response: ***Sampling was conducted in depositional areas likely containing the highest levels of contaminants. Additional sampling would likely demonstrate contaminant levels consistent with those already determined.***

There were three objectives of the overall study, and these objectives were followed in the Risk Assessment. The first objective was to identify contaminated environmental media and to determine the Contaminants of Potential Concern. The second was to identify pathways of exposure to the contaminants and to evaluate potential health effects and toxic responses. The last objective was to identify sampling locations where environmental media do and do not contribute to health risks.

The focus of the Human Health Risk Assessment sampling was on portions of the River study area where people would likely contact surface water, sediments, or the upland soils subject to flooding from the River. This was an appropriate emphasis for this study. The samples were analyzed for all Superfund target analytes and target metals, and the method used to select the Contaminants of Potential Concern for this site was appropriate. The Contaminants of Potential Concern for this site for the three environmental media studied were properly selected.

The Human Health Risk Assessment evaluated the following pathways for human exposure:

1. Recreation including wading: ingestion of sediment and surface soil; dermal contact with surface water, sediment, and surface soil.
2. Recreation including swimming: ingestion of surface water and sediment; dermal contact with surface water and sediment.
3. Recreation including fishing: ingestion of fish

This Risk Assessment evaluated both the most likely exposure scenario, using the average of the contaminant concentrations in environmental media (CT or central tendency exposures), and the worst case exposure, using the upper 95 percent confidence limit of the means of the concentration data (RME, or reasonable maximum exposures). This is consistent with Superfund Guidance. Exposure doses were calculated for each of the three receptor scenarios listed above using both the CT and the RME receptor. This Risk Assessment evaluated adults, children and older children for each exposure scenario.

The Baseline Human Health Risk Assessment concludes that Hazard Indices are greater than 1 and that ILCR's are greater than 1E-04 at some locations within the Study Area based on both current and future recreational scenarios. This means that the noncancer risk, indicated by the Hazard Index, and the cancer risk, indicated by the ILCR, are unacceptable at some locations based on the exposure analysis used. These risks require EPA to consider further action at the site. In addition, several ILCR's are between 1E-6 and 1E-4. Cancer risks in this range require EPA to make site-specific decisions about risk, based on several factors, including the likelihood that people may be exposed to contaminants. Because it is likely that people will be exposed to contaminants in the river, seeing the river flows within highly populated areas, it is recommended that EPA consider conservative action at locations where the risks are in this range.

EPA Response: ***The human health risk assessment has evaluated and documented the risk at all human health exposure stations, including those where the estimated risk is***

within or below regulatory guidelines. These risk calculations, along with site-specific considerations, will be factored into risk management decisions for the study area.

The primary concerns are with arsenic in the sediments. Benzo(a)pyrene also contributed to cancer risk in four of the sampling locations, but the risks from this compound were within the EPA risk range, although greater than 1E-06. The risks from arsenic in sediment drive the Risk Assessment, and should be considered the most significant risks at this site.

The inclusion of benzo(a)pyrene as a Contaminant of Potential Concern, although supported by the data, is a possible point for discussion, as this compound could have originated from sources other than those historically associated with the Wells G & H site. Benzo(a)pyrene is a polycyclic aromatic hydrocarbon produced from combustion of fossil fuels as well as from other combustion sources. It is also present in heavy oils, coal, asphalt, and other petroleum-based products. It is present in road runoff and in atmospheric deposition in urban areas. Benzo(a)pyrene in the sediments could have originated from several sources in addition to the G&H site and Industriplex. However, the cancer and noncancer risks from arsenic are significantly higher than those from benzo(a)pyrene, and provide sufficient basis for the conclusion that portions of the site warrant further evaluation and remediation in order to be used as a recreational area.

EPA Response***: The significance of benzo(a)pyrene as a risk contributor will be evaluated further through the risk management, feasibility study, and proposed plan process. Data within the BRA suggest that this compound is present at levels consistent with those found at background locations.***

The Human Health Risk Assessment must be considered along with the Ecological Risk Assessment, which demonstrates potential significant risks to the environment in the Study Area. Given the relatively limited human contact with sediments and surface water throughout most of the Study Area, and the relative inaccessibility of the most highly contaminated areas, the human health risks must be communicated to the public in an appropriate manner. If individuals are concerned about the risks associated with exposure to the river water and sediments, they should be cautioned against that exposure. Avoiding the river and its sediments will protect against risk from arsenic in the sediments. This is not a substitute for remediation, but advising against contact should be part of any risk communication program in Woburn. People should be reassured that they are not at risk of cancer or other illnesses from these exposures if they do not contact the sediments.

