UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
HABITAT CONSERVATION DIVISION
525 NE Oregon Street
PORTLAND, OREGON 97232-2737

December 9, 1998 F/NW03

W.B. Paynter, Chief, Regulatory Branch
Department of the Army
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Position Document for Use of Treated Wood in Areas within Oregon Occupied by Endangered Species Act Proposed and Listed Anadromous Fish Species

Dear Mr. Paynter:

On December 4, 1996, the U.S. Army Corps of Engineers (COE), Portland District, submitted a letter and biological assessment (BA) to the National Marine Fisheries Service (NMFS), requesting Endangered Species Act (ESA) section 7 informal consultation on use of treated wood in the Columbia River from McNary Dam (River Mile 293) downstream to the mouth. The COE determined that use of treated wood from McNary Dam downstream to the mouth was not likely to adversely affect proposed and listed anadromous salmonids. The NMFS requested additional information from the COE in a January 21, 1997, letter. The COE submitted a revised BA on November 18, 1997, that addressed most of the additional information needs requested by the NMFS. In an April 15, 1998, letter to the COE, the NMFS did not concur with the COE's determination that use of treated wood was not likely to adversely affect listed salmonids. Through that letter, the NMFS initiated formal consultation with the COE.

Upon further review and analysis of the BA and revised BA, the NMFS determined that the programmatic use of treated wood products in the Columbia River is not a Federal action as defined in the ESA (section 7(a)(2)) and its implementing regulations (50 CFR § 402.02). Therefore, consultation under the ESA is not warranted for the programmatic use of treated wood products in the Columbia River.

However, the NMFS has developed the enclosed position document with regard to use of treated wood pilings. This position document specifically addresses use of treated wood in the lower Columbia River, but also expands the analysis to be made applicable to other areas in Oregon where there are ESA proposed and listed anadromous fish species. This document will assist the COE in: (1) complying with its consultation obligations under section 7(a)(1) of the ESA, and (2) making ESA section 7 effects determinations on future permit requests for the use of treated wood pilings within Oregon.

If you have any specific questions regarding this letter, please contact Garwin Yip at (503) 230-5419.

Sincerely,

Steven L. Morris, Ph.D.
Chief, Oregon Branch
for Habitat Conservation

Enclosures

Position Document for the Use of Treated Wood in Areas within Oregon Occupied by Endangered Species Act Proposed and Listed Anadromous Fish Species

National Marine Fisheries Service
December, 1998

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Position Document for the Use of Treated Wood in Areas within Oregon Occupied by Endangered Species Act Proposed and Listed Anadromous Fish Species

National Marine Fisheries Service
December, 1998

I. Introduction

The purpose of this document is to present an analysis of the potential effects of ammoniacal copper zinc arsenate (ACZA), chromated copper arsenate (CCA), and creosote treated wood on Endangered Species Act (ESA) listed anadromous fish species and their habitat in the mainstem Columbia River from McNary Dam (River Mile 293) downstream to the mouth, in addition to other areas in Oregon where there are ESA proposed and listed anadromous fish species. This document also offers recommended water quality and sediment guidelines, and recommendations on cumulative effects to minimize these potential effects. The intended use of this document is to provide the National Marine Fisheries Service's generic detailed discussion of the effects of treated wood pilings on listed salmonids and recommendations that will be incorporated by reference into site-specific consultations on individual treated wood piling projects. When incorporating this generic analysis, the NMFS will: 1) determine if there is any new information available since this document was prepared that should be considered, 2) determine if the recommended measures are sufficient or minimize effects or whether additional measures unique to the particular site are warranted, and 3) authorize any incidental take for the particular project by incorporating the recommended measures discussed in this document into the Incidental Take Statement terms and conditions together with any site-specific terms and conditions that may be necessary.

In the NMFS' analysis of the effects of ACZA and CCA treated wood in the aquatic environment, copper is the main metal of concern because it is the most acutely toxic. In addition, copper leaches the most, followed by arsenic and chromium (Warner and Solomon 1990). Creosote contains over 300 compounds, including a variety of polycyclic aromatic hydrocarbons (PAH). Some PAHs are very toxic and bioconcentrate. Therefore, they are the principle concern for creosote treated wood.

