

CLIMATE CHANGE ADAPTATION MEASURES

Building and maintaining soil health to
assist in climate change mitigation



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Introduction

The value of healthy soils has come to the forefront in the last few years as both a means to address climate mitigation and adaptation. When healthy, soils are able to store and sequester atmospheric carbon; when damaged, soil becomes a source of atmospheric carbon. Increased carbon in healthy soils also has many co-benefits with respect to climate adaptation, including increased biomass, increased water holding capacity and reduced runoff, and improved water quality in surface and ground water. Despite these many benefits, measures for healthy soils are absent in many climate adaptation plans. To address this gap, we have proposed measures addressing the roles of soils, compost, and mulch, which can be incorporated into climate adaptation plans.

Proposing measures for healthy soils is aligned with state goals and policies. Governor Brown has clearly stated the importance of California soils to be sustainable and resilient to climate change. The State has now officially acknowledged the value of creating healthy soils with the California Department of Food and Agriculture's (CDFA's) Healthy Soils Initiative, which sets aside funds to spend on sequestering carbon on agricultural land by providing financial incentives to farmers and ranchers to improve soil health by incorporating best practices for soil management, including the application of compost.

In addition these measures support a growing international recognition of the importance of soils as a means to sequester carbon and improve ecosystems. Our work attempts to highlight the ways in which healthy soils can serve as adaptation measures and how they address specific climate hazards. Climate adaptation plans are needed for municipalities to meet new state laws, such as SB 379, which sets adaptation measure planning requirements, and FEMA requirements for local hazard mitigation plans. Integrating these soil-related measures into adaptation plans will help California municipalities meet those goals, while also complying with other regulations, such as the CA Model Water Efficient Landscape Ordinance and the Municipal Regional Stormwater Permit.

The measures in this document are organized according to the climate hazard they address and are focused on building soil health and supporting ecosystem services.

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I. Inland Flooding

1. Stormwater Management

Goal:	Incentivize green infrastructure for natural management of stormwater and storm-induced flooding and preserving and restoring natural features of the watershed for both new and existing development, rather than using engineered structures.
Description:	Natural infrastructure can be used as a cost-effective tool to address flood risk while allowing for flexibility in an uncertain climate future, providing public amenities and preserving the local environment.
Hazard(s):	Floods, sea level rise, changing precipitation
Co-benefits:	Biodiversity enhancement, natural resource conservation, carbon sequestration, increased public green space, groundwater recharge, urban heat island effect reduction, erosion control, and pollution reduction
Equity considerations:	Green infrastructure should be implemented in the areas that it can be most effective at protecting and empowering communities. Placement should also consider the surrounding communities' vulnerabilities and adaptive capacity to respond to flood events and extreme heat and/or their capacity to maintain the infrastructure.

A. Conduct watershed analysis

Action:	Conduct a watershed analysis to determine areas of insufficient capacity in storm drain and natural creek systems and predict impacts of abnormally high rainfall and sea level rise as well as to determine suitable locations for green infrastructure
Partners:	Local university experts, East Bay Municipal Utility District, neighboring local governments, Alameda County Clean Water Program, Green Plan-IT
Comments:	Understanding the capacity and weaknesses of the water management system throughout the city and the region is an important first step to making educated decisions for watershed and stormwater management. Since this analysis will naturally be only useful at a regional scale (the characteristics of other areas of the watershed will impact the areas within city borders), it will be important to coordinate with other regional/local entities and existing efforts. Regional tools, such as Green Plan-IT can inform green infrastructure planning and installation to address watershed issues.
Timeframe:	Short-term
Ease of Implementation:	High
Potential Funding:	California Department of Water Resources, California State Water Resource Control Board

B. Ensure local compatibility of flood-reduction projects

Action:	Ensure that projects to reduce flooding are compatible with and advance local conservation policies, including restoration and protection of riparian habitat. Protect wildlife through planting and restoration of native habitat.
Partners:	Bay Institute, Coastal Conservancy, San Francisco Bay Conservation and Development Commission, and other community groups and non-profit organizations.
Comments:	Green infrastructure presents opportunities to safeguard, restore and enhance habitats. Projects from other parts of the Bay Area, such as the South Bay Salt Pond Restoration Project, offer useful insights and lessons learned.
Timeframe:	Short-term
Ease of Implementation:	High
Potential Funding:	Coastal Conservancy

C. Promote proper sediment control

Action: Maximize use of compost berms, socks and blankets for erosion and sediment control to prevent erosion and contamination of watersheds from heavy rains.

Partners: Caltrans, StopWaste, engineers, landscape architects and contractors

Comments: Use compost berms:

- Adjacent to creeks or on a site perimeter to filter run off after earthquakes or wildfires
- To filter run-off on site perimeters after earthquakes or wildfires

Use compost socks:

- For check dams to slow areas of concentrated flow from stormwater
- For slope interruptions to slow run off on steep slopes
- For bank stabilization along water ways around storm drains for inlet protection from contaminated run off in storm events and after wildfire or earthquakes

Use compost blankets:

- For slope stabilization on bare or disturbed soils or post wildfires in appropriate areas and
- To create vegetated filter strips for stormwater control

Proper use of compost and mulch can also protect habitat from the impacts of flood and wildfire. This action can be combined with habitat restoration practices to achieve greater ecosystem resilience and faster hazard recovery.

Timeframe: Mid-term

Ease of Implementation: Medium

Potential Funding: California Natural Resources Agency Urban Greening Fund, EPA Clean Water State Revolving Fund

D. Update city standards to include compost requirements

Action: Incorporate compost requirements into city standards for contractors and department policies (public works, parks, fire departments, etc.).

Partners: StopWaste, public works departments, fire departments, parks, purchasing, etc.

Comments: Integrating these requirements into city-wide standards will increase effectiveness and uptake.

Timeframe: Mid-term

Ease of Implementation: High

Potential Funding: N/A

E. Utilize compost to protect bare soil

Action: Protect bare soil with local recycled compost and mulch.

Partners: Local community organizations and non-profit organizations, StopWaste, homeowners' associations

Comments: Adopting a city-wide policy to adopt this practice on public lands can help protect public assets. Community organizations can also be influential for implementation of mulching and maintenance of natural infrastructure. Providing education materials and building partnerships to drive community support in strategic locations that are not limited to publicly owned land can help to bring this strategy to scale.

