

*California Ocean Litter Prevention Strategy:
Addressing Marine Debris from Source to Sea*

DRAFT

November 9, 2017

****PLEASE NOTE****

Thank you for taking the time to review the draft *California Ocean Litter Prevention Strategy: Addressing Marine Debris from Source to Sea (Strategy)*. The draft Strategy was developed based on a wide range of stakeholder input and identifies Goals, Objectives, and a list of Action Items for stakeholders to collaboratively implement to prevent and reduce ocean litter.

Please note that the Strategy is still in draft form and a final version of this document will be made available **after the second workshop that is taking place on November 15-16, 2017 in La Jolla, CA**. You will notice that there is some text in red and sections of the tables that are blank. These were intentionally left red or blank and will be discussed and further fleshed out during the second workshop.

In particular, we are soliciting feedback on the following:

1. Please identify any Action Items that you (and your organization) may be interested in taking a lead or partnership role in implementing or feel strongly that you may want to be involved in. Identifying your name (and your organization) next to an Action Item means that you and your organization will give your best efforts to implement the action item, given organizational and funding availability. Your input will help us develop breakout groups during the second workshop and further fill out the tables.
2. Do you think five years is the appropriate time scale for this document? Do you think it would be better if the time frame was longer or shorter?
3. What are your thoughts on the three ocean litter priority Objectives?
 - a) Do they reflect your understanding of what the state's ocean litter priorities are/should be?
 - b) If not, what do you think the top priorities should be?
 - c) What ocean-based litter Objectives do you think should be included as a priority Objective?
4. Are there any actions that were not included in the draft Strategy that you would like to see incorporated?

Please see Appendix B of the draft Strategy for a complete list of Action Items that came out of workshop #1. Action Items that were identified during workshop #1 were compiled and condensed and those that were mentioned the most by workshop #1 participants, as well as those that the planning team identified as particularly important (and feasible), were included in this draft. Your comments on this draft, as well as discussion during the second workshop, will help identify and address any gaps in the draft Strategy's Action Items and/or priority Objectives, and ultimately finalize the Strategy.

Please send general comments, edits, and questions regarding the draft Strategy to oceanlitterstrategy@resources.ca.gov by **Monday, October 16, 2017**. When sending your comments, please include your thoughts on the above four questions. We anticipate circulating an updated version of the draft Strategy before the second workshop.

A formal invite with additional information regarding workshop #2 is forthcoming.
Thanks again and we look forward to hearing from you.

Sincerely,

The Planning Team

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EXECUTIVE SUMMARY

Ocean litter is a pervasive problem at a local, regional, and global scale with a wide range of consequences to human health, the environment, and the economy. To ensure that California communities, environments, and economies remain productive and vibrant, immediate actions need to be taken to reduce and prevent ocean litter. The Ocean Protection Council (OPC) is updating its [2008 Implementation Strategy to Reduce and Prevent Ocean Litter](#), in partnership with the National Oceanic and Atmospheric Administration's [Marine Debris Program](#) to develop the *California Ocean Litter Prevention Strategy: Addressing Marine Debris from Source to Sea (Strategy)*, which will provide guidance on implementing effective solutions to addressing this pressing issue.

Since the original Strategy was developed, many of the actions described in the document have either been accomplished or are in progress. In some cases, the State's regulatory or agency landscape has changed. In other cases, our understanding of the ocean litter problem has changed considerably since 2008, and some of the actions that were outlined in the 2008 Strategy may no longer be the best way to go about addressing ocean litter.

The update process expands the previous Strategy to include projects of a variety of scales and scopes so that entities including tribes, government agencies, industry, academia, and nonprofits can make meaningful contributions towards reducing ocean litter in California. The Strategy prioritizes source reduction objectives and actions, as agencies and experts agree that source reduction is the most effective tactic to address ocean litter. Preventing waste in the first place - through initiatives such as transitioning to reusable products and redesigning packaging - is a more effective method of reducing waste as it reduces the amount of litter to control, capture, and dispose.

The Strategy was drafted based on a wide range of stakeholder input and identifies Goals, Objectives, and a list of Action Items for stakeholders to collaboratively implement. The three priority Objectives listed below were identified as the most effective actions to reduce and prevent ocean litter:

Priority #1: Prohibit single use products, such as straws, stirrers, expanded polystyrene, and balloons, if a feasible, less damaging alternative is available.

Priority #2: Require the phase out of single use products in public institutions and facilities (i.e. government functions, campuses), such as convenience food and beverage packaging.

Priority #3: Advance research on microplastics and technological solutions to reduce microplastics in wastewater discharge.

Contributors to this document identified specific action items that are politically, socially, and economically feasible for California to accomplish within the **next five** years. Furthermore, with many dynamic and influential entities working on ocean litter throughout the state, it was important that organizations take ownership and implement action items that align with their respective goals and mandates.

In summary, this document provides a holistic, collaborative strategy for addressing ocean litter in California, with a focus on reducing land-based litter at its source. It focuses on high impact action items that entities can commit to working on over the **next five** years. The document provides both guidance with flexibility so that lead and partner organizations can work collaboratively to pursue funding (where needed) and implement these action items. Everyone has a vital role in working towards reducing and preventing ocean litter to ensure a healthy coast and ocean for current and future generations of Californians

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LIST OF ACRONYMS

**Update once after workshop #2 and all lead and partners organizations are identified*

| | |
|------------|---|
| BMP | Best Management Practices |
| CalRecycle | California Department of Resources Recycling and Recovery |
| CCC | California Coastal Commission |
| CSU | California State University |
| DTSC | Department of Toxic Substances Control |
| EPR | Extended Producer Responsibility |
| OPC | California Ocean Protection Council |
| MDP | Marine Debris Program |
| NRDC | Natural Resources Defense Council |
| NOAA | National Oceanic and Atmospheric Administration |
| SWRCB | State Water Resources Control Board; State Water Board |
| UC | University of California |

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BACKGROUND

The Global Problem of Ocean Litter

Ocean litter, or marine debris, is a persistent, well-documented problem of global scale. Anthropogenic litter has been observed in submarine canyons in the northeastern Atlantic Ocean (Pham et al. 2014), in surface waters of the Southern Ocean (Isobe et al. 2017), the Mediterranean Sea (Suaria et al. 2016), and the Caribbean Sea (Law et al. 2010), and on beaches and shorelines worldwide (Ocean Conservancy 2017, Browne et al. 2011). While there are many ways to classify ocean litter, it is common to characterize it as either land-based or ocean-based, depending on the way in which it enters the marine environment (Galgani et al. 2015). Land-based litter can enter the ocean through poor or inefficient waste management systems, or intentional or unintentional littering by individuals and industries (UNEP and GRID-Arendal 2016, Galgani et al. 2015). Furthermore, land-based litter may be discharged directly onto coastlines (through coastal tourism or recreation, for instance), or it may make its way to the marine environment through water treatment systems (especially in the case of microplastics), storm drains, rivers, or by wind (UNEP and GRID-Arendal 2016, Galgani et al. 2015, Rech et al. 2014). Ocean-based litter, on the other hand, is generated by the intentional or unintentional discharge of debris directly into the ocean. Marine activities that generate ocean-based litter include commercial shipping, recreational and commercial fishing, aquaculture, research and military endeavors, and offshore drilling (UNEP and GRID-Arendal 2016, Galgani et al. 2015).

The majority of marine debris comes from land-based sources, though ocean-based debris can be significant in some areas. Debris sources are dependent on nearby human activity (recreational beach use, shipping, fishing), proximity to population centers, and the efficiency of waste management systems (Jambeck et al. 2015, UNEP and GRID-Arendal 2016, Galgani et al. 2015). Most of the litter found in the world's oceans is plastic (Derraik 2002). Between 1950 and 2015, 6300 million metric tons of primary and secondary (or recycled) plastic waste was produced worldwide. Approximately 12% of this plastic waste was incinerated, and 9% was recycled, while 79% was discarded and is currently sitting in landfills or the environment (see Fig. 1 for historical and projected levels of plastic waste production and disposal) (Geyer et al. 2017). Currently, most (42%) of the primary non-fiber plastic produced comes in the form of packaging, most of which is used and disposed of within the same year it is produced (Geyer et al. 2017). Globally, it is estimated that between 4.8 and 12.7 million metric tons of plastic enter the ocean from land every year (Jambeck et al. 2015).

