Preliminary Investigation (PI-0240)

Caltrans Division of Research, Innovation and System Information

Use of Vegetation to Control Trash in Freeway Right of Way

Requested by
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October 25, 2019

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Executive Summary

Background

The February 2019 issuance of a cease and desist order (CDO) adopted by the San Francisco Bay Regional Water Quality Control Board requires the California Department of Transportation (Caltrans) to implement controls to meet full trash capture equivalency in significant trash-generating areas within Caltrans' freeway right of way (ROW). To aid in its compliance with the CDO, Caltrans is seeking information about methods—specifically, the use of vegetation—to control the discharge of trash from Caltrans freeway ROW to less than significant levels and allow for the capture of trash.

To assist Caltrans in this information-gathering effort, CTC & Associates conducted an online survey of state departments of transportation (DOTs) and selected regional agencies that sought information about these agencies' experiences and practices associated with the use of vegetation to control the discharge of trash in the ROW.

Summary of Findings

Survey of Practice

An online survey was distributed to state DOT members of two American Association of State Highway and Transportation Officials (AASHTO) committees—the Committee on Design and the Committee on Environment and Sustainability. Potential respondents from two regional agencies also received the survey. Representatives from 17 state DOTs and one regional agency responded to the survey.

Only two responding agencies reported on experience with the use of vegetation to control trash. The respondent from one of these agencies—Mile High Flood District—noted that his survey responses related to waterways and open channels, not the roadway ROW specifically addressed by the survey.

Trash Control Provision or Regulation

Four agencies reported on a trash control provision or regulation that regulates agency activities:

- In New York, the current State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from municipal separate storm sewer systems (MS4) is due for renewal soon. Proposed changes require a street sweeping frequency and catch basin inspection and cleaning efforts the respondents described as "significant" and "costly." The current permit also requires the DOT to inspect stormwater outfalls for illicit discharges (including trash and debris) and eliminate the discharges.
- Ohio DOT is required to maintain the state's roadways as specified in the Ohio Revised Code.
- The Virginia DOT respondent highlighted the MS4 General Permit issued by the Virginia Department of Environmental Quality (DEQ) and Minimum Control Measure 6, which describes the requirements for "pollution prevention and good housekeeping for facilities owned or operated by the permittee within the MS4 service area."

- Washington State DOT is required to coordinate with the Washington Department of Ecology's Solid Waste Division on coordinating and accomplishing cleanup activities.

Agency Case Studies

Respondents from two agencies—Ohio DOT and Mile High Flood District—reported on experience with the use of vegetation to control the discharge of trash. It's important to note that the Mile High Flood District respondent qualified all responses as being specifically related to in-stream trash removal and vegetation practices. Excerpts from the case studies describing survey responses are provided below.

Ohio DOT. Below are highlights from the case study that begins on page 7:

- *Site conditions*. Cut slopes are typically used with a horizontal-to-vertical (H:V) steepness of 3H:1V or flatter. Successful runoff conveyances include grass- and rock-lined ditches and sheet flow. Also helpful is a reduction in the amount of bare ground under guardrails, which allows the grass to capture litter where it can be more easily removed.
- *Vegetation use*. The agency uses roadside grass at a height of 12 to 18 inches with an 82 percent cover in the ROW to achieve a level of effectiveness estimated at 11 to 30 percent.
- *Maintenance*. When grass reaches 12 inches, it is mowed to a height of 6 inches. The median and edges of the roadway are mowed multiple times each year. The area 30 feet beyond the edge of the roadway is mowed once a year.
- *Trash collection*. Agency crews pick up trash before mowing and at other times when needed. In-house forces are mobilized in response to a complaint call or when a large amount of litter is identified. Adopt-A-Highway (AAH) and inmate crews also participate in litter collection.

