Southern California Bight 2013
Regional Marine Monitoring Survey
(Bight 2013)

Debris Workplan

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Introduction

The Southern California Bight Regional Monitoring Program is a partnership of now more than 60 organizations collaborating to address management questions of regional importance in the Bight offshore, nearshore and estuarine habitats. The Bight surveys provide a mechanism to develop standardized methods, quality assurance protocols and data transfer standards agreeable to all participants. This ensures that all data collected during the survey can be integrated and provides the foundation for enhanced coordination among southern California's monitoring programs. The surveys have also provided a forum for multi-party agreement about ways to analyze and interpret marine and estuarine monitoring data. "Core" components of Bight surveys include: 1) offshore water quality, 2) coastal ecology, focusing on sediment quality, and 3) shoreline microbiology.

Debris is a major class of contaminants found in the Southern California Bight and its coastal watersheds. "Debris" is defined as persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the environment. Debris causes severe adverse effects to marine and terrestrial wildlife via a variety of different pathways including ingestion and bioaccumulation of contaminants, entanglement, ingestion, smothering and destruction of critical habitat. It can result in direct effects to human health and reduce aesthetics of recreational experiences in freshwater and coastal environments, with clear economic impacts to fisheries, aquaculture, navigation, and tourism. It is estimated that 80% of debris found in the marine environment is generated from land-based sources. Sources of the debris include littering, dumping in rivers and streams, and industrial losses such as spillage of plastic resin pellets during production, transportation, and processing. The reduction of land-based sources is an important management action for reduction in marine debris.

The study of debris has been a component, though never the focus, of the previous four Bight studies (1994, 1998, 2003, and 2008). Results from previous Bight studies have shown the areal extent of debris in the SCB has ranged from 50 to 89%, without monotonic trend over time. The greatest extent of debris occurred in the summer of 1998 and the least in summer of 2003. Part of this may be due to timing of rainfall preceding the four regional surveys. The winter of 1997-98 had the greatest rainfall relative to the least rainfall in 2002-03 (205% vs. 109% of long-term annual rainfall, respectively). Interestingly, the aerial extent of anthropogenic debris remained relatively constant compared to the extent of natural debris. The aerial extent of anthropogenic debris ranged from 14 to 25% of the SCB between the four regional surveys. In comparison, the aerial extent of natural debris ranged from 40 to 88% of the SCB between the four surveys. It was this large range in natural debris, with a maximum in 1998 and a minimum in 2003 that was responsible for the overall extent estimates in the SCB. There were several similarities among the four regional surveys, many appearing to be trends of consistency. First, debris most frequently occurred in trace to low abundance and weight. Second, the aerial extent of natural debris was always greater than the extent anthropogenic debris regardless of survey. Third, the greatest extent of anthropogenic debris always occurred in the central and southern regions where the greatest most population centers are located. Finally, plastic was always the category of anthropogenic debris with the greatest areal extent.

Previous studies of debris in the SCB have not linked marine debris abundance with the types and distributions found in coastal watersheds. During Bight '13, the Debris Committee seeks to document the abundance, types and distribution of debris among major Bight habitats, from wadeable streams to the nearshore zone, using comparable methods. We also seek to link data on distribution to land-use based sources of debris.

The purpose of this document is to provide a workplan for the Bight '13 Debris study. Detailed field methods, laboratory methods and quality assurance plans are available as companion documents on the SCCWRP website.

Survey Design

A. Study Objectives

The overall objective of this study is to characterize the extent and magnitude of debris in SCB watersheds and marine environments and determine any linkages. Within this objective, there are 3 questions of interest:

1. What are the quantities and types of debris in marine and estuarine sediments and epibenthos?
2. What is the prevalence of debris in nearshore demersal and pelagic fish?
3. What are the quantities and types of debris in riverine channels?

The first question seeks to evaluate the differences in the abundance and types of debris found in surface sediments (epibenthos) and within sediments among major Bight estuarine and marine habitat types. The approach to answering this question leverages efforts conducted through Bight Contaminant Impacts Assessment Group (CIA) Benthic Ecology and Trawl components at sites randomly selected within 10 major strata. Marine debris found within sediment samples and retained on otter trawls will be picked, identified and quantified for comparison across major habitat types.

The second question will quantify the amount and types of debris ingested by demersal and pelagic fish found in onshore versus offshore habitats. Demersal fish will be sampled from Bight CIA otter trawls and pelagic fish will be seined across selected estuarine and nearshore habitat types. Fish stomach contents will be opened, sorted by size class, identified and counted for relative abundance.

The third question seeks to quantify the abundance and types of debris in the channels of wadeable streams throughout Southern California Bight (SCB) watersheds. It leverages ongoing annual debris surveys conducted through the Stormwater Monitoring Coalition (SMC) Regional Stream Bioassessment program at 90 urban, agricultural and open land use sites per year, conducted in the spring. The approach to answering this question involves assessing urban land use sites in the fall, with a mix of new sites to compare seasonal abundances and sites revisited from the spring to look at accumulation rates over the summer dry period.

B. Quantities and Types of Debris in Sediments and Epibenthos

B1. Conceptual Approach

The goal of this part of the Bight '13 Debris survey will be to determine the quantities and types of benthic (within sediments) and epibenthic (upon sediments) debris in marine and estuarine sediments. The approach is to collaborate and coordinate with the Bight '13 CIA Benthic Ecology and Trawl technical subcommittees to collect information on debris. Results from this component of the study will be used to determine the quantity and types of debris that are present in the nearshore benthic environment.

A large portion of marine debris is plastic. Examining plastic debris associated with the nearshore benthic habitat is a focal point for the Bight '13 Debris study, and will be used to provide information on the amounts and types of plastic available to marine organisms for potential consumption. Exposure to these plastics in the guts of these organisms can have two potential harmful effects: 1) bioaccumulation of contaminants; and/or 2) feelings of satiation with no nutritional value. In both cases, adverse effects can cause health and reproductive stress, and even death.