Timeframe: Short-term

Ease of Implementation: High

Potential Funding: California Natural Resources Agency Urban Greening Fund

I. INLAND FLOODING > 1. Stormwater Management (cont'd)

F. Address rainwater treatment

Action:	Plant trees to intercept rain and build rain gardens, green roofs, and other vegetative stormwater treatment features. Grade surfaces and direct downspouts so that stormwater flows toward vegetated areas.
Partners:	Bay Area Stormwater Management Agencies Association, Alameda County Clean Water Program, Bay Institute, Coastal Conservancy, other community groups, non-profit and non-governmental organizations, East Bay Municipal Utility District, Green Plan-IT
Comments:	Pairing these strategies with the other actions recommended here or by other expert organizations (see Potential Implementation Partners and Resources) can help create a robust stormwater management strategy that leverages the power of natural infrastructure while relieving the strain on the sewer system and providing additional greenspace to residents. Creating floodable landscape features or vegetative stormwater management solutions to accommodate storm-induced flooding can protect assets from flood damage. These tools include rain gardens, bioretention ponds and swales, green roofs and others. Tools such as Green Plan-IT can help to locate the areas where these installations can be most effective.
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	California Natural Resources Agency Urban Greening Fund, California Landscape Conservation Cooperative, Coastal Conservancy, EPA Clean Water State Revolving Fund, California State Water Resource Control Board

G. Encourage the use of pervious pavement

Action:	Encourage the use of pervious pavement in new and existing development (e.g., in parking lots), including rain gardens, bioswales, porous pavement and disconnected downspouts to reduce runoff.
Partners:	Alameda County Clean Water Program, Bay Area Water Management Agencies Association, Green Plan-IT, public works and planning departments.
Comments:	<p>Pervious surfaces allow water to drain directly into the soil rather than flowing to a storm drain and then to a water treatment plant or directly into local waterbodies. They help prevent pollution and flooding by reducing the load on the stormwater system, especially during intense precipitation, and are therefore an asset in a comprehensive adaptation strategy.</p> <p>Approaches to encouraging the use of pervious surfaces include providing zoning incentives, requiring a certain percentage of groundcover in zoning requirements, including porous pavements in good management practices, and removing any zoning provisions that restrict or prohibit the use of porous pavements.</p> <p>The Green Plan-IT tool can help locate where pervious surfaces are needed most and will have the biggest impact on the watershed and/or localized flooding. Results from the tool can be used to direct incentives, program outreach and appropriate solutions or strategies for implementation.</p> <p>Smaller demonstration projects can support these efforts by raising public awareness and acceptance of pervious surfaces. For example, in Chicago, they paved alleyways that tended to flood with porous pavement and clearly labeled them “green alleys” to increase visibility and awareness.</p>
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	California Natural Resources Agency Urban Greening Fund, California State Water Resource Control Board

2. Protect and Restore Soil Health

Goal:	Protect and restore soil health.
Description:	Soils provide many ecosystem services; they store carbon, filter and breakdown pollutants, store water, and promote plant health and resiliency. Soils are often depleted in the process of development and will be further impacted by climate change, drought, flooding, heat and wildfire. Intentionally restoring soil health can help restore these vital ecosystem services, and help buffer or avoid impacts from climate change.
Hazard(s):	Floods, changes in precipitation, droughts
Co-benefits:	Reduced greenhouse gas emissions, carbon sequestration, increased water retention, reduced stormwater runoff, erosion control, reduced need for fertilizers and pesticides
Equity considerations:	Green spaces can help to mitigate the impacts of urban heat islands and support stormwater management. Underserved communities typically have less access to green space, so ensuring the health and maintenance of the green space that does exist is important.

A. Enhance the drought- and flood-resistance of soils

Action:	Enhance the drought- and flood-resistance of soils in publicly managed lands, including open spaces, and city-owned facilities with compost and mulch.
Partners:	East Bay Regional Park District, Bay Area Open Space Council, urban landscape authorities, StopWaste, community organizations, urban agriculture and farm organizations, Office of Environmental Farming and Innovation, Carbon Cycle Institute, Center for Carbon Removal, landscape architects and contractors.
Comments:	Compost can mitigate the impact of drought on trees, grasslands and crops. Approximately 16,500 gallons of water per acre are retained for each additional 1% of organic material in the soil (depending on soil type). Soil organic matter can hold 20 times its weight in water. Compost also creates healthier plants, by providing key plant nutrients at a rate plants can uptake and by providing antibiotic protection.

Compost increases carbon sequestration in the soil and stimulates the growth of more biomass. One inch of compost applied on one acre can avoid emissions of 57 tons of carbon dioxide equivalent or more. It can help bind heavy metals and filter out sediment. The Marin Carbon Project is an effort to implement agricultural practices which help store carbon and enhance ecosystem function. Their research has found that a one-time, one-half inch application of compost sequesters 1 ton of carbon dioxide equivalent per acre-year. Exploring how the Project's research could apply to open spaces in Alameda County could provide both adaptation and mitigation benefits.

The following are recommended guidelines for the application of compost and mulch:

- For new plantings, achieve 5% soil organic matter content by adding compost. (The Model Water Efficient Landscape Ordinance (WELo) requires 4 cubic yards of compost/1,000 sq. ft. of planting area.) Exceptions can be made for plants that need low organic matter such as cactus or for undisturbed native soils.
- Have a 3-inch layer of coarse mulch. (WELo requirement) Prioritize the use of recycled content materials. Wood and plant material are preferred. Rock mulches heat up soil and deplete natural resources. Synthetic mulches can pollute the watershed and should be avoided.
- Avoid bare soil. Ensure that soil on roadsides, in median strips, and in planting areas is covered with a mulch layer. A University of British Columbia study recently found that woody mulch can reduce NOx emissions from soil by 28% compared to bare soil.
- For civic landscapes, top-dress irrigated planting beds as necessary with compost and maintain a mulch layer.
- For all landscape-based stormwater treatment, incorporate compost and apply mulch.

In order to achieve scale and impact of compost and mulch efforts to enhance soil throughout the city, it will be valuable to identify priority areas (e.g., forested parklands, shoreline areas, particularly vulnerable neighborhoods) and establish partnerships with waste management authorities and companies to guarantee an adequate supply of quality compost and mulch for urban and open space soils.

Timeframe:	Ongoing
Ease of Implementation:	High
Potential Funding:	Cap and trade funds, Proposition 1, Capitol improvement budgets, Healthy Soils Initiative

B. Develop and implement carbon farming plans

- Action:** Identify public and private sites for carbon farming, including rangeland, agricultural land, vineyards, urban farms, parks, and develop and implement carbon farming plans on those sites.
- Partners:** Alameda County Resource Conservation District, Natural Resource Conservation Service, StopWaste, Carbon Cycle Institute, composters, East Bay Regional Parks District, San Francisco Public Utilities Commission and other landowners.
- Comments:** Using the soil to store and sequester carbon helps reverse climate change, while enabling soil to adapt to the effects of climate change, such as increased periods of drought, high temperatures, and increased flooding. Carbon farming can be implemented on many types of sites, ranging in size. Identifying areas suitable for carbon farming is the first step. Tools such as the COMET planner and Compost Planner can be used to provide estimates of carbon stored and sequestered. Carbon farming is included as a protocol in the American Carbon Registry.
- Timeframe:** Short-term for planning, medium term for implementation
- Ease of Implementation:** High
- Potential Funding:** California Department of Food and Agriculture Healthy Soils Initiative, NRCS Environment Quality Incentives (EQIP) program, Alameda County Resource Conservation District, California Department of Water Resources, carbon markets

3. Establish Public Agency Cooperation for Flood Prevention

Goal:	Establish cooperative relationships among public agencies with responsibility for flood protection
Description:	Since flooding does not always respect city boundaries and often effects Bay area residents on a watershed scale, regional collaboration can help to more effectively and efficiently address flood risk by opening communication channels and providing consistent strategy across local jurisdictions.
Hazard(s):	Flood, changes in precipitation
Co-benefits:	Regional collaboration, mobilizing inter-agency communication and other cooperative efforts
Equity considerations:	Extend invitations to participate in regional efforts to groups that represent a variety of relevant sectors, issue groups and communities.