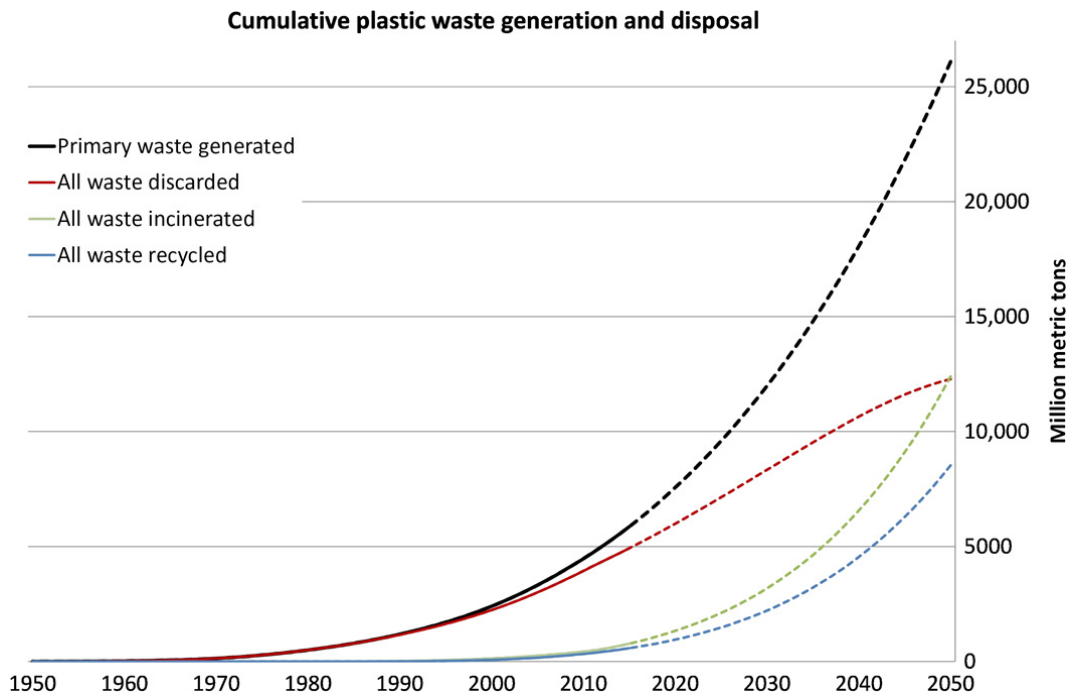


Fig.1. Historical and projected global cumulative plastic waste generation and disposal (here, disposal refers to how plastic waste is managed – either through incineration, recycling, or discard into landfills or the environment). Solid lines show historical data from 1950 to 2015, dotted lines show projections of historical trends to 2050. It is estimated that by 2050, 26,000 million metric tons of primary plastic waste will have been generated, 9,000 million metric tons of plastic waste will have been recycled, 12,000 million metric tons will have been incinerated, and another 12,000 million metric tons will have been discarded in landfills or the environment. Figure from Geyer et al. 2017.

Ocean litter has detrimental ecological, economic, and social impacts. Marine species, including seals, sea birds, sea turtles, whales, and dolphins, are entangled in debris, resulting in hindered movement, decreased feeding ability, injury, and death (NOAA MDP 2014, Kühn et al. 2015). Fish (Boerger et al. 2010), crustaceans (Murray and Cowie 2011), shellfish (Browne et al. 2008), and zooplankton (Cole et al. 2013) ingest microplastics, and some of these organisms consume less food and have decreased energy for growth as a result (Watts et al. 2015, Cole et al. 2013). Marine debris smothers and shades coral reefs and salt marshes, disrupting growth and surface cover (Richards and Beger 2011, Uhrin and Schellinger 2011). Plastics have recently been found in the digestive tracts of fish and shellfish and the soft tissues of shellfish sold at markets for human consumption (Rochman et al. 2015, Li et al. 2015, Van Cauwenberghe and Janssen 2014). A serving of six oysters grown off the coast of France could contain as many as 50 plastic particles (Van Cauwenberghe and Janssen 2014).

The economic impacts of ocean litter include costs associated with beach and harbor cleanup, loss of coastal tourism and recreation, rescue missions for vessels with entangled propellers, impacts to the fishing and aquaculture industries – including costs associated with repairing damaged vessels, repairing or replacing fishing gear lost or damaged as a result of encountering marine debris, loss of catch due to ghost fishing (the continued catch of marine species by lost or

discarded gear) or gear encounters with marine debris, and loss of earnings due to time spent dealing with litter – and other impacts to human welfare and ecosystem services (Newman et al. 2015). The UNEP estimates that the impacts of plastic pollution, specifically, on the world’s oceans amount to about \$13 billion a year, accounting for time spent on cleanup, as well as revenue lost by the fisheries and tourism sectors (UNEP 2014). Ghost fishing can be extremely costly – both ecologically and for the fishing industry. It is estimated that each year, the approximately 145,000 derelict blue crab pots in Chesapeake Bay catch more than 6 million blue crabs, killing over 3.3 million of them (which is the equivalent of 4.5% of the 73 million blue crabs harvested commercially in 2014) (Bilkovic et al. 2016). These derelict pots also catch approximately 3.5 million white perch and 3.6 million Atlantic croaker every year (Bilkovic et al. 2016). An effort that took place from 2008-2014 to remove almost 44,000 derelict pots from Chesapeake Bay is estimated to have increased blue crab harvests by 38.17 million pounds, valued at \$33.5 million, due to improved efficiency of active crab pots (Bilkovic et al. 2016). On average, removing one derelict pot increases blue crab harvest by 868 pounds (Bilkovic et al. 2016).

Ocean Litter and Waste Generation in California

Ocean litter is prevalent in California watersheds and ocean waters. For example, 78% of Southern California river miles¹ and about one third of seafloors and seafloor sediments in the Southern California Bight contain trash (Moore et al. 2016). Plastic is the most prevalent type of debris found across all habitats in the Southern California Bight, with wrappers, bags, plastic pieces, and Styrofoam being the most commonly found plastic items (Moore et al. 2016). 73 water bodies throughout the State of California are listed as having impaired water quality due to the presence of large amounts of trash (State Water Board 2015). The California coast and ocean are also impacted by lost fishing gear. Between May 2006 and November 2012, the California Lost Fishing Gear Recovery Project retrieved more than 60 tons of gear from California’s coastal ocean, and collected more than 1,400 pounds of recreational gear from public fishing piers from Santa Cruz to Imperial Beach (SeaDoc Society 2017). From 2001 to 2006, 31.1% of the reported cases of injured California brown pelicans at five California wildlife rehabilitation centers were fishing gear-related, while 11.1% of injured gull cases and 2.9% of injured California sea lion cases were fishing gear-related (Kaplan Dau et al. 2009).

In 2016, California generated approximately 76.5 million tons of waste (based on AB 341 definitions)², 35.2 million tons (~46%) of which were disposed in landfills, and another 7.5 million tons (~10%) of which went to disposal-related activities such as beneficial reuse at solid waste landfills and waste to energy conversion (CalRecycle 2017b). This means that California had a disposal rate of 6.0 pounds of trash per resident per day in 2016 (CalRecycle 2017b). Roughly 24.5 million tons (~32%) of the total trash produced in 2016 were diverted through source

¹ A river mile is a measure of distance in miles from the mouth of a creek or river.

