CREOSOTE PILING GUIDANCE ELIZABETH RIVERFRONT / HARBOR PARK AREA BROWNFIELDS REDEVELOPMENT PROJECT NORFOLK, VIRGINIA

Creosote pilings are located along the Elizabeth Riverfront, and Harbor Park Areas of Norfolk, and are (or were) used to form support foundations, retaining walls, or other structures for current and historical operations. As part of the City's waterfront brownfield redevelopment efforts, it is important to understand and develop an approach for the management of creosote pilings. This guidance is based on strategies approved by the U.S. Environmental Protection Agency (USEPA), other noted expert sources and waterfront municipalities, published white papers, and peer-reviewed publications.

Creosote

Creosote is a fungicide, insecticide, and sporicide derived from the distillation of coal tar, which consists of hundreds of compounds (between 200-250 identifiable substances), and has a variable composition (EPA 2008). Coal-tar creosote has been used as a wood preservative in the United States since the early 1900s (U.S. Department of Health and Human Services, September 2002). It is widely used to preserve wood for uses such as railroad ties, utility poles, and marine pilings. According to the USEPA, 85 percent to 90 percent of creosote substances are polyaromatic hydrocarbons (PAHs), which have high molecular weight and low water solubility. Some PAHs are known to be carcinogenic, mutagenic, and toxic to both humans and aquatic organisms (Smith 2008).

Creosote is a registered pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The FIFRA program requires periodic re-evaluation and re- registration. On November 19, 2008 the USEPA issued a Reregistration Eligibility Decision (RED) for the continued use of creosote as a wood preservative (Federal Register, Vol. 73, page 69646 – 69647). The FIFRA evaluation process is to ensure that the pesticide meets current scientific and regulatory standards, which according to the EPA's 2008 reregistration, the continued use of creosote as a wood preservative for marine pilings is allowed. The current FIFRA approval includes the use of creosote for marine pilings that are used in direct contact with water.

Environmental Risks

Although the use of creosote-treated pilings is legally acceptable and a commonly used material, several studies have proven the chemical treatment of wood have adverse impacts on water and sediment quality and can be toxic to aquatic organisms. Groyette and Brooks' 1998 study looked at creosote-treated pilings in the Sooke Basin of Vancouver Island, British Columbia. After one year, the study showed that PAH contamination was found downstream, considerable biological effects were seen around the perimeter, and sediment toxicity was observed around the pilings. They proposed the creosote transport theory, in which PAHs are transported in particulate form from the treated pile, allowing chemicals to accumulate in the sediment. PAHs can accumulate from the formation of surface sheen, and from surface heating, which causes creosote to expel from the wood and can cause PAHs to significantly increase in toxicity (NOAA 2009; Washington Department of Natural Resources 2014). Another study in San Francisco Bay showed that surface sheen was seen around pilings that were treated over fifteen years prior (WWPI & WPC 2011). Further, laboratory and field studies have examined the capacity for organisms to take up and accumulate creosote constituents, and have examined acute and chronic toxicity to marine organisms. Chronic and acute effects have been measured in several species, including, but not limited to: sea squirts, mussels, oysters, zooplankton, spot, and killifish (specifically noted in the Elizabeth River and Chesapeake Bay).

The Elizabeth River, near the mouth of the Chesapeake Bay, once housed a creosote-treatment facility, with documented numerous creosote spills. Elizabeth River sediments have some of the highest sediment PAH concentrations recorded in marine habitats (Werme et al. 2010). Two possible pathways of exposure to creosote compounds are a) direct exposure to animals that live or spawn on upright pilings, and b) continued exposure from derelict structures that end up washed up onto beaches.

Piling Removal

Studies have indicated that pilings and other artificial structures provide possible environmental benefits, such as habitat for invertebrates, roosts for birds, and a spawning location for certain fish species (e.g., herring). However, far more studies have indicated potential harm from treated structures. It is documented that pilings will leach the most during the first two years after installation and then leaching declines significantly. The Norfolk Riverfront area has been developed since at least 1887, and the use of treated pilings can be presumed. While a survey or inventory has not been performed, it is presumed that the vast majority of the existing pilings were installed over two years ago, and are therefore beyond the 2-year timeframe for significant leaching. Therefore, for those pilings that are shown to be in good condition and a viable use determined as part of the development effort, the pilings can be allowed to remain in place with little effect on the surrounding environment. However, those pilings that have been abandoned or are no longer going to be used, removal is recommended.