Epibenthic (trawl) debris has been examined in previous Bight surveys, and will be studied again for Bight '13. Previous Bight surveys have estimated up to about 25% of the Bight is affected by anthropogenic marine debris. In the past, information on debris has not been collected in a manner that makes it comparable to methods used in streams and beaches. The goal of this component of the study is two-fold: 1) is to update the methods for debris data collection in order to make it comparable with other terrestrial debris surveys and 2) document the temporal and spatial trends in debris abundance by nearshore habitat type of interest. The Bight '13 CIA group will conduct trawls to look at benthic fish and megabenthic invertebrate communities, and as part of the trawl component, the debris information will be collected, typed, and counted, with plastics returned to the lab for further analysis. Comparisons between the types and amounts of different types of plastic among epibenthic and benthic debris can provide useful information for determining the extent of area effected and hence determine the magnitude of the problem and to determine where and what types of debris should be targeted for management actions.

B2. Target Population, Sample Frame Development, and Site Selections

This study component is being leveraged over resources in place through the Bight '13 CIA Group, hence the target population, sample frame, and site selection has been pre-determined by that workgroup. The target population for the 20'13 CIA survey is all marine or marine-influenced, subtidal waters along the Southern California Bight to a depth of 1,000 m, excluding the Channel Islands. The sample frame (Figure 1) will include nine strata used in previous Bight surveys, as well as two new strata: Submarine Canyons (benthic grabs only) and Marine Protected Areas (MPAs). There will be 11 strata total with a target of 30 sites from each stratum. The strata are as follows:

1. Bays
2. Marinas
3. Ports
4. Estuaries
5. Inner Shelf
6. Middle Shelf
7. Outer Shelf
8. Upper Slope
9. Lower Slope
10. Canyons
11. Marine Protected Areas (MPAs)

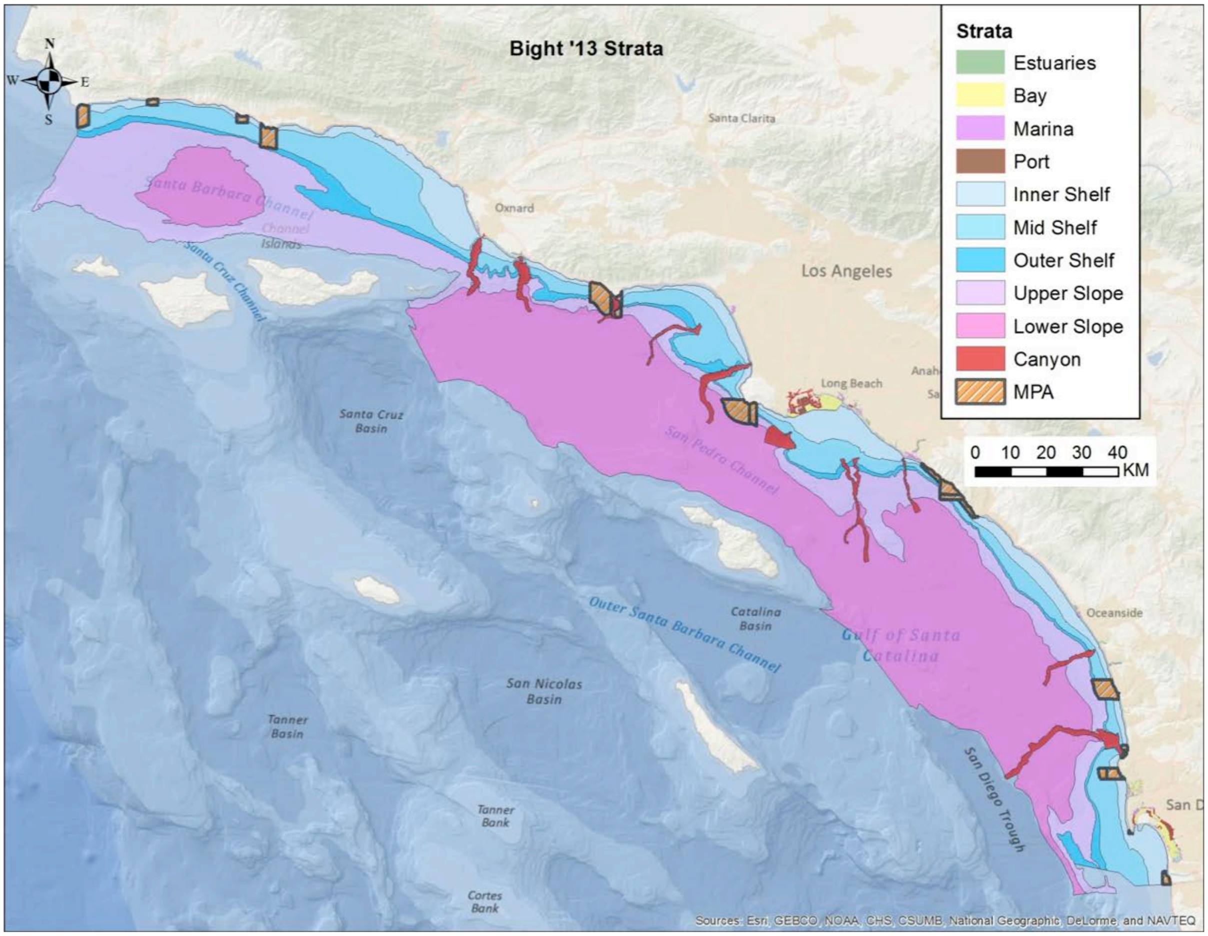

Figure1. Bight '13 CIA Sampling Strata.