A. Maintain corridors between undeveloped areas

Action:	Collaborate with agencies managing public lands to identify, develop, or maintain corridors and linkages between undeveloped areas.
Partners:	Association of Bay Area Governments, Urban Sustainability Directors Network, ICLEI, Green Cities, StopWaste, Alameda Flood Control and Water Conservation District, CalFIRE, California Department of Parks and Recreation, East Bay Regional Parks District, Pacific Gas & Electric (PG&E), East Bay Municipal Utility District, San Francisco Bay Regional Coastal Hazards Adaptation Resiliency Group (CHARG), Bay Area Regional Collaborative, San Francisco Bay Conservation and Development Commission (BCDC), San Francisco Baykeeper, Coastal Conservancy, and other land owners, local community groups and non-profit organizations.
Comments:	<p>This measure is explicitly called for in the SB379 guidelines. In addition, protecting natural infrastructure on a regional level will help reduce the vulnerability of individual cities to flood, and build capacity beyond what a city might be able to achieve on its own.</p> <p>Engaging representatives across cities and agencies in a working group or task force can help to communicate successes, tackle challenges and implement cohesive and practical programs that help to promote regional coordination around the implementation of floodplain development and stormwater management.</p>
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	Coastal Conservancy, participating implementing partners.

II. Sea Level Rise

1. Preserve High-Hazard Areas and Public Open Space

Goal:	Preserve and protect high-hazard areas and public open space
Description:	High-hazard areas include the wetlands that border the San Francisco Bay and act as a buffer between the bay and the development within the cities. Protecting these and other areas that are vulnerable to sea level rise and/or experience repeat exposure will save the city in repair costs and protect citizens from climate hazards.
Hazard(s):	Sea level rise, flood, changes in precipitation
Co-benefits:	Preservation of community assets, potential reduced costs from flood damages, carbon sequestration
Equity considerations:	Vulnerable communities will have the least resources to address damage from and potentially relocate in response to sea level rise. A comprehensive strategy will need to protect all community members.

A. Maintain and enhance natural shoreline buffers

Action:	Maintain and enhance natural shoreline buffers to protect inland development through mechanisms such as conservation easements and establishment of priority conservation areas.
Partners:	BCDC, CHARG, Bay Area Regional Collaborative, East Bay Regional Parks District, California Sea Grant, San Francisco Estuary Partnership, San Francisco Bay Restoration Authority.
Comments:	The 100-year floodplain and the area projected to be inundated by 36 inches of sea level rise should be areas of primary concern. At a minimum, preserving the existing natural buffers will be essential.
Timeframe:	Short-term/Ongoing
Ease of Implementation:	High
Potential Funding:	NOAA, California Sea Grant, Measure AA

B. Ensure shoreline plans consider long-term sea level projections

Action:	Ensure that land use and capital improvement decisions for the shoreline area consider long-term sea level projections.
Partners:	BCDC, other Bay Area cities or counties pursuing a similar sea level rise strategy.
Comments:	Update building codes and plans to mandate long-term sea level rise projections. A sample approach could include applying the BCDC sea level rise projections and associated timeline to the expected life of future building development and land use decisions. Also, consider sea level rise projections when updating zoning status and requirements.
Timeframe:	Mid-term/Ongoing
Ease of Implementation:	High
Potential Funding:	N/A

II. SEA LEVEL RISE > 1. Preserve High-Hazard Areas and Public Open Space (cont'd)

C. Transition shoreline areas towards lower-density, less critical uses

Action:	Develop a strategy to convert developed shoreline areas at risk from sea level rise to lower-density uses and/or natural features, and relocate critical assets
Partners:	HazMat site owners and operators, PG&E, East Bay Municipal Utility District, other asset owners.
Comments:	This can include creating a transition plan to account for the relocation of critical resources located in the projected floodplain for sea level rise. Include hazardous materials sites, key electric grid infrastructure and other key city assets. Planning for relocation should account for the life of the asset and the projected sea level rise that corresponds with that expected timeframe. Assets that are expected to serve local communities through the end of the century (hazmat control, energy transmission, sewer, etc.) should account for the “likely” scenario of 36 inches of sea level rise at a minimum. By identifying these assets and developing a transition strategy and schedule, the City and its partners will be able to adapt incrementally.
Timeframe:	Short-term plan development, long-term implementation
Ease of Implementation:	Medium
Potential Funding:	DOE, Ocean Protection Council (OPC) Local Coastal Program Sea-level Rise Grant Program

D. Build a living levee

Action:	Build a living levee.
Partners:	Committee for Green Foothills, The Bay Institute, San Francisco Bay Development Commission, California Landscape Conservation Cooperative, Coastal Conservancy, San Francisco Estuary Partnership, San Francisco Bay Restoration Authority, other community groups, non-profit and non-governmental organizations.
Comments:	Living levees are most appropriate along the Bay where existing wetlands and natural infrastructure may be threatened by sea level rise. Living levees can replace grey infrastructure by building up natural resources to protect vital city assets while maintaining the natural value and function of the Bay.
Timeframe:	Long-term
Ease of Implementation:	Low
Potential Funding:	California Natural Resources Agency Urban Greening Fund, Proposition 1, Bay Area Integrated Regional Water Management funds, California Landscape Conservation Cooperative, Coastal Conservancy, EPA Clean Water State Revolving Fund, Measure AA

2. Coordinate Local Sea Level Rise Efforts

Goal:	Coordinate sea level rise efforts with relevant regional entities as well as other local jurisdictions
Description:	Sea level rise is an inherently regional issue and local impacts will be best addressed through regional collaboration and coordination of resources.
Hazard(s):	Sea level rise
Co-benefits:	Regional coordination, mobilizing inter-agency communication and other cooperative efforts
Equity considerations:	Ensure that the voices of vulnerable communities are considered in regional efforts to address sea level rise, ideally through direct involvement of representative community groups.

A. Develop coordinated sea level rise adaptation measures

Action:	Coordinate with San Francisco Bay Development Commission (BCDC), Association of Bay Area Governments (ABAG), Bay Area Regional Collaborative and other regional entities to develop relevant, regionally coordinated sea level rise adaptation measures through programs such as Resilient by Design that leverage the results of Adapting to Rising Tides and other programs.
Partners:	BCDC, ABAG, Bay Area Regional Collaborative, Coastal Hazards Adaptation Resiliency Group (CHARG), the Coastal Conservancy, The Nature Conservancy, and other regional entities
Comments:	The San Francisco Bay is at risk from sea level rise, and many existing efforts have begun to assess and craft solutions to the issue. By engaging in or building upon existing efforts, the cities in Alameda County can support further work and build off the momentum of other programs. For instance, CHARG has working groups focused on issues such as adaptation strategies, implementation strategies, and funding. In addition to collaborating with regional agencies, cities can also leverage the experience of other cities and counties that have pursued sea level rise programs and planning, such as San Mateo County. These programs can inform effective and locally-appropriate strategies.
Timeframe:	Short-term
Ease of Implementation:	High
Potential Funding:	BCDC, Resilient by Design

B. Develop a waterfront protection and rehabilitation policy

Action:	Monitor and participate in regional and state-level policy and programmatic development on waterfront protection and rehabilitation.
Partners:	Urban Sustainability Directors Network, International Council for Local Environmental Initiatives, Green Cities, Alameda County Flood Control and Water Conservation District, Coastal Hazards Adaptation Resiliency Group, Bay Area Regional Collaborative, San Francisco Bay Development Commission, Cal FIRE, California Department of Parks and Recreation, East Bay Regional Parks District, East Bay Municipal Utility District, San Francisco Baykeeper, San Francisco Bay Restoration Authority, other local community groups and non-profit organizations
Comments:	Active engagement in regional and state-level policy and programmatic development will allow the city to leverage regional knowledge and resources for local protection while communicating specific, tangible community needs to the wider regional conversation around sea level rise.
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	Participating implementing partners