EPA Response*: **An active community relations component is in place for this project. Public meetings have been held, informing the public of the results of the human health and ecological risk assessments. These public forums will continue as more information becomes available for the study area or as need dictates. It is anticipated that the next public meeting will occur after the completion of the Comprehensive Remedial Investigation Report.***

Third Party Review of the Baseline Risk Assessment of the Aberjona River Study Area

Christopher Perkins, M.S.
University of Connecticut
Technical Outreach Service to Communities
USEPA Center for Hazardous Substances in Urban Environments

Objective

The objective of this document is to provide a third party review of the "Baseline Human Health and Ecological Risk Assessment Report – May 2003" and evaluate 1) the protocols applied in the studies used in the risk assessment (RA); 2) interpretation of information included in the risk assessment; and 3) report conclusions.

Questions Addressed in the Review

To fully evaluate this document, there were specific questions which required consideration:

1) Was the ecosystem properly characterized and then the information applied appropriately in the RA?
2) Was the selection of contaminants of potential concern (COPCs), receptor species, assessment and measurement endpoints appropriate?
3) Were the estimates of exposure and effects metrics appropriate?
4) Were the statistical techniques used appropriate and properly applied?
5) Was the assessment of risk supported by the available information?
6) Were the uncertainties in the analysis of the endpoints identified and adequately addressed?
7) Is the weight of evidence analysis regarding risk appropriate?

EPA Response: Responses are provided to the specific comments, below.

General Comments

Based upon my review of the report there was an adequate characterization of the site as it relates to surface water and sediment sampling. In addition, appropriate methodologies and associated detection limits were utilized for chemical characterization, with the possible exception of PCB Aroclor analysis. Aroclor analysis of biota (small fish and crayfish) is not appropriate for use in ecological risk assessment due to the potential underestimation of total PCBs. It should be noted that the use of more appropriate congener analysis would not change the associated risk to the indicator species.

EPA Response: No response required.

The biggest weakness of this report, from the ecological risk perspective, is the lack of a formal survey of flora and fauna. As a result of this, there may have been a more appropriate species that could be utilized as an indicator of risk for a species from a higher trophic level. The habitats, especially in reaches 1 and 2, are suitable for weasel species and possibly mink. These two mammals or an applicable raptor species, owl or hawk, are top level predators and are more representative of maximum exposure and potential effects. The report adequately took into account applicable exposure scenarios regarding home range and habitat usage, by undertaking both site-wide and 38 acre scenarios for muskrat and mallard indicators.

EPA Response: Although no formal survey of flora and fauna were conducted, habitats were qualitatively surveyed during several site visits on numerous dates by qualified biologists. In 1985, the USEPA conducted an evaluation of the wetlands near Wells G&H to determine the extent and type of wetlands in the study area (PRC, 1986). In both 1995 and 1997, USEPA, USF&WS, and NOAA biologists were extensively involved in qualitative field surveys, biological sampling, and reference site selection. The qualitative assessments provided an adequate characterization of the major flora and fauna present or potentially present based on habitat conditions. It was the opinion of EPA and the other reviewing resource agencies (USFWS, DEP, NOAA) that the characterization and qualitative description of the site from the early surveys were sufficient to develop a sound site conceptual model and problem formulation. More recently, in preparation of the revised BERA, the majority of the sampling stations were re-visited by teams of biologists from EPA, USFWS and DEP to confirm the habitat conditions and suitability of each station to represent each of the wildlife receptors, and also to select the sampling locations for the triad sampling. In addition, Habitat Assessment Field data sheets were completed (Appendix C) for each of the triad sampling locations. EPA believes that the site was adequately characterized for the purposes of the BERA. It is not a practical expectation or necessarily the goal of a risk assessment to provide quantitative data on all flora and fauna in a resource area.

The selection of receptor species was based not only on organisms potentially present, but also on the ecotoxicity of the contaminants identified on site. Using higher trophic level species would have been more appropriate if the major COPCs were organic compounds that are bioaccumulative. Metals, in general, and arsenic, specifically, do not tend to bioconcentrate in the food chain. In order to select receptors with greatest exposure, omnivorous species (muskrat and mallard) were selected. In order to address the issue of a potentially sensitive predator, however, the heron was included to provide a thorough and conservative assessment.