The planning phase of piling removal projects should include a historical significance assessment, an assessment of the logistics and costs for removal and disposal, and consideration of permitting and other legal issues (Werme et al. 2010). Additionally, the possible risks associated with temporarily increasing exposure to PAHs when creosote-treated pilings are removed (re-suspending contaminated sediment) versus the continued leaching of pilings left in place, albeit minimal, should be considered.

Pile removal techniques include complete-removal methods, such as vertical pulling and vibratory extraction, and partial-removal methods, such as horizontal snapping and breaking:

- **Vertical pulling** involves gripping the pile with a chain, cable, or collar, and pulling with a cable or hydraulic crane. Vertical pulling may result in removal or resuspension of sediments from the immediate area surrounding the pile.

- **Vibratory extraction** involves attaching a vibratory hammer to the pile to break the seal between the pile and the sediment and pulling with a crane or excavator. This technique is usually faster than vertical pulling. It may result in less resuspension of sediments and lower handling and disposal costs, because of less attached sediment.

- **Horizontal snapping** or breaking typically involves pushing or pulling the pile laterally to break off the pile near the mud line. Horizontal snapping is a faster removal technique than complete extraction. The technique removes less of the pile, possibly lessening sediment resuspension, and because it involves fewer materials handling and disposal costs are reduced. Most regulators prefer that piles be removed to a depth of at least two feet below the mud line. However, piles tend to break at their weakest points so that this technique can be inconsistent.

- **Cutting** is completed by divers, who use hydraulic or pneumatic chainsaws, or hydraulic shears to cut the piles.

The decision to use either complete or partial removal is typically based on considerations concerning future uses of the site, navigation hazards, environmental effects, and costs. Removal costs will depend on the size of the project, fuel prices, water depths, and funding sources (Werme et al. 2010). The timing of pile-removal projects may also affect costs due to certain restrictions (e.g., dredging and endangered species).

The EPA Region 10 (Pacific Northwest: Alaska, Idaho, Oregon, and Washington) has developed Best Management Practices (BMPs) associated with piling removal and placement that apply to projects conducted in marine and freshwater environments. These practices, summarized below, are being used by the Washington Department of Natural Resources (DNR) for their Puget Sound project, which is the largest creosote-removal project in the U.S., and by California in the San Francisco Bay. The BMPs may be adopted for projects in other states so long as they are consistent with relevant requirements of the appropriate state and federal agencies (EPA 2008). The potential cumulative effect of leaching uncertainties has led numerous agencies including:

1. (NMFS (1998, 2003, 2004),
2. Fisheries and Oceans Canada (Hutton and Samis 2000),
3. USDA (Lebow and Tippie 2001),
4. Washington Department of Fish and Wildlife and Department of Ecology (Poston 2001),
5. USACE (2006, Castanon, D., pers. Comm. 2004)) and industry (WWPI 2006a, 2006b)

to recommend BMPs to minimize avoidable and unnecessary risks to the environment. Their reccommendations include:

- Vibratory extraction is preferred over direct (vertical) pulling, cutting, and other methods.
- Complete removal is preferred over partial removal.
- Piles that cannot be completely removed should be cut at least one foot below the mud line.
- Sediment disturbance should be minimized.
- No barge grounding should occur over eelgrass beds.
- All piles, mud, and debris should be disposed of in a proper landfill.
- A floating boom with absorbent pads is required to capture debris suspended during removal.
- Project oversight by the state may include turbidity testing.

Disposal and Recycling Options

Creosote pilings are not listed or regulated as hazardous waste under the Resource Conservation and Recovery Act (RCRA). Removed creosote-treated lumber is typically managed and disposed as non-hazardous solid waste, or recycled. Disposal options include construction and demolition (CDD) landfills, municipal solid waste landfills, or industrial non-hazardous waste landfills. Disposal arrangements should be coordinated with the landfill before shipment, as the materials may be considered "special waste" and subject to pre-approval requirements.

