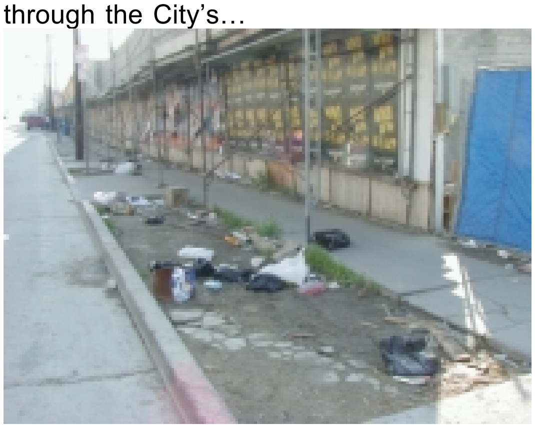
HIGH TRASH-GENERATION AREAS AND CONTROL MEASURES

City of Los Angeles
Department of Public Works
Bureau of Sanitation
Watershed Protection Division

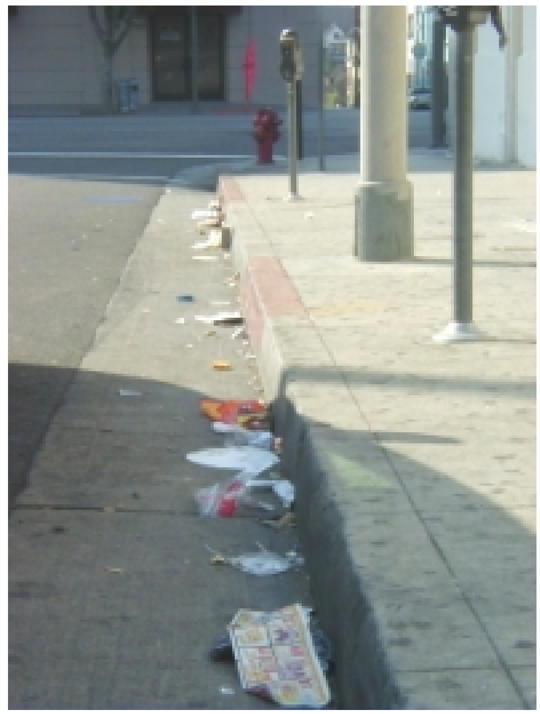
January 2002

Excessive amounts of trash illicitly disposed through the City's…

streets and …



sidewalks will eventually…



accumulate in street gutters and…

because of vehicles motion, wind, and runoff, the trash will be deposited…

in the local catch basins and eventually to local waterbodies.

ACKNOWLEDGMENT

City of Los Angeles
Department of Public Works
Bureau of Sanitation
Watershed Protection Division

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Introduction

Study Background

Urban runoff discharged through municipal storm drain systems has been identified as one of the principal causes of water pollution in the region. Urban runoff can contain a host of pollutants like trash and debris, bacteria and viruses, oil and grease, sediment, nutrients, metals, and toxic chemicals. These contaminants can adversely impact receiving waters and associated biota and public health.

In the Los Angeles (LA) area, trash has been designated as a major pollutant in urban runoff. Trash negatively impacts the region's receiving waters and marine organisms, fouling the local sea-bottom and beaches, and damaging the engines and propellers of marine vessels. Trash in waterways 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 in rivers and in riparian areas can be killed by ingesting or becoming entangled in floating trash. Settleables can be a problem for bottom feeders and can contribute to sediment contamination. 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.

To address this problem, it is important to identify the high trash-generation areas within the City of Los Angeles and develop control strategies. This will assist the City of Los Angeles in addressing the regulatory requirements and reducing the amount of trash found throughout the City's watersheds.

Stormwater Pollution Issues

The Los Angeles Regional Water Quality Control Board (LARWQCB) has acknowledged trash as impairing the beneficial uses of the rivers, creeks, and lakes within the Los Angeles County. LARWQCB has scheduled the development of Trash Total Maximum Daily Loads (TMDLs) for numerous waterbodies. Table 1 summarizes these waterbodies and the scheduled start and completion times for the trash TMDL.

For the Los Angeles River, LARWQCB identified that beneficial uses impaired by trash include contact recreation (REC 1) (contact sports: swimmers are spotted regularly in the Los Angeles River at Glendale Narrows and also at Willow Street in Long Beach) and non-contact recreation such as fishing (REC 2) (trash is aesthetically displeasing and deters recreational use and tourism); warm fresh water habitat (WARM); wildlife habitat (WILD); estuarine habitat (EST) and marine habitat (MAR); rare, threatened or endangered species (RARE); migration of aquatic organisms (MIGR) and spawning, reproduction and early development of fish (SPWN); Commercial and sport fishing (COMM); 19 Wetland Habitat (WET), and Cold freshwater habitat (COLD). These beneficial uses in the Los Angeles River are impaired by large accumulations of suspended and settled debris throughout the river system. The problem is even more acute in Long Beach where debris flushed down from the upper reaches of the river collects. Common items that have been observed by Regional Board staff include Styrofoam cups, Styrofoam food containers, glass and plastic bottles, toys, balls, motor oil containers, antifreeze containers, construction materials, plastic bags, and cans. Heavier debris can be transported during storms as well[1]. Similar impairments have been identified for Ballona Creek.[2]

Table 1 - TMDL for Waterbodies in the City of Los Angeles[3]

Watershed	Waterbody	Start	Complete	Comment
Santa Monica Bay	Ballona Creek, Ballona Wetlands	1999	2001	Draft TMDL prepared by LARWQCB
Los Angeles River	Entire Watershed	1999	2001	TMDL adopted by LARWQCB
	Echo Park Lake, Lincoln Park Lake	2008/09	2010/11	
Dominguez Channel & LA Harbor	Machado Lake	2006/07	2007/08	

Neighborhood Problem

Trash is present throughout the watershed in parking lots, streets, sidewalks, parks, and other public areas. Trash presence in these areas is not just visually unpleasant but it has further environmental and community drawbacks. Humans, birds, pets, and other animals are exposed to illicitly disposed trash, which can cause safety, and health related problems. Examples of these include, tripping hazards, pest and vector generation, and choking for pets and birds.

Quality-of-life issues related to environmental blight (including presence of trash) are rooted in the “broken window” theory, postulated in the 1940s. The theory suggests that a broken window left unrepaired in a building sends a signal that there is a lack of concern about the building. This pivotal event causes a chain reaction because when residents see the vandalism is being ignored, they begin to tolerate other negative activities as acceptable behaviors. Neglect and apathy take root in a neighborhood fueling further deterioration, often leading to other societal ills[4].