Mile High Flood District. Below are highlights from the case study that begins on page 8:

- *Site conditions*. Cut and fill slopes (cut is more typical) have a steepness of 4H:1V or flatter. Most channels are built to a maximum 3H:1V slope. Grass-lined ditches have been successful when used in conjunction with vegetation.
- *Vegetation use*. The agency uses wetland vegetation at a height of less than 3 feet and a 90 to 100 percent cover to achieve a level of effectiveness estimated at 51 to 70 percent.
- *Maintenance*. The agency does not mow, relying instead on vegetation and root structure to provide structural stability, prohibit noxious vegetation and improve water quality.
- *Trash collection*. The most frequent collection period is weekly, but it can be once every four to six weeks depending on the creek or river.

Other Respondent Feedback

While noting that their agencies did not have policies and practices to specifically manage vegetation in the ROW to control the discharge of trash, the respondents from two agencies commented more generally, and in one case, rather expansively, on agency practices.

- *Indiana DOT*. The respondent noted that the DOT does not manage vegetation to prevent the discharge of litter from ROW, though its management practices do impact, to some extent, where the litter ends up within the ROW.
- *New York State DOT*. While indicating that their agency does not "consciously manage the roadway to control trash," the respondents provided background information about agency practices and their personal perspectives on vegetation as a method to control trash. The case study presenting these responses begins on page 9.

Other Practices Used to Control the Discharge of Trash

Respondents reported on other practices their agencies employed to control the discharge of trash from roadway ROW, including:

- Working with AAH and state beautification groups, contracted labor and prisoners to collect trash.
- Using mechanical devices to remove trash.
- Implementing stormwater best management practices such as check dams within swales that trap debris, sand oil separators, trash racks at outlets and vegetative filter strips.

Gaps in Findings

Almost all agencies responding to the survey reported no experience with the use of vegetation to control trash in the ROW. One of the two respondents reporting on the use of vegetation to control trash qualified his responses by noting they applied to waterways and in-stream trash removal and not the roadway ROW of interest to Caltrans. Reaching out to agencies not participating in the survey, particularly transportation agencies with densely populated areas adjacent to waterways, could provide useful information about other agency experience and practices.

Next Steps

Moving forward, Caltrans could consider:

- Consulting with the two respondents reporting experience with the use of vegetation to control the discharge of trash (Ohio DOT and Mile High Flood District) to learn more about agency practices.
- Reaching out to selected agencies not responding to the survey to determine if these agencies have relevant experience.
- Investigating a possible research effort that examines the impact of various types of vegetation in controlling the discharge of trash from roadway ROW as envisioned by Caltrans.

Detailed Findings

Background

The February 2019 issuance of a cease and desist order (CDO) adopted by the San Francisco Bay Regional Water Quality Control Board requires the California Department of Transportation (Caltrans) to implement controls to meet full trash capture equivalency in significant trash-generating areas within Caltrans' freeway right of way (ROW). To aid in its compliance with the CDO, Caltrans is seeking information about methods—specifically, the use of vegetation—to control the discharge of trash from Caltrans freeway ROW to less than significant levels and allow for the capture of trash.

Information gathered through this Preliminary Investigation and other information-gathering efforts will be used to develop guidance to assist Caltrans in identifying the minimum parameter to be met when designating vegetated areas in significant trash-generating areas of freeway ROW as areas where the vegetation controls the discharge of trash to less than significant levels.

To assist Caltrans in its information-gathering efforts, CTC & Associates conducted an online survey of state departments of transportation (DOTs) that sought information about agency experience with and practices for the use of vegetation to control trash in roadway ROW. Selected regional agencies were also surveyed.

Survey of Practice

An online survey was distributed to state DOT members of two American Association of State Highway and Transportation Officials (AASHTO) committees—the Committee on Design and the Committee on Environment and Sustainability. Potential respondents from two regional agencies—the city and county of Honolulu and Mile High Flood District (formerly Urban Drainage and Flood Control District) in metropolitan Denver—were also provided with the survey.

The survey questions are provided in Appendix A.