Recycling options include facilities such as Tidewater Green, which grinds the treated wood for beneficial use as fuel for industrial boilers (www.tidewatergreen.com).

Living Shorelines

On the East Coast, restoration scientists have been developing techniques for incorporating naturalized habitat into shoreline-stabilization projects or "living shorelines" (which is Virginia's preferred approach). A living shoreline is a shoreline management practice that addresses erosion in lower energy situations by providing for long-term protection, restoration or enhancement of vegetated shoreline habitats (http://ccrm.vims.edu/livingshorelines). The natural substrate used in living shoreline designs include emergent marsh, submerged aquatic vegetation (SAV), riparian vegetation, and oyster shells (Werme et al. 2010). Hard artificial structures, such as sills, breakwaters, and spurs can be used in conjunction to form a hybrid design. Benefits of hybrid projects include providing space and structure for local species, wave attenuation, and improving water quality through a reduction in suspended sediments, without a commitment to a fully, non-structural shoreline (Werme et al. 2010). The NOAA Restoration Portal (https://habitat.noaa.gov/restoration/) summarizes information about habitats, techniques, and resources for restoration studies and projects, including those that have incorporated living shorelines.

Elements to be considered in the restoration or on new projects may include technical constraints, conservation goals, and public concerns such as the:

- Selection of appropriate shoreline-stabilization techniques.
- Protection and enhancement of native species habitat and shellfish beds.
- Collection of baseline information on aquatic habitats and biota.
- Assessment of sufficient light intensity for plant photosynthesis, fish recruitment, and growth.
- Minimization of shading effects and scouring.
- Documentation of success through continued monitoring of water quality, habitat variables, and flora/fauna recruitment.
- Stakeholder involvement.

Conclusion

There is no regulatory requirement to remove existing pilings. In conjunction with waterfront brownfields redevelopment projects, four primary considerations should be made before beginning a piling removal project:

- The distribution of pilings (whether abandoned or could be used again) needs to be evaluated, along with the condition of each piling or grouping of pilings;
- An environmental assessment should be conducted to evaluate the potential adverse effects of the creosote-treated wood, or if there are any potential benefits for leaving pilings in place (i.e., a finding of no significant impact);
- The historical significance of the piles should be evaluated; and
- An action plan for the feasibility and logistics of removal should be created.

Within the action plan, there should be a discussion on proper disposal methods. While most removed pilings are disposed of as solid waste, some pilings can be reused, or beneficially used, as fuel in wood-fired boilers (e.g., Tidewater Green).

Projects should be assessed on a case-by-case basis due to the variability of each site. However, the matrix below can provide a starting point and general guideline for deciding what to do with pilings. Please note this matrix is just for guidance and does not include all considerations and specifications of a particular site.

Table 1: Matrix

Piling Condition	Environmental Assessment	Historical Sigificance	Action
Good	No Significant Impact	Yes	Leave Piling *can remove if work with Virginia Department of Historical Resources (DHR) *environmental mitigation may be required if removed
Good	No Significant Impact	No	Leave Piling, Remove Fully, Removal Partially *environmental mitigation may be required if removed
Good	Adverse	Yes	Remove Piling, but work with DHR and others to minimize environmental impacts.
Good	Adverse	No	Leave Piling, Remove Fully, or Remove Partially *minimize environmental impacts if left in place
Bad	No Significant Impact	Yes	Remove Piling, but work with DHR *environmental mitigation may be required
Bad	No Significant Impact	No	Remove Fully or Partially *environmental mitigation may be required
Bad	Adverse	Yes	Remove Fully, but work with DHR *can removal partially if minimize environmental impacts
Bad	Adverse	No	Remove Fully *can partially remove to minimize environmental impacts

REFERENCES

American Wood Preservers' Associations Standards, 1998, pp 3-4.

California Coastal Commission. Spring 2012. California Coastal Nonpoint Source Program Water Quality Fact Sheet: Pilings – Treated Wood and Alternatives. Retrieved from https://www.coastal.ca.gov/nps/Pilings-Treated_Wood.pdf

Canadian Institute of Treated Wood – Western Wood Preservers Institute. 1997. Best Management Practices for the Use of Treated Wood in Aquatic Environments. Developed For Use In Specifying Materials For Use In Aquatic Projects in Canada and the Western United States.

