FINAL REPORT

Raytheon Company

Response to Public Comments Risk-Based Disposal Approval Application

Former Raytheon Facility
430 Boston Post Road
Wayland, Massachusetts

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John C. Drobinski, P.G., LSP
Principal-in-Charge

Rachel B. Leary
Project Engineer

Environmental Resources Management
399 Boylston Street, 6th Floor
Boston, Massachusetts 02116

CMG'S COMMENTS

I) ***2.1.4 SEPTEMBER 2001 – PHASE II – COMPREHENSIVE SITE ASSESSMENT - NATURE & EXTENT OF IMPACT TO WETLAND SURFACE WATER***

On page 11, the draft TSCA Application states that "copper in surface water and possibly sediment appear to be primarily related to background or 'local conditions' as defined in MA DEP guidance." The preceding text indicates the source of this condition is leaching of copper from town water supply lines due to low pH. As subsequently noted on page 25 of the draft TSCA Application, the Massachusetts Contingency Plan definition of background includes "… releases to groundwater from a public water supply system …" but does not include such releases to surface water or sediment. Furthermore, DEP provided relevant guidance on the topic of background in risk assessment in their Interim Final Policy WSC/ORS-95-141 "Guidance for Disposal Site Characterization – In Support of the Massachusetts Contingency Plan" (July 1995). This guidance provides only three cases where chemicals can be excluded from risk assessment:

- *When present at a low frequency of detection and in low concentration,*
- *When present at 'background' concentrations and there is no evidence that their presence is related to activities at the site, or*
- *The chemicals are field or laboratory contaminants.*

Therefore, it seems inappropriate to discount elevated copper concentrations in surface water and sediment from "future risk management decisions for the Site" based on DEP guidance, especially considering ERM cites elevated copper levels as one of the likely causative agents in the area of readily apparent harm (ARAH).

There appears to be some confusion regarding the difference between risk assessment and risk management. Risk assessment involves the quantification of potential risks to human health and/or the environment. Risk management refers to the process by which a variety of factors such as risk, feasibility, regulations, etc. are considered in developing remedial decisions to abate potential risks. Copper was considered in both the human health and ecological risk assessments. Copper appears to fall under the category of a local condition and was excluded from the risk management process because source of copper impact appears to be an ongoing release condition associated with the water distribution system and therefore could not be abated or controlled by the remedial action. It is also important to note that the distribution of copper in wetland

sediments is consistent with other metals requiring abatement. Therefore, copper will be remediated by default in the areas targeted for remediation.

II) 4.5 FEASIBILITY OF ABATEMENT TO BACKGROUND

Page 25 of the draft TSCA Application, ERM presents a table including 'average background' concentrations of Site contaminants of environmental concern. They state that the Phase II Comprehensive Site Assessment report provides "additional details regarding the calculation of Site background concentrations for wetland soil/sediment." However, Table 18 in the Phase II report indicates the calculated 'background' level for PCBs as 1.8 mg/Kg, while the table on page 25 of the draft TSCA Application indicates 0.88 mg/Kg. Furthermore, the Phase II report indicates ERM calculated PCB background using four sediment samples. CMG calculates background based on these four samples as either 1.12 or 1.08 mg/Kg (depending on whether one uses the method detection limit or half the method detection limit for sample location SS-2, where laboratory analysis did not identify any PCBs). In addition, in previous discussions Raytheon and ERM agreed not to use sample location GMS-7 (1.80 mg/Kg) because it exhibited significantly more PCB than the other samples used in background calculation. Calculating the PCB background without sample GMS-7 yields either 0.89 or 0.85 mg/Kg. Therefore, there is unclear how ERM arrived at 0.88 mg/kg as a background concentration for PCBs in the Site wetland.

ERM and Raytheon agreed to exclude sample location GMS-7 from background calculations in discussion with representatives of the PIP group following the submittal of the final Phase II report. Corrections to the Phase II report will be documented in an Addendum to the Phase II and III reports under a separate cover. ERM calculated the background concentration using sample locations SU-3 (1,100 ppb), SU-4 (1,310 ppb) and SS-2 (ND). One half the method detection limit (125 ppb) was used as the concentration for SS-2. The average of these three numbers is 887 ppb.

PCBs are completely anthropogenic, synthetic compounds that do not occur in nature. Therefore, any discussion of background levels must consider that the true 'background' level of PCBs is zero. It is more appropriate in the context of urban environments to describe PCB concentrations as 'widespread.'