The selection of the COPCs was appropriate based on the criteria utilized in this study. The selection tended to be more inclusive by utilizing the maximum detected levels of the chemicals as a screening method. This allowed for a more inclusive list of chemicals in the risk assessment than if alternate methods were utilized.

EPA Response: In accordance with EPA guidance, screening was conducted based on maximum observed concentrations in each medium of concern.

The report acknowledges the magnitude of uncertainty when it is associated with a benchmark. An example of this is the use of benchmark analysis in sediment for invertebrates and the acknowledgement of the uncertainty associated with bioavailability. However, in some cases uncertainty was not addressed. This is the case for the sediment toxicity testing data. There was no adequate explanation for the differences in the data or uncertainty associated with 10 day vs. chronic tests and reference vs. control comparisons.

EPA Response: See response under Specific Comments.

This report tends to accurately portray risk associated with each of the macro indicator species. The weight of evidence presented in this report support its assessment of risk for each of the indicator species within the study area.

EPA Response: No response required.

In general, this report tended to be conservative in its estimates of risk. One example that illustrates this is the way the report treats analytical data for use in the risk assessment. Analytical detection limits vary from sample to sample based upon dilutions and sample weight, and can be high in some instances. The report assigned ½ the sample specific detection limit to any data where data was reported from the laboratory as below the detection limit. This is standard practice, because it is assumed that the true sample concentration is somewhere between 0 and the detection limit.

EPA Response: It is standard practice to use ½ the detection limit for the sample, especially if the detection limit was not high and/or the contaminant was detected at quantified levels in other samples (USEPA, 1989).

One thing that needs to be taken into consideration while interpreting this report is that a Risk Assessment is a tool and not a certainty. It is meant to be used to guide management options which will enable regulators, decision-makers, and the public make better informed decisions. Inconsistencies are to be expected in a complex system, and

EPA Response: In the Risk Assessment Process for Superfund, completion of the baseline ecological risk assessment represents a step prior to preparation of the RI and Feasibility Study Reports and before scientific/management decisions related to

potential cleanup and preparation of a record of decision (USEPA, 1997). As a major part in the process, the BERA will be used by EPA to make an informed risk management decision.

<u>Specific Comments</u>

No formal surveys of flora or fauna was conducted
The biggest weakness of this report, from the ecological risk perspective, is the lack of a formal survey of flora and fauna. When conclusions are made regarding potential impacts on the survival and/ or reproduction of muskrats and mallards (pg 4-126) with no supporting field data, it only opens the door for uncertainty. This is especially true considering that in these two cases, there was a moderate level of uncertainty associated with the risk (Table 4-275). A survey can help assess whether or not these populations are stable, increasing, or decreasing and allow for comparisons with published data.

EPA Response:

EPA believes that the site was adequately characterized for the purposes of the BERA. It is neither a practical expectation nor necessarily a goal of a risk assessment to provide quantitative data on all flora and fauna in a resource area. In addition, quantitative surveys are very unlikely to detect population effects in highly mobile animals such as the muskrat and mallard. The results of the BERA identified probable effects (i.e. chronic impacts) on reproduction. For the BERA, the assessment population was operationally defined to be the population within study area (Aberjona River Basin, south of Route 128). The population is regulated by births and deaths (which may be affected by site conditions) as well as immigration and emigration of individuals from adjacent areas. Severe effects on a receptor could remove individuals from the assessment population, or decrease reproductive rates and cause the study area to serve a sink for the regional population. In this case, lower reproduction rates within the study area might be compensated by an increase in immigration. The resulting subtle impacts on population density within the study area would not likely be detected using standard field survey methods.

No formal sampling of indicator species for target organ analysis

The other main weakness in this report is its lack of tissue sampling from the higher level organisms/ indicator species. One potential criticism that can be aimed at this report is that you cannot assume that 100% of the chemical ingested is bioavailable (i.e. 100 % can be assimilated into the organism through the digestive process). There was an exception made for arsenic, where a laboratory study set this at 50% in the mammalian species. The 100% factor tends to be conservative in its estimation of risk.

