Best Management Practices (BMPs) for
Site-specific Non-water Release Corrective Action Plans
(Discussion Draft September 28, 2010)

California Department of Resources Recycling and Recovery (CalRecycle)

Introduction

New regulations adopted in December 2009 require the owners or operators of all disposal facilities that were or are required to be permitted as solid waste landfills and have been or will be operated on or after July 1, 1991 to provide financial assurance for corrective action based on the highest amount of either the water release corrective action or non-water release corrective action (http://www.calrecycle.ca.gov/lea/Regs/Implement/Postclosure/default.htm). The regulations allow the cost estimates to be based on a site-specific non-water release corrective action plan (CA Plan) in lieu of using costs for replacement of the final cover.

This document identifies the best management practices (BMPs) for development of the CA Plan. The CA Plan is required to provide an assessment of the impacts due to causal events and the associated costs to remediate any impacts. The BMPs define or characterize each causal event to be evaluated for potential damages to a landfill due to the causal event in the CA Plan. Also addressed is the requirement for containment and environmental monitoring and control systems to be maintained to standards, known releases, the requirement to use a third party to develop the plans, and frequently asked questions.

CalRecycle staff has prepared the BMPs to assist owners or operators in preparing the CA Plan. The BMPs will also assist CalRecycle and local enforcement agencies in minimizing resources needed for the regulatory review of the CA Plan. The BMPs do not change the required minimum standards for the siting, design, and operation of a landfill or provide recommendations on the methods for the determination of potential damage, required corrective action activities, and associated costs. It is expected that standard practices and methods will continued to be used to determine the potential damage, the required corrective action activities, and associated costs. The BMPS also do not address potential releases to groundwater or surface water from the disposal site that should be part of the water release corrective action plan which is under the jurisdiction of the Regional Water Quality Control Boards.

General Scope and Applicability of BMPs

Best management practices (BMPs) are practical and effective processes, practices, or techniques to achieve a desired outcome. They are offered as "good ideas" that may need to be adjusted to account for individual needs or site-specific circumstances. BMPs are **not** rules, regulations, or mandatory standards.

The scope of the BMPs is guidance for preparing the site-specific non-water release CA Plan prepared in lieu of using the cost estimates for final cover replacement. (http://www.calrecycle.ca.gov/Laws/Rulemaking/Postclosure/Phase2/default.htm).

The desired outcome for the BMPs for the CA Plan is to develop cost estimates based on sound science, engineering, and professional standards of practice to establish financial assurances ensuring known or reasonably foreseeable corrective actions at solid waste landfills are accounted for with minimal financial risk to the State.

The BMPs do not change the required minimum standards for a solid waste landfill (Class II or III landfill). The BMPs are recommendations to define or characterize a reasonably foreseeable corrective action due to each causal event. A causal event may be defined based on an established design standard that is not the required minimum standard for a solid waste landfill.

Technical Advisory Group

A technical advisory group (TAG) was established to assist CalRecycle staff in the development of the draft BMPs by providing comments, recommendations, and technical analysis and information. The TAG is comprised of stakeholder groups including local enforcement agency, environmental community, Air Resources Board, State Water Resources Control Board, and technical experts in the following areas: seismic, slope stability/soils, landfill cap design and repair, systems for monitoring and collecting landfill gases, leachate systems, erosion due to storms and flooding, and landfill fires. The BMPs may not reflect the views or opinions of the TAG which will be compiled in [provide link to all TAG written comments].

What is Correction Action?

Corrective Action means an activity, including restoring the integrity or establishing the adequacy of a damaged or inadequate containment structure or environmental monitoring or control system, to: bring a landfill into compliance with the applicable minimum standards, prevent a reasonably foreseeable release, or remediate a known release to the environment. The types of structures and systems requiring corrective action would include, but not limited to, cap and cover system, landfill gas monitoring and collection system, slopes, roads, run-on and run-off control (drainage) systems, vegetation and irrigation systems, and environmental monitoring and control systems. Corrective action does not include routine maintenance. Routine maintenance should are required to be addressed the postclosure maintenance plans.

Postclosure maintenance plans are required to include activities and associated costs for the maintenance and for replacement (when the useful life ends) of equipment and structures, including the final cover. Equipment and structures would include the monitoring and control systems for landfill gas and leachate, and drainage systems (27 CCR Sections 21815 and 21840). These activities and estimates are required to be addressed in the CA Plan to ensure that all necessary replacement costs are accounted for and if the item is considered routine postclosure maintenance and not corrective action.

Current regulations (27 CCR Sections 20917-20945) require all active solid waste landfills to have landfill gas monitoring and control systems to comply with the more definitive closed site standards. Furthermore, California Air Resources Board (CARB) pending landfill methane capture regulations will require monitoring and control systems at solid waste landfills. These requirements should minimize reasonably foreseeable landfill gas releases. However, should postclosure land use change, property boundaries be rezoned toward the fill area, or offsite land use is changed to more sensitive use, additional landfill gas monitoring and control measures and financial assurances may be required in the CA Plan. Additionally, landfills with long-term landfill gas violations are required to address the gas violations as a 'known release' in the CA Plan.

Background/ Regulatory Framework

The regulations (27 CCR Section 22221) require the owners or operators of all disposal facilities that were or are required to be permitted as solid waste landfills and have been or will be operated on or after July 1, 1991, to provide financial assurance for corrective action. The owner or operator is required to provide a cost estimate for initiating and completing corrective action for known or reasonably foreseeable releases to water and a cost estimate for the non-water release corrective action. The highest cost estimate, for water release corrective action or non-water release corrective action must be used to determine the amount of required financial assurance.

The cost estimate for the non-water release corrective action can be determined in following ways:

- Costs for replacing the final cover, this cost may be determined by either of the following methods:
  - Cost of removing the existing cover and installing the new cover, or
  - Providing the greater of the most recently approved or recently submitted closure cost estimate adjusted for current costs and the entire landfill; or
- Costs for implementation of a site-specific non-water release corrective action plan.

The regulatory citations are:

27 CCR Section 22101

(a) **Water release corrective action cost estimate**
The operator shall provide a cost estimate for initiating and completing corrective action for all known or reasonably foreseeable releases from the solid waste landfill to water in accordance with the program required by the SWRCB pursuant to Section 20380(b).

(b) **Non-water release corrective action cost estimate**
(1) Effective July 1, 2011, on or before the date of the first permit review or revision or plan review as determined by the schedule in Section 21865, the operator shall also provide a cost estimate for the complete replacement of the final cover. The operator shall calculate this cost in one of the following two ways:

(A) By providing a new estimate of the cost of complete replacement of the final cover, including, but not limited to, the cost of removing the existing cover and preparing for and installing the new cover, as necessary, depending on the replacement final cover system design: or,

(B) By providing the greater of either the most recently approved or most recently submitted closure cost estimate, adjusted, as necessary, to reflect closure of the entire solid waste landfill and current unit costs.

(2) The operator, in lieu of providing a separate corrective action cost estimate pursuant to (b) (1) (A) or (B) may provide a site-specific corrective action plan, as described in Section 22102.

(c) A cost estimate prepared pursuant to (a) or (b) must be a detailed written estimate, in current dollars, of the cost of hiring a third party to perform all applicable corrective action activities for the entire corrective action period.

(d) The operator shall prepare the cost estimates in accordance with the requirements of Section 21815.

(e) The operator shall increase the cost estimate if changes in the corrective action program, corrective action plan, or landfill conditions increase the maximum cost of corrective action.

(f) The operator may only reduce the amount of the cost estimate if the cost estimate exceeds the maximum remaining corrective action costs and the reduction is approved pursuant to (g).

(g)(1) The operator shall provide the cost estimate prepared pursuant to (a) to RWQCB for review and approval and shall provide a copy of this estimate to CalRecycle.

(2) The operator shall provide the estimate prepared pursuant to (b) to RWQCB, EA, and CalRecycle for review and approval in accordance with the schedule in Section 21860.

What must the CA Plan contain?

The non-water release site-specific corrective plan must include an evaluation of the known or reasonably foreseeable non-water release corrective action as a result of each known or reasonably foreseeable causal event. Causal events include earthquakes, flooding, tsunami, seiche, fire, precipitation, and degradation of or otherwise inadequate containment structure or environmental monitoring or control system. The CA Plan must include the following, pursuant to 27 CCR Section 22102:

- An evaluation of the known or reasonably foreseeable non-water release corrective action needed as a result of each known or reasonably foreseeable causal event;

- Cost estimates, prepared pursuant to 27 CCR Sections 22101(c)-(f), for all known or reasonably foreseeable corrective actions described in the plan. The cost estimate with the highest amount must be used to determine the amount of financial assurance required pursuant to 27 CCR Section 22221(b)(2);

- An evaluation of the long-term performance of the final cover system to ensure that it will continue to meet the requirements of 27 CCR Section 21140 without the need for corrective action; and

- Provisions to restore the integrity or establish the adequacy of a damaged or inadequate containment structure or environmental monitoring or control system, to bring a landfill into compliance with the applicable requirements.

