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Review of Treated Wood Documents by Stratus Corp.

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Review of *Treated Wood in Aquatic Environments: Technical Review and Use Recommendations* from Stratus Corp. Prepared for Joe Dillon, NOAA Fisheries. 2005

Executive Summary

This report has a very brief inadequate section that covers environmental fate and effects of the metals released from treated wood. By omitting a number of important peer-reviewed papers and taking at face value a large number of unrefereed reports from the wood treatment industry that tend to minimize and gloss over the risks, this report overall probably underestimates the risks posed by treated wood in the aquatic environment. However, it does include important information about best management practices and alternative materials that could be used, and does take a generally precautionary approach to protecting salmonids.

Background

I have read this report, and my findings and evaluation follow.

Findings

The Stratus reviewer has included a lot of papers, but has also omitted a number of important references – why this has been done is unclear. The report seems to have left out many peer-reviewed journal publications and included a large amount of "gray literature" reports. For example, a number of papers from the Weis group are omitted, and the many excellent papers of the Solo-Gabriele and Townsend group (some journal articles, some reports) dealing with leaching, and others are not included. I have included many of these references at the end of this evaluation. The report has 45 pages of appendices, including acute toxicity values of Cu, Cr, and As to all sorts of aquatic animals. It must have been time consuming to compile all this information that is probably not germane to the topic, since treated wood is not likely to cause mortality. They would have seen greater benefit from focusing on a better, more thorough, literature review.

I do not understand what kind of a literature search would come up with all this gray literature and leave out so many peer-reviewed journal articles. The consulting agreement says "The use of an independent firm was determined to be the best way to initiate and complete a <u>thorough review</u> of the <u>best available science</u>" (emphasis mine). This review does not meet that standard. Peer reviewed papers are the "gold standard" of scientific publishing, and good research should be submitted to scientific journals. Furthermore, with the exception of the chapter on models, the Stratus reviewer seems to have taken all the papers at face value, and has not read them all critically. The review does not distinguish between the value of peer-reviewed publications and "gray literature" reports from consultants to the wood preserving industry.

The report does include 11 citations by K. Brooks, who works for the wood preservers, of which only one was in a refereed journal. There are also several "personal communications" from Brooks. There do not seem to have been any personal communications with the investigators whose peer-reviewed publications have been omitted. I have not read all of Brooks' reports in detail, but one that I have read in detail was Brooks (2000) in the document from the Forest Products Laboratory studying the impact of preservative-treated wood in a wetland boardwalk. He concluded that leachates from wooden walkways increase the metal levels in sediments nearby, but do not affect the benthic community. Since Weis & Weis (1994, 1998) found clear effects on estuarine benthic communities near CCA-treated bulkheads, this finding of no effect of a "worst case scenario" on the benthic community was of considerable interest. When one reads the methods section of this report, one finds that the samples taken for infaunal community analysis were not replicated. Replication is essential for any good scientific study. In Brooks' study, replicates were taken for the invertebrates that settled on artificial substrates, but not for the Petite Ponar grab samples for infauna (although replicates were taken during the baseline survey prior to construction of the boardwalk). Although he found differences in abundance and diversity of organisms near and far from the treated wood, differences were not statistically significant. For example, at the AZCA site, taxa richness and diversity indices all drop immediately downstream of the site, but are not significant. For the CCA site, 16 species were found 1 m from the wood, while 46 species (3 times as many) were found 3 m away, but the difference was not considered significant. Similarly, for the sampling of invertebrates associated with vegetation, there were no replicates taken. Organisms in the vegetation at 0.5 m from the ACZA site are heavily dominated by one opportunistic species, *Limnodrilus* (a sign of stress), while at 2.0 m there is much greater evenness, reflecting a healthier environment. These differences are not considered significant. Biological samples tend to vary, and properly done benthic infaunal community studies generally take a minimum of 3-5 replicate samples. The fewer samples one takes, the less work one has to do and the less the chances of finding statistically significant differences. If there are no replicates taken, "statistically significant" differences are not likely to be found. If someone had the goal of finding "no significant differences" a good way to do it would be to not take replicate samples! This type of science would probably never have gotten through the peer review system of scientific journals. It is also interesting that there appears to be bias even in the formulation of a hypothesis for this study of a "worst case" scenario. Despite the fact that there was new wood and a poorly flushed system, Brooks hypothesized that "there would be no statistically significant changes in the benthic and epibenthic invertebrate community associated with the construction of wetland boardwalks…" This would be expected to be the <u>null</u> hypothesis for an unbiased researcher. The author of the Stratus review does not seem to have read this report critically and seen its major flaws, but takes its conclusions at face value, saying "no significant changes in invertebrate communities were reported." It is possible that careful critical review of other papers from this author would reveal other flaws.

