

City of Berkeley Stormwater Master Plan

August 28, 2025

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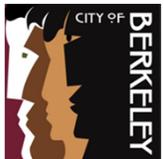
Agenda

- Introduction
- Purpose of Stormwater Master Plan
- The City's Role in Managing Stormwater
- Stormwater Management Challenges + Q&A
- Stormwater Master Plan Components and Status Update + 2 Q&A's
- Public Input Opportunities
- Project Schedule
- Final Q&A



Purpose of the Stormwater Master Plan

- Provide the comprehensive technical analysis needed to guide the future maintenance and improvements of the City's aging stormwater system.
- Develop and prioritize capital improvement projects based on a social equity and risk-based model.
- Develop the City's stormwater compliance strategy.
- Update maintenance and inspection plans for stormwater facilities.
- Provide information to support current and future Regional Shoreline Adaptation Plan grant pursuits.
- Identify funding needs and grant opportunities.



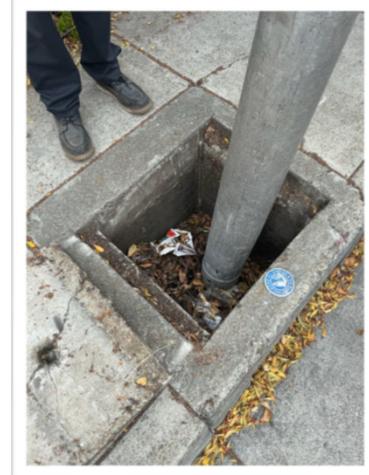
City's Role in Stormwater Management

- Maintaining and Improving Stormwater Infrastructure
- Protecting Water Quality through Regulatory Compliance
- Floodplain Management
- Protecting and Restoring Creeks

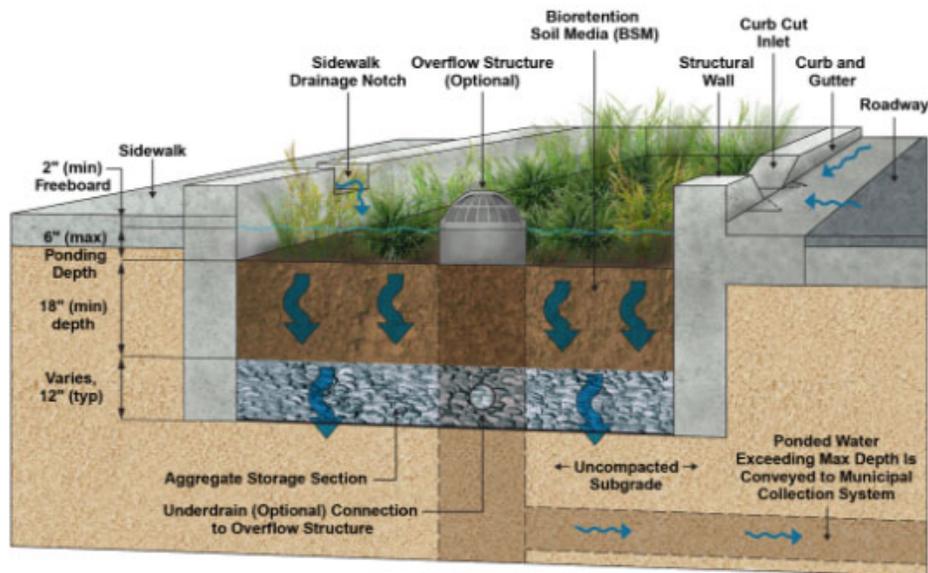


Maintenance & Improvement of Stormwater Infrastructure

- Nearly 100 miles of stormdrain
- 4 miles of creek culverts
- Catch basins, maintenance holes, junction boxes
- Underground cisterns
- Green Infrastructure
 - Bioretention, bioswales, green roofs, rainwater capture, permeable pavers
- Trash capture Infrastructure
 - Connector pipe screen



Bioretention Basins



- Remove pollutants from stormwater
 - Filtration
 - Uptake by vegetation
 - Decomposing and breakdown of pollutants by microbes and fungi

Can include overflow to direct excess flows to public drainage infrastructure

Protecting Water Quality through Regulatory Compliance

Municipal Regional Stormwater NPDES Permit regulates stormwater runoff.

- Regulate new Development and Redevelopment
 - Implement source control, site design, and stormwater treatment for new development and significant redevelopment projects.
 - **Requires stormwater treatment for regulated projects including street rehabilitation which meet certain criteria.**



Regulatory Compliance (cont.)

- Implement trash control measures
 - Permittees are required to reduce trash discharges to the Bay by 100% based on 2009 baseline levels
 - City performs a variety of activities to meet this goal, including street sweeping, creek and hot spot cleanups, source control measures, inspection programs/enforcement, and installation and maintenance of full trash capture devices.



Regulatory Compliance (cont.)

CONSTRUCTION CHECKLIST



- Conduct daily site inspections.
- Maintain construction entrance/exit and conduct street sweeping to prevent sediment leaving the construction site.
- Protect landscaping and stockpiled soil materials from wind and rain by storing them under tarps and installing perimeter sediment barriers.
- Label and store hazardous materials in sealed containers and on top of secondary containment.
- Cover open dumpsters securely with a tarp when not in use or if raining.
- Inspect portable toilets for leaks and place them on top of secondary containment within the construction site.
- Install perimeter controls around the site, such as staking fiber rolls into the ground or installing silt fences.
- Prevent sediment, debris, and pollutants from entering the storm drain by installing and maintaining gravel bag berms, biofilters, or other inlet protection measures appropriate for site conditions.
- Provide a contained and lined pit for washing concrete, paint, or stucco.
- Keep the Stormwater Pollution Prevention Plan at the work site.
- Educate workers about these best management practices.

ONLY RAIN DOWN THE STORM DRAIN

When it rains, stormwater washes over loose soil and debris on a construction site. As this water flows over the site, it can pick up pollutants like sediment, oil, and cement wash and transport them to nearby storm drains. Our storm drains connect to local creeks, and anything that enters these drains will flow directly to the San Francisco Bay. That's why it is important to have proper stormwater protection in place so that construction can proceed in a way that protects our water and the environment.

The City of Berkeley Stormwater Management and Discharge Control Ordinance (BMC 17.20) establishes water pollution control and prevention requirements for construction, demolition, and other activities. Dumping or discharging pollutants into the storm drain system is prohibited. Construction and demolition sites are required by law to implement measures that prevent pollutants from leaving the construction site.