The CA Plan must provide all assumptions used, provide references, and, identify the methodologies, models or formulas, used as part of the evaluation for each causal event and the resulting cost estimates. Attachment 2 is an example of how the costs can be summarized for each system or structure; a sheet would be used to address each causal event.

Use of Design Standards to Define Causal Events

Based on the causal event, potential impacts and associated corrective action activities would be required to be evaluated as shown in Attachment 1. CalRecycle staff has determined that reasonably foreseeable corrective action activities based on design standards above the minimum design standards is an appropriate guide for preparation of the CA Plan and the cost estimates. This approach also provides an incentive for owners or operators to use siting and design standards that are more stringent and protective than the minimum standards for solid waste landfills to minimize potential damage and minimize the resulting corrective action due to causal events.

Some TAG members suggested that the minimum design standards for a solid waste landfill be used to define or characterize a causal event. CalRecycle staff rejected the suggestion since applying the existing minimum design standards would not result in any corrective action for the causal event, which is inconsistent with the intent of the regulations.

An example of this approach is that owners or operators of landfills that are designed to the Maximum Probable Earthquake would be required to conduct an analysis of the potential additional damage that may result from a less frequent earthquake design event with higher ground motion, depending on site specific risk factors. A suitable upper bound whereby landfills designed to withstand damage from the event would incur no significant damage is the Maximum Credible Earthquake (or probabilistic earthquake with a very long return period). Landfills that are designed for the Maximum Credible Earthquake would not be required to conduct the seismic analysis and the earthquake causal event would not be considered a reasonable foreseeable causal event. For this causal event, the existing site-specific stability analyses in Joint Technical Document or Closure/Postclosure Maintenance Plans for the representative final cover, interim slope, liner, and global configurations may be required to be updated, revised, or replaced with a new analysis for evaluation of an earthquake that is considered MCE as part of the CA Plan.

The flooding and precipitation causal events are amenable to this approach since the minimum standards have minimum design requirements to address these events as shown in Attachment 1. Other causal events including, tsunami, seiche, and fire do not

have required minimum design standards and are addressed by other approaches relying on the expertise of other governmental agencies regarding these events.

BMPs for Causal Events and Known Releases

The following BMPs provide recommendations how each causal event should be addressed in the CA Plan. As mentioned, causal events include earthquakes, flooding, tsunami, seiche, fire, and precipitation. The location, design, operation and maintenance of a landfill are critical factors in determining if there will be any impacts due to a causal event and to what extent. The principal objective of the CA Plan is to provide cost estimates for corrective action. Solid waste landfills, as well as all structures, are required to be designed and engineered to be able to withstand specific conditions caused by events. To determine if corrective action is necessary, an evaluation must be conducted to determine if the design of the landfill can withstand each foreseeable event. The BMPs contain recommendations for defining or characterizing each causal event so that the required evaluations can be conducted with standard methodologies or standard practices. Potential impacts of each causal event can be found in Attachment 1.

The staff recommendation for defining or characterizing each casual event is provided in the following table.

Causal Event	**BMP to Define or Characterize the Causal Event**	**Design Standard**
Earthquake	Maximum Credible Earthquake Or Probabilistic Evaluation	Maximum Probable Earthquake
Flood	500-Year Flood	100-Year Flood
Precipitation	1000-Year 24-Hr Storm	100-Year 24-Hr Storm
Tsunami	Designated Inundation Zone	Not Applicable
Seiche	Within ½ Mile of Lake	Not Applicable
Fire	Designated Moderate or Higher Fire Hazard, or Contingency Approach for low hazard	Not Applicable

Known Releases

The CA Plan requires an evaluation of the known or reasonably foreseeable non-water release corrective actions needed as a result of each known or reasonably foreseeable causal event (27 CCR Section 22102(a)).The most likely non-water known release to be evaluated is likely to be a long-term landfill gas violation. Others may include corrective action related violations under the Inventory of Facilities Violating State Minimum Standards (see: http://www.calrecycle.ca.gov/SWFacilities/Enforcement/Inventory/Default.aspx).

If there is a known release due to a past causal event, the CA Plan must address the known release, remediation activities, and associated costs.

Earthquakes

An earthquake is a reasonable foreseeable causal event in California. The Working Group on California Earthquake Probabilities predicts that California has more than a 99% probability of an earthquake with a magnitude of 6.7 or greater in the next 30 years. Earthquakes can cause damage to a landfill and associated structures due to ground motions, liquefaction, or fault rupture. Fortunately, there are very few sites on or within 200 feet of Holocene fault zones where fault rupture would likely result in the need for substantial reconstruction corrective action activities and costs. Design standards are used to ensure that a structure is designed to withstand the ground movement and shaking resulting from a certain size earthquake taking into consideration the proximity and the geology between the location of the structure and faults.

Pursuant to 27 CCR Section 20370, a Class III landfill must be designed to withstand the Maximum Probable Earthquake (MPE) and a Class II landfill must be designed to withstand the Maximum Credible Earthquake (MCE). The Los Angeles Regional Water Quality Control Board (RWQCB) has required the MCE for some Class III landfills. On a voluntarily basis or as required by the RWQCB, more Class III landfills are designed to the MCE standard which minimizes potential corrective action and the associated costs due to damage from an earthquake. For a landfill designed to the MCE, any costs should already be accommodated as part of routine postclosure maintenance.

The MPE is defined in Title 27 as, "The maximum earthquake that is likely to occur during a 100-year interval", and the MCE is defined as, "The maximum earthquake that appears capable of occurring under presently known geologic framework". MCEs are required to be used in the design of structures such as dams, bridges, and hazardous waste landfills.

Use of the MPE or MCE is considered to be a deterministic approach in assessing the affects of an earthquake. In a deterministic approach, the evaluation considered the largest and closest fault to determine the level of ground motion. The probabilistic approach is referenced in the more recent building codes. The California Department of Water Resources (DWR) and consultants have stated that the probabilistic approach represents the state-of-the-practice for seismic evaluations. The probabilistic approach considers all possible faults, including the probability of a rupture, and the ground motion is statistically computed.

The following descriptions of the deterministic approach, probabilistic approach, and MCE are from the "Federal Guidelines for Dam Safety", FEMA, May 2005.. Another reference regarding the use of deterministic and probabilistic seismic hazard analysis is

the 'Guidelines for Evaluating and Mitigating Seismic Hazards in California, California Geological Survey, 2008.

"Deterministic Seismic Hazard Analysis (DSHA) The DSHA approach uses the known seismic sources near the site and available historical seismic and geological data to generate discrete single-valued events or models of ground motion at the site. Typically, one or more earthquakes that will produce the greatest ground motion at the site are specified by magnitude and location with respect to the site. Usually, the earthquakes are assumed to occur on the portion of the source closest to the site. The site ground motion parameters (peak ground acceleration/velocity, spectrum intensities, duration of strong shaking, etc.) are estimated deterministically for each source, given the magnitude, source-to-site distance, and site conditions, using an attenuation relationship and/or theoretical models."

"Probabilistic Seismic Hazard Analysis (PSHA) The PSHA approach uses the elements of the DSHA and adds an assessment of the likelihood that ground motions of a given magnitude would occur. The probability or frequency of occurrence of different magnitude earthquakes on each significant seismic source and inherent uncertainties are directly accounted for in the analysis. The possible occurrence of each magnitude earthquake at any part of a source (including the closest location to the site) is directly incorporated in a PSHA. The results of a PSHA are used to select the design earthquake ground motion parameters based on the probability of exceeding a given parameter level during the service life of the structure or for a given return period. Results from the PSHA approach can also be used to identify which combinations of magnitudes and distance (or specific seismic sources) are the largest contributor to hazard. Identification of these controlling earthquakes can then be used in scenario or DSHA analyses. Several of the Federal agencies are currently developing guidelines on procedures to follow when performing a PSHA study."

"Determining Maximum Credible Earthquakes. The MCE for each potential earthquake source, judged to have a significant influence on the site, is established by a DSHA based on the results of a seismtectonic study (site-specific investigations and/or literature review). The MCE for each seismtectonic structure or source area within the region examined is defined preferably by magnitude, but in some cases in terms of epicentral Modified Mercalli Intensity, distance, and focal depth. Earthquake recurrence relationships (i.e., the frequency of occurrence of earthquakes of different sizes if appropriate for the fault) should also be established for the significant seismic sources. For source zones consisting of random seismicity, an MCE can be determined by finding the magnitude and distance that best matches the equal hazard response spectrum from a PSHA in the design earthquake frequency range appropriate for the structure. Judgments on activity of each potential fault source are generally based on recency of the last movement. For high-hazard potential dams, movement of faults within the range of 35,000 to 100,000 years BP is considered recent enough to warrant an "active" or "capable" classification. All of the above MCE assessments for the various earthquake sources are candidates for one or more controlling MCEs at the site. It is

also important to look at earthquakes that have a long duration but not necessarily the highest peak acceleration at the dam site. For embankment dams and foundations subject to liquefaction, this longer duration earthquake may be the controlling event if it triggers liquefaction of the embankment/foundation materials. Other appurtenant structures should be evaluated to determine if a higher magnitude distant earthquake is critical to the overall stability of the structure."