By conducting analysis of tissues in indicator species, one can get a better idea of an individual's exposure and associated contaminant accumulation. The use of tissue analysis can give a much truer estimation of what the species are being exposed to. Additionally, body burdens can be compared to data published in peer reviewed literature to help assess individual and population level effects. This tool could be used for the shrew and muskrat with minimal field effort. When this tool is used in conjunction with the other metrics, it can increase the weight of evidence regarding ecological risk.

EPA Response: No tissue samples were collected from mammalian or avian species, however, tissue samples were collected and analyzed for several fish species. Although acute or subacute arsenic exposure can lead to elevated tissue residues (Eisler, 2000) in some mammals, low-level chronic exposures may not result in elevated tissue levels. Inorganic arsenicals are metabolized by many species and usually excreted rapidly in the urine. In studies on mallards, arsenic did not accumulate significantly in either the brain or the liver (Camardese, et al., 1990). Although arsenic was absorbed from the intestinal tract of young chicks, after the earliest stages (3 weeks) it is rapidly eliminated from the body. These studies conclude that although arsenic associated with vegetation could alter growth, development and physiology of ducklings, at low doses, there may not be indications of elevated concentration in brain or liver tissue. Consequently, sampling for tissue residues may not clarify the conclusion of effects on these species, if there are no tissue residue concentrations at which effects have been consistently documented for the species. The paucity of data linking tissue residues to effects contributed to EPA's decision not to collect samples from receptor species other than fish.

The quantitative analysis of PCBs as Aroclor equivalents in biota for use in risk assessment

Aroclor analysis of prey items (i.e. fish, crayfish) can result in a significant error in assessing the toxicological significance of PCBs especially as it relates to bioaccumulation. Aroclor analysis is based upon the assumption that the distribution of PCB congeners in biota is similar to that of the parent Aroclors. Aroclors are altered significantly via biological processes, which does not allow for an accurate analysis. These changes can significantly underestimate the actual concentration of PCBs in biological tissue. In some published reports and studies Aroclor analysis may underreport the total PCB concentration by 230% (USEPA Publication 823-B-00-007). Either PCB congener or homologue analysis is a more appropriate method for analysis. Unfortunately the only biota data is from the 1995 sampling round and congener and homolog analysis were not in common use during this period.

The use of Aroclor equivalents enters additional uncertainty into the estimates of risk by underestimating exposure from potential prey items, especially under the maximum case scenario. Although this potential underestimation may not effect the risk characterization, there should be some mention of this under uncertainties.

EPA Response: As noted in the comment, the original data was collected at a time when PCB congener and homolog analysis were not in common use. Consequently,

this analysis was not done. EPA acknowledges the uncertainty associated with the underestimation of PCB toxicity from prey items. However, as the comment acknowledges, PCBs were detected infrequently and at low concentrations in the study area. Inclusion of a more detailed analysis of PCB risk was not indicated from the potential risk calculated from the exposure to PCBs in the study area.

Muskrat (mallard) are likely present throughout the entire study area (pg 4-39) or overgeneralization of habitat use

The general assumption is made that muskrat populations inhabit all reaches of the watershed. The report states "Muskrats…likely occur in all of the open water habitats within the study area". Unfortunately with no actual population assessments, this statement must be taken with skepticism. It is implied in section 4.2.2.2 that the habitat quality, outside of the 38 acre wetland site (Wells G&H), is poor due to the presence of scrub and forested wetlands, maintained park lands, and encroaching development. The majority of anticipated muskrat activity would occur in reaches one and two, the areas with the highest ecological risk to the populations. Based upon my review of the appended field notes, aerial photographs, and limited first person observation, the remaining reaches, including the mystic lakes are not prime habitat for muskrats.

EPA Response: Comment noted. EPA, DEP, USF&WS, and various contractor biologists observed the entire study area. The study area was considered capable of supporting muskrat habitat, and there was a strong presence of muskrat habitat in Reach 1 and 2. The muskrat was selected to represent the assessment endpoint for aquatic mammals in the study area. Other aquatic mammals were also present in the study area, such as the beaver and river otter. It is important to note that the ecological risk assessment broadly evaluates the potential risks to various ecological habitats. The selection of the muskrat and calculated ecological risks represent risks to the muskrat and aquatic mammals.