III. Higher Temperatures and Extreme Heat

1. Decrease Urban Heat Islands

Goal:	Decrease urban heat islands through increased tree and vegetation planting and maintenance
Description:	Trees and greenspace can significantly reduce urban heat island effects by providing shade and absorbing heat from the surrounding area. Increasing vegetation and tree canopy in urban areas with a large concentration of buildings can reduce extreme heat impacts and decrease the risk of flood by increasing pervious surface.
Hazard(s):	Higher temperatures, extreme heat, droughts
Co-benefits:	Reduced risk for floods with increased pervious surface and greater stormwater capture, improved air quality, cooling of urban infrastructure, increased public green space, increased carbon sequestration, mitigation of drought and heat stress on individual street trees with increased rootable soil volume.
Equity considerations:	Consideration of the equitable distribution of trees across communities will be essential, targeting the areas that are the most vulnerable, underserved and/or will experience the most significant urban heat island impacts.

A. Assess existing vegetative cover

Action:	Assess the existing vegetative cover and plant health throughout the city.
Partners:	East Bay Regional Park District, Urban ReLeaf, California Urban Forests Council or other community organizations and non-profit organizations
Comments:	This is an important first step to understand gaps and vulnerabilities in the existing tree canopy and vegetative cover, and inform future planning and strategy. A comprehensive vegetative cover assessment, such as a biomass index, may be useful for some cities. In general, a tree canopy assessment may be sufficient because trees provide shade and therefore have a substantially larger impact on heat conditions in urban areas than other vegetation. An assessment should consider plant location, health and concentration. Assessing tree health throughout the city is especially important since trees provide substantial benefits. Maintenance of the existing canopy will be more feasible than replacement.
Timeframe:	Short-term
Ease of implementation:	Medium
Potential funding:	East Bay Regional Park District, California ReLeaf network, CalFIRE

B. Identify priority areas for the expansion of urban planting

Action:	Identify priority areas to expand urban tree and vegetation planting
Partners:	Urban forestry community organizations and non-profit organizations
Comments:	Consider the most vulnerable, underserved populations and areas with the least tree cover or green space and/or most urban heat island effect impacts. In addition to setting goals for increases in tree canopy, consider the location-specific benefits of including natural features (parks, streams, marsh areas, etc.) and native vegetation (shrubs, grasses, etc.). As part of a greater urban green space strategy, these different tools can help provide robust and feasible options.
Timeframe:	Short-term
Ease of implementation:	High
Potential funding:	California ReLeaf network

III. HIGHER TEMPERATURES AND EXTREME HEAT > 1. Decrease Urban Heat Islands (cont'd)

C. Establish a minimum rootable soil volume for trees

Action:	Establish a minimum rootable soil volume for trees to support a healthy urban forest. Retrofit tree wells accordingly. Incorporate compost and maintain layer of mulch to create healthy soils for trees and other vegetation.
Partners:	Developers; architecture, engineering, landscape architecture and construction firms
Comments:	<p>Street trees often are planted in compacted soil, subsoils, road base, or rock and/or are bound by concrete. To be healthy and grow to full size, trees need loose, arable soils. Urban trees would benefit from a soil organic matter content of 5% to grow to their full potential. The City of Emeryville requires that all new street trees have the following minimum rootable soil volumes:</p> <ul style="list-style-type: none">• Large tree: 1200 sq. ft.• Medium tree: 900 sq. ft.• Small tree: 600 sq. ft. <p>Meeting or exceeding this requirement would help to ensure adequate rootable soil volume. Enhancements to soil volume and quality may be made when retrofitting tree wells to make sidewalk, street or stormwater improvements adjacent to street tree plantings. Tree wells can also be used to intercept and treat stormwater from streets and paved areas but the design should include minimum rootable soil volumes and should avoid soil erosion from the tree well. Supporting actions can also include providing on-going city maintenance of street trees (shifting the responsibility from property owners), and providing discounts on trees and for pick-up of concrete to homeowners.</p>
Timeframe:	Mid-term
Ease of implementation:	Medium
Potential funding:	FEMA, developer fees

D. Promote the use of shade trees

Action:	Plant vegetation and shade trees with substantial canopies and require, where feasible, site design that uses trees and vegetation to shade parking lots, streets and other facilities.
Partners:	California ReLeaf network or other urban forestry organization as a tree maintenance partner.
Comments:	Selecting appropriate tree and plant species (native, drought resistant, low maintenance) and ensuring provisions for tree and plant maintenance can help to promote sustainability of these efforts.
Timeframe:	Mid-term
Ease of implementation:	Medium
Potential funding:	Explore options for public/private partnerships to reduce cost of tree planting, California Natural Resources Agency (CNRA) Urban Greening Grant Program, CNRA Environmental Enhancement and Mitigation Grant Program, California ReLeaf grants for non-profit partners, US Department of Agriculture, US Forest Service.

III. HIGHER TEMPERATURES AND EXTREME HEAT > 1. Decrease Urban Heat Islands (cont'd)

E. Preserve mature trees and vegetation

Action:	Encourage the preservation of mature trees and vegetation. When preservation is not feasible, require replacement trees and vegetation and ongoing maintenance measures to avoid net loss of plant coverage.
Partners:	Public communication partner or team
Comments:	Mature trees absorb more air pollution, provide more shade and have large inherent financial, social and environmental value. Some areas may have large numbers of co-aging trees that will experience turnover on the same timeline. Creating a tree replacement program to establish a plan for the strategic replacement of aging trees, and providing incentives or passing an ordinance that supports this action can help to address turnover.
Timeframe:	Ongoing/Long-term
Ease of implementation:	Medium
Potential funding:	California ReLeaf network

F. Encourage the planting and preservation of trees on private property

Action:	Provide services, education, and incentives to encourage the planting and preservation of trees and vegetation on private property.
Partners:	Landscape architects and designers, Master Gardeners, Tree People, Urban ReLeaf, California Conservation Corps, California Landscape Conservation Cooperative and nurseries.
Comments:	Examples of incentives or services include providing: on-going tree maintenance (shifting responsibility from property owners), discounts on trees and/or concrete pick-up post-planting for homeowners, and construction or certification benefits for funding green infrastructure, vegetation and trees in public rights of way. Building a network of existing non-profit organizations and community groups to advertise and support these programs can help encourage participation.
Timeframe:	Mid-term
Ease of implementation:	Medium
Potential funding:	California Natural Resources Agency (CNRA) Urban Greening Grant Program, CNRA Environmental Enhancement and Mitigation Grant Program, California ReLeaf grants for non-profit partners, US Department of Agriculture Forest Service.