² As required by AB 341, 1990-2010 waste generation levels (10.7 pounds per person per day) are used as baseline data. The amount of total waste generated in California in a year is estimated by multiplying the State’s population in that year by the 1990-2010 per person baseline. Source reduction is also calculated using these baseline data.

reduction and recycling, and another 9.2 million tons (~12%) were diverted through composting and mulching (CalRecycle 2017b). Overall, about 56% of California’s waste was disposed of and about 44% was diverted through source reduction, recycling, and composting in 2016 (CalRecycle 2017b). Though diversion has come a long way in 20 years (the state’s diversion rate was 31% in 1996), over the last three years, California’s source reduction, composting, and recycling rate has declined, from 50% in 2014, to 47% in 2015, and now to 44% in 2016 (CalRecycle 2017b) (see Fig. 2 for statewide disposal and recycling from 2010 to 2016). Through AB 341, California has declared a goal that by 2020, 75% of the solid waste generated in the state should be source reduced, recycled, or composted (as compared to 1990-2010 waste generation levels). This translates to a reduction in per capita disposal from the current 6.0 pounds per person per day to 2.7 pounds per person per day in 2020 (CalRecycle 2017b).

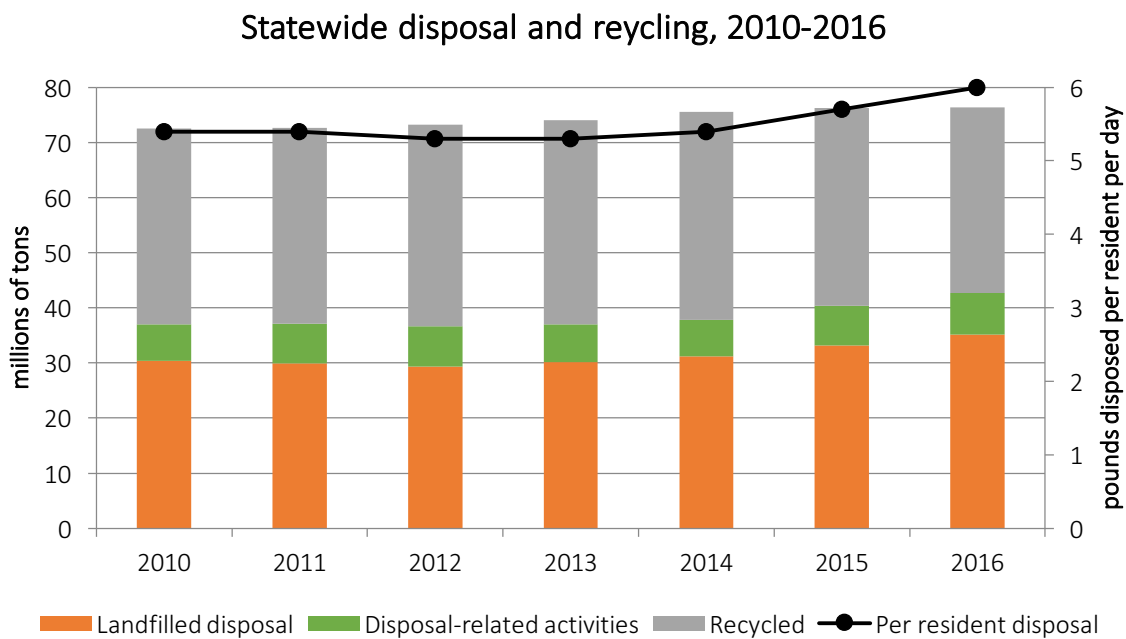


Fig.2. Amount of waste disposed and recycled in California, from 2010 to 2016. Included in this figure are estimates of the amount of waste disposed in landfills, the amount of waste managed through disposal-related activities, and the amount of waste recycled (which includes source reduction, recycling, and composting) every year in millions of tons (left axis). Also shown is the per resident disposal rate (pounds per resident per day) for each year (right axis). Figure adapted from CalRecycle’s webpage “California’s Statewide Recycling Rate” (CalRecycle 2017a).

California currently estimates the amount of waste that is source reduced and recycled by subtracting the quantities of waste disposed in landfills and through other disposal-related activities, and the quantities of waste that is managed through composting and mulching, from the estimated total amount of waste generated in the State (CalRecycle 2017b). This method of calculation assumes that all waste that is not disposed is source-reduced or recycled (CalRecycle 2017b). There is currently no way to know how much of California’s waste ends up in the environment and becomes marine debris every year. However, Jambeck et al. (2015) estimated that in 2010, the United States had 0.25-1 million metric tons of mismanaged plastic waste

available to enter the oceans, based on waste generated by populations within 50 km of the coast.

Ocean litter costs Californians money. California communities spend more than \$428 million annually to cleanup and control ocean litter through waterway and beach cleanup, street sweeping, installation of stormwater capture devices, storm drain cleaning and maintenance, manual litter cleanup, and public education (Stickel et al. 2013). From July 2012 to June 2016, Adopt-A-Highway participants removed over 77,000 cubic yards of litter that may have otherwise ended up in the ocean from California's roads, a service valued at \$18 million annually (Caltrans 2017). Orange County, California residents go out of their way to avoid trash-littered beaches, spending extra time and money in order to visit a cleaner beach or engage in other recreational activities; it is estimated that removing 100% of the marine debris on Orange County beaches could save California residents \$148 million during the three months of summer (Leggett et al. 2014). There are no known estimates of the costs of ocean litter to California's tourism, fishing, or aquaculture industries.

2008 Strategy "An Implementation Strategy for the California Ocean Protection Council Resolution to Reduce and Prevent Ocean Litter" Update

Recognizing the serious threats of ocean litter to human health, the economy, communities, and the environment, and the immediate need for decisive action in California, the California Ocean Protection Council (OPC) adopted a resolution on "Reducing and Preventing Marine Debris" in 2007. In 2008, the OPC initiated a steering committee to publish an Implementation Strategy, outlining three main priorities for addressing marine debris in the State. This Strategy was designed to provide a pathway to implement the recommendations in the OPC Resolution. The three priority actions were as follows:

1. Implement a producer take-back (EPR) program for convenience food packaging.
2. Prohibit single-use products that pose significant ocean litter impacts where a feasible less damaging alternative is available. Products specifically called out included polystyrene food packing and plastic bags.
3. Assess fees on commonly littered items.

Since the original Strategy was developed, many of the actions described in the document have either been accomplished or are in progress. In some cases, the State's regulatory or agency landscape has changed. For example, some items that were listed out separately in the Strategy are now being addressed under a single program, but there may be elements of those items that still need to be addressed (for instance, separate actions focused on minimizing toxins in packaging and developing sustainable alternatives are now jointly addressed by the California Department of Toxic Substances Control's (DTSC's) Safer Consumer Products Program, which examines product-chemical combinations that may have negative impacts on human health and the environment, and requires that manufacturers of priority products perform an alternatives analysis to determine whether such products can be made without the chemical of concern (DTSC 2013)). In other cases, our understanding of the ocean litter problem has changed

considerably since 2008 (for example, the examination of microplastics' impacts on marine life and their interaction with persistent organic pollutants has increased dramatically over the last decade (Ryan 2015)) and some of the actions that were outlined in the 2008 Strategy may not cover issues of emerging concern (such as microplastics and microfibers) or may no longer be the best way to go about addressing ocean litter.

This updated Strategy aims to expand collaboration to include projects of a variety of scales and scopes so that entities including tribes, government agencies, industry, and nonprofits can make a meaningful contribution towards reducing ocean litter in California.

See Appendix D for more detailed information on the progress made on the priorities and action items included in the 2008 OPC Strategy.