Inconsistencies in the 10 day vs. the chronic toxicity tests are not adequately explained

On several occasions, growth and survival effects that occurred during the 10-day acute test did not occur in the chronic tests for the respective site and test species. Additionally, on several occasions the station vs. reference toxicity differs from the comparison to the laboratory control samples (Tables 4-267 and 4-268). There was no discussion of these occurrences in the document. Since both the control and reference tests are key in the interpretation of the data, any inconsistencies that occur when comparing the data should be addressed.

EPA Response: Variability in toxicity tests is not unusual. The only stations with significant difference in **C. tentans** ***growth for the ten-day growth experiments, as compared to laboratory controls, are stations 12 and 13. However, for stream and wetland samples, stations TT-32, 13, TT-30, 12, 18, 10 had lower growth of*** **C. tentans** ***as compared to laboratory controls. The three stream stations with highest arsenic***

concentrations (Stations 12, 18 and 10) did demonstrate the lowest growth rate of **C. tentans***, and similarly, the four wetland stations with the highest arsenic concentrations had the lowest growth rates for* **C. tentans***, although the growth at all stations but 12 and 13 were not significantly different from the laboratory controls. This is due, in part to poor growth rate of* **C. tentans** *in the laboratory controls. This is why, when comparing these low growth rates against reference samples, significant differences were documented for stations that did not show significant differences in the comparison with laboratory controls.*

Although laboratory controls are frequently used as the basis of comparison for determination of significant toxicity endpoints, this is not their purpose. A major purpose of the laboratory controls are to establish that laboratory conditions (organism health, temperature, dissolved oxygen, ammonia concentrations), are maintained at acceptable growth levels during the test. Since the laboratory controls are based on artificial sediments, it is not uncommon to observe reduced growth of organisms in the laboratory controls, as compared to field reference. In reality, the better measure of comparison for possible chronic effects is natural reference sediment.

In the 20-day growth measurements, none of the stations had a significantly lower growth than the laboratory controls. The growth after 20-days was more variable, in part because it was based on fewer surviving individual organisms. Often in toxicity tests, the number of surviving individuals in a replicate influences the growth rate of the remaining individuals. In addition, the fewer number of individuals remaining decreases the power of the statistical tests to detect differences.

However, using these growth data for the 10-day **C. tentans** *tests, a consistent trend for lower growth rates on sediments with higher arsenic concentrations was observed. A plot of sediment arsenic concentration (log-transformed) versus the 10-day growth of* **C. tentans** *indicates the decreasing growth as compared with increasing arsenic concentration. This is a statistically significant relationship ($r^2 = -0.70$, $p = 0.004$, $n=15$) for wetland and stream samples alone or for all 20 samples, including the 5 lake/pond locations ($r^2 = -0.65$, $p=0.002$, $n=20$).*

This statistically significant relationship of arsenic concentration with growth of **C. tentans** *is not the sole basis of EPA's conclusion of evidence of impairment of benthic invertebrate communities associated with high concentrations of metals, including arsenic. These results were supported by other lines of evidence and presented in the text of the BERA. The growth of* **H. azteca** *was also significantly reduced as compared to reference at stations TT-33, TT-32, 19 and 13. Reduction in growth of* **H. azteca** *was correlated to arsenic concentration in the sediment. The analysis of community statistics also support the conclusions that the same stations with reduced growth of* **C. tentans** *and* **H. azteca***, and high metal concentrations, also showed reduction in diversity and high dominance of pollution-tolerant species. As stated in the BERA, EPA believes these separate lines of evidence, cumulatively, indicate that there is impairment of the benthic invertebrate communities at the stations with higher*

metals concentrations, which is most closely associated with the concentration of arsenic.

The use of superfluous and potentially confounding metrics in the assessment of the benthic invertebrate community composition

The use of % Oligochaetes and Chironomids analysis to help determine community abundance can be confounding in the analysis of the data. All of the stations selected were to represent depositional (i.e. fine sediment) areas, which would be expected to have a high abundance of these species. This in and of itself adds uncertainty to the data analysis by predisposing these sites to be high and then utilizing this in your analysis.

