Staff Report:

Reconsideration of Certain Technical Matters of the Trash TMDLs for the Los Angeles River Watershed and the Ballona Creek Watershed

Los Angeles Regional Water Quality Control Board

Revised May 2015

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1 Trash in the Los Angeles River and Ballona Creek Watersheds

This staff report presents analyses and rationale in support of recommendations to reconsider certain technical aspects of two trash total maximum daily loads (TMDLs) in the Los Angeles Region – the Los Angeles River Watershed Trash TMDL ("Los Angeles River Trash TMDL") and the Ballona Creek Trash TMDL ("Ballona Creek Trash TMDL"). No significant changes are proposed to the principal existing technical TMDL elements that were established in the original TMDLs, including problem statements, numeric targets, source and linkage analyses, waste load allocations (WLAs) and load allocations (LA), margins of safety, and critical conditions in either the Los Angeles River or Ballona Creek Trash TMDLs. Neither are there significant changes proposed to the overarching compliance options – full capture, partial capture, and institutional controls – identified in the Los Angeles River and Ballona Creek Trash TMDLs. The proposed changes are intended to ensure consistency between the two TMDLs where appropriate; provide clarity regarding compliance demonstration as responsible agencies approach final deadlines; provide greater specificity regarding implementation of load allocations; and improve compliance monitoring and ensure receiving water monitoring.

Section VI.A of the August 9, 2007 Los Angeles River Watershed Trash TMDL Staff Report (LARWQCB, 2007b) and the corresponding 2007 Basin Plan Amendment (LARWQCB, 2007a) established that the Los Angeles Regional Water Quality Control Board (Regional Board) would review and reconsider the final WLAs once a reduction of 50% has been achieved and sustained in the watershed.

Similarly, Section VI.A of the January 16, 2004 Staff Report for the Trash TMDL for the Ballona Creek and Wetlands (LARWQCB, 2004b) and the corresponding 2004 Basin Plan Amendment (LARWQCB, 2004a) established that the Regional Board would review and reconsider the final WLAs once a reduction of 50% has been achieved and sustained in the watershed.

As shown in Tables 3 and 4, a reduction of greater than 50% in the baseline trash loads has been reported by the majority of responsible agencies and sustained in both watersheds.

1.1 The Problem of Trash in Waterbodies Continues

Trash in waterbodies causes significant water quality problems. Small and large floatables can inhibit the growth of aquatic vegetation, decreasing spawning areas and habitats for fish and other living organisms. Wildlife living in rivers and in riparian areas can be harmed by ingesting or becoming entangled in floating trash. Floating debris that is not trapped and removed will eventually end up on the beaches or in the open ocean, repelling visitors away from our beaches and degrading coastal waters. Settleables include glass, cigarette butts, rubber, construction debris and more. Settleables can be a problem for bottom feeders and can contribute to sediment contamination. Some debris (e.g. diapers, medical and household waste, and chemicals) is a source of bacteria and toxic substances. The impacts of trash on beneficial uses and the current condition of waterbodies with regard to trash impairments have been well summarized in the State Water Resources Control Board's (State Water Board) staff report supporting its proposed amendments to the California Ocean Plan and the Inland Surface Waters and Enclosed Bays and Estuaries of California Plan to incorporate a water quality objective for trash and associated implementation provisions. Appendix A, Parts I and II of the State Water Board's staff report is included as Attachment A in its entirety.

The continued presence of trash in the Los Angeles River and Ballona Creek as described further in section 1.3.2, below, and the well documented negative impacts to beneficial uses supports the continued need for these TMDLs and the established targets and allocations, therein.

The prevention and removal of trash in the Los Angeles River and Ballona Creek Watersheds ultimately will lead to improved water quality and attainment of water quality standards. This, in turn, will aid in the protection of aquatic life and habitat, enhance the quality of recreational opportunities for the public, protect public health, and increase public interest in these waterbodies as valuable recreational and ecological resources.

1.2 Regulation of Trash through the Los Angeles River and Ballona Creek Trash TMDLs

1.2.1 The Establishment of the Los Angeles River and Ballona Creek Trash TMDLs

The Los Angeles River and Ballona Creek Trash TMDLs were among the first TMDLs in the Los Angeles Region and in California, and among the first trash TMDLs in the nation to address waterbody impairments due to trash in highly urbanized watersheds.

The Regional Board originally established the Los Angeles River Trash TMDL, by Resolution No. R01-013, on September 19, 2001. This TMDL included an implementation plan requiring a progressive reduction of trash in the Los Angeles River Watershed to achieve final WLAs by September 30, 2015. This TMDL was subsequently approved by the State Water Board on February 19, 2002, the Office of Administrative Law (OAL) on July 16, 2002, and the United States Environmental Protection Agency (USEPA) on August 1, 2002. The TMDL went into effect on August 28, 2002.

On June 8, 2006, pursuant to a writ of mandate in litigation filed by several cities challenging the TMDL, the Regional Board set aside Resolution No. R01-013 and the TMDL (Resolution No. 06-013). The Regional Board directed its staff to prepare and submit for the Board's reconsideration, as soon as possible, a revised TMDL consistent with the requirements of the writ of mandate, including revised California Environmental Quality Act (CEQA) documentation. On July 19, 2006, the State Water Board set aside Resolution No. 2002-0038, which had approved the TMDL, and remanded the TMDL to the Regional Board for further action.

On August 9, 2007, the Regional Board adopted, by Resolution No. R07-012, a new Los Angeles River Trash TMDL. This TMDL included an implementation plan requiring a progressive reduction of trash in the Los Angeles River Watershed to achieve final WLAs by September 30, 2016. The 2007 TMDL went into effect on September 23, 2008 (LARWQCB, 2007a).

The Regional Board established the Ballona Creek Trash TMDL, by Resolution No. R01-014, on September 19, 2001. This TMDL also included an implementation plan requiring a progressive reduction of trash in the Ballona Creek Watershed to achieve final WLAs by September 30, 2015. This TMDL was subsequently approved by the State Water Board on February 19, 2002, the OAL on July 18, 2002, and the USEPA on August 1, 2002. The TMDL went into effect on August 28, 2002 (LARWQCB, 2001). On March 4, 2004, by Resolution No. 04-023, the Regional Board amended the Ballona Creek Trash TMDL by incorporating minor language changes concerning implementation of the TMDL. The amendments were approved by the State Water Board on September 30, 2004 and the OAL on February 8, 2005. USEPA approval of the amendments was not required due to the nature of the changes. The revisions went into effect on August 11, 2005 (LARWQCB, 2004a).

The regulatory background, beneficial uses to be protected, geographical extent and complete TMDL elements, along with supporting analysis, are fully described in the respective staff reports and amendments to the Water Quality Control Plan for the Los Angeles Region (Basin Plan) (LARWQCB, 2001, 2004a and 2007a) at (http://www.waterboards.ca.gov/losangeles/water_issues/programs/tmdl/tmdl_list.shtml) and are not repeated, herein.

1.2.2 Trash Controls in Statewide Water Quality Control Plans

The State Water Board has proposed an amendment to incorporate provisions to control discharges of trash to the Water Quality Control Plan for Ocean Waters of California (Ocean Plan) and a similar amendment to the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries (ISWEBE Plan) Part 1 Trash Provision (State Trash Amendments). The purpose of the State Trash Amendments is to provide a statewide regulatory approach to protect aquatic life and public health beneficial uses from impacts due to trash in waterbodies statewide.

On June 10, 2014, the State Water Board released draft documents on the State Trash Amendments to the public for comment. On December 31, 2014, the State Water Board released proposed final documents for public review (SWRCB, 2014). On March 26, 2015, the State Water Board released revised proposed final documents (SWRCB, 2015). Adoption of the proposed final documents is anticipated in April 2015.

Because of the significant efforts that have already occurred to address trash impairments in waterbodies within the Los Angeles Region, the proposed final State Trash Amendments do not apply to waters within the jurisdiction of the Los Angeles Regional Board that have trash TMDLs in effect prior to the effective date of the State Trash Amendments. However, within one year of the State Trash Amendments' effective date, the proposed amendments direct the Los Angeles Regional Board to convene a public meeting to reconsider the scope of its trash TMDLs to particularly consider an approach that would focus its MS4 permittees' trash-control efforts on high-trash generation areas within each permittee's jurisdiction. This reconsideration of scope does not apply, however, to the Los Angeles River and Ballona Creek Trash TMDLs given that the final implementation deadlines for these TMDLs are in 2016 and 2015, respectively. The revised proposed final Part 1 Trash Provisions of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California states under Chapter IV – Implementation of Water Quality Objectives of the ISWEBE Plan, Part A.1.b:

> *b.* *These TRASH PROVISIONS apply to all surface waters of the State, with the exception of those waters within the jurisdiction of the Los Angeles Regional Water Quality Control Board (Los Angeles Water Board) for which trash Total Maximum Daily Loads (TMDLs) are in effect prior to the effective date of these TRASH PROVISIONS; provided, however, that:*
>
> *…*
>
> *(2)* *Within one year of the effective date of these TRASH PROVISIONS, the Los Angeles Water Board shall convene a public meeting to reconsider the scope of its trash TMDLs, with the exception of those for the Los Angeles River and Ballona Creek watersheds, to particularly consider an approach that would focus MS4 permittees' trash-control efforts on high-trash generation areas within their jurisdictions.*

The corresponding Staff Report states the following in Section 1.3 *Effect on Existing Basin Plans, Trash-Related TMDLs and Permits*:

> *The proposed final Trash Amendments would apply to all surface waters in the state, with the exception of those waters with the jurisdiction of the Los Angeles Water Board that have trash TMDLs in effect prior to the Trash Amendments. As the fifteen trash TMDLs in the Los Angeles Region have more stringent provisions than the proposed final Trash Amendments, the proposed final Trash Amendments would not result in a degradation of water quality standards in those water. While the proposed final Trash Amendments do not apply to existing trash TMDLs in the Los Angeles Region, the proposed Trash Amendments direct the Los Angeles Water Board to reconsider the scope of its trash TMDLs within one year of the Trash Amendments' effective date and focus its permittees' trash control efforts on high trash generation areas rather than all areas within each permittee's jurisdiction. The reconsideration would occur for all existing trash TMDLs, except for the Los Angeles River Watershed and Ballona Creek Trash TMDLs, because those two TMDLs are approaching final compliance deadlines of September 30, 2016 and September 30, 2015, respectively.*

1.3 Los Angeles River and Ballona Creek Trash TMDL Status

Both the Los Angeles River Trash TMDL and Ballona Creek Trash TMDL were in effect as of September 23, 2008 and August 28, 2002, respectively. Both TMDLs were subsequently incorporated into the Los Angeles County Municipal Separate Storm Sewer System (MS4) Permit. The WLAs and associated requirements of the Los Angeles River Trash TMDL were first incorporated into the Los Angeles County MS4 Permit through a reopener of the 2001 permit in 2009 (Order No. R4-2009-0130). These provisions were carried over during the reissuance of the Los Angeles County MS4 Permit in 2012 (Order No. R4-2012-0175) and similar provisions were also included at that time for the Ballona Creek Trash TMDL. The Los Angeles River Trash TMDL was also incorporated into the City of Long Beach MS4 Permit (Order No. R4-2014-0024). Provisions to implement both TMDLs were incorporated into the California Department of Transportation (Caltrans) Statewide Stormwater Permit (State Board Order No. 2012-0011-DWQ). The provisions of the Los Angeles River Trash TMDL have yet to be incorporated into the Ventura County MS4 Permit for the single MS4 permittee, the City of Simi Valley, which is subject to the Ventura County MS4 Permit but has some land area within the Los Angeles River watershed.

1.3.1 MS4 Compliance with Los Angeles River and Ballona Creek Trash TMDLs

The Trash TMDLs include three general implementation approaches, which are full capture systems, partial capture devices, and institutional controls, or any combination of these. MS4 permittees are assigned interim and final WLAs in the Los Angeles River and Ballona Creek Trash TMDLs and the WLAs are included as water quality-based effluent limitations (WQBELs) in MS4 permits, as described above. Demonstration of compliance under the MS4 permits can be assessed as percent of catch basins (or area draining to catch basins), which have been retrofitted with a certified full capture system or can be assessed as effectiveness of partial capture and institutional controls using either a mass balance approach, based on the daily generation rate (DGR) for trash from a representative area or a performance based approach, based on the performance of the device(s) and control(s) in the implementing area. (Los Angeles County MS4 Permit, Part VI.E.5.b.i.(1)-(3))

An examination of compliance data submitted since the 2012 Los Angeles County MS4 Permit became effective is summarized in the tables, below. This compliance data was submitted to the Regional Board in the form of TMDL compliance reports as an attachment or within Permittees' annual reports. In some cases, it was difficult for Regional Board staff to verify the degree of compliance because some MS4 Permittees reported summary data without including the underlying data and there were also inconsistencies in the assumptions made by MS4 Permittees.

In the Los Angeles River, for the 2012-2013 storm year, the interim WQBEL was a reduction in trash to 20% of the baseline annual trash load for each jurisdiction (as calculated in 2002-2003). For the 2013-2014 storm year, the interim WQBEL was a reduction in trash to 10% of the baseline annual trash load.

Table 1 Compliance Summary for the Los Angeles River Trash TMDL

Los Angeles River Trash TMDL Compliance Summary		
In Compliance	2012-2013 Reporting Year (20% of Baseline) (# of Permittees)	2013-2014 Reporting Year (10% of Baseline) (# of Permittees)
Yes	24	14
No	8	12
Undetermined	11	17
N/A	1	1

Undetermined: Compliance cannot be determined based on the information provided to the Regional Board because information is missing, or is of insufficient quality to determine compliance with interim WQBELs.
N/A: Assessment was not applicable for the City of Santa Clarita because there is no MS4 in the portion of City of Santa Clarita's jurisdiction that lies within the Los Angeles River watershed. Recommendations concerning the City of Santa Clarita are discussed below.

In Ballona Creek, for the 2012-2013 storm year, the interim WQBEL was a reduction in trash to 10% of the baseline annual trash load as calculated in 2002-2003. For the 2013-2014 storm year, the interim WQBEL was a reduction in trash to 3.3% of the baseline annual trash load.

Table 2 Compliance Summary for the Ballona Creek Trash TMDL

Ballona Creek Trash TMDL Compliance Summary		
In Compliance	2012-2013 Reporting Year (10% of Baseline) (# of Permittees)	2013-2014 Reporting Year (3.3% of Baseline) (# of Permittees)
Yes	2	1
No	2	3
Undetermined	3	3

Undetermined: Compliance cannot be determined based on the information provided to the Regional Board because information is missing, or is of insufficient quality to determine compliance with interim WQBELs.

In the following two tables, the column labeled % FCS is the percentage of storm drain catch basins within the portion of the jurisdiction's drainage to the perspective watershed that has certified full capture systems installed within those catch basins. For the column labeled partial capture/institutional controls, the percentage of trash reduced (% Trash Reduced) was calculated by dividing the estimate of the total trash discharged for the year using daily generation rates (DGRs) by the baseline and interim allocations.

Table 3 Compliance Summary by Method of Compliance for Los Angeles River

Permittee	2012-2013 Reporting Year (20% of Baseline)				2013-2014 Reporting Year (10% of Baseline)			
	Full Capture System (FCS)		Partial Capture and Institutional Controls (PCIC)		Full Capture System (FCS)		Partial Capture and Institutional Controls (PCIC)	
	% FCS	Compliance	% Trash Reduced	Compliance	% FCS	Compliance	% Trash Reduced	Compliance
Alhambra	58.3%	N/A	70.2%	No	58.3%	N/A	86.3%	No
Arcadia[#]	***95.4%***	Undetermined	N/A	N/A	***95.4%***	Undetermined	N/A	N/A
Bell	91.9%	Yes	N/A	N/A	91.9%	Yes	N/A	N/A
Bell Gardens	93.4%	Yes	N/A	N/A	93.4%	Yes	N/A	N/A
Bradbury	0.0%	N/A	90.6%	Yes	100.0%	Yes	N/A	N/A
Burbank[#]	*87.2%*	Undetermined	N/A	N/A	*86.6%*	Undetermined	N/A	N/A
Calabasas	72.0%	No	N/A	N/A	72.0%	Undetermined	N/A	N/A
Carson	**91.7%**	Yes	N/A	N/A	**91.7%**	Yes	N/A	N/A
Commerce	**84.7%**	Undetermined	N/A	N/A	**84.7%**	No	N/A	N/A
Compton	**87.1%**	Yes	N/A	N/A	***87.1%***	Undetermined	N/A	N/A
Cudahy	**88.4%**	Yes	N/A	N/A	**88.4%**	No	N/A	N/A
Downey	89.7%	Yes	N/A	N/A	89.7%	Yes	N/A	N/A
Duarte	**13.2%**	No	N/A	N/A	**13.2%**	No	N/A	N/A
El Monte	U	Undetermined	N/A	N/A	U	Undetermined	N/A	N/A
Glendale[#]	***60.1%***	Undetermined	N/A	Undetermined	***67.4%***	Undetermined	N/A	Undetermined
Hidden Hills	N/A	N/A	99.6%	Yes	N/A	N/A	99.8%	Yes
Huntington Park	**86.0%**	Yes	N/A	N/A	**85.6%**	No	N/A	N/A
Irwindale	N/A	Undetermined	N/A	N/A	N/A	Undetermined	N/A	N/A
La Cañada Flintridge	71.9%	No	N/A	N/A	71.9%	No	N/A	N/A
Long Beach	U	Undetermined	N/A	Undetermined	U	Undetermined	N/A	Undetermined
Los Angeles	N/A	N/A	91.5%	Yes	**17.1%**	N/A	91.5%	Yes
Los Angeles County	86.7%	Yes	N/A	N/A	96.4%	Yes	N/A	N/A
Lynwood	**92.2%**	Yes	N/A	N/A	**92.2%**	Yes	N/A	N/A
Maywood	**85.4%**	Yes	N/A	N/A	**85.4%**	No	N/A	N/A
Monrovia	N/A	N/A	98.5%	Yes	N/A	N/A	99.5%	Yes
Montebello	83.5%	Yes	N/A	N/A	83.5%	No	N/A	N/A
Monterey Park	36.8%	N/A	90.2%	Yes	36.8%	N/A	97.8%	Yes
Paramount	92.0%	Yes	N/A	N/A	*95.4%*	Undetermined	N/A	N/A
Pasadena	*44.0%*	Undetermined	N/A	N/A	*44.0%*	Undetermined	N/A	N/A
Pico Rivera	**83.6%**	Yes	N/A	N/A	***86.6%***	Undetermined	N/A	N/A
Rosemead	**5.8%**	No	N/A	N/A	**44.3%**	No	N/A	N/A
San Fernando	5.9%	No	N/A	N/A	9.9%	No	N/A	N/A
San Gabriel[#]	23.7%	No	N/A	N/A	17.5%	No	N/A	N/A

Permittee	2012-2013 Reporting Year (20% of Baseline)				2013-2014 Reporting Year (10% of Baseline)			
	Full Capture System (FCS)		Partial Capture and Institutional Controls (PCIC)		Full Capture System (FCS)		Partial Capture and Institutional Controls (PCIC)	
	% FCS	Compliance	% Trash Reduced	Compliance	% FCS	Compliance	% Trash Reduced	Compliance
San Marino	U	Undetermined	N/A	Undetermined	U	Undetermined	N/A	Undetermined
Santa Clarita	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sierra Madre	0.9%	No	N/A	N/A	0.9%	No	N/A	N/A
Signal Hill	89.0%	Yes	N/A	N/A	***89.0%***	Undetermined	N/A	Undetermined
Simi Valley	U	Undetermined	N/A	Undetermined	U	Undetermined	N/A	Undetermined
South El Monte	U	Undetermined	N/A	N/A	U	Undetermined	N/A	N/A
South Gate	**85.8%**	Yes	N/A	N/A	**85.8%**	Undetermined	N/A	N/A
South Pasadena	N/A	N/A	95.9%	Yes	N/A	N/A	98.5%	Yes
Temple City	N/A	N/A	94.0%	Yes	N/A	N/A	97.1%	Yes
Vernon	**93.1%**	Yes	N/A	N/A	**91.5%**	Yes	N/A	N/A
Caltrans	U	Undetermined	N/A	Undetermined	U	Undetermined	N/A	Undetermined

Undetermined: Compliance cannot be determined based on the information provided to the Regional Board because information is missing, or is of insufficient quality to determine compliance with interim or final WLAs.
N/A: Assessment was not applicable. A Permittee's compliance is either assessed per the FCS method or the PCIC method, as described above.
U: Unverified
#: Includes only permittee-owned catch basins and does not include LACFCD catch basins within the permittee's jurisdiction.
Italics: Values have been reported by permittees but supporting data have not been provided for verification
Bolded: Actual trash reduction may be higher due to installation of partial capture devices as well

Table 4 Compliance Summary by Method of Compliance for Ballona Creek

Permittee	2012-2013 Reporting Year (10% of Baseline)				2013-2014 Reporting Year (3.3% of Baseline)			
	Full Capture System (FCS)		Partial Capture and Institutional Controls (PCIC)		Full Capture System (FCS)		Partial Capture and Institutional Controls (PCIC)	
	% FCS	Compliance	% Trash Reduced	Compliance	% FCS	Compliance	% Trash Reduced	Compliance
Beverly Hills	U	Undetermined	N/A	Undetermined	U	Undetermined	N/A	Undetermined
Culver City	20.4%	N/A	90.5%	Yes	95.4%	N/A	74.8%	No
Inglewood	0.4%	No	N/A	N/A	0.4%	No	N/A	N/A
Los Angeles	N/A	N/A	98%	Yes	N/A	N/A	98%	Yes
Los Angeles County	87.7%[1]	No	N/A	N/A	88.0%[1]	No	N/A	N/A
Santa Monica	U	Undetermined	N/A	Undetermined	U	Undetermined	N/A	Undetermined
West Hollywood	U	Undetermined	N/A	Undetermined	U	Undetermined	N/A	Undetermined

[1] Since the 2007 baseline report of the County of Los Angeles, an additional 105 catch basin were identified through their investigation and identification process. This has been reflected in the County's compliance status. As of 2013-2014 reporting year, the County has addressed 55 of those previously unidentified catch basins.

Undetermined: Compliance cannot be determined based on the information provided to the Regional Board because information is missing, or is of insufficient quality to determine compliance with interim or final WLAs.
N/A: Assessment was not applicable. A Permittee's compliance is either assessed per the FCS method or the PCIC method, as described above.
U: Unverified

1.3.2 Status of Trash in Receiving Waters

While a great deal has been accomplished to control trash in the Los Angeles River Watershed and Ballona Creek Watershed, as detailed above, there is still considerable trash in waterbodies in both watersheds. The Los Angeles River and Ballona Creek Trash TMDLs do not, yet, include the requirement for receiving water monitoring for trash; however, information on trash is available from academic studies, trash "clean up" events, debris booms, and Regional Board surveys.

Academic studies
Numerous studies have been conducted in recent years concerning trash and, especially, plastics in southern California (Midbust et al., 2014; Moore et al., 2011; Stevenson, 2011 among others). Many of these studies have focused on plastics as a great deal of the trash that remains in waterbodies is plastics.

A 2011 study of trash in the Los Angeles and San Gabriel Rivers (Moore et al., 2011) calculated that approximately 2.3 billion plastic objects and fragments, with a total weight of 30 metric tons, were being transported by both rivers in a 72-hour period including rain events. The majority of pieces (71%) were foams, with miscellaneous fragments making up 14%, pre-production resin pellets making up 10%, and whole items making up 1%. Plastic particles less than 5 mm in size were 16 times more abundant than those greater than 5 mm.

Clean up events
Non-governmental organizations including Heal the Bay, Friends of the Los Angeles River (FoLAR), and Ballona Creek Renaissance conduct in-stream and coastal trash clean-up events, which provide snapshots of the amount of trash in the Los Angeles River and Ballona Creek.

Los Angeles River Watershed
Between 2004 and 2011, FoLAR has held 22 cleanup events with roughly 4,000 people participating in 2011 (FoLAR, 2011). These events were held in five locations: Lake Balboa, Fletcher Drive, Steelhead Park, Compton Creek, and Willow Street. In addition to trash collection, FoLAR sorts a subsample of the trash to determine the types of trash that are most commonly found in the river. Collected trash was sorted into 15 different categories with plastic making up the majority of the trash by weight and volume, followed by clothes and fabric or metal, depending on the site, and food service packaging in a few sites (FoLAR, 2011 and 2012).

Ballona Creek Watershed
Ballona Creek Renaissance organized or documented nine separate clean-up events within the Ballona Creek Estuary in 2014. These events were held at different locations in the estuary and collected between 50 to 869 pounds of trash per event, with an annual total of 2,373.5 pounds of trash collected (Ballona Creek Renaissance, 2014).

Debris booms

The Los Angeles County Flood Country District has installed a debris boom near the mouth of the Los Angeles River Estuary at the Ocean Boulevard Bridge. This boom was installed in 2000 and was fully optimized in 2007-08. The boom was designed to withstand typical flow volumes at the location of the debris boom and capture floatable debris present in those flows while bypassing the higher flows due to flooding concerns. The collected trash and other debris is gathered for disposal, but not separated or sorted. From April 2013 to March 2014, roughly 1,200 tons of debris from the Los Angeles River Estuary were collected as a result of the debris boom. Observations indicated that most of the debris was vegetation with smaller amounts of trash including plastics, packaging, etcetera (Naing, Win, County of Los Angeles, Department of Public Works, February 24, 2015, personal communication).

The Los Angeles County Flood Control District has also installed a debris boom near the mouth of the Ballona Creek Estuary downstream of Lincoln Boulevard Bridge. Like the Los Angeles River debris boom, this boom is designed to withstand typical flow volumes at the location of the debris boom and the debris is gathered for disposal but not separated or sorted. In 2014,roughly 6 tons of debris were collected from Ballona Creek Estuary. It was observed that most of it was trash including Styrofoam, plastics, packaging, etcetera and that the proportion of trash to vegetation was higher in Ballona Creek than the Los Angeles River (Naing, Win, County of Los Angeles Department of Public Works, February 24, 2015, personal communication).

Regional Board surveys

In 2011, the Regional Board conducted recreational use surveys of the Los Angeles River as part of its project, Re-evaluation of Recreational Uses in the Los Angeles River Watershed. Photographs taken by staff during these surveys show continued presence of trash in the Los Angeles River.

Figure 1 Plastic Chairs in Compton Creek, July 1, 2011

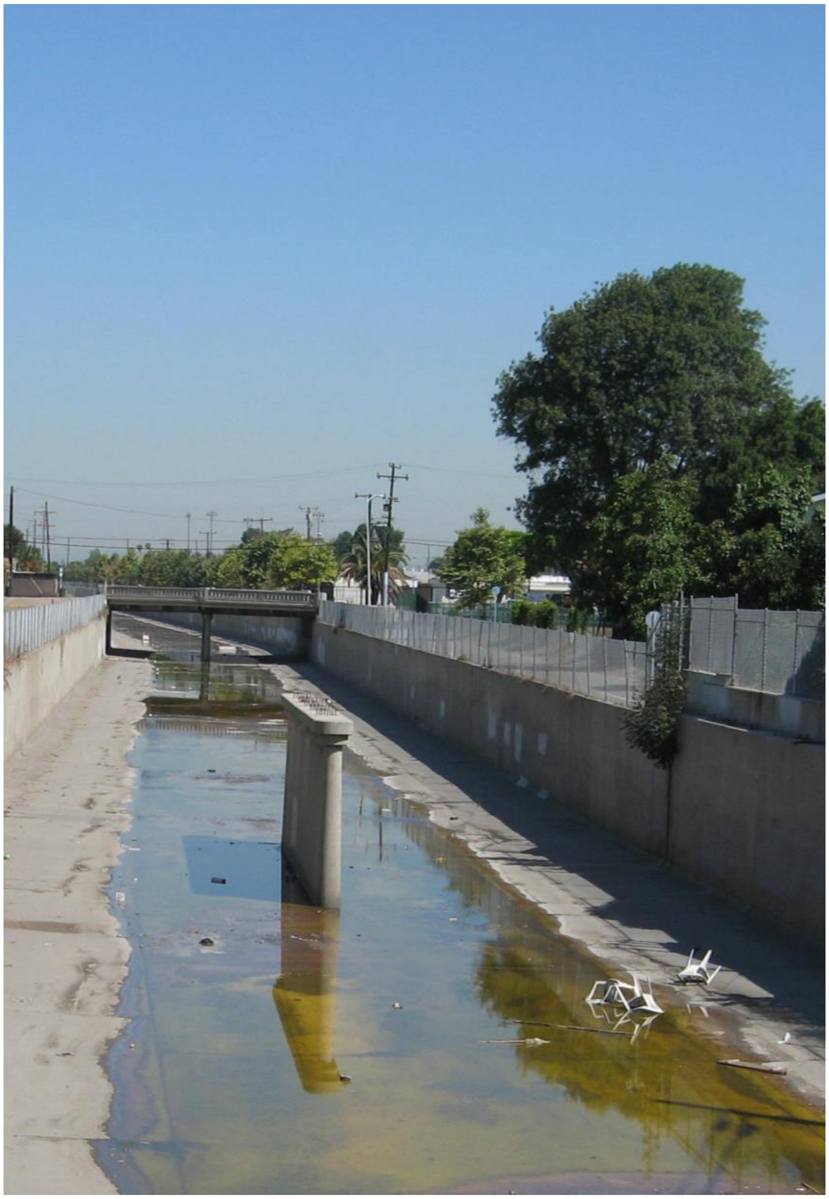

Figure 2 Shredded Plastics, Cudahy River Park, July 1, 2011

Figure 3 Plastic, Paper and Metal Debris, Arroyo Seco, Herman Park, July 1, 2011

2 Technical Matters to be Reconsidered

This reconsideration is not a general reconsideration of each and every element of these TMDLs. No significant changes are proposed to the existing fundamental technical TMDL elements that were established in the original TMDLs, including the Numeric Targets, Loading Capacity, WLAs and LAs, Margins of Safety, and Critical Condition and Seasonal Variations in either the Los Angeles River or Ballona Creek Trash TMDLs. Neither are there significant changes proposed to the overarching compliance options – full capture systems, partial capture devices, and institutional controls – identified in the Los Angeles River and Ballona Creek Trash TMDLs. The proposed changes are intended to ensure consistency between the two TMDLs where appropriate; advance alternatives for demonstrating full compliance; include greater specificity regarding responsible entities assigned WLAs and LAs; and expand monitoring requirements.

2.1 Responsible Entities

2.1.1 Flood Control Districts

In the Los Angeles River Trash TMDL and the Ballona Creek Trash TMDL, WLAs were assigned to MS4 Permittees based on land area. When these TMDLs were established, the Los Angeles County Flood Control District (LACFCD) was not identified as a responsible entity at that time. However, for clarification and consistent with recent practice, the Regional Board now recognizes LACFCD's separate authority over the MS4 and the fact that some of the key compliance strategies for the trash TMDLs rely on installations within the flood control districts' infrastructure. The Regional Board also recognizes the importance of the public agency activity provisions in MS4 permits relative to trash control, which flood control districts are required to implement. These include responsibilities for performing storm drain operation and maintenance, including but not limited to: catch basin labeling, catch basin label inspections, and open channel signage; open channel maintenance that includes removal of trash and debris; and implementation of activity specific BMPs, including those related to litter/debris/graffiti.

In fact, because of this, LACFCD was named as a responsible agency in the more recent Santa Monica Bay Debris TMDL (LARWQCB, 2010a and 2010b). The Santa Monica Bay Debris TMDL includes the Ballona Creek Watershed, therefore, LACFCD is already identified as a responsible agency in that watershed.

In the Santa Monica Bay Debris TMDL, LACFCD may be held responsible along with a jurisdiction and/or agency for non-compliance where the flood control district has either:

(i) without good cause denied necessary authority to a responsible jurisdiction or agency for the timely installation and/or maintenance of full and/or partial capture trash control devices for purposes of TMDL compliance in parts of the MS4 physical infrastructure that are under its authority, or

(ii) not fulfilled its obligations under its MS4 permit regarding proper BMP installation, operation and maintenance for purposes of TMDL compliance within the MS4 physical infrastructure under its authority,

thereby causing or contributing to a responsible jurisdiction and/or agency to be out of compliance with its interim or final WLAs.

Under these circumstances, the Santa Monica Bay Debris TMDL further states that LACFCD's responsibility shall be limited to non-compliance related to the drainage area(s) within the jurisdiction where the flood control district has authority over the relevant portions of the MS4 physical infrastructure.