2017 Strategy Process

The Ocean Litter Strategy includes the following:

- **5 Goals:** The first four Goals are dedicated to land-based ocean litter, while the last Goal is dedicated to ocean-based litter. These Goals focus on source reduction, behavior change, research, control, and cleanup.
- **3 Priority Objectives:** These key Objectives were identified as being essential to making the biggest impact in reducing and preventing ocean litter, and achieving the Goals. *(These priorities will be discussed during workshop #2)*
- **19 Objectives:** Nested under each Goal, these Objectives are approaches that may be taken to achieve a Goal. Three of them were identified as priorities.
- **61 Action Items:** Listed under each Objective, Action Items are concrete and measurable actions that partners can commit to working on during the duration of the plan to implement an Objective.

In 2016, the Ocean Protection Council and NOAA Marine Debris Program initiated a partnership with California Sea Grant to update the 2008 Strategy. The 2017 Strategy planning team was rounded out with the participation of the California Coastal Commission and Surfrider Foundation. Representatives from organizations active in conservation, research, waste reduction, and education, as well as industry, tribes, and State and Federal agencies were invited to participate in two workshops in 2017 aimed at generating solutions to the problem of ocean litter in California. All of the ideas included in this Strategy document were identified by workshop participants. *See Appendix B for the complete list of ideas for action items generated by workshop participants.*

The first of the two workshops, held in May 2017, allowed participants to brainstorm and discuss potential solutions to the presence of (and problems associated with) ocean litter in California. 148 solution ideas to reduce and prevent ocean litter were identified during this workshop. These ideas were streamlined (duplicative and similar ideas were condensed) and organized into a draft Strategy by the planning team, which was then circulated among the workshop

participants and posted on the OPC’s website for review and comment. The second of the two workshops, held in November 2017, allowed for further refinement of the Strategy’s action items and the selection of priority actions, and gave organizations the opportunity to commit to taking a leadership role in implementing proposed actions. Each workshop was attended by approximately 50 participants. *See Appendices A, B, and C for the complete list of ideas for action items generated during the first workshop, the agenda from the first workshop, and the participant list from the first workshop, respectively. Additional Appendices with the agenda and participant list from the second workshop will be added prior to finalizing the Strategy.*

Scope of Document

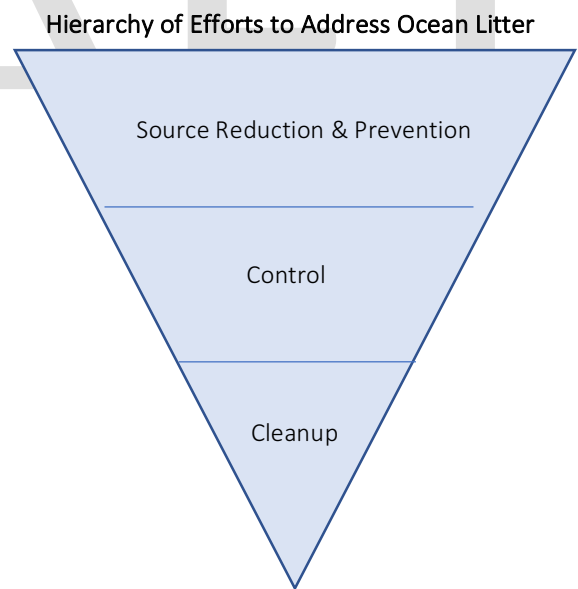
Emphasis on Source Reduction and Prevention

This document prioritizes source reduction objectives and actions, as agencies and experts agree that that is the most effective tactic to address ocean litter. Source reduction, or waste prevention, refers to practices that reduce the amount of materials entering the waste stream, including changes in the design, manufacture, purchase or use of materials (EPA 2016). Preventing waste in the first place through initiatives such as packaging redesign and reusing materials is a better method for reducing waste as it reduces the amount of litter to control, capture, and dispose. This method is considered by the US EPA to be the most preferred method for dealing with waste (EPA 2017).

Furthermore, source reduction creates significant opportunities for industry to take initiative and responsibility over the product and packaging they produce and procure. By altering their production, operation, and raw material use, industries can prevent litter at the source. In addition, these changes can lead to economic benefits to industries by reducing costs associated with transportation, disposal, or recycling of waste (Maryland Department of the Environment 2017).

Waste management and ocean litter are inextricably linked. This Strategy is intended to be a complementary document to other waste prevention and management strategies, with a focus on the issue of ocean litter. *See Appendix E for state agencies working on issues that affect ocean litter, and their accompanying mandates.*

The source of ocean-based litter can be traced to vessels, as well as ports, terminals, and marinas that serve them, offshore platforms, fishing, and other marine activities. However, for this document, the focus is on lost fishing and aquaculture gear. Workshop participants who deal with ocean-based litter were mainly from the fishing and aquaculture industries and it was



agreed that due to the large scope of ocean-based debris and complexities with international regulations, a bigger impact could be made by narrowing the scope to lost fishing and aquaculture gear. For example, the [International Convention for the Prevention of Pollution from Ships, MARPOL](#), (adopted in 1973) is the main international convention covering pollution of the marine environment from operational or accidental discharge from ships. MARPOL regulations prohibit many types of pollution from ships on a global scale.

Control and Cleanup

Controlling and cleaning up litter in the environment is important, but less efficient and effective in the longer term compared to source reduction and prevention. Examples of control and cleanup methods include: beach and waterway cleanups, street sweeping, stormwater capture devices, storm drain cleaning and maintenance, manual litter cleanup, and outreach and education to prevent littering. The public cost burden of these efforts makes a compelling argument for accelerating the search for effective strategies to reduce and prevent trash streams that enter our waterways and contribute to ocean litter.

In 2015, the State Water Resources Control Board (State Water Board) adopted a statewide water quality objective aimed at reducing the amount of trash that finds its way into rivers, lakes, and the ocean by prohibiting the discharge of trash into state surface waters; the water quality objective is commonly referred to as the “Trash Amendments.” These Trash Amendments provide statewide consistency in efforts to reduce trash in state waters, and use a land use-based compliance approach that targets high trash generating areas such as high density residential, industrial, commercial, mixed urban and public transportation land uses. This program allows flexibility for local governments to come up with compliance approaches that work best for them to effectively eliminate trash discharge from their stormwater systems. Local governments may choose to increase trash capture in stormwater runoff, or a use combination of source reduction approaches that are equivalent to full trash capture. This Strategy provides a suite of source reduction approaches that may be cost-effective and useful to local governments as they develop their compliance approach for the Trash Amendments.

California also has a robust and successful network for implementing cleanups. From local nonprofits to municipalities, beach cleanups are held on a regular basis throughout the state. California Coastal Cleanup Day is a notable program held once a year, where approximately 60,000 volunteers pick up hundreds of thousands of pounds of trash and recyclables from beaches, lakes, and waterways. In 2016, 59,154 volunteers participated in California Coastal Cleanup Day and collected 710,781 pounds of litter (California Coastal Commission 2016). California Coastal Cleanup Day is a part of International Coastal Cleanup Day, the world’s biggest effort to clean up ocean litter. Annually, nearly 12 million people volunteer to pick up litter in their communities (Ocean Conservancy 2017).

There are numerous organizations that also organize lost fishing gear cleanups on and off the water. For example, the California Lost Fishing Gear Project, administered by the University of California, Davis’ School of Veterinary Medicine and the Wildlife Health Center, encourages

ocean users to report the presence of lost gear, and hires experienced commercial SCUBA divers to remove gear from nearshore waters in a safe and environmentally sensitive manner. Between 2006 and 2012, this program has retrieved more than 60 tons of gear from California’s coastal ocean, primarily in Southern California, including around the California Channel Islands (Santa Rosa, Santa Cruz, Anacapa and Santa Catalina) (SeaDoc Society 2017).

GOALS

Broadly broken into land and ocean-based litter categories, the Goals are a framework to organize each Objective and Action Items of this Strategy and its focus on source reduction, cleanup, and control.

Land-Based Ocean Litter

Goal 1: Reduce land-based ocean litter at its source by implementing producer-oriented Action Items.