In contrast, peer-reviewed studies of benthic communities at a number of different estuaries on the Atlantic coast found major (statistically significant) reductions in diversity in communities adjacent to and out for a few meters from treated wood bulkheads of various ages in both well-flushed and poorly flushed environments (Weis and Weis 1998).

The review devotes three pages and includes a table from the Forest Products Laboratory 2000 (Lebow et al. 2000) report on the chemical accumulation under a wetland boardwalk. However, it does not mention a comparable peer-reviewed publication (Weis and Weis 2002) dealing with contamination of salt marsh sediments and biota from CCA boardwalks. In that study, sediments and marsh plants from directly underneath and out from walkways that were new (three years old) and older (15 years old) were analyzed for the three metals. Dispersal was greater in the low marsh than the high marsh (due to tidal effects) and accumulation of the metals was also greater in the low marsh. While levels right below the boardwalk were greater under the new walkway, contaminants had spread out over a greater area from the older walkway. On the Pacific Coast, marsh plants provide juvenile salmon places to forage and hide, and the detritus-based food web provides them with abundant prey. They could be considered essential fish habitat for the juveniles. Meyer et al. (1981) and Weitkamp and Campbell (1980) found that juvenile salmon showed preferences for marsh-associated copepods, chironomids, and amphipods in a number of Puget Sound estuaries. Therefore salt marshes and their potential contamination with metals from treated wood should have been of interest in this review. Since juvenile salmon associate with salt marshes and would be expected to associate more with the low marsh than the high marsh, it is surprising that this relevant paper is omitted from the report.

I am unable to evaluate the leaching models, but assume that since Brooks' model passed peer review for the journal "Estuaries" it is reasonable and sound. The Stratus reviewers analyze the strengths and weaknesses of the model. Models need to incorporate estuarine conditions as well as riverine conditions into them; flow rates and directions change and reverse during the tidal cycle in an estuary. I agree that it is likely that the environmental conditions in the field will probably in most cases produce greater leaching than observed in laboratory studies.

In discussing laboratory and field studies, the report repeatedly uses the word "potential" with regard to impacts or adverse effects, when many of these have been clearly demonstrated. On page 4-11 the report says that biological effects appear to become attenuated within several months of construction. This is repeated in first paragraph of the conclusions on page 7-1. While this is the case for leaching and water levels of the metals, this is not the case for bioaccumulation as seen in a number of papers (e.g. Weis and Weis, 1992; Weis et al 1993). The report doesn't appear to appreciate the fact that, although leaching decreases with time and the water concentrations of the metals will decrease with time, this does not apply to metal levels in the sediments or bioaccumulation in the benthic and epifaunal animals, and the potential effects on the benthos. Clear, statistically significant, effects were seen in decreased diversity and abundance of estuarine benthos in many sites near treated wood bulkheads that had been in place for many years (Weis & Weis 1994, 1998). In the discussion of the 1998 paper, he says "effects were negligible by >1 m from the structures." While this was true for some of the sites, other sites showed effects out to 3 or even 10 m. Effects were seen both at sites with low water movement and sites with much faster water movement.