Site will be selected using a generalized random tessellation stratified (GRTS) procedure, to ensure spatial balance among sampled sites and allow for inference into regional condition. A systematic component (reverse hierarchical ordering) will be used in site selection to minimize clustering of sampling sites. In general, a hexagonal grid will be randomly placed over a map of the sampling area, a subsample of hexagons chosen from this population, and one sample will be obtained at a randomly selected site within each grid cell. The hexagonal grid structure ensures systematic separation of the sites, while the random selection of sites within grid cells ensures an unbiased estimate of ecological condition. Sampling sites for MPAs will be selected using unequal probability with two multi-density categories: "small" and "large", separated by the median size value across all the MPAs in the frame, in order to increase the probability of sites falling in smaller MPAs. Only offshore MPAs that are associated with the mainland will be included in the MPA stratum. Canyon sample site selection will also be carried out using unequal probability, with the 10 major canyons serving as multi-density categories, to improve the chances that sites from all 10 canyons are included in the survey.

B3. Sampling and Analysis Methods

There are two major components to the field sampling: 1) benthic grabs and 2) epibenthic trawls. This section describes the field and laboratory methods associated with these components. Further detail are available in detailed Bight ‘13 Field Methods Manual and Bight ’13 Benthic Manual (http://goo.gl/pd3so).

BENTHIC (GRABS)

Benthic macroplastic sample collection will be done in collaboration with the Bight ‘13 CIA group. Sample collection methods in the field will follow the Bight ‘13 Field Operations Manual, and sample collections will occur during the summer of 2013. The main purpose of benthic sampling is to obtain data on localized community structure of infaunal invertebrate assemblages; however, the collection of these samples will serve a dual role in giving us a better idea of the amounts and types of macroplastic found in the sediment.

Field Methods

A 0.1 m^2 modified Van Veen grab will be used to collect sediment samples for physical, chemical, and infaunal analyses (Stubbs et al. 1987). The grab used for infaunal analysis will also be used for macroplastic analysis. Grab acceptance criteria will be the same as that for infaunal grabs, and will be based on two characteristics of the sample: sample condition and depth of penetration. Sample condition is judged using criteria for surface disturbance, leakage, canting and washing (see Field Operations Manual for details). Sediment penetration depth must be at least 5 cm; however, penetration depths of 7-10+ cm should be obtained in silt.

Once the sample is found acceptable, any larger plastic items (or items of questionable material) found on top or within (caught in jaws or found inside the grab) the sample will be retained and placed in a gallon Ziploc bag labeled with the sampling date, station and collecting agency. Samples will then be sent to SCCWRP or directly to AMRI, using appropriate Chain of Custody (COC) forms. The sample itself will be processed by washing the sediment from the grab and sending it and the wash through a 1.0-mm screen. Once the sample has been washed through the screen, the material left (debris, coarse sediment, and organisms) will be transferred to a labeled sample container. Samples will be treated with a relaxant solution and fixed after 30 minutes in a 10% formalin solution. Samples will then be returned to the lab for further analysis. COC forms will be used to track all infauna/debris samples from the field to the sorting lab to the AMRI lab for final debris analysis.

Laboratory Methods

Upon receiving samples at the lab, the samples will be washed and transferred to a preservative of a 70% solution of ethanol. Samples will then be sorted into broad taxonomic categories and debris for subsequent analysis. All plastic or questionable plastic items will be placed in labeled vials with water, ethanol, or left dry (whatever is easiest for the sorting lab). If more than one vial is filled, then the vials should be labeled as such, e.g. vial 1 of 2 or 2 of 2. All debris that has been sorted can be sent to SCCWRP for delivery to AMRI or delivered directly to AMRI for final analysis.

The sorting labs will also perform QA/QC for plastic debris as part of their QA/QC for infaunal samples. Samples that undergo QA/QC will be resorted and debris items that were missed from the original samples during the initial sort will be placed in a vial and sent to AMRI for analysis. Error rates will be computed and included in the final data analysis, though not to be associated with the infaunal measurement quality objectives. The debris found in the QA/QC process will not be used to determine whether a sample passed or failed for analysis, that determination will be made solely through the infauna QA/QC.

Final analysis of the debris samples will include counting, typing (e.g. fragment, line, film, foam or pellet), categorizing by size (e.g. 1.00mm-4.99mm, >5.00mm), and determining the polymer type. To determine the polymer type, the Andrady method will be used (Appendix E).

EPIBENTHIC (TRAWLS)

Epibenthic or trawl marine debris sample collection will be done in collaboration with the Bight '13 CIA group. Sample collection methods in the field will follow the Bight '13 Field Operations Manual, and sample collections will occur during the summer of 2013. The main purpose of the trawl survey is to obtain data on localized community structure of fish and invertebrate assemblages; however, the collection of these samples will serve a dual role in giving us a better idea of the amounts and types of marine debris found on the bottom of the ocean.

Field Methods

Trawls will be conducted using a semi-balloon otter trawl with a 7.6-m headrope (25 ft), 8.8-m footrope (29 ft), 3.8-cm (1.5 in) body mesh, and a 1.3-cm cod-end mesh (0.5 in). Trawls will be towed along isobaths at a speed-over-ground of 1.0 m/sec (or 1.5 to 2.0 kn) for 10 minutes. At the end of the prescribed trawl time, the net is retrieved and brought onboard the vessel. Any debris caught on the cable should be noted, but not included in the talley. The cod-end is then opened and the catch deposited into a tub or holding tank. The criteria used to evaluate the success of any trawl includes making sure that proper depth, scope, speed, and distance (or duration) were maintained, whether the net was fouled (net tangled), and whether the catch shows evidence that it was on the bottom (*e.g.*, rocks, benthic invertebrates, benthic fish). The trawl catch will be sorted on deck into containers.