Background, as defined in the MCP, does not constitute "pristine" conditions, but rather conditions that would exist in the absence of the disposal Site, but not necessarily adjacent to or in the vicinity of other disposal sites. Therefore, reference to upstream concentrations of PCBs in sediment as "background" is appropriate and technically consistent with the MCP.

DEP and EPA guidance require that one conduct statistical data quality analysis on the set of results used to establish background (or widespread) concentrations, including calculations of statistical power and confidence. Neither the Phase II report nor the draft TSCA Application includes these data statistics. It does not seem likely that three (or four) data points are enough to support risk management decisions for the Site with appropriate statistical power and confidence.

The Town of Wayland requests that Raytheon provide the data set used to determine widespread PCB concentrations (beyond Site boundaries); the results of statistical analysis on this data set, including calculated power and confidence values; and comparison of the calculated summary statistics to EPA or DEP published values. Given the relevance of the widespread average PCB concentration as a surrogate 'background' value, we believe it is important to back it up with rigorously defensible data.

The data set used to establish background was included in both the Phase II and TSCA reports. As indicated, background was established using available data from previous studies including those by US Fish & Wildlife Service, US EPA and ERM. The available data set consists of five data points (including one duplicate analysis), or four data points excluding GMS-7, a location that the PIP group had requested be removed from the analysis. ERM is not aware of any regulations (state or federal) that "require" measures of statistical power and or confidence in establishing background.

This response action is risk-based. Background is not used to determine the cleanup goals for the Site, therefore it is not appropriate to conduct a power analysis on that data set. To satisfy requirements of the MCP, the background levels are compared to clean up goals, but are not used in the determination of those goals. In addition the collection of additional background data would not be beneficial to remedial decision-making since regulations of the Massachusetts Wetlands Protection Act specifically prohibit implementation of remedial actions beyond the extent necessary to achieve a condition of "no significant risk." Since background levels are typically below risk-based cleanup criteria, further assessment of background would not affect the extent of cleanup necessary or allowable by law.

III) 4.6 ANALYSIS OF NET ENVIRONMENTAL BENEFITS FOR REMEDIAL SCENARIOS

4.6.3 Remedial Scenarios

At the May 3 PIP meeting, Raytheon told the public that they have considered several scenarios for PCB remediation in the Site wetlands area, not just the three presented for discussion (the ARAH only, the 'expanded ARAH,' and the area needed to achieve background). However, page 26 of the draft TSCA Application enumerates only these three scenarios. The same three scenarios appear on page 29 and elsewhere in the draft TSCA Application. Since these three scenarios are the only ones carried through the Net Environmental Benefits Analysis (NEBA; see Section 4.6 and Appendix A), it appears to be circular logic to defend the portion of the site defined as "the area proposed for remediation" as the best choice based on NEBA.

Wayland requests that Raytheon and ERM consider other scenarios, such as removing sediment at all areas that exhibit greater than widespread 'background' concentrations (whatever we finally determine that value to be), 2, 4, or 6, ppm total PCBs, and run these scenarios through the NEBA process. It may be that one of these incremental scenarios would produce a greater net environmental benefit than the remediation of the 'area proposed for remediation' would. If you have already conducted a NEBA for these (or similar) scenarios, the Town requests that you document this in the TSCA Application.

This comment requests documentation of additional NEBA scenarios used by Raytheon in determining that removal of the "Area Targeted for Remediation", and no more, will provide maximal environmental benefits for the site. Wayland is correct in its comment that if only the three NEBA scenarios were analyzed, it cannot be concluded that Scenario 2 optimizes environmental benefits from the site. This response outlines the additional NEBA investigations undertaken by Raytheon, and the basis for the conclusion that Scenario 2 optimizes environmental services from the site.

It should be kept in mind that the NEBA proceeded first with identification of areas for remediation based on net benefits of remediation of metals (copper and chromium) due to potential effects on wetland plants. Of course, if the NEBA identified that a target area should be removed for reasons of metals, any PCBs in that area would be removed as well. After consideration of metals, the NEBA then assessed additional remedial scenarios directed to PCBs.