Goal 2: Reduce the consumption of commonly found ocean litter items by implementing institution- and business-oriented Action Items.

Goal 3: Promote behavior change by educating and engaging communities and individuals to reduce ocean litter.

Goal 4: Conduct research on emerging issues impacting human health and the environment.

Ocean-Based Litter

Goal 5: Reduce ocean-based litter at its source, and maximize the efficiency of control and cleanup of ocean-based litter

(with the option to split Goal 5 into two) - Discuss further during workshop #2

OCEAN LITTER PRIORITY OBJECTIVES AND JUSTIFICATIONS

***NOTE:** In this draft, the priority Objectives below are suggested for stakeholder and public feedback. At the workshop in November, participants will have an opportunity to vote on the ocean litter priority Objectives, and the top priority Objectives coming out of that process will be identified here in the final Strategy.*

The following top three ocean litter priority Objectives were identified as being essential to making the biggest impact in reducing and preventing ocean litter:

Priority #1: Prohibit single use products, such as straws, stirrers, expanded polystyrene, and balloons, if a feasible, less damaging alternative is available.

Banning single use products, such as straws and stirrers, polystyrene packaging, and balloons, will help reduce land-based ocean litter at its source, by preventing these items from becoming waste in the first place and leaking into the environment. As mentioned above, the EPA

considers source reduction to be the most efficient method for managing waste and reducing pollution (EPA 2017, EPA 2016).

From 1989 to 2014, food wrappers and containers were the second most prevalent items removed from California’s coastlines and inland waterways on Coastal Cleanup Day, while straws and stirrers were the sixth most prevalent items (see Table 1 for the list of the top 10 litter items found on Coastal Cleanup Day from 1989-2014) (California Coastal Commission 2017). While balloons don’t make this list, they are important to address, as they are identified by experts as one of the top items of concern for impacts to marine life, particularly in terms of entanglement (Wilcox et al. 2016).

Many of these common litter items may already be manufactured using alternative, less damaging materials (e.g., takeaway containers made from compostable materials). Ultimately, reusing products (and reducing potential ocean litter) is the better option, but manufacturing compostable or readily recyclable materials can also help to reduce ocean litter. It is important to note that implementing bans and utilizing alternative materials should be undertaken in such a way that ensures, through adequate research and analysis, that the ban and/or alternative item considered are in fact more beneficial to the environment than the original material or product.

Table 1. Top ten litter items removed on California Coastal Cleanup Day, 1989-2014.

| Litter Item | Count | Percentage |
|------------------------------|-----------|------------|
| Cigarettes/Cigarette filters | 6,992,106 | 37.76% |
| Food wrappers/Containers | 1,940,013 | 10.48% |
| Caps/Lids | 1,619,071 | 8.74% |
| Bags (paper and plastic) | 1,462,726 | 7.90% |
| Cups/Plates/Utensils | 1,014,229 | 5.48% |
| Straws/Stirrers | 736,595 | 3.98% |
| Glass beverage bottles | 600,871 | 3.24% |
| Plastic beverage bottles | 475,799 | 2.57% |
| Beverage cans | 455,433 | 2.46% |
| Construction material | 330,711 | 1.79% |

A number of municipalities have already undertaken bans to prohibit these and other single use items in their jurisdictions. For example, San Francisco recently expanded its ban on polystyrene foam food containers (originally implemented in 2007) to prohibit the sale and distribution of polystyrene foam food ware and other products in the city (San Francisco Department of the Environment 2016). This regulation, called the Food Service and Packaging Waste Reduction Ordinance, went into effect January 1, 2017, and covers items such as foam cups, plates, clamshells, egg cartons, meat and fish trays, and packing peanuts (San Francisco Department of the Environment 2016).

Priority #2: Require the phase out of single use products in public institutions and facilities (i.e. government functions, campuses), such as convenience food and beverage packaging.

The State is the single largest purchasing entity in California, purchasing billions of dollars of products each year (Suh et al. 2017). As a result, the State can have a significant impact on, and set a good example for, preventing and reducing waste at the source through procurement policies that prioritize reusable items. Implementing sustainable purchasing programs can have environmental, health, social, and economic benefits for the state. For example, purchasing sustainable products can significantly reduce waste disposal costs. Through state legislation such as Assembly Bill 2490 and various Public Contracts Code Sections, the State has been actively purchasing more sustainable goods and services for over two decades, but additional actions can be taken to further the prevention and reduction of ocean litter (Responsible Purchasing Network 2017).

Priority #3: Advance research on microplastics and technological solutions to reduce microplastics in wastewater discharge.

Microplastics are small plastic pieces less than five millimeters in size which are either manufactured to be small in size (and often used in personal products such as face wash) or are created when larger pieces of plastic degrade over time (NOAA NOS 2017). Microfibers from synthetic clothing are another significant source of microplastics. Research on microplastics and their impacts is an emerging field of study, and microplastics are becoming recognized as one of the greatest threats posed to the aquatic environment (Crawford and Quinn 2017). Microplastics have been found in almost every marine habitat in the world (Lusher 2015) and there is still much to learn about the basic characteristics of microplastics, and the consequences these plastics have for environmental and human health.

Microplastics that are found in the aquatic environment have varying shapes, colors, and sizes which make it difficult to characterize their composition. Recent research has revealed that microplastics can adsorb organic contaminants (e.g., polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs)) (Rochman et al. 2013a) and trace metals (Holmes et al. 2012) from their surrounding environments, and, depending on concentration gradients, may transfer contaminants to marine organisms, inducing harmful health effects (Browne et al. 2013, Rochman et al. 2013b). Furthermore, once in the environment, microplastics are extremely difficult to remove. Many wastewater treatment plants and washing machines are not equipped to catch and filter microplastics before releasing effluent water from their systems, and (eventually) into rivers and the ocean. Therefore, research and technological advances need to be made to further address this pressing issue.

ACTION ITEMS

***NOTE:** In this draft, the Objectives and Action Items below are suggested for stakeholder and public feedback. At the workshop in November, participants will have an opportunity to discuss these Action Items further.*

In particular, please identify any Action Items that you (and your organization) may be interested in taking a lead or partnership role in implementing or feel strongly that you may want to be

involved in. Identifying your name (and your organization) next to an action item means that you and your organization will give your best efforts to implement the Action Item, given organizational and funding availability. Your input will help us develop breakout groups during the second workshop and further fill out the tables.

In the tables below, various Action Items to reduce and prevent ocean litter are grouped under broader Goals and Objectives. Definitions of the information in each column are as follows:

- **Action Items:** Outlines the Action Item proposed;
- **Needs & Barriers:** Identifies the information or resources needed to successfully implement the Action Item and the barriers anticipated to implementing the Action Item;
- **Status of Action & Resources Available:** Indicates whether the Action Item is a new or ongoing effort, and lists resources available to assist with implementation; resources may include organizations that have expertise in a relevant issue or topic or that collect data that could assist with implementation of the Action Item.
- **Lead & Partner Organizations:** Identifies the organization(s) that will take the lead on implementing the Action Item, as well as other organizations (partners) that would contribute to implementing the Action Item. The organization(s) will give their best efforts to implement the Action Item, given organizational and funding constraints. *During the public comment period, individuals and organizations identified Action Items that they would like to take a role in implementing. These individuals' and organizations' names appear in this Draft, **bolded** if they specified that they would like to take a lead role, unbolded if they specified that they would like to take a partnership role, and italicized if they did not specify whether they would like to be listed as a lead or partner organization, but expressed interest in being involved in some capacity. Those who indicated interest in an entire Objective were listed for all of the Action Items that fell under that Objective.*

LAND-BASED OCEAN LITTER

GOAL 1. Reduce land-based ocean litter at its source by implementing producer-oriented action items.