The catch should initially be rough sorted into major categories (*e.g.*, urchins, shrimp, other invertebrates, flatfishes, rockfishes, other fishes, debris). Trawl debris will be sorted into containers for processing. Debris collected during any trawl should be quantified by recording the specific types of material and their quantities on the Bight ‘13 Trawl Debris Form (Appendix 1). This form was developed based on the same form used by the SMC for collecting debris information for land-based sources. The major categories include Plastic, Glass, Metal, Miscellaneous Items, Marine Origin, and Terrestrial Origin. Items within these categories are specific and include those commonly found by the Bight ’13 Trawl Group in previous surveys (Appendix 2). Types of items within each of these categories will be counted and recorded. If an item is not on the list it will be placed in the appropriate “Other” category and a comment made to describe the item. In the case of items that could fit into multiple categories, count the item in the category that the item consists most of, and document any of the other categories it would fit in the comments field. Please note additional descriptive information regarding the debris such as brand names in the comments section for that type. For debris of marine or terrestrial origin, counts of each should be made; however, estimates are acceptable as well. For estimated counts place a qualifier in the estimate box based on the following categories: L for low abundance (2-10 items); M for Moderate abundance (11-100 items); and H for High abundance (>100 items). In cases where counts were not easily made, a comment explaining the difficulty would be helpful. No debris items will be weighed for Bight ’13, but comments that better describe the debris such as estimated size (e.g. the size of a basketball), condition (e.g. decayed kelp frond in pieces), or type/species (e.g. Macrocystis) are encouraged. After all of the debris has been categorized and counted, all plastic debris will be retained for further analysis. All or a piece (about the size of a quarter) of each plastic item will be placed in a gallon Ziploc bag and returned to be sent to the lab.

Laboratory Methods

All plastic items and pieces sent to the lab will be analyzed for polymer type using methods developed as described in section B3 under Laboratory Methods.

C. Prevalence of Debris in Demersal and Pelagic Fish

C1. Conceptual Approach

The goal of this part of the Bight '13 Debris survey will be to determine the quantities and types debris ingested by pelagic and demersal fish. As noted previously, exposure to these plastics in the guts of these organisms can have two potential harmful effects: 1) bioaccumulation of contaminants; and/or 2) feelings of satiation with no nutritional value. In both cases, adverse effects can cause health and reproductive stress, and even death.

The objectives of this component of the study are three-fold: 1) quantify the types, sizes and abundance of debris found in the guts of pelagic and demersal fish of selected guilds; 2) document the differences in prevalence of ingested debris by pelagic and demersal fish, 3) document spatial patterns in ingested debris associated with nearshore habitat types of interest.

As with the previous section, the approach is to leverage of the Bight '13 CIA Trawl group in order to acquire specimens of demersal fish. AMRI will provide resources to sample pelagic fish. Fish gut contents will be processed to quantify the size and shape, types and abundance of debris ingested by these organisms. Comparisons between the types and amounts of different types of plastic among pelagic and demersal fish can provide useful information for determining the extent of area effected as well as suggest pathways for ingestion of debris to determine where and what types of debris to focus on for management actions.

C2. Target Population, Sample Frame Development, and Site Selection

This part of the study will focus on two different areas for looking at plastic ingestion by fish. The first will examine ingestion in benthic versus pelagic areas and the second will look at difference between embayments and offshore. As with the "Sediments and Epibenthos" study component, the sample frame and site selection will be pre-determined by the Bight '13 CIA Group (see Section B2). A subsample from the overall sample draw of 30 sites will be taken each for embayments and the mainland shelf for fish ingestion analysis.

Samples for the pelagic portion of the study will be taken in areas proximal to sites sampled in enclosed bays and neashore. A Mamou trawl will be used to capture near surface pelagic species, using 10 minute trawls. In the event that fish are not found in the trawls, hook and line capture may be attempted, or samples may be procured from commercial operations.

C3. Sampling Methods

Field Methods

Five fish from each species found in three categories will be collected by trawl at each of the thirty sites within embayments and the nearshore strata. These three categories include the 1) Pelagobenthivore Guild, 2) Benthivore Guild, and 3) fish found to have consumed plastics. Fish species in each of these groups include:

Pelagobenthivore Guild:

- Pacific sanddab
- longfin sanddab
- Longspine combfish
- speckled sanddab
- Bay goby

Benthivores Guild:

- English sole
- blackbelly eelpout
- hornyhead turbot
- curlfin sole
- bearded eelpout

Fish found with plastic:

- white croaker
- queenfish
- shiner perch
- spotted cusk eel
- lizardfish

Pelagic species:

- Deepbody Anchovy
- Northern Anchovy
- Sardine
- Herring
- Jack Mackerel
- Pacific Mackerel
- Smelt

Trawls will be done using Bight ‘13 standardized procedures as found in the Bight ‘13 Field Methods Manual. Fish will be collected, counted, and weighed as part of the Bight CIA Group survey and the species of interest will then be collected, placed in a Ziploc bag and frozen. Larger, adult fish from each species with no indication of stomach content regurgitation should be targeted. Fish will then be transferred to SCCWRP for distribution to AMRi, or they may be delivered directly to AMRI. Chain-of-Custody forms will be used during this process.

C4. Laboratory Analysis Methods

In the laboratory, each fish will be measured for length, weighed, and sexed. The gut (stomach and intestinal tract) will be removed and washed into a 1mm sieve. The contents in the sieve will be examined under a 10X magnifying lens or dissecting scope for ingested plastic. Each plastic item will be removed, sized, sorted by shape, and typed (fragment, pellet, line, film, and foam). Plastic will be archived in shell vials and all pieces will be analyzed for polymer type using methods listed in section B2 above.