Another concern associated with earthquakes is when liquefaction occurs, when loose granular materials such as sands and silts below the water table can behave like a liquid when shaken by an earthquake. The landfill structure itself is composed of compacted soils and should not be saturated with water. The concern arises from the possibility of liquefaction in the soils which support the landfill structure. Soils in the state of liquefaction can liquefy and lose their ability to support structures or experience a loss of bearing strength. The California Geological Survey and US Geological Survey (USGS) have identified areas of California that are susceptible to liquefaction and landslides due to earthquakes. If a landfill in located within a "Seismic Hazard Zone" a site specific evaluation should be conducted for liquefaction and landslides.

"Seismic Hazard Zones" have been established by the USG`S and the California Geological Survey in order to provide the general public, land-use planners, utilities and lifeline owners, and emergency response officials, tools in which to assess their risks from earthquake damage. The hazard zone maps can be found at the USGS and California Geological Survey's website
http://www.conservation.ca.gov/cgs/shzp/Pages/Index.aspx

Damage to landfills from an earthquake may be due to fault displacement or to secondary hazards such as slope instability or liquefaction of the foundation. Potential damage to a landfill resulting from an earthquake includes damage to the:

- liner and cover systems;
- landfill gas control system; and
- surface water and drainage control systems.
- foundation due to liquefaction and landslides; and
- Other potential damages may include, settlement, slope failure, increased cracking of the final cover, shearing of wells and headers, and failure of structures, roads, irrigation systems and utility systems.

(Reference: RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities, EPA/600/R-95/051, April 1995)

CalRecycle staff in defining the seismic causal event considered the types of corrective action activities that may need to be undertaken at an active or closed solid waste landfill as a result of an earthquake and the specific characteristics of a landfill, including its design, location and level of compliance. In addition, since the deterministic approach is used in the regulations and the probabilistic approach is state-of-the-practice for evaluating potential seismic activity, the BMP for an earthquake as a causal event allows for use of both approaches and takes into consideration the potential risk posed by a landfill in determining the return interval for a probabilistic evaluation.

A method has been developed to rank a landfill as posing a high medium, or low potential risk. The method was developed as part of study conduct by ICF to assess the potential fiscal and environmental risks posed by landfills. The method considers 13 major characteristics: seismic; rainfall intensity; floodplain; fire (intrusion from off-site); engineering controls; permitted capacity; type of waste in place; slope stability; liquids management/ landfill bioreactor technology; hydrogeology; proximity to urban areas; proximity to sensitive habitat; and compliance status. CalRecycle staff needs to approve other methods that may be used to determine the potential risk of a landfill. The methodology is contained in Chapter 5 of the 'Study To Identify Potential Long-Term Threats And Financial Assurance Mechanisms For Long-Term Postclosure Maintenance And Corrective Action At Solid Waste Landfills, November 26, 2007' http://www.calrecycle.ca.gov/archive/lWMBMtgDocs/mtgdocs/2007/12/00022762.pdf

The BMP for an earthquake as a causal event is comprised of three elements:

(1) If a landfill is not designed to the MCE, a deterministic or probabilistic evaluation is required to compare the design of the landfill to determine the potential damage due to ground movement and ground acceleration. Please see the table below.

(2) Evaluate the potential effects of liquefaction if the landfill is located in a Seismic Hazard Zone.

(3) Evaluate for the potential damage from fault ruptures if the landfill is located within 200 feet of Holocene fault zones.

Minimum 27 CCR Seismic Design Event	*De Minimus* Corrective Action Cost Estimate[1]	Landfill Risk Category[2]	Probabilistic Ground Motions for Estimating Corrective Action Costs
MPE	MCE or 2475-yr return period design event, and ≤ 6 inches permanent deformation.	Low	200-475 year return period
		Medium	475 year return period
		High	475-950 year return period

[1] Seismic is not a reasonable foreseeable causal event if these criteria are met.

[2] Landfill risk category determination may utilize the following methodology, or an alternative approved by CalRecycle:*(November 26,2007, Study To Identify Potential Long-Term Threats And Financial Assurance Mechanisms For Long-Term Postclosure Maintenance And Corrective Action At Solid Waste Landfills (Chapter 5)* http://www.calrecycle.ca.gov/archive/lWMBMtgDocs/mtgdocs/2007/12/00022762.pdf

The evaluation needs to identify the methodology used, references for inputs, and address how the structures identified in the table below will be affected and the level of

activity required restoring the structures (as described in the table below) to the minimum standards.

Seismic Event Non-Water Release Corrective Action Component		Description of Activity	Notes
Cover System	Final Cover Vegetative Layer; Daily and Intermediate Cover	Earthwork and grading to cover waste and repair cracks, settlement, and slope failures.	Estimated quantities (acreage, cubic yards) based on total percentage of landfill footprint estimated to be damaged. Include mobilization, material acquisition, placement, construction surveys, and grading plan costs.
	Final Cover Barrier Layer	Removal and replacement of geosynthetic components (drainage, liner, gas collection) and reconstruction of compacted clay components.	Not applicable to monolithic systems or if site is active and estimates based on active site configuration. *De Minimis* if permanent deformation is ≤ 12 inches. Requires site-specific engineering plans and specifications and construction quality assurance. Estimate quantities based on portion of system breached and requiring repair.
Landfill Gas Collection and Control System	Extraction wells	Repair and/or removal and replacement of damaged collection system components and repair and restart of treatment device.	Not applicable to sites where landfill gas systems not required. Include disconnect/reconnect of gas collection system to allow for cover repair. Estimate number of wells, connector components, and linear feet of piping to be replaced and unit costs. Evaluate added lump sum operations and maintenance cost to immediately repair and restart treatment system.
	Header piping and connections		
	Flare or other treatment devices		
Drainage System	Open channels, pipes, downdrains, basins, appurtenances	Repair and/or removal and replacement of damaged structures.	Coordinate with cover system repair activities. Estimate as percentage damaged of total linear foot or lump sum drainage structures.
Erosion Control	Soil fills and cover	Seed/mulch and other erosion control structures to prevent erosion of soil exposed from corrective action grading activities.	Estimate acreage of disturbed area and unit costs; add lump sum or number/unit cost of erosion control structures. Include landscaping and irrigation systems if applicable.
Other	Onsite Roadways; Environmental Monitoring Systems; Site Security	Repair and/or replace key access roads; repair or replace damaged gas, leachate, and ground water monitoring system and fencing/site security components.	Add cost estimates for these components where vulnerable to damage on a site-specific basis.

Flooding

Flooding is a reasonably foreseeable causal event, based on the document, "California's Top 15 Weather Events of 1900's" by the National Weather Service Forecast Office (http://nimbo.wrh.noaa.gov/pqr/paststorms/california10.php), nine of the 15 events were associated with flooding. Several agencies implement programs regarding flooding, including the U.S. Geological Survey, California Department of Water Resources, Federal Emergency Management Agency (FEMA), California Office of Emergency Services, local flood control agencies, or local water districts. These agencies are excellent sources of information on potential flood events and past storm events for a specific location, including the potential height of the flood waters.

Flooding can be caused by storms, spring thaw, heaving rains, changes in the landscape due to fires or development, failure of engineered designed flood control systems such as levees or dams or flash flooding. Other than failure of a levee or dam or a heavy spring thaw, usually intense rainfall is the cause of flooding.

Damages at landfills due to a flood is caused by inundation or washout of slopes, drainage systems, and other structures; including soil erosion or structure failure due to the force of the moving water. The location, elevation, and design of a landfill, including capacity and the level of maintenance of the run-on and run-off control systems are major factors in determining if a flood will adversely affect the landfill.

Examples of the type of non-water release damages that may result from a flood include severe erosion, destabilization of the landfill, and significance subsidence as discovered at the Crown Vantage Landfill in Alexandria Township, New Jersey. The Crown Vantage Landfill operated in the 1970s, is on the national Priorities List, and would not meet applicable siting criteria and the minimum standards. More information on this landfill and the efforts of USEPA to stabilize the landfill can be obtained from http://nlquery.epa.gov/epasearch/epasearch?typeofsearch=area&querytext=crown+vantage&submit=Go&fld=oerrpage&areaname=Superfund&areacontacts=http%3A%2F%2Fwww.epa.gov%2Fsuperfund%2Fcontacts%2Findex.htm&areasearchurl=&result_template=epafiles_default.xsl&filter=sample3filt.hts

The required design standards for a solid waste landfill to address flooding are:

27 CCR § 20260 (c): New Class III and existing Class II-2 landfills shall be designed, constructed, operated, and maintained to prevent inundation or washout due to floods with a 100-year return period. MSW landfills are also subject to any more-stringent flood plain and wetland siting requirements referenced in SWRCB Resolution No.93-62 (i.e., see Sections 258.11, 258.12, and 258.16 of 40CFR258).