Litter is often viewed as one of the earliest indicators that a neighborhood is in distress. It can be a “broken window” in the same way a graffiti tag or an abandoned car reflects that there is a lack of ownership by residents in that community. According

[1] Los Angeles Regional Water Quality Control Board (September 19, 2001) *Trash TMDL for the Los Angeles River Watershed.*
[2] Los Angeles Regional Water Quality Control Board (September 19, 2001) *Trash TMDL for the Ballona Creek and Wetland.*
[3] Los Angeles Regional Water Quality Control Board (December 2000) *Watershed Management Initiative Chapter*.
[4] The United States Conference of Mayors Best Practices Center (October 1999) *Urban Partnership to Prevent Litter and Illegal Dumping.*

to the “broken window theory,” gangs, illegal dumpers and drug peddlers will not usually choose to enter neighborhoods that appear clean, safe and organized. They wait to be silently invited by distress indicators such as littered streets, abandoned properties, and illegal dump sites.

Once the downward spiral begins, litter begets dump sites, graffiti begets street crime and abandoned cars beget abandoned homes, it becomes expensive, time consuming and extremely difficult to reverse.

Study Components

The study undertaken by the Watershed Protection Division (WPD) staff has three major components. The first component of the study involves conducting literature research and reviewing regional data on the characteristics, sources, generation, and effects of trash. These elements of the study are described in the next chapter of this report.

The second component of the study is the identification of areas within the City where high rates of trash are generated. Towards this goal WPD staff reviewed available datasets and projected the data spatially to identify the parts of the City that generate proportionately more trash.

The third component of the study involves the identification of the available institutional and structural controls and developing control strategies for the reduction of trash for the high trash generation areas.

It should be noted that this study is not a TMDL compliance plan. This study only focuses on high trash generation areas and its goal is to identify solutions to significantly reduce trash from these areas. The TMDL development process has not been completed. Until this happens, the City will focus on identifying solutions to address trash generation as a mutual benefit to its citizens as well as to the local waterbodies.

Characteristics, Sources and Effects of Trash

Trash Characteristics

Two characteristics of trash, buoyancy and ability to be blown around, affect how easily the trash can enter local waterbodies. Styrofoam cups for example will be easily transported by stormwater where as heavier plastics may not. Another characteristic, degradability, affects how long the trash will remain in the marine environment. The more likely it is that a piece of trash will enter and remain in the water, the greater the threat it poses to people, aquatic life, and marine vessels.

Different types of trash also have distinct decomposition times. The following table shows the decomposition of various materials in the environment. It should be noted that the TMDL requirements as currently adopted does not distinguish between the various types of trash.

Table 2 - Trash Decomposition Time Line[5]

Paper towel	2-4weeks	Tin can	50 years
Newspaper	6 weeks	Styrofoam cup	50 years
Cardboard box	2 months	Styrofoam buoy	80 years
Apple core	2 months	Aluminum can	200 years
Waxed milk carton	3 months	Plastic beverage holder	400 years
Cotton glove	1-5 months	Disposable diaper	450 years
Cotton rope	3-14 months	Plastic bottle	450 years
Plywood	1-3 years	Monofilament fishing line	600 years
Wood glove	1 year	Glass bottle and jar	undetermined
Painted wooden stick	13 years		

Our study did not characterize the composition of the trash generated in the City of Los Angeles. However, two recently completed regional studies provided an insight on the composition of the trash. While these studies did not focus on City of Los Angeles areas, the composition and characteristics are noteworthy and applicable for the City. The first study was conducted by the Southern California Coastal Water Research Project (SCCWRP) which examined the composition and distribution of beach debris in Orange County**.** The study estimates that 106 million items, weighing approximately 13 tons were along the Orange County beaches in the summer of 1998.

The following table summarizes the total abundance and weight of trash on Orange County beaches.

[5] Adopted from Mote Marine Laboratory's poster "Marine Debris Biodegradation Time Line"

TABLE 3 - Estimated total abundance and weight of trash on Orange County beaches, August to September 1998[6]

Debris Type	Abundance	Weight (lbs)
Pre-production plastic pellets	105,161,101	4,780
Foamed plastics	742,296	1,526
Hard plastics	642,020	7,910
Cigarette butts	139,447	344
Paper	67,582	870
Wood	27,919	4,554
Metal	23,500	3,015
Glass	22,195	1,944
Rubber	10,742	817
Pet and bird droppings	9,388	17
Cloth	5,949	1,432
Other	10,363	401

The Department of Transportation of the State of California (Caltrans) conducted another regional study. As part of this study, trash collected along freeway catch basins was characterized by trash type. Figure 1 characterizes the composition of all trash collected as part of this study.

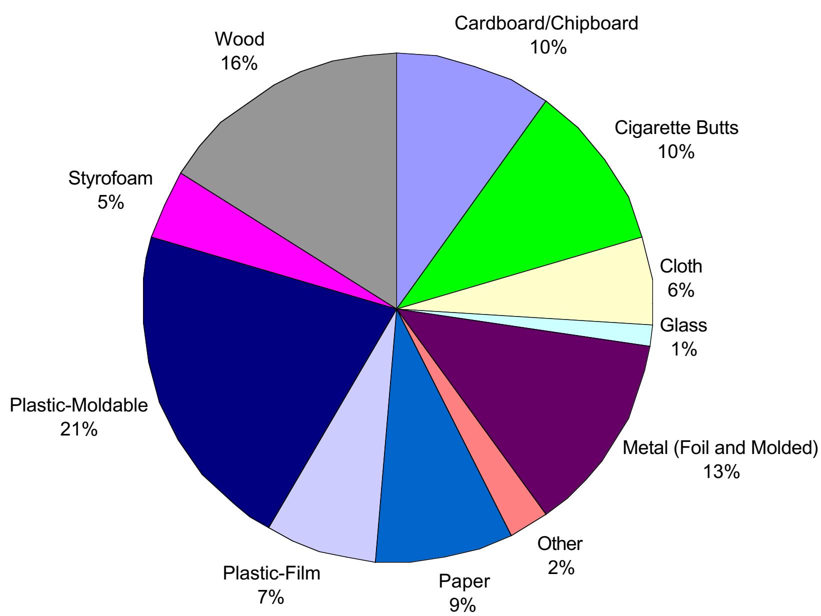


Figure 1 – Caltrans Litter Distribution by Air Dried Weight[7]

[6] SCCWRP, 2000 Annual Report. Composition and distribution of beach debris in Orange County, California.
[7] California Department of Transportation (June 2000) *District 7 Litter Management Pilot Study.*

Both studies show that plastics are the single largest types of trash. Other important categories of trash include cigarette butts, paper, and metal such as aluminum cans.