D. Quantities and Types of Debris in River Channels

D1. Conceptual Approach Approach

The goal of this component of the Bight '13 Debris survey will be to determine the quantities and types debris in the channels of wadeable streams. Debris deposited in riverine habits occurs through several primary processes including but not limited to 1) land use-based sources, 2) incidental or wind-blown debris from adjacent areas, and 3) direct deposit of debris through littering and illegal dumping. Understanding the quantity and types of debris in riverine habits is a first step in making the connections between land based sources and debris that is ultimately transported to the ocean.

The Bight Debris riverine study compliments the existing Stormwater Monitoring Coalition (SMC) effort to assess debris with a greater focus on the urban stratum. The objectives of this riverine habit study component are three-fold:

1) Compare the types and quantities of debris found in urban land uses during the spring (post-wet season) versus fall (end of summer dry weather),
2) Estimate the rate of accumulation of debris in urban channels over the summer dry weather period, and
3) Evaluate sources and pathways that contribute trash, including urbanized land uses associated with trash.

D2. Target Population, Sample Frame Development, and Site Selection

Because this study component is being leveraged over resources in place through the SMC Regional Watershed Monitoring Program, the target population, sample frame, and site selection has been pre-determined by that workgroup. The target population for the 2013 SMC survey is perennial, wadeable, and Strahler second order or higher classification streams across the Southern California watersheds. The sample frame will include the major strata used in previous SMC surveys, which are as follows:

1. Strahler Order
2. Land Use
    a. Urban
    b. Agriculture
    c. Open
3. Watershed Jurisdiction (Hydrologic Unit Boundaries)
4. County Jurisdictional Boundaries
5. Regional Water Quality Control Board Jurisdiction Boundaries

Sample sites were selected using a probabilistic approach weighting by watershed, land use, and stream order (Appendix F). The sampling frame includes watershed units located from Ventura to San Diego and as far east as San Bernardino and Riverside Counties. These watersheds equate to combinations of management units utilized by the Regional Water Quality Control Boards (RWQCB) or SMC member agencies. Altogether, these 15 watershed units are comprised of roughly 28,051 km2 (Table 2). The streamlines used to define the sampling frame were derived from the National Hydrography Dataset (NHD Plus). Altogether, there are 9,492 stream miles of Strahler order 2 and greater in the sampling frame. Land use was defined as either urban, agriculture, or open based on CCAP remote imaging algorithms (National Oceanic and Atmospheric Administration 1995). CCAP defines 35 different land use classes that have been aggregated into the three categories for this study (i.e., open, agriculture, urban, and water) (Table 3). The dominant land use within a 500-m buffer was assigned to each stream reach.

The Bight '13 debris study would pull existing SMC sites in two categories: 1) "new" sites which have not previously been assessed for debris) and 2) sites that have been assessed in the Spring 2013 period, from which debris has been removed.

To address the first objective, 30 new urbanized sites will be chosen from those which have previously undergone bioassessment, but not debris. These sites would be used to compare abundance and types of debris.

To address the second objective, a minimum of 15 sites (maximum of 30) will be sampled in the fall, and will be selected from those assessed in Spring 2013, in which debris had been removed. The sites would be used to estimate the rate of debris accumulation over the course of the summer dry weather.

To address the third question, two types of data would be used to analyze the sources: 1) land use in the upstream catchment and within a specified buffer surrounding the site and 2) data collected within the debris survey that relates to source. The data on sources will be used as an independent variable to explore relationships with abundance and debris.

D3. Sampling and Analysis Methods

The sampling approach required to conduct the stream trash assessment will utilize the "Count and Pick Up" approach adopted by the San Francisco Bay Regional Water Quality Control Board. This sampling approach is based on combination of field methods incorporating a multimetric rapid trash assessment index (RTA) and an associated item tally. Sites are numerically evaluated using the Surface Water Ambient Monitoring Program Rapid Trash Assessment approach developed by the San Francisco Bay Regional Water Quality Control Board. In addition to the RTA score, individual debris items will be recorded according to specific item categories on the Stream Trash Item Tally Sheet.

Debris collected during any survey should be quantified by recording the specific types of material and their quantities on the Stream Trash Item Tally Worksheet (Appendix 1). The major categories include Plastic, Glass, Metal, Biohazard, Biodegradable, Construction, Large, Toxic and Miscellaneous Items. Types of items within each of these categories will counted and recorded. If an item is not on the list it will be placed in the appropriate "Other" category and a comment made to describe the item. In the case of items that could fit into multiple categories, count the item into the category that the item has the greatest proportion of material, and document any other the other categories it would fit in the comments field. After all of the debris has been categorized and counted, all plastic debris will be retained for further analysis.

Field information collected during site assessments will include a description of site characteristics that will further aid in the data analysis. The additional site characterization data will include an evaluation of storm drain inputs, presence of homeless encampments, adjacent land features, and summaries of the stream geomorphologies.

Schedule

Below is an approximate schedule governing the major components of the Bight 13 debris study.

Element	**Schedule**	
	Marine Debris (Elements B and C)	**Riverine Debris (Element D)**
Field, laboratory methods and SOP development	March 2013-June 2013	June 2015
Field logistics, training and intercalibration	May - June 2013	March –August 2013
Field work	July - October 2013	March - September 2013
Data management	October 2013-October 2014	October 2013-January 2014
Data analysis	October 2014-April 2015	January 2014-June 2014
Reporting	October 2015	December 2014

Appendix A. Trawl Debris Field Data Sheet

BIGHT'13 TRAWL DEBRIS FORM **Agency:** ____________ **Page** ________ **of** ________

Station:_________ **Trawl #:**_______ **Date:** _______________ ☐ **CHECK HERE IF NO DEBRIS PRESENT IN SAMPLE**