II. Species Addressed in this Document

The lower Columbia River, from McNary Dam downstream to the mouth, provides a migratory corridor or rearing habitat for many anadromous fish species proposed or listed under the ESA. Snake River subyearling fall chinook salmon are the most vulnerable species and life stage of the proposed and listed species, as they rear in the lower Columbia River while making their downstream migration. Although juvenile Columbia River chum salmon are smaller than outmigrants of other salmonids (Johnson *et al.* 1997), they typically migrate downstream promptly after emergence (Salo 1991). Analysis of the use of treated wood pilings, therefore, will address the juvenile rearing life history stage, where juveniles concurrently outmigrate and rear.

If treated wood pilings are proposed in anadromous salmonid spawning habitat, additional analysis is warranted on the effects of treated wood pilings on incubating eggs and alevins.

III. Recommended Water Column and Sediment Guidelines for the Use of Treated Wood Pilings

The NMFS recommends the following water column and sediment guidelines for copper and PAH in the lower Columbia River from McNary Dam downstream to the mouth, and other areas within Oregon occupied by ESA proposed and listed anadromous fish species. These guidelines account for background concentrations in addition to allowable concentrations of copper and PAHs from ACZA/CCA and creosote treated wood pilings, respectively, before risk of adverse affects increases. Water column and sediment samples should be taken to determine background concentrations at the proposed project area.

A. Recommended water column guideline for copper: 7 parts per billion (ppb) at 55 mg/L hardness for behavioral avoidance.

Rationale:

- The guideline was based on the Environmental Protection Agency water quality guideline of 7 ppb, using the equation $(0.960)e^{[0.8545(\ln \text{hardness})-1.465]}$ (USEPA 1985). If hardness is lower than 55 mg/L, the above equation should be used to adjust the recommended water column guideline for copper. Hardness should be sampled within a few weeks prior to project installation. Following are examples of how water hardness plays a role in determining toxicity.
  - High water hardness decreases toxicity (Moore and Ramamoorthy 1984).
  - Finlayson and Wilson (1989) established a 96-h C_{50}[1] for juvenile chinook salmon at 13 ppb for copper, where hardness did not exceed 20 mg $CaCO_3$/l.
  - Chapman (1978) found 96-h LC_{50} values for chinook salmon swim-up fry, parr, and smolts ranging from 17-38 ppb for copper, with hardness at 24 mg $CaCO_3$/l.
- Chapman (1978) showed that the 96-h LC_{50} was 18 ppb for steelhead parr, 29 ppb for steelhead smolts, 38 ppb for chinook salmon parr, and 26 ppb for chinook salmon smolts with a mean hardness of 23 mg/L. Ninety-six hour LC_{50} values from Finlayson and Verrue (1982) agree with those of Chapman (1978) for chinook salmon swim-up fry in water of similar quality.
- McCarty and Mackay (1993), National Academy of Sciences and National Academy of Engineering (1973), and Windom *et al* (1979) used an acute to chronic ratio of 0.1. That is, the recommended safe levels of copper is estimated by multiplying the 96-h LC_{50} by the application factor 0.1.
- For the lower Columbia River, 2 ppb was used for the background water column concentration of copper. Therefore, this guideline allows a maximum contribution of 5 ppb copper into the water column from ACZA or CCA treated wood in the lower

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[1] LC_{50} (lethal concentration): the concentration that results in 50% mortality in a given time period.

Columbia River before risk of adverse affects increases. Mean background copper concentration was 1.4 ppb from a summary of background concentrations of total dissolved copper from 1995-1997, monitored from U.S. Geological Survey stations at Warrendale and Beaver (USACE 1997).

The NMFS recommends that ACZA or CCA treated wood not be installed when pH drops below 7.0. The pH should be sampled just prior to sunrise within a few weeks prior to project installation. Following are examples of how pH plays a role in determining leaching rates and toxicity.

- Copper leaches at a significantly faster rate below a pH of 7.0 compared to a pH of greater than 7.0 (Warner and Solomon 1990).
- Low pH increases the proportion of free ionic copper in solution, resulting in greater toxicity in acidic waters than in basic waters (Meador 1991).
- Figure C.1. of the Appendix in USACE (1996) demonstrates a graphical relationship between dissolved and ionic copper species as a function of pH. According to this figure, pH should not drop below 7.0 in the lower Columbia River.