The return period is commonly referred to as the recurrence level or for the 100-year return period, also commonly referred to as the "100-year flood". Flood maps, formally known as Flood Insurance Rate Maps or FIRMS, for the 100-year and 500-year flood are readily available from FEMA. The FIRMS are used to determine if flood insurance is

required and the potential for various degrees of flooding. FEMA, through the National Flood Insurance Program that is managed and implemented through FEMA in cooperation with local governments and property owners determines the degree of flood hazard in a given location. FEMA has considered that moderate flood hazards are in areas between the 100-year and 500-year flood and minimal flood hazards are areas above the depth of the 500-year flood. (reference: 'Definitions of FEMA Flood Zone Designations') Flood zone maps may be obtained from the local flood control agency or the FEMA website at: www.fema.gov .

Understanding Flood Areas (from the National Flood Insurance Program website http://www.fema.gov/about/programs/nfip/index.shtm)

Flooding can happen anywhere, but certain areas are especially prone to serious flooding. To help communities understand their risk, flood maps (Flood Insurance Rate Maps, FIRMs) have been created to show the locations of high-risk, moderate-to-low risk, and undetermined-risk areas. Here are the definitions for each:

High-risk areas (Special Flood Hazard Area or SFHA)
High-risk areas have at least a 1% annual chance of flooding, which equates to a 26% chance of flooding over the life of a 30-year mortgage. All homeowners in these areas with mortgages from federally regulated or insured lenders are required to buy flood insurance. They are shown on the flood maps as zones labeled with the letters A or V. The FIRM identifies these shaded areas as Zones A, AO, AH, A1-A30, AE, A99, AR, V, V1-30, and VE.

Moderate-to-low risk areas (Non-Special Flood Hazard Area or NSFHA)
In moderate-to-low risk areas, the risk of being flooded is reduced, but not completely removed. These areas are outside the 1% annual flood-risk floodplain areas, so flood insurance isn't required, but it is recommended for all property owners and renters. They are shown on flood maps as zones labeled with the letters B, C or X (or a shaded X).

Undetermined risk areas
No flood-hazard analysis has been conducted in these areas, but a flood risk still exists. Flood insurance rates reflect the uncertainty of the flood risk. These areas are labeled with the letter D on the flood maps.

The definitions of the FEMA Flood Zone Designations are provided in the table below:

100-Year Flood: (also called the Base Flood) is the flood having a one percent chance of being equaled or exceeded in magnitude in any given year. Contrary to popular belief, it is not a flood occurring once every 100 years.

100-Year Floodplain: The area adjoining a river, stream, or watercourse covered by water in the event of a 100-year flood.

Zone A	The 100-year or base floodplain. There are six types of A Zones: **A** The base floodplain mapped by approximate methods, *i.e.*, BFEs are not determined. This is often called an unnumbered A Zone or an approximate A Zone. **A1-30** These are known as numbered A Zones (*e.g.*, A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format). **AE** The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones. **AO** The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided. **AH** Shallow flooding base floodplain. BFEs are provided. **A99** Area to be protected from base flood by levees or Federal Flood Protection Systems under construction. BFEs are not determined. **AR** The base floodplain that results from the decertification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection.
Zone V and VE	**V** The coastal area subject to a velocity hazard (wave action) where BFEs are not determined on the FIRM. **VE** The coastal area subject to a velocity hazard (wave action) where BFEs are provided on the FIRM.
Zone B and Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.
Zone C and Zone X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone C may have ponding and local drainage problems that don't warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.
Zone D	Area of undetermined but possible flood hazards.

Figure 3-10: Flood Insurance Rate Map Zones

Note that the special Flood Hazard Area (SFHA) includes only A and V Zones.

There are a variety of sources for this information. FEMA maps are available for most communities. The U.S. Army Corps of Engineers will do floodplain delineation on a cost-sharing basis and has information on floodplains and project levees. DWR also has flood-plain information and a floodplain management pro-gram, as does the State Reclamation Board in the Central Valley. The Office of Emergency Services and DWR have information on past flooding. Local levee districts and Resource Conservation Districts may also have information to share.

In addition to the location of the landfill in proximity to the flood plain, the elevation of the flood waters is critical to evaluate if a flood will impact a landfill considering the elevation of the landfill to the flood waters. NFIP has computed the elevation to which floodwater is anticipated to rise during the 100 year flood or base flood is the Base Flood Elevation. For each FIRM, NFIP has conducted Flood Insurance Study (FIS) reports for over 19,000 communities, if a FIS report is available, the predicted elevation for a 500-year flood can be obtained from the report. Four flood levels are typically shown in the FIS report: the 10-, 50-, 100-, and 500-year (10%, 2%, 1%, and 0.2%) floods. More information on how to use the FIRM and other sources from NFIP can be obtained from http://www.fema.gov/library/viewRecord.do?id=2108

BMP for the flood as a causal event is:

- Flooding is not considered a reasonable foreseeable causal event if the landfill is not located in the 500-year flood zone or the elevation of the landfill is above the depth of the flood event.
- For the purposes of determining corrective action, any landfill located within the 500-year flood zone needs to assess the potential damage resulting from the 500-year flood. (Unless the lowest elevation of the landfill perimeter is higher than the predicted elevation of the flood waters)

The evaluation for the flood as a causal event needs to include documentation if the location of the landfill is outside of the 500-year flood zone, shown as C or X (unshaded area) on the flood map. If the landfill is within the 500-year flood zone, the evaluation needs to include a comparison of the predicted elevation of the flood waters to the elevation of the lowest point of the landfill boundary, an assessment of the potential for erosion and saturation due to the force of moving water or standing water, including a comparison of the potential depth of water to the lowest elevation of the landfill. Such an evaluation needs to assess the potential impacts of the flood causal event as identified in Attachment 1, consider the capacity of the run-on and run-off control systems and the maintenance of the system to minimize blockage. If the capacity of the system is exceeded, an assessment of the potential soil erosion and impacts on the stability of slopes and supporting soils need to be included, damage to structures associated with environmental monitoring or control, and the landfill cover; and associated costs for replacement or repair.

Damages at landfills due to a flood is caused by inundation or washout of slopes, drainage systems, and other structures; including soil erosion or structure failure due to the force of the moving water. The location, elevation and design of a landfill, including the level of maintenance of the run-on and run-off control systems are major factors in determining if a flood will adversely affect the landfill.

Tsunamis

A tsunamis are sea waves that may be generated by an earthquake, landslide, volcanic eruption, or even by a large meteor hitting the ocean. The California coast has experienced several tsunamis, some causing significant damage. It is anticipated that the types of damage caused by a tsunami would be similar to those resulting from a flood. An excerpt from the Department of Conservation website illustrates the impacts of a tsunami resulting from an earthquake in Alaska in 1964. The most devastating tsunami to affect California in recent history was from the magnitude 9.2 Alaskan earthquake of 1964. Areas of northern California experienced a six-meter (20-foot) tsunami wave that flooded low-lying communities, such as Crescent City, and river valleys, killing 11 people.

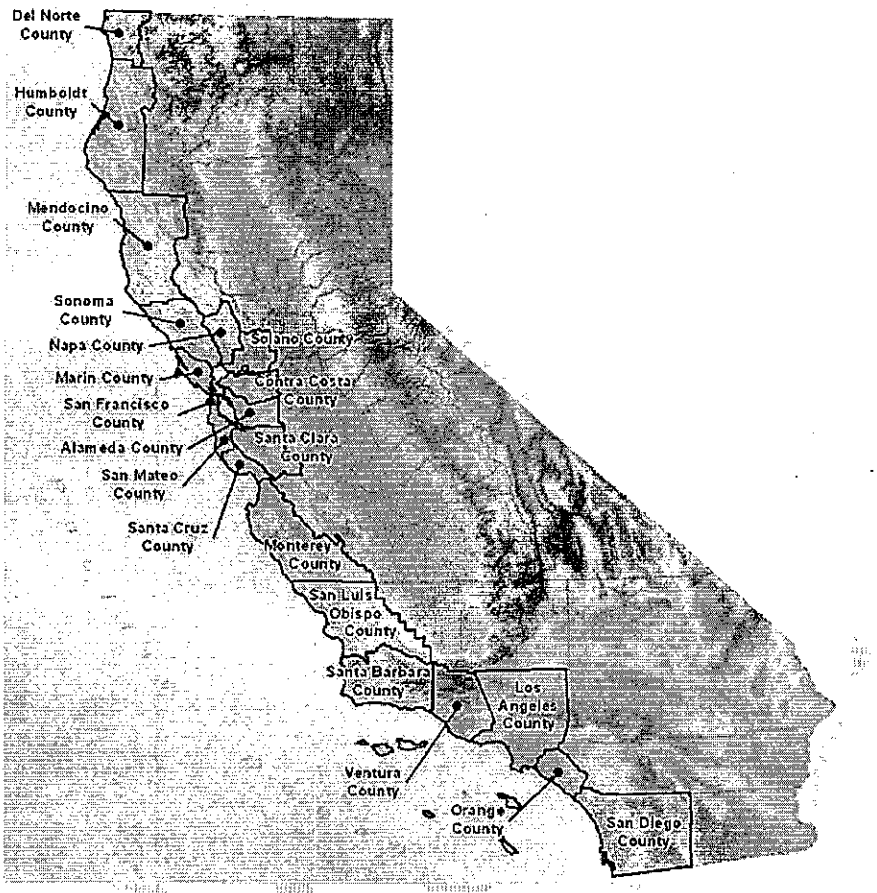
The siting standards, 27 CCR Section 20240 (f) allows new and existing Class II units to be located in areas subject to tsunamis if the units are designed, constructed and maintained to preclude failure due to the event. There is not a similar provision for Class III units.