Sources and Transport of Trash

Trash comes from different sources. Any trash or material that is improperly disposed, transported, and stored can find its way to Los Angeles River and Ballona Creek as well as to the beaches, lakes, or harbors. The sources of trash can be subdivided as follows:

- Direct disposal into the Los Angeles River, Ballona Creek or to the local beaches.
- Stormwater runoff that carry disposed trash throughout the watershed
- Light-weight trash that can be carried by wind action

Stormwater runoff can carry floatable materials through the street gutter to the catch basin of the stormwater collection system to nearby creeks, rivers, beaches and harbors. Figure 2 is a pictorial demonstration on how trash get transported to the catch basin and then to local waterbodies. The flowchart on Figure 3 also shows the transportation of trash by runoff to waterbodies.

Effect of Trash on Aquatic Life

Trash in waterways 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. Ingesting or becoming entangled in floating trash can harm wildlife living in rivers and in riparian areas. Except for large items such as shopping carts, settleable trash may not be visible to an observer along a waterbody. This type of trash can include glass, cigarette butts, rubber, construction debris and more. Settleable trash can be a problem for bottom feeders and can contribute to sediment contamination. Some trash (diapers, medical and household waste) are a source of bacteria and toxic substances. Floating debris that is not trapped along a creek or removed will eventually end up in local harbors, beaches and in the open ocean, will repel visitors away from our beaches and degrade coastal waters.

According to LARWQCB[1], a major trash problem is the broader phenomena that affects ocean waters, as small pieces of plastic called “nurdles” float at various depths in the ocean and affect organisms at all levels of the food chain. As sunlight and UV radiation render plastic brittle, wave energy pulverizes the brittle material, with a subsequent chain of nefarious effects on the various filter-feeding organisms found near the ocean’s surface. Studies indicate that in the North Pacific the number of large floating plastic and smaller fragments are increasing. Increased reports of resin pellet ingestion by aquatic wildlife and evidence that the ingested pellets are harming wildlife have led the Interagency Task Force on Persistent Marine Debris (ITF) to identify resin pellets (also know as plastic pellets) as a debris of special concern.

A 1999 study of marine debris in the Mid-Pacific Gyre attempted to assess the potential effects of ocean particles on filter feeding marine organisms, by collecting plankton samples at various locations throughout the gyre. The mass of plastic particles collected was six times higher than the mass of plankton (841 g/km^2). In that study, the most common type of identifiable particle, thin plastic film, accounted for 29% of the total. The study also concluded that many birds will die from ingesting this non-nutritive plastic.[8] LARWQCB used the results of this study as part of its justification for a very strict trash TMDL limit. It should be noted however that in the Mid-Pacific Gyre there is a concentration of debris that originated from many communities along the Pacific Coast.

[8] Moore, C.J., Moore, S.L., Leecaster, M.L., Weisberg S.B. A Comparison of Plastic and Plankton in the North Pacific Central Gyre. 2000 SCCWRP Annual Report.

Figure 2 – Trash Generation and Transportation to Local Waterbodies.