<u>Recommendation</u>: Update the Los Angeles River Trash TMDL to identify flood control districts as separate responsible agencies in the same manner as in the Santa Monica Bay Debris TMDL, and clarify that the LACFCD is already a responsible agency in the Ballona Creek Trash TMDL.

2.1.2 MS4 Permittees including MS4 Phase II Permittees

Per federal regulations, MS4 permits were developed in two phases. Phase I, which started in 1990, included the adoption of National Pollutant Discharge Elimination System (NPDES) permits for discharges from MS4s in medium (serving between 100,000 and 250,000 people) and large (serving more than 250,000 people) municipalities or metropolitan areas. In the Los Angeles Region, Phase I MS4 permits have been issued to (1) Ventura County, Ventura County Watershed Protection District, and the municipalities in Ventura County; (2) Los Angeles County, Los Angeles County Flood Control District, and the municipalities in Los Angeles County except the City of Long Beach; and (3) the City of Long Beach.

Phase II addresses MS4 discharges from small municipalities (population less than 100,000) and non-traditional MS4s, such as public campuses, military bases, prison and hospital complexes, and State parks. On April 30, 2003, the State Water Board issued a General Permit for the Discharge of Storm Water from Small MS4s (WQ Order No. 2003-0005-DWQ) to provide permit coverage for these smaller municipalities and non-traditional MS4s. The Phase II Small MS4 General Permit covers Phase II Permittees statewide. The 2003 Phase II Small MS4 General Permit was issued for a 5-year permit term. The 2003 General Permit expired in May 2008; however, it continued in force and in effect until the State Water Board reissued the permit in 2013 (Order No. 2013-0001 DWQ). The Los Angeles Region has only a single traditional Phase II MS4 Permittee, the City of Avalon, located on Catalina Island, which is not subject to either of the trash TMDLs being reconsidered. Non-traditional Phase II MS4 Permittees are discussed below for each watershed.

Los Angeles River
The Los Angeles River Trash TMDL includes interim and final WLAs for Phase I MS4 Permittees and also specifies a final WLA for Phase II MS4 Permittees.

An implementation schedule for Phase II MS4 Permittees will be established as specific TMDL provisions are incorporated into the Statewide Phase II Small MS4s General Permit or when a regional Phase II MS4 permit is issued.

Phase II MS4 facilities designated in the 2013 Phase II MS4 General Permit within the Los Angeles River watershed include:

- California State University, Los Angeles
- California State University, Northridge
- University of California, Los Angeles, offsite facilities

The 2013 Phase II MS4 General Permit provides that other non-traditional facilities may be designated by the Regional Board as Phase II MS4 Permittees on a case-by-case basis in the future.

Ballona Creek
In contrast to the Los Angeles River Trash TMDL, the Ballona Creek Trash TMDL includes interim and final WLAs for "municipal permittees."

In order to maintain consistency and sufficient flexibility to ensure fairness, the Ballona Creek Trash TMDL should be updated to include all designated and potential Phase II MS4 Permittees, both municipal and non-traditional.

An implementation schedule for Phase II MS4 Permittees will be established as specific TMDL provisions are incorporated into the Statewide Phase II Small MS4s General Permit or when a regional Phase II MS4 permit is issued.

Phase II MS4 facilities designated in the 2013 Phase II MS4 General Permit within the Ballona Creek watershed include:

- University of California, Los Angeles main campus and offsite facilities
- VA Greater Los Angeles Healthcare System (GLA)

The 2013 Phase II MS4 General Permit provides that other non-traditional facilities may be designated by the Regional Board as Phase II MS4 Permittees on a case-by-case basis in the future.

In addition, in the Los Angeles River Trash TMDL, the Phase I MS4 Permittees are listed by name in the Basin Plan Amendment language, while in the Ballona Creek Trash TMDL, the MS4 Permittees are named only in the Staff Report, but not the Basin Plan Amendment language. For clarity, the names of the Phase I MS4 Permittees (as well as designated Phase II MS4 Permittees) in the Ballona watershed should be included in the Basin Plan Amendment language.

Recommendation: Include both municipal and non-traditional Phase II MS4 Permittees in the Ballona Creek Trash TMDL. Identify by name the Phase I and designated Phase II MS4 Permittees in the Ballona Creek Trash TMDL Basin Plan Amendment language and the designated Phase II MS4 Permittees in the Los Angeles River Trash TMDL Basin Plan Amendment language.

2.1.3 Santa Clarita

The City of Santa Clarita was assigned WLAs in the Los Angeles River Trash TMDL as a MS4 Permittee because a small area within the City's jurisdiction is in the Los Angeles River Watershed.

Accordingly, requirements for trash reductions in MS4 discharges from the City of Santa Clarita were included in the Los Angeles County MS4 Permit.

In the City of Santa Clarita's Annual Report on TMDL Compliance with the Los Angeles River Trash TMDL to the Regional Board dated November 15, 2011, the City of Santa Clarita clarified that the Los Angeles River watershed area, 0.21 sq. miles, is undeveloped open space and that there are no storm drains or MS4 infrastructure in the area. The City has undertaken trash management activities in the area such as street sweeping and monitoring for illegal dumping.

Further, the Individual Annual Report Form (Attachment U-4) for the Los Angeles County MS4 Permit filed by the City of Santa Clarita for 2014, reported that the City of Santa Clarita has posted six “No Dumping” signs and continues to clean and maintain the 0.09 sq. mile area.

Regional Board staff inspected the area in September of 2013 and confirmed that no MS4 features (roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made storm channels, or drains) are located within the 0.09 sq. mile area of the Los Angeles River watershed located within the City of Santa Clarita. The Sierra Highway is the only road through this area and it is a State Department of Transportation (Caltrans) Highway. Regional Board staff also confirmed that the size of the City’s area within the Los Angeles River watershed is 0.09 sq. mile.

The City of Santa Clarita, in coordination with the County of Los Angeles and the Los Angeles County Flood Control District (LACFCD), is developing an Enhanced Watershed Management Program (EWMP) for the Upper Santa Clara River Watershed to comply with requirements of the Los Angeles County MS4 Permit. A workplan for this EWMP was submitted to the Regional Board in June 2014. In addition to implementation of the EWMP for areas with MS4s, the EWMP will also address portions of the City of Santa Clarita and County of Los Angeles that are rural and undeveloped. The EWMP workplan includes the undeveloped area (0.09 square mile) of the Los Angeles River watershed located within the City of Santa Clarita. Institutional controls, such as street sweeping, will contribute to the control of trash in that area. The City of Santa Clarita should, therefore, be provided a load allocation rather than a WLA in the Los Angeles River Trash TMDL.

However, if there are any changes in land use or drainage infrastructure in the portion of the City of Santa Clarita within the Los Angeles River watershed, the Regional Board reserves the right to reconsider the City’s responsibility under the Los Angeles River Trash TMDL and to re-impose MS4 requirements on the City of Santa Clarita to ensure that water quality is protected.

The City of Santa Clarita’s baseline WLA is 901 gallons (2,336 lbs.) of trash. See section 2.4.2 and 2.4.3, below, for requirements for monitoring and complying with load allocations for trash.

<u>Recommendation</u>: Remove the WLA for the City of Santa Clarita in the Los Angeles River Trash TMDL. .

2.2 Compliance Determination

MS4 Permittees have several compliance options to achieve the requirement of zero trash discharged to the Los Angeles River and Ballona Creek. These include:

(i) a technology based approach whereby best management practices (BMPs) meeting the design standard of “full capture” may be properly installed and maintained throughout the Permittee's drainage within the watershed to demonstrate compliance with the WLAs,

(ii) a numeric effluent limitation based approach whereby "partial capture" BMPs and institutional controls not meeting the design standard of "full capture" may be implemented in drainage areas, in which case compliance with the WLA shall be demonstrated by measuring actual reductions in trash discharges in these areas (or, alternatively, the performance of these BMPs in the implementing area).

Either or both approaches may be used within a jurisdictional area.

Staff does not recommend changing these options in the Los Angeles River or Ballona Creek Trash TMDLs. However, these options present several practical issues in determining compliance.

2.2.1 Municipalities Approaching 100% Compliance using Full Capture Systems

For municipalities implementing the Los Angeles River or Ballona Creek Trash TMDLs by retrofitting all catch basins with full capture systems, compliance is demonstrated when 100% of the catch basins in the jurisdiction have been retrofitted with a certified full capture system or 100% of the drainage area is served by full capture systems (where devices may be located within the MS4 downgradient of several catch basins).

Exclusive use of full capture systems provides advantages and many responsible agencies have chosen to use full capture systems exclusively to achieve their WLAs. However, some of these responsible agencies have found that there are some catch basins for which retrofitting with a full capture system, or even a partial capture device, is technically infeasible due to the configuration of the catch basin (i.e., usually too shallow to accommodate a full capture system). In these cases, installation of a full capture system would create a flood risk or would require significant expense to redesign the catch basin and the connected storm drain system that may be out of proportion with the reduction in trash that would be achieved.

Under both the Los Angeles River and Ballona Creek Trash TMDLs, for areas where catch basins have partial capture devices or have no structural trash control devices, a responsible agency has the option of implementing institutional controls or a combination of partial capture devices and institutional controls and then assessing compliance within the catchment area using a mass balance approach based on a Daily Generation Rate (DGS) to calculate the annual trash discharge. However this compliance alternative is not practical for a responsible agency that has installed full capture systems everywhere technically feasible leaving only a few unretrofitted catch basins irregularly interspersed with the full capture retrofitted catch basins. The mass balance/DGR approach is used on a subwatershed or catchment basis, so because there is a mixture of full capture retrofitted catch basins and unretrofitted catch basins in the same subwatershed, on the same street, it is not possible to apply the mass balance/DGR approach.

Alternatively, staff propose that in drainage areas where the vast majority of catch basins are retrofitted with full capture systems and there are only a few catch basins for which retrofit is technically infeasible, which are mixed among the retrofitted catch basins, responsible agencies may request that the Executive Officer make a determination that the agency is in full compliance with their WLA/WQBEL under either TMDL if all of the following criteria are met:

- 98% of all catch basins within the agency's jurisdictional land area in the watershed are retrofitted with FCS (or, alternatively, 98% of the jurisdiction's drainage area is addressed by FCS) and at least 97%[2] of the catch basins (or, alternatively, drainage area) within the agency's jurisdiction in the subwatershed (the smaller of the HUC-12 equivalent area or tributary subwatershed) are retrofitted with FCS.
- The agency prepares and submits to the Regional Board a technical report (1) providing an inventory of the remaining catch basins, including their location within the MS4 and relative to the receiving water; (2) detailing the reason that each catch basin cannot be retrofitted with a full capture system, (3) containing an engineering evaluation of whether each catch basin could be retrofitted with a partial capture device, and an engineering evaluation of whether the catch basins are clustered along a particular storm drain and, if so, an evaluation of whether a downgradient full capture system or partial capture device can be installed along the storm drain or at the MS4 outfall.
- The agency prepares and submits to the Regional Board a report which details the partial capture devices and/or institutional controls implemented in the affected subwatershed and includes an assessment of the effectiveness of the partial capture devices and/or institutional controls using existing data and studies representative of the subwatershed or jurisdictional area.
    - Depending on Regional Board evaluation of the assessment of institutional controls and partial capture devices using existing data and studies, the municipality may need to also conduct a special study of institutional controls and partial capture devices in the particular subwatershed(s) where the non-retrofitted catch basins are located.
- The agency re-evaluates the effectiveness of institutional controls and partial capture devices and reports the findings to the Regional Board if significant land use changes occur in the affected subwatershed (based on permits for new and significant re-development) or if there is a significant change in the suite of implemented partial capture devices and/or institutional controls (e.g., reduced frequency of implementation, reduced spatial coverage of implementation, change in technology employed). Because compliance is evaluated on an annual basis, such re-evaluation shall occur within one year of the identification of the significant changes.

Recommendation: Add to the Los Angeles River and Ballona Creek Trash TMDLs the alternative described in the paragraph above for demonstrating full compliance for agencies that are using full capture systems exclusively to achieve their WLAs/WQBELs.

2.2.2 DGR Calculation Requirements

[2] In 22 areas of unincorporated County of Los Angeles, the County of Los Angles has found 68 (out of 4,289) catch basins to be not suitable for full capture systems, allowing for a full capture installation of approximately 98%, overall. Catch basins in each of the 22 areas will allow at least 97% full capture installation.

Currently, MS4 Permittees that have opted to implement the Los Angeles River or Ballona Creek Trash TMDLs using partial capture devices and institutional controls must, each year, calculate a Daily Generation Rate (DGR) from a representative area of their jurisdiction so that they can then calculate their yearly trash discharge to be compared to interim and final WLAs.

DGR is direct measurement of trash deposited in the drainage area during any 30-day period between June 22 and September 22. The formula is as follows:

1. Daily Generation Rate (DGR) = Amount of trash collected in 30-day period / 30 days
2. Storm Event Trash Discharge = Days since last street sweeping from a given storm event x DGR - Amount of trash recovered from catch basins
3. Total Storm Year Trash Discharge = Sum of all storm events that generate precipitation greater than 0.25 inch.

Calculation of a DGR has been required annually to serve as a measure of the effectiveness of source reduction methods including street sweeping, public education, and enforcement, as well as partial capture devices. Annual calculation of a DGR has been important during the years of implementation leading up to the final implementation deadline. During this period, there were phased reductions required by interim WLAs and agencies needed to actively implement increasing numbers of partial capture devices and add or enhance institutional controls to achieve the final WLAs. However, once an agency has demonstrated compliance with its final WLA, it becomes less important to update the DGR annually unless there is a significant change in institutional controls or land use such that the previously calculated DGR is no longer representative. . Similarly, once a responsible agency has determined that it has implemented all the anticipated institutional controls for a particular area, it will be less important to update the agency's DGR annually unless there are significant changes in the institutional controls being implemented.

In summary, once responsible agency has 1) demonstrated compliance with its final WLA, or 2) implemented all anticipated institutional controls in an area and the DGR for that area is not expected to change, then a less frequent DGR calculation is appropriate. Staff proposes that the Los Angeles River Trash TMDL and Ballona Creek Trash TMDL be revised to reduce the frequency of DGR calculation for agencies that have demonstrated compliance, while still requiring a periodic recalculation of the agency's DGR to evaluate the continued effectiveness of the agency's suite of partial capture devices and institutional controls.

Recommendation: Modify both the Los Angeles River and Ballona Creek Trash TMDLs to allow responsible agency that has demonstrated compliance with its final WLA to reduce the frequency of DGR calculation from annually to once every five years as long as there are no reductions in implementation of partial capture devices and institutional controls over the time period and no significant changes in land use that would render the last DGR calculation unrepresentative of current land uses and trash controls within the agency's jurisdiction. Responsible agencies will be required to request Executive Officer concurrence to reduce the frequency of DGR calculation and will be required to report annually on the continued implementation at the same level of partial capture devices and institutional controls and any land use changes that have occurred over the past year.

2.2.3 Scientifically Based Alternative Compliance

In addition, responsible agencies that have opted to implement the Los Angeles River or Ballona Creek Trash TMDL using partial capture devices and institutional controls may demonstrate compliance using an "alternative compliance monitoring program."

The Los Angeles River Trash TMDL Staff Report from the 2007 adoption of the TMDL (LARWQCB, 2007) and the LA County MS4 Permit discuss alternative compliance and state that the Executive Officer may approve alternative compliance monitoring programs other than those described above [for Partial Capture Treatment Systems and Institutional Controls], upon finding that the program will provide a scientifically based estimate of the amount of trash discharged from the MS4.

For example, the City of Los Angeles has completed studies on the effectiveness of the institutional controls that the City has implemented (City of Los Angeles, 2013) and on the effectiveness of the partial capture devices that the City has deployed (City of Los Angeles, 2006). Using the performance estimates from both these studies, in combination with implementation of full capture systems, the City of Los Angeles has calculated its reduction of trash from its baseline load in the Los Angeles River watershed.

Staff proposes that once a responsible agency has determined that, for a particular land use or land area, it has commenced implementation of all anticipated institutional controls for that land use or land area, the agency may conduct a study of the effectiveness of the suite of institutional controls and propose a performance standard to be applied to the suite of institutional controls (e.g., 10% reduction in trash from baseline load). Staff proposes a similar allowance for an agency to conduct a study of the effectiveness of its partial capture device(s) and propose a performance standard to be applied to the device(s). These performance standards could then be used to calculate the agency's trash reduction and determine its compliance with WLAs/WQBELs.

Recommendation: Clarify the Basin Plan Amendment language for both the Los Angeles River and Ballona Creek Trash TMDLs to allow a responsible agency to conduct studies of institutional controls and partial capture devices or demonstrate that existing studies of institutional controls and/or partial capture devices are representative and transferable to the implementing area within the Permittee's jurisdiction. Executive Officer concurrence will be required for the design of the study, and for the use of study results for compliance determination. Proposals for use of study results to determine compliance must include a schedule for repeating aspects of the study to confirm ongoing effectiveness.

2.2.4 DGR Calculation and Effectively 100% Compliance as a Permittee Approaches 100% Reduction from Baseline Trash Load

The DGR is a representative estimate of a daily trash generation rate for a responsible agency's land area. Therefore, the actual amount of trash discharged from the agency's land area to receiving waters may be higher or lower than estimated. For example, a DGR calculated over one particular 30-day period may be higher or lower than a DGR calculated over a different 30-day period, but will never be less than zero. In addition, a DGR calculated in one particular catchment chosen to be representative may be higher or lower than a DGR calculated in a different catchment, but will never be less than zero. The Total Storm Year Trash Discharge, using the mass balance approach, is also an estimate, as it is calculated by applying the DGR to the rest of the jurisdictional area and summing the total daily trash discharge for all days with precipitation equal to or greater than 0.25 inch. The Total Storm Year Trash Discharge is then compared to the WLAs to determine compliance with the TMDLs.

A responsible agency using a combination of partial capture devices and institutional controls and using DGR and the mass balance approach to calculating its annual trash discharge to determine compliance can accommodate the potential inaccuracy for the interim WLAs by exceeding the required reduction at each interim deadline. That is, an agency can accelerate its implementation of partial capture devices and institutional controls to ensure that, even with variability in the estimation of annual trash discharge, the interim allocation is met. However, when a responsible agency using this combination of partial capture devices and institutional controls approaches 100% reduction from its baseline trash load, the agency cannot exceed the required 100% reduction to ensure compliance.

The Los Angeles River Trash TMDL Staff Report from the 2007 adoption of the TMDL, section VII.A, states that "[t]he final waste load allocation will be considered complied with when the Executive Officer finds that devices or systems and/or institutional controls have removed effectively 100% of the trash from the storm drain system discharge to Los Angeles River or its listed tributaries" (LARWQCB, 2007) [emphasis added].

Due to the variability in the estimation of annual trash discharge using the DGR approach, staff proposes that the demonstration of "effectively 100%" removal of the trash as Permittees using a mass balance approach and the DGR, approach the final WLA of 100% reduction from their respective baseline loads, may be achieved using one of the alternatives described below.

Alternative 1. Within the Effectiveness of a Structural Vortex Separation Systems (VSS)

With this alternative, responsible agency demonstrates that the suite of partial capture devices and/or institutional controls implemented by the Permittee are at least as effective as the Vortex Separation System (VSS) relied on to establish the expected performance of full capture systems in the Los Angeles River Trash TMDL. A 1998 report on the efficiency of a Continuous Deflective Separation (CDS), a type of VSS, demonstrated efficiency of approximately 99% (Allison et al., 1998).

Alternative 2. Within Demonstrated Full Capture System Effectiveness

With this alternative, a responsible agency demonstrates that the suite of partial capture devices and/or institutional controls implemented by the Permittee are at least as effective as adequately sized, operated, and maintained full capture systems installed in a similar land use in the Los Angeles River or Ballona Creek watersheds.

Full capture is defined as follows:

> A full capture system is any device or series of devices that traps all particles retained by a 5 mm mesh screen and has a design treatment capacity of not less than the peak flow rate (Q) resulting from a one-year, one-hour, storm in the sub drainage area. The Rational Equation is used to compute the peak flow rate: Q = C x I x A, where Q = design flow rate (cubic feet per second, cfs); C = runoff coefficient (dimensionless); I = design rain fall intensity (inches per hour).

So, even with a full capture system, some trash may enter the MS4, when design capacity is over reached in a greater than one-year, one-hour storm. Because these storms are infrequent, institutional controls are implemented reduce trash available to be washed into the MS4, and some of the trash washed into the MS4 during a one-year, one-hour storm will be retained in the full capture system until it is cleaned out, the actual trash that reaches receiving waters is expected to be small.

Responsible agencies could conduct a study to determine how much trash gets past full capture systems in a particular land use-type area, calculate it as a percentage, and then apply that percentage as an acceptable error rate for partial capture devices/institutional controls.

For example, a hypothetical study of full capture systems in commercial area shows that for every 100 lbs of trash retained, approximately 4 lbs is discharged to the MS4, which is 3.8%. Therefore, a responsible MS4 Permittee must demonstrate a 96.2% reduction of its baseline trash load to demonstrate full compliance with its final WLA.

Alternative 3. Practical Calculation Limit of Partial Capture Devices and Institutional Controls

With this alternative, a responsible agency demonstrates that the suite of partial capture devices and/or institutional controls it is implementing meets the practical limit of calculation of effectiveness of partial capture devices and institutional controls.

Despite the challenge of demonstrating compliance as a responsible agency approaches 100% reduction of trash from its baseline, several MS4 Permittees are achieving and demonstrating very high levels of reduction using the mass balance/DGR calculations.

Table 5 Percent Trash Reduced in Cities in the Los Angeles Watershed using Partial Capture/Institutional Controls for which Compliance Can Be Determined

	Calculated Reduction using Mass Balance DGR Approach (%)	
City	2012-2013 storm year	2013-2014 Storm year
Hidden Hills	99.6	99.8
Monrovia	98.5	99.5
Monterey Park	90.2	97.8
South Pasadena	95.9	98.5
Temple City	94.0	97.1

Even when, in 2012-2013, reductions were as great as 98.5% in Monrovia and 99.6% in Hidden Hills, increases in trash reduction were possible and, in 2013-2014, Monrovia reported a 99.5% reduction and Hidden Hill reported a 99.8% reduction. Hidden Hills has twice reported reductions greater than 99%. Based on the performance of these cities, 99% could be an appropriate practical calculation limit using the mass balance DGR approach for partial capture devices and/or institutional controls.

However, Hidden Hills, a very small residential city with low population density, may not be a representative jurisdiction in terms of land use and population density, and other characteristics of the catchment it uses to calculate its DGR may not be representative of other Permittees' jurisdictional areas. Several cities, more typical in terms of land use and density, have demonstrated compliance above 97%.

Therefore staff concludes that 99% is an appropriate, higher bound, practical calculation limit using the mass balance DGR approach, although, in some cases, 97% may be a more appropriate practical calculation limit. More than two years of data may be necessary to determine an appropriate practical calculation limit for a particular city.

A responsible agency may be able to demonstrate that a practical calculation limit using the mass balance DGR approach for its jurisdictional area is a number at or above 97% and less than 99% with additional data. Any such demonstration would necessarily include:

- Two or more years of data showing that the agency's compliance was at or above a 97% reduction in its baseline trash load;
- An evaluation of institutional controls in the agency's jurisdiction demonstrating their continued effectiveness and any potential enhancements; and
- A demonstration that opportunities to implement partial capture devices have been fully exploited.

Staff proposes Alternative 3 because given that the mass balance DGR method produces an estimate, this alternative demonstrates that *effectively 100% of the trash* is kept out of the MS4 and several cities have demonstrated the achievability of reducing trash to between 1% to 3% of their baseline load.

Recommendation: For both the Los Angeles River and Ballona Creek Trash TMDLs, the TMDLs should be revised to include implementation language deeming an agency in full compliance with its WLA when using the mass balance DGR approach where the reduction of trash from the agency's baseline load is between 99% and 100%. In addition, any agency may request a determination from the Regional Board that the practical calculation limit using the mass balance DGR approach for their jurisdictional area is a number at or above a 97% reduction from the baseline load, where the demonstration includes the data/evaluations identified above.

2.2.5 Operation and Maintenance of Full Capture Systems and Partial Capture Devices

All of the MS4 Permittees complying with the Los Angeles River Trash TMDL or the Ballona Creek Trash TMDL are relying, to a greater or lesser extent, on devices installed in or on catch basins and storm drains. While poorly maintained trash screens and inserts can become blocked, increasing the potential for flooding, poorly maintained devices are also less effective or ineffective, at preventing the discharge of trash from the MS4 to receiving waters. Therefore, operation and maintenance is a key component in ensuring the continued efficiency of full capture systems and partial capture devices. As such, it is important for MS4 Permittees to ensure that these full capture systems and partial capture devices are always functioning properly in order to yield expected water quality and environmental benefits.

The importance of proper operation and maintenance of full capture systems is recognized in MS4 permits. Part VI.E.5.b.i.(1)(c) of the Los Angeles County MS4 Permit and similar provisions of the City of Long Beach MS4 Permit incorporate the requirement for proper operation and maintenance in compliance determination.

> "…attainment of the effluent limitations shall be conclusively presumed for any drainage area… where certified full capture systems treat all drainage from the area, provided that the full capture systems are adequately sized and maintained, and that maintenance records are up-to-date and available for inspection by the Regional Water Board." (emphasis added).

Similarly, where the determination of compliance includes dependence on a calculation of the efficiency of partial capture devices, that determination must also be dependent on the proper operation and maintenance of the partial capture device.

Recommendation: Clarify that for the Los Angeles River Trash TMDL and the Ballona Creek Trash TMDL, compliance determination is dependent on proper operation and maintenance of full capture systems and partial capture trash devices.

2.3 Non-point Sources of Trash

Nonpoint sources are assigned load allocations (LA) in TMDLs. According to the State's Nonpoint Source Policy, load allocations may be addressed by Statewide general waste discharge requirements (WDRs), conditional waivers of WDRs, or individual WDRs among other implementation mechanisms. Most trash and debris TMDLs in the Los Angeles Region address discharges from nonpoint sources through load allocations to be implemented through either waste discharge requirements or a conditional waiver from waste discharge requirements. In these cases, nonpoint source dischargers may achieve compliance with the load allocations by implementing a minimum frequency of assessment and collection/best management practice (MFAC/BMP) program. The MFAC/BMP program includes an initial minimum frequency of trash assessment and collection and suite of structural and/or non-structural BMPs.

Many recreational land uses, such as parks, campgrounds, and picnic areas, experience considerable littering. In urban areas, recreational areas will generally contribute trash to a waterbody through the MS4; however, when the recreational area is directly adjacent to the waterbody, the trash may enter the waterbody directly or may be transported by wind to the waterbody. There are limited studies to define the relationship between the strength of winds and movement of trash from land surface to a waterbody, but lighter trash with sufficient surface area to sail with wind, such as plastic bags, beverage containers, and paper or plastic convenience food containers are easily lifted, and carried to waterbodies.

In this section, LAs for recreational areas and MFAC/BMP programs for the recreational areas and for the City of Santa Clarita, also assigned a LA, are discussed.

2.3.1 Load Allocations in the Los Angeles River and Ballona Creek Trash TMDLs

The Los Angeles River Trash TMDL includes a load allocation of zero trash discharged, but the entities responsible for implementing the load allocation are not specifically identified. There are numerous parks and other recreational facilities along the Los Angeles River, which may contribute trash to the river, as described above. Staff proposes assignment of the load allocation to responsible entities owning or operating recreational facilities directly abutting the Los Angeles River and its tributaries.

While load allocations for the nonpoint sources of trash to Ballona Creek were not explicitly included in the Ballona Creek Trash Basin Plan Amendment, the load allocations were clarified in a memo from the Regional Board to USEPA Region IX dated July 29, 2002 (LARWQCB, 2002). In this memo, the Regional Board clarified that,

> "…Non-point sources were identified as wind blown trash and direct deposit of trash into the water. Since the numeric target is zero, implicitly both the Load Allocation and the Waste Load Allocation must be zero. This clearly was our intent."

In addition, in the USEPA's letter to the State Water Board approving the Los Angeles River Trash TMDL and the Ballona Creek Trash TMDL, dated August 1, 2002 (USEPA, 2002), states, in the "TMDL Checklist" review of the Ballona Creek Trash TMDL:

> "…Based on the information in the TMDL Report, Basin Plan Amendment, and clarifying letter of July 29, 2002, EPA concludes that the TMDLs include as appropriate wasteload and load allocations which are consistent with the TMDLs and with provisions of the Clean Water Act and federal regulations. The State's TMDL acknowledges the

presence of trash discharges from both point and nonpoint sources. …Therefore, the State has treated the load allocation as a gross allotment accounting for the nonpoint sources of trash discharges…"

While there are few parks or other recreational facilities directly abutting Ballona Creek, there is a trail which goes around the approximately 600-acre Ballona Creek wetlands. Beyond this trail, the Ballona Wetlands are generally closed to the public but wetlands tours are offered by Friends of Ballona Wetlands several times a month along with additional club and school tours. In addition, access to the wetlands is easy through holes in the chain link fence. Therefore, staff proposes to assignment of the load allocation to the California Department of Fish and Wildlife as the operator of the Ballona Wetlands.

By applying a similar land use area concept that was applied to develop the WLAs, the baseline load allocation per year for any designated recreational area is the sum of the products of each land use subarea multiplied by the baseline load allocation for the land use subarea, as shown below:

$$LA = \sum for\ each\ Nonpoint\ source\ (subarea\ by\ land\ uses \bullet allocations\ for\ this\ land\ use)$$

It is appropriate to assume the same trash generation rate or allocation for different types of recreational land uses, in which case: LA = recreational area in square miles • 640 gallons trash.

Trash TMDLs in the Los Angeles Region have used 640 gals of trash per year, per square mile, (based on a study by the City of Calabasas) to assign a baseline trash allocations in all trash TMDLs that did not have an unique baseline study.

The baseline load allocations are used as the basis for the progressive reduction of trash in nonpoint sources. Responsible entities will be required to monitor the trash quantity deposited in defined recreational areas to comply with reductions from the baseline load allocation.

Table 6 Designated Recreational Areas along the Los Angeles River and its Tributaries

Responsible Party	Park/Facility	Approximate Nonpoint Source Area (acres)	Nonpoint Source Area (miles^2)	Approximate Baseline Load Allocation (mi^2 x 640 gal/mi^2/yr = gal/yr)
Arcadia Golf Course	Arcadia Golf Course	25.63	0.040	25.63
City of Arcadia	Eisenhower Park	4.69	0.007	4.69
City of Bell Gardens	Ford Park	35.2	0.055	35.2
City of Burbank	Compass Tree Park	0.12	0.000	0.12
City of Burbank	Buena Vista Park	11.2	0.018	11.2
City of Compton	Raymond Street Park	1.73	0.003	1.73
City of Cudahy	Cudahy Park	4.71	0.007	4.71
City of Downey	Treasure Island Park	3.44	0.005	3.44

City of Glendale	Glorietta Park	8	0.013	8
City of Glendale	Dunsmore Park	9.63	0.015	9.63
City of Long Beach	DeForest Park	28	0.044	28
City of Los Angeles	Montecito Rec Center	14.01	0.022	14.01
City of Los Angeles	Hermon Park	1.3	0.002	1.3
City of Los Angeles	Elysian Park	600	0.938	600
City of Los Angeles	Los Feliz Golf Course	15	0.023	15
City of Los Angeles	Valleyheart Greenway	2.36	0.004	2.36
City of Los Angeles	Moorpark Park	2.95	0.005	2.95
City of Los Angeles	Hansen Dam Park	45	0.070	45
City of Los Angeles	Sepulveda Rec Center	10.65	0.017	10.65
City of Los Angeles	Paxton Park (Richie Valens Park)	6.79	0.011	6.79
City of Los Angeles	Sepulveda Basin Recreation Area	2000	3.125	2000
City of Los Angeles	Vanalden Park	5.52	0.009	5.52
City of Los Angeles	Northridge Rec Center	18.56	0.029	18.56
City of Los Angeles	Mae Boyer Rec Center	2.03	0.003	2.03
City of Los Angeles	West Hills Rec Center	14.41	0.023	14.41
City of Los Angeles	Reseda Park & Rec Center	21.17	0.033	21.17
City of Los Angeles	LA River Greenway Park	4.05	0.006	4.05
City of Los Angeles/ Mountains Recreation & Conservation Authority	Marsh Street Park	3.9	0.006	3.9
City of Maywood	Maywood Riverfront Park	5.57	0.009	5.57
City of Montebello	Grant Rea Park	20.7	0.032	20.7
City of Pasadena	Eaton Blanche Park	5.5	0.009	5.5
City of Pasadena	Gwinn Park	2.5	0.004	2.5
City of Pasadena	Lower Arroyo Park	150	0.234	150
City of Pico Rivera	Rio Hondo Park	11.9	0.019	11.9
City of Rosemead	Sally Tanner Park	1.42	0.002	1.42
County of Los Angeles	Whittier Narrows County Golf Course	250	0.391	250
County of Los Angeles	Pamela County Park	3.17	0.005	3.17
County of Los Angeles	Crescenta Valley Park	18.5	0.029	18.5
County of Los Angeles/ Santa Anita Associates	Santa Anita County Golf Course	140	0.219	140
LA Equestrian Center/ City of Los Angeles	LA Equestrian Center	75	0.117	75
City of Long Beach	Wrigley Greenbelt	9.8	0.015	9.8
San Gabriel Country Club	San Gabriel Country Club	105.96	0.166	105.96

In the Ballona Creek Watershed, the single designated recreational area is the Ballona Creek Wetlands. The California Department of Fish and Wildlife is assigned a baseline load allocation based on the approximately 600-acre site, such that the load allocation is approximately 600 gal/year.