Based on analysis of metals and impacts on plant services, the NEBA determined that remedial Scenarios 1 and 2 would provide positive net

environmental benefits. In addition to these scenarios, ENTRIX examined a scenario involving areas of the wetland with a wetland plant hazard quotient (HQ) for copper plus the HQ for chromium greater than five. This new scenario (henceforth Scenario 2-A) corresponds to Zone 3 in the NEBA sampling plan (see Figure 5 in Appendix A). Scenario 2-A will be added to the NEBA in the TSCA submission. HQs are calculated by comparing metal concentration levels at the site to a toxicity reference value (TRV). It should be noted that in computing the HQs for the additional NEBA scenario, the TRV was given by literature values for effects. As noted in the Phase II Ecological Risk Characterization (ERC), these literature values do not incorporate the influences of aging of metals and organic content of wetland soils in reducing the exposure and hence toxic impacts of metals through reduced bioavailability of these contaminants at the site. For this reason, the ERC also employed a field-based TRVs equal to the 95% lower confidence limit for metal concentrations in the area of stunted growth. These TRVs were given high weight in the weight of evidence analysis. Based on these field-based TRVs, the individual metal HQs for Scenario 2-A range up to about 0.6, with most sample points in this target area well below this value. Thus, while the NEBA scenario is based on HQs greater than 1, the more applicable field-based HQs are well below 1. In the final NEBA, for convenience, Scenario 2-A will be labeled Scenario 3.

The NEBA analysis was directed to "target areas" defined by the remedial scenario under investigation. Wetland plant services were measured by the target area's annual productivity. This was computed as the average reed free productivity (RFP) for the target area. As discussed in the NEBA, Zones 4 and 5 were judged to have a RFP that is representative of baseline conditions. The average RFP level in Zones 4 and 5 is 560 (g/m^2). The average RFP level in the Scenario 2-A target area is 476. This is 85% of baseline productivity. The NEBA analysis applied to Scenario 2-A shows net environmental benefits associated with remediation of this area equal to minus 3.8 DSAYs per acre. Thus, Scenario 2-A results in negative net environmental benefits. The magnitude of net loss of services is approximately equal to the complete destruction of 1/2 acre of fully-functioning natural wetland. This result is shown in the table on page 14.

To further examine the possibility that other scenarios could generate positive environmental benefits, ENTRIX undertook the following analysis. First, we solved for the threshold level of current services where, if current services are suppressed below this level by contaminants, then positive net environmental benefits are generated by remediation. This threshold value is 78% of baseline services. Thus, if current services are below 78%, then remediation generates positive net environmental benefits, while if current services are above 78%, then remediation results

in negative net environmental benefits. Next, we searched for sample points that met three criteria:

(1) The sample point is outside of the area targeted for remediation;

(2) RFP at the sample point is below 78% of the 95% upper confidence limit for RFP in the reference area (Zones 4 and 5); and

(3) HQ for either copper or chromium above 1, using as a TRV the weighted average of literature values (weight = 1/3) and site-specific field TRVs (weight = 2/3) from the ERC.

No sample points met these criteria. Therefore, it was concluded that remediation of the target areas in NEBA Scenarios 1 and 2 generate positive net environmental benefits, and that any expansion of the area targeted for remediation beyond these target areas would only result in a net environmental loss.

The above analyses were directed to metals. Wayland also questioned the use of only three scenarios in the NEBA when examining remediation of PCBs. Wayland requested that additional remediation scenarios be analyzed using NEBA, such as removing sediment at all areas that exhibit greater than widespread 'background' concentrations, such as 4 or 6 ppm total PCBs.

Additional scenarios were not originally considered as part of the NEBA based on the results of Scenario 3. In Scenario 3 (to be labeled Scenario 5 in the final NEBA) we analyzed an area which is outside the area targeted for remediation and which has average PCB concentrations above 2.0 ppm. This area was approximately 3.46 acres in extent (i.e. 3.46 acres larger than the area targeted for remediation). To conduct the NEBA we compared current service levels under a natural attenuation decision, to the threshold service level of 78%. To identify potential suppression of current services by PCBs, ENTRIX used results of the ERC. The ERC demonstrated that, outside the ARAH, there was no risk to any receptor from PCBs. The services considered in this analysis include and plant services, wildlife abundance and diversity, and food web services. The ERC demonstrated that concentrations of PCBs sufficient to cause reduced plant growth do not appear outside of the ARAH. Hence, there is no suppression of current plant services due to PCBs in the target area of scenario 3. Regarding food services. PCBs can pose a risk to animals via the food web. The ERC considered an exposure of a variety of avian and mammalian receptors to PCBs, and concluded that PCB concentrations outside of the ARAH do not pose a risk of either acute or chronic effects to these receptors. Thus, the ERC demonstrated that key services associated

with wildlife abundance and diversity and food services of the wetland community are not currently impaired. Thus, there is no loss of services due to PCBs in this area.

Given this risk-based finding from the ERC, the NEBA concluded that removal of additional locations of PCBs does not increase ecological services and provides no environmental benefit. Therefore, the NEBA concluded that active remediation of any additional scenarios for PCBs only results in environmental harm via physical disruption of current services as the existing wetland plants and soil communities are removed.