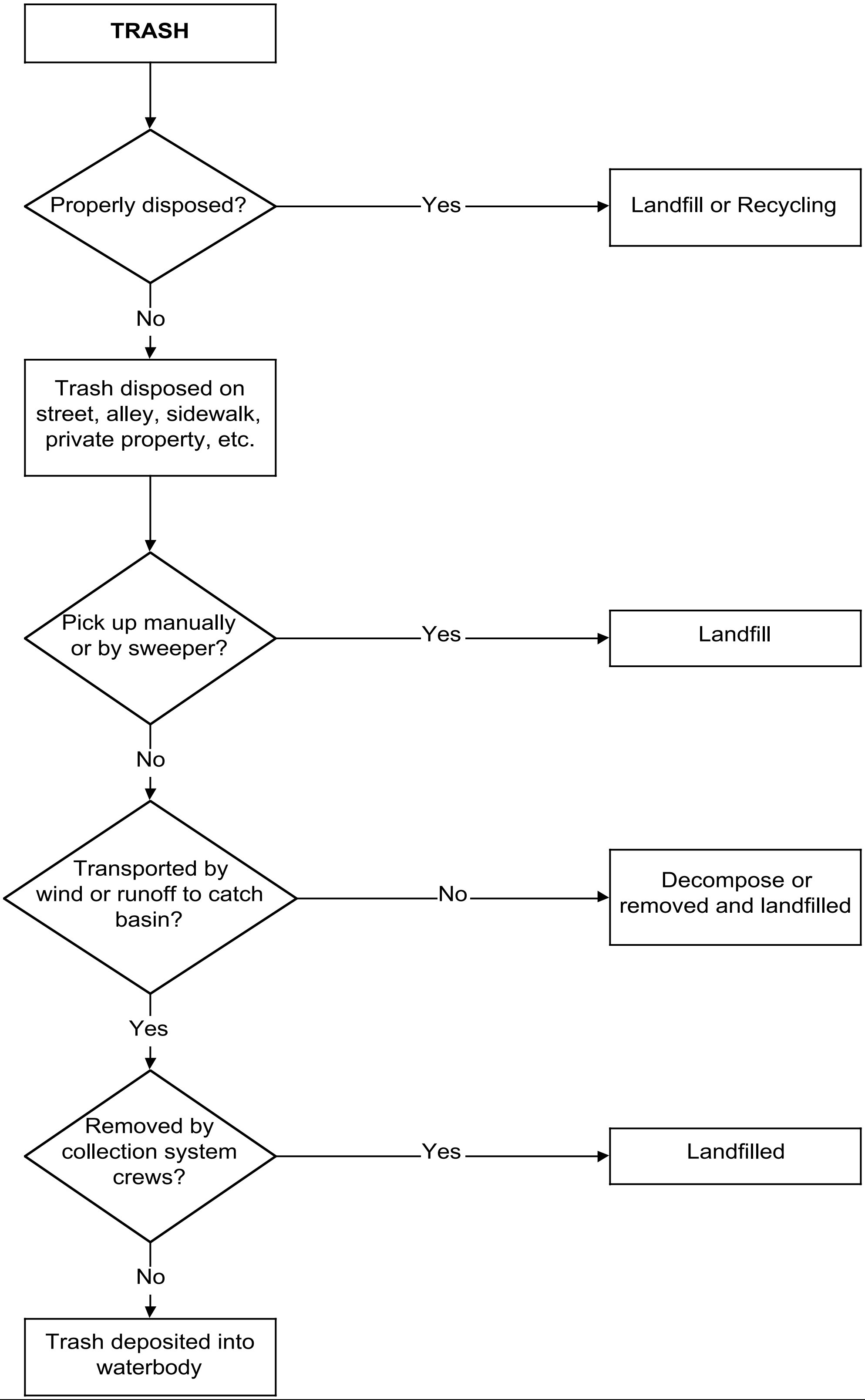


Figure 3 - Trash Flow diagram

Geographical Analysis of Trash Generation in Los Angeles

Datasets & Analyses

WPD staff has been able to identify the areas within the City of Los Angeles that generate disproportionate amounts of trash. This analysis was based on the following information and considerations:

Wastewater Collection System Division (WCSD) Catch Basin Cleaning Data records the relative amount of trash within a catch basin. WCSD staff records each catch basin that is being cleaned as full, _ full, _ full, _ full and empty, as well as documenting its major content. For this analysis, the only content of concern is trash. This dataset contains WCSD catch basin cleaning history from January 1999 to June 2000. Spatially displaying the information using Geographic Information System (GIS) software illustrates areas that have the most trash deposited in catch basins. To employ this dataset, an assumption is made that the amount of trash in a neighborhood is proportional to the trash collected by the catch basins. According to such claim, the trash level in catch basins may help identify relatively high trash-generation areas within the City of Los Angeles. The following limitations or assumptions however need to be understood.

1. No information on trash is presented for the County-owned catch basins.
2. The size of the drainage area to each catch basin may vary.
3. Catch basins are in different sizes and shapes with different volumes.

WPD Hotline Data on "Abandoned Trash/Bulky Items" shows where in the City more trash is being illicitly abandoned. These reported locations are geographically displayed and overlaid with other trash indicator(s). The dataset contains records from July 1993 to March 2001.

WPD Hotline Data on "Request for Catch Basin Cleaning" shows problematic locations where catch basins are being filled up with trash, flood during storms, as well as odor complaints. These reported locations are geographically displayed and overlaid with other trash indicator(s). The dataset contains records from July 1993 to March 2001.

Land Use Profile of the City will be used to suggest possible correlation with the trash data. The analysis will focus on any correlation pattern from one land use to the others, as well as identifying major land use that contributes to a particular high trash area.

Population Density is a supplementary indicator for potentially high trash areas not only because more people will generate more trash but also there is more pedestrian traffic in these areas. This dataset was developed by Environmental System Research Institute, Inc. (ESRI) based on 1990 United States Census.

WPD staff believes that no dataset listed above should be used to solely conclude any high trash areas and that a credible conclusion can be deduced from the collaborative set of data.

Results of Analysis and Discussion

The results of the analysis show that trash is a problem most severe for Central City (Downtown LA) and nearby communities. Map 1 shows how full with trash the catch basins were when cleaned by WCSD crews. It suggests that most of the trash-filled catch basins can be found in the central parts of the City. The map shows the citywide profile of trash-filled catch basins. Note that these catch basins are rather concentrated within certain areas or street stretches. In contrast to these results, calls to stormwater hotline show more widespread reporting through out the City of abandoned trash and requests of catch basin cleaning.

The citywide land use profile reveals (Map 2) that the Downtown LA and Central City North consist of mainly commercial and industrial land uses. Residential and commercial developments are commonly seen in Westlake, West Adams area, South Central and Southeast Los Angeles. These communities contribute to the majority of trash collected in catch basins. Furthermore, the summarized data in Table 4 show that the overwhelming majority (83%) of the full-trash catch basins in Downtown LA are associated with commercial and industrial land uses. In contrast, citywide only about half (52%) of the full catch basins were found in commercial and industrial areas.

Many of the trash-filled catch basins (Map 2) are actually situated on commercial strips & business districts. Besides the downtown commercial areas, other notable strips with full catch basins include Western Ave., Vermont Ave., Broadway, Main St., Slauson Ave., and Jefferson Blvd.

Highly populated and highly visited areas often time happen to be places that generate the most trash. Such pattern were observed for Westlake, Boyle Height, Southeast and South Central Los Angeles with the majority of City population above 22,500 capita per square mile, according to 1990 U.S. Census. Communities with less population like Central City, certain parts of Hollywood and Wilshire, are known to host many daytime businesses, tourist attractions, sidewalk retails and restaurants. These places also have significant daily visits, attract high vehicular and pedestrian traffic and are also found to be high trash-generation areas.

Table 4 - Percent of Full-trash Catch Basins in Various Landuses (99-00)

OVERALL

Landuse	Within Downtown	Outside Downtown	Citywide
Residential	6%	42%	36%
Commercial	46%	31%	33%
Industrial	27%	18%	19%
Utilities	1%	0%	0%
Transportation	5%	2%	3%
Open / Recreation	1%	2%	2%
Others	14%	6%	7%
Total	100%	100%	100%

BREAKDOWN

Landuse		Within Downtown	Outside Downtown	Citywide
Residential (36%)	Single Family	0%	25%	21%
	Multi-Family	6%	8%	8%
	Mobile Homes	0%	0%	0%
	Mixed	0%	8%	7%
Industrial (19%)	Light Manufacturing	23%	17%	18%
	Heavy Manufacturing	0%	0%	0%
Commercial (33%)	Regional Shopping Centers	1%	0%	0%
	Retail Centers	1%	0%	1%
	Modern Commercial Strip	0%	7%	6%
	Older Commercial Strip	15%	21%	20%
	Attendant Pay Parking	7%	0%	1%
	Non-Attendant Pay Parking	1%	0%	0%
	Offices	19%	1%	4%
	Hotels and Motels	3%	0%	0%
Schools (2%)	Pre-Schools / Day Care	0%	0%	0%
	Elementary	0%	1%	1%
	Junior High	0%	1%	1%
	High Schools	0%	0%	0%
	Colleges / Univ.	0%	0%	0%
	Trade Schools	0%	0%	0%
Others		25%	8%	11%
	Total	100%	100%	100%

For the purpose of watershed management and to design trash control systems, it is often useful to examine the situation based on sub-watersheds, or “sub-basins”. Since each sub-basin is divided so that the stormwater runoff is drained to a single downstream outlet, theoretically, the assumption is made that most of the illicit trash that is present within a sub-basin will be carried to the same downstream outlet. To proceed with such an examination, an average size of 8 ft by 3 ft by 3 ft (75 cubic feet) catch basin is assumed to estimate the total volume of trash collected during catch basin cleaning. The sub-basins that scored the most trash per area (cf/ac.) are shown in Map 3. These sub-basins clearly show the estimated amount of trash found in their drainage areas and how they compare. This sub-basin prioritization can be used as an advanced planning tool to select locations for site-specific trash controls.