In addition, the City of Santa Clarita was previously assigned a baseline WLA of 901 gallons of trash per year. Per Section 2.1.3, the City of Santa Clarita will now be assigned a baseline LA of 901 gallons of trash per year.

Recommendation: The load allocation should be assigned to specific responsible entities that own and/or operate designated recreational areas along the Los Angeles River and its tributaries, as described in Table 6 above, the Ballona Creek Wetland and the City of Santa Clarita. The existing load allocation of zero trash discharged would apply to these entities as well as any entities that may be identified as nonpoint source dischargers in the future.

2.3.2 Conditional Waiver, MFAC/BMPs Compliance for Los Angeles River Trash TMDL and Ballona Creek Trash TMDL

In the near future, Regional Board staff will separately recommend that the Regional Board issue WDRs or a conditional waiver of WDRs to implement the load allocations for trash. A conditional waiver or WDRs provide a regulatory structure whereby continued monitoring and iterative BMPs are deployed to attain zero trash discharged by nonpoint sources according to the TMDL Schedule for Load Allocations, Table 7.

Compliance is based on implementing a program for trash assessment and collection to attain a progressive reduction in the amount of trash discharged to the Los Angeles River or Ballona Creek and Wetlands from nonpoint sources. Responsible entities shall propose a program of Minimum Frequency of Assessment and Collection (MFAC). The MFAC program is required to achieve a progressive reduction in the amount of trash collected from the river or the river's edge through implementation of BMPs. Responsible entities may implement structural or nonstructural BMPs as required to attain a progressive reduction in the amount of trash discharged by nonpoint sources to the Los Angeles River and tributaries.

Nonpoint Source Implementation
Key provisions of the implementation include:

- Baseline Load Allocations
- WDRs or a conditional waiver of WDRs for nonpoint source dischargers who implement MFAC programs; and
- Trash monitoring to provide data to assess effectiveness of BMPs and trash abatement programs, and assess levels of trash

Responsible entities should propose the mitigation measures incorporating an individual method or combinations to progressively reduce nonpoint source discharges of trash. A wide variety of methods possibly alleviating nonpoint source trash contributions from recreational areas and open spaces to the Los Angeles River and tributaries and Ballona Creek and Wetlands include but are not limited to:

Trash Receptacles

Most of trash disposed of on the ground may result from the lack of trash receptacles. Installing trash receptacles can reduce nonpoint trash loadings. The receptacles should be visible and conveniently reachable. Sufficient trash receptacles in the picnic area should be provided. Receptacles should be equipped with lids to prevent wildlife browsing through or the wind re-mobilizing the trash inside.

Varieties of land uses determine the proper locations and necessary density of the trash receptacles. More receptacles are needed along trails, near park entrances and exits, adjacent to picnic areas or areas with higher activity frequencies. Sanitation should be maintained to avoid nuisances.

Enforcement of Litter Laws

The existing litter laws can be posted in the prominent location for the park users or residents to understand the regulations.

Patrolling or designated personnel should have authorities to illustrate, execute, and enforce the litter laws. The effectiveness of enforcement should be monitored.

Public Education

Public education refers to posting information, giving presentation, or conducting direct or indirect communication with individuals. This outreach can be applied to public entities such as city halls, schools, community centers, senior centers, and to private meeting/activity locations.

The educational materials should include the relevant ordinances, the importance of protecting environment, possible environmental and biological impacts from pollution, and the necessary response if pollution occurs.

Community Involvement

Involving communities may be more effective in promoting the importance of protecting water quality and environment. Communities can organize activities to illustrate that environmental protection involves every individual's continuous efforts.

Reporting System

Patrol personnel, park users, or residents should report accumulation of trash or illegal disposal of trash to the river and its adjacent areas. Information with a toll-free number should be conveniently available near the river for timely reporting. Responsible agencies, after receiving reports, should conduct inspections to formulate proper cleanup actions.

Surveillance Cameras

Surveillance cameras can be installed to monitor the water quality and any illegal disposal that may require immediate cleanup. They can also be used to enforce the littering laws, if necessary.

Tax Benefit by Adopting Waterbodies, Parks, etc.
This concept is adapted from the "Adopt-a-Highway" program. The participation from industries or entities in the vicinity of the river will help the responsible agencies to maintain the cleanliness of the environment, and increase the cleaning frequency. Industries or any entities that contribute resources, time, or efforts to keep the environment clean could be encouraged by having a tax benefit.

Recommendation: Include MFAC/BMP compliance in the Basin Plan Amendment language for the Los Angeles River Trash TMDL and Ballona Creek Trash TMDL and issue a Conditional Waiver of WDRs at a later date.

2.3.3 Nonpoint Source Monitoring for Los Angeles River Trash TMDL and Ballona Creek Trash TMDL

Responsible entities for load allocations should be required to develop a Trash Monitoring and Reporting Plan (TMRP) to be approved by the Executive Officer. The minimum requirement for trash monitoring includes the assessment and quantification of trash collected from the designated recreational areas. The monitoring plan shall provide details on the frequency, location, and reporting of trash monitoring. Responsible entities shall propose a metric (e.g., weight, volume, pieces of trash) to measure the amount of trash in the river, and on adjacent land areas. Responsible entities may include other metrics to provide data for revision of the baseline load allocations, determine effectiveness of BMPs, and assess compliance with the TMDL. Responsible entities may coordinate their trash monitoring activities.

Responsible entities may refine the trash baseline load allocations with the first year of the data collection as approved by the Executive Officer by implementing the approved TMRPs to obtain site-specific trash generation rates.

Recommendation: Include the requirement for a TMRP in the Basin Plan Amendment language for the Los Angeles River and Ballona Creek Trash TMDLs.

2.3.4 Nonpoint Source Schedule for Los Angeles River Trash TMDL and Ballona Creek Trash TMDL

Compliance is assessed in accordance with responsible entities' implementation of MFAC and BMPs and attainment of the progressive trash reductions in accordance with the schedule below. Note that these parks and other recreational areas already manage trash on their facilities and many will already have implemented trash control BMPs.

Table 7 Schedule for Implementation of Load Allocations*

Task No.	Task	Date
1	Baseline Load Allocations in Effect	Effective date of the reconsideration of the Los Angeles River and Ballona Creek Trash TMDLs
2	Submit Minimum Frequency Assessment and Collection (MFAC) Program Plan	Upon enrollment in Conditional Waiver or WDR for trash
3	Achieve 100% reduction of trash from baseline load allocations	Three years from effective date of the reconsideration of the Los Angeles River and Ballona Creek Trash TMDLs

*The implementation deadline for the LA assigned to the City of Santa Clarita is September 30, 2016 per the schedule for implementation of WLAs, since the City's LA was previously identified as a WLA.

Recommendation: Compliance should be assessed in accordance with responsible entities' implementation of MFAC and BMPs and attainment of the progressive trash reductions in accordance with the schedule in Table 7.

2.3.5 Cost Considerations – MFAC

This section provides an estimate of costs to comply with the Minimum Frequency of Assessment and Collection program for nonpoint source responsible jurisdictions. The cost estimate is based on the minimum frequency of assessment, collection (including cleanup after critical conditions) and evaluation monitoring recommended in section 2.3.3.

It is assumed that the personnel for trash assessment and collection will be employed by one of the responsible entities that provide services to the nonpoint source area. As such, equipment and vehicles are available and costs for these items are assumed to be included in the estimate below. It is also assumed that a single person can conduct the complete critical conditions clean up in eight hours per event, and the morning trash assessment and afternoon evaluation in two hours per event.

An estimation of the total number of hours per year to implement critical conditions cleanup events is provided below. Critical conditions take into account the 27 weekends between April 15 and October 15, plus four major storms. These 31 critical conditions can be directly applied to each monitoring site listed in Table 6, the Ballona Creek Wetlands and the open space of Santa Clarita. Assuming eight hours per event, the total number of 5,704 hours is estimated.

Table 8 Estimated Critical Condition hours of Implementing Minimum Frequency of Assessment and Collection Program per Monitoring Location

Critical Conditions (per year)	Hours per Event	Total Hours
31	8	248

The cost for these entities to comply with the MFAC program will not include the current routine maintenance schedules, and will only include the additional costs of trash compliance assessment and evaluation. The estimated hours needed to conduct assessment, collection, and evaluation events per monitoring location that are required are summarized below, with a total of 552 hours.

Table 9 Estimated Assessment, Collection, and Evaluation hours of implementing MFAC program

MFAC Description per monitoring location	MFAC (per year)	Hours per Event	Total Hours
Assessment once per month immediately following cleanup event.	12	2	24

The costs per year to implement the Los Angeles River and Ballona Creek Trash TMDLs are summarized below. Assuming a burdened hourly rate of $37.50 per hour, the estimated annual costs to conduct the Minimum Frequency of Assessment and Collection program is approximately $10,200/yr/monitoring location. For 42 sites in Table 6 and the Ballona Creek Wetlands and the open space of the City of Santa Clarita, the total cost is approximately $448,800 per year.

Table 10 Estimated costs per year of implementing MFAC Program per Monitoring Location

Critical Condition Hours/yr	Assessment and Collection Hours/yr	Total Hours/yr	Rate	Total Cost/yr
248	24	272	$37.50	$10,200

2.4 Pre-production Plastic Pellets

Pre-production plastic pellets, also known as nurdles, are very small (usually < 5 mm) plastic beads that are melted down to make plastic objects. As a result of their tiny size, these plastic pellets are easy to transport in bulk (via railway and trucks). Through accidental spills during transport, transfer, or processes within industrial facilities, these plastic pellets can make their way into MS4s, onto local beaches, and ultimately into the ocean.

Birds, fish, and mammals often mistake plastic pellets for food. With plastic filling their stomachs, animals have a false feeling of being full, and may die of starvation. Smaller elements such as pre-production plastic pellets are often more harmful to aquatic life than larger plastic elements, since they can be ingested by a large number of small organisms, which can then suffer malnutrition or internal injuries. In addition to malnutrition, plastic pellets may contain chemicals that are toxic (e.g. persistent organic pollutants). These toxic substances may be additives that were intentionally mixed into the resin to achieve specific properties, or contaminants that were adsorbed by the pellets from the environment (U.S. EPA, 1992).

Pre-production plastic pellets in waterways can cause other significant water quality problems. Pellets that sink may inhibit the growth of aquatic vegetation, decreasing spawning areas and habitats for fish and other living organisms. Plastic pellets that settle at the bottom can also contribute to sediment contamination (U.S. EPA, 1992).

Assembly Bill (AB) 258, which became effective January 1, 2008, added section 13367 to Division 7 of the California Water Code, entitled “Preproduction Plastic Debris Program.” This section of the Water Code applies to facilities in California that manufacture, handle, or transport preproduction plastics, the raw materials used to produce plastic products.

2.4.1 Plastic Pellets in Los Angeles Region Trash TMDLs

Pre-production plastics have been addressed in a recent Los Angeles Region trash TMDL, the Santa Monica Bay Nearshore and Offshore Debris TMDL (R10-010) (LARWQCB, 2010). MS4 permittees subject to the Ballona Creek Trash TMDL are already addressing plastic pellets, as these jurisdictions are identified as responsible jurisdictions in the Santa Monica Bay Debris TMDL, which includes a requirement for MS4 permittees to monitor and report discharges of plastic pellets from their MS4s. Staff proposes adding this plastic pellet monitoring requirement to the Los Angeles River Trash TMDL.

2.4.2 Plastic Pellet Impairments in the Los Angeles River and Ballona Creek

Several studies have investigated the presence of plastics in the waters off of southern California. Plastic pellets, polystyrene, hard plastic fragments, thin films, and line have all been documented in the Santa Monica Bay. A study conducted by the Algalita Marine Research Foundation (AMRF) conducted sampling at two Santa Monica Bay sites offshore of Ballona Creek, and found that plastics were present not only at surface levels, but also in mid-water depths, and at the bottom of the Santa Monica Bay (Lattin et al., 2004).

Another study conducted by AMRF examined the quantity and type of plastic debris flowing from the Los Angeles River and San Gabriel River to the beaches, and ultimately the ocean. Out of the different categories of plastic found in the Los Angeles River, pre-production plastic pellets had the greatest density. Plastic pellets were the second most abundant material found after expanded polystyrene in the Los Angeles River (Moore et al., 2011).

In addition to studies completed offshore of Ballona Creek and in the Los Angeles River, AMRF is also leading a study with the Southern California Coastal Water Research Project (SCCWRP) and other agencies to investigate plastic pollution in the Southern California Bight. This study is investigating plastic ingestion by fish, in addition to benthic plastics found on the ocean floor. The results of this study will be released by SCCWRP in 2015 as part of the California Bight Study.

Plastic pellets have been found along many beaches in the Southern California Bight. A more localized study conducted in the summer of 1998 by SCCWRP examined the composition and distribution of beach debris on Orange County beaches. The study found over 105 million pre-production plastic pellets, weighing more than 4,700 pounds (Moore, 2000).

2.4.3 Sources of Plastic Pellets

Like trash, the pre-production plastic pellets can reach storm drains, which lead to the Los Angeles River, and then the Pacific Ocean. Plastic pellets are transported by ships, trucks, and trains from plastic manufacturers to plastic industries. Once discharged, the pellets are easily blown by wind or carried by stormwater through the storm drain system and to the beaches and ocean. As a result of their very small size, plastic pellets are not captured by most trash capture devices. Studies in New York, Boston, and Houston showed that combined sewer overflows and storm drains were sources of pellets in the aquatic environment (U.S. EPA, 1992).

According to the American Chemistry Council (ACC) Plastics Industry Producers' Statistics (PIPS) Group, U.S. resin production was 107.5 billion pounds in 2013. Industries that manufacture, store, process, and otherwise handle plastic pellets as raw material are sources of pellets in the environment. Although the plastic pellets ultimately make their way to the beaches and ocean through storm drain systems, they originate on the premises of the plastic industries, and discharges from these facilities are regulated through separate regulatory mechanisms. When industries release plastic pellets onto the ground and adjacent areas of the site, they are responsible for ensuring that the plastic pellets are not transported off-site via runoff and stormwater.

Although plastic industries are the primary point source for plastic pellets, it is likely that any spills that happen during transport, transfer, or handling release plastic pellets to the MS4 and eventually the ocean. Any such spills will be addressed by the previously mentioned land based point source of plastic pellets or the MS4 Permittees.

MS4 Permittees subject to the Ballona Creek Trash TMDL are already addressing plastic pellets, as these jurisdictions are identified as responsible jurisdictions in the Santa Monica Bay Debris TMDL, which includes a requirement for MS4 Permittees to monitor and report discharges of plastic pellets from their MS4s. Therefore, a plastic pellet monitoring requirement is only proposed for addition to the Los Angeles River Trash TMDL. Plastic pellet requirements in the Los Angeles River Trash TMDL will be consistent with existing plastic pellet requirements in the Santa Monica Bay Debris TMDL.

Industries

Industrial facilities that import, manufacture, process, transport, store, recycle or otherwise handle plastic pellets are subject to California Water Code section 13367 and section 122.26(b)(12) of Title 40 of the Code of Federal Regulations.

California Water Code section 13367 establishes a requirement to eliminate discharges of pre-production plastics and that requirement is being implemented through the Statewide Industrial Storm Water General Permit (Order No. 97-03-DWQ and NPDES Permit No. CAS 000001 expiring June 30, 2015; and 2014-0057-DWQ and NPDES Permit No. CAS 000001 effective July 1, 2015) (IGP) and other stormwater permits. Due to the implementation through the IGP, staff do not recommend load allocation be assigned for industrial facilities. This is consistent with the approach in the proposed State Trash Amendments.

The Standard Industry Classification (SIC) codes associated with industrial activities involving plastic pellets may include, but are not limited to, 282X, 305X, 308X, 39XX, 25XX, 3261, 3357, 373X, and 2893. Additionally, industrial facilities with the term "plastic" in the facility or operator name, regardless of the SIC code, may be subject to the provisions of California Water Code section 13367 and section 122.26(b)(12) of Title 40 of the Code of Federal Regulations. Other industrial permittees within the Los Angeles River Watershed that fall within the above categories, but are regulated through other general permits and/or individual industrial storm water permits, may also be required to control plastic pellets.

Industries must comply with the IGP or other general or individual industrial permits, which require a Stormwater Pollution Prevention Plan (SWPPP) to be prepared and kept onsite at all times. The SWPPP should address the areas where pellets tend to spill, as well as an overall plan to keep plastic pellets from being released off of the premises. The SWPPP shall incorporate structural and nonstructural BMPs that are implemented to keep pellets on site, including specific practices that are used to clean up incidental or large spills.

Industrial permittees my comply with the requirements of the IGP by using best management practices such as appropriate containment systems, sealed containers, vacuum devices for cleaning, and frequent inspection and cleaning at operational areas and outlets of water discharge, to effectively control and prevent discharges of pre-production plastics pellets. In addition, necessary best management practices shall be exercised to eliminate spillage of plastic pellets during transportation that could be later mobilized and transported to waters of the State.

MS4s

MS4s may be a point source for plastic pellets to the Los Angeles River and tributaries. MS4 Permittees in the Los Angeles River Watershed should be required to monitor for plastic pellets. MS4 Permittees in the Los Angeles River Watershed shall either prepare a Plastic Pellet Monitoring and Reporting Plan (PMRP), or demonstrate that a PMRP is not required as described, below. The PMRP will serve to (1) monitor the amount of plastic pellets being discharged from the MS4 at critical times and locations, (2) establish triggers for a possible need to increase industrial facility inspections and enforcement of SWPPP requirements for industrial facilities having Standard Industry Classification (SIC) codes associated with industrial activities involving plastic pellets, as listed above, or industrial facilities with the term "plastic" in the facility or operator name, regardless of the SIC code, and (3) address possible plastic pellet spills. In the event of a plastic pellet spill, the Regional Board shall be notified by the agency or jurisdiction within 24 hours of the responsible agency or jurisdiction becoming aware of the spill. The PMRP shall include protocols for a timely and appropriate response to possible plastic pellets spills within their jurisdictional area, and a comprehensive plan to ensure that plastic pellets are contained.

MS4 Permittees will fall into one of the following three categories for requirements of a PMRP:

1. MS4 Permittees that have industrial facilities or activities related to the manufacturing, handling, or transportation of plastic pellets within their jurisdiction must prepare a PMRP.

2. Responsible jurisdictions that have no industrial facilities or activities related to the manufacturing, handling, or transportation of plastic pellets may not be required to conduct monitoring at MS4 outfalls, but must have a response plan in place to address plastic pellet spills. If satisfactory documentation is provided that shows there are no industrial facilities or activities related to plastic pellets within the jurisdiction, the responsible jurisdiction may be excused of the requirement to monitor MS4 outfalls. LACFCD will be in this category.

3. Responsible jurisdictions that only have residential areas within their respective jurisdictions, and have limited commercial or industrial transportation corridors (including railways and roadways), may be exempted from the requirements of preparing a PMRP. In order for a responsible jurisdiction to be exempted from this requirement, sufficient documentation including municipal zoning plans must be submitted to the Regional Board and approved by the Executive Officer.

If a jurisdiction changes its zoning and land use plans, or issues operating licenses to industries that import, manufacture, process, transport, store, recycle, or otherwise handle plastic pellets within its jurisdiction, then it must submit a PMRP within 90 days of the above actions.

Recommendation: The Los Angeles River Trash TMDL should be made consistent with the requirements of the Santa Monica Bay Debris TMDL (which includes the Ballona Creek watershed) by incorporating a requirement for MS4 Permittees to submit PMRPs for plastic pellets as described above.

2.4.4 Plastic Pellet Monitoring

MS4 permittees should submit a Plastic Pellet Monitoring and Reporting Plan that will address monitoring of plastic pellets at outfalls in the MS4 under their respective jurisdictions.

In the alternative, responsible jurisdictions may propose additions to their Integrated Monitoring Program (IMP) or Coordinated Integrated Monitoring Program (CIMP) under the Los Angeles County and Long Beach MS4 Permits.

The PMRP will be submitted to the Regional Board according to the TMDL Implementation Schedule as revised by this reconsideration. The Regional Board's Executive Officer will have full authority to review, revise, approve, or disapprove the PMRPs.

Data Collection
Because the amount of plastic pellets deposited into the Los Angeles River and tributaries through MS4s may depend on rainfall patterns, monitoring will include events at a minimum of once in the rainy season and once in the dry season every year. The rainy season is defined as the period from October 15 to April 15.

Unit of Measure
The amount of plastic pellets discharged at MS4 outfalls shall be reported in a single unit of measure. The responsible agencies may select the unit. The unit of measure will be used to establish triggers for the possible need for increased industrial facility inspections and enforcement of SWPPP requirements for industrial facilities.

Disposal of Collected Plastic Pellets
Plastic pellets captured during monitoring must be disposed of in accordance with all applicable laws and regulations.

Location
Plastic pellets will be monitored at MS4 outfalls within the Los Angeles River watershed where industrial Permittees, as described above, are located.

Recommendation: The Los Angeles River Trash TMDL should be made consistent with the requirements of the Santa Monica Bay Debris TMDL (which includes the Ballona Creek watershed) by incorporating a requirement for MS4s to monitor for plastic pellets as described above.

2.4.5 Cost Considerations – Plastic Pellet Monitoring

In order to comply with the Los Angeles River Trash TMDL, MS4 permittees must implement a Regional Board Executive Officer-approved Plastic Pellet Monitoring and Reporting Plan. MS4 permittees will conduct plastic pellet monitoring at critical MS4 outfalls to be identified. Critical MS4 outfalls do not need to be identified for areas for which PMRPs do not need to be developed. This section estimates the cost of monitoring at approximately 100 MS4 outfalls along the Los Angeles River and tributaries.

MS4 permittees will monitor each of the MS4 outfalls twice per year (one dry event, and one wet event per year). Assuming that each event takes one staff person four hours to conduct at a burdened hourly rate of $37.50 per hour, the total cost of implementing PMRPs in the Los Angeles River watershed is $30,000 per year.

Table 11 Estimated costs of implementing the plastic pellet monitoring and reporting plan

Monitoring Events per Year	Hours per Event	Rate	Total Cost per Year
=2*100 storm drains	4	$37.50	$30,000

2.5 Receiving Water Monitoring

Assessment and monitoring are key components of TMDLs. At the time of the development of the Los Angeles River and Ballona Creek Trash TMDLs, no standard method for trash assessment was in use and, consequently, neither the Los Angeles River Trash TMDL nor the Ballona Creek Trash TMDL included receiving water monitoring.

Furthermore, while it appears that great progress has been made by MS4 permittees in preventing trash from entering the Los Angeles River and Ballona Creek from the MS4, staff, and stakeholders, cannot objectively assess the degree of improvement in the River or the Creek. The goal of receiving water monitoring for trash is to be able to evaluate the status of trash in the River or the Creek, themselves, and to be able to evaluate the effectiveness, and continued effectiveness, of implementation actions.

Monitoring activities and results, including implementation and effectiveness of BMP implementation, should be reported and submitted to the Regional Board on an annual basis. Receiving water monitoring as discussed in this section shall be conducted by MS4 Permittees.

This section discusses the receiving water monitoring only. Compliance with the TMDL WLAs for point sources through full capture systems, partial capture devices, and institutional controls are addressed in the previously adopted Basin Plan amendments, Resolution Nos. 2001-014 and 2007-012. Compliance and monitoring required for TMDL load allocations for nonpoint sources is discussed in Section 2.4 of this Staff Report, Non-Point Sources.

Responsible agencies should be required to propose and implement a Trash Monitoring and Reporting Plan (TMRP) to be approved by the Executive Officer. The Regional Board's Executive Officer will have full authority to review the monitoring plan(s), to modify the plan, to select among the alternate monitoring sites, and to approve or disapprove the plan(s). Responsible agencies can report receiving water monitoring through a separate TMRP annual report or in conjunction with annual reporting under MS4 permits.

The receiving water monitoring program describes the methodologies that will be used to assess and monitor trash in the Los Angeles River and tributaries and Ballona Creek. Regional Board staff finds that monitoring protocols prescribed by the Rapid Trash Assessment are appropriate for this TMDL (Attachment B). Responsible agencies may also proposed altnerative protocols for Executive Officer approval. Elements of the receiving water monitoring plan are described below:

A. Monitoring Plan: Responsible jurisdictions will submit a TMRP with the proposed receiving monitoring sites and at least two additional alternate monitoring locations. The

TMRP must include maps of the drainage and storm drain data, and locations where trash accumulates in the waterbody. Trash monitoring shall focus on visible trash at representative and critical locations. Locations for trash assessment shall include, but not be limited to locations where trash enters and exits each reach/segment and their tributaries, and areas of recreational access.

B. Sampling Site and Frequency: The TMRP shall detail the monitoring frequency, number and location of sites, including at least one monitoring station per each river segment, reach, and tributary. Each sampling evaluation should consider trash levels over time and under different seasonal conditions. Sampling assessment shall be repeated at the same site where trash was collected during previous assessment. Responsible agencies should consider trash assessment before and after community clean up events.

C. Site definition: Site definition shall follow the Rapid Trash Assessment Protocol. A 100-foot section of the stream shall be identified for trash collection/assessment. Site characteristic shall also be defined as provided in the protocol and shall be used to facilitate the comparison of trash assessments conducted at the same site at different times of the year.

D. Trash Assessment/Survey: All trash items within an assessed site shall be picked up and recorded so that the site can be revisited and reassessed for impairment and usage pattern. Trash assessment/survey at the site shall follow the Rapid Trash Assessment protocol including notes and scoring of trash at the site.

E. Trash Assessment Parameters: Rapid trash assessment includes a range of six parameters that capture the breadth of issues associated with trash and water quality. The first two parameters focus on qualitative and quantitative levels of trash, the second two parameters estimate actual threat to water quality, and the last two parameters represent how trash enters the water body at a site, either through on-site activities or downstream accumulation.

    1. Level of Trash. This assessment parameter is intended to reflect a qualitative "first impression" of the site, after observing the entire length of the reach. Sites scoring in the "poor" range are those where trash is one of the first things noticeable about the waterbody. No trash should be obviously visible at sites that score in the "optimal" range.

    2. Actual Number of Trash Items Found. Based on the tally of trash along the 100-foot stream reach, total the number of items both above and below the high water line, and choose a score within the appropriate condition category based on the number of tallied items. Where more than 100 items have been tallied, assign the following scores: 5: 101-200 items; 4: 201-300 items; 3: 301-400 items; 2: 401- 500 items; 1: 501-600 items; 0: over 600 items. Use similar guidelines to assign scores in other condition categories.

Sometimes items are broken into many pieces. Fragments with higher threat to aquatic life such as plastics should be individually counted, while paper and broken glass, with lower threat and/or mobility, should be counted based on the parent item(s). Broken glass that is scattered, with no recognizable original shape, should be counted individually. The judgment of whether to count all fragments or just one item also depends on the potential exposure to downstream fish and wildlife, and waders and swimmers at a given site. Concrete is trash when it is dumped, but not when it is placed. Consider tallying only those items that would be removed in a restoration or cleanup effort.

3. Threat to Aquatic Life. Certain characteristics of trash make it more harmful to aquatic life. If trash items are persistent in the environment, buoyant (floatable), and relatively small, they can be transported long distances and be mistaken by wildlife as food items. Larger items can cause entanglement. Some discarded debris may contain toxic substances. All of these factors are considered in the narrative descriptions in this assessment parameter.

4. Threat to Human Health. This category is concerned with items that are dangerous to people who wade or swim in the water, and with pollutants that could accumulate in fish in the downstream environment, such as mercury. The worst conditions have the potential for presence of dangerous bacteria or viruses, such as with medical waste, diapers, and human or pet waste.

5. Illegal Dumping and Littering. This assessment category relates to direct placement of trash items at a site, with "poor" conditions assigned to sites that appear to be dumping or littering locations based on adjacent land use practices or site accessibility.

6. Accumulation of Trash. Trash that accumulates from upstream locations is distinguished from dumped trash by indications of age and transport. Faded colors, silt marks, trash wrapped around roots, and signs of decay suggest downstream transport, indicating that the local drainage system facilitates conveyance of trash to water bodies, in violation of clean water laws and policies.

F. Rapid Trash Assessment

Trash assessment shall include a visual survey of the waterbody (e.g., streambed and banks) and adjacent areas from which trash can be carried to the waterbody by wind, water, or gravity. The delineation of these adjacent areas is site-specific and requires some judgment and documentation. The rapid trash assessment worksheet shall be prepared and designed to represent the range of effects that trash has on the physical, biological, and chemical integrity of water bodies, in accordance with the goals of the Clean Water Act and the California Water Code. The worksheet should also provide a record for evaluation of the management of trash discharges, by documenting sites that receive direct discharges (i.e., dumping or littering) and those that accumulate trash from upstream locations.

2.5.1 Cost Considerations – Receiving Water Monitoring

Monitoring with a team of no less than two people may take one or two hours depending on the number of people participating in the monitoring (SFRWQCB, 2004). Initial assessments may take longer to gain familiarity with reach and method. Assuming that each reach, sub-reach, or tributary is monitored twice per year, Los Angeles River Watershed would be monitored roughly 36 times per year in the receiving water and Ballona Creek Watershed would be monitored roughly 10 times per year in the receiving water, totally 144 hours and 40 hours to monitor annually per respective watershed. With a burdened hourly rate of $37.50 per hour, the cost to implement the TMRP in Los Angeles River Watershed is $5,400 and $1,500 for Ballona Creek Watershed.

Table 12 Estimated costs of implementing receiving water monitoring Los Angeles River

Monitoring Events per Year	Hours per Event	Rate	Total Cost per Year
=2*18 reaches	2	2 * $37.50	$5,400

Table 13 Estimated costs of implementing receiving water monitoring Ballona Creek

Monitoring Events per Year	Hours per Event	Rate	Total Cost per Year
=2* 5 reaches	2	2 * $37.50	$1,500

Recommendation: Add a requirement for receiving water monitoring to the Los Angeles and Ballona Creek Trash TMDLs as described above.

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APPENDIX A: TRASH BACKGROUND

I. Beneficial Uses Impacted by Trash

The proposed final Trash Amendments are directed toward achieving the highest water quality consistent with the maximum benefit to California. Beneficial uses, as defined by Porter-Cologne section 13050, are the uses of surface water and groundwater that may be protected against water quality degradation. The Water Boards are charged with protecting these uses from pollution and nuisance that may occur as a result of waste discharges. Beneficial uses of surface waters, ground waters, marshes, and wetlands serve as a basis for establishing water quality objectives and discharge prohibitions to attain these goals and are defined in the basin plans for each regional water board and the Ocean Plan.

There are many beneficial uses in California, defined in the basin plans for each regional water board and the Ocean Plan, which can be impacted by trash. This section discusses the impacts of trash to beneficial uses associated with aquatic life and public health (Figure 1).

Trash is a threat to aquatic habitat and life as soon as it enters state waters. Mammals, turtles, birds, fish, and crustaceans are threatened following the ingestion or entanglement of trash (Moore et al. 2001, U.S. EPA 2002). Ingestion and entanglement can be fatal for freshwater, estuarine, and marine life. Similarly, habitat alteration and degradation due to trash can make natural habitats unsuitable for spawning, migration, and preservation of aquatic life. These negative effects of trash to aquatic life can impact twelve beneficial uses. A summary of specific impacts associated with each aquatic life beneficial use are presented in Table 1.