Summary of Survey Results

Seventeen state DOTs responded to the survey:

- Arizona (two responses).
- Arkansas.
- Connecticut.
- Indiana.
- Kansas.
- Minnesota.
- Montana.
- Nevada.
- New York.
- Ohio.
- Oklahoma.
- Oregon.
- Pennsylvania.
- Utah.
- Virginia.
- Washington.
- Wyoming.

One of the two regional agencies contacted—Mile High Flood District—also responded. (While the flood district respondent responded to all questions, he qualified his responses by noting that all responses "relate to waterway[s]/open channels.")

Survey results are summarized below in the following topic areas:

- Trash control provision or regulation.
- Agency case studies.
- Other practices used to control the discharge of trash.

Trash Control Provision or Regulation

Only four agencies reported on a trash control provision or regulation that regulates agency activities:

- In New York, the current State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from municipal separate storm sewer systems (MS4) requires New York State DOT to track miles of streets swept and number of catch basins cleaned but does not set goals or target volumes. The current permit also requires the DOT to inspect stormwater outfalls for illicit discharges (including trash and debris) and eliminate the discharges. The SPDES permit is due for renewal soon. Proposed changes require a street sweeping frequency and catch basin inspection and cleaning efforts the respondents described as "significant" and "costly."
- Ohio DOT is required to maintain the state's roadways as specified in the Ohio Revised Code (see Section 5501.31 cited in Related Resources below).
- The Virginia DOT respondent highlighted the MS4 General Permit issued by the Virginia Department of Environmental Quality (DEQ) and Minimum Control Measure 6, which describes the requirements for "pollution prevention and good housekeeping for facilities owned or operated by the permittee within the MS4 service area." The respondent also mentioned unspecified solid waste regulations and the DEQ's Construction General Permit for active construction sites as providing guidance for the agency's trash control activities.
- Washington State DOT is required to coordinate with the Washington Department of Ecology's Solid Waste Division on coordinating and accomplishing cleanup activities. (The respondent did not provide the provision or regulation requiring this coordination.)

Related Resources

New York

Title 8, State Pollutant Discharge Elimination System, Article 17, Water Pollution Control, The Laws of New York, New York State Senate, undated.
https://www.nysenate.gov/legislation/laws/ENV/A17T8
This law describes the rules and regulations, permit issuance, and additional terms and conditions for those applying "for a permit to discharge pollutants into the waters of the state."

Ohio

Section 5501.31, Director of Transportation—Powers and Duties, Title 55 LV Roads—Highways—Bridges, Ohio Revised Code, 2013.
http://codes.ohio.gov/orc/5501.31
This is the regulation cited by the respondent when asked about the trash control provisions or regulations guiding DOT activities.

Virginia

2018 MS4 General Permit, Virginia Department of Water Quality, 2018.
https://www.deq.virginia.gov/Portals/0/DEQ/Water/PollutionDischargeElimination/MS4/20181106_2018_Virginia_MS4_General%20Permit_ADACompliant%20(1).pdf?ver=2019-03-08-160940-160
See page 18 of the report (page 20 of the PDF) for the requirements associated with Minimum Control Measure 6, pollution prevention and good housekeeping for facilities owned or operated by the permittee within the MS4 service area.

General information about the MS4 General Permit is available at https://www.deq.virginia.gov/Programs/Water/StormwaterManagement/VSMPPermits/MS4Permits.aspx.

Construction General Permit, Virginia Department of Environmental Quality, undated.
https://www.deq.virginia.gov/programs/water/stormwatermanagement/vsmppermits/constructiongeneralpermit.aspx
This web site provides information about the issuance of this permit, who must apply and development of a site-specific Stormwater Pollution Prevention Plan.

Agency Case Studies

Respondents from two agencies—Ohio DOT and Mile High Flood District—reported on experience with the use of vegetation to control the discharge of trash. It's important to note that the Mile High Flood District respondent qualified all responses as being specifically related to in-stream trash removal and vegetation practices. Below are case studies summarizing the survey responses from these agencies.