The section on toxicity of the chemicals is quite cursory and brief, and omits many important papers on sublethal effects of low levels of the three metals to aquatic biota. Effects generally are seen at the low *u*g/l level. It does do a good job on the avoidance response of salmonids to Cu, however, this is the only sublethal effect that is considered in any detail. The section does not consider Cu toxicity to algae and gastropods, both of which are particularly sensitive taxa (Cu can be used as an algicide and molluscicide) and important members of aquatic communities. The report has omitted a number of papers demonstrating additional aspects of leaching and the toxicity of CCA wood leachates. In fresh water subject to simulated acid rain, Warner and Solomon (1990) found that the leaching rate was accelerated. The copper leached was far in excess of the lethal level for *Daphnia magna*. Buchanan and Solomon (1990) reported that the LC_{50} for this species is about 36 µg Cu l^{-1}, which is only about 2% of the concentration in the leachate. Leachates from treated wood from different tree species all failed LC_{50} tests using fish. The acute toxicity of the three metals together to *Daphnia* was greater than that for Cu alone indicating that the metals act jointly. There was evidence that Cu and Cr interact synergistically. Sublethal effects were seen in oysters living on CCA bulkheads, which had elevated levels of micronuclei, an indication of genotoxicity (Weis et al. 1995). Laboratory bioassays of leachate were performed on larval oysters (*Crassostrea gigas*) to investigate behavioral responses (Prael et al. 2001). Early veliger stage larvae were observed to avoid concentrated leachate, and three- and seven-day old larvae swam faster in leachate than in clean seawater and moved up and down more in the leachate. This altered behavior may retard settlement of the larvae to metamorphose into adults.

Bacteria that normally degrade pentachlorophenol (PCP) play an important role in degrading and waste removal of this other chemical used as a wood preservative. When exposed to CCA, their ability to degrade the PCP was inhibited. Inhibitory effects were seen at concentrations thousands of times less than those used commercially (Wall and Stratton 1994). Other ecosystem level effects on microbial activities have been seen in terrestrial environments. Microbes in CCA-contaminated soils in the field have been shown to be negatively affected (Bardgett et al, 1994). Microbial biomass, carbon, and nitrogen were lower in contaminated soils. Bacterial respiration, biomass P, and denitrification all declined with increasing CCA contamination. In another study, biological activities, including respiration, nitrification and sulphatase, were reduced in soils contaminated by CCA (Yeates et al. 1994). It is likely that similar effects would be seen in bacteria in aquatic environments.

There is only one small paragraph devoted to dietary exposure to chemicals from leachate (P. 3-11). This is the probable route of exposure for salmon, which are the main reason for this report. This section should be much longer. He concludes that there is little likelihood of dietary toxicity because of limited potential for substantial metal accumulation in invertebrates. There have been at least two journal articles showing trophic transfer of CCA wood-derived contaminants. Algae taken from CCA bulkheads were fed to mud snails (*Ilyanassa obsoleta*), which caused snails to retract into the shells, cease activity, and eventually die (Weis and Weis 1992). Oysters taken from CCA bulkheads were fed to carnivorous snails (*Thais haemastoma*) and caused them to reduce their feeding rate, and thus reduce their growth (Weis and Weis 1993). After two months of consuming these contaminated oysters, the snails acquired body burdens of Cu equal to that of snails collected from treated wood bulkheads. These studies indicate that there is indeed a "potential for dietary toxicity." Trophic transfer is related to the way in which the prey organism stores the metal. The marine isopods *Limnoria* spp. (gribbles) bore through wood, including CCA-treated wood. (This is ironic, since one of the reasons for the use of preservative-treated wood in the marine environment is to prevent damage by marine borers.) They can tolerate the high concentrations of metals by storing copper in granules. An increased number of copper-containing granules were found in isopods from CCA-treated wood compared to those taken from untreated wood. The ability to store copper in inert granular form may explain why these organisms can consume CCA wood without suffering toxicity (Tupper et al. 2000). Furthermore, metals stored in granules are not available to consumers (Wallace et al 2003). This is another aspect of trophic transfer that is not covered in the report.