| Objective 1.1. Prohibit single use products, such as straws, stirrers, expanded polystyrene, and balloons, if a feasible, less damaging alternative is available. | | | |
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| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 1.1.1. Implement a city pilot project banning expanded polystyrene and measure the efficacy of the ban (reduction in polystyrene, environmental impacts, economic impacts). | - Industry opposition (i.e. food service/retail customer service) | - Ongoing effort - Plastic bag ban, local foam bans, local water bottle in government venues bans - NGOs, Clean Seas Coalition, Plastic Pollution Coalition - Local governments that have passed bans previously | <i>Californians Against Waste, Plastic Recycling Corporation of California</i> |

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| 1.1.2. Develop a toolkit for local advocates (fact sheets, talking points, sample letters to the editor, sample media engagement strategies) to aid in the process of banning single use items. | | - Ongoing effort | San Francisco State University Institute for GIS, Surfrider Foundation, UPSTREAM, Plastic Recycling Corporation of California, Californians Against Waste |
| 1.1.3. Engage with industry allies that are already using alternative products to help advocate for transition away from single use items | | - Ongoing effort | Surfrider Foundation, Plastic Recycling Corporation of California, Clean Water Action & Clean Water Fund |
| 1.1.4. Implement statewide ban/s of single-use items as opposed to starting on local ordinances | <ul style="list-style-type: none"> - Determine economic impacts to businesses - Industry opposition (i.e. manufacturers, trade associations) - Specific parameters of the law (i.e. hospitals, disabilities) - Who will enforce the ban? | <ul style="list-style-type: none"> - New effort - Statewide plastic bag ban, local foam bans, local water bottle in government venues bans - NGOs; Clean Seas Coalition - Local governments that have passed bans | Surfrider Foundation, UPSTREAM, Plastic Recycling Corporation of California, Clean Water Action & Clean Water Fund, Californians Against Waste |
| 1.1.5. Expand the statewide bag ban to apply to retail stores. | | <ul style="list-style-type: none"> - New effort - Oahu just expanded their bag ban and outlawed the thicker bags after 2020 | Surfrider Foundation, Californians Against Waste, Plastic Recycling Corporation of California |

Objective 1.2. Support and promote extended producer responsibility (EPR).

| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
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| 1.2.1. The Ocean Protection Council will promote EPR as a policy to consider as part of CalRecycle’s Packaging Reform Effort. | | - Ongoing effort | Ocean Protection Council, UPSTREAM, Californians Against Waste, Plastic Recycling Corporation of California |
| 1.2.2. Include performance measures in mandatory/extended producer responsibility programs for both prevention and recycling; with prevention being a higher priority. | | - New effort | UPSTREAM, Plastic Recycling Corporation of California, Californians Against Waste |

| 1.2.3. Producers share responsibility to help municipalities achieve and pay for requirements under the trash amendments. | | - New effort | <i>UPSTREAM, Plastic Recycling Corporation of California, City of San Diego Transportation & Storm Water Department</i> |
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| Objective 1.3. Support voluntary packaging redesign with the aim of creating packaging with no/less plastic, and/or to be more recyclable, marine degradable (when appropriate), and less likely to emit toxins. | | | |
| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 1.3.1. Encourage redesign of products that are commonly littered to have less plastic and/or make them recyclable. | | - Ongoing effort | <i>Plastic Recycling Corporation of California, Californians Against Waste, Amcor</i> |
| 1.3.2. Implement packaging design challenges. | | - Ongoing effort - CalRecycle | <i>Plastic Recycling Corporation of California</i> |
| 1.3.3. Create a venue for sharing innovative designs, support the innovators (e.g., take-out paper cups with no plastic resin liner). | | - New effort | <i>Plastic Recycling Corporation of California</i> |
| 1.3.4. Engage corporations to enhance packaging design. | | - New effort | <i>UPSTREAM, Plastic Recycling Corporation of California, Amcor</i> |
| 1.3.5. Attach lids to bottles. | | - New effort | <i>Surfrider Foundation, UPSTREAM, Plastic Recycling Corporation of California, Californians Against Waste</i> |

GOAL 2. Reduce the consumption of commonly found ocean litter items by implementing institution- and business-oriented action items.

| Objective 2.1. Require the phase out of single use products in public institutions and facilities (i.e. government functions, campuses), such as convenience food and beverage packaging. | | | |
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| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |

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| <p>2.1.1. Require the phase out of single use products in the UC and CSU systems (e.g., ban single use water bottles, ban expanded polystyrene containers on campuses, require dishwashing in dining halls, etc.), through Executive Order or mandate from the UC Regents/UC Office of the President and CSU Board of Trustees, or internal sustainability policy. Encourage the procurement of safer alternatives where available.</p> | <ul style="list-style-type: none"> - Additional water stations to refill reusable water bottle, dishwashing capacity, reusable alternatives to disposable products. - Pre-existing franchises on campus that are required to use franchise packaging and products - Timetable for contract negotiations between campuses and vendors. | <ul style="list-style-type: none"> - Ongoing/New (?) effort - UC Sustainable Practices Policy, which mentions the UC's commitment to sending zero waste to the landfill by 2020, and to procuring environmentally preferable products (UC 2004) - Individual UC campus sustainability offices and programs - CSU Sustainability Policy, which declares the pursuit of sustainable practices in procurement, waste management, and food services as a goal; CSU aims to reduce solid waste disposal by 80% by 2020 and move to zero waste after that (CSU 2014a) - Individual CSU campus sustainability offices and programs (e.g., CSU San Marcos has a robust recycling program, which has helped reduce individual student waste by 349%, from .244 tons/student in 2004 to .05 tons/student in 2014) (CSU 2014b) | <p>San Francisco State University Institute for GIS, Surfrider Foundation, <i>Clean Water Action & Clean Water Fund</i></p> |
| <p>2.1.2. Require the phase out of single use products in government (local, state, federal) buildings and events, through Executive Order or internal policy. Encourage the procurement of safer alternatives where available.</p> | <ul style="list-style-type: none"> - Additional water stations to refill reusable water bottle, dishwashing capacity, reusable alternatives to disposable products. - Pre-existing contracts between company and campus/institutions | <ul style="list-style-type: none"> - New effort | <p>Surfrider Foundation, <i>UPSTREAM, Clean Water Action & Clean Water Fund, Californians Against Waste</i></p> |
| <p>2.1.3. Require the phase out of single use products in other public institutions (i.e. hospitals).</p> | <ul style="list-style-type: none"> - Additional water stations to refill reusable water bottle, dishwashing capacity, reusable alternatives to disposable products. - Pre-existing contracts between company and campus/institutions | <ul style="list-style-type: none"> - New effort | <p>Surfrider Foundation, <i>UPSTREAM, Clean Water Action & Clean Water Fund, Californians Against Waste</i></p> |

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| | - Potentially (for hospitals) health concerns surrounding bacteria transmission. | | |
| 2.1.4. Perform plastic audits for institutions (governments, campuses) that are required to transition to reusables. | | - Ongoing effort | <i>Clean Water Action & Clean Water Fund</i> |
| 2.1.5. Local governments charge businesses a fee if they produce a high volume of single use packaging (i.e., take out containers), which could be used to fund cleanups and other programs addressing trash pollution. | | - New effort | <i>UPSTREAM, Clean Water Action & Clean Water Fund, Californians Against Waste</i> |
| 2.1.6. Require restaurants to have dishwashing capacity. | | - Ongoing effort | <i>UPSTREAM, Clean Water Action & Clean Water Fund, Californians Against Waste</i> |
| 2.1.7. Charge consumers for disposables/single use food service packaging, where funding could be used for cleanups and other programs focused on reducing trash pollution. | | - New effort | <i>UPSTREAM, Clean Water Action & Clean Water Fund, Californians Against Waste</i> |
| Objective 2.2. Encourage institutions, businesses, public venues, and events to voluntarily transition to using reusable products. | | | |
| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 2.2.1. Encourage businesses and corporations to transition to reusables (e.g., corporate dining systems purchasing, water refill stations). | | - Ongoing effort | <i>Surfrider Foundation, UPSTREAM, Clean Water Action & Clean Water Fund, Amcor</i> |
| 2.2.2. Encourage events such as music festivals, concerts, sports competitions, etc. to implement zero waste principles and develop a | | - New effort - Green Sports Alliance - NRDC | <i>Clean Water Action & Clean Water Fund</i> |