Figure 1. Trash Impacting Beneficial Uses (NOAA Marine Debris Program, Algalita Marine Research Institute, California Coastal Commission, and LA County Flood Control District).

Impacts of Trash to Aquatic Habitat and Life

Regardless of the method trash reaches waterways, trash is a threat to aquatic habitat and life as soon as it enters state waters. Mammals, turtles, birds, fish, and crustaceans are threatened following the ingestion or entanglement of trash (Moore et al. 2001, U.S. EPA 2002). Ingestion and entanglement can be fatal for freshwater, estuarine, and marine life. Similarly, habitat alteration and degradation due to trash can make natural habitats unsuitable for spawning, migration, and preservation of aquatic life. These negative effects of trash to aquatic life can impact several beneficial uses. A summary of specific impacts associated with each aquatic life beneficial use is presented in Table 1.

Table 1. Trash-Related Impacts to Aquatic Life Beneficial Uses.

Beneficial Use	Impact of Trash to Specific Aquatic Life Beneficial Use
Warm Freshwater Habitat Cold Freshwater Habitat	• Ingestion and entanglement by fish or wildlife (including invertebrates). • Freshwater habitat alteration or degradation. • Interference with ecosystem function, including interference with benthic communities. • Transportation of invasive species from floating trash.
Inland Saline Water Habitat	• Ingestion and entanglement by fish or wildlife (including invertebrates). • Saline water habitat alteration or degradation. • Interference with ecosystem function, including interference with benthic communities. • Transportation of invasive species from floating trash.
Estuarine Habitat	• Ingestion and entanglement by fish or wildlife (including estuarine mammals, waterfowl, and shorebirds). • Ingestion of toxic ~~or biological~~ compounds (including shellfish) associated with trash. • Estuarine habitat alteration or degradation. • Interference with ecosystem function, including interference with benthic communities and shellfish. • Transportation of invasive species from floating trash.
Marine Habitat	• Ingestion and entanglement by fish or wildlife (including marine mammals, birds, and turtles). • Ingestion of toxic ~~or biological~~ compounds (including shellfish) associated with trash. • Marine habitat alteration or degradation, including alterations to kelp habitat. • Interference with ecosystem function, including interference with benthic communities, shellfish and kelp. • Transportation of invasive species from floating trash.
Wildlife Habitat	• Ingestion and entanglement by wildlife (including mammals, birds, reptiles, amphibians, and invertebrates). • Terrestrial habitat alteration or degradation, including alterations to wildlife water and food sources. • Interference with ecosystem function. • Transportation of invasive species from floating trash.
Preservation of Biological Habitats	• Habitat alteration and degradation, including alterations to established refuges, parks, sanctuaries, and ecological reserves. • Interference with ecosystem function. • Transportation of invasive species from floating trash, potentially leading to species displacement.

Beneficial Use	Impact of Trash to Specific Aquatic Life Beneficial Use
Preservation of Areas of Special Biological Significance	• Habitat alteration or degradation of marine life refuges, ecological reserves, and designated Areas of Special Biological Significance. • Interference with ecosystem function, including interference with kelp propagation. • Transportation of invasive species from floating trash, potentially leading to species displacement.
Rare, Threatened, or Endangered Species	• Ingestion and entanglement by plant or animal species listed as rare, threatened or endangered. • Alteration or degradation of habitat that supports plant or animal species listed as rare, threatened or endangered. • Interference with ecosystem function. • Transportation of invasive species from floating trash, potentially leading to species displacement.
Migration of Aquatic Organisms	• Alteration or degradation of habitat that supports migration or other temporary activities by aquatic organisms. • Interference with ecosystem function.
Spawning, Reproduction, and/or Early Development	• Alteration or degradation of habitat that is suitable for reproduction and early development of fish. • Interference with ecosystem function.
Wetland Habitat	• Ingestion and entanglement by fish, invertebrates, and insects. • Ingestion of toxic ~~or biological~~ compounds (including shellfish) associated with trash. • Natural or man-made wetland ecosystem alteration or degradation. • Interference with ecosystem function, including interference with benthic communities and shellfish. • Transportation of invasive species from floating trash.

Effects of Trash on Aquatic Habitat

Trash that settles to a riverbed, bottom of a bay, or ocean floor can interfere with normal ecosystem functions and have immediate and long-term effects on the aquatic habitat. Settled trash is a problem for bottom feeders and dwellers and can contribute to sediment pollution. Settled trash can smother the growth of aquatic vegetation, disrupt nurseries and spawning areas, and disturb benthic communities (United Nations Environment Program 2009). Trash can alter the aquatic habitat and impact the aquatic biodiversity as it introduces hard surfaces for colonization as well as provides increased places of refuge for mobile species. Hard surfaces may attract hard-substratum sessile species that may have been previously limited and, consequently, displace soft bottom species due to competition and predation (Katsanevakis et al. 2007). Serious alterations, such as hypoxia and anoxia conditions, can result when the gas exchange between the overlying waters and pore waters of the sediments is prohibited by the accumulation of trash, specifically plastic trash (Goldberg 1994). Settled trash can also disturb benthic communities by mechanical scouring as trash twists and moves with flow, currents, and tides, damaging the bottom fauna (United Nations Environment Program 2009). Furthermore, aquatic life can be threatened by trash when it causes increased siltation and turbidity resulting in blocking of essential sunlight or smothering of sea grass species.

Trash is found settling in the deep-sea to depths of 13,028 feet. Specifically in the Monterey Canyon, trash is most abundant where aggregation and downslope transport of trash from the continental shelf are enhanced by canyon dynamics (Figure 2). Based on 1,149 video records over a 22-year time period, the majority of trash was plastic (33%) and metal (23%) with relatively high number of observations of trash in the deep-sea environment (Schlining et al. 2013). Thus, submarine canyons can function to transport trash from coastal to deep-sea habitats.

Figure 2. A Discarded Tire in Monterey Canyon (Monterey Bay Aquarium Research Institute).

Trash that does not settle can float and be suspended for great distances. Floating trash, specifically plastic trash, is capable of carrying and distributing potentially harmful, non-native species of animals and plants to foreign aquatic habitats (Winston 1982, Highsmith 1985, Minchin 1996, Barnes 2002, Masó et al. 2003). ~~In fact, t~~Trash is found to more than double the rafting opportunities for biota at 30 remote islands across subtropics locations and higher latitudes (Barnes 2002). Trash drifting on ocean currents eventually becomes home to entire communities of encrusting and attached organisms. Aquatic life that uses trash as transport includes bryozoans, barnacles, polychaete worms, hydroids, and mollusks (Barnes 2002). Plastics are not readily biodegradable, but travel slowly in oceans, making them a more effective invasive species dispersal mechanism than vessels or ballast water (Barnes 2002). Although plastics constitute the larger percentage of floating trash, other common anthropogenic floating objects include polystyrene, wooden items, and fishing gear (Barnes and Milner 2005). While these studies have largely focused on trash in marine waters, similar conditions are expected to occur in estuarine, freshwater, and saline systems.

Not only can trash serve as a vessel for aquatic life, but trash, particularly plastic trash, can serve as a transport medium for pollutants and ~~ab~~sorb persistent organic pollutants in the marine environment (Carpenter et al. 1972, Mato et al. 2001, Derraik 2002). Although the quantities and effects of these contaminants have yet to be fully determined, plastic trash in the marine environment, including resin pellets, plastic fragments have been found to contain organic contaminants, including polychlorinated biphenyls, polycyclic aromatic hydrocarbons, petroleum hydrocarbons, organochlorine pesticides, phthalate ester plasticizers, polybrominated diphenylethers, and alkylphenols and bisphenol- A (Giam et al. 1978, Teuten et al. 2009; DG Europe 2011). Some of these compounds are added during plastic manufacture (e.g., nonylphenol, bisphenol- A, and polybrominated diphenylethers), while others (e.g., polychlorinated biphenyls and DDT) are ~~ad~~sorbed from the surrounding seawater (Mato et al. 2001, Moore et al. 2005, Teuten et al. 2009, Hirai et al. 2011). Although plastic trash may have the capacity to ~~ab~~sorb toxins, there is limited research on the extent of toxic exposure from plastic vectors compared to other exposure pathways such as atmospheric deposition and ocean currents (Gouin et al. 2011). Microplastics are unlikely to be an important global geochemical reservoir for historically released persistent organic pollutants such as polychlorinated biphenyls, dioxins, and DDT, and it is not clear if microplastics play a larger role as chemical reservoirs on smaller scales (NOAA 2008b).

Persistent organic pollutants found in or carried by trash may present potential threats in aquatic environments as they can leach from surface of trash to state waters. Leaching and degradation of plasticizers, polymers, and other plastic additives are complex phenomena dependent on environmental conditions and the chemical properties of each additive (Teuten et al. 2009). Persistent organic pollutants, however, have a high affinity for plastic in seawater, which may elevate POP concentrations on microplastic particles but reduce their bioavailability (NOAA 2008b).

Effects of Trash Ingestion on Wildlife, Freshwater, Estuarine, and Marine Aquatic Life

Many species, including mammals, birds, turtles, and fish, have been reported to ingest several different forms of trash. Ingestion of trash may occur either because of misidentification of trash items or accidental consumption during feeding and normal behavior. The effects of trash ingestion include starvation, suffocation, and internal injuries and infections. Ingested items can block air passages, prevent breathing, and be fatal (U.S. EPA 1992; 2002). In addition, some trash (e.g., diapers, medical and household waste, and chemicals) can be a source of bacteria, viruses, and toxic substances that can impact aquatic life. As described below, many studies have been completed on the impact of trash ingestion in marine environments; the effects of trash ingestion are expected to be the same in freshwater, saline, and estuarine environments.

For birds, ingestion of small plastic fragments and preproduction plastic pellets floating at the water surface pose a significant threat. At least 50 species of seabirds are known to ingest plastic debris (Day et al. 1985). Birds confuse these plastic fragments and preproduction plastic pellets with normal prey items, such as fish eggs or larvae, which are similar in both size and color.

Ingestion of trash by marine mammals has been reported to cause fatalities. In 2008, the ingestion of floating trash was fatal to two large sperm whales that were found stranded along the northern California coast (Jacobsen et al. 2010).

Sea turtles are especially prone to ingestion of marine trash, particularly plastics. Sea turtles, mistaking them for food, swallow plastic bags that block the turtle's digestive tract and lead to starvation (U.S. EPA 1992). Trash items that have been found in digestive tracts of turtles include plastic bags, tar, fishing lines, ropes, polystyrene, rubber, fishing hooks, charcoal, aluminum cans, aluminum foil, cardboard, net fragments, cloth, plastic spherules, strings, wood, cigarette filters, cellophane, bottles, vinyl films, pieces of latex balloons, and beer crown corks (Balazs 1985, Gramentz 1988, Plotkin and Amos 1990, Bjorndal et al. 1994, Tomás et al. 2002). Numerous studies that have reported high incidence of trash ingestion include: 10 of 33 leatherback turtles (30.3%) (Sadove and Morreale 1990); 19 of 32 sea turtles (59.4%) (Duronslet et al. 1991); 25 of 51 sea turtles (49%) (Bjorndal et al. 1994), and 23 of 38 green turtles (60.5%) (Bugoni et al. 2001). Even small quantities of trash can be fatal as seen by the death of two sea turtles where the trash represented only 4.6 and 5.8 percent of wet mass and 3.2 and 9.8 percent of volume of gut contents of the two turtles, respectively (Bjorndal et al. 1994).

Ingestion of trash can be particularly detrimental to aquatic life when trash contains or carries toxic compounds. Trash, particularly plastic trash, has plastic additives and can ~~ab~~sorb contaminants ambient in state waters such as polychlorinated biphenyls and DDT. These contaminants can be assimilated by aquatic life through ingestion. Ryan et al. (1988) found that the mass of ingested plastic in birds was positively correlated with polychlorinated biphenyls in their fat tissue and eggs. Also, Teuten et al. (2007) found that a priority pollutant, phenanthrene, was transmitted to a lugworm by plastic that was mixed into the sediments inhabited by the worm. Phenanthrene is not a plastic additive, but was ~~ab~~sorbed by the plastic from the ambient water.

Although there is limited research on the bioaccumulation of toxic compounds associated with plastics, a preliminary experiment demonstrating the transfer of contaminants from plastics to higher trophic level organisms was performed by Endo et al. (2005). The results of this study suggest that plastic-derived polychlorinated biphenyls are transferrable to biological tissue of birds after ingestion, especially lower-chlorinated congeners commonly found in plastic resin pellets. Since lower-chlorinated congeners are easily metabolized and cannot be biomagnified through the food chain, their presence in animal tissue is indicative of plastic ingestion. This phenomenon was also demonstrated by Yamashita et al. (2011), which found that the mass of ingested plastic in short-tailed shearwaters in the North Pacific Ocean was positively correlated with concentrations of lower-chlorinated congeners. Given the limited research of the biological uptake and bioaccumulation of toxics from plastics, plastic trash is not a significant vector of toxics relative to other exposure processes, such as atmospheric deposition and ocean currents (Gouin et al. 2011). Using lungfish and North Sea cod as model species, Koelmans et al. (2014) determined the potential leaching of nonylphenol and bisphenol A in the intestinal tracts from plastic ingestion. They found that plastic ingestion will make a negligible contribution to the transfer of additive as compared to other routes of exposure. However, salinity has been shown likely to have a strong effect on the sorption of contaminants, especially polymers, on plastic (Velzeboer et al. 2014). The transport and movement of contaminants by plastic particles in the aquatic environment are greatly influenced by local conditions. The transport of pollutants, such as DDT and polyaromatic hydrocarbons, is from freshwater and estuarine to fully marine conditions (Bakir et al. 2014). Overall, while the uptake and bioaccumulation of pollutants from plastics has been shown to occur, there is limited understanding of the significance in comparison to other modes of pollutant transfer in the environment.

Ingestion of toxic compounds and aquatic fatalities in freshwater, estuarine, and marine water systems negatively impact beneficial uses of aquatic life. Fatalities induced by trash ingestion or toxicity can affect aquatic life in warm and cold freshwater, inland saline water, estuarine, marine, wetland, and terrestrial habitats. Beneficial uses can be impacted when the ingestion of trash causes aquatic life fatalities or physiological stress in ASBS, and mortality or physiological stress in rare, threatened, or endangered species. See Table 1 for a summary of specific impacts of trash ingestion associated with each aquatic life beneficial use.

Effects of Trash Entanglement on Wildlife, Freshwater, Estuarine, and Marine Aquatic Life

In addition to ingestion, entanglement can result when an animal becomes encircled or ensnared by trash. Entanglement can cause wounds and associated infections, strangulation or suffocation, and impair the ability of an animal to swim, fly, find food, and escape predators (Figure 3; U.S. EPA 1992). Once entangled, animals have trouble eating, breathing or moving, all of which can be fatal. Similar to the discussion on trash ingestion, the studies describing effects of trash entanglement in marine environments also apply to freshwater and estuarine environments since the impacts are the same, regardless of the aquatic habitat.

Figure 3. Trash Entanglement (NOAA Marine Debris Program 2013).

According to the US Marine Mammal Commission, 136 marine species have been reported in entanglement incidents, including six species of sea turtles, 51 species of seabirds, and 32 species of marine mammals (Marine Mammal Commission 1996). Marine animals, particularly seals and sea lions, become entangled because of the natural curiosity and tendency to investigate unusual objects in the environment. Between 1982 and 2006, 268 entanglements of the endangered monk seal were documented in the Northwestern Hawaiian Islands. Additionally, many birds, including ducks geese, cormorants, and gulls have been found entangled in six-pack rings (U.S. EPA 1992), and nearly one million seabirds are thought to die from entanglement or ingestion of floatable material each year (U.S. EPA 2002).

Although entanglement is considered a serious mortality factor, the mortality rate due to entanglement is difficult to quantify. Many species vulnerable to entanglement are oceanic or migratory and are scattered across wide areas. Animals that become entangled and die either quickly sink or are consumed by predators, eliminating them from potential detection (Laist 1987). For these reasons, the estimated mortality rates and the effects of trash entanglement may actually be underestimated.

Fatalities induced by entanglement can affect aquatic life in warm and cold freshwater habitats, as well as inland saline water, estuarine, marine, wetland, and terrestrial habitats. Aquatic life fatalities in these habitats impact the beneficial when entanglement causes aquatic life fatalities in preserved areas of biological significance and fatalities of rare, threatened, or endangered species. See Table 1 for a summary of specific impacts associated with trash entanglement on each aquatic life beneficial use.

Impacts of Trash on Public Health

Trash in state waters can impact humans by means of jeopardizing public health and safety and posing harm and hindrance to recreational, navigational, and commercial activities. Trash can also affect the traditional and cultural rights of indigenous people or subsistence fishers to waters of the state. Specific impacts associated with each public health beneficial use are presented in Table 2.

Table 2. Trash-Related Impacts to Public Health Beneficial Uses.

Beneficial Use	Impact of Trash to Specific Public Health Beneficial Use
Municipal and Domestic Supply	• Alterations or degradation to waters that are used for community, military, or individual water supply systems (including drinking water). • Health hazards due to ingestion of water where diseases were transported by trash.
Navigation	• Safety hazards (including hazards to boats, rafts or other vessels used for shipping, travel, or transportation by private, military or commercial vessels).
Water Contact Recreation	• ~~Any amount of trash impacts this beneficial use.~~ • Health and safety hazards (including hazards from bacteria, viruses, toxic substances, mosquito production, and injuries). • Health hazards due to consumption of fish with diseases transported by trash or ingestion of water where diseases were transported by trash. • Safety hazards (including hazards to boats, rafts or other recreational vessels). • Alterations or degradation to waters that support contact water recreation.
Non-Contact Water Recreation	• ~~Any amount of trash impacts this beneficial use.~~ • Safety hazards (including hazards to boats, rafts or other recreational vessels). • Alterations or degradation to waters that support non-contact water recreation.
Commercial and Sport Fishing	• Safety hazards (including hazards to boats, rafts or other commercial or recreational vessels). • Health hazards due to consumption of fish, shellfish, or other aquatic species with diseases transported by trash. • Alterations or degradation to waters that support commercial and sport fishing.
Aquaculture	• Health hazards due to consumption of aquatic plants or animals with diseases transported by trash. • Alterations or degradation to waters that support aquaculture.
Shellfish Harvesting	• Safety hazards (including hazards to boats, rafts or other commercial or recreational vessels). • Health hazards due to consumption of filter-feeding shellfish with diseases transported by trash. • Alterations or degradation to waters that support shellfish harvesting.
Native American Culture	• Health hazards due to consumption of fish or shellfish with diseases transported by trash. • Elimination/reduction of native fish or shellfish populations that support the cultural and/or traditional rights of indigenous people. • Alteration or degradation to the habitat of or death to aquatic life that support the cultural beliefs of indigenous people. • Alterations or degradation to waters that support Native American culture.

Beneficial Use	Impact of Trash to Specific Public Health Beneficial Use
Subsistence Fishing	• Health hazards due to consumption of fish or shellfish with diseases transported by trash. • Alterations or degradation to waters that support subsistence fishing.
Note: Not all kinds of trash impact the specific human life beneficial uses.	

Effects of Trash on Public Health

Trash poses health and safety hazards for the safety of fishermen, recreational boaters, and children playing in the waterways and beaches. Items such as broken glass, medical waste, rope, and fishing line pose immediate risks to human safety. Injuries incurred by incisions from glass and metal can expose a person's bloodstream to microbes in the stream's water that may cause illness (Los Angeles Water Board 2010). Swimmers, divers, and snorkelers can become entangled in submerged or floating trash such as rope or fishing line. Some trash (e.g., diapers and medical and household waste) can be a source of bacteria, viruses, and toxic substances (Musmeci et al. 2010). Medical and personal hygiene trash, for instance, can indicate the presence of pathogenic contaminants such as streptococci, fecal coliform, and other bacterial contamination. Consumption or contact with water contaminated with these pathogens could result in infectious hepatitis, diarrhea, bacillary dysentery, skin rashes, and even typhoid and cholera. Also, some debris, such as containers or tires, can collect water and support mosquito production and associated risks of diseases such as encephalitis and the West Nile Virus (Los Angeles Water Board 2010). Trash, specifically plastic waste, has a potential to expose humans to chemicals, such as bisphenol A and phthaletes (DG Europe 2011).

Trash in state waters can pose serious risks to recreational users including incisions and exposure to disease. Because of these health and safety hazards, trash may be an immediate threat to public health depending on the type of trash, where there is bodily contact with water, and where ingestion of water is reasonably possible. Therefore, waters designated with the beneficial use water contact recreation (Table 2) can be negatively impacted by the presence of trash. In addition, beneficial uses associated with the human consumption of water, shellfish, aquatic plants and animals, and commercial and sport fish, may be impacted by trash. Specifically, the ingestion of water or food that may be contaminated by bacteria, viruses, or toxic compounds found in trash poses a significant public health concern.

Effects of Trash on Contact & Non-Contact Water Recreation, Commercial and Sport Fishing, and Navigation

Beyond the immediate health and safety hazards caused by trash, the presence of trash in state waters can also affect beneficial uses of waters where there is less bodily contact with water. Damage to boats, rafts, and other recreational vessels through entanglement of equipment and propellers can lead to potentially hazardous and perhaps fatal situations for boaters (Figure 4). For these circumstances, trash present in waters designated for recreational activities and for transportation can impact the beneficial uses of non-contact water recreation and navigation, respectively.

Figure 4. Entangled Propeller (NOAA Marine Debris Program).

Effects of Trash on Native American Culture

Some waters within the jurisdiction of the North Coast Water Board are protected by the beneficial use, Native American Culture. This beneficial use describes waters that support the cultural and/or traditional rights of indigenous people such as subsistence fishing and shellfish gathering, basket weaving, jewelry material collection, navigation to traditional ceremonial locations, and ceremonial uses. Trash affects this use by reducing the numbers of fish and/or shellfish, and/or by introducing toxic compounds to the waters making the waters too dangerous or unsuitable for this beneficial use. The North Coast Water Board also has a subsistence fishing beneficial use that protects the use of waters for subsistence fishers. Many people living near freshwater or marine areas depend on food from their nearby water bodies for survival. Similar to the Native American Culture use, trash affects the subsistence fishing use if waters are void of fish and/or shellfish or if toxic compounds associated with trash impact the aquatic life. The effect on these uses is similar to the aquatic life and public health impacts of trash described above.

II. Trash in the Environment

The presence of trash in surface waters, especially in coastal and marine waters, is a serious issue in California. According to California's 2008-2010 Integrated Report, there are 73 water bodies listed as having impaired water quality due to the presence of large amounts of trash. Trash discarded on land is frequently transported through storm drains and to waterways, shorelines, the seafloor, and the ocean. Statewide and local studies have documented the presence of trash in state waters and the accumulation of land-based trash in the ocean. Street and storm drain trash studies conducted in regions across California have provided insight into the composition and quantity of trash that flows from urban streets into the storm drain system and out to adjacent waters (Figure 5).

Figure 5. Don't Trash California (Caltrans).

Composition of Trash

Since 1986, the California Coastal Commission and the Ocean Conservancy have organized the Coastal Cleanup Day to collect trash from beaches, inland waterways, coastal waters, and underwater annually through voluntary efforts at sites around the world (Figure 6). In 2012, volunteers removed 854,496 pieces of trash totaling 1,444,546 from 2,023 miles of Coastal Cleanup sites throughout California. The top ten items collected from 1989-2012 were: (1) cigarette butts; (2) bags (paper and plastic); (3) food wrappers and containers; (4) caps and lids; (5) cups, plates, forks, knives, and spoons; (6) straws and stirrers; (7) glass beverage bottles; (8) plastic beverage bottles; (9) beverage cans; and (10) building materials. These items made up nearly 90 percent of the items removed and cataloged by Coastal Cleanup Day events. These data generated by the Coastal Cleanup Day efforts provide valuable information on the sources of debris, as well as the types and quantity of debris in California.

In addition to the dominance of consumer products in the waste stream, preproduction plastics pellets are a particular concern when the raw material is improperly disposed and reaches a water body. A 1998 study, conducted in Orange County by Moore et al., found the most abundant debris items on beach sites were preproduction plastics, foamed plastics, and hard plastics. A 2009 collaborative baseline study conducted by the Southern California Coastal Water Research Project and the State Water Board estimated that preproduction plastic made up 95 percent of the debris on California's beaches, and other plastic debris items made up an additional 4.6 percent (Moore et al. 2013). The densest distribution of debris was found in the San Diego, Orange, Los Angeles and San Francisco County Regions, and appears to correlate with the more densely populated coastal watersheds in California.

Plastic, the largest component and among the longest of life spans of trash materials, is an increasingly local and global threat to aquatic and marine life and environments. Although plastics are one of the most common forms of trash and may have lasting and deleterious impacts, all forms of trash are a threat to state waters.

Figure 6. California Coastal Cleanup Day Advertisements (California Coastal Commission).

Transport of Trash in the Environment

Trash in state waters is related to the direct and indirect activities of inhabitants inland, along coastal shorelines, and offshore (NOAA 2008a). A major source of trash is either intentionally or accidentally improperly discarded waste, thrown or deposited on land and in water bodies. If trash occurs on land, it is commonly transported to nearby water bodies by wind and/or rain or dry ~~season~~ weather runoff. The five primary sources and transport mechanisms for trash to state waters are (Figure 7):

1. Littering by the public on or adjacent to waterways;
2. Storm events draining watersheds and carrying trash originating from littering, inadequate waste handling or illegal dumping via the storm drain system to receiving waters;
3. Wind-blown trash, also originating from littering, inadequate waste handling or illegal dumping;
4. Illegal dumping into or adjacent to water bodies, and;
5. Direct disposal (overboard disposal and/or dumping) of trash into water bodies from vessels involved in commercial, military, fishing or recreational activities.

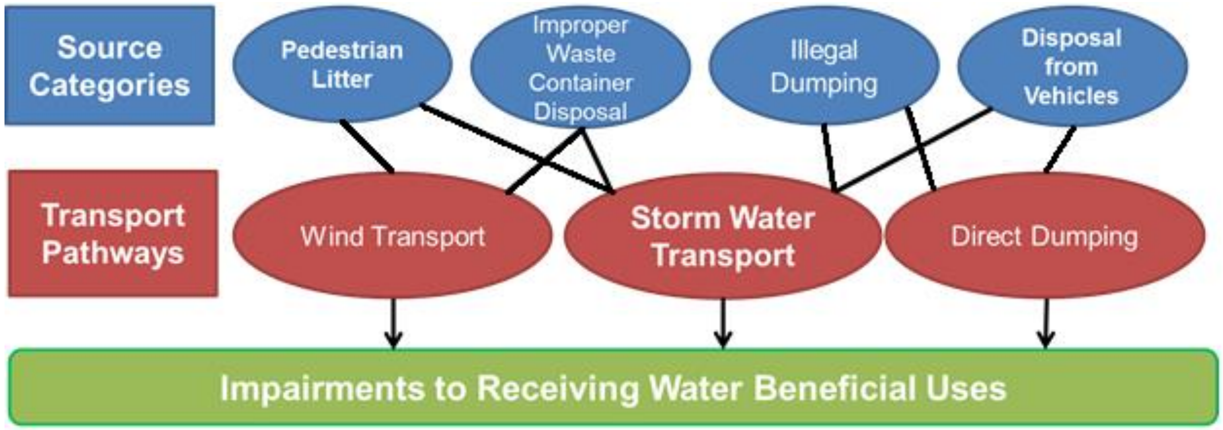

Figure 7. Transport of Trash to Waters of the State.

Littering is commonly the first route for trash to enter the environment. It is considered as a land-based source of trash and frequently accumulates in the vicinity of shopping centers, car parking lots, fast food outlets, railway and bus stations, roads, schools, public parks and gardens, garbage bins, landfill sites, and recycling depots. Results of trash generation studies conducted in Los Angeles County and City of Los Angeles in 2001 and 2004 concluded that high trash generation rates occur at highly populated and highly visited areas that attract vehicular and pedestrian traffic. Objects that can be easily transported by wind, such as plastic and paper trash, are a particular problem because they can become floatable trash even when originally disposed of in an appropriate manner. Uncontained trash can be blown directly into inland surface waters (including rivers, lakes, estuaries, and drains), enclosed bays, and the ocean, or it can be transported to the ocean if blown into a river, stream, or enclosed bay that empties to coastal waters (U.S. EPA 2002, San Diego CoastKeeper 2010).

Storm water can also wash trash into drainage systems, where it is able to travel via the storm water systems, streams, rivers, lakes, and estuaries until it eventually reaches coastal waters (Armitage and Rooseboom 2000, Richmond and Clendenon 2011). Trash will accumulate in areas of generation until the local authority either removes it or it is transported by wind and/or storm water runoff to nearby drainage systems and water bodies (Armitage and Rooseboom 2000). During storms and other periods of high winds or high waves, almost any kind of trash (including glass, metal, wood, and medical waste) can be deposited into the waters of the state (U.S. EPA 2002). A significant contribution from runoff has been shown in recent studies monitoring the density of marine trash before and after storm events. A study conducted on the Los Angeles and San Gabriel Rivers found the greatest abundance of plastic trash occurred after a rain event (Moore et al. 2011). A study conducted off the Southern California coast found trash increased after a storm event, reflecting inputs from land-based runoff and re-suspended matter (Lattin et al. 2004).

According to NOAA, it is estimated that 80 percent of marine trash comes from land-based sources (1999). Evidence of floating trash and trash on the seafloor suggests that trash from land-based sources can travel and impact waters downstream, along coastal shores, and in marine waters of the state. Trash that ends up on California beaches is indicative of trash accumulated from upstream sources, as well as other sources such as visitor littering, poor management of waste containers, and recreational water activities. The transport of trash from land-based sources is not unique to California; the transport of trash is occurring globally. For example, the Danube River in Austria is reported to have a net flow rate of 4.2 tons of trash per day, with industrial raw materials accounting for over 70 percent of the reported items (Lechner et al. 2014). In the Tamar Estuary in London, plastics accounted for 82 percent of the trash found and the tidal cycle was a factor in the transport of trash (Sadri et al. 2014).

Illegal dumping and direct disposal of trash can take place in both fresh and marine waters. Trash is directly deposited into surface waters from accidental loss, improper waste management or by illegal disposal. Sources may include commercial fishing vessels; merchant, military and research vessels; recreational boats; cruise ships; and offshore petroleum platforms and associated supply vessels; beach recreation; and illegal encampments adjacent to waterways and water bodies. Trash deposition associated with recreational boating (Richmond and Clendenon 2001) also contributes to the problem, a majority of which is found to be plastic trash (Milliken and Lee 1990). One study that assessed trash generation along the shorelines of Orange County, suggested that water-based sources, such as overboard disposal were more significant than littering or wind deposition at these locations (Moore et al. 2001). While there are laws regulating the dumping of trash from boats and vessels in rivers, streams, marinas and seas, the global nature of trash, the inability to confine trash within territorial boundaries and the complexity of identifying trash sources have made laws difficult to develop and even harder to enforce.

Trash Assessment Studies

Potential sources of trash have been identified in trash assessment studies performed in the San Francisco Bay Region, Los Angeles River watershed and in Santa Clara County. Collectively, these trash assessments have identified the following as potential sources: direct littering and dumping, downstream transport and accumulation, recreational land-uses, industrial land-uses, urban runoff, pedestrians, vehicles, and improper management of waste containers (Santa Clara Valley Urban Runoff Pollution Prevention Program 2007, Surface Water Ambient Monitoring Program 2007, U.S. EPA 2012b).

Over the 2003-2005 monitoring period, the San Francisco Bay Region Rapid Trash Assessment study found that over 50 percent of the trash collected in urban streams was composed of plastic items. Glass (19%) and biodegradable items (10%) were also commonly found. Direct littering and dumping as well as downstream transport and accumulation were the two major transport mechanisms identified as responsible for the trash in streams in this region (Surface Water Ambient Monitoring Program 2007). High trash deposition rates were generally associated with wet weather, which reflects accumulation from upstream sources. As for dry season deposition, elevated deposition rates were primarily associated with localized littering and dumping, wind-blown trash from nearby sources, and, at certain sites, accumulation from upstream sources due to dry season runoff. Overall, trash levels generally increased in a downstream direction from headwaters to the mouth of the watershed. Other sources of trash near creek channels were identified as parks, schools, roads, or poorly kept commercial facilities.