In any risk assessment, there is a need to distinguish between bulkheads or walkways, which have a lot of surface area for leaching, and pilings, which have much less surface area. From an overview of the literature, it appears that leachates from pilings in reasonably well-flushed areas do not produce obvious negative effects in the immediate vicinity. It would be expected that when flow rate is higher, the leaching rate might be higher, but the metals would be swept away downstream rather than accumulate near the treated wood. It should be noted, however, that estuaries have areas in which there are high rates of sediment deposition ("turbidity maximum") and the leachates that are swept away from the immediate site of the treated wood are probably being deposited somewhere else downstream. Metals do not degrade, but will accumulate at these depositional sites. The question is whether the risk assessment will be only for the immediate vicinity of a treated wood structure, or if it will consider potential effects at the depositional sites further downstream. Another factor that needs to be incorporated is the initial concentration of metals in the wood – for marine and estuarine uses it is 2.5 lb/ft^2 but in freshwater the wood used may be lower than this.

The best management practices (BMPs) as listed and described will reduce the potential for toxicity somewhat, but since there will still be leaching from treated wood, and the leaching is greatest when the wood is new, I would recommend another, more effective, BMP. If the wood were to be soaked out on site at the treatment facility for a few months before being put into service, the greatest amount of leaching into the environment, and thus the greatest amount of risk, would be eliminated. The water into which the wood leached could later be recycled by pressure-treating it into new pieces of wood. This would eliminate the large amount of leaching from newly installed wood, which is responsible for the greatest amount of the problems.

The discussion of alternative materials is good and appears to be thorough.

Specific comments

P. 2-18 discusses factors that could affect the leaching rates. The presence of knotholes in the wood is not discussed and could affect leaching rate. Knotholes are common in Southern yellow pine, which is the wood used most frequently in the Atlantic coast.

Chapter 3 , 3.1 discusses water exposures and briefly considers the toxicity of each of the three metals, but does not discuss the possibility of interactions (additivity, synergism, antagonism) when all three are present in the water.

I was surprised that there was no discussion of the importance of speciation and bioavailability of any of the metals. These are very important issues relevant to the effects of leachates from metal-treated wood in the aquatic environment and should be included in a report like this.

P 3-10 has bulleted different approaches to sediment toxicity, but does not include the Effect Range-Low and Effects Range Median approach of Long and Morgan, that is discussed later. The acid-volatile-sulfide (AVS) (Long et al.1998) approach and other sulfide-related approaches (Rozan et al. 2000) might also be included among the approaches to sediment toxicity.

P 7-4, recommendation #4, last bullet suggests that minimum current velocities should be greater than 2 cm/sec for treated wood to be acceptable. If taken strictly, this could rule out its use in estuaries, where during parts of the tidal cycle current velocities are less than this, or zero.

Summary and Conclusions

Overall, by having a very cursory review of sublethal toxicity studies, omitting many relevant peer-reviewed publications, and not critically reviewing the "gray literature" cited in the report. The report generally seems to underestimate the risks associated with copper-based treated wood, and says that any effects would attenuate after several months. This is clearly not the case in terms of bioaccumulation and effects on the benthic community, or in terms of trophic transfer. However, it does take a precautionary approach to salmon, especially juvenile life stages.

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Review of "*Creosote-treated Wood in Aquatic Environments: Technical Review and Use Recommendations*." from Stratus Corp. Prepared for Joe Dillon, NOAA Fisheries. 2005

Executive Summary

This report includes a much more adequate and comprehensive review of the literature than the previous report on metal-treated wood. It documents extensive toxicity of creosote and its components to aquatic life at low concentrations, includes regulations from many areas banning its use, and demonstrates that creosote components can accumulate in sediments many meters away from the structure. Therefore, the conclusions and recommendations that tend to say that this is not something to be concerned about do not seem to be in keeping with the documented effects. The report does not have a section discussing the breakdown of the PAHs in water and sediments, which should be important considerations in evaluating the risks posed by creosote treated wood. They do take a precautionary approach to salmonids, however.

Background

I have read this report and my evaluation follows.