Ohio Department of Transportation

Site Conditions:	Cut slope steepness has a horizontal-to-vertical (H:V) ratio of 3H:1V or flatter.
Runoff Conveyances:	The agency has found the following runoff conveyances to be successful when used in conjunction with vegetation: • Grass-lined ditch. • Rock-lined ditch. • Sheet flow. The agency is reducing the amount of bare ground under guardrails, which allows the grass to capture litter where it can be more easily removed.
Other Factors Considered in Conjunction With Vegetation:	Typically, the agency reduces its mowing on rural sections of highway to only one mowing per year on back slopes and bench areas, and multiple times on the foreslopes. Mowing the near road section multiple times each year creates a grass wall that captures the trash and prevents it from entering the woody area of the ROW.
Other ROW Controls:	None.

Use of Vegetation:	The agency uses roadside grass at a height of 12 to 18 inches with an 82 percent cover in the ROW. *Level of effectiveness*: 11 to 30 percent.
Maintenance Practices:	*Height of grass when mowing takes place*: 12 inches. *Height of grass after mowing*: 6 inches. *Time of year for mowing period*: The median and edges of the roadway are mowed multiple times each year. The area 30 feet beyond the edge of the roadway is mowed once a year. *Frequency of mowing*: See above.
Trash Collection Practices:	Agency crews pick up trash before mowing and at other times when needed. In-house forces are mobilized in response to a complaint call or when a large amount of litter is identified. The agency also maintains 1,400 Adopt-A-Highway (AAH) groups that pick up litter four times a year; 20 inmate litter crews pick up litter daily.

Mile High Flood District

Note: As the respondent indicated, the information below and other feedback from the Mile High Flood District respondent appearing in this Preliminary Investigation relate to waterways and open channels.

Site Conditions:	Cut and fill slopes (cut is more typical) have a steepness of 4H:1V or flatter. Most channels are built to a maximum 3H:1V slope.
Runoff Conveyances:	Grass-lined ditches have been successful when used in conjunction with vegetation.
Other Factors Considered in Conjunction With Vegetation:	The agency also considers the slope of the channel, velocity of water and sources of trash.
Other ROW Controls:	Ineffective flow areas, SAFL baffles (porous baffles that fit into new or existing sumps and keep sediment out of downstream water bodies) and water quality treatment best management practices are also used.
Use of Vegetation:	The agency uses wetland vegetation at a height of less than 3 feet and a 90 to 100 percent cover. *Level of effectiveness*: 51 to 70 percent.
Maintenance Practices:	The agency does not mow, relying instead on vegetation and root structure to provide structural stability, prohibit noxious vegetation and improve water quality.

Trash Collection Practices:	Practices depend on the creek or river. The most frequent collection period is weekly but can be once every four to six weeks.

Other Respondent Feedback

While noting that their agencies did not have policies and practices to specifically manage vegetation in the ROW to control the discharge of trash, the respondents from two agencies commented more generally, and in one case, rather expansively, on agency practices.

- *Indiana DOT*. The respondent noted that the DOT does not manage vegetation to prevent the discharge of litter from ROW, though its management practices do impact, to some extent, where the litter ends up within the ROW.
- *New York State DOT*. While indicating that their agency does not "consciously manage the roadway to control trash," the New York State DOT respondents provided background information about agency practices and their personal perspectives on vegetation as a method to control trash. These survey responses are presented below using the same format as the preceding case studies.

