

Review of
**“Creosote-Treated Wood in Aquatic Environments:
Technical Review and Use Recommendations”**

and

**“Treated Wood in Aquatic Environments:
Technical Review and Use Recommendations”**

Prepared by:
Timothy T. Townsend, PE, PhD

Prepared for
“University of Miami Independent System for Peer Review”

March 13, 2006

Executive Summary

Treated wood products by design contain toxic chemicals that are designed to prevent deterioration of the wood by organisms. Several treated wood applications involve submerged wood structures, and in these cases, preservative chemicals are known to leach from the wood products into the surrounding aquatic environment. Concerns have been raised as to the effect of leached preservative chemicals on non-target organisms. The National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration (NOAA) has such a concern with respect to the impact of treated wood on threatened and endangered species in NMFS trust fishery resources. As such, the NMFS is in the process of developing guidelines for the appropriate use of treated wood products in these habitats. The NMFS commissioned two technical documents for use in the development of this guidance, and this current report is a review of those documents.

The following two reports were reviewed: “Treated wood in aquatic environments: Technical review and use recommendations” and “Creosote-treated wood in aquatic environments: technical review and use recommendations.” The information covered in the two documents summarizes several different topic areas pertaining to treated wood in aquatic environments: leaching and transport, toxicity of preservative chemicals, risk assessment and evaluation, and best management practices for minimizing risks. This reviewer responded to specific review questions.

The two documents provide an excellent summary of currently available information regarding preserved wood in aquatic environments, specifically information regarding pollutant leaching, available models for predicting transport and fate of preservative chemicals, toxicity of preserved wood chemicals to aquatic organisms, factors to consider in conducting a risk assessment, and existing best management practices for treated wood usage in aquatic environments. These documents represent the most complete, up-to-date compilation of this information currently available. The documents further propose a set of use recommendations for assessing whether treated wood use is appropriate for specific construction projects in a given aquatic environment. These recommendations are warranted and their application is supported by existing data. Given the many uncertainties associated with the current available science on the impact of treated wood products on the aquatic environment, these recommendations should provide conservative protection to threatened and endangered species in NMFS trust resources.

One fundamental component of the use recommendations is the performance of a site-specific ecological risk assessment for projects identified as sensitive in a screening-level project evaluation. The documents provide elements that should be included in such assessments and the factors that should be considered. The documents do not, however, provide sufficient guidance or documentation to conduct a site-specific ecological risk assessment; this does not appear to have been part of the scope of work. Thus, NMFS should focus future guidance development on the production of detailed guidelines for conducting such a risk assessment. Based on past use by the reviewer of

some of the existing leaching and transport models cited, these tools are not adequately reviewed, validated, nor documented to be of wide-spread use. NMFS guidelines should include detailed description of leaching and transport models, and should include a sensitivity analysis so that those conducting ecological risk assessments understand which factors most heavily influence the assessment. The guidelines should include very specific examples demonstrating the application of these models as part of a risk assessment; several examples should be provided, included those where results find that treated wood usage should be restricted and those where usage is not restricted. A logical component to such guidelines would be an easy-to-use software application.

1. Background

Treated wood products contain preservative chemicals specifically added for the purpose of preventing biological decay. The chemicals act as toxins (biocides) to organisms that would otherwise deteriorate the wood. The presence of these toxic chemicals raises natural concern when other non-target species may be impacted. An area of such concern is the use of treated wood structures in aquatic environments and the impact they may have on fish and aquatic invertebrates. Preservative systems are designed to remain active and retained in or on the wood structure for many years, but preservative chemicals do leach at relatively low concentrations over time when exposed to water. These chemicals have the potential to impact biota when dissolved in water and when accumulated in sediment.

The National Marine Fisheries Service (NMFS) of the National Oceanic and Atmospheric Administration (NOAA) are in the process of developing guidelines for the use of treated wood products in aquatic environments utilized by federal trust fishery resources. NOAA contracted with Stratus Consulting to prepare two technical reports that dealt with treated wood use in aquatic environments. One report focused on the use of creosote treated wood and the other focused on water-soluble preservatives (referred to herein as the “waterborne” report). The reports contain (1) background information on treated wood, (2) data on preservative chemical leaching in aquatic environments, (3) available toxicity information for a variety of biota and different preservative chemicals, (4) existing policies and best management practices for treated wood use in aquatic environments, and (5) recommendations for future projects that might involve the use of treated wood. The purpose of these reports is to assist NMFS and NOAA in future guidance development.

The present document provides a review of the above referenced reports by Timothy Townsend. Dr. Townsend is an associate professor in the Department of Environmental Engineering at the University of Florida in Gainesville, Florida. His area of specialization is solid and hazardous waste management. Much of his research has focused on the leaching of preservative chemicals from treated wood, particularly CCA-treated wood. Some of his research has involved evaluating the toxicity of treated wood leachates use in a variety of aquatic toxicity assays. Under agreement with the University of Florida, Dr. Townsend also provides technical consulting services to a variety of public and private organizations.