Findings

The report documents faster leaching from newly treated wood, and shows that leaching occurs faster when flow rate is faster. It also shows that temperature can affect the leaching rate, and that different PAHs have different leaching rates, with low molecular weight compounds dissolving more readily than the heavier PAHs.

It considers the Brooks (1997) model, and notes that it has not been published in the peer-reviewed literature. The report critically examines the various models of Brooks and Poston and points out their strengths and weaknesses. One criticism of the Brooks model they do not mention is the assumption that low molecular weight PAHs do not volatilize. One criticism of the Poston model is using acute levels (LC_{50}) for the toxic threshold. A point where 50% of the animals die is certainly an extremely high level to be considered a threshold!

The authors of the report spend considerable time discussing Goyette and Brooks (1998, 2001) study of a "worst case scenario" of leaching, and note that "no positive controls were reported and percent recovery was not reported." They also point out that higher than expected amounts of creosote were found in the offshore direction – suggesting greater transport than the model expected. They also point out that the model does not consider the number or density of pilings, which would appear to be important issues, and that the model ignores the effect of water flow on leaching rate. This indicates that the Stratus reviewers were reading this part of the report critically – a good thing.

The chapter on toxicity is much more thorough and comprehensive than the comparable chapter of the other report dealing with CCA and related chemical treatments. They review routes of exposure, cover many peer-reviewed papers dealing with both water and sediment exposures, and indicate that effects in fish can be seen at water concentrations down to 16 *u*g/L. They have a brief section on phototoxicity, which can increase the toxicity of PAH compounds. They cover carcinogenesis, which has been studied extensively by the NOAA Seattle group, as well as researchers studying the Atlantic Wood Superfund site in the Elizabeth River. They have a good section on developmental effects, both laboratory studies and the field observations of herring eggs deposited near treated wood (Vines et al.2000). Eggs deposited on a very old creosote piling (40 years old!) failed to develop. This is a very important finding, in that the leaching and toxicity would have been expected to be minimal from such an old piling. That work indicated that 0.003 mg/L significantly reduced hatching success, and increased abnormalities in herring eggs. Wassenberg and diGiulio (2004) found effects of low concentrations on developing *Fundulus heteroclitus*, a species that is quite tough and insensitive to environmental toxicants. They cover effects on immunotoxicity, reporting that sediment levels of 25 mg/kg produced effects on winter flounder, and that Karrow et al (1999) found effects in rainbow trout at 17 *u*l/L. There is a table on pg 3-15 indicating that effects generally become apparent around 3 *u*g/L in the water.

The report does not have a section discussing the breakdown of the PAHs in water and sediments. The rate of degradation under various environmental conditions, pathways, persistence and toxicity of the degradation products should be important considerations in evaluating the risks posed by creosote treated wood. There is an extensive body of literature on this topic. Rates of degradation would be expected to be rather slow (given the creosote-loaded Superfund sites at former wood treatment facilities), and faster in aerobic vs anaerobic environments, both of which would be relevant to the issues involved in this report.

In examining community-level effects, they note that microcosm studies have found community level effects on zooplankton at levels as low as about 3 ug/L (Sibley et al. 2001). In contrast, Goyette and Brooks (1998, 2001) found significant sediment accumulation as far as 7.5 meters away from creosote-treated pilings, but no effects on the benthic community ("No significant changes in benthic community structure were observed.") Another study by Brooks (2000) is reported as finding that "Despite the toxicity threshold exceedences, the biological data that was collected did not reveal adverse effects on biota from PAHs at either the newer bridge site or the older bridge site" (p. 4-10). These reports are not in the open literature and were provided to me. I note that sampling procedures used by Goyette and Brooks (1998) involved three replicates, although, interestingly enough, they state that they were originally going to do only one sample per site. Perhaps this is the influence of Goyette on Brooks and it is a much better design than that used by Brooks subsequently (2000) in the study of walkways treated with copper preservatives in which no replicate samples were taken for infauna. In the creosote report, they note that baseline (before putting in the pilings) benthic community was extremely variable from place to place around Sooke Bay. It is likely that this natural variability masked any potential effects of the creosote. Given such a variable baseline, it might have been better to take benthic samples at the very same sites before and after putting in the pilings. In their graphs of abundance and taxa richness at different distances from the wood, despite taking three replicates, they do not indicate the variance around the means. Since they found that after over one year, the sediments 0.5 m from the piling exceeded various standards for PAHs, that mussel larval development was impaired, and that amphipod survival was reduced by these sediments, it is likely that a before/after design would have indicated a reduced benthic community as well. It should also be noted that this site, in British Columbia, has rather cold temperatures, and leaching and effects would be more severe at warmer temperatures.