B. <u>Recommended sediment guideline for copper</u>: 34 parts per million (ppm).

Rationale:

- The sediment guideline utilized the effects range-low value of 34 ppm, developed by the Environmental Protection Agency Office of Solid Waste and Emergency Response (Jones *et al.* 1996).
- For the lower Columbia River, 20 ppm was used for the background sediment concentration of copper. Maximum sediment copper concentrations collected from the Priest Rapids reservoir, three sloughs in the Hanford Reach, and McNary Reservoir did not exceed 20 ppm (USACE 1997). Therefore, this guideline allows a maximum contribution of 14 ppm copper into the sediment from ACZA or CCA treated wood in the lower Columbia River before risk of adverse affects increases.

C. <u>Recommended water column guideline for PAH</u>: 0.018 toxic units (TU).

Rationale:

- The $\sum$PAH model in Swartz *et al.* (1995) assigns a 5% probability of mortality greater than 24% for all samples with $\sum TU_i < 0.186$. The water column criterion of 0.018 TU for PAH incorporated an application factor of 0.1 to protect species against potential chronic affects (USACE 1997).
- The TU approach was used because the combined stresses of multiple contaminants may cause environmental effects that would not be expected if the risk of each contaminant were evaluated separately.

D. Recommended sediment guideline for total PAH: 2 ppm dry weight for 1% total organic carbon to a mixing zone of 0.5 cm.

Rationale:

- This guideline is based on both NMFS (1996) and the USACE (1996).
- Preliminary analyses of histopathological, chemical, and biochemical data collected in Puget Sound over the past 10 to 15 years suggest that threshold levels for the early hepatic lesions and other biological responses are in the vicinity of 0.5 to 2 ppm total PAHs in sediment (Johnson *et al.* 1994; Horness *et al.* 1998).
- Reduced DNA content, indicating reduced growth, was evident in larval surf smelt where total PAHs in sediment occurred at 2 ppm (Misitano *et al.* 1994).
- For the lower Columbia River, 0.5 ppm PAH dry weight was used for the background sediment concentration of PAH. Therefore, this guideline allows a maximum contribution of 1.5 ppm total PAH dry weight into the sediment from creosote treated wood in the lower Columbia River before risk of adverse affects increases.

In cases where the above recommended water column and sediment guidelines are used in the lower Columbia River, the background concentrations may be exceeded at various locations. In these instances, the allowable contributions from ACZA/CCA and creosote treated wood should be adjusted so the recommended water column and sediment guidelines are not exceeded.

IV. Model Predictions of Copper and PAHs

Ted Poston (Battelle Pacific Northwest National Laboratory)[2] developed simple models based on a set of assumptions and that utilize available information to conservatively predict the level of leachates from ACZA, CCA, and creosote treated wood (Appendix A to USACE (1997)).

A. Assumptions made for the box models:

Assumptions common to all of the models:

- All of the pilings in a given project are installed at the same time.
- The target species are exposed in the leachate plume for four days.

Assumptions for copper in water:

- Water column concentrations are based on the leaching rate for the initial day of immersion, even though the leaching rate decreases substantially with each day of immersion.
- All copper leached from the pilings is in the dissolved state, with no accounting for the fraction that will sorb to solid phase material in the water column or precipitate out of solution.

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[2]For additional information regarding the models, contact: Ted Poston, Battelle Pacific Northwest National Laboratory, P.O. Box 999, Richland, Washington 99352; Phone: (509) 376-5678; FAX: (509) 376-2210; E-mail address: tm_poston@pnl.gov

- The water column guideline for copper was calculated using a water hardness of 55 mg $CaCO_3$/L, lower than the usual range of 65-70 mg $CaCO_3$/L in the lower Columbia River.

Assumptions for copper in sediment:
- The model does not account for any resuspension factor, turbulence effects, or lateral dispersion factor.
- The mixing depth of the sediment was limited to 0.5 cm and a density of 1.6 g/cm^3.

Assumptions for PAHs in water:
- All of the PAHs are assumed to be dissolved in the water column.
- There is no volatilization or biodegradation of creosote constituents.