EPA Response: Community metrics used by EPA were considered relevant and appropriate. Many of the "standard" indices are most suitable for stream communities in riffle/run habitats. In the slow-moving, depositional environments characteristic of the samples in the river and wetlands, some of the "normal" stream metrics are not applicable. However, all of the metrics used are listed in Barbour, et al., 1999 or Plafkin, et al., 1989 as acceptable community metrics, and most have been used in other studies of metal toxicity to evaluate similar data sets (e.g., Canfield, 1994). The only modification of these metrics was to use the tolerance of the dominant species as a simplified metric rather than Hisenhoff's Biotic Index and to use percent oligochaetes plus chironomids, rather than just percent chironomids. Due to the depositional nature of the sediments, it is not surprising that high abundances of oligochaetes and chironomids are found. It has been noted in other studies, high proportions of these groups, with the relative low proportions of other taxa are usually considered indicative of contaminated sediments (Canfield, et al., 1994). Based on these characteristics, evaluation of percent dominant and percent oligochaetes and chironomids was considered relevant.

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F. Town of Winchester

August 19, 2003

Ms. Angela Bonarrigo
U.S. Environmental Protection Agency
One Congress Street, Suite 1100 (HIO)
Boston, MA 02114

Dear Ms. Bonarrigo:

Re: Draft Baseline Human Health Risk Assessment Report
Aberjona River Study Area

The town of Winchester appreciates this opportunity to comment on the Draft Baseline Human HealthRisk Assessment Report (the Draft Report). Overall, we find the Draft Report to be thorough. For simplicity, our comments are numbered below:

1. <u>Arsenic concentrations in Davidson Park</u> -- We note that arsenic and other contaminants have been detected in the soil and sediments in and around Davidson Park. Recognizing and accepting EPA's methodology which indicates that the levels are within acceptable limits,. please comment on the relationship between your risk findings and DEP's standards. Of particular interest are EPA's exposure assumptions and how they compare/differ with the residential and recreational exposure assumptions in DEP's published standards.

EPA Response: DEP's regulation (the Massachusetts Contingency Plan or the MCP) provides for 3 different methods of evaluating risk. We assume that the DEP standards mentioned in the comment are referring to the MCP risk assessment Method 1 standards, which are promulgated lists of soil and groundwater standards that are compared to contaminant concentrations detected at a site. All of the DEP risk assessment procedures are intended to be generally consistent with guidance provided by the EPA; however, the EPA's methods are most similar to DEP's Method 3 risk characterization procedures, which employ site-specific information, including potential exposure scenarios, to evaluate the risks of harm to health, public welfare and the environment and develop site-specific clean-up numbers. Generally, Method 1 standards are not intended for use in Method 3 risk assessments. Nevertheless, to address the comment a comparison of the Method 1 MCP standard exposure assumptions and those used in the EPA risk assessment are set forth below.

DEP's Method 1 S-1 soil standards are based on a residential scenario which assumes 153 days of outdoor exposure and 212 days of indoor dust exposure per year. The Wells G&H OU-3 risk assessment for Davidson Park assumed 78 days of outdoor exposure per year. Both EPA and DEP methodologies evaluate childhood and adult exposures. EPA uses higher soil ingestion rates but lower dermal adherence factors and skin surface areas than DEP. These factors would tend to offset each other. Toxicity assumptions are generally consistent between the two. However, the 2003

Wells G&H OU-3 report may have used some updated toxicity values that have not, as of yet, been incorporated into the DEP standards. The most notable difference between the two methods is that DEP's Method 1 standards are based on a cancer risk of 1x10^{-6} and/or a noncancer hazard quotient of 0.2 for individual compounds, while the Wells G&H OU-3 risk assessment uses a cumulative risk management guideline for all contaminants of a cancer risk between 1 x 10^{-6} and 1 x 10^{-4} and a target organ hazard index of 1. The DEP's Method 1 standards are developed to be used generically and to be protective of sites with multiple contaminants present. By using Method 3/EPA-type risk assessment methods, more precise estimates of risk can be developed, since site-specific information is used and cumulative risk (the presence of multiple contaminants) is factored into the evaluation.

2. Impacts from future flooding events – We understand that the conditions described in the Draft Report are based upon conditions that have been measured one or more times between 1995 and 2002. The town of Winchester has the following concerns about how future heavy rain/high river flow/flooding events may change these conditions and impact Winchester and its residents in the future. Our concerns are as follows:

a. If no cleanup is performed in Woburn and other portions of the Aberjona River, will additional contamination continue to migrate downstream, particularly into areas of the river that Winchester may have dredged or excavated as part of its flood control projects?