Learn more or access guidance:

cleanwaterprogram.org/businesses/construction
Scan the QR code or visit the link above.



Protect Local Waterways

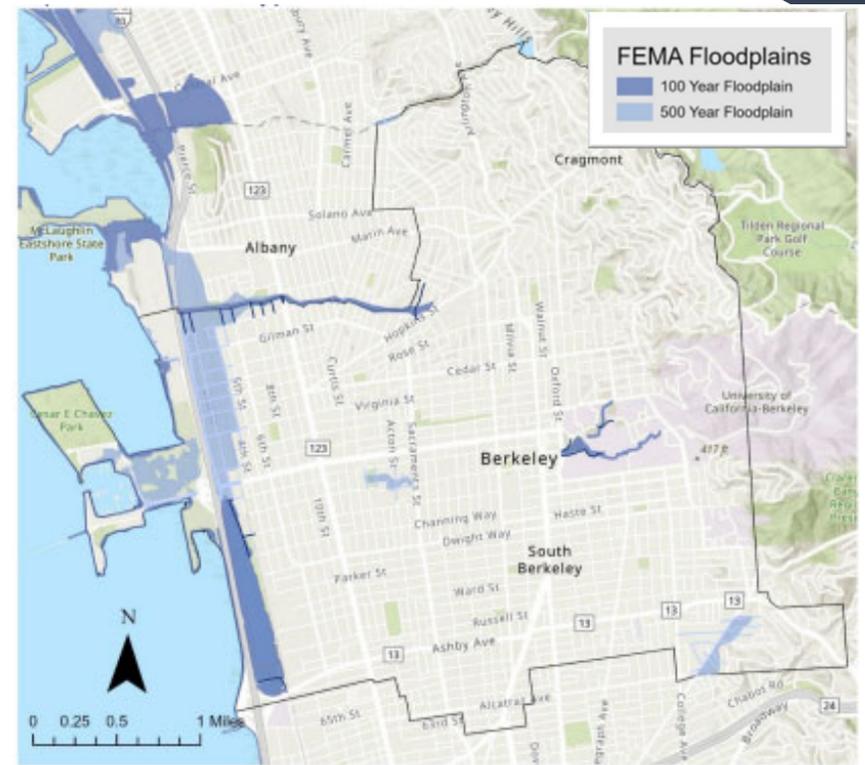
Construction runoff pollutes creeks and the Bay.

- Industrial, commercial, and illicit discharge controls
 - Inspection programs
 - Enforcement
- Construction controls
- Public Information & Participation
 - Catch basin stenciling
 - Adopt-a-Drain
 - Clean-ups
 - Outreach/Public Events



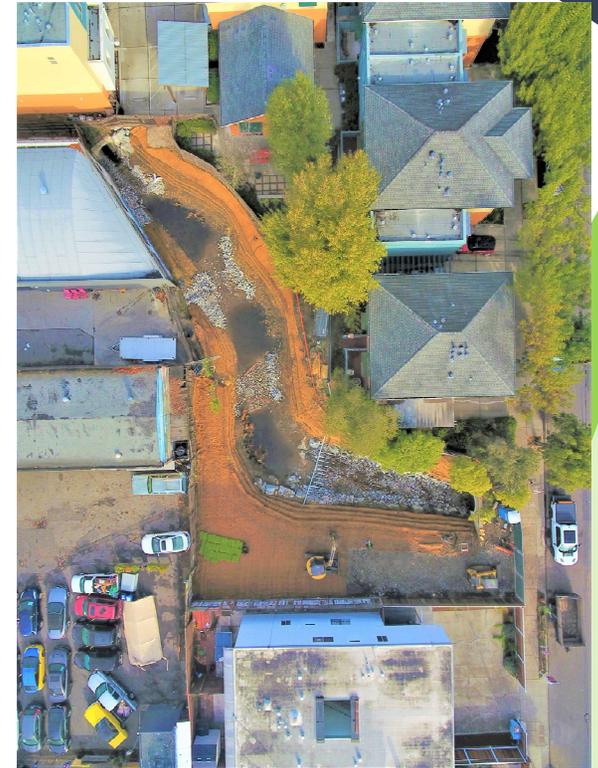
Floodplain Management

- Regulate development in flood zones
- Administer floodplain ordinance
- Review development in or near floodplains
- Maintain compliance with National Flood Insurance Program

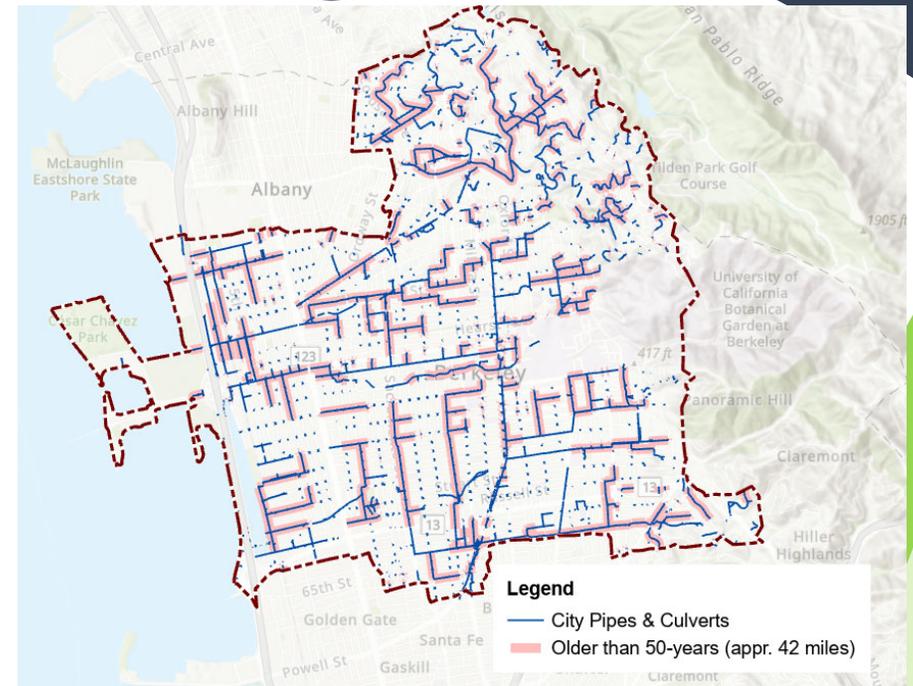


Creek Protection, Restoration, and Stewardship

- Administer Creeks Ordinance
 - Development setback and standards for construction near creeks or culverted creeks
- Creek Restoration