2. Promote the Use of Cool Infrastructure

Goal:	Promote the use of cool infrastructure
Description:	Cool infrastructure that reflects light and heat rather than allowing it to absorb into buildings and pavement helps to alleviate urban heat island impacts during high heat days. Examples include white or cool roofs, reflective pavement, green roofs, permeable pavement and more.
Hazard(s):	Extreme heat
Co-benefits:	Greater energy efficiency, cost savings in building operation
Equity considerations:	Cool infrastructure will have the greatest impact in areas most vulnerable to urban heat island impacts. These impacts may be exacerbated in low income communities where the quality of housing stock tends to be lower and residents generally have less access to public green space. It will be important to focus cool infrastructure installations in areas that have both high urban heat island impact risk and a large population of people living and working there.

A. Promote cool parking

Action:	Promote the use of cool parking in new parking facilities and existing parking lots undergoing resurfacing by shading parking areas with shade structures and trees and using light colored paving or other surface treatments.
Partners:	Contractors and companies that provide resurfacing services, community groups working on these issues (e.g. Climate Resolve), CoolCalifornia.org, Global Cool Cities Alliance
Comments:	<p>Shading reduces heat absorption in asphalt by limiting direct exposure to sunlight. Light colored pavement and similar surface treatments reduce heat absorption by increasing the albedo of the pavement to reflect more light and heat.</p> <p>Balance the need for pervious pavement vs. cool parking. Take advantage of opportunities to implement action when resurfacing is taking place by partnering with the companies that provide resurfacing services. They are the first point of contact and can provide advice directly to parking facility owners and decision makers.</p>
Timeframe:	Short-term
Ease of Implementation:	Medium
Potential Funding:	N/A

B. Promote cool-roof reach codes

Action:	Promote adoption of cool-roof reach codes for new construction and re-roofing/roofing upgrading.
Partners:	International Council for Local Environmental Initiatives, Urban Sustainability Directors Network, Green Cities
Comments:	Provide incentives for cool infrastructure, especially on/in affordable housing and within high urban heat island areas.
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	N/A

IV. Changes in Precipitation

1. Manage and Conserve Groundwater

Goal:	Manage and conserve groundwater
Description:	Groundwater is a critical water resource for California. Preserving local groundwater helps to combat land subsidence and drought.
Hazard(s):	Changes in precipitation, drought
Co-benefits:	Flood prevention
Equity considerations:	Groundwater recharge efforts should be conducted with consideration of the best interest of all communities. Where groundwater management actions can coincide with other water management and green infrastructure efforts, pursuing benefits to vulnerable communities should be considered a priority.

A. Monitor groundwater elevation and quality

Action:	Monitor groundwater elevation and quality. Support the California Statewide Groundwater Elevation Monitoring Act (CASGEM).
Partners:	Local ground water management agency, Bay Area Integrated Regional Water Management (BAIRWM) group, East Bay Municipal Utility District, California State Water Resource Control Board, California Department of Water Resources (DWR).
Comments:	Understanding the status of groundwater resources in the jurisdiction and region can help inform water use and management decisions. Refer to the South East Bay Plain Basin Groundwater Management Plan.
Timeframe:	Ongoing
Ease of Implementation:	High
Potential Funding:	DWR Sustainable Groundwater Planning Grant Program

B. Comply with California's Sustainable Groundwater Management Act

Action:	Comply with California's Sustainable Groundwater Management Act to develop sustainability plans to prevent overdraft of groundwater by 2022 and to achieve sustainability by 2040.
Partners:	Local water and groundwater management agencies.
Comments:	According to the California Statewide Groundwater Elevation Monitoring Act, groundwater management agencies must be created across California by 2017. By 2020, groundwater basins that are "over-drafted" (meaning more water is being pumped than replenished) must have sustainability plans, and by 2022, all other basins must have such plans. By 2040, all "high and medium priority" basins must achieve sustainability.
Timeframe:	Mid-Long Term
Ease of Implementation:	Medium
Potential Funding:	California Department of Water Resources Sustainable Groundwater Planning Grant Program

IV. CHANGES IN PRECIPITATION > 1. Manage and Conserve Groundwater (cont'd)

C. Identify priority recharge areas

Action:	Identify priority recharge areas and ensure that land use planners consider the need to protect these areas in land use processes through codes and ordinances.
Partners:	Bay Area Integrated Regional Water Management (BAIRWM), Alameda Local Agency Formation Commission, Association of Bay Area Governments, East Bay Municipal Utility District
Comments:	Priority recharge areas include land that drains into local aquifers and/or is of an appropriate soil type for effective infiltration. Refer to the South East Bay Plain Basin Groundwater Management Plan.
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	California Department of Water Resources Sustainable Groundwater Planning Grant Program

D. Locate local aquifers and increase water infiltration

Action:	Determine the location of local aquifers and promote strategies to increase water infiltration over them, such as green infrastructure and pervious paving.
Partners:	BAIRWM, Alameda Local Agency Formation Commission, Association of Bay Area Governments, East Bay Municipal Utility District
Comments:	Use the information from the previous action to inform the best location to implement these strategies. For more information, see the pervious surface and green infrastructure measures under overland flooding.
Timeframe:	Long-term
Ease of Implementation:	Medium
Potential Funding:	California Department of Water Resources Sustainable Groundwater Planning Grant Program

E. Increase water holding capacity through the use of compost and mulch

Action:	Incentivize the use of compost and mulch in new and existing landscapes and gardens to increase the water holding capacity of soil and increase infiltration.
Partners:	East Bay Regional Park District, Bay Area Open Space Council, urban landscape authorities, community organizations, nurseries, compost and mulch producers and vendors, water agencies, Caltrans, ReScape California
Comments:	See Measure II.5.A on improving soil health.
Timeframe:	Ongoing
Ease of Implementation:	Medium
Potential Funding:	Department of Water Resources, water agencies, California State Water Resource Control Board

2. Conserve and Reuse Water in Buildings and Landscapes

Goal:	Conserve and reuse water in existing buildings/landscapes
Description:	Higher temperatures and changing precipitation patterns, as well as the growing population and increased water demand will place increased pressure on water sources. Water efficiency and saving programs can help reduce water insecurity, both in the short and long term.
Hazard(s):	Changes in precipitation, droughts
Co-benefits:	Utility cost savings, energy savings, decreased sewer system load
Equity considerations:	In the design of incentives and regulations, consider different uses of water (basic vs. luxury) and ensure that low-income populations are not adversely affected.

A. Establish water reduction targets

Action:	Assess current water usage and available technologies and practices, and set ambitious but feasible water reduction targets at the city level.
Partners:	Water efficiency consulting companies, California Department of Water Resources (DWR), Alameda County Water District, East Bay Municipal Utility District, Zone 7 Water Agency
Comments:	This action represents the starting point for the actions under this measure. The information gathered through this assessment and the associated goals should inform the prioritization and selection of strategies for increased water efficiency and reuse throughout the city.
Timeframe:	Short term
Ease of Implementation:	Medium
Potential Funding:	DWR Water-Energy Grant Program, Bureau of Reclamation Water-SMART Grants

B. Promote water efficient landscaping

Action:	Promote and incentivize water efficient landscaping through rebates for lawn conversions with sheet mulch and irrigation repair and upgrades.
Partners:	Alameda County Water District, East Bay Municipal Utility District, home and business owners, landscape professionals, ReScape California, Lawntogarden.org
Comments:	Promote resources through water agencies and lawntogarden.org. Craft these programs to complement the implementation and enforcement of the city's WELO.
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	California Department of Water Resources, Bureau of Reclamation Water-SMART Grants