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| certification for participating events. | | | |
| 2.2.3. Engage with the film industry to implement zero waste principles and develop a certification for participating films. | | - New effort | |

GOAL 3. Generate behavior change by educating and engaging communities and individuals to reduce ocean litter.

| Objective 3.1. Formal and Informal education on the watershed, regarding how litter on land becomes ocean litter. | | | |
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| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 3.1.1. Integrate ocean litter curriculum into school programs. | | - Ongoing effort - CA Department of Education’s Education and the Environment Initiative | <i>California Coastal Commission, Monterey Bay Aquarium, Plastic Recycling Corporation of California, City of San Diego Transportation & Storm Water Department</i> |
| 3.1.2. Provide toolkits for local high school/college students to educate people on their campuses and in their communities. | | - Ongoing effort | <i>Monterey Bay Aquarium, Plastic Recycling Corporation of California, City of San Diego Transportation & Storm Water Department</i> |
| Objective 3.2. Engage consumers in campaigns targeting producers of commonly found ocean litter items. | | | |
| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 3.2.1. Educate consumers using compelling communication strategies that reach coastal and inland communities. | - Language and cultural relevancy - Cost of outreach (time, face-to-face) - Measurement/sustained results - Identifying best way to | - Ongoing effort | <i>CSU Channel Islands Environmental Science and Resource Management (ESRM) Program, Surfrider Foundation, California Coastal Commission, Plastic Recycling Corporation of</i> |

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| | communicate to the population of CA (i.e., millennials) - Developing targeted messaging | | <i>California, Californians Against Waste, City of San Diego Transportation & Storm Water Department</i> |
| 3.2.2. Conduct public education about microfibers and encourage consumers to not buy plastic-based clothing. | | - New effort | <i>CSU Channel Islands Environmental Science and Resource Management (ESRM) Program, Plastic Recycling Corporation of California, Californians Against Waste</i> |
| 3.2.3. Implement significant public education and engagement campaign targeting the ban of expanded polystyrene (i.e., NGO campaign). | | - New effort | <i>Surfrider Foundation, Plastic Recycling Corporation of California, Californians Against Waste</i> |
| 3.2.4. Implement a “truth” campaign about cigarette filters. | | - New effort - Truth Initiative | <i>California Coastal Commission, Plastic Recycling Corporation of California, Californians Against Waste</i> |
| 3.2.5. Conduct consumer behavior research to look at behavior and convenience, choices, and incentives to better understand consumer choices. | | - New effort | <i>Dr. Sean Anderson (CSU Channel Islands), Plastic Recycling Corporation of California, Clean Water Action & Clean Water Fund</i> |
| 3.2.6. Implement a behavior modification campaign (i.e. single-use plastic, littering), targeting young adults for behavior change and education. | - Engaging target audience | - New effort | <i>Surfrider Foundation, Plastic Recycling Corporation of California, Californians Against Waste</i> |

Objective 3.3. Support the State Water Resources Control Board’s Trash Amendments.

| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
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| 3.3.1. Create alternative funding mechanism for local government to fund stormwater trash programs | | - New effort | <i>Plastic Recycling Corporation of California, City of San Diego Transportation & Storm</i> |

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| (prop 218 for trash collection?) | | | <i>Water Department</i> |
| 3.3.2. Implement a statewide Adopt a Storm Drain program. | - Develop and share BMPs based on knowledge from local municipalities | - Ongoing effort - City of Oakland | <i>Plastic Recycling Corporation of California</i> |
| 3.3.3. Establish trash receptacles in high use areas and improve management (e.g. more containers for cigarette disposal, closed receptacles and proper maintenance schedules at access points, user-friendly trashcan lids, oversight for transportation ways/trails). | - Analyze effectiveness of program (e.g. Ocean Beach in San Francisco removed trash cans to prevent ocean litter. The theory being that people are more likely to leave trash next to an overflowing trash can than on the beach, and would otherwise pack their trash out.) | - Ongoing effort - Surfrider Hold on to Your Butt Campaign and collaboration with San Francisco's Union Square Business Improvement District | <i>California Coastal Commission, Plastic Recycling Corporation of California, Amcor</i> |

Objective 3.4. Engagement with homeless communities - Discuss further during workshop #2

| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
|---|--|---|---|
| 3.4.1. Look at effectiveness of social programs to engage homeless communities and address issues related to trash hotspots from homeless camps (e.g. municipalities get credit for implementing programs that tackle homelessness) | - Map hotspots of homeless camps - Outreach to homeless communities | - New effort | |

GOAL 4. Conduct research on emerging issues related to land-based ocean litter.

| Objective 4.1. Conduct a comprehensive characterization study of trash inputs to identify the most common litter products. | | | |
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| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 4.1.1. Analyze and quantify discharges from a variety of endpoints, including street | | - New effort | <i>Clean Water Action & Clean Water Fund, East Bay Municipal Utility District,</i> |

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| <p>litter, stormwater, wastewater, and direct discharges from coastal tourism and homeless encampments, etc. throughout the state of California. Develop targets for reduction and implementation plans for each product (connect data to action plan, product source).</p> | | | <p><i>City of San Diego Transportation & Storm Water Department, Sanitation Districts of Los Angeles County, Plastic Recycling Corporation of California, Dr. Andrew Gray's Lab at UC Riverside</i></p> |
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Objective 4.2. Increase the characterization of microplastics and macro-debris.

| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
|---|--|--|---|
| <p>4.2.1. Invest in source identification for plastics by funding studies using Fourier Transform Infrared (FTIR) microscope.</p> | <p>- There is currently not a clear understanding of the source of plastics entering the marine environment - Equipment is costly (e.g. the cost of a microscope is roughly \$70,000)</p> | <p>- Ongoing effort - California State University Channel Islands has previously borrowed a FTIR microscope and learned that they had previously underestimated the amount of plastic in their samples. - This type of microscope would allow researchers to determine the composition of the plastic and possibly its source, as well as forensic tracking of substances.</p> | <p><i>CSU Channel Islands Environmental Science and Resource Management (ESRM) Program (including Dr. Clare Steele), Dr. Erika Holland (CSU Long Beach), Southern California Alliance of Publicly Owned Treatment Works (SCAP), Bay Area Clean Water Agencies (BACWA), City of San Diego Transportation & Storm Water Department, Sanitation Districts of Los Angeles County, Dr. Andrew Gray's Lab at UC Riverside</i></p> |
| <p>4.2.2. Develop standardized monitoring/data collection and compliance methods for trash and microplastics, including methodologies for measuring reductions of litter.</p> | | <p>- Ongoing effort</p> | <p><i>CSU Channel Islands Environmental Science and Resource Management (ESRM) Program (including Dr. Clare Steele), Dr. Erika Holland (CSU Long Beach), San Francisco Estuary Institute, 5 Gyres Institute, Southern California Coastal Water Research Project, California Association of Sanitation Agencies (CASA), Bay Area Clean Water Agencies (BACWA), Southern California Alliance</i></p> |