IV) 4.6.4 IMPLEMENTATION OF NEBA APPROACH

On page 30, the draft TSCA Application states that "staging and access costs are associated only with Scenario 1." At face value, this seems to indicate that ERM did not consider removal of wetland soils under Scenarios 2 and 3 would also involve 'staging and access costs.' Section 5.3.3 of Appendix A states that "staging and access areas do not apply to Scenarios 2 and 3, because scenarios are analyzed on an incremental basis, and no staging or additional access is needed once the first scenario is included." However, it would appear that Scenario 2, which comprises 1.53 total acres, would involve about 2½ times as much staging effort as Scenario 1 (0.60 acres), and Scenario 3 (5.20 acres total) would involve almost 9 times as much. Therefore, it seems evident that Scenarios 2 and 3 must necessarily involve greater staging costs, even if no greater access costs. Wayland requests that Raytheon either explain why you have not considered these incremental environmental costs for Scenarios 2 and 3, or revise your NEBA calculations to reflect consideration of these costs.

Wayland requested a further explanation of the ecological service losses associated with staging costs and suggested that incremental service losses for staging and access be considered in Scenarios 2 and 3 of the NEBA.

We thank Wayland for their comments on this issue and have revised the NEBA estimates to include incremental environmental staging and access losses across the NEBA scenarios. We continue to use a fixed access service loss for roadways and access to the wetland from the upland area. However, in response to Wayland's comments, we add incremental service losses of two kinds. First, we increase the staging losses associated with the volume of soils removed. Second, we consider the negative environmental effects of gaining access to isolated removal points in the wetland.

As shown in Figure 17 of the draft TSCA application, the staging area is comprised of two separate areas – the contaminated staging area and the

clean staging area. The staging area required under each scenario will vary according to the amount of material that is to be removed from the site under each remedial scenario. The estimated size of the contaminated staging area is based upon loading the contaminated soils into rectangular-shaped piles to facilitate heavy equipment access and installation of a containment trench. The estimated size of the clean staging area is based upon calculations of the size of a cone-shaped soil pile that is required to replace the contaminated soil under each scenario.

We have therefore revised the calculation for the initial net environmental benefits of remediation under each scenario to include the associated staging service losses incurred under each remediation scenario. These costs are included in the table on page 14, in response to question IX.

Regarding service losses due to access, we have also revised our NEBA estimates to include the losses incurred from destroying habitat in accessing isolated sample locations on the Site. We assume a ten-foot wide access path, with zero ecological services during the remediation period and a one-year recovery following remediation. We also add a twenty-five foot disturbance zone around the access paths with a 25% loss of services in this zone. Again, these service losses have been included in the revised NEBA estimates shown in the table on page 14.

V) ***4.6.5 SERVICES UNDER NATURAL ATTENUATION***

PCBs

On page 31, the draft TSCA Application states that "potential PCB effects are examined only in the area outside of the ARAH. Thus, net environmental benefits from remediation of PCBs only are examined in Scenario 3." However, Scenario 2 involves remediation of 0.93 acres outside of the ARAH. The Town requests that Raytheon explain why you have not considered 'service suppression' for Scenario 2.

Wayland questions why no service suppression is considered for PCBs in Scenario 2. Wayland correctly notes that an area is included in Scenario 2 that lies outside of the ARAH (sample points T-7-A through 4 plus T-10-2 through 4). Wayland incorrectly states that this represents 0.93 acres. The 0.93 acres is the full area of Scenario 2, which includes the expanded area of ARAH and the area to be removed by risk management decisions (Figure 9). The area of Scenario 2 outside of the ARAH and the expanded ARAH is approximately 0.1 acres.

As discussed above in the NEBA, the amount of service suppression from PCBs is derived from the ERC. The ERC determined that the site-wide

mean concentration of PCBs outside of the ARAH is below values that would cause risk of environmental harm at the Site. Thus, there is no service suppression from PCBs in areas outside of the ARAH. Therefore, the 0.1 acre area targeted for remediation that falls outside of the ARAH and the expanded ARAH, if considered alone in the NEBA, would have negative net environmental benefits from remediation. The NEBA has been corrected to include this negative effect.

Regarding metals, ENTRIX did not include in the NEBA any suppression of plant services from metals in the 0.1 acre area outside of the ARAH and the expanded ARAH. Further examination of this issue reveals that the metal concentrations in this area are very similar to those in Zone 3, and well below those in Zone 2. As discussed above for Scenario 2, there is a net environmental loss of remediation of the target area in Zone 3. Inclusion of a net environmental loss from remediation of the 0.1 acre area outside of the ARAH and expanded ARAH would slightly reduce the estimated net environmental benefits of removal of the area targeted for remediation.