EPA Response: The comprehensive Remedial Investigation (RI) for the entire study area, north and south of Route 128, being prepared by TetraTech NUS, will evaluate and address potential downstream migration of contaminated sediments. One goal of the RI is to understand the transport of contamination within the study area so that measures may be implemented to prevent downstream migration, as necessary.

b. Will implementation of Winchester's flood control projects affect EPA's conclusions of no unacceptable risk to human health?

EPA Response: At this time, EPA does not believe the Town's proposed work will affect EPA conclusions. EPA and the Town have discussed their potential projects, and the agency has suggested that the Town's contractor collect additional information in areas they propose work and assess the situation further with their LSP. EPA understands that the Town's contractor has collected some additional sediment information and the results are consistent with Agency data. Note: EPA has recently collected sediment core samples at 13 locations along various reaches of the river to evaluate historical contamination deposition. These sediment core samples will be evaluated for potential human health risks posed by dredging. EPA will document the results of the dredging risk assessment in the revised Wells G&H OU-3 Risk Assessment report. At this time, EPA does not anticipate that the dredging risk assessment will affect EPA's Aberjona River Study conclusions.

c. Based on the Report's findings, would EPA require notification from Winchester prior to undertaking any of the flood control projects along the

Aberjona River and its banks?

EPA Response: EPA would request that Winchester officials communicate the findings of any sampling conducted at areas targeted for dredging/excavation. EPA can then work with the community to provide guidance in maintaining a condition of no significant risk.

3. Sampling adequacy – Please explain the rationale for the sampling locations, in particular whether enough samples were collected in Winchester to assess the risk to human health and the environment? We note that no samples were collected between Bacon Street and the Upper Mystic Lakes, a slow moving portion of the river that appears to be an area of heavy sediment deposition.

EPA Response: Sampling was conducted further upstream of these areas in depositional locations. Since contaminant levels are generally decreasing from north to south, locations in Winchester were selected to represent what were believed to be the most highly contaminated depositional areas. These locations demonstrated contaminant levels corresponding to risks below regulatory guidelines. Therefore, it may be inferred that other depositional areas within Winchester, downstream of those that were sampled, would also demonstrate similar levels of contaminants and risks. Notwithstanding this approach, EPA will further assess the area between Bacon Street and the mouth of the Aberjona River, and agrees with the Town that the area is much wider, slower moving and may contain significant sediment deposition. As a result, EPA will collect additional sediment samples in this area to further evaluate human health and ecological risks. The evaluation of these data will be presented in the revised Wells G&H OU-3 Risk Assessment.

4. Residential Areas - The Winchester Board of Health has inquired as to why residential areas adjacent to the Aberjona**, that are prone to flooding,** were not sampled and included in the risk assessment as these areas represent different exposure scenarios than those contemplated in the Report. Will this issue be addressed in your fate and transport report? If not, please explain the basis for the scope of the assessment work.

EPA Response: Soils samples were collected along frequently flooded areas of the river (e.g., Davidson Park and Kraft Foods), as well as other frequently flooded areas further upstream in Woburn such as Danielson Park and the former Cranberry Bog. Human health risks were assessed at each of these locations and considered to be within acceptable guidelines. Soil contaminant levels in residential yards, present as a result of flooding events, are expected to be lower than those present in soils on the river banks or sediments within the streambed. The extrapolation of the recreational risk calculations to a residential scenario indicates that risk above regulatory guidelines would not be present at these residences. This extrapolation assumes that the measured contaminant levels would be present in the residential yards. This issue will be discussed and documented more fully in the revised Wells G&H OU-3 Risk Assessment. The revised Wells G&H OU-3 Risk Assessment will also evaluate storm

event surface water data, collected after the draft risk assessment was completed, to determine the risk to residents who contact this medium during flooding events.

Thank you for the opportunity to comment and request clarifications on this important subject.

Very truly yours,

Brian F. Sullivan
Town Manager

BFS/pt

cc: Board of Selectmen
Mark J. Twogood
Wade Welch
Hamilton Hackney
Joseph Tabbi
Board of Health
Joseph Lemay

G. Other Comments

Comment provided by Ms. Carol Michelini on April 30, 2003:

Dear Ms. Bonarrigo,

I am a resident of Woburn and I just received the pamphlet that was left at the homes in the area. My question is what type of impact has the resent flooding had on the homes and yards along the Old Cranberry Bog due to this contaminated sediment? In the past few years there have been some extensive flooding along the Aberjona River. During the last severe storm the Aberjona River overflowed on to Salem Street and the companies along the street were flooded. I live on Pernokas Dr and I know that the house along the street in the back had water up to their back yard (the bog is directly behind them). The house on the corner of Washington St and Washington Circle was completely flooded, the yard was under several feet of water and the house had a considerable amount water in the lower level. They sold the house this past fall. Also what about the families that lived here in the past? I know of many people I went to school with that would play in and around the bog when they were younger. The bog was a great place to ice skate years ago.