There is only one paper discussed dealing with trophic effects (Rice et al. 2000), in which contaminated worms were fed to English sole, producing growth impairment. I am confident that there must be other papers dealing with trophic transfer. This issue, as with metals, is quite important if salmonids are of particular interest.

Risk Evaluation

Having established that effects can be seen at quite low levels, and that significant amounts of PAHs leach from treated wood and persist in the sediments, I was surprised by their risk evaluation. The evaluation seems to discount much of this work, although as they say on page 4-3 these results indicate that "PAHs that leach from treated wood are present at concentrations that are predicted to be toxic to aquatic biota under realistic environmental scenarios."

The report describes the large studies at Charlestown Navy Pier and Naval Station San Diego where new pilings severely contaminated the water and produced sediments with PAH concentrations 250 times greater than at a control site (Costa and Wade, 1989). The risk evaluation section then relies on the Goyette and Brooks (1998). Their Addendum Report (Goyette and Brooks, 2001) indicated that even after four years, evidence of sediment toxicity could still be detected as far as 2 m away from the wood.

It was a big surprise, after all the documentation, to read their conclusions on 4-14 that sediment accumulation "appears to be relatively minor." They further write "the duration of any biological effects appears to be attenuated within several months of construction (the time period when leaching rates are likely to be the highest)." This is not true for the creosote in the sediments that can cause tumors in bottom-dwelling fish, nor for the unfortunate herring eggs deposited on a 40-year old piling. The only possible justification for such a conclusion would be if the creosote degraded rapidly in sediments, which does not appear to be the case. There ought to be a section in the report covering rates of degradation of creosote PAHs, degradation pathways, toxicity of degradation products, and the length of time that various degradation products persist.

In any risk assessment, there is a need to distinguish between bulkheads or walkways, which have a lot of surface area for leaching, and pilings, which have much less surface area. It is expected that when flow rate is higher, the leaching rate will be higher, but the

PAHs would be swept away downstream rather than accumulate near the treated wood. It should be noted, however, that estuaries have areas in which there are high rates of sediment deposition ("turbidity maximum") and the leachates that are swept away from the immediate site of the treated wood are probably being deposited somewhere else downstream. The question is whether the risk assessment will be only for the immediate vicinity of a treated wood structure, or if it will consider potential effects at the depositional sites further downstream. After their conclusion they then advocate a precautionary approach with regard to salmonids.

The best management practices (BMPs) as listed and described will reduce the potential for toxicity somewhat, but there will still be leaching from treated wood, and the leaching is greatest when the wood is new. The Goyette and Brooks (1998, 2001) studies used wood treated to BMP standards, and nevertheless found persistent accumulation and toxicity in the sediments near the wood. And this was just a piling! I would recommend another, more effective, BMP. If the wood were to be soaked out on site at the treatment facility for some time before being put into service, the greatest amount of leaching into the environment, and thus the greatest amount of risk, would be eliminated. The water into which the wood leached could then be recycled into new pieces of wood for treatment.

Summary and Conclusions

The report documents numerous studies demonstrating toxic effects of creosote at very low environmental concentrations and the leaching of creosote from treated wood and accumulation in sediments going out over 7 meters. However, the conclusions then imply that effects are relatively minor, of short duration and not of great concern. The conclusions do not seem to follow from all the research documented in the report. Since many states and municipalities have banned the use of creosote treated wood in aquatic environments, they must have concluded that effects are of great concern. Nevertheless, the Stratus reviewers do recommend a precautionary approach to dealing with salmonids' exposure to creosote leached from treated wood.