Assumptions for PAHs in sediment:
- The model does not account for any resuspension factor, turbulence effects, or lateral dispersion factor.
- The mixing depth of the sediment was limited to 0.5 cm and a density of 1.6 g/cm^3.
- The model makes no provision for biodegradation of PAH compounds over time.

B. Results of modeling water column copper concentrations:
A box model was developed to model water column copper concentrations (Table 4.1 of Appendix A, USACE (1997)). Values were entered for the various parameters to produce Table 2.1 in Appendix A (USACE (1997)). Data from Table 2.1 (Appendix A of USACE (1997) was used to develop Table 1 in this document. Scenarios with redline and preceded with asterisks occur under conditions where the use of ACZA or CCA treated wood exceeds the recommended water column guideline of 7 ppb copper.

The NMFS recommends using Table 1 in this document to determine whether placement of ACZA or CCA treated wood pilings would result in water column copper concentrations that exceed the recommended water column copper guideline. Appendix A of USACE (1997) provides a comparison of the differences in leaching rates between ACZA and CCA treated wood. Copper losses from ACZA treated wood decline very quickly to negligible rates within 10 days (Brooks 1995b). However, copper loss from CCA-treated wood occurs most during the first 30 days after installation (Brooks 1995a). The point in time when the amount leached from CCA treated wood exceeded the amount leached from ACZA treated wood was between days 8 and 9. Appendix A of USACE (1997) provides analysis that shows that even in the worst case scenario, leaching from either ACZA nor CCA treated wood, in conjunction with the background concentration of 2 ppb water column copper in the lower Columbia River, would not exceed the recommended water column guideline of 7 ppb.

Table 1 (data taken from Table 2.1 of Appendix A of USACE (1997). Model predictions of total water column copper (background concentration of 2 parts per billion (ppb) plus copper contributions from ACZA or CCA treated wood pilings), based on pH, pilings, cross section, and current velocity (* = Cu concentrations > 7 ppb).

No. of Pilings	pH	Cross Section (m^2)	Copper Concentration (ppb) Velocity (cm/sec) 10	1	0.5	0.3
350	7.2	200	3.5	*17	*32	*52
350	7.2	400	2.75	*9.5	*17	*27
350	7.2	800	2.38	5.8	*9.5	*15
350	7.2	1600	2.2	4.0	6.0	*8.6
350	7.5	200	3.3	*15	*29	*47
350	7.5	400	2.67	*8.7	*15	*24
350	7.5	800	2.34	5.4	*8.7	*13
350	7.5	1600	2.17	3.7	5.4	*7.6
350	8	200	3.1	*13	*24	*39
350	8	400	2.56	*7.6	*13	*20
350	8	800	2.28	4.8	*7.6	*11.2
350	8	1600	2.14	3.4	4.8	6.6
100	7.2	200	2.43	6.3	*10.6	*16
100	7.2	400	2.22	4.2	6.3	*9.2
100	7.2	800	2.11	3.1	4.2	5.6
100	7.2	1600	2.054	2.54	3.1	3.8
100	7.5	200	2.38	5.8	*9.7	*15
100	7.5	400	2.19	3.9	5.9	*8.4
100	7.5	800	2.096	2.96	3.9	5.2
100	7.5	1600	2.048	2.48	2.96	3.6
100	8	200	2.32	5.2	*8.3	*13
100	8	400	2.16	3.6	5.2	*7.3
100	8	800	2.079	2.79	3.6	4.6
100	8	1600	2.04	2.40	2.79	3.3
24	7.2	200	2.10	3.0	4.1	5.4
24	7.2	400	2.052	2.52	3.0	3.7
24	7.2	800	2.026	2.26	2.52	2.86
24	7.2	1600	2.013	2.13	2.26	2.43
24	7.5	200	2.092	2.92	3.8	5.1
24	7.5	400	2.046	2.46	2.92	3.5
24	7.5	800	2.023	2.23	2.46	2.77
24	7.5	1600	2.012	2.12	2.23	2.38
24	8	200	2.076	2.76	3.5	4.5
24	8	400	2.038	2.38	2.76	3.3
24	8	800	2.019	2.19	2.38	2.63
24	8	1600	2.01	2.095	2.19	2.32