In the Los Angeles River Watershed, the ~~Santa Clara Valley Urban Runoff Pollution Prevention Program~~ U.S. EPA and Los Angeles Water Board staff performed Rapid Trash Assessment in the lakes, along lakeshores, near fences and at the outlet of storm drains to document the impairment of Los Angeles area lakes. Rapid Trash Assessment site visits evaluated different land use types surrounding the lakes such as recreational use, industrial businesses, and urban runoff (U.S. EPA 2012b). The study suggests that trash in recreational areas surrounding the lake is likely transported from people littering in the area and from uncovered trash cans. In recreational areas, trash problems were primarily caused by overflowing trash cans and littering of small trash items, such as cigarette butts. Facilities in recreational areas, such as bathrooms and parking lots, were also identified as key hotspots for trash. Although industrial sites surrounding Peck Road Park Lake were too steep to appropriately conduct a quantitative trash assessment, items observed from a distance included plastic bags, milk jugs, a tire, a cooler, metal cable, and industrial scraps. Lastly, an inlet to Peck Road Park Lake was assessed to evaluate trash derived from urban runoff. This area demonstrated heavy accumulation of trash and evidence of trash dumping. Specific items found in the inlet of the lake included semiconductors, pepper sprays, spray paint cans, cigarette butts, large furniture items, foamed polystyrene, and plastic pieces (U.S. EPA 2012b).

Based on urban creek trash assessments in Santa Clara County, four source categories of trash have been identified by Santa Clara Valley Urban Runoff Pollution Prevention Program: pedestrians, vehicles, waste containers, and illegal dumping (Santa Clara Valley Urban Runoff Pollution Prevention Program 2007). Pedestrian locations are likely the greatest source of trash that ends up in local water bodies. Areas most affected by trash include high foot traffic locations (e.g., shopping plazas, convenience stores, and parks), transition points (e.g., bus stops, train stations, and entrances to public buildings), and special event venues (e.g., concerts, sporting events, and fairs). Drivers and passengers are also responsible for trash when they litter directly from vehicles or do not adequately cover their vehicles when transporting trash. Land areas that may accumulate trash from vehicles include roads, highways, and parking lots. Waste containers that are overflowing or uncovered and the improper handling of trash during curbside collection may also contribute to the problem. Illegal dumping of trash may occur within a watershed or directly into a waterway. High occurrences of illegal dumping often are by illegal encampments near or within riparian areas (Santa Clara Valley Urban Runoff Pollution Prevention Program 2007).

Land-Based Generation Studies

Studies show that trash is predominantly generated on land and then transported to a receiving water body. The main transport pathway of trash to receiving water bodies is through storm water transport. Several studies have been conducted to determine the sources of land-based trash generation and the rates of trash generation areas. The land areas evaluated in these studies typically included the following: high density residential, low density residential, commercial services, industrial, public facilities, education institutions, military institution, transportation, utilities, mixed urban, open space, agriculture, water, and recreation land uses.

In 2001, the City of Los Angeles Watershed Protection Division performed a geographical analysis of trash generation in the City of Los Angeles. The study showed that trash is most severe in Central City (Downtown LA) and nearby communities where commercial, industrial, and residential land uses are predominant (City of Los Angeles 2002). According to the 2004 Trash Baseline Monitoring results in Los Angeles County, the highest trash-generating land-uses were high-density residential, mixed use urban, commercial, and industrial land uses in the Ballona Creek ~~Watershed~~ and Los Angeles River Watershed, respectively (County of Los Angeles Department of Public Works 2004a; 2004b). The results indicate that high generation of trash is commonly found at highly populated and highly visited areas that attract high vehicular and pedestrian traffic.

BASMAA worked collaboratively with the permittees of the San Francisco Bay Area's Regional Stormwater Permit to develop a regionally consistent method to establish baseline trash loads from their municipality. The project, BASMAA Baseline Trash Generation Rates Project, assisted the permittees in establishing a baseline by which to demonstrate progress towards trash load reduction goals. The project assessed the baseline trash generation rates at 137 monitoring sites at nine different land uses, determined that the four land uses with the highest trash generation rates are (1) retail and wholesale, (2) high-density residential, (3) K-12 schools, and (4) commercial/services and industrial, and developed a conceptual model for trash generation rates (EOA, Inc. 2012a). The project provided a scientifically-sound method for developing trash generation rates that can be adjusted, based on permittee/site specific conditions, and used to develop baseline loading rates and loads (EOA, Inc. 2012a). Baseline loads form the reference point for comparing trash load reductions achieved through control measure implementation (EOA, Inc. 2012b).

Outfall and Storm Drain Monitoring

Outfall and storm drain monitoring results are useful in determining the types of trash that is transported to receiving waters from inland locations. Paper, plastics, cigarette butts, and vegetation are common forms of trash collected in the outfalls and storm drains by Caltrans and municipalities such as Fresno and Stockton.

The Litter Management Pilot Study conducted in 1998 through 2000 by Caltrans identified that trash collected during outfall monitoring in the Los Angeles area consists of paper, plastic, wood, cigarette butts, foamed polystyrene, metal, and glass (Caltrans 2000). Further evaluation of the Litter Management Pilot Study data indicated that smoking- and food-related trash accounted for 20-30 percent of the trash by weight and volume and that approximately 90 percent of the trash collected at the storm drain outfall is floatable (Caltrans 2000). The high percentage of floatable trash can be indicative of the short residence time in the drainage system. Though plastics are one of the more common forms of trash in receiving waters (Moore et al. 2001, Moore et al. 2005; 2011), the Litter Management Pilot Study showed that non-plastics represent 67 percent of trash composition by weight, 57 percent by volume and 66 percent by count (Caltrans 2000). Caltrans reported that polystyrene items represented 5 percent by weight and 15 percent by volume. Plastic film including bags represented 7 percent by weight and 12 percent by volume.

During the 2001-2002 monitoring season, the Caltrans Public Education Litter Monitoring Study collected storm water trash data at Caltrans highway sites in Fresno and Stockton, California. The majority of material collected was vegetation. Trash, however, as defined as manufactured items greater than 5 millimeters, ranged from 5 to 18 percent by weight and 11 to 43 percent by volume (Caltrans 2004~~2~~).

Street and Storm Drain Trash Audits

Street and storm drain trash audits characterize trash that can be transported to surface waters by wind, runoff, or storm water collection systems. Trash audits reveal the composition of littered products depicting the materials (paper, plastic, metal, and glass), type of product (bottle, cup, can, and cigarette butt), and sometimes the land-based sources of littered items. In California, two studies that have collected and assessed trash for brands and identifiable sources are the Source Reduction Pilot Project in the San Francisco Bay area and the storm drain trash audit of the City of Oxnard. A street trash audit was conducted in San Francisco, but the sources of the trash were not identified.

In 2010-2011, Clean Water Action coordinated a Source Reduction Pilot Project in which trash was characterized at isolated sites in four jurisdictions: Oakland, Richmond, San Jose, and South San Francisco. The results of the project identified that cigarette butts were the most common item found in trash. The leading quantifiable type of trash on city streets was food and beverage packaging (67%) (Clean Water Action 2011a). Altogether, 81 percent of trash collected originated from food establishments, including fast food, cafes, grocery stores, and convenience food stores. The results of this study suggest that businesses that sell “take-out” food and beverages are the largest sources of trash after cigarette smokers. These studies are instructive because businesses and institutions that decide to purchase packaged and disposable products influence the quantity of potential material that is available to become littered, dumped, improperly disposed, and thus potentially transported to nearby waters.

In 2005, the City of Oxnard completed a study of trash in the open channel storm drain system. According to the Stormdrain Keeper program, the most common trash items collected were plastic, cellophane, paper products, and foamed polystyrene (Pumford 2005). While much of the trash removed from the storm drain open channel was unmarked, key contributors of marked trash were fast food businesses and markets.

A street trash audit was conducted in San Francisco in April 2007 and April 2008. Within this study, trash was classified as “large” for items over four square inches or as “small” for items smaller than four square inches. For both monitoring periods, the most significant type of large trash observed was paper products, followed by plastic materials. Plastic materials include plastic packaging, wrap, plastic bags, and beverage containers. As for small trash observations, the most significant type of small trash was chewing gum, followed by glass pieces (City and County of San Francisco 2007, City of San Francisco 2008).

Attachment B

SWAMP
Surface Water Ambient Monitoring Program

Final Technical Report	**2007**

A Rapid Trash Assessment Method Applied to Waters of the San Francisco Bay Region: Trash Measurement in Streams

April 2007

California Water Boards

www.waterboards.ca.gov/swamp

Attachment B

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This report was authored by Steven M. Moore, Matthew R. Cover and Anne Senter of the Regional Water Quality Control Board, San Francisco Bay Region, Surface Water Ambient Monitoring Program.

Cover Photo of Peralta Creek at Cesar Chavez Park, Oakland, CA, by Anne Senter

Introduction

Trash is a term used in water quality control, synonymous with litter, debris, rubbish and refuse. Trash is a regulated water pollutant that has many characteristics of concern to water quality. It accumulates in streams, rivers, bays, and ocean beaches throughout the San Francisco Bay Region of California, particularly in urban areas. Trash in streams can impair beneficial uses such as human health and aesthetic enjoyment (REC-2) and aquatic life. Trash in urban waterways of coastal areas can become "marine debris," known to harm fish and wildlife and cause adverse economic impacts (Moore and Allen, 2000). Absent numeric guidelines or standard assessment methodologies, assessing trash levels and prioritizing water bodies for trash management remains a challenge for the California Regional Water Quality Control Board, San Francisco Bay Region (Water Board).

This report documents a pilot effort conducted by the Surface Water Ambient Monitoring Program (SWAMP) to systematically assess trash levels in streams, which are sources of marine debris to the San Francisco Bay and Pacific Ocean. SWAMP staff developed a Rapid Trash Assessment (RTA) protocol for examining the amount and types of trash present in stream channels, the effects of trash on beneficial uses, and potential sources of trash.

The goals of this report are to (1) describe a rapid trash assessment protocol and (2) provide a regional assessment of trash deposition in fresh waters of the San Francisco Bay Region. The objectives are to document (1) dry and wet weather trash deposition rates, (2) longitudinal variability within watersheds, and (3) variability across watersheds in urban settings. The Introduction of the report includes a discussion of the water quality impacts of trash and relevant water quality standards, and describes the impetus for the study. The Methods section describes the RTA methodology, sampling design considerations, and QA issues. In the Results and Discussion sections we present data on site scores, trash abundance, and types of trash, followed by a discussion of likely sources of trash and potential management measures. Results from year-round surveys of 26 sites around the San Francisco Bay Region are presented and discussed (Figure 1). Sites with the highest trash deposition rates in dry and wet weather conditions are presented as case studies in a discussion of sources of trash pollution and potential management actions.

Trash and Water Quality Standards

Water quality standards consist of (1) designated beneficial uses for specific water bodies, (2) water quality objectives (narrative and/or numeric) to protect beneficial uses, and (3) the State's Antidegradation Policy, which mandates the maintenance of high quality waters, preventing degradation to the minimally acceptable standard. Water quality standards for the San Francisco Bay Region are contained in the San Francisco Bay Region Water Quality Control Plan (Basin Plan).

Trash adversely affects numerous beneficial uses of waters, particularly recreation and aquatic habitat. Not all litter and debris delivered to streams are of equal concern with regards to water quality. Besides the obvious negative aesthetic effects, most of the harm of trash in surface waters is imparted to wildlife in the form of entanglement or ingestion (Laist and Liffmann, 2000; McCauley and Bjorndahl, 1999). Some elements of trash exhibit significant threats to human health, such as discarded medical waste, human or

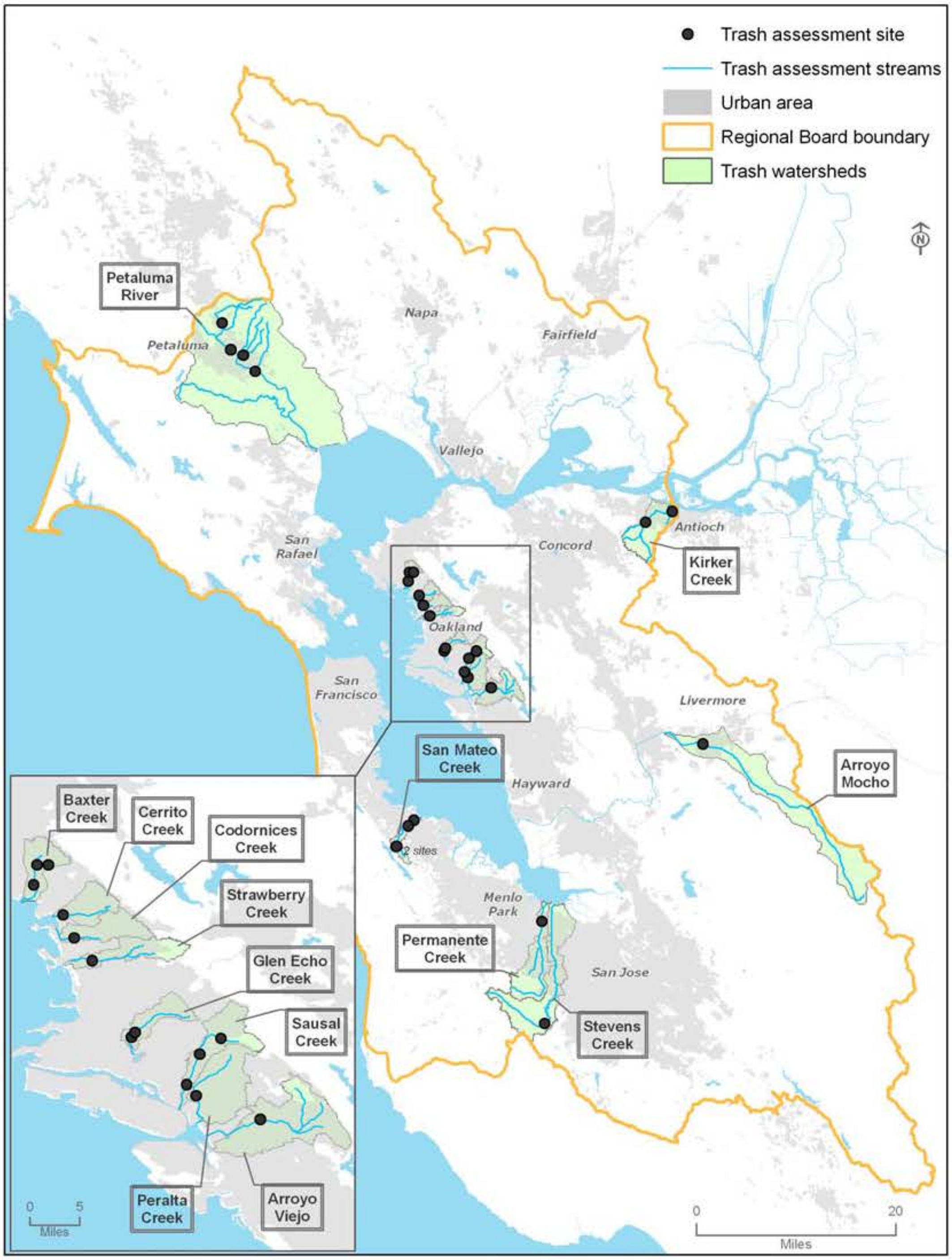

Figure 1 – Map of Trash Assessment Sites, San Francisco Bay Region SWAMP Program, 2003-2005

pet waste, and broken glass (Sheavly, 2004). Also, some household and industrial wastes may contain toxic substances of concern to human health and wildlife, such as batteries, pesticide containers, and fluorescent light bulbs that contain mercury. Large trash items such as discarded appliances can present physical barriers to natural stream flow, causing physical impacts such as bank erosion. From a management perspective, the persistent accumulation of trash in a water body is of particular concern, and signifies a priority for prevention of trash discharges. Also of concern are trash "hotspots" where illegal dumping, littering, and/or accumulation of trash occur.

The narrative water quality objectives applicable to trash are:

- Floating Material (*Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses*),
- Settleable Material (*Waters shall not contain substances in concentrations that result in the deposition of material that cause nuisance or adversely affect beneficial uses*), and
- Suspended Material (*Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses*).

The Basin Plan prohibits discharge of rubbish and refuse to waters of the state (Table 4-1, Discharge Prohibitions, No. 7). This prohibition was adopted by the Water Board in the 1975 Basin Plan, primarily to protect recreational uses such as boating.

Several water bodies in California are listed under Section 303(d) of the Clean Water Act (CWA) as impaired by trash, which means they are not meeting water quality standards. The 303(d) List includes Lake Merritt of Oakland as impaired by trash. In 2001, the Los Angeles Regional Water Board began adopting Total Maximum Daily Loads (TMDLs) for trash in its jurisdictional area, which established numeric targets of zero trash items in waterbodies including the Los Angeles River. The San Francisco Bay Regional Water Board keeps an informal "watch" list for impaired water bodies, and has placed trash in all urban creeks, lakes and shorelines on this list. As part of this action in November 2001, the Water Board identified the need for better information on trash assessment in order to discern which water bodies should be included on the 303(d) Impaired Water Bodies List.

Assessment Method Development

Recognizing the need for assessment procedures to support 303(d) listing decisions, the staff of the Water Board developed, refined, and implemented a rapid trash assessment method from 2002 through 2005 as part of its Surface Water Ambient Monitoring Program (SWAMP) (Water Board, 2004, Appendix A). The method was refined through field experience and by conferring with representatives from local government and nonprofit groups. The method generates site-specific scores on a scale from 0 to 120, with higher scores indicating cleaner sites. The method also documents the number of pieces of trash per one hundred feet of stream or shoreline, and the rate of return of trash under different hydrologic conditions. This data can be used to identify problem areas where trash accumulates during dry weather due to littering or dumping and in wet weather due to accumulation from upstream sources, and to assess the effectiveness of targeted management measures.

Trash assessment includes a visual survey of the water body (e.g., streambed and banks) and adjacent areas from which trash elements can be carried to the water body by wind, water, or gravity. The delineation of these adjacent areas is site-specific and requires some judgment and documentation. The rapid trash assessment worksheet is designed to represent the range of effects that trash has on the physical, biological, and chemical integrity of water bodies, in accordance with the goals of the CWA and the California Water Code. The worksheet also provides a record for evaluation of the management of trash discharges, by documenting sites that receive direct discharges (i.e., dumping or littering) and those that accumulate trash from upstream locations. The specific items on the tally sheet were determined based on common items retrieved during numerous pilot surveys.

There is a need to systematically measure trash levels in Bay Area and California water bodies to establish baseline conditions, and evaluate the success of educational, institutional, operational and structural efforts to control trash. In some systems that behave as trash "catchments," such as Lake Merritt, tons of trash removed may be an appropriate indicator to measure over time to gauge success, as long as it is measured consistently. The Water Board staff developed the rapid trash assessment method to provide such a systematic approach for non-catchment systems such as streams and shorelines, where "tons of trash removed" may not provide an accurate tracking mechanism. Trash weight can be a misleading indicator, since the trash of most concern to beneficial uses is small, buoyant and persistent (U.S. EPA, 2001).

Water Quality Impacts of Trash

For aquatic life, buoyant (floatable) elements tend to be more harmful than settleable elements, due to their ability to be transported throughout the water body and ultimately to the marine environment. Persistent elements such as plastics, synthetic rubber and synthetic cloth tend to be more harmful than degradable elements such as paper or organic waste. Glass and metal are less persistent, even though they are not biodegradable, because wave action and rusting can cause them to break into smaller pieces that are less sharp and harmful. Natural rubber and cloth can degrade but not as quickly as paper (U.S. EPA, 2002). Smaller elements such as plastic resin pellets (a by-product of plastic manufacturing) and cigarette butts are often more harmful to aquatic life than larger elements, since they can be ingested by a large number of small organisms which can then suffer malnutrition or internal injuries. Larger plastic elements such as plastic grocery bags are also harmful to larger aquatic life such as sea turtles, which can mistake the trash for floating prey and ingest it, leading to starvation or suffocation. Floating debris that is not trapped and removed will eventually end up on the beaches or in the ocean, repelling visitors and residents from the beaches and degrading coastal and open ocean waters.

Trash in water bodies can threaten the health of people who use them for wading or swimming. Of particular concern are the bacteria and viruses associated with diapers, medical waste (e.g., used hypodermic needles and pipettes), and human or pet waste. Additionally, broken glass or sharp metal fragments in streams can cause puncture or laceration injuries. Such injuries can then expose a person's bloodstream to microbes in the stream's water that may cause illness. Also, some trash items such as containers or tires can pond water and support mosquito production and associated risks of diseases such as encephalitis and the West Nile virus.

Leaf litter is considered trash when there is evidence of intentional dumping. Leaves and pine needles in streams provide a natural source of food for organisms, but excessive levels due to human influence can cause nutrient imbalance and oxygen depletion in streams, to the detriment of the aquatic ecosystem. Other biodegradable trash, such as food waste, also exerts a demand on dissolved oxygen, but aquatic life is unlikely to be adversely affected unless the dumping of food waste is substantial and persistent at a given location.

Wildlife impacts due to trash occur in creeks, lakes, estuaries, and ultimately the ocean. The two primary problems that trash poses to wildlife are entanglement and ingestion, with entanglement the more common documented effect (Laist and Liffmann, 2000). Marine mammals, turtles, birds, fish, and crustaceans all have been affected by entanglement in or ingestion of floatable debris. Many of the species most vulnerable to the problems of floatable debris are endangered or threatened by extinction.

Entanglement results when an animal becomes encircled or ensnared by debris. It can occur accidentally, or when the animal is attracted to the debris as part of its normal behavior or out of curiosity. Entanglement is harmful to wildlife for several reasons. Not only can it cause wounds that can lead to infections or loss of limbs; it can also cause strangulation or suffocation. In addition, entanglement can impair an animal's ability to swim, which can result in drowning, or in difficulty in moving, finding food, or escaping predators (U.S. EPA, 2001).

Ingestion occurs when an animal swallows floatable debris. It sometimes occurs accidentally, but usually animals feed on debris because it looks like food (e.g., plastic bags look like jellyfish, a prey item of sea turtles). Ingestion can lead to starvation or malnutrition if the ingested items block the intestinal tract and prevent digestion, or accumulate in the digestive tract, making the animal feel "full" and lessening its desire to feed. Ingestion of sharp objects can damage the mouth, digestive tract and/or stomach lining and cause infection or pain. Ingested items can also block air passages and prevent breathing, thereby causing death (U.S. EPA, 2001).

Common settled debris includes glass, cigarettes, rubber, construction debris and more. Settleables are a problem for bottom feeders and dwellers and can contribute to sediment contamination. Larger settleable items such as automobiles, shopping carts, and furniture can redirect stream flow and destabilize the channel.

In conclusion, trash in water bodies can adversely affect humans, fish, and wildlife. Not all water quality effects of trash are equal in severity or duration, thus the trash assessment methodology was designed to reflect a range of trash impacts to aquatic life, public health, and aesthetic enjoyment.

Sources and Fate of Trash

Movement and fate of trash in the landscape and waterways varies based on its size, buoyancy, and degradability. Small, buoyant and persistent trash items such as plastic or synthetic rubber may travel from land all the way to mid-ocean locations, whereas other trash items may have a more transient or localized presence in waters.

The primary sources of trash to waters of the state are urban runoff in nearshore areas such as creeks and San Francisco Bay, and fishing boats in offshore areas (Moore and Allen, 2000). In most of the region, storm drainage in urban areas had been designed to move water as quickly as possible to surface waters. One unfortunate by-product of this design is that medium to heavy rain events move trash that is deposited on streets and other impervious surfaces directly to waters of the state, unless it is screened out by coarse metal grates in urban gutters.

Surveys of the ocean floor of the Southern California Bight for trash and natural debris concluded that land-based trash sources contributed the most to the ocean bottom trash levels near the shoreline, but the trash on the outer continental shelf was dominated by discarded fishing gear and incidental waste from recreational and commercial fishing boats (Moore and Allen, 2000).

Surveys of the North Pacific central gyre for floating plastics and plankton suggest that the amount of plastic material in the ocean is increasing over time (Day and Shaw, 1987). Plastic degrades slowly in the ocean (Andrady, 1990; U.S. EPA, 1992). The eddy effects of the gyre probably serve to retain plastics, whereas plastics may wash up on shore in greater numbers in other areas. This is based on the observation that a large fraction of the materials in the central gyre study appeared to be remnants of offshore fishing-related activity and shipping traffic. The survey indicated that the mass of plastics is about six times that of plankton, but the abundance of plankton is still about five times that of plastic pieces (Moore et al., 2001).

Methods

In order to generate consistent and comparable results, the methods of site definition, data collection, scoring, and overall monitoring program design are discussed in this section.

Monitoring Design Considerations

The rapid trash assessment method can be used for a number of purposes, such as ambient monitoring, evaluation of management actions, determination of trash accumulation rates, or comparing sites with and without public access. In this report, the data collected is used for all of these purposes. Ambient monitoring provides information on the spatial and temporal patterns of trash dynamics. Additionally, the ambient sampling design should document the effects of episodes that affect trash levels such as storms or community cleanup events. Pre- and post-project assessments can assist in evaluating the effectiveness of management practices ranging from public outreach to structural controls, or to document the effects of public access on trash levels in waterbodies (e.g., upstream/downstream). Such evaluations should consider trash levels over time and under different seasonal conditions. Revisiting sites where trash was collected during previous assessments enables the determination of accumulation rates. Alternatively, if a monitoring objective is to characterize trash conditions over time in a stream, it may be more appropriate to revisit different nearby reaches or not pick up trash if the same site is revisited. Ultimately, the monitoring design strongly affects the usefulness of any rapid trash assessment information.

SWAMP Trash Monitoring Design

In accordance with the goal of this report, sites were selected to represent the range of conditions found in the tributaries to San Francisco Bay, from rural residential areas in the foothills to dense, urbanized areas in the plains. All sites were near or within city limits, representing areas of public access (e.g., parks) or at the bottom of watersheds.

The SWAMP program rotates water quality monitoring through 46 planning watersheds in the San Francisco Bay Region, as budget allows. Trash assessments were conducted at sites where water quality was monitored in the SWAMP program from 2003 to 2005. The 26 sites assessed using the rapid trash assessment methodology are located in five of the nine Bay Area counties (see Figure 1). Two of the 26 sites were surveyed only once, due to dangerous field conditions and extremely high trash levels, while other sites were surveyed three to five times over a year in order to calculate deposition rates of trash during dry and wet weather conditions. Surveys sometimes integrated both dry and wet conditions, but these assessments were classified as “wet weather” due to the observed overwhelming effect of wet weather conditions on trash deposition. Of the 26 sites, 13 were located at the bottom of the watershed (BOTW), representing areas just upstream of the San Francisco Bay intertidal zone. The remainder of the sites were located further upstream, allowing for longitudinal analyses of trash deposition in the San Mateo Creek, Baxter Creek (Richmond), Petaluma River, and Sausal Creek (Oakland) watersheds. This report presents results and discussion for a total of 93 individual site surveys.

Site Definition

Defining site-specific characteristics facilitates the comparison of trash assessments conducted at the same site at different times of the year. Upon arrival at a designated monitoring site, a team of two people or more defined or verified a 100-foot section of the stream or shoreline to analyze, associated with a SWAMP water quality sampling location or station. When a site was first established, the 100-foot distance was accurately measured. The length was measured not as a straight line, but as 100 feet of the actual stream or shore length, including sinuous curves. Where possible, the starting and ending points of the survey were easily identified landmarks, such as an oak tree or boulder, and noted on the worksheet ("Upper/Lower Boundaries of Reach"), or documented using a global positioning system (GPS), so that future assessments could be made at the same location. The team conferred and documented the upper boundary of the banks to be surveyed, based on evaluation of whether trash could be carried to the water body by wind or water (e.g., an upper terrace in the stream bank). At each site, the team documented the location of the high water line based on site-specific physical indicators, such as a debris line found in the riparian vegetation along the stream channel. If the high water line could not be determined, bank full height was documented in the field sheets, noting that the high water line could not be determined. Trash located below the high water line can be expected to move into the streambed or be swept downstream during the next significant rain event.

Trash Data Collection

The trash assessment protocol involves picking up and tallying all of the trash items found within the defined boundaries of a site. When repeated several times throughout a year, this procedure allows for the assessment of temporal changes in impairment, usage patterns, and trash deposition rates under wet and dry weather conditions. Surveys, including trash collection, note taking, and scoring, typically took one to two hours, depending on how trash-impacted the site was and the number of people on the survey crew. The first time a site was assessed the process generally took longer than on subsequent visits.

There are numerous potential human health hazards, such as puncture hazards and pathogens, that could affect field technicians performing trash assessments. We suggest that other entities using the RTA protocol consult the SWAMP program's health and safety standard operating procedures (SOPs) for general field work and trash assessments (Appendix 1) prior to beginning field work.

All surveys are initiated at the downstream end of the selected reach so that trash is not obscured after disturbing the streambed. Tasks are divided according to the number of team members. For a team with two members, both persons, equipped with gloves and garbage bags, pick up trash. A trash grabber, metal kitchen tongs, or a similar tool can also be used to help pick up trash. One team member begins walking along the bank at the edge of the stream or shore, looking for trash on the bank up to the upper bank boundary, above and below the high water line. This person picks up trash and tallies the items on the trash assessment worksheet as either above or below the high water line. The other person walks along the streambed and up and down the opposite bank, picking up and calling out trash items found in the water body and on the opposite bank, both above and below the high water line, for the tally person to mark down appropriately on the trash assessment sheet. A three-member team has one designated note-taker and two trash collectors.

To make sure that trash items are not missed from the survey, team members look under bushes, logs, and vegetation to see if trash has accumulated underneath. The ground and substrate is closely inspected to ensure that small items such as cigarette butts and pieces of broken glass or Styrofoam are picked up and counted. Special attention was paid to items that can affect human health such as diapers, fecal matter, and medical needles; these items can strongly affect the total score. The person tallying the trash indicates on the worksheet whether the trash was found above the high water line on the bank, or below the high water line either on the bank or in the stream (i.e., tally dots or circles (•) for above high water line, tally lines (|) for below). If it is evident that items have been littered, dumped, or accumulated via downstream transport, notes are made in the designated rows near the bottom of the tally sheet - this helps when assigning scores.

Clumps of leaf litter and yard waste from trash bags should be treated as trash in the water quality assessment, and not confused with natural inputs of leaves to streams. If there is a question in the field, check the type of leaf to confirm that it comes from a nearby riparian tree. In some instances, leaf litter may be trash if it originates from dense ornamental stands of nearby human planted trees that are overloading the stream's assimilative capacity for leaf inputs.

When considering the water quality effects of trash while conducting a trash assessment, remember to evaluate individual items and their buoyancy, degradability, size, potential health hazard, and potential hazards to fish and wildlife. Utilize the narratives in the worksheet, refer to the technical notes and trash parameter descriptions in the text as needed, and select your scores after careful consideration of actual conditions.

Once the team is finished collecting trash, the recorder indicates in the margins of the tally sheet the total number of items in each category found above and below the waterline. All worksheets are completed before leaving the site, while everything is still fresh in the memory. The team discusses each scoring parameter (described below under "Scoring") and agrees on a score for each of the condition categories, The team also discusses and records hypotheses of potential sources of trash, such as neighboring or upstream land uses.

Scoring

The rapid trash assessment includes six condition categories that capture the breadth of issues associated with trash and water quality. The first two parameters focus on qualitative and quantitative levels of trash, the second two parameters estimate actual threat to water quality, and the last two parameters represent how trash enters the water body at a site, either through on-site activities or downstream accumulation.

Within each trash parameter, narrative language is provided to assist with choosing a condition category. The worksheet provides a range of numbers within a given category, allowing for a range of conditions encountered in the field. For instance, trash located in the water results in lower scores than trash above the high water line. Not all specific trash conditions mentioned in the narratives need to be present to fit into a specific condition category (e.g., "site frequently used by people"), nor do the narratives describe all possible conditions. Scores of "0" should be reserved for the most extreme conditions. Once team members assigned the scores for the six categories in the field, the final scores were summed and specific notes about the site included at the end of the sheet. Each site was assessed three or four times in a given year, during different seasons, to characterize the variability and persistence of trash occurrence for water quality assessment purposes.

The scoring categories include:

1. *Level of Trash*. This assessment parameter is intended to reflect a qualitative "first impression" of the site, after observing the entire length of the reach. Sites scoring in the "poor" range are those where trash is one of the first things noticeable about the water body. No trash should be obviously visible at sites that score in the "optimal" range.