C. Require high indoor water efficiency

Action:	Require new construction and major remodels to achieve indoor water efficiency 20 percent above the California Building Standards.
Partners:	Relevant city departments
Comments:	Adjust the specific percent goal based on the city's capacity, water resource use and needs and other existing goals, plans or ordinances.
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	California Department of Water Resources, Bureau of Reclamation Water-SMART Grants

IV. CHANGES IN PRECIPITATION > 2. Conserve and Reuse Water in Building and Landscapes (cont'd)

D. Promote indoor water conservation

Action:	Collaborate with local water agencies to promote indoor water conservation.
Partners:	Alameda County Water District, East Bay Municipal Utility District, StopWaste
Comments:	Some potential activities include pursuing or expanding a communications strategy for water conservation in residential use and offering incentives for water efficient appliances and fixtures. Leveraging the knowledge, skills and resources of various agencies working toward the same goal can increase the effectiveness of water conservation efforts.
Timeframe:	Short-term
Ease of Implementation:	High
Potential Funding:	N/A

E. Promote the use of graywater

Action:	Provide incentives and education to promote the use of graywater.
Partners:	East Bay Municipal Utility District, Alameda County Water District, Berkeley EcoHouse, Greywater Action, Alliance for Water Efficiency, California Department of Water Resources, other local water departments with graywater incentive programs (for recommendations and advice)
Comments:	East Bay Municipal Utility District currently offers a rebate for the installation of graywater systems. Support and build upon existing rebates and related programs through city-run efforts.
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	East Bay Municipal Utility District

F. Streamline the permit process for graywater systems

Action:	Streamline the permit process for graywater systems, and align the permit process with the degree of system risk.
Partners:	California Water Foundation, California Building Standards Commission
Comments:	Review and streamline the permitting process for graywater systems, including any disincentives in this or related permitting that may discourage interested developers and property owners from pursuing graywater systems. System risk in this case is defined as the risk of installing and operating the graywater system incorrectly. Systems that connect graywater to landscape irrigation will have less risk of human exposure than internal dual plumbing to toilets.
Timeframe:	Long-term
Ease of Implementation:	Medium
Potential Funding:	N/A

IV. CHANGES IN PRECIPITATION > 2. Conserve and Reuse Water in Building and Landscapes (cont'd)

G. Require dual plumbing for graywater in new developments

Action:	Promote graywater use by requiring dual plumbing for graywater from laundry and showers in new developments.
Partners:	California Water Foundation, California Building Standards Commission
Comments:	As an additional element to a comprehensive graywater use strategy throughout the city, requiring graywater systems in new development will help the city decrease water use and promote efficiency into the future.
Timeframe:	Long-term
Ease of Implementation:	Low
Potential Funding:	N/A

H. Incentivize rainwater harvesting

Action:	Encourage the use of rainwater harvesting facilities, techniques and improvements where appropriate, cost effective, safe and environmentally sustainable.
Partners:	Greywater Action, Wholly H2O, non-profit organizations and other community organizations
Comments:	Rainwater harvesting systems include the rainwater collection system, storage tanks, filtration and processing. The type of filtration and processing required will depend on the target use of the rainwater. It can be used for irrigation, flushing toilets, washing clothes, pressure washing, and more. Providing education materials, city-specific guidelines and recommended contractors and retail locations can help promote rainwater catchment installations. Materials and incentives should target multiple sectors and scales of catchment, including residential, small and large commercial, and industrial.
Timeframe:	Short-term
Ease of Implementation:	High
Potential Funding:	Bureau of Reclamation Water-SMART Grants

I. Incentivize irrigation audits and advance water recycling programs

Action:	Coordinate with local water agencies to incentivize irrigation audits and advance water recycling programs – including treated wastewater to irrigate parks, golf courses, and roadway landscaping – and to encourage rainwater catchment system-wide and greywater usage in new buildings.
Partners:	East Bay Municipal Utility District, Alameda County Water District, Alameda County Flood Control and Water Conservation District, home and business owners, California Water Foundation, Irrigation Association
Comments:	Leverage existing relationships and create new connections to expand the scope of new or existing water recycling and rainwater catchment programs and public communication efforts.
Timeframe:	Mid-term
Ease of Implementation:	High
Potential Funding:	California Department of Water Resources, Bureau of Reclamation Water-SMART Grants

IV. CHANGES IN PRECIPITATION > 2. Conserve and Reuse Water in Building and Landscapes (cont'd)

J. Build municipal cisterns

Action:	Build municipal cisterns.
Partners:	East Bay Municipal Utility District, Bay Area Stormwater Management Agencies Association, American Rainwater Catchment Systems Association, Alameda County Flood Control and Water Conservation District
Comments:	Municipal cisterns are installed under streets or other municipal facilities and serve multiple functions for stormwater mitigation and flood control, in addition to providing water for landscape irrigation, firefighting and post-earthquake emergency response. Cities should repair existing and install new cisterns to improve coverage for stormwater capture, firefighting and emergency resources.
Timeframe:	Long-term
Ease of Implementation:	Low
Potential Funding:	Bureau of Reclamation Water-SMART Grants

K. Promote the use of compost and mulch in existing landscapes

Action:	Incentivize and promote the use of compost and mulch in existing landscapes and gardens to create drought resistant soils.
Partners:	StopWaste, ReScape California, PG&e Energy Center, Lawntogarden.org
Comments:	In addition to efforts to increase the flood and drought resistance of soils on public lands (see Measure 5), provide information and incentives to residential and commercial landowners to promote compost and mulch use throughout their existing green space. Leverage the available information and programs in the region, such as lawntogarden.org, ReScape California and others.
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	StopWaste

L. Use Bay-Friendly landscape maintenance practices

Action:	Use practices in the Bay-Friendly Landscape Maintenance Manual to maintain city landscapes.
Partners:	StopWaste, ReScape California
Comments:	Minimum landscape practices to include are: <ul style="list-style-type: none">• Use climate-adapted plant species that use little to no water.• Do not overplant.• Avoid invasive plant species.• Use compost and mulch to create drought-resistant soils.• Capture and use or infiltrate and/or filter storm water on site.• Use efficient irrigation systems.• Install a designated landscape water meter or sub-meter.• Use a weather-based self-adjusting irrigation controller.• Design and implement lawn replacement plans to convert decorative turf to summer-dry plantings with sheet mulch.• When implementing lawn replacement programs, require sheet mulching.• Use a 1 ½ inch layer of compost in sheet mulch with a minimum total sheet mulch blanket of 4 inches.
Timeframe:	Mid-term
Ease of Implementation:	High
Potential Funding:	N/A

M. Require Bay-Friendly Qualification for city landscape staff

Action: Require city landscape maintenance staff to become Bay-Friendly Qualified Professionals.

Partners: ReScape California, StopWaste

Comments: For example, 100 percent of City of Oakland full time staff who manage or maintain landscapes are Bay-Friendly Qualified Professionals. The training includes 24 hours of classes and a final practicum, and is taught by leading experts in stormwater management, soil health, irrigation, plant selection, and more.