2. Review Activities

The following two reports were provided:

- “Treated wood in aquatic environments: Technical review and use recommendations” by Stratus Consulting, Inc., and Paladin Water Quality Consulting

- “Creosote-treated wood in aquatic environments: technical review and use recommendations” by Stratus Consulting, Inc., and Duke University

The reviewer read through each of these documents and prepared a review report based on specific questions that were posed.

3. Summary of Findings

This summary of findings is organized by restating the questions that were asked as part of the review (see original scope of work in Appendix A) followed by a detailed response.

Task 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.

Toxicity information is provided in Chapter 3 of the waterborne preservatives report and in Chapter 3 of the creosote report. The report authors provide what appears to be a very complete and up-to-date compilation of aquatic toxicity data related to the wood preservative chemicals evaluated.

Surface water: In the creosote report, the final section of the chapter (3.4) summarizes biological effects concentrations for surface water. In the waterborne report, US EPA water quality criteria for the preservative chemicals of interest are first summarized. Then in the detailed text that follows, the authors conclude that in most cases (cautions are noted) the water quality criteria are protective of regulated species.

Sediment. In the creosote report, the final section of the chapter (3.4) summarizes sediment quality guidelines from several different organizations. In the waterborne report, sediment toxicity thresholds for freshwater sediment were summarized, and it was concluded that these thresholds can serve as meaningful screening tools, but that site specific risk assessment may be needed in some cases.

The report authors did a good job of synthesizing and interpreting the toxicological data. The conclusions reached on potential effects on target species are supported. Certainly the impact of preservative of chemicals on aquatic organisms is influenced by numerous factors and will be very site specific. It is very likely that in many cases no deleterious effects will be observed. But the existing toxicological data do suggest that in some circumstances, preservative chemicals can result in a negative impact to some species.

Task 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.

Fate and transport information is provided in Chapter 2 of the waterborne preservatives report and in Chapter 2 of the creosote report. Both reports review available data preservative leaching from submerged treated wood and review available models that have been proposed to predict leaching. Both reports also describe several transport models that have been developed to assess the fate of leached chemicals in a water body (water column concentrations and sediment concentrations). Finally each report describes available data that compare model predictions to actual measured data.

The authors conclude that the available models do provide a useful tool for predicting how different conditions and parameters impact preservative concentrations in the sediment and the water column, but that the caution must be used when evaluating the absolute magnitude of the modeled concentrations. Results from field measurements and model predictions were reported in most cases to be different.

The specific conclusions that are reached with regard to various aspects of fate and transport appear to be supported by the available data. More discussion on this question is provided in response to questions below.

Task If the conclusions are not supported by the available evidence, please provide a detailed explanation and new conclusions.

See above. The conclusions provided by the authors are supported by the data.

Task 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.

The reports did a good job of describing the fate and transport models, but the level of review is not sufficient for someone to then apply the models. The reports were not prepared to the level of a users guide; this is assumed not to have been part of the work scope. Assumptions and uncertainties were adequately characterized. The applicability to ESA listed salmonids and trust resource habitats was adequately characterized in general terms. The reports did not provide sufficient detail and

examples for someone to apply the models.

This reviewer has in the past tried to use some of the models referenced in the report. It is important to note that the models familiar to the reviewer were not peer reviewed, and often times the documentation was minimal and it was very difficult to understand why certain model steps were undertaken. The models (that the reviewer is familiar with) were not particularly user-friendly.

One recommendation is that additional work needs to be conducted to develop a new model (based on the same methodology already described in the existing models) or to take an existing model, peer review it, and provide better documentation, i.e., create a users guide. The authors of the two reports reviewed here did a good job of summarizing the models that exist, but a detailed critique/examination of the models was not presented (I assume this was outside their work scope).

The above recommendation does not imply that the authors made any false conclusion. The conclusions reached by the authors are appropriate.

Task

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.

In my opinion, this conclusion is somewhat overstated. The authors of the waterborne report conclude that in-service conditions are “likely to produce much higher leaching rates” compared to laboratory studies. In response to the question above, this conclusion is not supported by the scientific evidence. But I do not believe that the authors were basing their conclusion on measured data as much as they were on plausible expectations.