Thank you.

EPA Response (provided to Ms. Michelini on May 2, 2003): The study evaluated potential health concerns to adults and children using the river sediments and floodplain soils areas for recreational purposes. The floodplain includes low lying areas intermittently flooded by the river which may transport contaminants to the floodplain. Evaluation of these floodplain areas did not reveal any health concerns to children or adults. In addition, contact with surface waters coming from the river, which might occur during times of flooding, was also not of concern.

Only one of seven areas evaluated within the former cranberry bog indicated a health concern to children and adults who come in contact with sediments. This area was CB-03 which is located on the west side of the center of the cranberry bog. As a landmark, the center of the cranberry bog contains a recently constructed foot bridge. The exterior drainage channels to the west of the foot bridge is the area representing exposure station CB-03. This station is on the opposite side of the cranberry bog (west side) from your property and neighborhood. We will work with the town at posting signs by this area.

Near your property and the house at the corner of Washington and Washington Circle , we collected sediment samples along the edge of the bog in back of residential yards (e.g. station CB-01 and CB-02). These sediment samples exhibited relatively low levels of metals , such as arsenic. Neither of these areas were a health concern, nor is the residential use of these properties a health concern.

Comment provided by Mr. Hamilton H. Hackney, III, on April 29, 2003:

Angela - I have two questions concerning the draft risk assessment for the Aberjona that USEPA recently released:

1. When does the 60-day public comment period end?
2. The figures for the risk assessment are not available with the .pdf file online. Are they available electronically?

Thank you.

EPA Response (provided to Mr. Hackney on May 1, 2003): The report was publically released on April 28, 2003. The 60 day comment period will conclude on June 27, 2003.

The figures should be accessible through the internet web address provided in EPA Fact Sheet (www.epa.gov/region01/superfund/sites/wellsgh/42364_TOC_Text.pdf). If you have a telephone dial up modem, then it may take up to 5 minutes per figure to download. If you continue to have difficulty downloading the figures, please reply to this e-mail with a telephone number and EPA will have a technician contact you directly for assistance.

<u>Comment provided by Mr. James Graham on April 28, 2003</u>:

Angela,

Thanks for the recent information on the Aberjona River. Our home is located on Marilyn Ct., which is the third right off of Washington Street as you travel from Salem St. Woburn going south towards Winchester. Our culdesac backs up to the cranberry bogs and I would guess the Aberjona River is about 150 yards from our house (although the cranberry bog area seems fairly wet and I'm sure the river runs higher at different times).Going by the map you circulated, our house would be located about 150 yards east of the Aberjona River and perhaps slightly north of sample station CB-03.

My questions are, from your study, are there any indications of health risks for children (or adults) playing in the street, in the yards or,in general living in this area ? Also question # 2 : my wife would like to start a vegetable garden in our yard, is that okay or would there be any health risks associated with the consumption of vegetables grown here?

Thanks very much,
Jim Graham

EPA Response (provided to Mr. Graham on May 1, 2003): The study evaluated potential health concerns to adults and children using the river and floodplain areas for recreational purposes. The floodplain includes low lying areas intermittently flooded by the river which may transport contaminants to the floodplain. Evaluation of these floodplain areas did not reveal any health concerns to children or adults. Therefore, areas that do not flood and are

further removed from the river (upland areas) would not be a health concern. Typical residential use of these upland areas, including a vegetable garden, would not be of concern.

One area within the former cranberry bog did indicate a health concern to children and adults should contact with sediments along a drainage channel located at the west side of central portion of the cranberry bog occur. As a landmark, the center of the cranberry bog contains a recently constructed foot bridge. The exterior drainage channels to the west of the foot bridge is the area representing exposure station CB-03. This station is on the opposite side of the cranberry bog (west side) from your property. We will work with the town at posting signs by this area.