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Review of scientific conclusions that serve as basis for the proposed California Trash Amendments.

Conclusion #1: Trash threatens public health and safety, reduces aesthetic appeal, degrades aquatic habitats, and endangers wildlife in surface waters

The need for the proposed Trash Amendments is based on a number of claims. The first claim is that trash is present in streams, rivers, lakes, estuaries, wetlands, the ocean, and along beaches. This claim is supported by data in peer-reviewed publications cited in the Draft Staff Report (e.g. EPA 2002, Moore et al. 2001). Additional supporting evidence is provided by Ribic et al. (2012), who provide a 10-year perspective on debris quantities at locations on the US Pacific Coast. Furthermore, Smith and Markic (2013) suggest that quantitative estimates of trash deposition along marine shorelines are likely low because of the low sampling frequencies employed in most studies.

The second claim is that trash interferes with beneficial uses of surface waters by adversely affecting public health and safety as well as aquatic habitat and life. Examples of public health and safety effects include health and safety hazards for fishermen, recreational boaters, and children playing on beaches and in the water. Examples of effect on aquatic habitat and life include fatalities of mammals, turtles, birds, fish, and crustaceans as a result of trash ingestion or entanglement by trash. Harmful effects of trash on aquatic habitat and life are well supported by the peer-reviewed literature cited in the Draft Staff Report (e.g., Bjorndahl et al. 1994, EPA 1992, 2002, Gramenetz 1988, Jacobsen et al. 2010, Tomas et al. 2002). The 2008 National Research Council Report "Tackling Marine Debris in the 21st Century," which was mentioned in the March 10 memo, as well as the paper by Gregory (2009) could be added to further support the claim that trash interferes with beneficial uses of surface water. Both sources include additional examples and citations regarding trash impacts on aquatic life and habitat. Other claims associated with the degradation of aquatic habitat made in Appendix A of the Draft Staff Report (trash is a transport medium for invasive species, trash inhibits gas exchange at the sediment/water interface and promotes hypoxia/anoxia) are based on sound scientific knowledge and documented through appropriate citations. Claims associated with the adverse effects of trash on public health and safety are primarily supported through examples provided in a 2010 report prepared by the Los Angeles Water Quality Control Board. The 2008 National Research Council Report "Tackling Marine Debris in the 21st Century" as well as papers by Gregory (2009) and Hastings and Potts (2013) provide additional support that could be incorporated in the Draft Staff Report if needed.

Persistent organic pollutants (POPs) sorbed to microplastics may pose another hazard for aquatic life. The Draft Staff Report appropriately points out that limited research exists on the biological uptake and bioaccumulation of toxics from plastics (p. A-193); however, the conclusion that plastic trash is therefore not a significant vector of toxics relative to other exposure processes (p. A-193) does not necessarily follow from the recognized data scarcity. The Draft Staff Report

correctly points out that some studies have suggested that plastic trash may not be an important vector for wildlife exposure to POPs (Gouin et al. 2011, which is cited in the Draft Staff Report). In addition, a recent paper arrived at a similar conclusion for bisphenol A and nonylphenol (Koelmans et al. 2014). On the other hand, Besseling et al. (2013) showed that the internal PCB105 concentration in lugworms increased upon microplastic ingestion from sediment containing ~0.1-1% microplastic; however, the study also concluded that the microplastic contents tested in the sediments were not representative of those found in affected aquatic habitats. Data gaps are still too large to draw conclusions about the importance of POP exposure via ingestion of microplastics. It also needs to be pointed out that trash is defined as particles >5 mm in diameter/size while a substantial fraction of microplastics is <5 mm in size (Moore et al. 2011). As a result, trash removal from stormwater will reduce but not eliminate the exposure of aquatic organisms to microplastics and POPs sorbed to microplastics.

Related claims in Appendix A of the Draft Staff Report (Effects of Trash on Contact and Non-Contact Water Recreation, Commercial and Sport Fishing, and Navigation as well as Effects of Trash on Native American Culture [and subsistence fishers]) are reasonable and can be further supported, at least in part, by the information presented by National Research Council (2008), Gregory (2009), Hastings and Potts (2013) and references therein. Both National Research Council (2008) and Hastings and Potts (2013) address economic implications of trash on tourism and fisheries.

Based on the above analysis, conclusion #1 is based on sound scientific knowledge and warrants the development of a narrative water quality objective for trash.

Conclusion #2: Different land uses have different rates of trash generation

Both the March 10 memo and Appendix A (p. A-200) suggest that 80% of marine debris is derived from land-based sources, and this figure is based on a 1999 NOAA publication. This claim could be further substantiated with the data of Ribic et al. (2012), who illustrate that at least 60% of debris on Southern California beaches is derived from land-based sources while at least 8% is derived from ocean-based sources; the balance could not be assigned to either origin. Ribic et al. (2012) also report data for other Pacific Coast locations.