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| | | | <i>of Publicly Owned Treatment Works (SCAP), Clean Water Action & Clean Water Fund, East Bay Municipal Utility District, City of San Diego Transportation & Storm Water Department, Sanitation Districts of Los Angeles County, Dr. Andrew Gray's Lab at UC Riverside</i> |
| 4.2.3. Develop a program to model and monitor microplastics transport and degradation. | | - Ongoing effort | <i>Dr. Natalie Mladenov (San Diego State University), San Francisco Estuary Institute, 5 Gyres Institute, California Association of Sanitation Agencies (CASA), Bay Area Clean Water Agencies (BACWA), Southern California Alliance of Publicly Owned Treatment Works (SCAP), City of San Diego Transportation & Storm Water Department, Sanitation Districts of Los Angeles County, Dr. Andrew Gray's Lab at UC Riverside</i> |
| Objective 4.3. Advance research on microplastics and technological solutions to reduce microplastics in wastewater discharge. | | | |
| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 4.3.1. Research wastewater effluent to identify and quantify microfibers and microplastics. | | - Ongoing effort - San Francisco Estuary Institute | <i>CSU Channel Islands Environmental Science and Resource Management (ESRM) Program, Dr. Natalie Mladenov (San Diego State University), San Francisco Estuary Institute, 5 Gyres Institute, Southern California Alliance of Publicly Owned Treatment Works (SCAP), Bay Area Clean Water Agencies (BACWA), East Bay Municipal Utility District, Dr.</i> |

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| | | | <i>Andrew Gray's Lab at UC Riverside</i> |
| 4.3.2. Research technological solutions at wastewater treatment plants or in washing machines (filtration/collection system). | | - Ongoing effort - Rozalia ball | <i>Southern California Alliance of Publicly Owned Treatment Works (SCAP), East Bay Municipal Utility District, Dr. Andrew Gray's Lab at UC Riverside</i> |
| 4.3.3. Research technical solutions for microfibers in apparel (i.e., washing machines/add-ons and innovative solutions). | | - Ongoing effort | <i>Southern California Alliance of Publicly Owned Treatment Works (SCAP), East Bay Municipal Utility District, Dr. Andrew Gray's Lab at UC Riverside</i> |

Objective 4.4. Research toxicological impacts of commonly found ocean litter (including plastics, microplastics, and microfibers) on marine resources and human health.

| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
|--|-----------------------------|---|--|
| 4.4.1. Work with DTSC and others to identify ongoing research and other work that may help fill knowledge gaps on the chemical components of common ocean litter items; the potential for chemicals to migrate from litter items into the environment; and the potential for chemicals from various forms of ocean litter to expose and harm people, aquatic organisms and the marine environment. | - Scope of DTSC priorities | - Ongoing effort - Unknown, may depend on scope of DTSC 2018-2020 Priority Products Work Plan; potentially the Safer Consumer Products Program | Ocean Protection Council, California Department of Toxic Substances Control, San Diego State University Graduate School of Public Health, Dr. Erika Holland (CSU Long Beach), California Lost Fishing Gear Recovery Project at UC Davis, <i>CSU Channel Islands Environmental Science and Resource Management (ESRM) Program (including Dr. Clare Steele), UPSTREAM</i> |
| 4.4.2. Research on relationship between plastic toxicity and human health via consumption of seafood exposed to plastic debris. | | - Ongoing effort - EPA compilation paper | <i>California Lost Fishing Gear Recovery Project at UC Davis, UPSTREAM</i> |
| 4.4.3. Research alternative materials and composition of plastics so they break | | - Ongoing effort | |

| down easier, and are less likely to emit toxins. | | | |
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| Objective 4.5. Assess the effectiveness of existing bans and policies. | | | |
| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 4.5.1 Conduct cost-benefit analyses for implementation of different litter reduction policies/strategies and provide them to cities (i.e. local ordinances to ban expanded polystyrene). | | - New effort - Reporting on effectiveness of bag ban (a few NGOs and local governments are collecting data) | <i>Dr. Andrew Gray's Lab at UC Riverside</i> |
| 4.5.2. Analyze impact of the statewide plastic bag ban (i.e. how many bags are kept out of circulation, corresponding environmental protection gains, cost savings to government, if any). | | - New effort | <i>California Coastal Commission, Dr. Andrew Gray's Lab at UC Riverside</i> |

OCEAN-BASED LITTER

GOAL 5. Reduce ocean-based litter at its source, and maximize the efficiency of control and cleanup of ocean-based litter.

| Objective 5.1. Improve tracking for lost fishing and aquaculture gear. | | | |
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| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 5.1.1. Improve reporting system for lost fishing gear. | | - Ongoing effort | <i>California Lost Fishing Gear Recovery Project at UC Davis, Channel Islands National Marine Sanctuary, The Bay Institute</i> |
| 5.1.2. Develop centralized database for lost fishing gear/Develop centralized website to report GPS | | - New effort | <i>California Lost Fishing Gear Recovery Project at UC Davis, The Bay Institute, Dr. Andrew Gray's Lab at UC</i> |

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| location of traps without penalty to fishermen. | | | <i>Riverside</i> |
| 5.1.3. Implement a pilot project testing the best tagging and marking methods for aquaculture gear. | | - New effort | <i>The Bay Institute</i> |
| Objective 5.2. Implement Best Management Practices (BMPs) for the aquaculture industry. | | | |
| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 5.2.1. Compile BMPs for the aquaculture industry through collaboration with, and between, growers. Educate growers about BMPs. | | - Ongoing effort | <i>The Bay Institute</i> |
| 5.2.2. Update Fish and Game Commission policies to include BMPs in permits. | | - New effort | <i>Channel Islands National Marine Sanctuary, The Bay Institute</i> |
| Objective 5.3. Improve fishing gear to increase durability, decrease loss, and mitigate environmental impact. | | | |
| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 5.3.1. Design fishing line to be biodegradable. | | - Ongoing effort | <i>The Bay Institute</i> |
| 5.3.2. Improve fixed gear technology to minimize repetitive gear losses (i.e. traps and pots). | | - Ongoing effort | <i>The Bay Institute</i> |
| Objective 5.4. Leverage industry knowledge to prevent lost fishing gear. | | | |
| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 5.4.1. Leverage fishermen's knowledge about strategies to prevent gear loss to educate within the industry and to educate new fishermen (education could | | - Ongoing effort | <i>California Lost Fishing Gear Recovery Project at UC Davis, Channel Islands National Marine Sanctuary, The Bay Institute</i> |

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| be incentivized, required, or voluntary; fishermen could work with other partners to create educational materials). | | | |
| 5.4.2. Share lessons learned with other stakeholders and managing bodies to focus policy and funding on prevention and recovery of lost gear. | | - New effort | California Lost Fishing Gear Recovery Project at UC Davis, Channel Islands National Marine Sanctuary, <i>The Bay Institute</i> |
| Objective 5.5. Increase the removal of lost fishing and aquaculture gear. | | | |
| Action Items | Needs & Barriers | Status of Action & Resources Available | Lead & Partner Organizations |
| 5.5.1. Implement a buyback program for old and/or unused gear. | | - Ongoing effort - Humboldt County Crab Pot Gear Recovery Project - State Bill 1287 | California Lost Fishing Gear Recovery Project at UC Davis, Channel Islands National Marine Sanctuary, <i>The Bay Institute</i> |
| 5.5.2. Remove legacy aquaculture debris from historic aquaculture lease operations in Tomales Bay and in other areas of historic aquaculture activities in the State. | | - Ongoing effort | California Lost Fishing Gear Recovery Project at UC Davis, <i>The Bay Institute</i> |
| 5.5.3. Engage boaters, fishermen, divers, and community to participate in cleanup programs organized by Bay/Harbor industries (i.e. growers, kayak companies, etc.). | | - Ongoing effort | Channel Islands National Marine Sanctuary, CSU Channel Islands Environmental Science and Resource Management (ESRM) Program, <i>California State Parks Division of Boating & Waterways and California Coastal Commission, The Bay Institute</i> |
| 5.5.4. Research policy barriers to lost gear removal and ocean-based marine debris cleanup. | | - Ongoing effort | California Lost Fishing Gear Recovery Project at UC Davis, Channel Islands National Marine Sanctuary, <i>The Bay Institute</i> |

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| 5.5.5. Identify funding and start program to remove derelict commercial fishing vessels. | | - New effort | <i>The Bay Institute</i> |
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