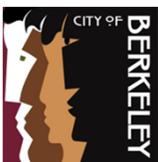
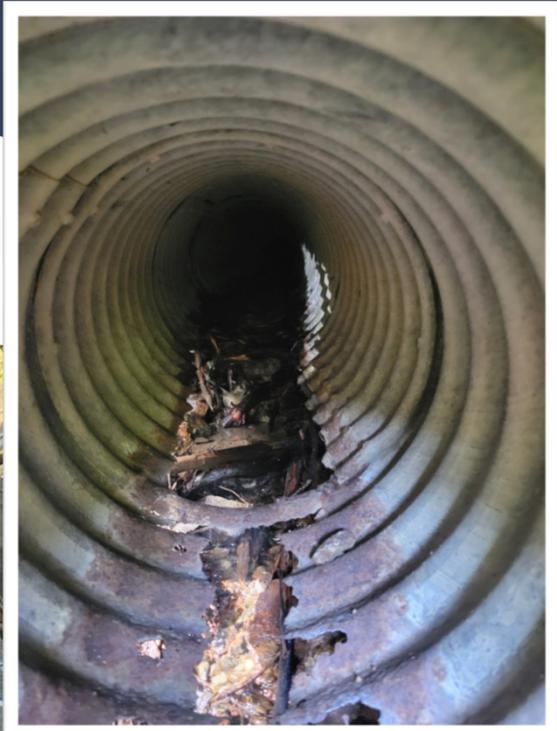


Stormwater Management Challenges



Aging Infrastructure

A large portion of stormdrain pipes and creek culverts are at or beyond useful life expectancy.



Climate Change

- Increased precipitation intensities
- Sea-level rise
- Rising groundwater table in coastal areas



Green Infrastructure Implementation

- Competing for space with parking and transportation uses
- Conflicts with existing utilities
- Low-permeability soils
 - Poor infiltration
 - Requires underdrain pipe installation
- Lack of Irrigation
- Difficult to maintain

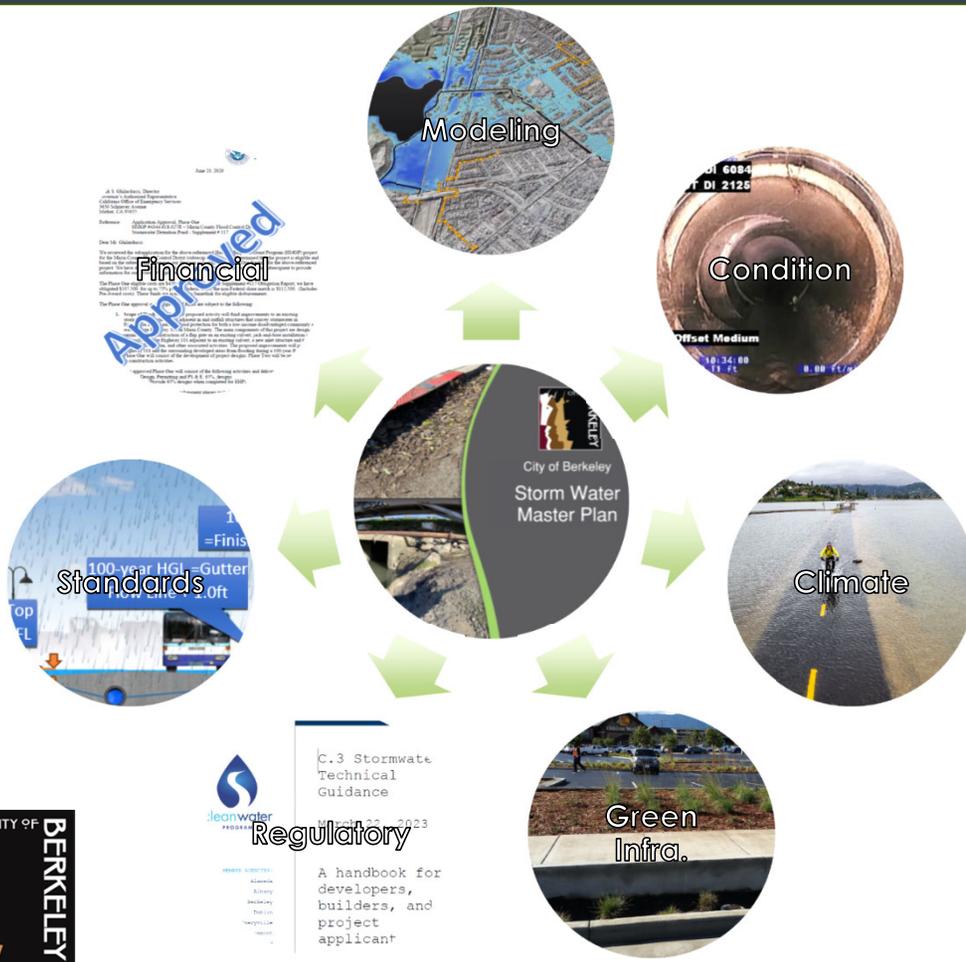


Q&A on Purpose of Stormwater Master Plan, City Responsibilities and Challenges

- Coming up:
 - Data Collection
 - Field Inspections
 - Condition Assessment

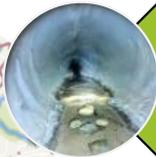


Stormwater Master Plan Components



- Field verification & targeted condition assessment of stormwater assets
- Comprehensive hydraulic modeling of all City watersheds
- Climate change adaptation analysis
- Emphasis on incorporating large stormwater capture, trash capture, and LID opportunities
- Strategies for meeting updated regulatory requirements
- Update drainage design standards
- Detailed financial analysis

Data Collection



Storm Drainage Facilities



Review As-Builts



Inspection & Condition Assessment



Community Input

Field Inspections



Field
Inspection



Reported flooding &
deficient pipe incidents



Aged Corrugated Metal
Pipes (CMP)