Anthropogenic Debris - Include Brand Names in Comments if known

Plastic	Count	Comment
Bag		
Bandaid		
Balloon (mylar/latex)/Ribbon		
Bottle		
Buoy		
Cap/Lid		
Cigarette box/wrapper		
Cup		
Filmstrip (movie)		
Fishing Line/Net		
Food Bag / Wrapper		
Polypropylene Rope		
Straw		
Toy		
Utensil		
Plastic Piece (unid.)		
Other Plastic *(comment req.)*		

Glass	Count	Comment
Beer Bottle		
Glass Bottle/Jar -other		
Glass Piece (unid.)		
Other Glass *(comment req.)*		

Misc. Items/Pieces	Count	Comment
Boat/Ship/Engine part		
Clothing		
Concrete/Asphalt		
Fiberglass		
Food		
Leather		
Lumber		
Paper		
Rag/Cloth		
Rubber		
Shoe		
Tape		
Tire		
Other Misc. *(comment req.)*		

Metal	Count	Comment
Drink Can		
Can - other		
Can Pull-tab		
Fishing Gear		
Wire		
Metal Piece (unid.)		
Other Metal *(comment req)*		

Natural Debris

Marine Origin	Count	Est.*	Comment
Foliose Algae - not kelp			
Gorgonian Sea Fan (dead)			
Kelp Holdfast			
Kelp Stipe/Blade			
Rock			
Seagrass			
Other Marine *(comment req)*			

Terrestrial Vegetation	Count	Est.*	Comment
Leaves/Seed Pod			
Stick/Branch/Driftwood			
Other Terrest. *(comment req)*			

****For Natural Debris only***, if an exact count cannot be made, leave the "Count" column blank and estimate the amount (L, M or H) in the "Est." column:

Low: **L** = 2-10
Moderate: **M** = 11-100
High: **H** = > 100

Completed by: _______________

Appendix C. Trawl Debris Category Lookup List

DebrisCollectionMethod	DebrisOrigin	DebrisCategory	DebrisType	CommentRequired?
Trawl	Anthropogenic	Plastic	Bag	N
Trawl	Anthropogenic	Plastic	Bandaid	N
Trawl	Anthropogenic	Plastic	Balloon (mylar/latex)/Ribbon	N
Trawl	Anthropogenic	Plastic	Bottle	N
Trawl	Anthropogenic	Plastic	Buoy	N
Trawl	Anthropogenic	Plastic	Cap/Lid	N
Trawl	Anthropogenic	Plastic	Cigarette box/wrapper	N
Trawl	Anthropogenic	Plastic	Cup	N
Trawl	Anthropogenic	Plastic	Filmstrip (movie)	N
Trawl	Anthropogenic	Plastic	Fishing Line/Net	N
Trawl	Anthropogenic	Plastic	Food Bag / Wrapper	N
Trawl	Anthropogenic	Plastic	Polypropylene Rope	N
Trawl	Anthropogenic	Plastic	Straw	N
Trawl	Anthropogenic	Plastic	Toy	N
Trawl	Anthropogenic	Plastic	Utensil	N
Trawl	Anthropogenic	Plastic	Plastic Piece (unid.)	N
Trawl	Anthropogenic	Plastic	Other Plastic (comment req.)	Y
Trawl	Anthropogenic	Glass	Beer Bottle	N
Trawl	Anthropogenic	Glass	Glass Bottle/Jar -other	N
Trawl	Anthropogenic	Glass	Glass Piece (unid.)	N
Trawl	Anthropogenic	Glass	Other Glass (comment req.)	Y
Trawl	Anthropogenic	Misc. Items/Pieces	Boat/Ship/Engine part	N
Trawl	Anthropogenic	Misc. Items/Pieces	Clothing	N
Trawl	Anthropogenic	Misc. Items/Pieces	Concrete/Asphalt	N
Trawl	Anthropogenic	Misc. Items/Pieces	Fiberglass	N
Trawl	Anthropogenic	Misc. Items/Pieces	Food	N

Trawl	Anthropogenic	Misc. Items/Pieces	Leather	N
Trawl	Anthropogenic	Misc. Items/Pieces	Lumber	N
Trawl	Anthropogenic	Misc. Items/Pieces	Paper	N
Trawl	Anthropogenic	Misc. Items/Pieces	Rag/Cloth	N
Trawl	Anthropogenic	Misc. Items/Pieces	Rubber	N
Trawl	Anthropogenic	Misc. Items/Pieces	Shoe	N
Trawl	Anthropogenic	Misc. Items/Pieces	Tape	N
Trawl	Anthropogenic	Misc. Items/Pieces	Tire	N
Trawl	Anthropogenic	Misc. Items/Pieces	Other Misc. (comment req.)	Y
Trawl	Anthropogenic	Metal	Drink Can	N
Trawl	Anthropogenic	Metal	Can - other	N
Trawl	Anthropogenic	Metal	Can Pull-tab	N
Trawl	Anthropogenic	Metal	Fishing Gear	N
Trawl	Anthropogenic	Metal	Wire	N
Trawl	Anthropogenic	Metal	Metal Piece (unid.)	N
Trawl	Anthropogenic	Metal	Other Metal (comment req)	Y
Trawl	Natural	Marine Origin	Foliose Algae - not kelp	N
Trawl	Natural	Marine Origin	Gorgonian Sea Fan (dead)	N
Trawl	Natural	Marine Origin	Kelp Holdfast	N
Trawl	Natural	Marine Origin	Kelp Stipe/Blade	N
Trawl	Natural	Marine Origin	Rock	N
Trawl	Natural	Marine Origin	Seagrass	N
Trawl	Natural	Marine Origin	Other Marine (comment req)	Y
Trawl	Natural	Terrestrial Vegetation	Leaves/Seed Pod	N
Trawl	Natural	Terrestrial Vegetation	Stick/Branch/Driftwood	N
Trawl	Natural	Terrestrial Vegetation	Other Terrest. (comment req)	Y