VI) METALS

*On page 32, the draft TSCA Application states that "the Shannon-Weiner diversity index is lower for Zone 1 than for the other zones." However, the tabulated values (**Diversity Measures by Zone**) are all negative numbers. Therefore, the values for Zone 1, which are smaller in magnitude than those of Zones 2 through 4, are higher than the other ones, not lower. (Note: Table 4-3 in Appendix A presents essentially the same values, except the latter table has positive values, and truncates these values at two decimal places. These two tables cannot both be correct.) Wayland requests that you provide a correction.*

Wayland correctly pointed out an inconsistency in the sign of the Shannon-Weiner diversity index in two tables in the NEBA appendix. These will be corrected in a revised document.

VII)

The draft TSCA Application describes five field sampling zones in the Site wetlands. However, the only figure illustrating the locations of these five zones is Figure 5 on page 4-2 of Appendix A. The Town requests that Raytheon have ERM specifically reference Appendix A, Figure 5 in the text of Section 4.6.5, or else prepare a separate ERM Figure illustrating the five sampling zones (and refer to this figure in the aforementioned text).

ERM will edit the text in Section 4.6.5 to reference Figure 5 in Appendix A.

VIII) 4.6.6 RESULTS

The NEBA results in Section 4.6.6 (and Appendix A) rely on a conclusion that remediation of wetland areas outside of the expanded ARAH produces zero environmental benefit. It seems evident that of the 11 'wetland services' that Entrix considered in NEBA (see Section 2.1 of Appendix A), at least four would stand to benefit from further reduction of widespread PCB (or metals) concentrations: sediment/toxicant retention, production export, wildlife diversity/abundance, and recreation. (Note: Entrix states in Section 2.2.2 of Appendix A that "In this NEBA, no loss in wetland services was calculated for PCB effects within the area targeted for remediation under the Phase III for the Site. That is, all analyses for this area are based on metals.")

Wayland requests that Raytheon fully consider the negative effects of residual PCBs and metals remaining at the Site under all remediation scenarios in the NEBA for the Site, and conversely the net environmental benefit to be gained by mitigating such residual PCB and/or metals concentrations. We request that you provide documentation for NEBA of additional, incremental excavation scenarios, because this seems to us the best way to determine what size the appropriate area to remediate should be.

Wayland stated that 4 of the 11 wetland services would stand to benefit from further reduction in widespread PCB and/or metal concentrations. These services are sediment/toxicant retention, production export, wildlife diversity/abundance, and recreation. Wayland requested that we consider potential effects of contaminants on these services.

The NEBA included any services that are directly related to plant productivity. To a large extent, sediment retention will be related to stem density and aboveground biomass, and production export will be related to plant productivity. Much of the incoming toxicant load to the wetland from the River will be retained via sediment retention. Thus, the NEBA implicitly considered these effects.

We agree with Wayland that some amount of toxicant retention capacity may be reduced by residual concentrations of metals and PCBs. However, in a dynamic system with sediment deposition and annual addition of organic material, toxicant retention capacity is continually added. Thus, this potential negative service loss is judged to be extremely small and will be offset by increase in detrital matter over time. The NEBA considered this process of service recovery in its specification of service gains over time under a natural attenuation decision.

Wildlife effects were considered in the NEBA when existing services were specified using the results of the ERC. Outside of the ARAH, no risks of effects on avian or mammalian receptors were identified. Based on this conclusion of the ERC, we have no reason to believe that residual concentrations of contaminants in the wetland will reduce future abundance or diversity of wildlife.

The NEBA did not consider recreation services of the wetland. According to the planned remedial action for the Site, the Site will be under use restrictions. No recreational use of the Site is anticipated. Since aesthetic attributes of the wetland area are not currently suppressed, the primary potential negative effect on recreation services will occur during the period of active remediation.

IX) 4.7 SELECTION OF REMEDIAL ACTION OBJECTIVES

The Town agrees with the "additional locations targeted for removal" listed on page 34 of the draft TSCA Application, where measured total PCB concentrations range from 4.70 ppm (or only 1.89 ppm if you count the 12-18" sample from T-7-A) to 61 ppm. Nevertheless, it is a consistent source of puzzlement why Raytheon has not considered extending the remediation area to encompass other sample locations that exhibit total PCBs within this concentration range, namely T-8-1 (4.80 ppm), T-10-9 (8.46 ppm), T-10-12 (6.46 ppm), T-12-8 (6.56 ppm), T-14-C (5.70 ppm), and T-15-2 (5.12 ppm).