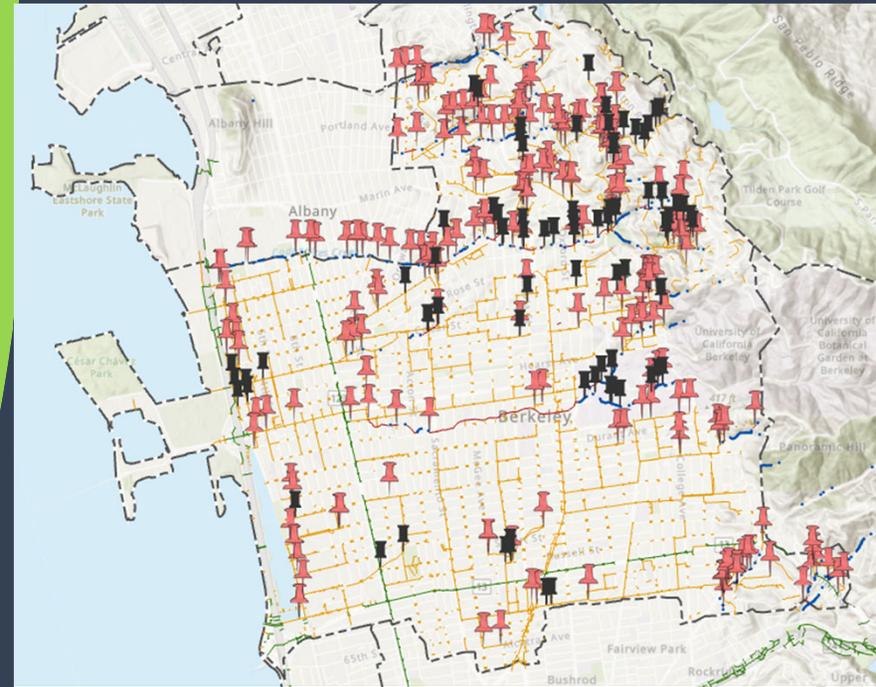
Upstream inlets, flat slope
& backwater



Hillsides & outfall
structures

Field Inspection Status

- Red pins: 209 planned inspection sites
- Black pins: 90 completed inspections (69 structures and 21 culverts)
- Inspection Examples:
 - Evaluate the Strawberry bypass on Aquatic Park.
 - Assess high and low flow bypass systems to understand how they interact with Aquatic Park and the Potter Watershed.



Inspection Planning Map

Field Inspections



*Field inspections of channels (left)
and the storm drain system (right)*

Field Inspection - Pipes

- Verify dimensions, inverts, spatial location, and perform a condition assessment
 - A structural deficiency is a condition in a pipeline that compromises its integrity or function, such as cracks, fractures, deformation, or collapse.
 - An operations & maintenance (O&M) deficiency is a condition that may require maintenance to restore proper function, such as debris or vegetation.



A pipe with a structural and O&M observation on Euclid Avenue

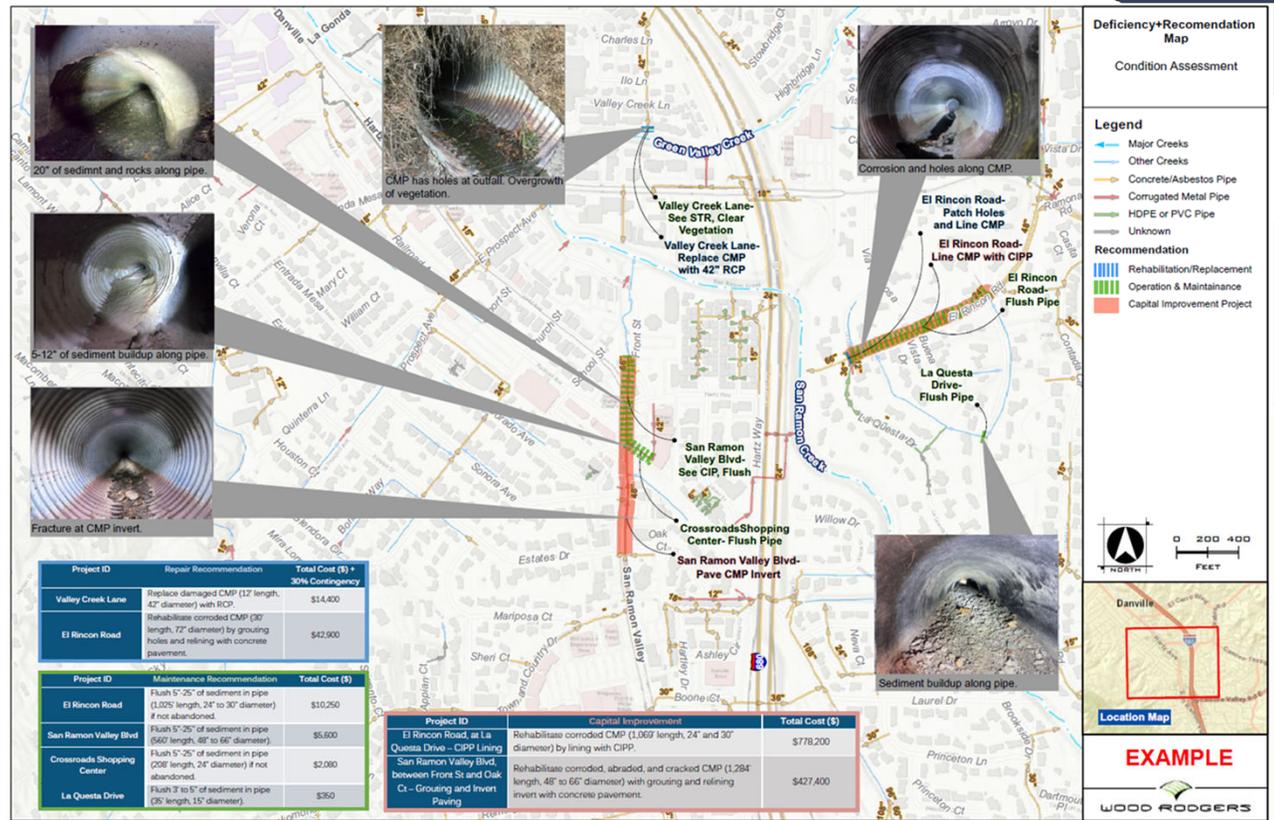
Field Inspection - Channels



Channel inspection photo of Oxford Street culvert on Codornices Creek (left). Inspectors collected LiDAR scans to verify dimensions, inverts, and performed a condition assessment (right).

Condition Assessment

Summary maps of the condition assessment show deficiency images, location extent, recommended actions, and cost estimates for maintenance and rehabilitation needs.