2. *Actual Number of Trash Items Found*. Based on the tally of trash along the 100-foot stream reach, total the number of items both above and below the high water line, and choose a score within the appropriate condition category based on the number of tallied items. Where more than 100 items have been tallied, assign the following scores: 5: 101-200 items; 4: 201-300 items; 3: 301-400 items; 2: 401-500 items; 1: 501-600 items; 0: over 600 items. Use similar guidelines to assign scores in other condition categories. Sometimes items are broken into many pieces. Fragments with higher threat to aquatic life such as plastics should be individually counted, while paper and broken glass, with lower threat and/or mobility, should be counted based on the parent item(s). Broken glass that is scattered, with no recognizable original shape, should be counted individually. The judgment of whether to count all fragments or just one item also depends on the potential exposure to downstream fish and wildlife, and waders and swimmers at a given site. Concrete is trash when it is dumped, but not when it is placed. Consider tallying only those items that would be removed in a restoration or cleanup effort.

3. *Threat to Aquatic Life*. As indicated in the technical notes, below, certain characteristics of trash make it more harmful to aquatic life. If trash items are persistent in the environment, buoyant (floatable), and relatively small, they can be transported long distances and be mistaken by wildlife as food items. Larger items can cause entanglement. Some discarded debris may contain toxic substances. All of these factors are considered in the narrative descriptions in this assessment parameter.

4. *Threat to Human Health*. This category is concerned with items that are dangerous to people who wade or swim in the water, and with pollutants that could accumulate in fish in the downstream environment, such as mercury. The worst conditions have the potential for presence of dangerous bacteria or viruses, such as with medical waste, diapers, and human or pet waste.

5. *Illegal Dumping and Littering*. This assessment category relates to direct placement of trash items at a site, with "poor" conditions assigned to sites that

appear to be dumping or littering locations based on adjacent land use practices or site accessibility.

6. *Accumulation of Trash*. Trash that accumulates from upstream locations is distinguished from dumped trash by indications of age and transport. Faded colors, silt marks, trash wrapped around roots, and signs of decay suggest downstream transport, indicating that the local drainage system facilitates conveyance of trash to water bodies.

Quality Assurance

To address concerns about observer bias and differences in interpretation of narrative language, SWAMP and Alameda County stormwater staff performed a methods repeatability study in July 2002. Three teams of two members assessed and scored the same two sites in a blind comparison. A summary of the study is included as Appendix B, Rapid Trash Assessment Method Evaluation.

Results and Discussion

There are two major mechanisms responsible for trash in streams of the San Francisco Bay Region: ***direct littering or dumping***, and ***downstream transport and accumulation***. Littering and dumping were usually documented in dry weather conditions between sampling events, while downstream transport and accumulation of trash occurred extensively at the bottom of watersheds in wet weather conditions between sampling events. Results confirmed that these two phenomena occur at remarkable rates of deposition and levels of trash per 100-feet of stream in every watershed studied. In this section, the sites with the highest dry and wet weather deposition rates are described, sources of trash are identified, and potential management measures are discussed. In addition, two public access sites with high RTA scores and relatively low trash deposition rates are discussed to identify management efforts that appear to be working to keep trash out of the streams.

Regional Conditions

The 93 site visits conducted by Water Board staff and students over three years and multiple seasons confirmed that high levels of trash are present throughout urban streams in the San Francisco Bay Region. On average, across all sites and seasons, 288 pieces of trash were collected per 100 foot reach of stream, equaling 2.88 pieces per linear foot of stream (Figure 2). Over 50% of this total, or 1.56 pieces per linear foot of stream, was composed of plastic items. Glass (19%) and biodegradable items (10%) were also commonly found. Most sites contained less than 500 pieces of trash, while several sites contained many more pieces, up to a maximum of 1133 pieces, or 11.33 pieces per linear foot of stream (Figure 3). Overall, 72% of all trash items were found below the high-water line, while 28% of items were found above the high-water line. Certain types of items were found almost exclusively below the high-water line, including toxic items (87%), construction debris (87%), and glass (82%). Forty-two percent of biodegradable items were found above the high water line, indicative of the frequency with which paper is transported by wind into stream channels. The average total Rapid Trash Assessment (RTA) score was 47, with a range from 8 to 112 (out of a possible 120) (Figure 4). Lower RTA scores reflect higher levels of trash. A high RTA score, overall or in a specific category, represents more desirable, less trashed conditions. Total RTA scores were strongly related to the number of plastic pieces found at sites (Figure 5).

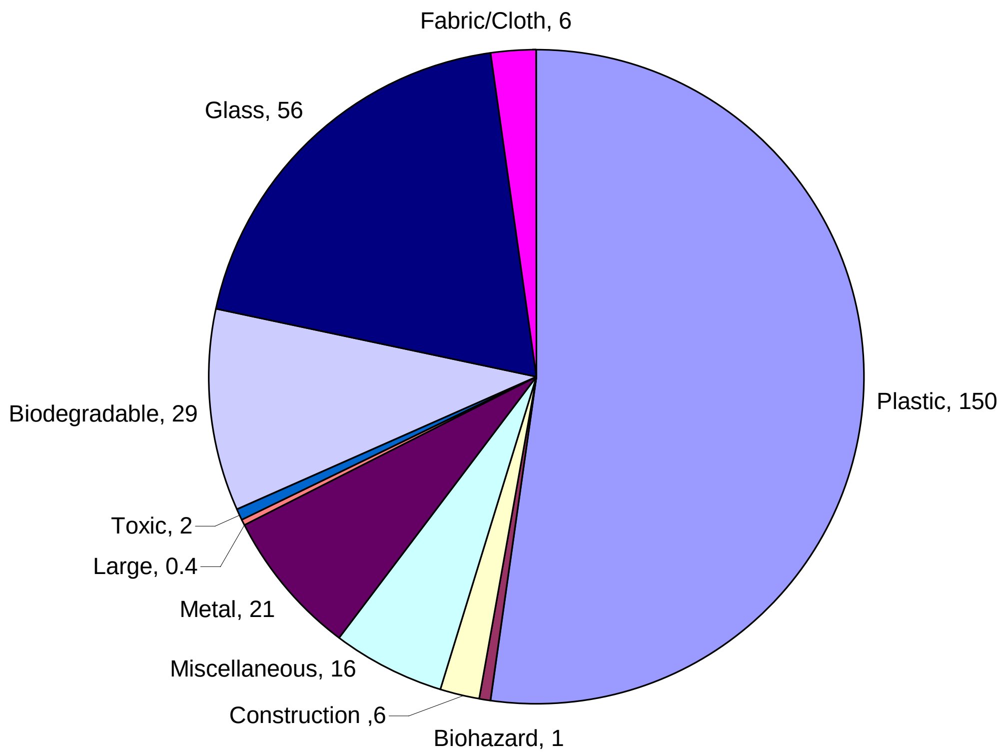

Figure 2: Average number of pieces of trash, by category, per 100 foot reach for all sites and all seasons.

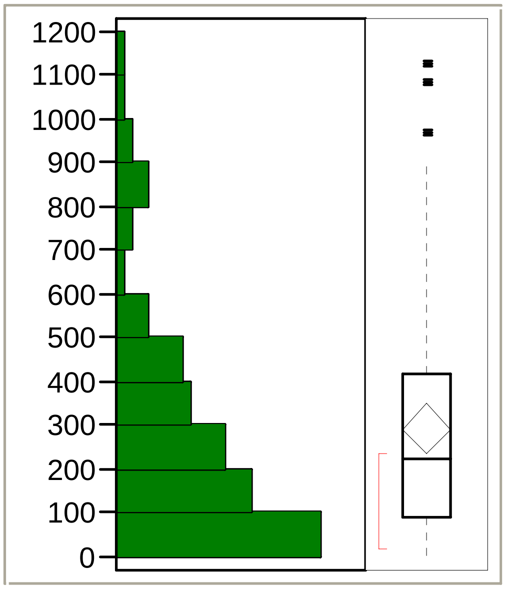

Figure 3: Frequency histogram of the number of pieces of trash found per 100 foot reach (site). A total of 93 site visits were conducted. The diamond indicates the mean and the standard error about the mean. The box indicates the median and the 25th and 75th percentiles, while the whiskers indicate the 5th and 95th percentiles.

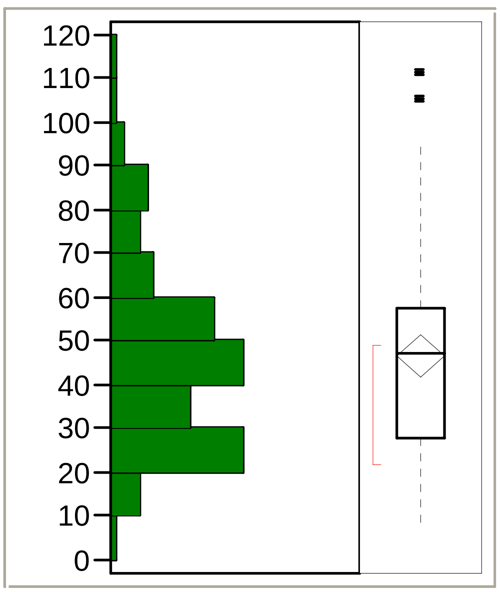

Figure 4: Frequency histogram of total RTA trash scores for each site visit. A total of 93 site visits were conducted. Symbols are the same as in Figure 3.

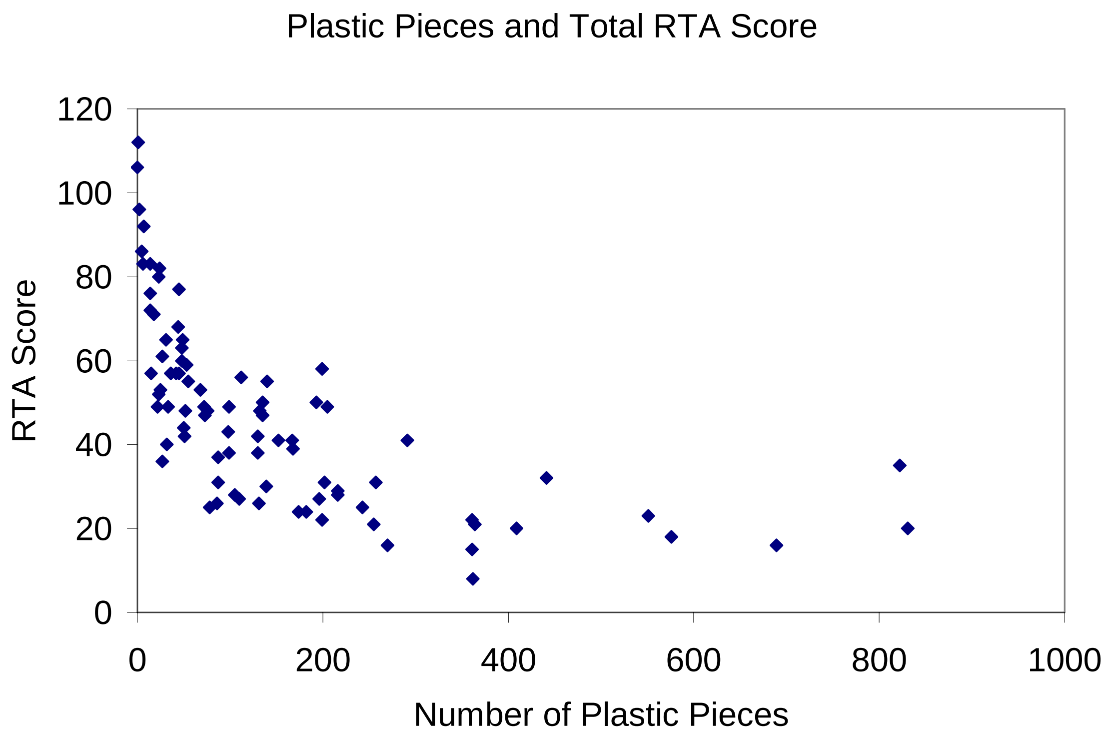

Figure 5: Total RTA score relative to the total number of plastic pieces collected.

The 26 sites surveyed did not include the worst-case conditions of trash in the region (e.g. Figure 6), where obstructions can cause buildup of floating trash in wet weather conditions. The most trash pieces per 100 feet of stream documented in this report was 1,133 pieces at Baxter Creek at Booker Park in Richmond. For comparison, trash stored behind obstructions may exceed 10,000 pieces per 100 feet (Figure 6). Other problem sites not surveyed include homeless encampments, although some of the sites were downstream of such major sources of trash.

There were significant differences in amounts and types of trash found at sites located at the bottom of watersheds and sites located in parks with high public access. Bottom-of-the-watershed (BOTW) sites (Table 2) received very low upstream accumulation scores (average score 3.3) relative to sites located higher in the watershed (average score 8.5). Conversely, littering was more important at sites with high public access (average score 3.9) than at sites without high public access (average score 5.4). Many more pieces of plastic were found below the high water line at BOTW sites (average 192) than at non-BOTW sites (average 52). Glass, however, was much more common at public access sites (average 92) than at non-public access sites (average 14). Overall, BOTW sites tended to most adversely affected by trash, in terms of highest total number of pieces (average 398) and lowest total RTA scores (average 35).

Condition category scores within the total RTA score reflected differences in trash deposition between both (1) wet and dry seasons and (2) BOTW and sites further upstream. Bottom of the watershed (BOTW) sites generally scored lower than sites further upstream in the watershed in nearly all trash condition category scores, with the exception of dumping and littering (Figure 7). Qualitative scores were much lower at BOTW sites than upstream sites, indicating the "first impression" of BOTW sites is consistently more negative with respect to trash.

Accumulation scores were also much lower at BOTW sites than upstream sites, but wet season scores are much lower for both site locations than dry season scores, reflecting the seasonality of trash accumulation. At BOTW sites, the dry season scores for accumulation were markedly lower than the wet season accumulation scores for upstream sites, shown at the far right of Figure 7. As noted above, at BOTW sites the trash is dominated by plastics. Plastics continue to be delivered to the bottom of watersheds and into the San Francisco Bay during the dry season. Trash can be delivered to streams, the topographic low points in watersheds, by wind and dry season urban runoff (e.g., over-irrigation), and these data suggest it is a significant source. Trash control efforts in the Los Angeles region associated with TMDL implementation tend to focus on runoff events to capture the largest volume of trash, but the observations documented in this report show that dry season delivery of trash is likely significant.

Figure 6: Photo of the trash buildup behind a fallen tree immediately downstream of the Julian Street bridge, Coyote Creek, San Jose, CA, January 27, 2004. Photo by Friends of Coyote Creek.

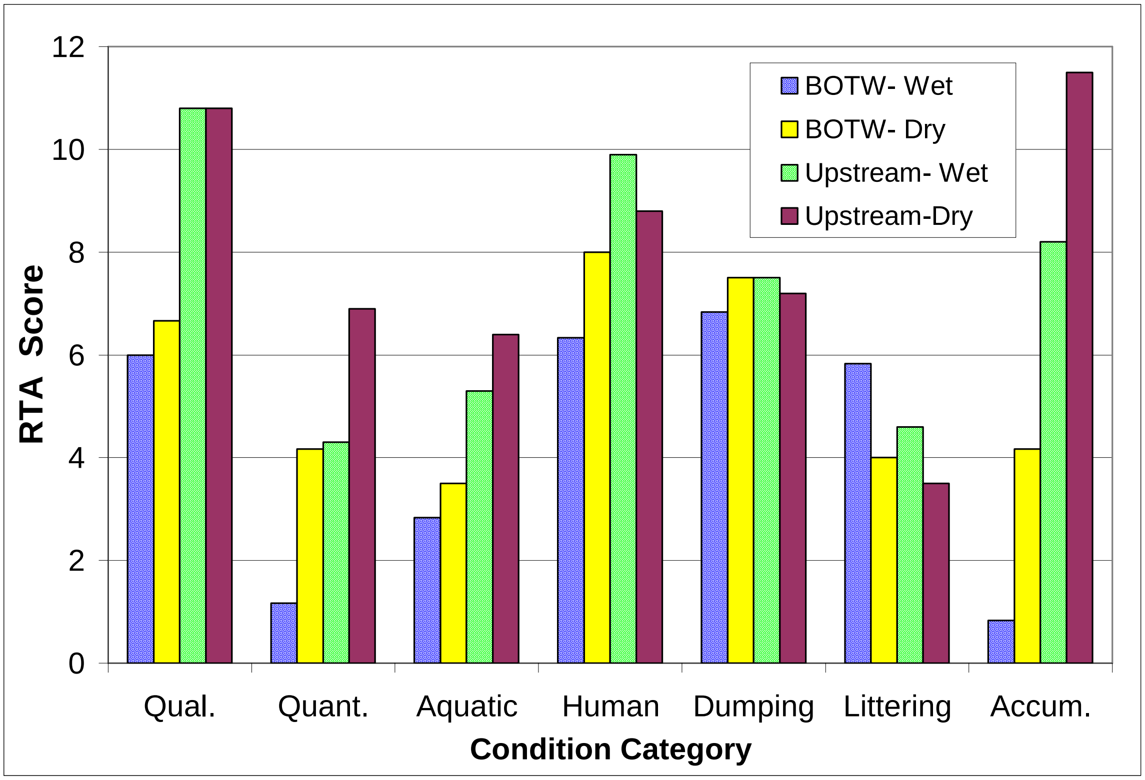

Figure 7: Average condition category scores from a subset of sites that were sampled during revisits that bracketed both and wet and dry seasons. Data are presented for both wet and dry season surveys from 6 BOTW sites and 10 upstream sites. Maximum RTA scores for all condition categories is 20, except littering and dumping which is 10.

Trash Deposition Rates

The monitoring design provided the opportunity to estimate trash deposition rates because trash was removed from 100-foot survey reaches during the initial site visit. Trash collected in the landmarked reach during subsequent surveys was assumed to have been deposited since the previous survey. Excluding initial site visits, the were a total of 67 site revisits (2-4 per site). A rate of deposition (pieces per reach per day) was calculated for all sites for wet and dry weather conditions, and ranked from highest to lowest (Table 1). Overall, the average trash deposition rate was 2.16 pieces of trash per 100-foot reach per day. Sites with high and low deposition rates are discussed in more detail below.

Wet Season Deposition

Very high trash deposition rates were generally associated with wet weather (Table 1), particularly at BOTW sites (listed in Table 2). Following the wet season, BOTW sites had a higher number of plastic pieces, indicating that this type of trash is more transportable in runoff events. The average number of plastic pieces found below the water line at BOTW sites, in all weather conditions, was 192 pieces per 100 feet. The average number of plastic pieces found below the water line at non-BOTW sites was 57 pieces per 100 feet. Deposition rates also reflect the importance of upstream accumulation versus littering and dumping. The highest deposition rates tended to occur at sites that received low accumulation scores, indicating that most trash was deposited at these sites via accumulation from upstream transport (Figure 8). Based on condition category scores, littering and dumping was believed to be the dominant process resulting in trash deposition at only a few sites during the wet season.

Dry Season Deposition

Deposition rates were usually lower in the dry season than the wet season, generally below 1 piece of trash per day (Table 1, Figure 8). Several sites on small urban creeks in or near public parks, however, had some of the highest measured deposition rates in this study during the dry season (Figure 9). The high dry season deposition in these streams is most often associated with localized littering and dumping during the summer months (July-August), although some sites also receive some trash from upstream accumulation during this time period. Management priorities at these sites should focus on encouraging the proper disposal of trash in and around the stream.

TABLE 1

SAN FRANCISCO BAY REGION TRASH ASSESSMENT STUDY
SITES RANKED BY TRASH DEPOSITION RATE

Date	Rank	Location	Creek	City	Season (dry, wet)	Days between surveys	Trash Deposition Rate (pieces/100 ft.-day)
8/23/2005	1	Booker T. Anderson Park	Baxter Cr.	Richmond	d	76	8.66
11/19/2004	2	Booker T. Anderson Park	Baxter Cr.	Richmond	w	130	7.47
12/10/2004	3	Oak Glen Park	Glen Echo Cr.	Oakland	w	100	7.17
8/23/2005	4	Baxter Cr. below San Pablo Av.	Baxter Cr.	Richmond	d	76	6.36
12/10/2004	5	Strawberry Creek Park	Strawberry Cr.	Berkeley	w	114	5.61
11/7/2003	6	Washington @ McDowell	Washington Cr.	Petaluma	d	108	5.19
2/6/2004	7	Schollenberger Park	Petaluma R.	Petaluma	w	91	5.14
11/5/2004	8	Albany Hill/Creekside Park	Cerrito Cr.	El Cerrito	d	116	5.03
8/23/2005	9	Lower Sausal Cr.	Sausal Cr.	Oakland	d	67	4.96
6/10/2005	10	Oak Glen Park	Glen Echo Cr.	Oakland	w	182	4.53
2/20/2004	11	Buchanan Park	Kirker Cr.	Pittsburg	w	210	4.30
1/27/2004	12	Washington @ McDowell	Washington Cr.	Petaluma	w	81	4.17
2/20/2004	13	Dow Wetlands	Kirker Cr.	Pittsburg	w	210	4.17
7/12/2004	14	Albany Hill/Creekside Park	Cerrito Cr.	El Cerrito	d	108	4.11
2/13/2004	15	Gateway Park	San Mateo Cr.	San Mateo	w	116	4.10
12/3/2004	16	Lower Sausal Cr.	Sausal Cr.	Oakland	w	109	3.83
7/12/2004	17	Lower Codornices Cr.	Codornices Cr.	Albany	d	122	3.40
6/8/2005	18	Booker T. Anderson Park	Baxter Cr.	Richmond	w	201	2.92
11/7/2003	19	Schollenberger Park	Petaluma R.	Petaluma	d	108	2.90
7/12/2004	20	Booker T. Anderson Park	Baxter Cr.	Richmond	d	115	2.77
7/25/2003	21	Buchanan Park	Kirker Cr.	Pittsburg	d	128	2.71
3/12/2004	22	Lower Codornices Cr.	Codornices Cr.	Albany	w	300	2.70
11/5/2004	23	Lower Codornices Cr.	Codornices Cr.	Albany	d	116	2.47
12/10/2004	24	Lower Glen Echo Cr.	Glen Echo Cr.	Oakland	w	100	2.41
8/23/2005	25	Oak Glen Park	Glen Echo Cr.	Oakland	d	74	2.01
1/27/2004	26	Petaluma Factory Outlets	Petaluma R.	Petaluma	w	81	1.96
3/14/2004	27	Lower Permanente Cr.	Permanente Cr.	Mountain View	w	135	1.85
7/22/2003	28	Washington @ McDowell	Washington Cr.	Petaluma	d	124	1.85
8/23/2005	29	Canyon Trail Park	Baxter Cr.	El Cerrito	d	76	1.68
7/29/2003	30	Lower Permanente Cr.	Permanente Cr.	Mountain View	d	124	1.68
2/13/2004	31	Lower Polhemus Cr.	Polhemus Cr.	San Mateo	w	116	1.58
6/8/2005	32	Baxter Cr. below San Pablo Av.	Baxter Cr.	Richmond	w	208	1.52
6/10/2005	33	Lower Glen Echo Cr.	Glen Echo Cr.	Oakland	w	182	1.43
6/17/2005	34	Lower Sausal Cr.	Sausal Cr.	Oakland	w	196	1.42
7/29/2003	35	Moss Rock	Stevens Cr.	Cupertino	d	124	1.38
8/23/2005	36	Lower Glen Echo Cr.	Glen Echo Cr.	Oakland	d	74	1.30
10/31/2003	37	Lower Permanente Cr.	Permanente Cr.	Mountain View	d	94	1.14
2/13/2004	38	Arroyo Court Park	San Mateo Cr.	San Mateo	w	116	1.11
6/8/2005	39	Canyon Trail Park	Baxter Cr.	El Cerrito	w	208	1.11
7/22/2003	40	Schollenberger Park	Petaluma R.	Petaluma	d	124	1.07
10/31/2003	41	Moss Rock	Stevens Cr.	Cupertino	d	94	1.03
8/20/2004	42	Madeiros Pkwy. @ Stanley	Arroyo Mocho	Livermore	d	119	0.99
10/20/2003	43	Gateway Park	San Mateo Cr.	San Mateo	d	89	0.94
3/14/2004	44	Moss Rock	Stevens Cr.	Cupertino	w	135	0.93
10/7/2004	45	Gateway Park	San Mateo Cr.	San Mateo	w	237	0.86
11/7/2003	46	Petaluma Factory Outlets	Petaluma R.	Petaluma	d	108	0.85
8/23/2005	47	Dimond Park	Sausal Cr.	Oakland	d	67	0.84
7/23/2003	48	Gateway Park	San Mateo Cr.	San Mateo	d	124	0.79
12/3/2004	49	Dimond Park	Sausal Cr.	Oakland	w	109	0.72
8/18/2004	50	Strawberry Creek Park	Strawberry Cr.	Berkeley	d	159	0.70
1/27/2004	51	Penngrove Park	Lichau Cr.	Petaluma	w	81	0.64
2/13/2004	52	Upper San Mateo Cr.	San Mateo Cr.	San Mateo	w	116	0.53
6/10/2005	53	Madeiros Pkwy. @ Stanley	Arroyo Mocho	Livermore	w	294	0.53
7/23/2003	54	Arroyo Court Park	San Mateo Cr.	San Mateo	d	124	0.51
7/23/2003	55	Lower Polhemus Cr.	Polhemus Cr.	San Mateo	d	124	0.51
7/25/2003	56	Dow Wetlands	Kirker Cr.	Pittsburg	d	128	0.45
11/7/2003	57	Penngrove Park	Lichau Cr.	Petaluma	d	108	0.37
10/20/2003	58	Arroyo Court Park	San Mateo Cr.	San Mateo	d	89	0.31
10/20/2003	59	Upper San Mateo Cr.	San Mateo Cr.	San Mateo	d	89	0.29
7/23/2003	60	Upper San Mateo Cr.	San Mateo Cr.	San Mateo	d	124	0.25
6/17/2005	61	Dimond Park	Sausal Cr.	Oakland	w	196	0.17
7/22/2003	62	Penngrove Park	Lichau Cr.	Petaluma	d	124	0.15
7/22/2003	63	Petaluma Factory Outlets	Petaluma R.	Petaluma	d	124	0.14
10/20/2003	64	Lower Polhemus Cr.	Polhemus Cr.	San Mateo	d	89	0.13
8/23/2005	65	Joaquin Miller Park	Palo Seco Cr.	Oakland	d	67	0.04
12/3/2004	66	Joaquin Miller Park	Palo Seco Cr.	Oakland	d	109	0.04
6/17/2005	67	Joaquin Miller Park	Palo Seco Cr.	Oakland	w	196	0.03

TABLE 2

**BOTTOM OF THE WATERSHED (BOTW)
TRASH MEASUREMENT LOCATIONS**

Location	Water Body	City
Booker T. Anderson Park	Baxter Cr.	Richmond
Albany Hill/Creekside Park	Cerrito Cr.	El Cerrito
Lower Codornices Cr.	Codornices Cr.	Albany
Strawberry Creek Park	Strawberry Cr.	Berkeley
Lower Glen Echo Cr.	Glen Echo Cr.	Oakland
Lower Sausal Cr.	Sausal Cr.	Oakland
Cesar Chavez Park	Peralta Cr.	Oakland
Arroyo Viejo Rec. Center	Arroyo Viejo	Oakland
Schollenberger Park	Petaluma R.	Petaluma
Dow Wetlands	Kirker Cr.	Pittsburg
Madeiros Pkwy. @ Stanley	Arroyo Mocho	Livermore
Gateway Park	San Mateo Cr.	San Mateo
Lower Permanente Cr.	Permanente Cr.	Mountain View

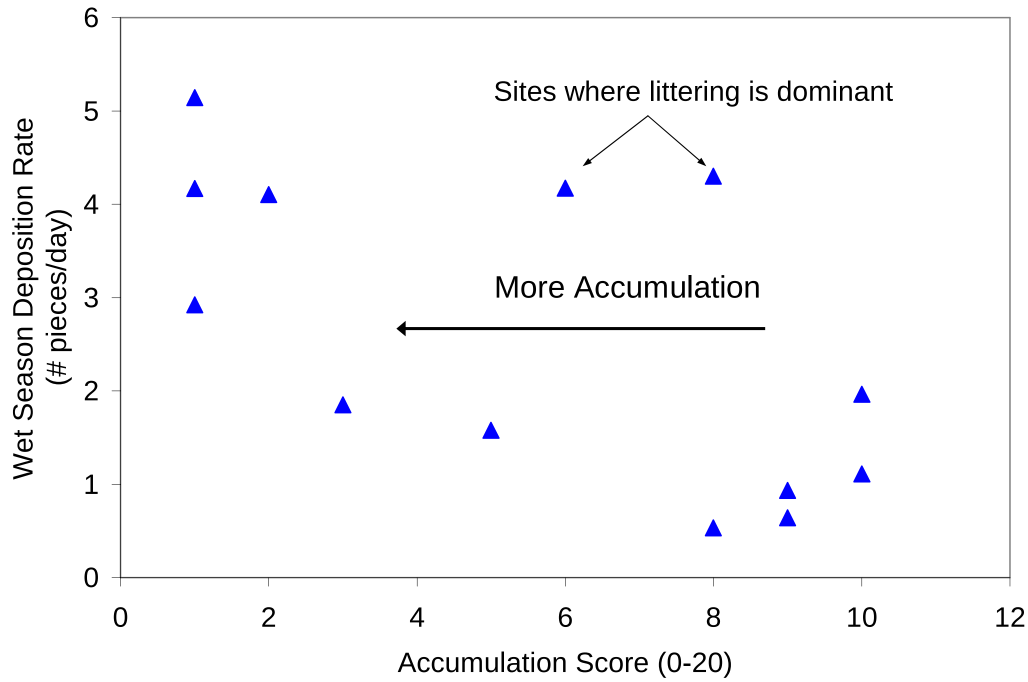

Figure 8: Wet-season trash deposition rates relative to the RTA accumulation score. As the accumulation score decreases (more accumulation) the deposition rates are higher, except at several sites where littering is responsible for high deposition rates during the wet season.

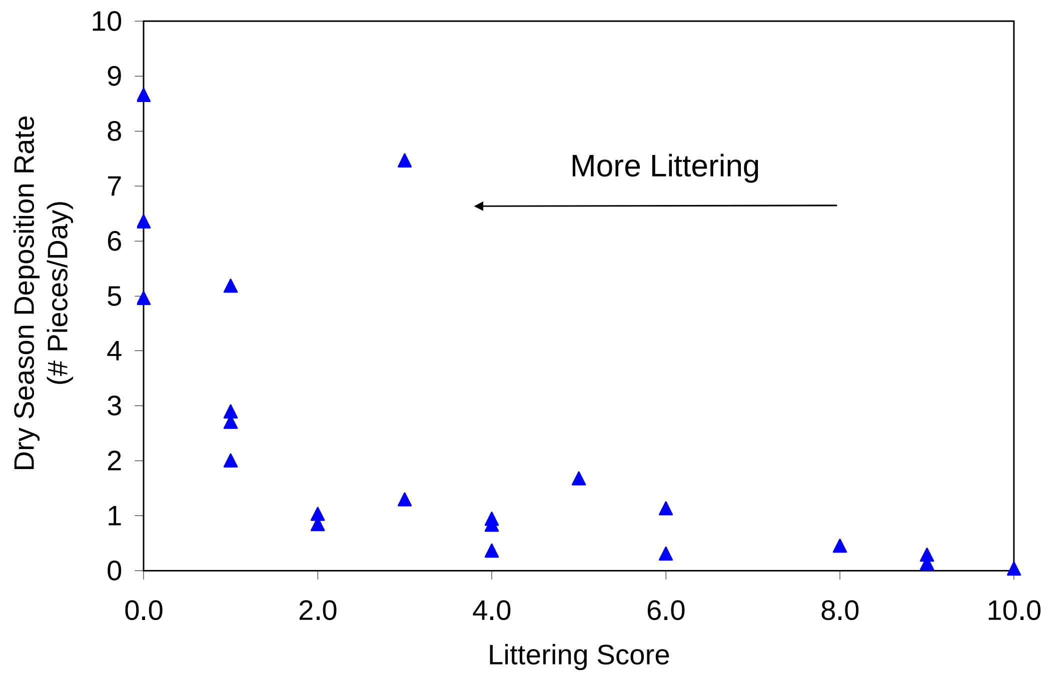

Figure 9: Dry season trash deposition rates relative to the RTA littering score. As the littering score decreases (more littering) the deposition rates are higher.