The March 10 memo states that “the primary transport mechanism of land-based trash is through storm water and urban runoff” and references National Research Council 2008. I could not verify the use of “primary” in National Research Council (2008), which states “stormwater runoff, which is recognized as a major source of the marine debris along U.S. coasts and waterways, is regulated as a point source under the National Pollutant Discharge Elimination System.” However, the Draft Staff Report takes a more global approach to defining important sources and transport mechanisms for trash, which is more appropriate. Through appropriate citations, the Draft Staff Report also appropriately supports the argument that runoff during storm events is an important transport mechanism for land-based trash (p. A-200). National Research Council (2008) could be added to the list of references for additional support.

The March 10 memo and the Draft Staff Report appropriately state that land use plays a role in trash generation rates. In addition to the cited studies in the Draft Staff Report (pp. A-201 -

A-204), the paper by Hipp et al. (2006) could be cited. While not focusing directly on trash, Hipp et al. (2006) illustrate that total suspended solids (TSS) inputs vary by land use and that placement of treatment devices can be optimized based on knowledge of TSS sources. Hipp et al. (2006, Supplementary Information) identified vacant lots as an important TSS source term.

Based on the above analysis, conclusion #2 is based on sound scientific knowledge and has important implications for the development of cost-effective strategies compliance strategies.

Conclusion #3: A full capture system is an effective method for capturing trash greater than 5 mm from entering a surface water body via storm water

Based on the importance of storm water as an importance conveyance mechanism for land-based trash, it is claimed that properly functioning full capture systems (defined as treatment controls capable of capturing trash that is 5 mm or greater in size) are an effective way to capture trash and divert trash in areas of high trash generation from the waterways and beaches. Full capture systems can include catch basin inserts, vortex separation systems, trash nets, and gross solids removal devices. While there is little information on the performance of full capture systems in the peer-reviewed literature, an undated report by the California Coastal Commission and the Algalita Marine Research Foundation (http://plasticdebris.org/Trash_BMPs_for_Munis.pdf) provides a useful summary of the performance, maintenance needs, and costs of full capture systems. I will refer to this report as the CCC report.

When assessing the effectiveness of a full capture system, its performance during storm events is important. For example, the CCC Report points out that catch basin inserts of the box and tray kind have limited volume capacity and cannot be considered full capture systems because trash escapes the catch basin inserts during storm events. Also, accumulated material can lead to loss of drainage capacity and local flooding. Some catch basin inserts are also vulnerable to damage by lit cigarette butts (Kostarelos et al. 2011). Nonetheless, catch basin inserts, when properly designed and maintained, offer the possibility to function as a full capture system

Some vortex separation systems can be problematic because they impart additional head loss that cannot be accommodated by some existing storm drains, and upstream flooding can be a result (CCR Report).

End-of-pipe nets can quickly clog when net openings of 5 mm are used (CCR Report). As a result, inspection is needed after every storm >0.25 in. This inspection frequency is also recommended for other netting systems, such as in-line netting and floating systems. A study conducted by the US Environmental Protection Agency and Fresh Creek Technologies illustrated that the Netting Trash Trap system was 93-97% effective for trash removal from a combined sewer overflow (US EPA 1999). Mesh openings of 6.5 and 13 mm were tested and yielded similar trash removal efficiencies; however, no information about the size of non-retained particles was reported.

According to the CCR report, gross solids removal devices are effective to very effective for removing litter from discharges of highway storm water runoff (linear radial device: 98%

removal by weight, 92% removal by volume; inclined screen device: 100% removal). Annual maintenance of gross removal devices at the end of the wet season appears to be sufficient.

Overall, conclusion #3 is based on sound scientific knowledge, and a number of studies and reports illustrate that full capture treatment options are available that effectively remove trash from storm water. Because storm water is an important trash conveyance mechanism, trash removal by full capture devices is expected to lead to substantial reductions in trash introduction to surface waters, including coastal waters. I recommend that the Draft Staff Report be updated with information presented in the CCR Report to more completely capture the pros and cons associated with each of the presented full capture treatment options.

Additional comments/questions:

1. Table 13 (p. A-189-190): What is meant by "biological compounds"? See entries for Estuarine Habitat, Marine Habitat, Wetland Habitat.
2. Last 4 lines on p. A-198: Fit? Needed?
3. Page A-199: "five primary transport mechanisms" should be changed to five primary sources and transport mechanisms"
4. Define dry season runoff. Dry season streamflow?
5. Use "sorb" instead of "adsorb" or "absorb" when discussing POP sorption to plastics. Depending on the type of plastic and the POP concentration, adsorption or absorption can dominate. Sorb is a more general term that encompasses both mechanisms.

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