Map 4 delineates trash data based on the City's Planning Communities. Central City (Downtown LA) is estimated to generate 20 cf/ac of trash and Westlake generates 16 cf/ac of trash. The communities of Central City North, Wilshire, South Central and Southeast Los Angeles generate 9-12 cf/ac. of trash

We also examined the relative location of Business Improvement Districts (BIDs) with respect to the high trash-generation areas. Only five downtown BIDs, and Wilshire, Jefferson Corridor, Figueroa Corridor and Wilmington BIDs fall within high trash-generation areas. Institutional BMPs have been employed among some districts. For instance, Fashion District and Historic Core in Downtown LA have their own sweeping teams using manual broom or machine to clean the sidewalk daily. It becomes apparent that if more commercial strips that generate high-amounts of trash is formed into BIDs these control measures will result in significant trash reduction.

Ranking of High Trash Areas

Based on the analysis results, WPD staff have developed a comprehensive ranking of high trash areas for the City of Los Angeles. Table 5 summarizes the ranking results by City Planning communities.

Table 5 – Ranking of High Trash-Generation Areas by City Planning Communities

Rank	Area / Planning Community	Sub-basin #s[1]	Major Land Use	BIDs contained[1]	Est. Trash[2] collected in catch basins	Relative Trash Ratio	Popul-ation[3]	Hotline[4] calls /mi^2
1	Central City Downtown	7325, 7345, 7350, 7390, 7380, *6405, 7270, 7375*	Commer-cial 36%	Downtown Center Toy District Historic Core Industrial Fashion/ DPOA	43,578 cf/ 2,235 ac.	1	12,000	10
2	Westlake	*6405, 7270, 5450*	Residential 49%	*Wilshire*	31,320 cf / 1,943 ac.	0.83	70,000	10
3	Central City North	6490, 7330, 7340, 7385, *7380, 7375*	Industrial 46%	none	21,708 cf / 2,022 ac.	0.55	6,000	5
4	Southeast Los Angeles	8070, *7270, 8650*	Residential 51%	none	88,758 cf / 9,890 ac.	0.46	257,000	109
5	South Central Los Angeles	7295, *7270, 7815*	Residential 67%	Figueroa Corridor	78,714 cf / 9,883 ac.	0.41	218,000	90
6	Wilshire	7220, 7135, 5330, 5390, 6278, 7135, 7137, *4690*	Residential 75%	Wilshire *Jefferson Corridor*	62,154 cf / 8,961 ac.	0.35	25,000	30
7	West Adams	7170, 7820, *7815*	Residential 78%	Jefferson Corridor	47,772 cf / 8,241 ac.	0.30	126,000	51

[1] Partial Sub-basin or Partial Business Improvement Districts are in italic.
[2] Estimated based on an average catch basin size of 75 cubic feet.
[3] Based on U.S. Census 1990.
[4] Hotline calls on abandoned trash received by Watershed Protection Division, Bureau of Sanitation, Department of Public Works, City of Los Angeles, from July 1993 to March 2001.

Trash Control Measures

Trash control is a major challenge for the City of Los Angeles. The City already prevents most of the illicitly generated trash from entering local waterbodies. This section documents the existing trash control measures, lists ways to enhance and supplement these measures and identifies various structural systems that capture trash.

Operational Trash Control Measures

The City through its institutional requirements and operations discourages the generation of illicit trash and collects the bulk of this trash from streets, sidewalks, alleys, and catch basins. The existing institutional and operations controls that the City employees include the following:

Anti-littering statutes such as Sections 56.08, 57.21.06, 62.54, 66.04, 66.25, and 64.70.02 of the Los Angeles Municipal Code (LAMC) forbid littering in the City of Los Angeles. Several agencies are responsible for enforcing these requirements. The Los Angeles Police Department is the leading entity in enforcing LAMC requirements. However, other entities such as the Department of Public Works and Department of Recreation and Parks also deploy inspectors to prevent littering along city streets or in public parks, respectively.

Street sweeping is accomplished almost exclusively using motorized sweepers to sweep streets and municipal parking lots. The frequency of sweeping varies from daily for selected commercial strips to monthly for the least urbanized portions of the City. The presence of known areas with visible trash is one of the many criteria that the Bureau of Street Services uses to determine street sweeping frequency. Street sweeping and its frequency are driven by aesthetics and not reduction of trash that is deposited to waterbodies such as Los Angeles River or Ballona Creek. Furthermore, street sweeping occurs year-round and is not targeted in anticipation of rain events.

Catch basin cleaning is conducted by WCSD. Efforts have been made over the past few years to optimize the catch basin cleaning both temporal and spatial. Catch basins that quickly fill with trash is cleaned more often and more cleanings take place during late summer to early fall period.

Abandoned trash is reported to WPD’s hotline. Pick-ups are conducted by the Bureaus of Street Services and Sanitation. WPD has documented 630 calls for trash and bulky items pick-up over the last eight year. The response to a call is typically one to two weeks. There is a need improve reporting of abandoned trash, and shorten response time.

Trash Receptacles maintained by the Bureau of Street Services and BIDs have reduced the amount of illicit trash along selected commercial strips.

Formation of BIDs along commercial strips has been successful in reducing trash along sidewalks. Most of the 30 formed BIDs in the City incorporate sidewalk sweeping, litter pick-up, and maintenance of trash receptacles. These practices reduce the amount of visible trash, thus making these commercial strips more attractive to customers.

Educational antilittering outreach efforts have only recently been emphasized and currently are limited to stormwater program's anti-pollution public education. Citizens are also discouraged to illicitly dispose trash through postings, signs, and billboard, television and radio advertisement. These efforts have generally been citywide and not targeted to high trash generation areas.