Case Studies- High Trash Deposition Rates

1. Booker T. Anderson Park, Baxter Creek

The two highest trash deposition rates recorded in the study occurred at the BOTW site of the Baxter Creek watershed in Richmond and El Cerrito. The initial site survey, prior to trash pickup, yielded the most pieces of trash per 100 feet of any survey conducted (1,133). This site absorbs the impact of trash delivered from upstream during storm events, but there is much evidence of local littering and dumping as well, which combine to result the highest rates of deposition recorded in the regional study.

The site is surrounded by residential areas. A stream restoration project several years ago removed concrete channel and planted riparian vegetation that is now well established (though at most 20’ in width). There was evidence of park use during each survey, particularly on the east bank where there is grass, a playground, and a ball field. At the upstream end of the park is a culvert and a large pool. Many dumped items were observed in this pool, but it is not located within the 100-foot survey reach. The pool is at the edge of the park, along a road, with easy dumping access for vehicular traffic. Some of the dumped items were carried downstream, such as mattresses that were observed in the stream at the lower end of the park. Littering is prevalent here also, though trash cans and a dumpster are present. On the west side of the creek is a recreation center and a large parking lot. A street sweeper was observed cleaning the parking lot. The recreation center has a dumpster at the curb which probably prevents some large items from being dumped into the creek.

The highest trash deposition rate measured in this study occurred at this site during the dry summer months. Following site cleanup on June 8, 2005, 658 pieces of trash were collected on August 23, yielding a trash accumulation rate of 8.66 pieces of trash per day. Much of this trash was believed to have been directly littered (littering score = 0) in the stream at Booker T. Anderson Park. There was also evidence, however, of significant levels of trash coming from upstream sources (accumulation score = 2), even during summer baseflow conditions.

The second highest deposition rate (7.47 pieces/day) was recorded during the survey of November 19, 2004, soon after the first significant rain event of the season. Despite the trash removal associated with the first survey, the site received a lower RTA score during the November survey than the initial site visit. There were 543 plastic pieces of trash located below the high water line, and 33 above. The combination of significant downstream transport, with notable littering and dumping, makes the Booker T. Anderson site particularly unique.

Potential Management Measures

Trash is managed at this park, but the management activities are not successfully preventing littering or dumping. Many park patrons simply ignore the trash receptacles that have been made available. A major change in the behavior of park patrons and illegal dumpers is needed to improve the trash issue in Baxter Creek. Downstream transport is also a significant problem at Booker T. Anderson Park, however, so trash management practices need to address the entire watershed. The next site upstream, where the creek runs under San Pablo Avenue, received a lower RTA score on November 12, 2004 than this site, due to extensive littering of food wrappers from nearby fast-food restaurants. The San Pablo Avenue site also had the fourth highest deposition rate measured in this study; 6.36 pieces per day were deposited during the summer dry season. The Baxter Creek watershed appears to be a significant source of floatable trash to the Bay, and warrants special attention. A progressive program of education, warnings, and penalties may be needed in order to achieve behavioral change. Given the ubiquitous nature of trash in this watershed, structural trash removal alternatives should be evaluated as well.

Figure 10: View looking upstream from Booker T. Anderson Park trash survey site (BAX030), showing dumped mattress and low fence above culvert at street crossing, upstream of park. Photo by Steve Moore, August 23, 2005.

2. Dow Wetlands, Kirker Creek

The lower portion of Kirker Creek flows in a realigned channel between the Dow Wetlands, a large, restored wetland on the edge of Suisun Bay, and the Dow Chemical industrial facility. The Dow Wetlands is commonly used by bird watchers, hikers, dog walkers, and school groups. Although a dirt road follows the creek along much of its length, the road is not open to public vehicular traffic.

Wet season deposition rates were extremely high (4.3 pieces/day), but dry season deposition was among the lowest recorded for BOTW sites (0.45 pieces/day). After the initial trash collection effort, only 58 pieces of trash were deposited during the summer dry season. Even during the dry season, accumulation from upstream sources was judged to be the dominant source of trash, rather than local littering and dumping. During the subsequent wet season, 887 pieces of trash were deposited, all of which was judged to come from upstream sources. In both summer and winter, over 90% of the deposited trash was plastic pieces. Plastic pieces are buoyant, and are easily transported long distances. They accumulate at sites such as this one in low gradient channels near the mouths of watersheds.

Potential Management Measures

Although this site is open to public access, little or none of the trash at the site appears to come from littering. Dumping is not possible at this site because vehicular access is limited. Virtually all of the trash deposited at this site is plastic pieces that are efficiently transported from the streets of Pittsburg into the storm drain system. Management actions must focus on this conveyance system in order to remove trash before it enters the stream network.

3. Washington and McDowell, Washington Creek (Petaluma River)

The highest dry season trash deposition rate recorded in this study occurred at Washington Creek, at the corner of Washington and McDowell in the City of Petaluma. This is a very heavy vehicle traffic area, with an off-ramp from Highway 101, a busy intersection, a gas station, and a mall next to the creek at this station.

A concrete channel encloses the stream, with the top of the ~ 15' tall southeast wall bordering the sidewalk adjacent to Washington Street. On the opposite bank is a plaza-style shopping mall. Dumpsters are located about 100 feet from the creek, with no enclosure. Directly north of the site, near the intersection, is a gasoline station. One dumpster is located behind the gas station in a concrete block enclosure with a semi-solid gate. A chain link fence separates the creek corridor from the gas station trash enclosure and the mall. The creek is accessible by climbing over the chain link fence (about 4' high). At the upstream edge of the site the stream flows through a large culvert under a gas station and McDowell Avenue.

The dominant trash at this location was plastic wrappers, cigarette butts, paper, and aluminum foil or cans. An overflowing dumpster at the gas station and wind blown trash from the shopping center parking lot likely contributed most of the plastics and paper, much of which was above the high water line. During the summer survey, 59% of the pieces found above high water line were plastics. 62 of 92 plastic pieces found above the high water line were plastic wrappers. 46 of 157 (29%) pieces above the high water line were paper pieces. 130 of 233 (56%) total pieces were plastic in origin. The winter survey was dominated by plastic (291 of 338 pieces).

Potential Management Measures

The overflowing dumpsters and trash blowing off the large shopping mall parking lot combine to create a continuous loading of trash to this site. The implied message to the public, due to the perpetually polluted condition, is that it is okay to dispose of solid waste into the creek. Unless nearby businesses improve their trash management, high rates of trash loading will continue. The public needs to be better educated about the harmful effects of disposing trash near water bodies. Education efforts should be followed up by regulation and enforcement.

4. Moss Rock, Stevens Creek

The Moss Rock site (STE100) is located at a roadside pullout in the steep and narrow Stevens Creek Canyon near Stevens Creek County Park. There is minimal upstream human land use, and no adjacent houses or urban land use.

Trash levels were fairly high (290 pieces) at the initial site visit in March, 2003. The vast majority of the trash pieces collected was littered beverage containers, including many broken glass bottles. Also collected in the stream were several hypodermic needles. Trash levels were lower during 3 subsequent visits (97-171 pieces), suggesting that some of the trash picked up during the initial visit was old, relict trash. Trash deposition rates were moderately high throughout the year (0.93-1.38 pieces/day), however, and littering scores and overall scores were consistently low. Based on the types of trash collected, the site is likely commonly used throughout the year as a recreation spot. Most of the trash was related to alcoholic beverages or snack food.

Potential Management Measures

This site is believed to be located on private property just outside of the County Park boundary, although there are no signs indicating if it is public or private property. Thus, many visitors to this site may unknowingly be trespassing. There are no trash receptacles at or near this pullout. There was evidence, however, that visitors deposited trash in a pile at a location near a fence separating the pullout from the creek, where a trash can was expected to be located. This site is used both for water recreation and picnicking, but the human health hazard posed by broken glass bottles and needles makes these two uses virtually incompatible. Installing and maintaining trash receptacles would encourage visitors to properly dispose of trash, making the site, as well as downstream sites in the County Park, safer for water contact recreation.

Case Studies – Low Trash Deposition Rates

1. Dimond Park, Sausal Creek

The assessment site is directly adjacent to the Dimond Park Recreation Center and Swimming Pool. The recreation center is frequently full of children using the jungle gym play area just upstream of the survey reach. There are many trash cans at the recreation center. Maintenance workers have been observed picking up trash on the grass lawn, near the creek. Friends of Sausal Creek are an active volunteer group that picked up trash at this site in May 2005, shortly before our June 2005 trash survey. Most of the trash found in the June 2005 survey was located in the vegetation on the bank opposite the recreation center, and not in the stream itself. Although most of the trash found at this site comes from littering, management efforts appear to be adequate at keeping high levels of trash from entering the creek. The combined efforts of the recreation center staff, who actively manage trash on the recreation center property, and Friends of Sausal Creek, keep trash levels here lower than at sites in other public park settings. Although there is urban residential land use in the upstream watershed, very low levels of trash accumulate at this site from upstream sources.

2. Joaquin Miller Park, Palo Seco Creek (Sausal Creek)

Juaquin Miller Park is located near the top of the Sausal Creek watershed, upstream of Highway 13. While there is public access to the park, the trailhead is not well-marked. There are two trash cans and plastic bags available for dog waste at the small three-car parking area at the trailhead. This site may have less public use than many parks, which may explain the remarkably low levels of trash in the stream. Still, there is some evidence of littering, probably related to the use of the site by dog walkers and hikers. On one occasion, pet waste was found near the stream.

Figure 11: View of trash survey site on Palo Seco Creek in Joaquin Miller Park, Oakland, CA, showing no trash during dry season survey. Some dog waste was in the creek bed, lowering the RTA score from optimal due to the threat to human health. Photo by Steve Moore, August 23, 2005.

Longitudinal Trends Within Watersheds

To assess how trash levels varied along a longitudinal gradient (i.e., headwaters to mouth) in watersheds, multiple sites were monitored in four watersheds: San Mateo Creek, Petaluma River, Baxter Creek, and Sausal Creek. Overall, trash levels generally increased (and RTA scores decreased) in a downstream direction.

Because trash is removed during the assessments, we would expect RTA scores to increase and trash levels to decrease over successive sampling events. RTA scores tended to improve on subsequent visits at the upstream sites during the dry season, but conditions often worsened following the wet season, due to reintroduction of high levels of trash. BOTW sites exhibited less improvement following cleanup attempts, indicating very high levels of trash deposition throughout the year, though more significant during wet weather. In many cases, even after several assessments had been performed, trash levels returned to pre-assessment conditions following the winter season. These results suggest that picking up trash in streams is not an effective management approach in systems that receive high trash inputs. This also suggests that trash levels may be partly governed by the capture efficiency of channels; once the channel has reached its trash storage capacity, excess trash may be transported downstream.

1. San Mateo Creek Watershed

The San Mateo Creek watershed is a relatively narrow, urbanized watershed, with two main tributaries in the hillside portion of the city (Figure 1). Polhemus Creek drains a residential area, while upper San Mateo Creek runs along a roadway downstream of Crystal Springs Dam and minimal urban land use. Two sites were monitored in the urbanized bayshore plain (Arroyo Court Park (SMA060) and the BOTW site Gateway Park (SMA020)), and two sites were monitored upstream of the confluence of the two main tributaries.

The Gateway Park site, though not initially having the highest trash levels, had higher deposition rates of trash in subsequent surveys and hence lower RTA scores (Figure 12). Located 2 miles upstream of the Gateway Park site, the Arroyo Court Park site improved slightly following trash cleanup events, but winter flows delivered high levels of trash that lowered RTA scores. Dry season RTA scores were lower at the Gateway and Arroyo Court Park sites, due to direct littering into the stream at these publicly accessible sites. The Polhemus Creek (SMA110) site had the lowest initial score, but following cleanup it had the highest score in the watershed. Winter flows brought large levels of trash from the upstream residential area, however, significantly lowering the RTA score. The upper San Mateo creek site (SMA120) saw less return of trash with wet weather, due to less upstream sources.

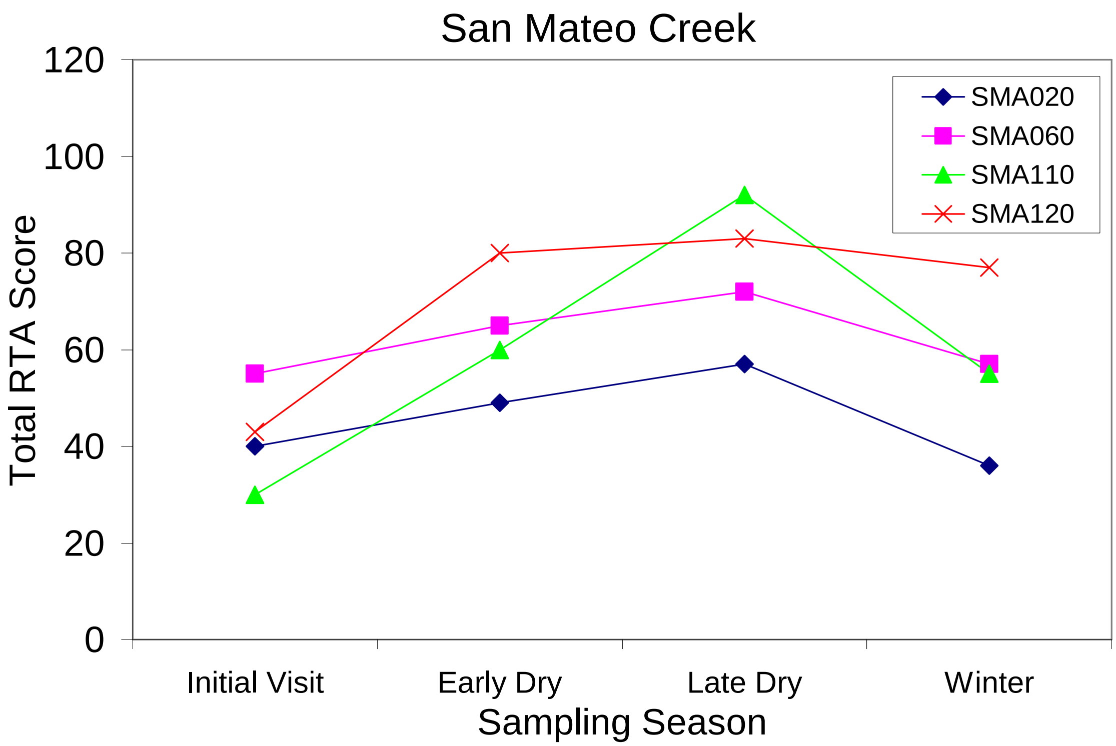

Figure 12: RTA Scores at four sampling sites in the San Mateo Creek watershed along a longitudinal gradient.

2. Petaluma River Watershed

The Petaluma River watershed is a broad, low gradient watershed with many small tributary creeks that flow into a large tidal slough, the Petaluma River (Figure 1). The land use is mixed urban, rural residential, and rangeland. The BOTW site is Schollenberger Park (PET100), located along a tidal shoreline downstream of the confluence of Petaluma River and Adobe Creek, and downstream of the City of Petaluma. The Petaluma Factory Outlets site (PET310) is the most downstream freshwater site on the Petaluma River. Sites located on small tributaries include Washington Creek (PET220) and Lichau Creek at Penngrove Park (PET400).

The Penngrove Park site had relatively low levels trash deposition in both dry and wet seasons, compared to other sites in the watershed. Trash at this site was predominantly legacy trash, as more trash was picked up during the first survey (45 pieces) than during the subsequent three surveys combined (38 pieces). The Factory Outlets site, which is publicly accessible but seldom visited, had low dry season deposition and very high wet season deposition during the winter.

The Washington Creek site, discussed above under Trash Deposition Rates, experienced high levels of trash inputs during the dry season. Although some trash accumulated from upstream sources during the wet season, overall this site appears to be a net source of trash to downstream waters. The adjacent shopping plaza, large paved parking lot, and gasoline station with overflowing dumpster contributed high levels of litter to the stream and represents a trash source area that should be targeted in watershed-wide trash reduction efforts. During site surveys, wind was observed carrying plastic trash over a 4-foot cyclone fence separating the commercial land uses from the stream corridor.

A similar pattern was seen at the BOTW site in the tidal Petaluma River – indicative of both littering and accumulation in an area characterized by bi-directional flows and deposition on higher tides. The BOTW site in this watershed was unique due to the tidal characteristics and high dry season deposition rates. Management of trash at Schollenberger Park could be improved: trash receptacles are not located in a convenient place for use by the park visitors (trash cans are only located at the parking lot, not at the beach), and there is no evidence that the responsible jurisdiction is cleaning trash from the beach.

The Petaluma River watershed sites had lower scores at the end of the survey, following extensive cleanup, than the initial scores (Figure 13), suggesting that trash deposition is pervasive and watershed-wide management efforts are needed.

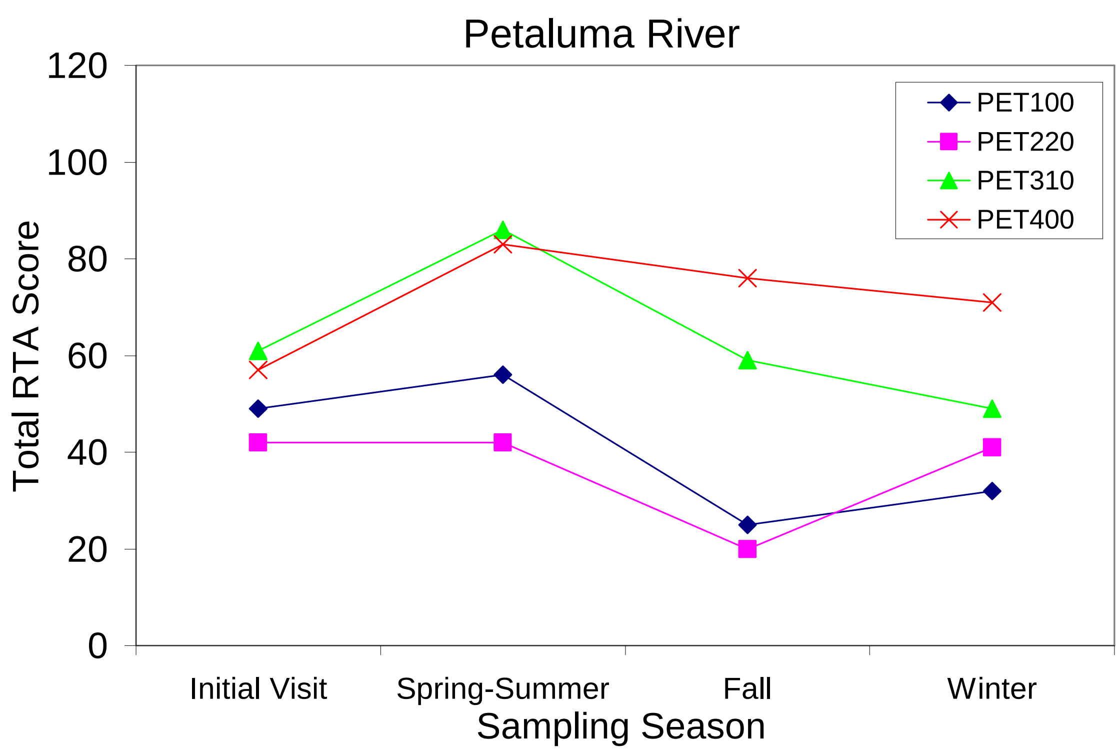

Figure 13: RTA Scores at four sampling sites in the Petaluma River watershed along a longitudinal gradient. PET100 is the lowest site, PET310 is upstream on the main branch, and PET220 and PET400 are the tributary sites. PET220 tributary (Washington Cr.) enters the main branch downstream of PET310. Except for PET400, the final scores are below the initial scores, indicating that trash levels may be getting worse in this watershed.

3. Baxter Creek Watershed

The Baxter Creek watershed is a small watershed with its headwaters in the hills of El Cerrito. It drains to San Francisco Bay through the City of Richmond, in a densely urbanized area (Figure 1).

The downstream site, at Booker T. Anderson Park (BAX030), exhibits extremely high trash inputs in both the dry and wet seasons. The consistently low RTA scores indicate a constant, high level of trash regardless of trash removal efforts and season (Figure 14). Similar problems were documented at the upstream site (BAX040), but there was less wet season deposition than at Booker T. Anderson Park. The site at Canyon Trail Park in the El Cerrito hills (BAX080) had higher RTA scores in both the dry and wet seasons, but the low to moderate scores (50-62) indicate that this site also experiences significant wet-weather and dry-weather trash deposition.

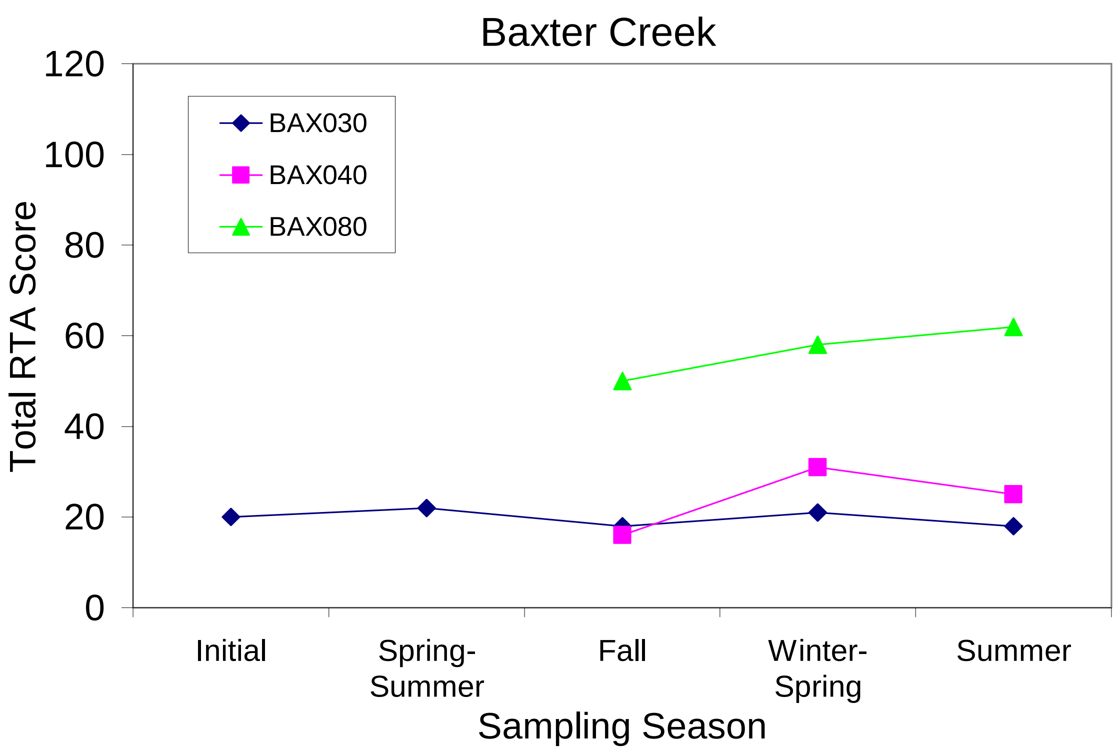

Figure 14: RTA Scores at three sampling sites in the Baxter Creek watershed along a longitudinal gradient. BAX030 is the downstream site, BAX040 is upstream at San Pablo Avenue, and BAX080 is at Canyon Trail Park, in El Cerrito.

4. Sausal Creek Watershed

The Sausal Creek watershed is a small watershed that begins in the hills above Oakland and drains through a dense urban landscape to the Oakland Inner Harbor (Figure 1). The active Friends of Sausal Creek group has elevated the visibility of the creek to the City and the community, and effective cleanup and restoration projects have been implemented in this watershed.

The two upper sites in the watershed, Dimond Park (SAU060) and Joaquin Miller Park (SAU130), have the lowest deposition rates in this regional study (discussed above). The City of Oakland's Parks Department and local volunteers from the Friends of Sausal Creek actively manage and remove trash in Dimond Park. Scores at the Dimond Park site improved with successive site surveys; the highest RTA score was recorded at the last site visit during the summer season. The site on Palo Seco Creek in Joaquin Miller Park (SAU130) is publicly accessible, but upstream of most urban areas and not as frequently visited. This site serves as a regional "reference" site in this study because of the very low trash levels.

The downstream Sausal Creek site at East 22nd St. (SAU030) is heavily impacted by trash. The open channel upstream of the site appears to attract illegal dumping and littering, and adjacent landowners were observed dumping their household trash into the stream area. This area could be a focus for progressive education, warning and enforcement of existing littering laws.

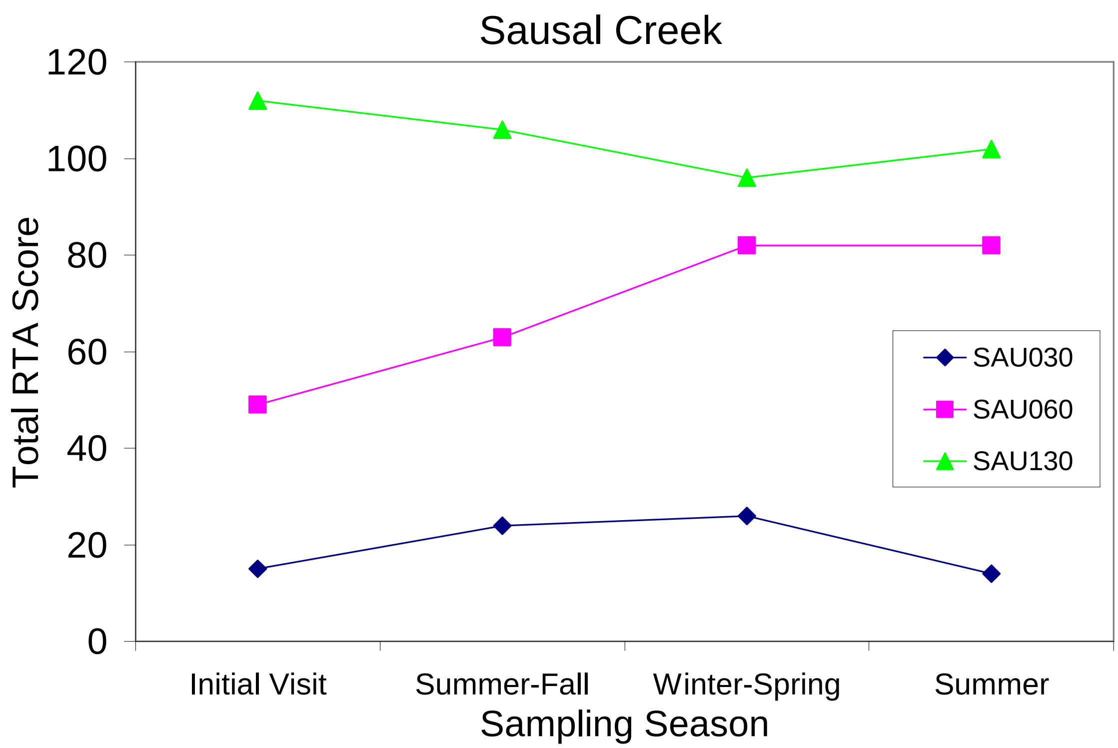

Figure 15: RTA scores at three sampling sites in the Sausal Creek watershed along a longitudinal gradient. SAU030 is the downstream site at E. 22nd Street, SAU060 is at Dimond Park, and SAU130 is on Palo Seco Creek in Joaquin Miller Park, all in Oakland, CA.

Conclusions and Recommendations

Levels of trash in the waters of the San Francisco Bay Region are very high, despite the fact that the Basin Plan prohibits discharge of trash and that littering is illegal with potentially large fines. Based on 93 surveys conducted at 26 sites throughout the Bay Area, we found an average of 2.88 pieces of trash per linear foot of stream channel. Following trash removal, there were very high return rates of trash, even during the dry season. Over the 2003-2005 study, an average of 2.16 pieces of trash were deposited in each study reach each day. There did not appear to be one county or region with higher trash levels, as high and low deposition rates were measured in each county surveyed. Rather, high trash levels were most common at lower watershed sites in urban areas, where both upstream accumulation and local littering was prevalent. Without an assessment method such as the one used in this study, people could draw the wrong conclusion that high trash levels at bottom of the watershed sites are due solely to localized littering. This study shows that these areas, which tend to have lower property values, are polluted cumulatively by the entire watershed.

In summary, the trash assessment data collected for this study using the Rapid Trash Assessment methodology confirms that:

- All watersheds studied in the San Francisco Bay region (Figure 1) have high levels of trash.

- Lower watershed sites tend to have higher densities of trash.

- Trash source hotspots near creek channels, usually associated with parks, schools, roads, or poorly kept commercial facilities, contribute a significant portion of trash that is deposited at lower watershed sites.

- Dry season deposition of trash is primarily associated with localized littering and dumping, wind-blown trash from nearby sources, and, at certain sites, accumulation from upstream sources due to dry season runoff.

- Wet season deposition of trash is primarily due to accumulation from upstream sources. This trash is predominantly plastic, especially at lower watershed sites, which suggests that urban runoff is a major source of floatable plastic found in the ocean and on beaches as marine debris.

- Parks that have more evident management of trash by City staff and local volunteers, including cleanup within the creek channel, have measurably less trash pieces and higher RTA scores. At sites that drain urban areas, however, trash can rapidly accumulate from upstream sources even in the absence of local littering and dumping.

The ubiquitous, unacceptable levels of trash in waters of the San Francisco Bay Region warrant a comprehensive and progressive program of education, warning, enforcement, and structural controls. Based on our informal discussions with members of the public, even the well-educated are unaware that storm drain systems are directly connected to streams and the Bay. It seems that the public do not grasp the risks associated with littering on streets that drain to waters, let alone in parks that have running streams. A more aggressive campaign for educating the public about the ultimate fate of litter is overdue.

Municipal jurisdictions should implement comprehensive trash management programs. Employees of parks and schools that pick up trash need to be instructed to pick up trash near and within streams, and equipped accordingly. Trash receptacles need to be placed near publicly accessible waters, with educational messages about marine debris and human health risks of trash. These receptacles need to be actively managed so they do not become a source of trash to waters. Curbside trash pickup and recycling can be a source of trash if containers are overflowing or not effectively storing debris.

Businesses need to do a better job of keeping trash associated with their operations from waters of the state. Styrofoam pellets were one of the most common and abundant types of trash surveyed and removed in this study, and the literature shows that they are long-lived and harmful to marine life (Marine Mammal Commission, 1996). They are most often used as packing and shipping materials. Businesses should be a target of education and then enforcement with respect to management of packing and shipping materials. Large amounts of these pellets were documented downstream of downtown Berkeley in Strawberry Creek, and this serves as an example of business contribution to the trash problem. This Styrofoam (303 pellets and 125 pieces in December 2004) could be coming from careless handling of packing materials and their allowance to enter the storm drains.

Similarly, dumpsters at gasoline stations such as the one at Washington St. and McDowell Blvd. in Petaluma should be identified and regulated as potential sources of trash to waters of the state. The adjacent shopping plaza at that location was an unmanaged, continuous source of litter and trash to waters of the state, regardless of season. These businesses need to be first educated and then regulated, preferably by municipalities as part of the municipal stormwater program, as potential sources of trash to streams, bays and the ocean.

Structural controls and treatments may be the most effective options for reducing trash inputs into water bodies in many areas. As with most issues, not every member of the public will follow littering rules, even if better educated about the harm litter can do to people and animals. Certain watersheds with chronic trash problems will warrant structural controls, as has been the case with the 303d-listed Lake Merritt in Oakland. Structural controls in the Los Angeles region have been effective at intercepting large amounts of trash from entering streams, bays and the Pacific Ocean. The results documented in this report suggest that the maintenance of structural controls should not be limited to wet weather loading events.

The Rapid Trash Assessment protocol has been shown to be useful in distinguishing trash levels in streams between sites, in determining trash deposition rates, in ranking sites, and determining whether significant deposition of trash occurs in the dry season, wet season or both. The RTA method examines the types of trash that have been deposited at a site, and allows for identification of sources. This approach is most useful for identifying the site-specific management actions that will have the most potential for reducing trash loading to streams. In many cases the results of the assessment confirmed what could be determined by visual observation. The benefits of using this rigorous protocol, however, include: (1) providing a systematic quantification and indexing of sites that can facilitate prioritization for pollution abatement, and (2) providing quantitative data on rates of trash deposition following initial clean-up efforts.