Tsunamis are considered a reasonable foreseeable causal event as evidenced by the chart below of historic tsunamis in California. Seismic events at locations thousands of miles away have been documented to impact California's coast. In a 2003 report prepared by GeoSyntec Consultants, Inc, it was reported that 17 landfills were located in a coastal setting.
(Reference: http://www.calrecycle.ca.gov/Publications/default.asp?pubid=1046)

Tsunamis documented in California document seismic events from as far away as Japan, Chile and Alaska have resulted in tsunamis with a height as high as 6 meters.
(Reference:
http://www.humboldt.edu/~geology/earthquakes/tsunami!/n_coast_tsunamis.html)

The Department of Conservation has generated maps for the 20 counties located on the coast in California identifying areas that may be affected by a tsunami. These maps are developed for all populated areas at risk to tsunamis in California, and represent a combination of the maximum considered tsunamis for each area The intended uses for the maps are for emergency planning (such as coastal evacuation planning) purposes and to assist cities and counties in identifying their tsunami hazard. The maps identify areas that may be inundated by a tsunami. The maps can be obtained from http://www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/Inundation_Maps/Pages/Statewide_Maps.aspx

The figure below illustrates the counties that have tsunami maps generated by the Department of Conservation:



The maps identifying the inundation areas in California can be downloaded at the following web site:
http://www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/Inundation_Maps/Pages/Statewide_Maps.aspx

General information on tsunamis can found at
www.conservation.ca.gov/cgs/geologic_hazards/Tsunami/Pages/About_Tsunamis.aspx

For information about the National Tsunami Hazard Mitigation Program, please visit the following website: http://nthmp.tsunami.gov/

Other Tsunami related links:

- California Emergency Management Agency – http://www.calema.ca.gov/WebPage/oeswebsite.nsf/Content/3F07513B078EE8A78825741F0060B548?OpenDocument
- Tsunami Research Center at University of Southern California - http://www.usc.edu/dept/tsunamis/2005/index.php
- National Ocean and Atmospheric Administration Tsunami page - http://www.tsunami.noaa.gov/
- U. S. Geological Survey Tsunami page - http://walrus.wr.usgs.gov/tsunami/

- Redwood Coast Tsunami Work Group - http://www.humboldt.edu/~geology/earthquakes/rctwg/index.html

The BMP for the tsunami as a causal event is:

- Tsunamis are not considered a reasonable foreseeable causal event if the landfill is located in an area that is not designated to be prone to be inundated by a tsunami by the Department of Conservation or local emergency response agency.
- For landfills located in an area that is prone to be inundated by a tsunami, the CA Plan needs to address the potential impacts and damage that may result.

The evaluation for the tsunami causal event needs to include documentation that the landfill is not located in an area designated by the Department of Conservation. If the landfill is located in an area that may be inundated by a tsunami, the evaluation needs to include the predicted height of the waves and duration, with an assessment of the potential impacts of the predicted waves given the elevation of the landfill as identified in Attachment 1. The assessment should address the potential impacts with consideration of the amount of water and the velocity of the water in regards to erosion, instability of slopes, and damage to structures associated with environmental monitoring or control, and the landfill cover; and associated costs for replacement or repair.

Seiche

A seiche is a wave on the surface of a lake or landlocked bay caused by atmospheric or seismic disturbances and may be defined as an occasional rhythmic oscillation of water above and below the mean level of lakes or seas, lasting from a few minutes to an hour or more. Seiches are uncommon but have been known to have occurred on Lake Tahoe and the Great Lakes. Damages anticipated to result from a seiche would be similar to those from a flood or tsunami. In a 2003 report prepared by GeoSyntec Consultants, Inc, it was reported that 8 landfills were located near a bay or estuary. The report can be downloaded at: http://www.calrecycle.ca.gov/Publications/default.asp?pubid=1046

The siting standards, 27 CCR Section 20240 (f) allows new and existing Class II units to be located in areas subject to seiches if the units are designed, constructed and maintained to preclude failure due to the event. There is not a similar provision for Class III units.

BMP for the seiche as a causal event is:

- Seiche is not a reasonable foreseeable causal event, if the landfill is located greater than ½ mile away from a lake or a landlocked bay.
- Landfill that located within ½ mile of a lake or landlocked bay needs to identify the height of the wave and evaluate if the wave will inundate the landfill and cause any damage.

The evaluation for the seiche causal event needs to include documentation that the landfill is not located within ½ mile of a lake or landlocked bay.

If the landfill is located within ½ mile of a lake or landlocked, the evaluation needs to include the predicted height of the waves and duration, with an assessment of the potential impacts of the predicted waves given the elevation of the landfill. The assessment should address the potential impacts as identified in Attachment 1 with consideration of the amount of water and the velocity of the water in regards to erosion, instability of slopes, and damage to structures associated with environmental monitoring or control, and the landfill cover; and associated costs for replacement or repair.

Precipitation

There are case studies that document damages to landfills caused by storms. Damage to the cover, displacement or exposure of waste, damage and clogging of the drainage system, failure or erosion of slopes, and roads can occur due to erosion of soil and inundation by water (Sunrise Mountain in Nevada, Jim Hogg County Landfill in Texas, and the Anderson report). In the fall of 2001 Jim Hogg County experienced several major rain events that caused serious flooding in the area. Floodwaters cut a trench, approximately 1200 feet long, 30 feet wide and 15 feet deep through a disposal area of the landfill, displacing approximately 12,000 tons of waste material. These examples were primary of closed landfills that may not have been maintained, but they are indications that storms are capable of causing significant damage to a landfill. Although every landfill is unique in its design and location, precipitation is a reasonable foreseeable causal event.

Landfills are required to maintain systems to control run-on and run-off due to precipitation during its active life and into the postclosure period. The systems are required to protect against a 100-year, 24-hour storm event (Class III landfills). Class I landfills are required to be designed to withstand the Probable Maximum Precipitation rain event and Class II landfills are designed to withstand the 1000-year, 24-hour rain event. Since solid waste landfills can be either a Class II or Class III as determined by the RWQCB, staff recommends that the Class II design standard be used to define the causal event.

The theoretical return period is the inverse of the probability that the event will be exceeded in any one year. For example, a 10-year storm has a 1/10 = 0.1 or 10% chance of being exceeded in any one year and a 50-year storm has a 0.02 or 2% chance of being exceeded in any one year. The 24-hour refers to the length of the storm event. Other storm event lengths are also used for design purposes. For example, a 10 yr, 6 hr storm may be the peak period within a 10 yr, 24 hr storm.

While a 10-year event will occur, on average, once every 10 years and that a 100-year event is so large that it is expected only to occur every 100 years, based only on statistics or probability. It does not mean that 100-year storms will happen *regularly*, every 100 years, despite the connotations of the name "return period": in any *given* 100-year period, a 100-year storm may occur once, twice, more, or not at all, and each of outcomes has a probability that can be computed.

The difference in the amount of rain between a 100-year and 1000-year storm event is not a tenfold increase in the amount of water, but may vary to less than one inch to several inches, as illustrated in conditions for the following Central Valley RWQCB documents:

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD CENTRAL VALLEY REGION

ORDER NO. R5-2005-0024
WASTE DISCHARGE REQUIREMENTS FOR MUSCO FAMILY OLIVE COMPANY

AND THE STUDLEY COMPANY CLASS II SURFACE IMPOUNDMENTS TRACY PLANT San Joaquin County

16. The 100-year, 24-hour precipitation event is estimated to be 2.5 inches, based on the California Department of Transportation Intensity-Duration-Frequency Rainfall Curve Program for the Tracy 2 SSE Station No. 116. The 24-hour, 1;000 year storm event is 3 inches.

ORDER NO. R5-2008-XXXX WASTE DISCHARGE REQUIREMENTS FOR COUNTY OF SHASTA FOR OPERATION OF REDDING REGIONAL SEPTAGE DISPOSAL FACILITY SHASTA COUNTY

12.The 100-year, 24-hour precipitation event is estimated to be 5.5 inches, based a map published by the National Oceanic and Atmospheric Administration (NOAA) in *NOAA Atlas 2, Volume XI, Isopluvials of 100-Year 24-Hour Precipitation for Northern Half of California in Tenths of an Inch.*

13.The 1,000-year, 24-hour precipitation event is estimated to be 6.86 inches, based on data for Station Anderson STP (DWR #A00 0201 30) for the years 1976 through 2000, compiled and analyzed by the Department of Water Resources, Red Bluff. For the same station and the same years of record, the 100-year wet season precipitation is 59.84 inches.