Community clean-up programs such as Operation Healthy Neighborhoods by the Mayor's Office or Operation Clean Sweep by the Department of Public Works have incorporated trash clean-up and litter reduction. These programs involve partnerships between the City, community activists and volunteers for joint effort to beautify the most affected communities.

The project team in cooperation with other City agencies has identified a number of additional measures that can be taken that will assist and will further reduce the amount of trash through out the City and especially the high trash-generation areas. Table 6 summarizes these trash control measures. Table 6 also makes suggestions for implementation and contains information on cost, disadvantages, and advantages.

Structural Trash Control Systems

There are a number of systems that can be placed on the stormwater collections system that can prevent the deposition of trash to a local water body. These systems can be placed in catch basins and in storm drain lines to capture trash. These systems include:

- Catch basin opening covers such as boards or coarse screens
- Catch basin inserts that trap trash inside the catch basin
- Hydrodynamic separation technology
- Storm drain line nets

The following is a listing, description, and relevant information for the various structural devices. The information provided below were gathered by WPD engineers through meetings with vendors of proprietary technologies, contacting of other agencies, conducting literature research, and analyzing and sorting through relevant data. Table 6 provide schematics of the various systems.

Continuous Deflective Separation (CDS™) is a cylindrical structure that is connected to the storm drain system to allow the storm water to flow in the device. In the chamber, the pollutants are removed because of the natural flow of the water, maintaining the tangential force of the water around the chamber to be more than its centrifugal force, hence allowing the solids to move to the center of the vortex and drop down into a sump basket. The continuous circular motion swipes clean the mesh preventing clogging. These units also have the advantage of removing small particles, suspended solids and toxic substances that are bound to these solids. The screen typically has 4.7 mm (0.185 inch) openings. The largest precast units can treat up to 62 cubic feet per second (cfs).

A major drawback of the CDS unit is the energy headloss of close to 3 feet for the 62-cfs unit. This would potentially cause flooding of upstream catch basin locations. Another major draw back is the cost. WPD engineers estimate that a 62 cfs unit's purchase and installation costs will be about $600,000 without considering engineering costs for design and construction management. The capital cost then averages to about $2,500/acre of drainage areas. Operational and maintenance costs are estimated to be $20,000/year for a 62-cfs unit or $120/acre/year.

Netting TrashTrap™ is a floatable collection system consisting of a fabricated mesh connected to the storm drain line. The floatable materials flowing with the stream are trapped in the disposable mesh bags. The Netting Trash Traps may be connected in three different ways: In-Line, End-of-Pipe and Floating (which floats at the end of the outfall). The mesh opening sizes are either _" or _ ". The largest Netting TrashTrap installation has a treatment capacity of 300 cfs. The system can be designed to trap trash for the entire flow in a storm drain without significant headloss (less than 4").

Based on preliminary estimates by WPD engineers the cost per acre for this unit is comparable with that of CDS ($2,400/acre) for flows smaller than 60 cfs, and will also have similar operation and maintenance costs. For larger flows the netting system will be more economical. Thus, the advantage that this unit may have is its ability to capture larger volumes and be installed for larger storm drains.

Catch basin inserts such as liners or baskets placed inside a catch basin will trap trash. For this application, it is recommended that the insert consist of mesh or thin liner. Catch basin inserts that use filtering walls or filter media are not applicable for trapping trash. The inserts should have large trash storage volumes and ideally cover the entire catch basin box. The typical cost $600/unit. Since a typical 3-acre urban area of the City will have on the average 1 catch basins, the capital unit cost is only $200/acre. Based on City's experience, the filtration media made of flexible fabric have performed better in trapping trash; they often offer a much larger storage volume with adequate support. However, it should be noted that if a fabric liner is used instead of a metal mesh, such liner may need to be replaced periodically. In contrast, the operation and maintenance of these systems will become about $400/acre. It should be clearly understood that the term "insert" used here does not refer to configurations that use filter media for removing pollutants other than trash. These filters tend to clog and are not considered for trash capture.

Catch basin opening covers such as coarse screens (Figure 6) can be placed at the opening of the catch basins will prevent the deposition of the trash and will not be carried to the waterbody through the storm drain system. They are typically manufactured of galvanized steel. One potential concern is the clogging of the screens by the trash and debris that may result in flooding street infrastructure. WPD engineers observations in November 2000 indicate that the experimentally installed coarse screens did not clog. If catch basin inserts are removed during the rainy season, their effectiveness is minimized. An alternative solution may be to use modified coarse covers that hydraulically open when runoff is detected. However, examination of this type of screens has not been performed.

Typical cost for a catch basin opening cover is $400/unit for the conventional type or $1,500 for the hydraulic-open type. Therefore, the capital costs per acre of drainage area are $65/acre and $250/acre respectively. The operation and maintenance on these units is very minimal, especially if they do not need to be removed during the rain season.

Other trash capture systems include screening vaults and end-of-pipe trash capture screens or cages. These systems have been developed by WPD. The first type is used extensively for trapping trash as a part of the low-flow diversion structures installed in the City. This system is not considered for use during the rain season because of its limitation in intercepting trash from large flow-rates. The second configuration is currently been used and tested in trapping trash at five storm drain outlet locations in the Los Angeles River. This system uses a 5-mm metallic mesh to trap trash on the riverbank and upstream open drain.

Finally, various designs of booms have been used for in-stream trash control. One type of booms that is used in Los Angeles River and Ballona Creek consists of floatable nets that are placed against the flow.

Table 7 summarizes and compares the advantages and disadvantages of the various structural control measures currently available.

Table 6. Institutional Controls

	Ticketing/ Citations	Increase Trash Receptacles	Additional Catch Basin Cleaning	Enhanced Street Sweeping
Description	Enforce anti-littering laws. Educate existing staff on importance of ticket writing. Hire more ticketers or require other code enforcement employees to issue more tickets for littering.	Require trash cans near commercial establishments such as restaurants, liquor and convenience stores, venders, industrial strips, etc. Add cans at every bus stop, shuttles, etc. Add lids to beach cans and cig. butt holders to all cans.	Spatial and temporal analysis to target proper timing and catch basin locations. More intense cleaning during August –October	Sweep more frequently areas that have high trash problems. Increase sweeping before and during beginning of rain season.
Cost	Enforcement staff salary range: $50-100K depending on class. $ 20,000 for educational program.	Cost/can = $67.00 O&M/can/year = $750.00	Additional research required	Additional research required
Advantages	• Change in public attitudes • Easy implementation	• Limited City costs • Business awareness • Aesthetic improvements	• Optimize catch basin cleaning operation • Can potentially be cost neutral	• Optimize street sweeping operation • Can be cost neutral if sweeping is shifted from low to high trash areas •
Disadvantages-Restraints	• Partial solution • Public resistance • Can't cite homeless • Lag time between implementation and significant change in behavior	• Resistance by businesses • Regulatory requirements	• Unknown trash reduction • May require overtime during fall	• Unknown trash reduction • May require overtime during fall

Table 6. Institutional Controls (cont.)