The RTA method does not directly measure loading of trash to downstream waterbodies. Given the observed high accumulation rates of trash resulting from winter floods, it is expected that even greater amounts of trash are delivered directly to downstream water bodies, including San Francisco Bay. Future efforts should focus on developing a monitoring approach for measuring transport rates of trash during flood events.

The San Francisco Bay Region has a problem with trash in streams and the Bay. This protocol has assisted the Water Board in understanding the sources, management issues, and the overall scope of the problem of trash in waters of the state. It is hoped that the protocol will be as useful in evaluating the success of management efforts yet to come.

Acknowledgements

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Figure 16: Water Board staff remove a shopping cart from the Booker T. Anderson Park site on Baxter Creek. Photo by Kim Harrison, August 23, 2005.

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APPENDIX A

RAPID TRASH ASSESSMENT PROTOCOL

Attachment B
Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

WATERSHED/STREAM: ______________________________ DATE/TIME: _______________
MONITORING GROUP, STAFF: ________________________ SAMPLE ID: _______________
SITE DESCRIPTION (Station Name, Number, etc.): _____________________________________

	CONDITION CATEGORY			
Trash Assessment Parameter	**Optimal**	**Sub optimal**	**Marginal**	**Poor**
1. Level of Trash	On first glance, no trash visible. Little or no trash (<10 pieces) evident when streambed and stream banks are closely examined for litter and debris, for instance by looking under leaves.	On first glance, little or no trash visible. After close inspection small levels of trash (10-50 pieces) evident in stream bank and streambed.	Trash is evident in low to medium levels (51-100 pieces) on first glance. Stream, bank surfaces, and riparian zone contain litter and debris. Evidence of site being used by people: scattered cans, bottles, food wrappers, blankets, clothing.	Trash distracts the eye on first glance. Stream, bank surfaces, and immediate riparian zone contain substantial levels of litter and debris (>100 pieces). Evidence of site being used frequently by people: many cans, bottles, and food wrappers, blankets, clothing.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Actual Number of Trash Items Found	0 to 10 trash items found based on a trash assessment of a 100-foot stream reach.	11 to 50 trash items found based on a trash assessment of a 100-foot stream reach.	51 to 100 trash items found based on a trash assessment of a 100-foot stream reach.	Over 100 trash items found based on a trash assessment of a 100-foot stream reach.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Threat to Aquatic Life	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 (<10 pieces) transportable, persistent, buoyant litter such as: hard or soft plastics, Styrofoam, balloons, cigarette butts. Presence of settleable, degradable, and non-toxic debris such as glass or metal.	Medium prevalence (10-50 pieces) of transportable, persistent, buoyant litter such as: hard or soft plastics, Styrofoam, balloons, cigarette butts Larger deposits (< 50 pieces) of settleable debris such as glass or metal. Any evidence of clumps of deposited yard waste or leaf litter.	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; or large amount (>50 pieces) of settleable glass or metal.
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 bacteria or virus hazards such as 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 bacteria or virus hazards or sources of toxic substances, but small presence (<10 pieces) of puncture and laceration hazards such as broken glass and metal debris. No presence of ponded water in trash items such as tires or containers that could facilitate mosquito production.	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

Attachment B
Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

	CONDITION CATEGORY			
Trash Assessment Parameter	**Optimal**	**Sub optimal**	**Marginal**	**Poor**
5. Illegal Dumping	D: No evidence of illegal dumping. No bags of trash, no yard waste, no household items placed at site to avoid proper disposal, no shopping carts.	D: Some evidence of illegal dumping. Limited vehicular access limits the amount of potential dumping, or material dumped is diffuse paper-based debris.	D: Presence of **one** of the following: furniture, appliances, shopping carts, bags of garbage or yard waste, coupled with vehicular access that facilitates in-and-out dumping of materials to avoid landfill costs.	D: Evidence of chronic dumping, with **more than one** of the following items: furniture, appliances, shopping carts, bags of garbage, or yard waste. Easy vehicular access for in-and-out dumping of materials to avoid landfill costs.
Illegal Littering	L: Any trash is incidental litter (< 5 pieces) or carried downstream from another location.	L: Some evidence of litter within creek and banks originating from adjacent land uses (<10 pieces).	L: Prevalent (10-50 pieces) in-stream or shoreline littering that appears to originate from adjacent land uses.	L: Large amount (>50 pieces) of litter within creek and on banks that appears to originate from adjacent land uses.
D-SCORE	10 9	8 7 6	5 4 3	2 1 0
L-SCORE	10 9	8 7 6	5 4 3	2 1 0
6. Accumulation of Trash	There does not appear to be a problem with trash accumulation from downstream transport. Trash, if any, appears to have been directly deposited at the stream location.	Some evidence (<10 pieces) 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.	Evidence that (10 to 50 pieces) 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.	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. Over 50 items of trash have been carried to the location from upstream.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Total Score ________________

SITE DEFINITION:
UPPER/LOWER BOUNDARIES OF REACH: ____
HIGH WATER LINE: ____
UPPER EXTENT OF BANKS OR SHORE: ____
____

NOTES:
____
____
____
____
____
____

Attachment B
Rapid Trash Assessment Worksheet

Surface Water Ambient Monitoring Program, San Francisco Bay Regional Water Quality Control Board

TRASH ITEM TALLY (Tally with (•) if found above high water line, and (|) if below)

PLASTIC # Above___ # Below____	**METAL** # Above___ # Below____
Plastic Bags	Aluminum Foil
Plastic Bottles	Aluminum or Steel Cans
Plastic Bottle Caps	Bottle Caps
Plastic Cup Lid/Straw	Metal Pipe Segments
Plastic Pipe Segments	Auto Parts (specify below)
Plastic Six-Pack Rings	Wire (barb, chicken wire etc.)
Plastic Wrapper	Metal Object
Soft Plastic Pieces	**LARGE (specify below)** # Above___ # Below____
Hard Plastic Pieces	Appliances
Styrofoam cups pieces	Furniture
Styrofoam Pellets	Garbage Bags of Trash
Fishing Line	Tires
Tarp	Shopping Carts
Other (write-in)	Other (write-in)
BIOHAZARD # Above___ # Below____	**TOXIC** # Above___ # Below____
Human Waste/Diapers	Chemical Containers
Pet Waste	Oil/Surfactant on Water
Syringes or Pipettes	Spray Paint Cans
Dead Animals	Lighters
Other (write-in)	Small Batteries
CONSTRUCTION DEBRIS#Above___#Below__	Vehicle Batteries
Concrete (not placed)	Other (write-in)
Rebar	**BIODEGRADABLE** # Above___ # Below____
Bricks	Paper
Wood Debris	Cardboard
Other (write-in)	Food Waste
MISCELLANEOUS # Above___ # Below____	Yard Waste (incl. trees)
Synthetic Rubber	Leaf Litter Piles
Foam Rubber	Other (write-in)
Balloons	**GLASS** # Above___ # Below____
Ceramic pots/shards	Glass bottles
Hose Pieces	Glass pieces
Cigarette Butts	**FABRIC AND CLOTH** # Above___# Below____
Golf Balls	Synthetic Fabric
Tennis Balls	Natural Fabric (cotton, wool)
Other (write-in)	Other (write-in)
Total pieces Above: **Below:** **Grand total:**	
Tally all trash in above rows; make notes below as needed to facilitate scoring.	
Littered:	
Dumped:	
Downstream Accumulation:	

SPECIFIC DESCRIPTION OF ITEMS FOUND:____

____

APPENDIX B

RAPID TRASH ASSESSMENT METHOD EVALUATION
OCTOBER 2002

Attachment B

Evaluation of the Rapid Trash Assessment Methodology

October 20, 2002

The rapid trash assessment methodology was developed by Steve Moore and Matthew Cover of the San Francisco Bay Regional Board's Surface Water Ambient Monitoring Program. The scoring system is based on the physical habitat evaluation forms associated with the federal and state guidance on rapid bioassessment. This methodology was developed with three goals: to be representative, sensitive, and objective.

To be representative, the generated scores need to represent an assessment of impairment of beneficial uses by trash. Beneficial uses affected by trash include aquatic life uses, water contact uses, and aesthetic enjoyment of waters. Also, the assessment methodology needs to consider how trash gets to the water body (direct dumping vs. accumulation in drainage systems) to represent an evaluation of management actions related to controlling dumping, littering, or accumulation of trash. The six trash assessment parameters of the methodology cover this range of issues associated with beneficial uses and management actions related to trash in water bodies. The assessment methodology has been structured to balance these issues in a scoring system, which we believe has achieved the necessary level of representativeness.

To be sensitive, the generated scores need to be able to distinguish light, medium, and heavy states of impairment of beneficial uses by trash at different sites and seasons. The overall score range of 0 to 120 should provide this sensitivity, where sites with scores of 60 +/- 15% can be distinguished in threat to beneficial uses from sites with scores of 80 +/- 15%.

To be objective, variability needs to be minimized. The generated scores by different teams on the same reach should not range too widely. The scores should not be more than 15% different than one another.

To evaluate sensitivity and objectivity of this methodology, three teams were deployed on the same day at four sites located along East Bay creeks. One site was located on Wilkie Creek, a tributary to San Pablo Creek in El Sobrante (next to a high school). Another site was located on Wildcat Creek in Alvarado Park in Richmond. These two sites were surveyed by Regional Board staff on August 14, 2002. Two sites were located on Sausal Creek in Oakland, at Dimond Park and at Barry Street (residential area), surveyed on August 20, 2002 by staff of the Regional Board and the Alameda and Santa Clara urban runoff programs.

Of these test sites, the two urban park sites are considered to be more actively "managed" for trash, with nearby trashcans and available park and volunteer personnel. The high school site and the residential site had no evident active management, and these sites had higher trash tallies. Therefore, in evaluating whether the assessment methodology is sufficiently sensitive, we believe the scores generated for the park sites should be statistically higher (more optimal) than the other sites.

Attachment B

TABLE 1
RAPID TRASH ASSESSMENT
RESULTS OF METHODOLOGY EVALUATION

				Trash Assessment Parameter Scores							Trash Item
Site	**Water Body**	**Date**	**Staff**	**1** Qual.	**2** Quant.	**3** Aq. Life	**4** Hum. Health	**5** Dumping	**6** Accum.	**Total Score**	**Tally Total**
Alvarado Park	Wildcat Creek	8/14/02	NW, GC	10	5	10	13	15	15	**68**	**55**
Alvarado Park	Wildcat Creek	8/14/02	SM, PE	14	4	9	10	8	15	**60**	**68**
Alvarado Park	Wildcat Creek	8/14/02	MC, KT	10	5	6	6	13	16	**56**	**50**
	Coefficients of Variation:			0.20	0.12	0.25	0.36	0.30	0.04	0.10	0.16
Anza School	Wilkie Creek	8/14/02	GC, MC	5	0	3	16	10	2	**36**	**334**
Anza School	Wilkie Creek	8/14/02	SM, PE	3	1	3	13	14	2	**36**	**140**
Anza School	Wilkie Creek	8/14/02	KT, NW	6	0	6	13	12	2	**39**	**444**
	Coefficients of Variation:			0.33	1.73	0.43	0.12	0.17	0.00	0.05	0.50
Dimond Park	Sausal Creek	8/20/02	GC, Alej.	13	0	11	20	15	15	**74**	**138**
Dimond Park	Sausal Creek	8/20/02	MC, PR	10	4	10	15	11	14	**64**	**70**
Dimond Park	Sausal Creek	8/20/02	SM, NW	8	4	9	10	13	14	**58**	**75**
	Coefficients of Variation:			0.24	0.87	0.10	0.33	0.15	0.04	0.12	0.40
Barry Street	Sausal Creek	8/20/02	MC, PR	2	1	5	10	6	8	**32**	**291**
Barry Street	Sausal Creek	8/20/02	NW, SM	3	1	3	12	5	9	**33**	**293**
Barry Street	Sausal Creek	8/20/02	GC, Alej.	4	0	5	11	6	10	**36**	**404**
	Coefficients of Variation:			0.33	0.87	0.27	0.09	0.10	0.11	0.06	0.20

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The tallies and scores from the test assessments are summarized in Table 1. Overall, they demonstrate that the assessment methodology is sufficiently sensitive and objective to be useful in evaluating ambient conditions, trash management actions, and the effect of public access on trash levels. Except for two experienced staff persons, these test assessments were conducted mostly by staff with little or no experience, but some limited training in the use of the methodology. As such, the test assessment is a reasonable representation of what would be expected if a team of municipal employees or interested citizens conducted the assessment. The consistency of the scores in the test assessment underscores the confidence that Regional Board staff have in the methodology. Nevertheless, a few lessons were learned through this exercise and improvements made to create Version 6 of the Rapid Trash Assessment, discussed below.

As shown in Table 1, the total scores for the 4 sites were clustered closely, with some variability noted in individual trash assessment parameters. The exception was the Dimond Park site at Sausal Creek, with scores ranging from 58 to 74. During the field exercise, the staff discussed this difference and traced it to the variable human health score (20, 15, and 10). The key to the scoring difference was that one team noted the presence of a used diaper on the stream bank near the water, and others had mis-characterized it as paper or fabric waste. Also, some broken glass on the bank was noted by the team that scored a “15.” This example shows the importance of identifying human health hazards, if any, and how the presence of one or two items can change the score significantly. The instructions have been modified accordingly, emphasizing that tallying can be estimated, but that bio-hazards must be carefully tallied to allow consistent scoring. All field staff agreed that the scores would have been less variable if all the teams had correctly identified the diaper.

Despite some variability between teams, the assessment methodology achieved the desired level of sensitivity. As hoped, the urban park sites had significantly higher scores than the unmanaged sites, demonstrating the desired sensitivity of the methodology. Alvarado Park (mean=61, CV=0.10) and Dimond Park (mean=65, CV=0.12) were clearly distinguishable from Anza School (mean=37, CV=0.05) and Barry Street on Sausal Creek (mean=34, CV=0.06).

In Table 1, the coefficient of variation (CV), which is the standard deviation divided by the arithmetic mean, expresses the variability of the scores and tallies of the rapid trash assessment. The CV overstates variability at the low end (scores of 0, 1, and 2), so the relatively high CVs associated with these scores for the quantitative level of trash (assessment parameter 2) can be ignored and the scores visually compared. For the overall score, a CV of 0.15 or less is desirable for demonstrating objectivity of the methodology. As discussed above, the only case where significant variability occurred was Dimond Park, and the variability was due to improper field identification of trash. As with the physical habitat evaluation associated with the rapid bioassessment procedures, such skills are expected to be acquired by a field technician through experience, and variability of that technician’s scoring subsequently minimized.

The total trash tallies were substantially more variable than the assessment scores, as expected (Table 2). The rapid trash assessment procedure does not emphasize that these tallies be exact, but rather be used to help guide the assessment scoring by characterizing relative levels of different trash items and materials. Much of the variability in the overall tallies in Table 2 is ascribed to different teams’ conventions of counting broken items as individual pieces or just as one item (e.g., a broken glass bottle). Additional guidance is now provided in Version 6 regarding conventions to be used for tallying “broken” trash items, rooted in the principle of exposure to fish, wildlife, or human users of the water body. Tallies less than 50 are expected to be less variable and with the additional guidance, we expect tallies to exhibit less variability than these test assessments.

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TABLE 2
RAPID TRASH ASSESSMENT METHODOLOGY EVALUATION
TRASH ITEM TALLY RESULTS

Site	Water Body	Date	Staff	Plastic		Biohaz.		Const.		Misc.		Metal		Large		Toxic		Biodeg.		Glass		Fabric		TOTAL
				in*	out*	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	in	out	
Alvarado Park	Wildcat Creek	8/14/02	NW, GC	21	4	0	0	0	0	7	1	1	1	0	1	0	0	3	7	7	0	1	1	**55**
Alvarado Park	Wildcat Creek	8/14/02	SM, PE	11	19	0	2	1	1	7	3	0	1	0	5	0	0	10	3	2	0	0	3	**68**
Alvarado Park	Wildcat Creek	8/14/02	MC, KT	15	6	0	1	0	0	3	2	5	0	0	0	1	0	7	2	3	3	1	1	**50**
	Coefficients of Variation:																							0.16
Anza School	Wilkie Creek	8/14/02	GC, MC	192	87	0	0	3	4	14	0	3	6	0	0	0	0	8	13	1	1	1	1	**334**
Anza School	Wilkie Creek	8/14/02	SM, PE	21	69	0	0	11	4	7	0	3	3	0	0	0	0	3	19	0	0	0	0	**140**
Anza School	Wilkie Creek	8/14/02	KT, NW	200	147	0	0	3	4	1	17	7	8	0	0	0	0	10	46	1	0	0	0	**444**
	Coefficients of Variation:																							0.50
Dimond Park	Sausal Creek	8/20/02	GC, Alej.	8	88	0	0	0	0	2	2	5	4	0	0	0	3	23	0	0	0	3	0	**138**
Dimond Park	Sausal Creek	8/20/02	MC, PR	20	17	0	0	0	0	1	0	5	3	0	0	0	0	9	8	2	2	3	0	**70**
Dimond Park	Sausal Creek	8/20/02	SM, NW	16	25	0	1	6	0	2	1	2	3	0	0	0	0	6	9	0	0	3	1	**75**
	Coefficients of Variation:																							0.40
Barry Street	Sausal Creek	8/20/02	MC, PR	59	26	0	0	26	2	35	1	25	1	0	1	1	2	13	9	82	2	5	1	**291**
Barry Street	Sausal Creek	8/20/02	NW, SM	65	42	0	0	49	8	9	2	10	14	0	1	1	1	8	15	57	6	2	3	**293**
Barry Street	Sausal Creek	8/20/02	GC, Alej.	63	50	0	0	84	8	5	4	15	13	0	1	0	0	10	13	73	59	5	1	**404**
	Coefficients of Variation:																							0.20

Trash Item Tally: columns Plastic through Fabric.

* "in" refers to in-stream, and "out" refers to above high water line, but on banks or shore where transport to water body is probable.

Attachment B

The tallies above 50 do not have a significant effect on the scoring outcome, because the assessment parameter 2, actual number of trash items, allows a small range of 0-5 scoring for sites with more than 50 items. Resolution is not required at these higher levels of trash, but items that can substantially affect the score, such as large appliances or health-related items need to be tallied to ensure consistent and accurate scoring.

In applying the methodology, it has been SWAMP staff's experience that photography does not provide adequate illustration of trash conditions, unless there are large items or the photography is very close-up (but then it only represents a few square feet). Much of the trash that can affect aquatic life or human health is not visible in a digital photograph of a sampling site, due to vegetative cover and reflection of the water surface. Based on evaluations at over 40 sites, we have determined without exception that photography is less effective at documenting trash conditions than the Rapid Trash Assessment scoring methodology.

The Rapid Trash Assessment is less sensitive at the low end of the scoring range, corresponding to conditions commonly observed in the lower watersheds of urbanized areas. Based on SWAMP surveys conducted in 2002, many of the urban sites located in the lower portions of watersheds exhibit total scores below 40. It is difficult to distinguish conditions at these "trash hotspots," since this Rapid Trash Assessment methodology covers the range of conditions from optimal to poor. Since the urban areas that register "poor" scores tend to be of most interest in cleanup programs sponsored by local organizations and agencies, some concern has been expressed that a separate hotspot evaluation methodology may need to be developed, perhaps making more use of photography. A separate methodology may be necessary to demonstrate progress at the most impacted sites, but this methodology evaluation, utilizing independent assessment teams, has shown that the Rapid Trash Assessment can distinguish sites within urban areas that are receiving more trash management from areas that are not. In both examples evaluated, the urban parks had significantly higher scores than the sites that appear to receive little or no trash management.

Attachment B

APPENDIX C
RAW RTA TRASH SCORE DATA

Attachment B

				Trash Assessment Parameter Scores							
Date	Station ID	BOTW	Park w/ High Public Access	1	2	3	4	5	6	7	Total
				Qualitative	Quantitative	Aquatic	Human	Dumping	Littering	Accumulation	
3/19/2004	203BAX030	1	1	5	0	0	10	5	0	0	**20**
7/12/2004	203BAX030	1	1	9	3	1	2	3	0	4	**22**
11/19/2004	203BAX030	1	1	3	0	0	4	8	3	0	**18**
6/8/2005	203BAX030	1	1	8	1	3	5	2	2	0	**21**
8/23/2005	203BAX030	1	1	6	0	0	5	5	0	2	**18**
11/12/2004	203BAX040			0	0	0	3	8	0	5	**16**
6/8/2005	203BAX040			5	3	4	3	1	0	15	**31**
8/23/2005	203BAX040			5	1	1	4	0	0	14	**25**
11/12/2004	203BAX080			10	4	2	17	10	5	2	**50**
6/8/2005	203BAX080			15	4	5	13	10	9	2	**58**
8/23/2005	203BAX080			19	5	4	15	10	5	4	**62**
3/26/2004	203CER010	1	1	3	3	4	9	5	2	2	**28**
7/12/2004	203CER010	1	1	3	2	0	4	9	0	9	**27**
11/5/2004	203CER010	1	1	1	1	1	3	8	2	0	**16**
5/17/2003	203COD040		1	7	3	8	9	7	0	5	**39**
3/12/2004	203COD040		1	7	0	3	0	6	5	3	**24**
7/12/2004	203COD040		1	10	3	4	3	6	0	3	**29**
11/5/2004	203COD040		1	8	3	4	0	7	1	4	**27**
3/12/2004	203STW010	1		0	0	1	3	9	9	0	**22**
8/18/2004	203STW010	1		13	5	5	9	3	8	5	**48**
12/10/2004	203STW010	1		5	0	0	5	8	5	0	**23**
4/23/2004	204AMO080		1	10	10	7	19	10	4	8	**68**
8/20/2004	204AMO080		1	7	5	6	5	4	2	15	**44**
6/10/2005	204AMO080		1	8	1	5	15	4	1	14	**48**
7/19/2004	204AVJ020		1	3	2	1	4	7	2	2	**21**
9/1/2004	204LME100	1		10	4	3	5	3	0	3	**28**
12/10/2004	204LME100	1		14	4	3	10	9	8	2	**50**
6/10/2005	204LME100	1		13	3	3	8	3	8	3	**41**
8/25/2005	204LME100	1		10	6	7	10	10	3	7	**53**
9/1/2004	204LME130		1	7	2	4	3	3	2	10	**31**
12/10/2004	204LME130		1	10	0	3	0	8	4	0	**25**
6/10/2005	204LME130		1	14	0	3	0	10	9	2	**38**
8/25/2005	204LME130		1	7	5	5	9	10	1	9	**46**
7/19/2004	204PRL020	1	1	3	0	0	0	2	3	0	**8**
8/16/2004	204SAU030	1		0	0	0	0	7	0	8	**15**
12/3/2004	204SAU030	1		8	2	3	3	3	1	4	**24**
6/17/2005	204SAU030	1		8	4	2	2	2	5	3	**26**
8/25/2005	204SAU030	1		3	3	0	0	0	0	8	**14**
8/16/2004	204SAU060		1	9	5	4	10	10	1	10	**49**
12/3/2004	204SAU060		1	13	7	7	15	10	4	7	**63**
6/17/2005	204SAU060		1	19	13	9	15	10	8	8	**82**
8/25/2005	204SAU080			14	10	8	14	10	4	8	**68**
8/16/2004	204SAU130		1	20	19	19	15	10	9	20	**112**
12/3/2004	204SAU130		1	20	18	15	15	10	9	19	**106**
6/17/2005	204SAU130		1	20	18	14	10	10	9	15	**96**
8/25/2005	204SAU130		1	19	19	15	9	10	10	20	**102**
3/21/2003	204SMA020	1	1	11	0	8	6	9	4	2	**40**
7/23/2003	204SMA020	1	1	6	6	8	10	8	1	10	**49**
10/20/2003	204SMA020	1	1	10	4	10	13	6	4	10	**57**
2/13/2004	204SMA020	1	1	9	2	9	2	8	4	2	**36**
10/7/2004	204SMA020	1	1	11	4	4	9	10	0	15	**53**
3/21/2003	204SMA060		1	13	5	6	13	9	5	4	**55**
7/23/2003	204SMA060		1	14	9	9	10	10	7	6	**65**
10/20/2003	204SMA060		1	14	10	10	15	4	6	13	**72**
2/13/2004	204SMA060		1	12	5	9	9	7	5	10	**57**
3/21/2003	204SMA110			5	3	3	3	4	9	3	**30**
7/23/2003	204SMA110			11	9	6	13	7	9	5	**60**
10/20/2003	204SMA110			17	13	14	13	9	9	17	**92**
2/13/2004	204SMA110			11	4	4	14	9	8	5	**55**
3/21/2003	204SMA120			9	4	4	13	6	2	5	**43**
7/23/2003	204SMA120			16	13	10	15	10	7	9	**80**
10/20/2003	204SMA120			17	10	10	17	7	9	13	**83**
2/13/2004	204SMA120			19	9	7	18	9	7	8	**77**
3/27/2003	205PER010	1	1	6	2	2	13	9	5	1	**38**
7/29/2003	205PER010	1	1	6	3	2	13	10	5	2	**41**
10/31/2003	205PER010	1	1	9	7	4	4	9	6	8	**47**
3/14/2004	205PER010	1	1	10	3	5	7	9	10	3	**47**
3/27/2003	205STE100		1	12	3	9	11	7	1	14	**57**
7/29/2003	205STE100		1	9	4	9	3	8	1	15	**49**
10/31/2003	205STE100		1	15	6	6	8	10	2	5	**52**
3/14/2004	205STE100		1	14	5	9	1	5	10	9	**53**
3/20/2003	206PET100	1	1	7	3	2	19	10	7	1	**49**
7/22/2003	206PET100	1	1	10	5	3	19	10	5	4	**56**
11/7/2003	206PET100	1	1	7	3	0	7	5	1	2	**25**
2/6/2004	206PET100	1	1	6	1	0	9	10	6	0	**32**
3/20/2003	206PET220			5	4	3	15	9	4	2	**42**
7/22/2003	206PET220			3	3	3	14	9	1	9	**42**
11/7/2003	206PET220			0	1	0	10	3	0	6	**20**
1/27/2004	206PET220			7	3	0	15	10	0	6	**41**
3/20/2003	206PET310			10	8	8	13	9	9	4	**61**
7/22/2003	206PET310			15	14	14	14	10	10	9	**86**
11/7/2003	206PET310			9	7	5	9	9	2	18	**59**
1/27/2004	206PET310			8	4	4	14	8	1	10	**49**
3/20/2003	206PET400		1	9	8	6	14	9	9	2	**57**
7/22/2003	206PET400		1	16	14	13	12	6	5	17	**83**
11/7/2003	206PET400		1	18	12	7	9	10	4	16	**76**
1/27/2004	206PET400		1	14	10	9	10	10	9	9	**71**
3/19/2003	207KIR020	1		7	4	3	13	10	10	1	**48**
7/25/2003	207KIR020	1		10	10	6	17	9	8	5	**65**
2/20/2004	207KIR020	1		0	0	0	15	10	10	0	**35**
3/19/2003	207KIR110		1	9	2	3	7	8	1	7	**37**
7/25/2003	207KIR110		1	3	2	2	2	9	0	8	**26**
2/20/2004	207KIR110		1	8	2	3	3	7	0	8	**31**

Attachment B

APPENDIX D
FIELD VISIT AND TRASH COLLECTION HEALTH AND SAFETY SOPs

Attachment B

California Regional Water Quality Control Board, San Francisco Bay Region (Region 2)
Surface Water Ambient Monitoring Program (SWAMP)

Field Visit Health and Safety Standard Operating Procedure (SOP)
Version 2.0 2/27/2007

This document describes the health and safety procedures and equipment that SWAMP staff should follow for all field visits. The procedures below are in addition to what is specified in the SWAMP Quality Assurance Management Plan (QAMP) Appendix D and H (Puckett 2002).

1. All SWAMP staff and student technicians must receive, at a minimum, a 4-hour health and safety training and any appropriate refresher courses given by a certified industrial hygienist within the previous 12 months.

2. It is recommended that all personnel review the SWAMP Field Methods Training CD prior to any field visit.

3. Prior to visiting a site, permission to access the site should be obtained from the landowner or manager. Permission should be either in writing or verbal. Written permission documents should be on file at the office. Complete written notes should reference all verbal permissions granted.

4. Prior to visiting a site, a field reconnaissance form should be completed. This form contains the location and route to the nearest hospital, cell phone coverage information, 911 information, and specific site access information. A copy of this form should accompany the personnel visiting the site.

5. Prior to visiting a site, the field technicians' planned site visits, contact info, and schedule should be shared with at least one other staff member who will be working in the office during the site visit. The field crew will establish a time by which they will return to the office. If the crew has not returned by the appointed time nor made phone contact, the staff member in the office should attempt to contact the crew. If unsuccessful, the staff member in the office should notify the appropriate authorities in the area the field crew is working.

6. Site visits should always be performed by a minimum of two persons.

7. The following equipment should be on hand any time SWAMP field technicians perform a field visit:
   - First aid kit
   - Copy of field recon sheet
   - Information on nearby hospitals
   - Road maps
   - Cell phone with charger
   - Copy of access permission(s)

Attachment B

Reference

Puckett, M. 2002. Quality Assurance Management Plan for the State of California's Surface Water Ambient Monitoring Program ("SWAMP"). California Department of Fish and Game, Monterey, CA. Prepared for the State Water Resources Control Board, Sacramento, CA. 145 pages plus Appendices.

Attachment B

California Regional Water Quality Control Board, San Francisco Bay Region (Region 2)
Surface Water Ambient Monitoring Program (SWAMP)

Rapid Trash Assessment (RTA) Health and Safety Standard Operating Procedures (SOPs)
Version 2.0 2/27/2007

This document describes the health and safety procedures and equipment that SWAMP staff should follow for all field work performed during the Rapid Trash Assessment (RTA) methodology. The procedures below are in addition to what is specified in the SWAMP Field Visit SOP, SWAMP Quality Assurance Management Plan (QAMP) Appendix D and H (Puckett 2002).

1. All SWAMP staff and student technicians must receive, at a minimum, a 4-hour health and safety training and any appropriate refresher courses given by a certified industrial hygienist within the previous 12 months.

2. The following equipment should be on hand, in addition to equipment specified in the Field Visit SOP:
   - Nitrile gloves
   - Heavy duty rubber or neoprene gloves
   - Puncture resistant gloves
   - Safety glasses
   - Hard hat
   - N-95 face masks
   - Heavy duty trash bags
   - Sharps disposal container
   - Hazardous waste disposal container
   - Trash litter pick-up tools (e.g. Nifty Nabber©, EZ-Reacher©)

3. Field technicians picking up trash should have current vaccinations for tetanus and hepatitis A and B.

4. During most RTA field visits sampling technicians are required to remove all trash items found at the site. Some trash items may pose a threat to the health and safety of field technicians. The following precautions should be followed:
   a. Appropriate protective gloves and safety glasses should always be worn when handling trash.
   b. When possible, trash should be picked up with the litter pick-up tool.
   c. When picking up uncontaminated sharp objects, such as glass or metal, puncture resistant gloves should be worn. Sharps should be stored in a sharps disposal container.
   d. Do not remove trash objects that are an unsafe weight or size to lift and carry.

e. Trash objects that are obviously hazardous, such as feces (human or other) and hypodermic needles, should only be removed by trained personnel. If an object poses a substantial health risk to people visiting the site, and it can be removed safely, the objects should be picked up using the trash litter pick-up tool and placed into a hazardous waste disposal container.
f. Many common household and construction materials found in trash may be hazardous, and should be disposed of separately as hazardous waste. These include fluorescent and high-intensity light bulbs and lamps (mercury), lighting ballasts (PCBs), thermostats (mercury), old pipes (lead), painted wood (prior to 1978: lead), batteries (heavy metals), transformers (PCBs), smoke detectors (metals), cleaning solutions, electronic equipment, and motor oil.
g. If crystalline material is noted on or in any container, the contents shall be considered to be a shock-sensitive waste and the container shall not be moved.
h. Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled by trained personnel.
i. Drums and containers under pressure, as evidenced by bulging or swelling, shall not be moved.
j. Drums and containers containing packaged laboratory wastes shall be considered to contain shock-sensitive or explosive materials and should not be moved.
k. Drums and containers containing radioactive wastes shall not be handled or moved.
l. Report any suspicious, inappropriate or potentially hazardous waste dumping to appropriate authorities.

Reference

Puckett, M. 2002. Quality Assurance Management Plan for the State of California’s Surface Water Ambient Monitoring Program (“SWAMP”). California Department of Fish and Game, Monterey, CA. Prepared for the State Water Resources Control Board, Sacramento, CA. 145 pages plus Appendices.