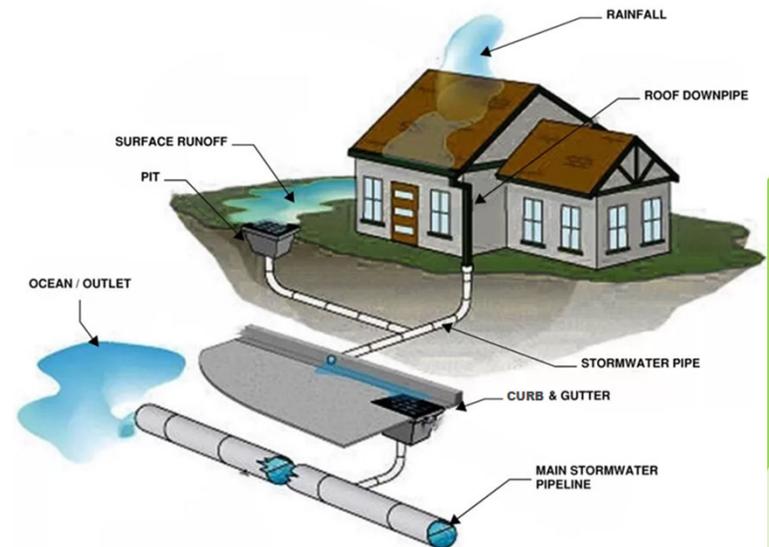
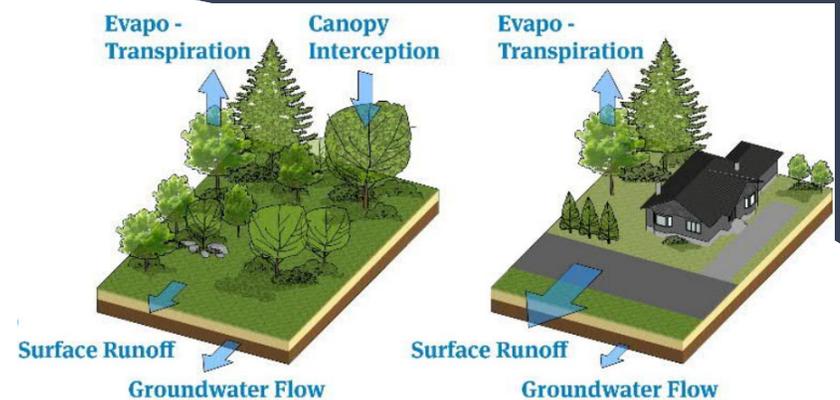
Q&A on Data Collection, Field Inspections, and Condition Assessment

- Coming up:
 - Hydrologic and Hydraulic (H&H) Model
 - Green & Gray Infrastructure
 - Model Complexity at Aquatic Park



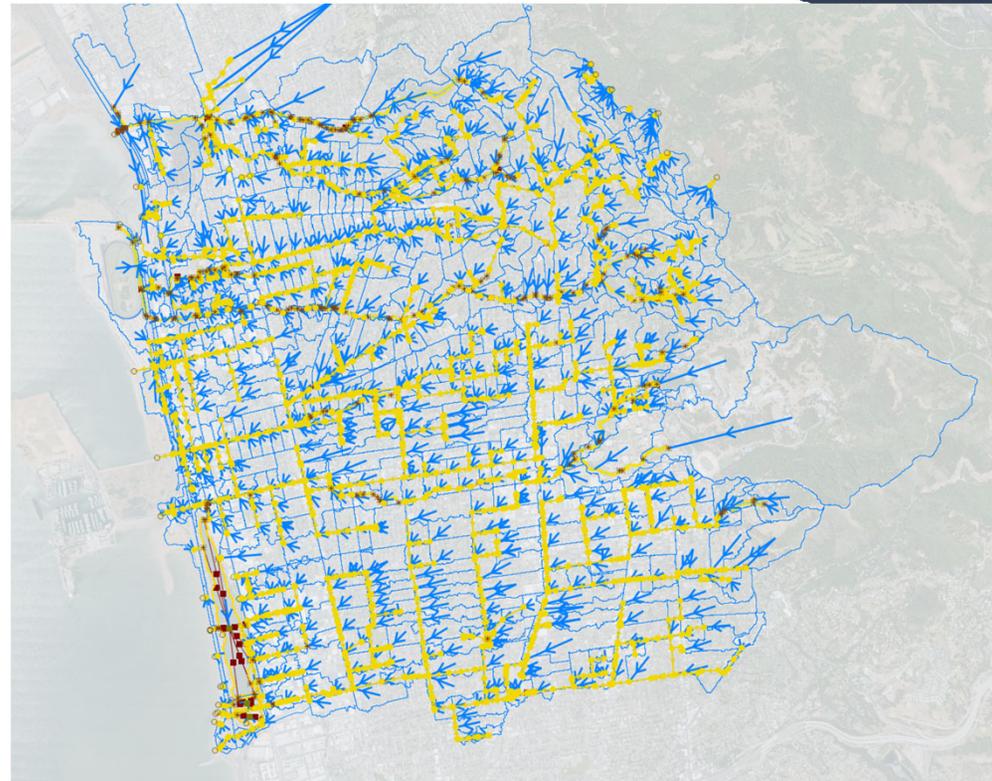
Capacity Assessment

- Hydrologic and hydraulic (H&H) evaluations of the storm drainage system using Design storms allow engineers to evaluate the system performance.
- H&H modeling allows engineers to identify capacity deficiencies and to evaluate system improvements to increase capacity.



H&H Model

The H&H model represents catchment runoff, pipe network conveyance, and open-channel flow within creeks to evaluate system performance under various storm conditions.



The H&H model of the City of Berkeley

Calibration – Accurate & Defendable

- Flow depth gauges, rain gauges and Gauge Adjusted Radar Rainfall (GARR) data are used to calibrate the H&H model.
- Ensures accurate representation of flow and flooding during hypothetical design storms.