Dunn B.P. and H.F. Stitch. 1976. Monitoring procedures for chemical carcinogens in coastal waters. Journal of the Fisheries Research Board Canada 33:2040-2046.

Goyette, D. and K.M. Brooks. 2001. Addendum Report: Continuation of the Sooke Basin Creosote Evaluation Study (Goyette and Brooks, 1998); Year four – Day 1360 & Day 1540. Prepared for: Creosote Evaluation Steering Committee Regional Program, Report PR0-03, May 12, 2001.

Goyette, D. and K.M. Brooks. 1998. Creosote Evaluation: Phase II Sooke Basin Study – Baseline to 535 Days Post Construction 1995-1996. Prepared for: Creosote Evaluation Steering Committee Regional Program, Report PR98-04, December 1998.

Hyotylainen, T. and A. Oikari. 2004. Bioaccumulation of PAHs from creosote-contaminated sediment in a laboratory-exposed freshwater oligochaete, *Lumbriculus variegates*. Chemosphere: 57:159-164.

National Oceanic and Atmospheric Administration, October 2009. The Use of Treated Wood Products in Aquatic Environments. Retrieved from http://www.westcoast.fisheries.noaa.gov/publications/habitat/treated_wood_guidelines_final_2010.pdf

Smith, K.M. 2006. Integrating habitat and shoreline dynamics into living shoreline applications. In Management, Policy, Science, and Engineering of Nonstructural Erosion Control in the Chesapeake Bay. Proceedings of the 2006 Living Shoreline Summit, S.Y. Erdle, J.L.D. Davis, and K.G. Sellner, editors. CRC Publication 08-164.

Smith, P. (2008). Risks to Human Health and Estuarine Ecology Posed by Pulling Out Creosote-Treated Timber on Oyster Farms. Aquatic Toxicology, 86(2), 287-298.
doi: 10.1016/j.aquatox.2007.11.009

United States Department of Health and Human Services, September 2002. Toxicological Profile for Wood Creosote, Coal Tar Creosote, Coal Tar, Coal Tar Pitch, and Coal Tar Pitch Volatiles. Public Health Service, Agency for Toxic Substances and Disease Registry.

United States Environmental Protection Agency (USEPA), September 2008. Reregistration Eligibility Decision for Creosote (Case 0139). Prevention, Pesticides and Toxic Substances EPA Document 739-R-08-007. Retrieved from https://archive.epa.gov/pesticides/reregistration/web/pdf/creosote_red.pdf

United States Environmental Protection Agency (USEPA), 2001. Assessment of Potential Creosote Inhalation and Dermal Exposure Associated with Pressure-Treatment of Wood with Creosote. Office of Pesticides and Toxic Substances, January 30, 2001.

United States Environmental Protection Agency (USEPA) Decument 540-RS-88-066. Guidance for the Registrations of Pesticide Products containing Coal Tar/Creosote.

Virginia Institute of Marine Science. Living Shorelines brochure. Prepared for: The Center for Coastal Resources Management. Retrieved from http://ccrm.vims.edu/livingshorlines/

Washington Department of Natural Resources, 2013. Derelict Creosote Piling Removal Best Management Practices for Pile Removal & Disposal. Retrieved from http://wa-dnr.s3.amazonaws.com/publications/aqr_rest_pilingremoval_bmp.pdf

Werme, Christine, Jennifer Hunt, Erin Bellar, Dristen Cayce, Marus Klatt, Aroon Melwani, Eric Polson, and Robin Grossinger. December 2010. Removal of Creosote-Treated Pilings and Structures from San Francisco Bay. Prepared for: California State Coastal Conservancy.

Western Wood Preservation Institute and Wood Preservation Canada, 2011. Best Practices for Use of Treated Wood in Aquatic and Wetland Environments. Retrieved from http://www.wwpinstitute.org/documents/BMP_Revise_4.3.12.pdf

Younie, Tamara, University of British Columbia, May 2015. Creosote-Treated Pilings in the Marine and Freshwater Environments of Metro Vancouver: Risks, Financial Impacts, and Alternatives. Prepared for: the Port of Metro Vancouver in partial fulfillment of UBC Geography 419: Research in Environmental Geography, for Dr. David Brownstein.