New York State Department of Transportation

Site Conditions:	Though the agency doesn't manage the roadway to control trash, the respondents noted that "fill slopes adjacent to the road would help contain the trash near the road for easier pickup."
Runoff Conveyances:	The respondents noted that "[i]n theory, if left unmowed, a grass-lined ditch should trap trash" and a "rock-lined ditch traps debris within the rock voids."
Other ROW Controls:	Adjacent land use can come into play when attempting to control trash in the ROW, especially where facilities are adjacent to residential areas. The agency uses vegetation for screening and to enhance or "soften" the appearance of noise walls and fencing typically installed in more built-up areas. These installations can inadvertently aid in trash trapping and facilitate its pickup on the ROW.
Use of Vegetation:	While vegetation is installed and present for many reasons that would assist in trash collection control, the agency does not have a formal program for vegetation installation to control trash in the ROW. Standard roadside vegetation is managed at varying intensities (height and variety) at different locations along the ROW; special features such as living snow fences may also contribute to litter and debris collection although these features are typically managed for other criteria. The respondents noted no specific height that the agency would "consciously consider" to control the discharge of trash from the ROW. In some cases, the agency has avoided the introduction of vegetation so that trash will blow up against fences, removing the

need for workers to work their way through a lot of vegetation to remove the trash.

Level of effectiveness: 0 to 10 percent.

Maintenance Practices:

Height of grass when mowing takes place: Primary criteria for timing of mowing is not specifically by height but considerations such as maintaining safety (sight distances), preventing growth that will become trees, and supporting the function of the roadway and wildlife.

Height of grass after mowing: Height can vary, but the agency currently recommends mower deck heights of 6 inches.

Time of year for mowing: Generally, May through October. However, mowing in areas outside of the immediate safety zone (approximately 15 feet off pavement) may have time restrictions to support certain endangered species (such as Karner blue butterfly), pollinator species and migratory birds.

Frequency of mowing: One to three times per year for the safety zone (approximately 15 feet off pavement) based on highway type and needs. Annually in clear zone and other targeted mowing areas (30 feet or more off pavement). Other criteria or circumstances may increase mowing frequencies.

Trash Collection Practices:

AAH program participants collect litter four times per year. Maintenance forces collect litter on an as-needed basis and as resources are available to perform the work. Litter is collected to make the highway more visually appealing and to keep litter from:

- Blowing onto the highway and perhaps cause an accident.
- Damaging mechanical mowing equipment.
- Multiplying after being mowed over.

These criteria also prevent litter and debris from entering drainage and stormwater systems.

Other Practices Used to Control the Discharge of Trash

Respondents reported on other practices their agencies employed to control the discharge of trash from roadway ROW. The following summarizes survey responses:

- AAH groups that collect trash (Arizona, Montana, Oklahoma, Pennsylvania, Virginia and Wyoming).
- Mechanical devices that remove trash (not as successful as hand picking) (Minnesota).
- Roadway maintenance contracts requiring trash pickup before mowing (Virginia).
- State programs with private participation (for example, Keep Oklahoma Beautiful) (Oklahoma).
- Stormwater management practices:
    - Check dams within swales that trap debris (New York).
    - Development of catch basin lid that does not allow litter to enter (Ohio; see *Related Resource* below).

    - Sand oil separators (Nevada).
    - Trash racks at outlets (New York).
    - Trash racks in stormwater management facilities, which also help retain trash that is removed during maintenance (Virginia).
    - Vegetated conveyance systems (not intended as a trash control practice, but they often collect trash that is generally removed prior to mowing) (Virginia).
    - Vegetative filter strips used to trap sediment that could also trap debris if left unmowed (New York).
- Use of contract labor (Arizona, Oklahoma).
- Use of prisoners (Oklahoma (program discontinued a few years ago), Pennsylvania).
- Other practices:
    - Chain link fences with barbed wire to retain trash in rural areas (Arizona).
    - Partnering with local law enforcement to give away tarps for trucks at landfills (Ohio).