Timeframe: Mid-term

Ease of Implementation: Medium

Potential Funding: StopWaste

IV. CHANGES IN PRECIPITATION (cont'd)

3. Increase Use of Local Sources of Water

Goal:	Increase the use of local sources of water
Description:	Two thirds of the region's water is from the snowpack in the Sierras. By the end of the century the spring snow pack in the Sierras could be reduced by as much as 70 to 90 percent. Increasing capacity to utilize local sources of water, such as graywater, rainwater, air conditioning condensate, and foundation drainage, will help minimize the local impacts of drought by decreasing reliance on shrinking no-local resources.
Hazard(s):	Changes in precipitation, drought
Co-benefits:	Water conservation, firefighting water resources
Equity considerations:	Local water resource use could be implemented in public facilities, especially those that serve vulnerable or underserved communities that may not have the resources to pursue local water capture and reuse as an adaptive action for personal or community assets.

A. Promote the use of alternative sources of water

Action:	Provide incentives and education on the use of alternative sources of water, such as graywater, rainwater, air conditioning condensate and foundation drainage.
Partners:	San Francisco Public Utilities Commission, US Green Building Council, architects, engineers, landscape architects, developers, and water agencies
Comments:	<p>Methods of encouraging local water use include:</p> <ul style="list-style-type: none">• Require dual plumbing and greywater use for laundry, toilets, onsite irrigation and showers in new developments.• Provide incentives and education to promote the use of greywater.• Streamline the permit process for greywater systems and align the permit processes with the climate risks for a particular system. <p>Air conditioning condensate can be used for toilet flushing and/or irrigation. Similarly, Low Impact Development and Green Infrastructure infiltrate water on site, or can facilitate water capture for reuse on site. At the city level, municipal cisterns can help increase resilience. Municipal cisterns can be located under streets or other municipal facilities and serve multiple functions of stormwater mitigation and flood control, landscape irrigation, and an emergency source of water for firefighting and post-earthquake response and recovery.</p>
Timeframe:	Short- to mid-term
Ease of Implementation:	Medium
Potential Funding:	N/A

4. Build Landscapes Adapted to California Climate and Soils

Goal:	Build landscapes adapted to California climates and soils
Description:	About half of urban water use in California is for landscape irrigation. With the appropriate use of native plants and soils, city landscaping can require less water and less maintenance while improving the long-term resilience of local green spaces and soils.
Hazard(s):	Changes in precipitation, drought
Co-benefits:	Water conservation
Equity considerations:	Applying Bay-Friendly landscape practices to all public facilities and green spaces, with preference for those in areas vulnerable to the effects of floods, sea level rise or drought. Civic landscapes can act as a powerful education tool and model for the community.

A. Use the Bay-Friendly Landscape Scorecard for public landscape construction

Action:	Meet the minimum qualifying score on the Bay-Friendly Landscape Scorecard for all new and renovated public landscape construction and have civic landscapes act as models for water conservation and sustainability for the community.
Partners:	Rescape California
Comments:	Minimum landscape practices to include are: <ul style="list-style-type: none"> • Use climate-adapted plant species that will use little to no water. • Do not overplant. • Avoid invasive plant species. • Use compost and mulch to create drought-resistant soils. • Capture and use or infiltrate and/or filter storm water on site. • Use efficient irrigation systems. • Install a designated landscape water meter or sub meter. • Use a weather-based self-adjusting irrigation controller. • Design and implement lawn replacement plans to convert decorative turf to summer-dry plantings with sheet mulch. • Require sheet mulching when implementing lawn replacement programs. • Use a 1 ½ inch layer of compost in sheet mulch with a minimum total sheet mulch blanket of 4 inches.
Timeframe:	Mid-term
Ease of Implementation:	High
Potential Funding:	N/A

B. Enforce the California Model Water Efficient Landscape Ordinance (WELO)

Action:	Train staff or hire contractors to enforce WELO for new and renovated permitted landscapes.
Partners:	California Department of Water Resources (DWR), StopWaste
Comments:	That state updated the WELO in 2015. Local jurisdictions are responsible for adopting and enforcing the state model WELO or a local, more stringent version. Best practices include more efficient irrigation systems, greywater usage, onsite storm water capture, and limitations on the proportion of turf cover on landscapes. Jurisdictions without in-house expertise should train staff or hire contractors to review plans and inspect construction to ensure compliance.
Timeframe:	Short-term
Ease of Implementation:	High
Potential Funding:	California Department of Water Resources

IV. CHANGES IN PRECIPITATION > 4. Build Landscapes Adapted to California Climate and Soils (cont'd)

C. Require Bay-Friendly Qualification for city and agency landscape staff

Action:	Require city and agency staff involved in landscape design, construction, maintenance or regulation to become Bay-Friendly Qualified Professionals.
Partners:	ReScape California, StopWaste
Comments:	For example, 100 percent of City of Oakland full-time staff who manage or maintain landscapes are Bay-Friendly Qualified Professionals. The training includes 24 hours of classes and a final practicum and is taught by leading experts in stormwater management, soil health, irrigation, plant selection and more.
Timeframe:	Mid-term
Ease of Implementation:	Medium
Potential Funding:	StopWaste

V. Landslides

1. Minimize Landslide Risks for New and Existing Development

Goal:	Avoid and minimize landslide risks for new and existing development
Description:	More intense precipitation events in conjunction with poor development planning could lead to soil instability and landslides in the hills. Updated policies and regulations need to be set in place to ensure that existing and new development are designed accordingly.
Hazard(s):	Landslides, changes in precipitation patterns
Co-benefits:	Reduced risk of flooding downstream, erosion control
Equity considerations:	Property owners and residents will have varying capacity to comply with requirements and/or implement protective measures. It will be important to consider the opportunity to provide technical or financial support to those who might be unable to meet or might be displaced by updated requirements due to a lack of resources.

A. Implement zoning and subdivision practices through General Plan elements

Action:	Implement zoning and subdivision practices through General Plan elements (safety, housing, land use) that restrict development in landslide risk areas.
Partners:	Alameda County Community Development Agency, Association of Bay Area Governments, Alameda County Flood Control and Water Conservation District
Comments:	Projected changes in precipitation indicate increased variability of precipitation events, with implications for the predictability of extreme events. Many high-risk landslide areas are located on public park land. Maintaining park property and natural land in areas susceptible to landslides will help protect from landslide occurrence and limit damage in the event of severe winter weather (such as in 1997-1998). Restricting development or enhancing codes and standards for properties in areas vulnerable to landslides will also help achieve this goal.
Timeframe:	Long-term
Ease of Implementation:	Medium
Potential Funding:	N/A

B. Mitigate landslide risks in the hills

Action:	Mitigate landslide risks in the hills by improving drainage, reconstructing retaining walls, installing netting and vegetation, avoiding clear cutting, and stabilizing the soil after tree clearing with compost and mulch.
Partners:	Alameda County Flood Control and Water Conservation District
Comments:	Implementing this action requires a progressive process that includes best practices, routine maintenance, evaluation and targeted repair of problem areas. The goal is to monitor conditions and conscientiously implement practices that maintain low risk levels to avoid compromising sites as they change with development and changes in ownership.
Timeframe:	Mid-term/Ongoing
Ease of Implementation:	Medium
Potential Funding:	California Storm Water Grant Program, California Natural Resources Agency Urban Greening Fund, EPA Clean Water State Revolving Fund