		TARGETED OUTREACH PROGRAMS			
	Limit High Litter Items	**Educational Outreach**	**Neighborhood Outreach**	**1-800 Hotline Number**	**BIDs**
Description	Possible bans or restrictions on the following high pollutant items in the City of LA: Styrofoam cups (cfc products), plastic grocery bags, six-pack rings, balloon releases, smoking on the beach.	Develop targeted outreach programs.	Target high trash areas, such as central, high-density neighborhoods, etc. City supported community clean-up days such as Op. Clean Sweep or "Trash-Free Zone." Join effort with community/enviro n-mental activists.	Post public hotline number on "No Dumping" signs, trash cans, buses, and city vehicles. Respond to public reports of litterbugs, full trash cans, etc. Include letter from police for litterbug violations.	Educate Business Improvement Districts (BIDs) to include sidewalk sweeping.
Cost	Minimal costs for staff to prepare ordinance packages.	$1.0 M/yr in outreach campaign	$ 90,000 - $100,000 per collection event	Use current BOS staffing for hotline. Minimal cost for police letter	Negligible cost to educate BIDs
Advantages	• Immediate protection of wildlife • Eliminates most visible trash • Low Cost	• Educate the general public • Stops trash/litter at the source	• Enhance community pride • Targets high trash areas • Educates public	• Neighborhood improvement • Awareness on proper disposal	• Increase property values
Disadvantages-Restraints	• Politically controversial • Impact to businesses	• Advertising time and space is expensive • Difficult to quantify results • Lag time between education and significant change in behavior	• Requires City oversight and resources	• New staffing requirements • Must witness violation in order to be effective	• New responsibilities for shop-owners • Potential subsidy cost to City

Table 7. Structural Trash Control Systems

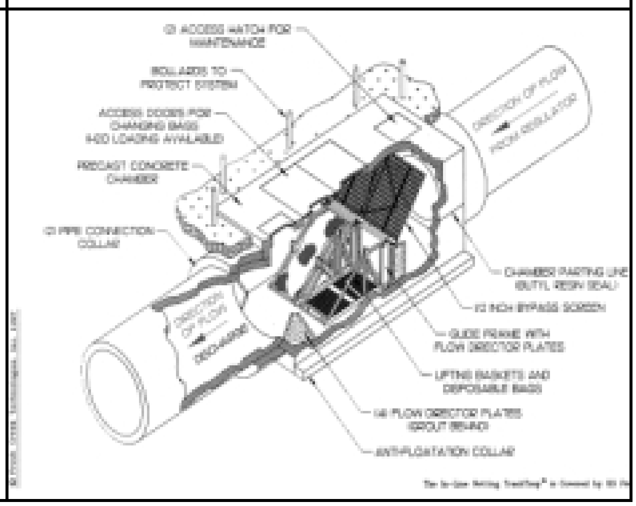
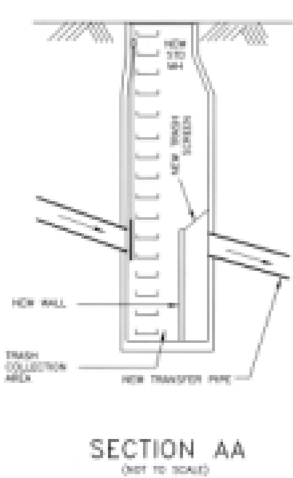
	Continuous Deflective Separation (CDS™)	Netting TrashTrap™ (Fresh Creek Inc)
Performance	Remove almost all trash and floatables, which are one-half the size of the screen opening, or larger. There is no removal for the high flow that is bypassing the unit. Removal of 70-80% TSS (Total Suspended Solids).	The nets are designed to hold up to 0.7 m^3 (25 ft^3) of floatables (90 to 97% of floatable capture) and a weight of 227 kg (500 lbs)
Cost	Capital: $300,000 for a 26-cfs unit $600,000 for 62-cfs unit O&M:$20,000/unit/yr (10 cleanings/yr)	Capital: $330,000 for 62-cfs unit (NJ) $300,000 for 130-cfs unit (Cleveland) O&M: $20,000/unit/yr, (10 cleanings)
Advantages	• Separation Screen does not clog and requires no power or supporting infrastructure • Placed below ground and City's right-of-way • Maintenance using Vactor equipment for smaller units • Treatment capacity of 1.1 to 62 cfs • Proven Technology	• Applicability to a wide spectrum of weather conditions. • Placed below ground and City/County right-of-way • Multiple nets used for larger pipes • Widely used in CSSs
Disadvantages/ Restraints	• Major capital expense • Head loss and land prohibitive for selected locations • Require use of crane for trash pick-up • Stagnant water, possible odors and aesthetic impact • Difficult to retrofit or install in built-up areas	• Major capital expense • Land prohibitive for selected locations • Requires crane for trash pick-up • Possible odors and aesthetic impact • Difficult to retrofit or install in built-up areas
Picture/Schematic		

Table 7. Structural Trash Control Systems (cont.)

	Catch Basin Inserts	Catch Basin Opening Covers	End of Pipe Screens/Cages
Performance	If appropriately sized can trap nearly all floatables. If liner is clogged, overflow will carry floatables.	No removal if covers are removed during rain season. Items smaller than the screen can still be deposited in the catch basin.	Performance has not been tested. Five cages will be installed in Los Angeles River (Summer 2001) are designed to capture trash >5mm
Cost	Capital: $600 per unit O&M: $2000/unit/yr	**Capital (simple):** $400 per unit, **Capital (automatically opened)**: $1,500 per unit, O&M: $100/unit/yr	Capital: $5,000 for each cage O&M:$20,000/unit/yr (10 cleanings per year)
Advantages	• Inexpensive to retrofit • Can be used to trap oil and grease and sediments • Easily implementation	• Inexpensive to retrofit • Easy implementation, minimum construction	• Relatively inexpensive • Simple design and installation • Maintenance using Vactor equipment for smaller units
Disadvantages/ Restraints	• Frequent maintenance and cleaning • Periodic replacement • Overflow will occur if liner is clogged • Multiple units required for subwatershed	• Potential flooding concerns • Not effective if opened during rain season	• Aesthetically unpleasant • Makes trash more visible and adversely impacts recreational uses of the River • Not fully enclosed and may let trash escape • Some outlets are below LA River surface elevation and will result in trash escaping
Picture/Schematic			

Table 7. Structural Trash Control Systems (Cont.)