Related Resource:

Catch Basin Inserts for Ohio Roadways, Tom Dietrich, Mark McCabe and Kathryn Gruver, Ohio Department of Transportation, September 2018.
https://cdm16007.contentdm.oclc.org/digital/collection/p267401ccp2/id/17091
From the abstract: Detailed evaluation of roadside catch basin inserts (CBIs) for the removal of total suspended solids (TSS). Study consisted of both field and laboratory testing. Field testing evaluated the installation, maintenance and removal needs for CBIs during a year-long installation period. The [l]ab testing evaluated the sediment retention associated with each CBI. Since none of the units met both the sediment removal and installation requirements, and due to the high effort and cost to maintain, the CBIs tested do not appear to be a viable option to be added as post-construction stormwater best management practices (BMPs) for Ohio Department of Transportation (ODOT).

Contacts

CTC contacted the individuals below to gather information for this investigation.

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Appendix A: Survey Questions

The following survey was distributed to members of two American Association of State Highway and Transportation Officials (AASHTO) committees: Committee on Design and Committee on Environment and Sustainability. Potential respondents from the city and county of Honolulu and Mile High Flood District (formerly Urban Drainage and Flood Control District) in metropolitan Denver were also provided with the survey.

Use of Vegetation to Control Trash in Roadway Right of Way

1. Is there a trash control provision and/or regulation that regulates your agency's activities?
    - No
    - Yes (please describe these requirements)

Note: The response to the question below determines how a respondent is directed through the survey.

(Required) 2. Does your agency have experience with the use of vegetation in roadway right of way (ROW) to control the discharge of trash from the ROW?
    - Yes (directs the respondent to **Site Conditions Affecting Trash Control**)
    - No (directs the respondent to **Agencies With No Experience Using Vegetation to Control Trash**)

Agencies With No Experience Using Vegetation to Control Trash

Has your agency employed practices other than the use of vegetation to control the discharge of trash from roadway ROW?

- No
- Yes (please describe these practices)

Note: After responding to the question above, this group of respondents is directed to **Wrap-Up**.

Site Conditions Affecting Trash Control

1. Please describe below the general site conditions most conducive to controlling the discharge of trash from roadway ROW.
    - Type of slope (select all that apply)
        - Cut
        - Fill
    - Steepness of slope (select all that apply)
        - 4H:1V or flatter
        - 4H:1V to 2H:1V
    - Other site conditions (please describe)

2. Please describe the other factors that are considered when using vegetation to control trash (for example, urban/rural, traffic volume and adjacent land use).
3. Please identify below the type(s) of runoff conveyance your agency has found to be most successful when used in conjunction with vegetation to control the discharge of trash from roadway ROW. Select all that apply.
    - Grass-lined ditch
    - Rock-lined ditch
    - Sheet flow
    - Subsurface drains
    - Unlined ditch
    - Other (please describe)
4. What types of control other than vegetation are in place at sites where your agency has had success in controlling the discharge of trash from roadway ROW? Select all that apply.
    - No other types of control
    - Chain link fence
    - Wire mesh fence
    - Other type of fence
    - Sound wall or retaining wall
    - Other (please describe)

Vegetation Used for Trash Control

1. Please describe below the vegetation your agency uses in roadway ROW to control the discharge of trash.
    - Types of vegetation
    - Height of vegetation
    - Density of vegetation (percent cover)
2. Please estimate the degree to which vegetation has controlled the discharge of trash from roadway ROW under your jurisdiction.
    - 0% to 10%
    - 11% to 30%
    - 31% to 50%
    - 51% to 70%
    - Higher than 70%
3. If available, please provide links to documentation related to your agency's use of vegetation to control trash in roadway ROW. Send any files not available online to chris.kline@ctcandassociates.com.

Maintenance Practices

1. Please describe below your agency's mowing practices for roadway ROW.
    - Height of grass when mowing takes place

- Height of grass after mowing
- Time of year for your agency's mowing period
- Frequency of mowing

2. Please describe how often your agency's maintenance crews collect trash in roadway ROW for each applicable time period below.
    - Every week
    - Every two weeks
    - Every month
    - Every two months
    - Every three months
    - Every six months
    - Every year
    - Other (please describe)

Wrap-Up

Please use this space to provide any comments or additional information about your previous responses.