C. Results of modeling sediment copper concentrations:
A box model was developed to model sediment copper concentrations (Table 4.2 of Appendix A, USACE (1997)). Values were entered for the various parameters to produce Table 2.3 in Appendix A (USACE (1997)). Data from Table 2.3 (Appendix A of USACE (1997) was used to develop Table 2 in this document. Scenarios with redline and preceded with asterisks occur under conditions where the use of ACZA or CCA treated wood exceeds the recommended sediment guideline of 34 ppm. The NMFS recommends that Table 2 in this document be used to determine whether placement of ACZA- or CCA-treated wood pilings would exceed the recommended sediment copper guideline.

D. Results of modeling water column PAH concentrations:
A box model was developed to model water column PAH concentrations using the toxic unit (TU) approach (Table 4.3 of Appendix A, USACE (1997)). Values were entered for the various parameters to produce Table 3.2 in Appendix A (USACE (1997)). Table 3.2 from Appendix A (USACE (1997)) was reproduced in Table 3 in this document. Scenarios with redline and preceded with asterisks occur under conditions where the use of creosote treated wood exceeds the recommended water column PAH guideline of $\sum TU<0.018$. The NMFS recommends using Table 3 in this document to determine whether placement of creosote treated wood pilings would result in water column PAH concentrations that exceed the recommended water column PAH guideline.

E. Results of modeling sediment PAH concentrations:
A box model was developed to model sediment PAH concentrations (Table 4.4 of Appendix A, USACE (1997)). Values were entered for the various parameters to produce Table 3.4 in Appendix A (USACE (1997)). The U.S. Army Corps of Engineers (COE) proposed a maximum allowable contribution of 2.8 ppm total PAH from creosote treated wood, and scenarios followed by asterisks in Table 3.4 (Appendix A, USACE (1997)) occur under conditions where the use of creosote treated wood exceeded the COE proposed maximum allowable contribution of 2.8 ppm total PAH. Since the NMFS recommended sediment PAH guideline is 2.0 ppm dry weight for 1% total organic carbon to a mixing zone of 0.5 cm (for the lower Columbia River, background concentration of 0.5 ppm PAH dry weight plus a maximum contribution of 1.5 ppm total PAH dry weight from creosote treated wood), additional asterisks should be added to those scenarios where the resulting sediment concentration exceeds 1.5 ppm (for the lower Columbia River, or 2.0 ppm PAH dry weight minus the background concentration for other areas in Oregon).

The NMFS recommends that the box model used to model PAH concentrations in sediment (Table 4.4 of Appendix A, USACE (1997)) be modified to incorporate 10 years of leaching (Columns Q and R), rather than the 30 days of leaching that was used, to more realistically depict leaching from creosote treated wood. PAHs leach from creosote treated wood for a much greater length of time than the 30 days proposed in the sediment PAH model. Even with some degradation, PAHs accumulate in sediments, unlike water column concentrations that flow downstream. The NMFS acknowledges that the sediment PAH model does not account for

Table 2 (data taken from Table 2.3 of Appendix A of USACE (1997)). Model predictions of total sediment copper (background concentration of 20 parts per million (ppm) plus copper contributions from ACZA- or CCA-treated wood pilings) (* = Cu concentrations > 34 ppm)