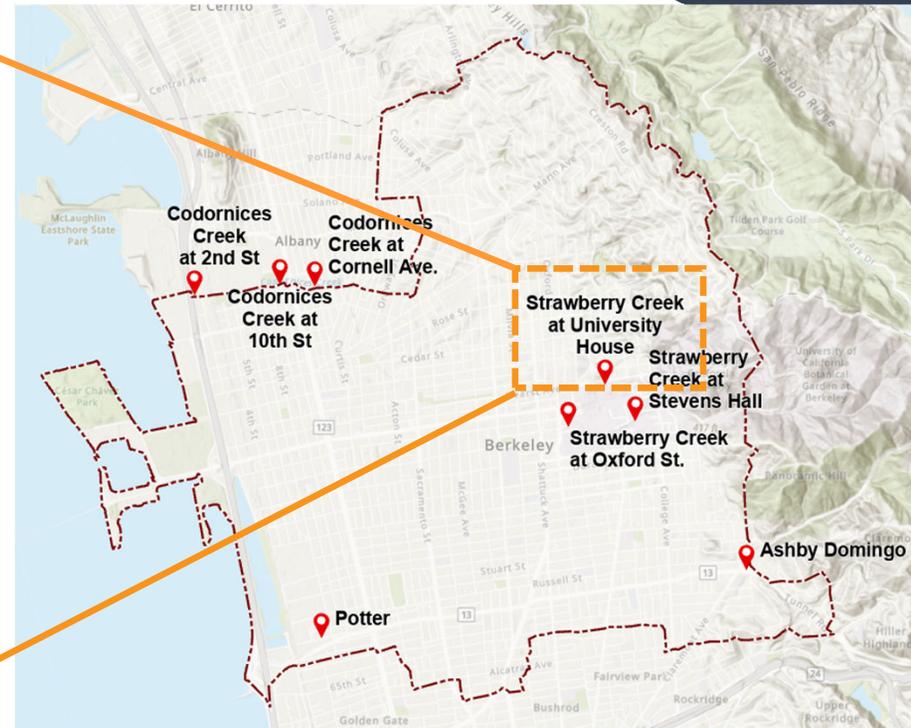
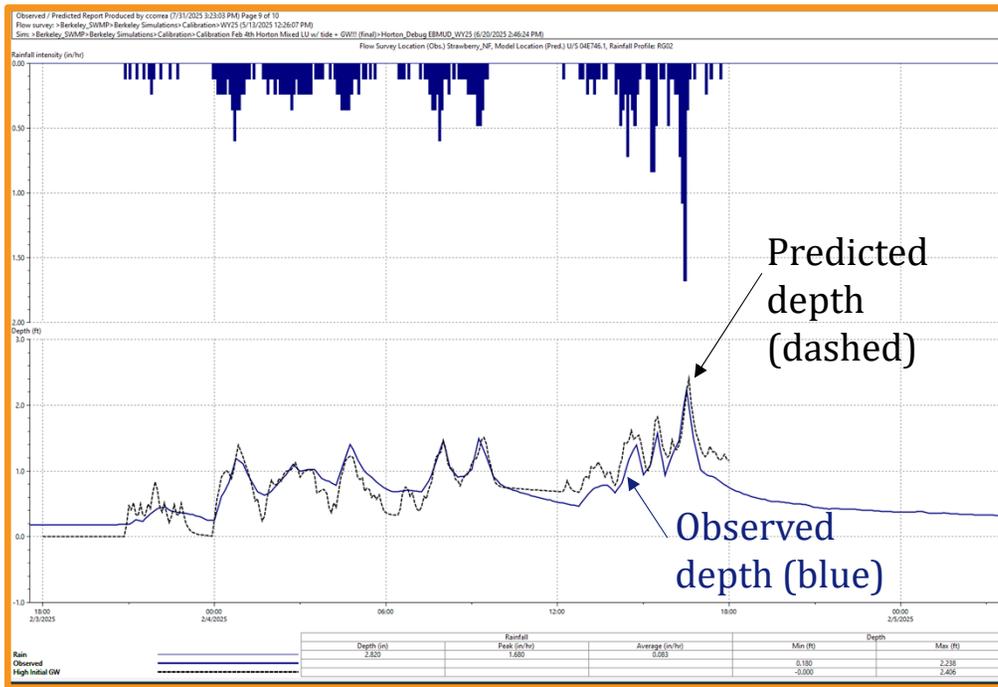
Calibration – Gauges

Depth gauges collected during specific storm events provide peak water level and timing at various locations throughout the storm drainage system.

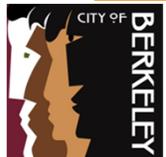


Gauge at Strawberry Creek near Oxford Street

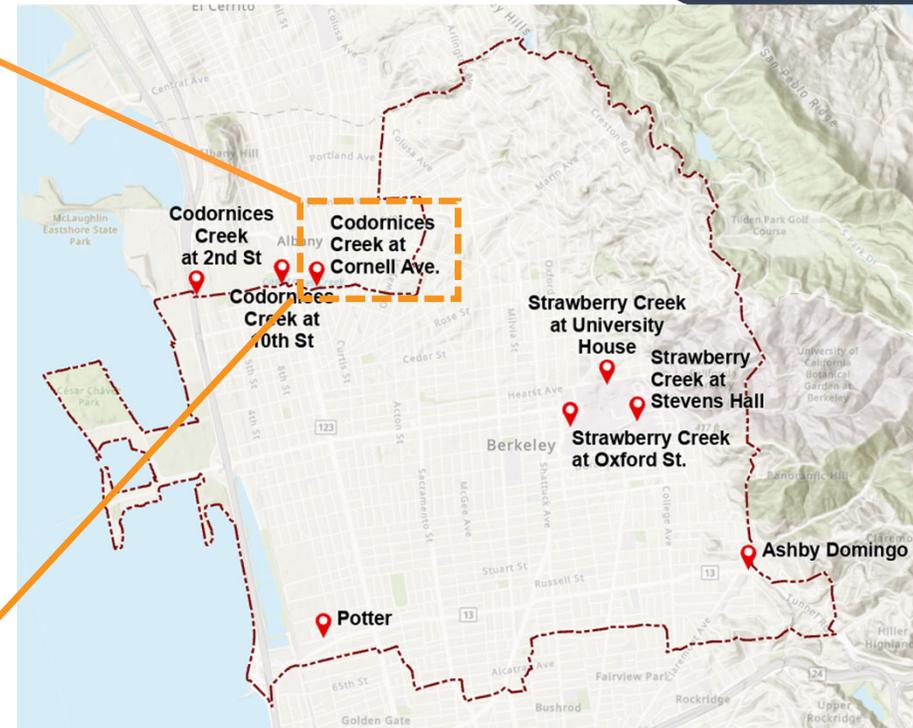
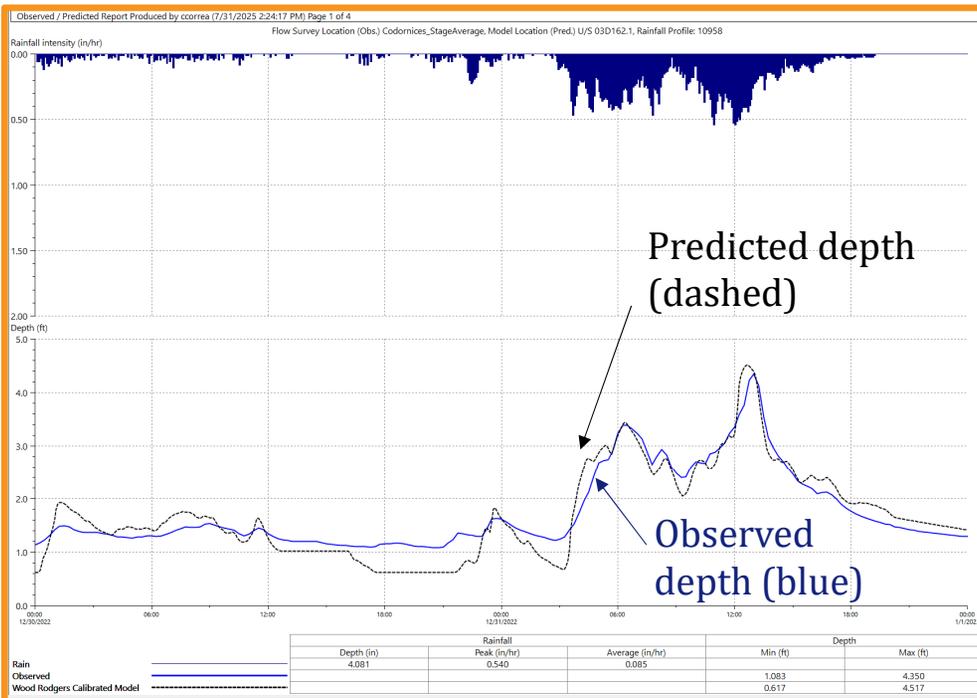
Calibration at Strawberry Creek