*At the October 3 PIP meeting, Raytheon stated that you have considered other remediation areas intermediate in size between Scenario 2 and Scenario 3. However, there is no documentation of these intermediate scenarios in the draft TSCA Application. As indicated under comment **VIII**, the Town requests that you provide documentation for NEBA of additional, incremental excavation scenarios.*

Wayland requests that Raytheon consider extending the remediation area to encompass other sample locations that exhibit total PCB concentrations above 4.70 ppm.

We have analyzed an additional scenario (Scenario 2-B) to consider the net environmental benefits of removal of the area targeted for remediation plus all additional sample locations with PCB concentrations above 4.70 ppm.

The table below shows the NEBA estimates for all the scenarios including a breakdown of staging, access and disturbance zone costs associated with each.

Environmental Benefits and Costs of Removal (DSAYs)						
Scenario	**Description**	**Benefits**	**Removal Costs**	**Staging & Access**	**Environmental Total Costs**	**Environmental Net Benefits**
1	Stunted Growth	7.95	0.05	3.22	3.27	4.68
2	Area To Be Remediated	10.36	0.01	0.67	0.68	9.69
2-A	HQs > 5	2.02	0.06	5.79	5.84	-3.82
2-B	Area with PCBs ≥ 4.7	0	0.01	1.33	1.34	-1.34
3	Area with PCBs ≥ 2.0	0	0.01	19.26	19.27	-19.27

Note – Summing errors exist due to rounding

The scenarios specify target areas that are incremental. Thus, Scenario 2 considers the additional area, beyond the area of stunted growth, incorporated in the Area Targeted for Remediation. Scenarios 2-A, 2-B and 3 are all incremental to the Area Targeted for Remediation.

The results show that active remediation of the area of stunted growth in Scenario I result in a present value of benefits equal to 7.95 DSAYs. The present value of the environmental costs are 3.27 DSAYs. Therefore, remediation of the target area in Scenario 1 generates a net environmental benefit of 4.68 DSAYs. Further, remediation of the target area in Scenario 2 also generates positive net environmental benefits. Combined, the NEBA results show that, active remediation of the Area Targeted for Remediation generates net environmental benefits equal to 14.4 DSAYs, equivalent to creation of about 2 acres of new wetlands. Remediation of the area outlined in Scenario 2-A results in net environmental benefits of minus 3.82 DSAYs.

Additional remediation to remove locations with PCB concentrations above 2.0 ppm or 4.7 ppm results in net environmental losses. The target areas for Scenarios 2-B and 3 are comprised of areas in Zones 3, 4, and 5. In these zones, no effect of metals on plant productivity is seen. Moreover, the ERC demonstrated no risk of food service reductions outside of Zones 1 and 2. These considerations imply no loss of services in this area. Therefore, there are no environmental benefits to be gained from remediation of these areas. The net environmental benefits from

remediation of the target areas under Scenario 2-B and 3 are minus 1.34 DSAYs and minus 19.27 DSAYs respectively.

Again, for convenience, in the final NEBA, the five scenarios presented and discussed above will be labeled Scenarios 1 through 5. For instance, Scenario 2-A will be labeled Scenario 3, Scenario 2-B will be labeled Scenario 4 etc.

X) ***6.5 VERIFICATION SAMPLING PLAN/CLOSURE DOCUMENTATION***

6.5.2 Sample Locations, Depths and Frequency

Page 52 of the draft TSCA Application indicates Raytheon/ERM intends to collect all post-excavation soil/sediment grab samples from a depth of 7.5 cm (approximately 3 inches). Since the remediation plan calls for removal of the 18 inches above this, it seems more reasonable to collect confirmatory samples from the (newly-exposed) soil or sediment surface. Collecting samples from three inches deeper is well-suited to answering whether remediation should extend to 21 inches, but will not necessarily verify that remediation was successful at 18 inches. Wayland requests that you amend the remediation plan to collect soil/sediment grab samples from the exposed surface (0 to 1 inch below grade) following excavation.

The verification sampling plan was prepared in accordance with 40 CFR 761 Subpart O. 40 CFR 761.286 specifies that samples should be collected using "a core sampler having a diameter ≥2 cm and ≤ 3 cm to maximum depth of 7.5 cm."