	Screening Vaults	In-stream Booms and Nets	Others
Performanc e	Can trap most trash, but will allow smaller items to pass through. No testing has been done.	Currently designed nets only catch ~ 80% trash in 1-2 year storms (net only 5 feet deep)	Systems such as outlet screening devices can be installed for large, rectangular outlets into the Los Angeles River. They can conceivably trap most of the trash.
Cost	Capital: $50,000 per location for smaller locations O&M: $10,000/unit/yr	Capital: Net = $60,000 (replace every 2 years) Boom = $700,000 (estimate) O&M: unknown	**Capital:** $3 million per unit **O&M:** $50,000 per unit/year (10 cleanings/year)
Advantages	• Relatively inexpensive • City has used them for screening trash in low-flow diversion projects	Nets: • Low Cost • Easily Removed Both Net & Boom: • Targets entire flow • Shared costs with other entities	• Inexpensive unit cost per cfs
Disadvantages Restraints	• Energy loss through the unit limits its applicability for many locations	Nets: • Only good for small storms • Difficult to retrieve debris Both Net & Boom: • Possible aesthetic issue • Needs more research	• LA County owns the large outlets. Coordination is needed. • New and innovative engineering designs are needed • Screens will not meet LARWQCB standard of 5 mm
Picture/Schematic			Schematic Not Available.

Approach for Developing a Trash Control Strategy

The identification of the trash control measures and the overall trash reduction strategy requires the coordination and cooperation of multiple local agencies, private and non-profit institutions, and the general public. This section does not identify the specific trash control measures but rather provides a discussion for the selection of the control measure. It presents selection criteria, the team approach that will be used, and the framework to develop the trash control strategy.

Criteria for Selection

A technically-based approach to the selection of the trash control strategy can assist in meeting our goals while minimizing adverse impacts such as cost. The following criteria and factors can be used in developing such an approach.

- <u>Effectiveness</u> of the proposed control measure defines the relative amount of trash captured with respect to the total targeted amount and is usually expressed as a ratio or a percentage. The effectiveness of operational and institutional controls is typically hard to quantify. For structural or engineered systems the effectiveness is better known or would be relatively easier to quantify. Pilot studies in control settings can be designed to evaluate the effectiveness as well as other parameters such as cost.

- <u>Cost</u> is the other major factor. It should include real estate, design, construction, start-up, training, operation, maintenance, and other costs associated with the implementation of a control measure or system.

- <u>Regulatory compliance</u> such as the current TMDL requirement is a major consideration. However compliance with the LARWQCB's TMDLs that requires full capture and zero trash emissions is not a deciding criterion because it is not attainable. Basic environmental economics dictate the allocation of infinite resources to achieve zero pollution. Attempts to meet the TMDL requirement as currently proposed would result in high expenditures per trash removed without attaining the listed numerical targets. It is anticipated however that a better-quantified and attainable TMDL limit be established.

- <u>City Council mandate</u> requires that by 2008, there will a 60% reduction of the trash deposited in local waterbodies.

- <u>Neighborhood trash reduction</u> for aesthetic reasons can only be accomplished through source control measures such as the operational and institutional controls. Structural and engineered systems can't be considered for preventing and reducing the presence of trash on local streets, sidewalks, etc.

- Regulatory and community compatibility with safety, buildings and environmental standards, as well as with local conditions is required prior to implementing a specific control. For example, specific trash capture systems may encourage growth of bacteria, pests, and other vectors.

- Site specificity is another factor to consider in order to maximize trash removal while minimizing costs. Different BMPs need to be applied at different locations.

Team

WPD staff is currently coordinating with other City agencies in developing the City's strategy to reduce trash. As part of the TMDL-Technical Advisory Committee, the Trash Reduction Group has been formed. This group which was formed in response to the newly enacted trash TMDLs, consists of the following City agencies:

- Council Legislative Affairs Office
- Department of Public Works, Bureau of Sanitation
- Department of Public Works, Bureau of Street Services
- Department of Recreation and Parks
- Environmental Affairs Department
- Los Angeles Police Department

The Trash Reduction Group has embarked on conducting seven pilot studies to examine the effectiveness of a number of control options. It is proposed, in conjunction with these studies, that a trash management plan be developed to select the appropriate control measures for the high trash-generation areas.

Framework for Selecting Controls

Table 6 that was presented in the previous chapter can be used as a framework for institutional controls throughout the City and for targeting high trash-generation areas. However, additional studies are needed to determine the effectiveness of these programs. An approach, that the City can use, is to pilot selected institutional controls for a specific part of the City. In these pilot studies, the City should track trash reduction and cost, as well as identify major constraints for wider implementation. Other approaches in evaluating the institutional controls include contacting other municipalities to learn about their experience, as well as extrapolating from our current experience. Prospective institutional controls have to be examined for implementability, compliance with regulations, public acceptance, and funding availability. It is further recommended that these institutional controls be primarily studied and implemented for the most impacted communities identified earlier and shown in Map 4.

Structural Controls should generally be limited to high trash-generation areas. Furthermore, to meet the City Council mandate of 60% reduction, structural controls such as catch basin technologies and inexpensive end-of-pipe trash capture systems can be employed in high trash-generation areas. End-of-Pipe systems should be placed on outlets of the sub-basins with high trash-generation rates as shown in Map 3. In contrast catch basin-type systems can be placed along any areas known to generate trash, especially selected commercial, industrial and transportation strips or areas with high pedestrian traffic. For these structural controls the primary factors that will determine the selected type is cost and effectiveness. Some of these systems will be examined as part of the pilot studies currently being executed by the Trash Reduction Workgroup. Upon conclusion of these studies, there will be a better understanding of the cost, effectiveness, and implementability of these options.