V. LANDSLIDES > 1. Minimize Landslide Risks for New and Existing Development (cont'd)

C. Require the use of compost as a best management practice for erosion and sediment control

Action:	Maximize the use of compost berms, blankets and socks for erosion and sediment control, especially on disturbed soils or post-fire where appropriate.
Partners:	California Landscape Conservation Cooperative, fire department, city departments that perform land maintenance, watershed groups, community groups specializing in watershed restoration
Comments:	See Measure 4, Action C for example guidelines on the use of compost berms, socks and blankets. Providing education materials and building partnerships to drive community support for installing these solutions in strategic locations that are not limited to publicly owned land can help to bring this strategy to scale.
Timeframe:	Short-term
Ease of Implementation:	High
Potential Funding:	California Natural Resources Agency Urban Greening Fund, EPA Clean Water State Revolving Fund

VI. Resources

I-1. Stormwater Management

- California Governor's Office of Planning and Research Integrated Climate Adaptation and Resiliency Program (ICARP) Adaptation Clearinghouse.
» www.opr.ca.gov/clearinghouse/adaptation/
- Caltrans. Erosion Control Toolkit: Compost.
» www.dot.ca.gov/hq/LandArch/16_la_design/guidance/ec_toolbox/organics/compost_blanket.htm
- Coastal Conservancy Climate Ready Program.
» scc.ca.gov/climate-change/climate-ready-program/
- Committee for Green Foothills. "Living Levees': Protecting Against Sea Level Rise by Restoring Wetlands."
» www.greenfoothills.org/living-levees/
- David Crohn et al. 2013. Composts as Post-Fire Erosion Control Treatments and Their Effect on Runoff Water Quality. Transactions of the American Society of Agricultural and Biological Engineers, Vol. 56(2): 423-435.
» www.hcd.ca.gov/nationaldisaster/docs/crohn_et_al_2013_trans_asabe.pdf
- Green Plan-IT.
» www.sfei.org/projects/greenplan-it#sthash.0TGBjtJO.dpbs
- Hoverter, Sara P. 2012. Adapting to Urban Heat: A Toolkit for Local Governments. Georgetown Climate Center.
» kresge.org/sites/default/files/climate-adaptation-urban-heat.pdf
- The Nature Conservancy. Reducing Climate Risks with Natural Infrastructure.
» www.nature.org/ourinitiatives/regions/northamerica/unitedstates/california/ca-green-vs-gray-report-2.pdf
- Measure AA, "San Francisco Bay Clean Water, Pollution Prevention and Habitat Restoration Program."
» sfbayrestore.org/docs/BallotMeasureLanguage.pdf
- South Bay Salt Pond Restoration Project.
» www.southbayrestoration.org/
- The Sustainable Site: The design manual for green infrastructure & low impact development.
» www.foresterpress.com/fps_sustain.html
- Bay Area Stormwater Management Agencies Association.
» www.bassma.org
- Alameda County Clean Water Program. C.3 Technical Guidance, A Handbook for Developers, Builders and Project Applicants.
» cleanwaterprogram.org/resources/resources-development.html

I-2. Protect and Restore Soil Health

- Cal Recycle:
» www.calrecycle.ca.gov/Climate/GrantsLoans/
- Caltrans. Erosion Control Toolkit: Compost.
» www.dot.ca.gov/hq/LandArch/16_la_design/guidance/ec_toolbox/organics/compost_blanket.htm
- Marin Carbon project
» www.marincarbonproject.org/
- The Sustainable Site: The design manual for green infrastructure & low impact development.
» www.foresterpress.com/fps_sustain.html
- Carbon Cycle Institute
» www.carboncycle.org/

I-3. Establish Public Agency Cooperation for Flood Prevention

- Bay Area Regional Collaborative. Bay Area Climate Asset Map (2014)
» bayarearegionalcollaborative.org/pdfs/BACERP_Bay_Area_Climate_Asset_Map_Nov_2014_v2.doc
- California Governor's Office of Planning and Research. Safety Element Section of the General Plan Guidelines.
» www.opr.ca.gov/docs/OPR_C4_final.pdf

II-1. Preserve High-Hazard Areas and Public Open Space

- San Francisco Estuary Partnership. Oro Loma Pilot Project - Horizontal Levee
» www.sfestuary.org/oroloma/
- The Oro Loma Sanitary District Horizontal Levee Project.
» oroloma.org/horizontal-levee-project/
- BCDC. Adapting to Rising Tides. DOE. Climate Change and the Electricity Sector: Guide for Assessing Vulnerabilities and Developing Resilience Solutions to Sea Level Rise. (2016).
» energy.gov/epsa/downloads/climate-change-and-electricity-sector-guide-assessing-vulnerabilities-and-developing
- Brody, Samuel D. and Wesley E. Highfield. 2013. Open space protection and flood mitigation: A national study.
» [Land Use Policy 32:89-95. DOI: 10.1016/j.landusepol.2012.10.017](https://doi.org/10.1016/j.landusepol.2012.10.017)

II-2. Coordinate Local Sea Level Rise Efforts

- BCDC. Adapting to Rising Tides.
» www.adaptingtorisingtides.org/
- Bay Area Regional Collaborative. Bay Area Climate Asset Map (2014)
» bayarearegionalcollaborative.org/pdfs/BACERP_Bay_Area_Climate_Asset_Map_Nov_2014_v2.doc
- Coastal Hazard Adaptation Resiliency Group (CHARG)
» www.acfloodcontrol.org/SFBayCHARG/
- Sea Change San Mateo County
» seachangesmc.com/

III-1. Decrease Urban Heat Islands

- The Nature Conservancy. 2016. Planting Healthy Air. Available at:
» global.nature.org/content/healthyair
- Hoverter, Sara P. 2012. Adapting to Urban Heat: A Toolkit for Local Governments. Georgetown Climate Center.
» kresge.org/sites/default/files/climate-adaptation-urban-heat.pdf
- City of Emeryville Water Efficient Landscape Ordinance. Accessed at DeepRoots web page of municipal codes.
» www.deeprroot.com/blog/blog-entries/soil-volume-minimums-organized-by-stateprovince
- A list of urban forestry organizations in the Bay Area can be found on the Benicia Tree Foundation website.
» www.beniciatrees.org/about-us/urban-forestry-organizations-bay-area
- The Sustainable Site: The design manual for green infrastructure & low impact development.
» www.foresterpress.com/fps_sustain.html

III-2. Promote the Use of Cool Infrastructure

- California Climate Action Team. Preparing California for Extreme Heat: Guidelines and Recommendations (2013).
» www.climatechange.ca.gov/climate_action_team/reports/Preparing_California_for_Extreme_Heat.pdf
- Global Cool Cities Alliance.
» www.globalcoolcities.org
- Hoverter, Sara P. 2012. Adapting to Urban Heat: A Toolkit for Local Governments. Georgetown Climate Center.
» www.law.georgetown.edu/academics/academic-programs/clinical-programs/our-clinics/HIP/upload/Urban-Heat-Toolkit_RD2.pdf
- EPA. Heat Island Community Actions Database.
» www.epa.gov/heat-islands/heat-island-community-actions-database
- California Code of Regulations. Title 24, Part 6. California Energy Code.
» www.energy.ca.gov/title24/
- PG&E: Energy-Efficient, Cool Roof, Multi-family, and Customized Retrofit Rebates & Incentives
» www.pge.com

IV-1. Manage and Conserve Groundwater

- Local Government Commission, “Smart Water, Smart Planning: Managing California’s Groundwater”.
» www.lgc.org/resources/community-design/lpu/oct2016/
- South East Bay Plain Basin Groundwater Management Plan.
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