No. of Pilings	Cross Sectional Area (m^2)	Velocity (m/sec)	Silt Area of impact m^2	Clay Area of impact m^2	Zone 1[1] Ten-day sum Cu mg/kg	Zone 2[2] Ten-day sum Cu mg/kg
350	200	0.003	1765	300000	*145.5899	22.0060
350	200	0.005	2941	500000	*95.3540	21.2036
350	200	0.01	5882	1000000	*57.6770	20.6018
350	200	0.1	58824	10000000	23.7677	20.0602
350	400	0.003	3529	600000	*82.7950	21.0030
350	400	0.005	5882	1000000	*57.6770	20.6018
350	400	0.01	11765	2000000	*38.8385	20.3009
350	400	0.1	117647	200000000	23.8838	20.0301
350	800	0.003	7059	1200000	*51.3975	20.5015
350	800	0.005	11765	2000000	*38.8385	20.3009
350	800	0.01	23529	4000000	29.4192	20.1504
350	800	0.1	235294	40000000	20.9419	20.0150
350	1600	0.003	14118	2400000	*35.6987	20.2507
350	1600	0.005	23529	4000000	29.4192	20.1504
350	1600	0.01	47059	8000000	24.096	20.0752
350	1600	0.1	470588	80000000	20.4710	20.0075
100	200	0.003	1765	300000	*55.8828	20.5731
100	200	0.005	2941	500000	*41.5297	20.3439
100	200	0.01	5882	1000000	30.7649	20.1719
100	200	0.1	58824	10000000	21.0765	20.0172
100	400	0.003	3529	600000	*37.9414	20.2866
100	400	0.005	5882	1000000	30.7649	20.1719
100	400	0.01	11765	2000000	25.3824	20.0860
100	400	0.1	117647	200000000	20.5382	20.0086
100	800	0.003	7059	1200000	28.9707	20.1433
100	800	0.005	11765	2000000	25.3824	20.0860
100	800	0.01	23529	4000000	22.6912	20.0430
100	800	0.1	235294	40000000	20.2691	20.0043
100	1600	0.003	14118	2400000	24.4854	20.0716
100	1600	0.005	23529	4000000	22.6912	20.0430
100	1600	0.01	47059	8000000	21.3456	20.0215
100	1600	0.1	470588	80000000	20.1346	20.0021
24	200	0.003	1765	300000	28.6119	20.1376
24	200	0.005	2941	500000	25.1671	20.0825
24	200	0.01	5882	1000000	22.5836	20.0413
24	200	0.1	58824	10000000	20.2584	20.0041
24	400	0.003	3529	600000	24.3059	20.0688
24	400	0.005	5882	1000000	22.5836	20.0413
24	400	0.01	11765	2000000	21.2918	20.0206
24	400	0.1	117647	200000000	20.1292	20.0021
24	800	0.003	7059	1200000	22.1530	20.0344
24	800	0.005	11765	2000000	21.2918	20.0206
24	800	0.01	23529	4000000	20.6459	20.0103
24	800	0.1	235294	40000000	20.0646	20.0010
24	1600	0.003	14118	2400000	21.0765	20.0172
24	1600	0.005	23529	4000000	20.6459	20.0103
24	1600	0.01	47059	8000000	20.3229	20.0052
24	1600	0.1	470588	80000000	20.0323	20.0005

[1]Zone 1 refers to the depositional zone for silt (0.0223-0.062 mm diameter) and clay (0.0014-0.004 mm diameter) particles nearest each pile.

[2]Zone 2 refers to the depositional zone for and clay (0.0014-0.004 mm diameter) particles downstream of zone 1.

Table 3 (reproduced from Table 3.2 of Appendix A of USACE (1997). Toxic unit (TU) summary for polycyclic aromatic hydrocarbons (PAHs) leached from creosote treated wood piling scenarios (* = $\sum$TU > 0.018).

No. of Pilings	Cross section (m^2)	Velocity (m/sec)	TU Summary
350	200	0.003	*2.940
350	200	0.005	*1.767
350	200	0.01	*0.884
350	200	0.1	*0.088
350	400	0.003	*1.473
350	400	0.005	*0.884
350	400	0.01	*0.442
350	400	0.1	*0.044
350	800	0.005	*0.442
350	800	0.01	*0.221
350	800	0.05	*0.044
350	800	0.1	*0.022
350	1524	0.003	*0.387
350	1524	0.005	*0.232
350	1524	0.01	*0.116
350	1524	0.1	0.012
100	200	0.003	*0.840
100	200	0.005	*0.505
100	200	0.01	*0.250
100	200	0.1	*0.025
100	400	0.003	*0.420
100	400	0.005	*0.250
100	400	0.01	*0.126
100	400	0.1	0.012
100	800	0.005	*0.126
100	800	0.01	*0.060
100	800	0.05	0.012
100	800	0.1	0.006
100	1524	0.003	*0.110
100	1524	0.005	*0.060
100	1524	0.01	*0.033
100	1524	0.1	0.003
24	200	0.005	*0.121
24	200	0.01	*0.060
24	200	0.1	0.006
24	400	0.003	*0.101
24	400	0.005	*0.061
24	400	0.01	*0.030
24	400	0.1	0.003
24	800	0.005	*0.030
24	800	0.01	0.002
24	800	0.05	0.003
24	1524	0.003	*0.027
24	1524	0.005	0.015
24	1524	0.01	0.007
24	1524	0.1	0.001