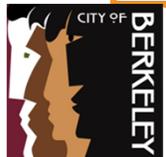
Predicted Depth in Calibrated Model vs Observed Depth from Gauge Data



Calibration at Codornices Creek



Predicted Depth in Calibrated Model vs Observed Depth from Gauge Data



Evaluation of Green & Gray Infrastructure

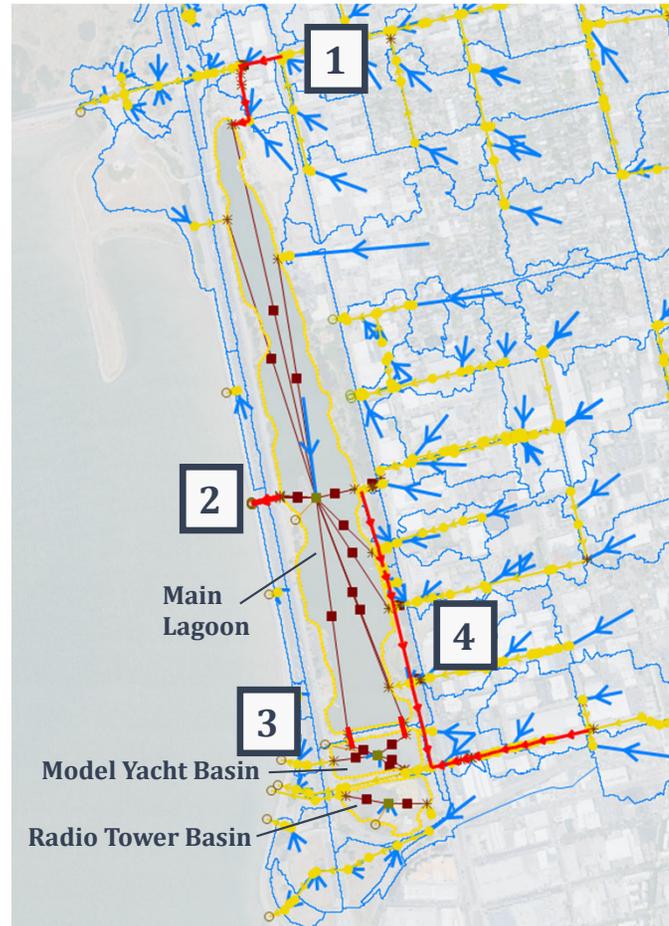
Example:
The Woolsey cistern integrates a large underground storage system with a bioswale to manage stormwater runoff, improve water quality, and enhance green space.



Cistern on Woolsey St between Adeline and Tremont

Model Complexity at Aquatic Park

1. 2nd St and University weir structure – Connect with Strawberry Watershed
2. Tide Tubes – Connect with the Bay
3. Equalization tubes – Connect Model Yacht Basin and Main Lagoon
4. Transite pipe – high and low flow bypass systems interact between Aquatic Park and Potter Watershed