Literature Cited

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Appendix 1

Materials Provided:

Stratus Consulting, 2005. Treated Wood in Aquatic Environments: Technical Review and Use Recommendations. 160 pp.
Stratus Consulting, 2005. Creosote-treated Wood in Aquatic Environments: Technical Review and Use Recommendations. 104 pp.

Appendix 2 – Statement of Work

Consulting Agreement Between the University of Miami and Reviewer

February 20, 2006

Background

The purpose of the technical review documents requiring independent review is to present an analysis of the potential effects and mitigations for the use of treated wood products in aquatic environments. The documents focus on copper treated wood, primarily ammoniacal copper zinc arsenate (ACZA), as this is the most prominent material used on the west coast of the United States and in Alaska, and creosote treated products.

These products are being examined by NOAA's National Marine Fisheries Service (NOAA Fisheries) to determine the risks generated by their usage to the living marine resources which NOAA is responsible for managing, referred to as NOAA's Trust Resources. These include anadromous salmonids managed under the Endangered Species Act (ESA) and Essential Fish Habitat (EFH) as designated by the Magnuson-Stevens Fishery Management and Conservation Act. The use of treated wood in or near aquatic environments commonly requires a permit issued by the U.S. Army Corps of Engineers under section 404 of the Clean Water Act. Under the ESA, federal agencies are to consult with NOAA Fisheries to insure that any action authorized, funded or carried out by the federal agency does not jeopardize the continued existence of any threatened or endangered anadromous salmonids or result in the destruction or adverse modification of designated critical habitat. The issuance of this permit by the U.S. Army Corps of Engineers requires consultation under the ESA to determine whether its approval action would jeopardize Federally-listed species or adversely modify designated critical habitat, and requires an EFH assessment to determine whether its approval action would adversely affect EFH. Since the use of treated wood materials in situations that may expose aquatic ecosystems is widespread along the west coast of the United States and in Alaska, development of these guidelines should help to streamline the review of permitting processes as well as the permitting processes themselves. In some instances, these guidelines may be used to update existing policies regarding treated wood.

The purpose of the ESA is to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved, to provide a program for the conservation of threatened and endangered species and to take steps that may be appropriate to achieve this conservation. Conservation is defined in the ESA to mean using, and the use of all methods and procedures necessary to bring any endangered or threatened species to the point at which the protections provided by the ESA are no longer necessary. It is the policy of Congress, as declared in the ESA, that all Federal departments and agencies shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the ESA. ESA regulates an activity with an eye toward its impact to as little as a single listed individual. These guidelines are meant to clarify the extent to which these authorities need to be applied for the use of treated wood.

The Magnuson-Stevens Fishery Conservation and Management Act established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. EFH regulates an activity with an eye toward its impact on habitat characteristics. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle. Essential Fish Habitat for salmonids includes their saltwater and fresh water ranges.

Effects of treated wood that need to be examined under the ESA and EFH regulations include direct, indirect, and cumulative effects. An example of direct effects includes the acute and sublethal impacts of copper and polycyclic aromatic hydrocarbons to salmonids and EFH regulated species. An example of an indirect effect includes the adverse impacts to the prey base upon which ESA listed and EFH regulated species depend. An example of a cumulative effect includes the impacts of multiple structures and contaminants in an area with or without additional loading from urban sources, historic mining, smelters, ships' hulls or any other source. The synthesis of these effects to habitat and to individuals, coupled with local environmental conditions and specific species of concern, defines the risk of a project proposing the use of treated wood.

The objective of the technical review and use recommendations development was to establish a solid scientific basis from which guidance development and implementation could proceed, particularly concerning potential direct and indirect effects.