BMP for precipitation as a causal event is the design standard for a Class II landfill which is the 1000-year, 24-hour storm event. The 1000-year, 24-hour storm event is also used by DWR for some dams. (http://www.water.ca.gov/damsafety/docs/fitz-paper.pdf

The evaluation for the precipitation causal event needs to include documentation for determination of the 1000-year, 24–hour precipitation event and the evaluation needs to include the assessment of the capacity of the drainage system to properly manage the estimated quantity of water. If the capacity of the drainage system is exceeded, the assessment should address the potential impacts regards to erosion, instability of slopes, run-off, and damage to structures associated with environmental monitoring or control, and the landfill cover; and associated costs for replacement or repair

Fires

Fires at landfills are either surface or subsurface fires The potential for these fires to occur is dependent on the location of the landfill for wild fires, management of wastes that are still smoldering, accidents or arson, availability of vegetation or fuel for a fire. (References: CalRecycle Guidance on Landfill Fires at http://www.calrecycle.ca.gov/SWFacilities/Fires/LFFiresGuide/default.htm, and Landfill Fires by FEMA at: http://www.usfa.dhs.gov/downloads/pdf/publications/fa-225.pdf)

Subsurface fires

The most common cause of subsurface landfill fires is an increase in the oxygen content of the landfill, which increases bacterial activity (aerobic decomposition) and raises temperatures creating "hot spots" that come into contact with pockets of methane gas resulting in a fire. Subsurface fires can cause damage to the landfill gas collection systems and potentially the cap. The postclosure maintenance plan should contain provisions for subsurface fires. If not, subsurface fires should be addressed in the CA Plan.

Wild Fires

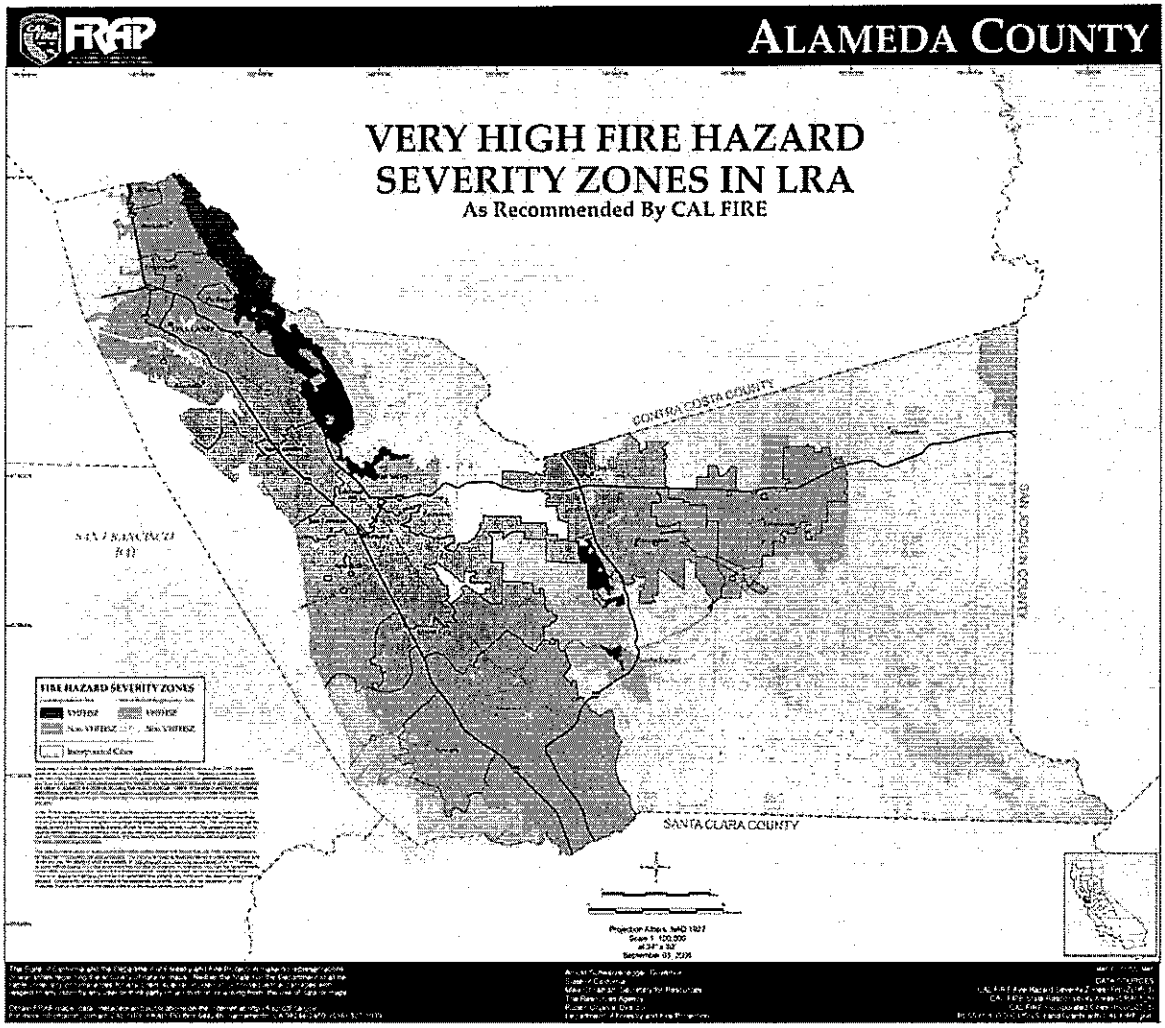
Wild fires have been documented to destroy or damage all or portions of the landfill gas collection and monitoring systems, vegetation and irrigation systems designed to protect the cap and cover, drainage systems, and utility conveyance systems. The potential damage is dependent on mitigating circumstances such as whether the structures are buried to be protected from fires and if there are engineered mitigation measures such as fire breaks to protect against surface fires.

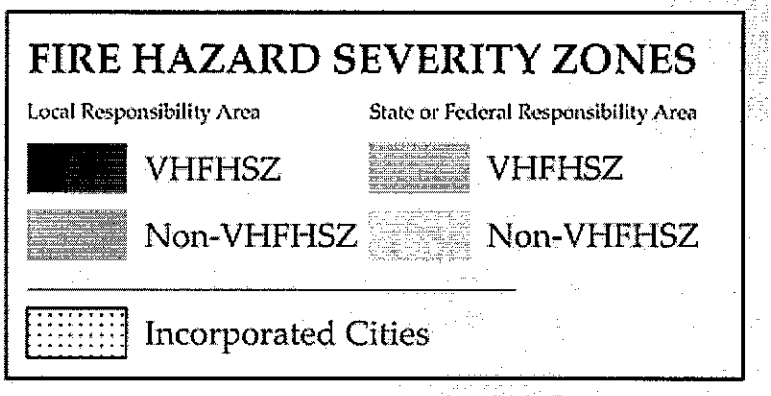
The California Department of Forestry and Fire Protection (CAL FIRE) and the Office of the State Fire Marshal (OSFM) and local agencies have prepared maps that identify areas of the state have a very high or moderate fire hazard. The maps are a result of implementation of Government Code Sections 51175 – 51189, the purpose of this chapter is to classify lands in accordance with whether a very high fire hazard severity is present so that public officials are able to identify measures that will mitigate the rate of spread, and reduce the potential intensity of uncontrolled fires that threaten to destroy resources, life, or property, and to require that those measures be taken. The objective of the fire hazard maps is to determine which areas are subject to requirements affecting construction materials and for defensible space to minimize losses from a fire.

The science based fire hazard model used to generate the maps considers the wildland fuels. Fuel is that part of the natural vegetation that burns during the wildfire. The model also considers fire history, topography, especially the steepness of the slopes, existing and potential fuel or natural vegetation, and typical weather for an area. Fires burn faster as they burn up-slope. Weather (temperature, humidity, and wind) has a significant influence on fire behavior. The model recognizes that some areas of California have more frequent and severe wildfires than other areas. Finally, the model considers the production of burning fire brands (embers) how far they move, and how receptive the landing site is to new fires.

More information on the responsibilities of the Cal Fire and local agencies, as well as the fire hazard maps can be obtained at:
http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland.php
and
http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_development.php

There are three jurisdictions that have responsibilities, the federal, state, and local responsible agencies. The map by the state identifies which area is the responsibility of the federal, state or local fire agency. As illustrated on the map below:





Government Code 51175-89 directs the California Department of Forestry and Fire Protection

The fire plans for all counties can be obtained at the following web site:
http://cdfdata.fire.ca.gov/fire_er/fpp_planning_plans

CalRecycle website
http://www.calrecycle.ca.gov/SWFacilities/Fires/LFFiresGuide/default.htm

The fire hazard zone maps can be downloaded at:
http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_maps.php

The graphic below illustrate the area at the Olinda Alpha Landfill that sustained damage from a fire in November 2008. An assessment showed that all materials exposed to the fire were damaged. The landfill gas system was destroyed in the yellow shaded area. Subsequent to the fire, the replaced landfill gas system is buried below surface to be protected against future fires. It is interesting to note that although the fire burned for several days, other portions of the landfill did not sustain damage. Another landfill, Simi Valley LF, experienced a wildfire in 2003. The LFG header pipe and 20' of six-inch header pipe was damaged. The cost for removal and replacement of this pipe section was less than $500.