If you look at table 2.5, the authors describe many factors that could result in more leaching to occur in the field than predicted in the lab. The primary reason provided is incomplete fixation and excess preservative material. While it is true that incomplete fixation might tend to be less of a problem in the laboratory (because of the controlled nature of the experiments), the authors imply that incomplete fixation is a common occurrence. It is not my understanding that incomplete fixation is that common of an occurrence; it certainly happens, but one could argue the other way. In some cases, wood is not treated to sufficient retention levels, and thus the concentrations in the field might be less than what is observed in controlled laboratory experiments. With regard to post-

treatment cleanup, yes, perhaps excess material might exist in a full-scale situation that might not exist in the lab, but again I am aware that this was a very common occurrence. And in the actual applications, there are also factors that could result in leaching already occurring before these products are installed. For example, after treatment, the wood is stored out doors, it is transported on open truck beds and it may be stored at the construction site. During this time period it might be exposed to rain thus washing off preservatives that would not be washed off in the lab.

So I agree that the factors in table 2.5 do suggest that in some cases the mass of preservative leaching per volume of water it comes in contact with may be greater in the field than predicted in the lab, but this concern seems to be overstated. The authors should provide more documentation that treated wood is not being properly fixed or post-treated if this is truly the case. It seems that the error introduced by this might be less than the error inherent in the other factors of the risk assessment. I do not suggest removing this discussion, but it should be thought through better and referenced, and it may need to be toned down accordingly.

Task Are these models sufficient to predict leaching concentrations for use in ecological risk assessments concerning ESA listed species and their habitat?

I believe the approach behind the models is sound and appropriate. In this respect they are sufficient. However these models are not available in a format that could be used routinely by different parties to conduct site-specific ecological risk assessments. In this respect they are insufficient. The models need to be reviewed for their scientific merit as part of a separate review, a user's guide with detailed explanations of terms and procedures needs to be developed, and detailed examples for different use scenarios need to be published. This type of modeling is something that lends itself well to producing easy-to-use software as well.

Task Are additional precautions required to add a margin of safety to the model predictions? Provide examples?

The steps described above are needed. As part of the review above, there should be a sensitivity analysis of the different parameters. This would enable one to recommend where it is appropriate to assign safety factors.

Task 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 list appears complete. As noted elsewhere in the report, other water quality factors may impact toxicity, e.g., dissolved organic carbon

content. Perhaps these factors should be mentioned in this section as well.

The variability of the current velocity and direction may also be important. Which velocity do you choose in the model? The average? Again, it would be helpful to see a sensitivity analysis to determine how important these choices are.

Under “size of proposed structure,” does this include above water treated wood? If the piles are holding up a walkway, does the preservative leaching from the walkway after a rain and after abrasion matter? It is unclear whether this is included in the “surface area of the exposed wood.” So in addition to “size of proposed structured,” may also want to add information for “type of structure” and “proposed structure usage.”

Task 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?

This is good information. It would be helpful to get a better handle of the proposed lifespan of different materials. This clearly has a strong impact on the annualize costs. The only life spans that are used are 15 and 20 years. It has always been my understanding that plastic can last a lot longer than treated wood. The authors should comment on how reliable these numbers are; limitations of the assumptions and the impact the results should be noted. Otherwise some alternative materials may be unduly dismissed from consideration on a project. A recommendation of getting site specific costs for all projects may be warranted.

Task 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?

The available scientific evidence does warrant the use of BMPs. Preservative chemicals do leach and they can be toxic. The data suggest that although the risk to biota should be low in many cases, there may be times when the risk is not acceptable. The use of proper BMPs can provide protection to ESA listed species. As described above, some components of the “tools” to be used as part of the BMPs need to be refined. A big component of the BMPs is conducting a site specific ecological risk assessment for sensitive sites. The guidance for

conducting this risk assessment needs to be strengthened.

Task 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.

The recommended BMPs provided in chapter 7 are appropriate. The institution of manufacturing/processing/production BMPs could make a very big difference. The conditions in the screening-level project evaluation review are appropriate and supported by existing information. Additional guidance needs to be provided on how to conduct site-specific ecological risk assessments.

4. Conclusions and Recommendations

The information summarized and presented in the two documents appears to be complete and thorough with respect to the topic of treated wood and its use in aquatic environments. The best management practices recommended are sound and would, if properly used, provide protection of ESA biota. The reports review existing models for determining fate and transport of preservative chemicals from treated wood used in aquatic environments that are conceptually correct and can be used as a tool in an overall risk assessment. Based on the reviewer's understanding of some of these models and the state of their documentation, validation and support, additional work needs to be performed to create a guide that can be used to conduct a site-specific ecological risk assessment of a proposed treated wood project on a potentially sensitive site. This guide should include detailed definitions and derivations of the equations used (with appropriate references), recommended tables for water and sediment toxicity thresholds (these are outlined in the existing report, but they need to be summarized in one spot), a sensitivity analysis, and several examples for different projects (outlined in a step by step fashion). Such a guide could also easily be accompanied by a spreadsheet or simple software package.

Appendix A: Statement of Work

Consulting Agreement Between the University of Miami and Dr. Timothy Townsend

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 review¹. 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.

Appendix B: Background material

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.