Objectives of the CIE Review

The information presented for review has been developed by a consulting firm under contract to NOAA Fisheries. The use of an independent firm was determined to be the best way to initiate and complete a thorough review of the best available science concerning effects of treated wood, effects of the most likely contaminants coming from treated wood, and policies and guidelines already developed and in use throughout the United States, Canada and/or other jurisdictions involving the use of treated wood products. A brief review of the economic aspects of treated wood and its leading competitors as well as engineering aspects of all these materials was also commissioned as part of the process.

The review panelist is required to review the following reports (*Treated Wood in Aquatic Environments: Technical Review and Use Recommendations* and *Creosote – Treated Wood in Aquatic Environments: Technical Review and Use Recommendations*), in particular, the aquatic toxicology, the fate and transport aspects of the suite of contaminants that may result from its use, and the modeling that is used in conducting risk assessments concerning treated wood. These sections make up the bulk of the submitted documents and have been an area of considerable debate for many years.

Specific terms of reference for the review include:

- Evaluate the synthesis and interpretation of the toxicology information, and state whether or not the conclusions regarding the potential effects to ESA and EFH regulated species and habitats are supported by the scientific evidence.
- Evaluate the synthesis and interpretation of fate and transport information and state whether or not the conclusions regarding potential effects to ESA and EFH regulated species and habitats are supported by the scientific evidence.
- If the conclusions are not supported by the available evidence, please provide a detailed explanation and new conclusions.
- Evaluate the review of the leaching and environmental concentration models presented in both of the reports.
  - A) Did the review adequately characterize these models by addressing model assumptions, uncertainties, and their applicability to ESA listed salmonids and the habitats of NOAA's Trust Resources? If not, provide explanation(s) and how subsequent conclusions are affected.
  - B) The review concluded that most of the factors present in the models would lead to an increase in leaching in the field compared to that observed in the laboratory. Is this conclusion supported by the scientific evidence? Please explain in detail why the models do or do not result in an under prediction of leaching.
  - C) Are these models sufficient to predict leaching concentrations for use in ecological risk assessments concerning ESA listed species and their habitat?
  - D) Are additional precautions required to add a margin of safety to the model predictions? Provide examples?
- The risk evaluation chapters in both reports conclude with a list of factors to be considered in risk assessments concerning the use of treated wood. Are there any other factors missing from the lists?
- The copper treated wood report contains a chapter concerning alternative materials and includes a brief examination of toxicity considerations regarding these products. Are there any other considerations that are not mentioned in this chapter?
- The current regulations and best management practices (BMP) chapter in the copper treated wood report discusses BMPs put forth by the industry as well as several government agencies. Do you feel that the available scientific evidence warrants the use of these BMPs? Do you think that utilization of the BMPs, given consideration of the site specific factors listed at the end of the

risk evaluation chapters, will provide protection to individuals of ESA listed species and to the habitat components of EFH?

- Do any of the BMPs or restrictions seem unwarranted or are there additional BMPs or restrictions which should be utilized? Please provide explanations to answers including any site specific factors that should be considered in making decisions regarding the use of treated wood products in aquatic environments.

Specific Activities and Responsibilities

The review panelist's duties shall occupy a maximum of 5 workdays (i.e., a few days for document review and a few days to prepare a Review Report). The review panelist will review the treated wood technical review and use recommendations documents and develop a review report in the context of responsiveness to the terms of reference. See Annex 1 for further details on report contents.

No later than March 13, 2006, the review panelist shall submit the Review Report to the CIE for review[1]. The CIE reports shall be addressed to "University of Miami Independent System for Peer Review," and sent to Dr. David Die, via e-mail to ddie@rsmas.miami.edu and to Mr. Manoj Shivlani via e-mail to mshivlani@rsmas.miami.edu.

[1] All reports will undergo an internal CIE review before they are considered final.

ANNEX 1: Contents of Panelist Report

1. The report shall be prefaced with an executive summary of findings and/or recommendations.

2. The main body of the report shall consist of a background, description of review activities, summary of findings, conclusions/recommendations, and references.

3. The report shall also include as separate appendices the bibliography of all materials provided and any papers cited in the Panelist's Report, along with a copy of the statement of work.