Appendix C. Benthic and Epibenthic Debris Laboratory Sheet

Ocean Plastic Size and Type Data Sheet

Site No:_______________ Sample Date:_________________ Lab Technician:_______________

Latitude:______________ Longitude:___________________ Sample Device Type:___________

SIZE	Fragments	Pellets	Line	Thin Film	Foam	Total Count
	Count	Count	Count	Count	Count	
> 4.75 mm						
1.00 - 4.75 mm						
Total Count						

POLYMER TYPE	Fragments	Pellets	Line	Thin Film	Foam	Total Count
	Count	Count	Count	Count	Count	
PS Foam						
PU Foam						
HDPE						
LDPE/LLDPE						
PP						
PS						
Nylon						
PVC						
PET (or PC)						
Total Count						

Van Veen Grab – analyze for both Size and Polymer Type
Otter Trawl – analyze for only Polymer Type

Appendix D. Rapid Trash Assessment Worksheet

Rapid Trash Assessment Worksheet

SMC Regional Stream Assessment Project

WATERSHED: ______________________ DATE: ______________

STREAM: ______________________ STAFF INITIALS ______________

STATION ID: ______________________

	CONDITION CATEGORY			
Trash Assessment Parameter	**Optimal**	**Sub optimal**	**Marginal**	**Poor**
1. Aesthetic Value	No visual impact	On first glance, no trash is visible. After closer look, small amounts of trash are present.	Small amounts of trash up to moderate amounts are present.	Trash levels distract your view up to conditions of "This site is horrible and I can't wait to leave."
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Accumulation of Trash	There does not appear to be a problem with trash accumulation from upstream sources. Trash, if any, appears to have been wind blown onto site from adjacent land use.	Some evidence that litter and debris have been transported from upstream areas to the location, based on evidence such as silt marks, faded colors or location near high water line. (< 10 items)	Evidence that trash is carried to the location from upstream, as evidenced by its location near high water line, siltation marks on the debris, or faded colors. (11-50 items)	Trash appears to have accumulated in substantial quantities at the location based on delivery from upstream areas, and is in various states of degradation based on its persistence in the waterbody. (> 50 items from upstream locations)
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
(as % found)	0 5 10 15 20	25 30 35 40 45	50 55 60 65 70	75 80 85 90 95 100
3. Threat to Aquatic	Trash, if any, is mostly paper or wood products or other biodegradable materials. **Note:** A large amount of rapidly biodegradable material like food waste creates high oxygen demand, and should not be scored as optimal.	Little or no transportable, persistent, buoyant litter such as: hard or soft plastics, Styrofoam, balloons, cigarette butts. (<10 items)	Medium prevalence of transportable, persistent, buoyant litter such as: hard or soft plastics, Styrofoam, balloons, cigarette butts. Any evidence of clumps of deposited yard waste or leaf litter. (11-50 items)	Large amount (>50 pieces) of transportable, persistent, buoyant litter such as: hard or soft plastics, balloons, Styrofoam, cigarette butts; toxic items such as batteries, lighters, or spray cans; large clumps of yard waste or dumped leaf litter.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Threat to Human Health	Trash contains no evidence of medical waste, diapers, pet or human waste. No evidence of toxic substances such as chemical containers or batteries. No ponded water for mosquito production. No evidence of puncture and laceration hazards such as broken glass or metal debris.	No human health hazards or disease vectors. Small presence (<10 pieces) of puncture and laceration hazards such as broken glass and metal debris.	Presence of any one of the following: hypodermic needles or other medical waste; used diaper, pet waste, or human feces; any toxic substance such as chemical containers, batteries, or fluorescent light bulbs (mercury). Medium prevalence (10-50 pieces) of puncture hazards.	Presence of more than one of the items described in the marginal condition category, or high prevalence of any one item (e.g. greater than 50 puncture or laceration hazards).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