resuspension, turbulence, lateral dispersion, or biodegradation of PAH compounds over time, and therefore, use of 10 years rather than 30 days of continuous leaching may overestimate the accumulation of PAHs in the sediment. However, lack of inclusion of the above factors does not discount the fact that PAHs leach for years, and should be addressed. "Leaching of PAHs is a protracted process and occurs for years after pilings have been installed" (USACE 1997). "Consequently, long-term accumulation is a concern and would need to be considered in an assessment when creosote treated wood is used" (USACE 1996). Ingram *et al.* (1982) determined that even after 12 years, a creosote treated pile leaches 8.0 $\mu g/cm^2/day$ of creosote.

F. Additional analysis:

Tables 1-3 above provide scenarios that were input into the box models to predict water column and sediment concentrations of copper and PAH. However, proposed treated wood piling projects may not fit into any one of these scenarios. For example, the number of pilings proposed in a treated wood project may fall between 24 and 100 pilings. If an applicant chooses to use the tables to determine if their proposed treated wood project falls within the recommended water column and sediment guidelines, the NMFS recommends that the more conservative scenario be used. For example, if an applicant proposes to use 40 treated wood pilings, the scenario with 100 pilings should be used.

An alternative to using the general scenarios presented in Tables 1-3 is to use multiple regression equations based on site specific data. These multiple regression equations can also be used if proposed ACZA, CCA, or creosote treated wood projects exceed the recommended water column and sediment copper or PAH guidelines based on the use of Tables 1-3 above. The recommended water column and sediment copper and PAH guidelines will not change if site specific data are used for the additional analysis. However site specific data may provide more accurate information in determining actual resulting concentrations from placement of treated wood. Below are multiple regression equations taken from USACE (1997) for the individual analyses:

1. For water column copper:

$$Cu=10^{[-\log flow + \log piles - \log XS + 0.883]}$$

where:

Cu = copper concentration in ppb;
flow = current velocity in cm/sec;
piles = number of piles; and
XS = cross sectional area in $meters^2$.

2. For sediment copper:

$$Cu=10^{[-\log piles - \log XS - \log flow - 0.667]}$$

where:

Cu = copper concentration in ppm;
piles = number of piles;
XS = cross sectional area in meters^2; and
flow = current velocity in m/sec.

USACE (1997) stated that scenarios that exceeded the recommended guideline for water column copper also exceeded the recommended guideline for sediment copper. As a result, individual ACZA or CCA treated wood projects could be individually analyzed using either equation #1 or #2 above.

3. For water column PAH:

$$\sum TU=10^{[1.07\log piles - 1.04\log XS - \log flow - 2.34]}$$

where:

piles = number of piles;
XS = cross sectional area in meters^2; and
flow = current velocity in m/sec.

4. For sediment PAH:

$$\text{total PAH (ppm)}=10^{[\log piles - \log XS - \log flow - 2.56]}$$

where:

piles = number of piles;
XS = cross sectional area in meters^2; and
flow = current velocity in m/sec.

This multiple regression equation was based on the box model presented in Table 4.4 of Appendix A (USACE 1997). Since 10 years, rather than 30 days, of accumulation was recommended to be incorporated into the box model for creosote treated wood, the coefficients of the above regression equation will change.

V. Cumulative Effects

The NMFS recommends that background concentrations, rather than time frames, be used in the cumulative impacts assessment. If a treated wood project is proposed within the vicinity (footprint) of an older project (based on the box models in Appendix A of USACE 1997), background concentrations of sediment copper or PAH (for ACZA/CCA or creosote treated wood projects, respectively) should be sampled prior to permitting the installation of the treated wood project. If the site specific background concentration exceeds that specified above, the allowable contributions from ACZA, CCA, and creosote treated pilings should be reduced by the same concentration in order to stay within the recommended water column and sediment guidelines.

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