XI)

The proposed remediation plan does not include any sidewall sampling at grid cells that abut the excavation perimeter. The Town requests that you amend the plan to include sidewall samples where appropriate. (Note: the draft TSCA Application mentions 'perimeter' samples in Section 6.5.4, but Section 6.5.2 does not explain where ERM would collect these, and Section 6.5.3 does not explain how.) The final sampling plan must include information regarding the frequency, location, and depth of sample collection for sidewall samples. It must also provide contingencies for expanding the remediation area if these sidewall samples do not meet target cleanup goal criteria (e.g., less than 210 mg/Kg total lead). At the October 3 PIP meeting and previously, Raytheon assured the public that you would expand the area of remediation as necessary to meet target cleanup goals. The Town believes that this is the appropriate place to provide a written commitment to document these assurances.

Perimeter sampling around the area targeted for remediation will be used to ensure that, after removal of soils and replacement by clean fill, clean up goals are met. These clean up goals are stated on page 34 of the draft TSCA application.

Sampling will be performed at 10 pre-determined locations on the perimeter of the remediation area. Contamination concentrations in the perimeter samples will then be included in the calculation of average residual contaminant concentrations along with existing data from outside the area remediated and data for sample locations within the area remediated.

PCBs

Clean fill soil will be placed into the area remediated. PCB concentrations of the samples in the fill area will be set to a value of ½ the method detection limit for PCBs. As a proxy for this value, the lowest detection limit for the historical samples was used, which equals 0.184 ppm. Based on this approach, sample locations in the area of clean fill were set to 0.092 (1/2 the detection limit) to reflect the replacement of contaminated soil with clean soil.

Two criteria will be used to determine if additional removal of sediments is necessary to meet clean-up goals. First, perimeter sample points in excess of 50 ppm total PCBs will be evaluated for additional action. Such sample points would have been included in the ARAH according to its definition in the ERC. Second, if the average remaining contaminant concentrations exceed the target clean-up goals, further remedial action will be evaluated.

We have computed the maximum allowable mean concentration in the 10 perimeter samples such that clean-up goals would be achieved. Using the arithmetic mean of sample points, the 10 perimeter samples must have a mean PCB concentration of less than 20.0 ppm to meet target cleanup goals.

Metals

A similar analysis was conducted for metals (copper and chromium). To meet clean up goals, the 10 perimeter samples must have average copper concentrations less than 2,824 ppm, and average chromium concentrations less than 2,534 ppm.

XII)

The sampling plan calls for compositing nine grab samples from each cell and submitting the composite samples for PCB analysis. While this will substantially reduce the number of individual analyses, it also means that one grab of the nine could approach 18 ppm (if the other eight were below detection limits) and yet you could deem that cell 'remediated' based on the target cleanup goal of 2 ppm. To avoid this situation, one must calculate an allowable threshold based on statistical analysis of data accuracy and precision, below which you will need to analyze individual grab components of the composite sample to determine which (if any) exceed the target cleanup goal. Our preliminary evaluation of this issue suggests that the 'individual analyses indicated' threshold would be close to 1 mg/Kg, which is close to the 'background' (widespread) concentration and not far above the analytical method detection limit. Wayland requests that Raytheon explain how you will avoid this situation (including the statistical analysis you will use), or why you believe it is not significant.

There are approximately 165 grids to be sampled in the targeted remedial area. Each grid is 20' by 20'. There are nine sample locations within each grid that are composited to determine the average concentration of that 400 square foot area. A total of approximately 165 samples will be used to determine the average residual concentration of the targeted remedial area. This is a significant number of samples to determine if a 1.6 acre area has met its cleanup goal. If individual locations were sampled the number of analysis would approach 1,500, which is not appropriate.

The cleanup goal of this remedial action is not to reach background. In fact, the Wetlands Protection Act (310 CMR 10.53) prohibits implementation of a remedial design to "reduce contamination to a level lower than what is required to achieve a condition of no significant risk." This is a risk-based disposal plan and potential risk is calculated using average concentrations over space and time for wetland soil/sediment. Therefore ERM believes that this sampling approach is appropriate for this Site.

XIII) FIGURES

Figure 9 of the draft TSCA Application has several errors in the depicted PCB concentrations. Sample T-8-3 should be 5.80 mg/Kg, not "ND"; T-8-6 should be 4.01, not 4.1 mg/Kg; and T-8-7 should be 4.42, not 4.5. The total PCB concentrations for T-8-A (3.72 mg/Kg), T-8-1 (4.80), T-8-5 (0.97), and T-12-8 (6.56) are omitted. In addition, the values for T-8-7 and T-8-12 should be centered below the sample locations (as are all other PCB results). For consistency, ERM should delete the PCB concentration values beneath T-5-10 and T-7-11. The

*legend box on Figure 9 indicates total PCB 'background' concentrations are 1.1 mg/Kg average and 1.8 mg/Kg maximum; see comments numbered **II** and **XVI** for additional commentary on this issue. The Town requests that you provide a correction.*

PCB values at sample locations T-8-3, T-8-6, T-8-7 in Figure 9 will be corrected as indicated above. The purpose of this figure was not to present all PCB concentrations outside of the ARAH, but to provide as many PCB concentrations at sampling locations that would fit within the space constraints of the figure. At Wayland's request, the figure will be modified to present only concentrations of PCBs outside of the ARAH.