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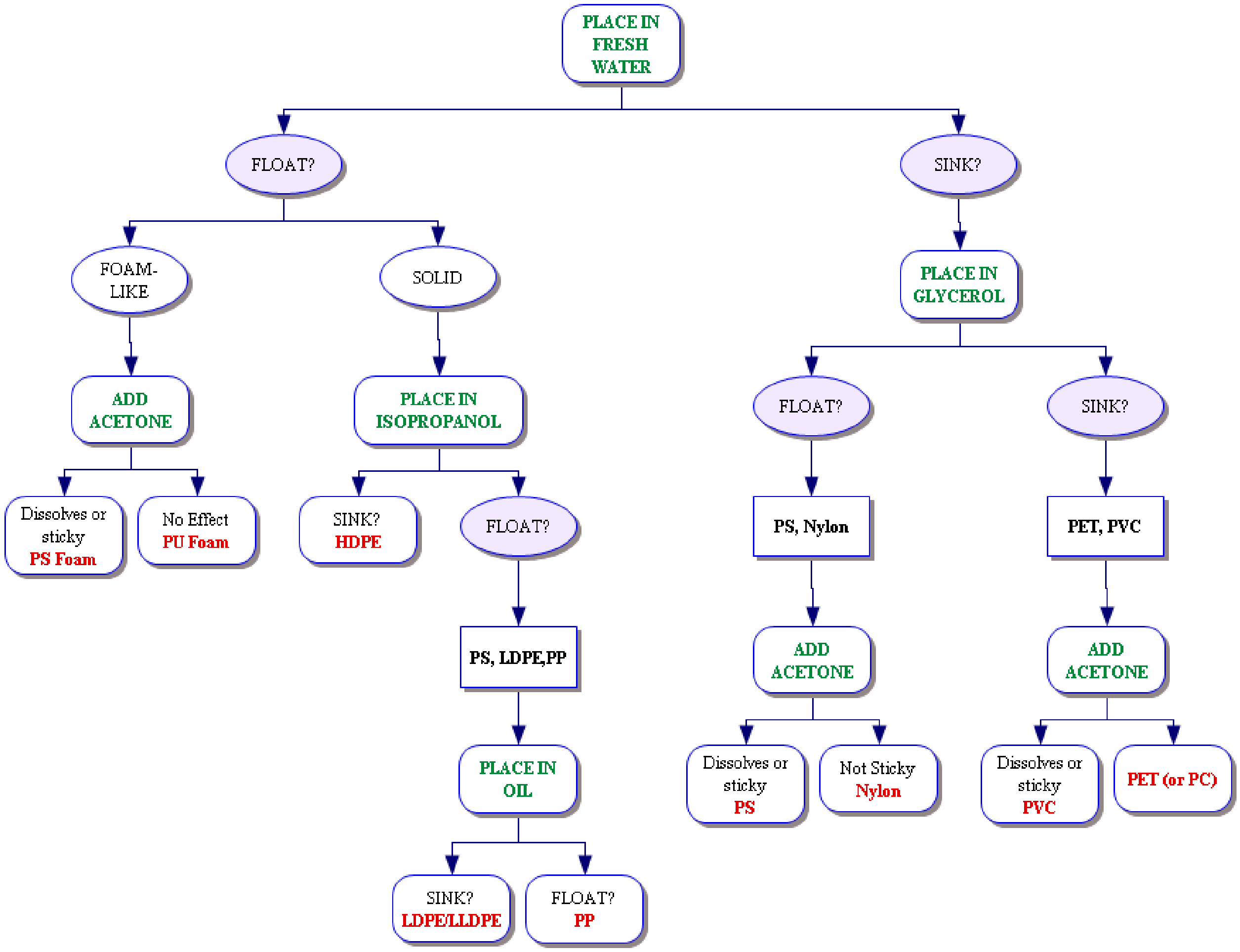
Appendix E: Andrady Method for Plastic Type Determination



Appendix F: Sampling Sites for Riverine Debris Study

Organization	County	SMCCode	SMCShed	Latitude	Longitude	GNIS_NAME
Heal the Bay						
	LOS ANGELES	SMC04264	Santa Monica Bay	34.13	-118.75481	Medea Creek
	LOS ANGELES	SMC11880	Santa Monica Bay	34.12529	-118.70828	Las Virgenes Creek
Los Angeles Waterkeeper						
	LOS ANGELES	SMC00318	Los Angeles	33.81288	-118.20559	Angeles River, Los
	LOS ANGELES	SMC00440	Los Angeles	34.28659	-118.52966	Aliso Canyon Wash
	LOS ANGELES	SMC00748	Los Angeles	34.07549	-118.07881	Rubio Wash
	LOS ANGELES	SMC01004	Los Angeles	34.15016	-118.16579	Seco, Arroyo
	LOS ANGELES	SMC01128	Santa Monica Bay	34.1039	-118.71271	Las Virgenes Creek
	LOS ANGELES	SMC05992	Santa Monica Bay	34.15698	-118.75878	Medea Creek
San Diego Coastkeeper						
	SAN DIEGO	SMC00153	Northern San Diego	33.22193	-117.34612	San Luis Rey River
	SAN DIEGO	SMC00198	Central San Diego	32.93709	-117.13851	Penasquitos Creek, Los
	SAN DIEGO	SMC00345	Central San Diego	33.21048	-117.22484	Buena Vista Creek
	SAN DIEGO	SMC00473	Central San Diego	33.03916	-117.15803	San Dieguito River
	SAN DIEGO	SMC00665	Northern San Diego	33.27401	-117.23159	San Luis Rey River
	SAN DIEGO	SMC00857	Northern San Diego	33.2461	-117.30088	San Luis Rey River
	SAN DIEGO	SMC01046	Mission Bay and San Diego River	32.7951	-117.18495	Tecolote Creek
	SAN DIEGO	SMC01258	Southern San Diego	32.6495	-117.05887	Sweetwater River
	SAN DIEGO	SMC01606	Mission Bay and San Diego River	32.84199	-117.23481	Rose Canyon
	SAN DIEGO	SMC01990	Mission Bay and San Diego River	32.79654	-117.11327	Murphy Canyon
	SAN DIEGO	SMC06458	Southern San Diego	32.66902	-117.01724	Sweetwater River
	SAN DIEGO	SMC08426	Southern San Diego	32.650714	-117.054823	Sweetwater River
Orange County Coastkeeper/AMEC/SCCWRP						
	ORANGE	SMC00766	Lower Santa Ana	33.65719	-117.83739	Sand Canyon Wash
	ORANGE	SMC01923	Lower Santa Ana	33.67222	-117.78872	San Diego Creek
	ORANGE	SMC02270	Lower Santa Ana	33.79574	-117.77242	Handy Creek
	ORANGE	SMC05230	Lower Santa Ana	33.87308	-117.75077	Santa Ana River
	LOS ANGELES	SMC00288	San Gabriel	34.13119	-117.76	Live Oak Wash
	LOS ANGELES	SMC00446	San Gabriel	34.02018	-118.04628	San Gabriel River Tributary
	LOS ANGELES	SMC00686	San Gabriel	34.0322	-117.8382	San Jose Creek tributary
	ORANGE	SMC00926	San Gabriel	33.9074	-117.88297	Fullerton Creek

ORANGE	SMC00206	San Juan	33.54359	-117.65964	Trabuco, Arroyo
ORANGE	SMC00873	San Juan	33.59849	-117.62668	Tijeras Canyon
ORANGE	SMC00963	San Juan	33.56402	-117.6514	Trabuco, Arroyo
ORANGE	SMC01257	San Juan	33.60842	-117.6186	Tijeras Canyon