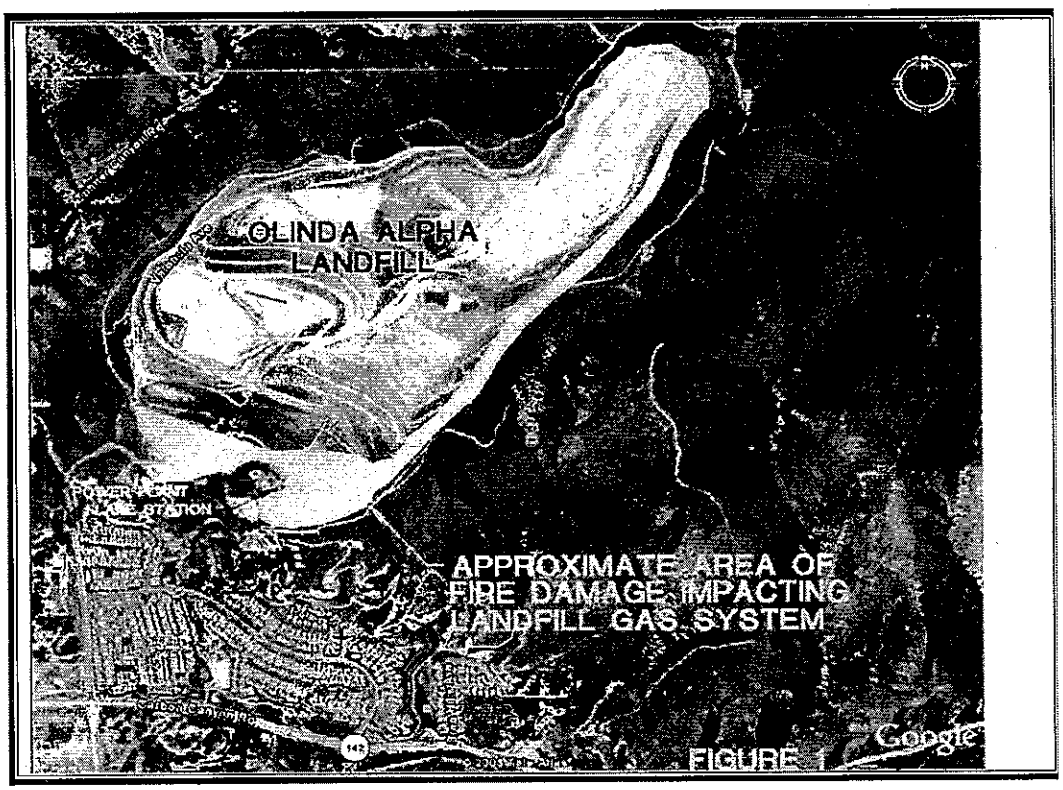


FIGURE 1

BMP for a fire as a causal event is that landfills located within or adjacent to fire hazard zones determined by California Department of Forestry and Fire Protection (Cal Fire), federal or the local fire control agency as moderate/medium, high, or very high must

evaluate the potential damage to surface structures, vegetation and irrigation systems, and utilities; and other potential impacts as identified in Attachment 1.

- It is recommended that an assumption that 80% of the combustible surface structures within 300 feet of the landfill cell boundaries are destroyed if the landfill is located in a very high fire hazard zone, the percentage of structures potentially destroyed should reduced if there are engineered systems to mitigate surface fires such as berms or fire breaks, or if there is no vegetation to sustain a fire. The percentage of structure potentially destroyed should be increased if there is substantial vegetation at the landfill that would fuel a fire; this may be the situation for a closed landfill that does not maintain vegetation growth.

- For landfills located in high fire hazard zone, the recommendation is that an assumption that 70% of the combustible surface structures within 300 feet of the landfill cell boundaries is destroyed.

- For landfills located in a moderate/medium fire hazard zone, the recommendation is that an assumption that 50% of the surface structures are destroyed.

- For landfills not located in the above zones, a contingency of 20% to replace surface structures is recommended.

The CA plan also needs to address the potential for a subsurface fire; the BMP for the subsurface fire is to provide the costs necessary to employ one of methods to extinguish a subsurface fire (as discussed at CalRecycle's website) or to provide a contingency of 20% to repair the cover and landfill gas system.

Evaluation of the Final Cover System

The regulations (27 CCR 22102(a)(3)), also require that the CA Plan, including updates and revisions, contain an evaluation of the long-term performance of the final cover system to ensure that the final cover system will continue to meet the requirements of 27 CCR Section 21140 without corrective action. Should the final cover no longer comply with 27 CCR 21140, repair or partial to complete replacement may be required. The permeability of final cover systems will likely degrade with time depending on the site and design and potentially to a less protective permeability level than the original design standard. Under such circumstances, non-water release corrective action would not be required unless the degradation results in violation of the applicable 27 CCR Section21140 final cover performance standards.

The requirements of 27 CCR 21140 are:

> (a) The final cover shall function with minimum maintenance and provide waste containment to protect public health and safety by controlling at a minimum, vectors, fire, odor, and litter and landfill gas migration. The final cover shall also be compatible with postclosure land use.
>
> (b) In proposing a final cover design meeting the requirements under section 21090, the owner or operator shall assure that the proposal meets the requirements of this section. Alternative final cover designs shall meet the performance requirements of (a) and, for MSWLF units, 40 CFR 258.60(b); shall be approved by the enforcement agency for aspects of (a).
>
> (c) The EA may require additional thickness, quality, and type of final cover depending on, but not limited to the following:
> (1) a need to control landfill gas emissions and fires;
> (2) the future reuse of the site; and
> (3) provide access to all areas of the site as needed for inspection of monitoring and control facilities, etc.

Degraded/Inadequate Containment or Environmental Monitoring and Control Systems

The regulations require that each CA Plan provide an analysis of the adequacy of the design, capacity, or component useful life of the containment or environmental monitoring and control systems as a causal event. Containment systems (e.g., final cover) and monitoring and control systems (e.g., landfill gas, leachate, and drainage systems) may significantly degrade or have inadequate design to prevent leachate, gas, or waste releases.

Repair or replacement of these systems or components will be required as part of the CA Plan if needed for compliance with applicable performance standards. Applicable standards include: 27 CCR 20917-20945 (landfill gas) for all sites; for active sites, 27 CCR 21600(b)(4) (design), 20790 (leachate), 20820 (drainage); and for closed sites, 27 CCR Sections21140-21160 (final cover, grading, stability, leachate) and 21190 (postclosure land use).

Active vs. Closed Landfills

The financial assurance requirements for corrective action apply to active, closed, and closing solid waste landfills. It may be appropriate to have the CA Plan address the planned closed landfill configuration as defined in the closure and postclosure maintenance plans for the landfill if the landfill is active because of the anticipated long-term or indefinite postclosure maintenance period (when causal events are most likely to occur). Under this approach the operator would need to demonstrate that the landfill configuration at any time during its active life would not result in a higher CA Plan cost estimate than the closed landfill configuration.

Alternatively, the operator may submit a CA Plan for the active landfill configuration as described in the Joint Technical Document, scaling back from full build out to progressive cumulative development phases provided the CA Plan addresses the configuration prior to the next plan update. Under this approach, updated CA Plan and significantly higher financial assurances would be required for new development phases and upon submittal of final closure and postclosure maintenance plans.

Frequently Asked Questions

A set of frequently asked questions regarding the CA Plan and its preparation (CA Plans are required to be prepared by licensed third-party professionals pursuant to 27 CCR Section 22102(c)) and the responses are provided below:

1. In practice the "entity responsible for the design of the solid waste landfill" usually comprises a team of firms, consisting of a primary consultant, subconsultants, and contractors. The "entity" or engineer of record (PE or CEG) that signs off on the JTD/Closure Plan is typically the primary consultant. In this scenario, would the subconsultants and contractors be excluded from being on the third party team?

   No. The regulations would only exclude the entity (primary consulting firm) and the engineer of record (PE or CEG).

2. We have had a case where a firm who designed our landfills and is the engineer of record was recently purchased as a subsidiary of another company. Would the parent company be excluded from being a third party preparer despite not being involved in the design work?

   No, the regulations would not exclude the parent company from being a third party preparer. The only regulatory restriction related to subsidiary/parental relationships is that associated with the owner/operator (Section 22102(c)(1)(D)).

3. Similarly to number 2, a parent company who designed the landfill acquires a firm that was clearly eligible to be a third party preparer prior to the acquisition. Does the firm lose its eligibility status under the new ownership?

   This one depends on the meaning of "acquires."

   If the acquired firm remains a separate entity it would not lose its eligibility.

   If the acquired firm is subsumed by the "entity responsible for the design of the solid waste landfill" the acquired firm would lose its eligibility.

4. Section 22102 refers to the entity/engineer of record in the JTD/Closure Plan of the most recent SWFP. Throughout the life of a landfill, many different entities/engineers may have played a role in the design of the landfill and signed off on the JTD. Does the phrase "most recently issued SWFP" mean that previous entities/engineers that are not referenced in the most recently issued SWFP are now eligible third party preparers?

   Yes, previous entities/engineers not referenced in the most recently issued SWFP would be eligible.