XIV)

Figures 10 through 14 of the draft TSCA Application each indicate "Total PCB Concentrations" in the Legend box (lower left), although these figures illustrate "Total EPH in Sediment," "Trivalent Chromium in Sediment," "Total Copper in Sediment," "Total Lead in Sediment," and "Areas Targeted for Abatement of OHM in Wetlands Soil/Sediment," respectively. For consistency, ERM should delete the total copper concentration values beneath T-5-10 and T-7-11 on Figure 12, and the total lead value beneath T-5-10 on Figure 13. Wayland requests that you provide a correction.

The legend in Figures 10 through 14 will be corrected as appropriate. As stated in the response to comment, Figure 12 and 13 will be modified per Wayland's request.

XV) APPENDIX A, NET ENVIRONMENTAL BENEFIT ANALYSIS

2.0 HABITATS AND SERVICES AT THE WAYLAND SITE

2.2 Risk Assessments and Service Indicators

2.2.1 Metals and Plant Productivity

Page 2-2 of this appendix ends abruptly with the words "This diversity measure etc" and the following page does not continue this topic. It appears that Entrix or ERM has not yet completed this section. Please forward the remainder of Section 2.2.1 to the Town for review.

In addition to biomass, it is possible that the presence of COPECs has changed species composition and species diversity, a valued attribute of plant

communities. We use the Shannon-Wiener diversity index to investigate this possibility.

This section was inadvertently cut off. This section has now been included in the revised TSCA document and is discussed below.

The Shannon-Wiener index is a function of the number of species present and their relative frequencies at a sample location. The index was developed to measure information, based on the in the ability to predict the species encountered at the location. If you are unlikely to successfully predict the next species encountered, then the area is thought to have high diversity, and, conversely, if you are very likely to successfully predict the next species encountered, then the area is judged to have low diversity.

The diversity index is expressed mathematically as

$$H = \frac{n \log n - \sum_{i=1}^{k} f_i \log f_i}{n},$$

where H is the index of diversity, n is the sample size (number of plants in the sample quadrant), k is the number of different species represented, and f_i is the number of plants of species i. Given this equation, for a given total sample n, as the number of species (k) increase, the index increases; indicating a higher level of diversity. As well, for any given number of species, as the ratio f_i/f_j approaches 1 for all species categories, so that the plants are spread evenly across the species rather than clumped into relatively few species, the index approaches its maximum value (equal to log k). In contrast, if all the plants are of the same species, then the diversity index equals zero.

XVI) 3.0 REMEDIAL SCENARIOS

Page 3-1 in Appendix A states that "Remediation of all locations with concentrations above 2 ppm will result in a residual average PCB concentration equal to background levels of 1.1 ppm of PCBs." How did Entrix arrive at this value? Is it area-weighted? Does this presume remediation will result in a restored area with an average PCB concentration of 2 ppm, or that remediation will remove PCBs to below detection limits? Wayland requests that you document your calculations to support Entrix's conclusion. Comment ***II*** *above also provides pertinent information on the topic of background (widespread) PCB concentrations, which has been a subject of extensive previous commentary and discussion.*

The residual concentrations of PCBs were calculated as follows. An (non-area weighted) arithmetic mean of concentrations at all sample locations was calculated. For all locations outside of the Area Targeted for Remediation, either the actual PCB total concentration was used, or for non-detects, ½ the method detection limit for that sample was used.

Clean fill soil will be placed into the area remediated. PCB concentrations of the samples in the fill area were set to a value of ½ the method detection limit for PCBs. As a proxy for this value, the lowest detection limit for the historical samples was used, which equals 0.184 ppm. Based on this approach, sample locations in the area of clean fill were set to 0.092 ppm (1/2 the detection limit) to reflect the replacement of contaminated soil with clean soil.

Based on this approach, the residual average concentration after removal of Scenario 3 total PCBs is 0.20 ppm, well below the "background" concentration of 0.88 ppm. This is a change from the original calculation of 1.1 ppm due to an error in the treatment of detection limits for total PCBs in the original calculation, which incorrectly summed the detection limit for individual congener-specific analyses.