5. The design engineer of record would be excluded from being a third party preparer. However, that engineer does not work alone. Would an individual from the design team be eligible as third party preparers assuming they left the entity and worked for another firm? Likewise, if the design engineer of record sought opportunities at another firm, could he/she be on the third party team provided this individual did not sign off on the corrective action plan.

   Yes to both. An individual from the design team would be eligible as a third party preparer assuming they left the entity and worked for another firm. Likewise, if the design engineer of record sought opportunities at another firm, he/she could be on the third party team provided this individual did not sign off on the corrective action plan.

6. Although Section 22102 explicitly refers to the JTD and Closure Plan, we assume that the entity/engineer of record for third party eligibility determination also extends to the PCMP. Is this correct?

Yes. Although Section 22102 does not explicitly refer to PCM plans it does reference Section 21780, which applies to both closure and PCM plans

7. Should the non-water release Corrective Action Plan address impacts on groundwater or water quality?

No, the regulations require a separate water release corrective action plan and a non-water release corrective action plan. LEA, CalRecycle, and the Regional Water Quality Control Board will jointly respond to an event at a solid waste landfill. In the situation that an event results in a release that affects water quality, LEA and CalRecycle will refer any water problems to the Regional Water Quality Control Board who will be the lead agency to oversee the release (LEAs and CalRecycle do not have authority to address water quality issues).

8. What is the timeframe to be addressed as part of the corrective action (what is considered long term)?

The requirements for providing financial assurance for corrective action are in effect during the entire period that the landfill is active and/or subject to postclosure maintenance requirements.

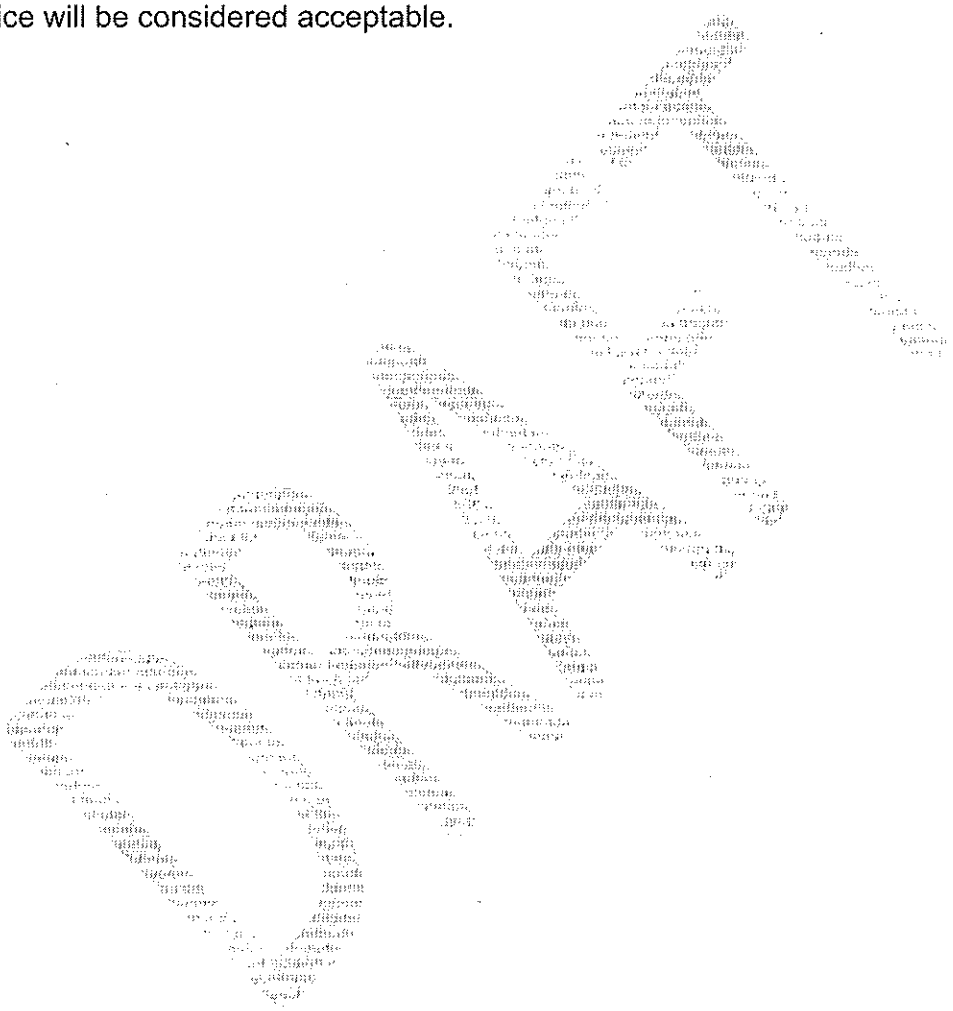
9. How are engineering flaws or failures addressed as part of corrective action?

The regulations require that if an operator chooses to use the non-water release site-specific correction action plan, the plan must contain an analysis of the containment and environmental monitoring and control systems for adequacy with the applicable standards. If the there are engineering flaws or failures that would prevent compliance with the applicable standards, the plan would need to address how the standards would be satisfied either through repair or replacement of the systems. If engineering flaws or

failures require corrective action, the funds if needed may be used to remediate the flaws or failures.

10. How does one calculate the change from the MPE to the MCE?

An analysis needs to be completed to estimate the amount of deformation and ground acceleration based on each event and compare that to the design of the landfill to determine if there will be any damage and, if yes, to what extent. It is not the intent of BMPs to recommend a methodology for this analysis. Methodologies that are standard practice will be considered acceptable.



Attachment 1

Causal Event, Potential Corrective Action, Design Standards And AB 2296 Study

Causal Event 27 CCR §22100(c)(2)	Potential Impact Requiring[1] Corrective Action §22100(c)(1)	Design Standards 27 and 22 CCR[2]	AB 2296 Study Risk Category[3]
Earthquake (seismic shaking, liquefaction, ground rupture)	Slope or containment failure with or without breach of cover system, including waste exposure; damage to environmental monitoring and control systems (gas, leachate, drainage).	Class III- MPE; not on Holocene fault; Class II/I- MCE and >200' from Holocene fault.	Low- MCE with FS>1.5 Medium- MPE FS 1.3-1.5 High- < MPE
Flooding (regional flood inundation)	Inundation/washout of monitoring and control systems; erosion; slope failure; increased leachate/gas generation with potential for public contact.	Class III/II/I- 100-year flood.	Low- >500yr Medium- 100-500yr High- <100yr
Precipitation (high intensity storm event)	Washout of monitoring and control systems; erosion; waste exposure; slope failure.	Class III- 100-year 24-hour Class II- 1000yr 24hr Class I- Probable Maximum Precipitation (PMP)	Low- 1000yr 24hr Medium- 100yr 24hr High- <100yr 24hr
Tsunami (seismic sea wave) **Seiche** (natural wave in lake or bay)	Similar to Earthquake, Flooding, Precipitation causal events.	NA	NA
Fire (surface wildfire or subsurface landfill fire)	Destruction of monitoring and control systems and release of gas and leachate; subsurface fire may also cause collapse and breach of cover systems and related systems damage.	NA	Surface fire hazard zones: Low, Medium, and High.
Degraded/inadequate containment or environmental monitoring and control system	Containment systems and/or monitoring and control systems no longer capable of meeting applicable performance standards. Requires partial or complete replacement and/or upgrade and repair.	See footnote 2	Final Cover: Low- >Subtitle D; Medium=Subtitle D; High- < Subtitle D.

[1] Impact will vary on a site-specific basis, including status as active or closed.

[2] For primary design standards see: SWRCB- 27 CCR 20310-20377 and Table 4.1 (www.calrecycle.ca.gov/Laws/Regulations/Title27/Table4.htm). CalRecycle applicable 27 CCR standards: 20917-20945 (landfill gas); Active Sites- 21600(b) (4) (design), 20790 (leachate), 20820 (drainage); Closed Sites- 21140-21160 (final cover, grading, stability, and leachate) and 21190 (postclosure land use); CalRecycle: Department of Resource Recycling and Recovery, formerly California Integrated Waste Management Board (CIWMB).

[3] Reference: www.calrecycle.ca.gov/SWFacilities/Financial/2007Study/default.htm.

Attachment 2

Suggested Table As a Cost Estimating Tool
For Each Causal Event

Damage	Landfill Cover Corrective Action	Drainage System Corrective Action	Gas Collection System Corrective Action	Gas Monitoring System Corrective Action	Leachate Collection System Corrective Action	Site Security Corrective Action	Other Landfill Infrastructure Corrective Action
100%	$ (AA)	$	$	$	$	$	$
90%	$	$	$	$	$	$	$
80%	$	$	$	$	$	$	$
70%	$	$	$	$	$	$	$
60%	$	$	$	$	$	$	$
50%	$	$	$	$	$	$	$
40%	$	$	$	$	$	$	$
30%	$	$	$	$	$	$	$
20%	$	$	$	$	$	$	$
10%	$	$	$	$	$	$	$

AA-Title 27, Section 22101(b) (1) which is the cost of complete replacement of the final cover.