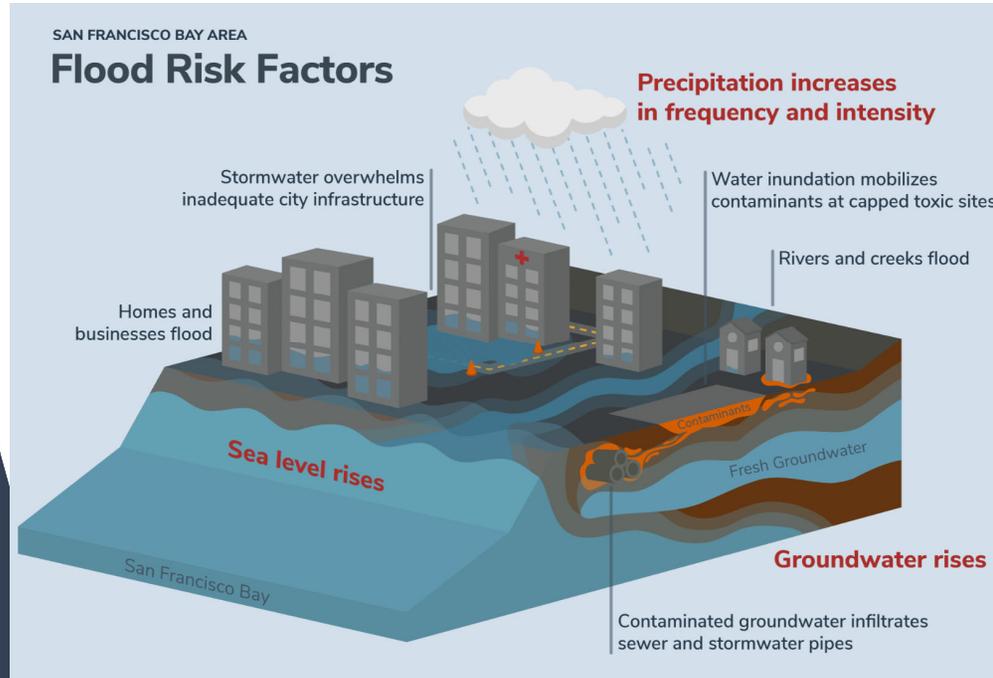
ICM Model Schematic

Q&A on Model, Green & Gray Infrastructure, and Model Complexity at Aquatic Park

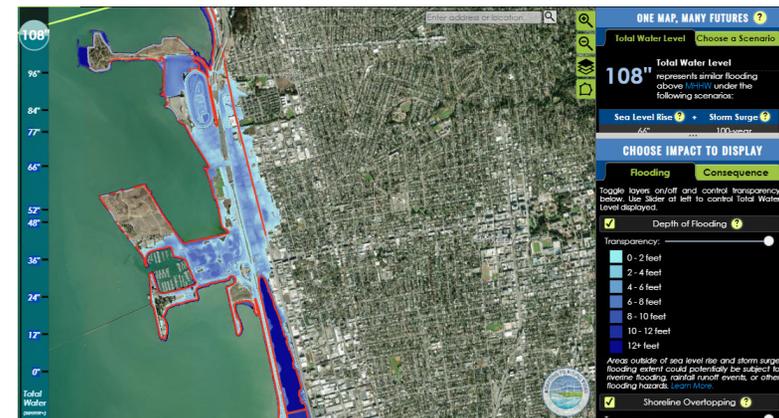
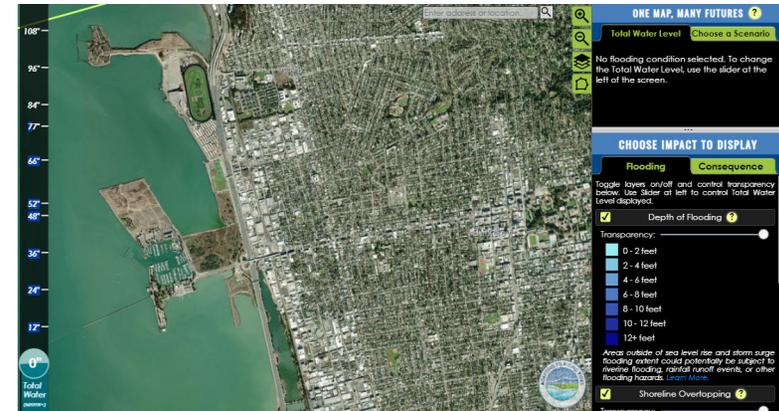
- Coming up:
 - Climate Change Analysis
 - Maintenance and Inspection Plan
 - Benefit Cost Analysis
 - Public Input Opportunities
 - Project Schedule



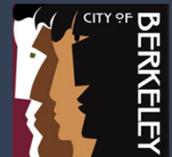
Climate Change Analysis



Climate change analysis includes rising sea levels, increased precipitation intensity, and elevated groundwater levels.

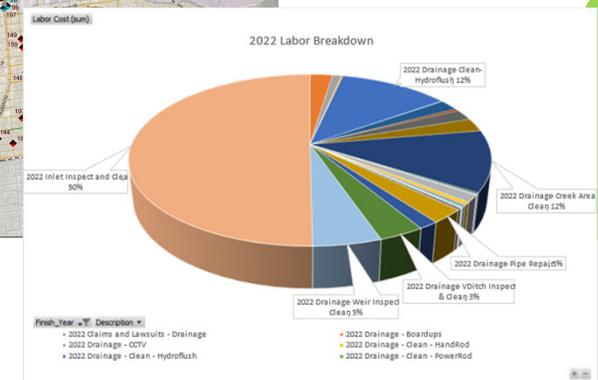
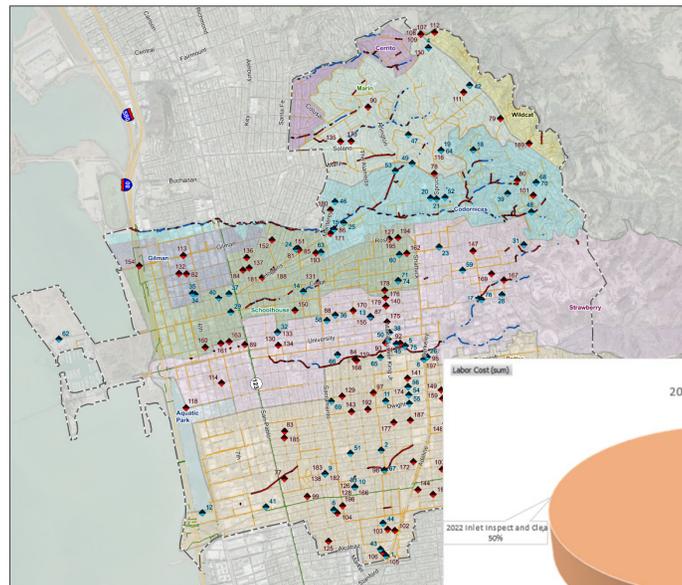


Online Sea Level Rise Viewer



Maintenance and Inspection Plan

- Hot spot reporting prioritizes inspection locations and maintenance needs.
- Document and review existing maintenance operations conducted
- Recommend inspection activities to inform and optimize maintenance activities, thereby extending the useful life of the drainage facilities



Maintenance Effort

Risk-Based Project Prioritization



Modeled Floodplain



Floodplain Damage Estimates



Deficient System	Likelihood (%)	Design Storm (year)	Consequence* (\$)	Annualized Risk ¹² (\$/year)
Middlefield Road	50	2	2.7 M	\$5.02 M
	10	10	17.3 M	
	1	100	28.5 M	
El Camino Real / Alto Lane	50	2	1.8 M	\$2.63 M
	10	10	8.0 M	
	1	100	19.1 M	
Arbor Road	50	2	0.4 M	\$1.01 M
	10	10	3.7 M	
	1	100	7.2 M	

Recommended Improvements	Annualized Flood Risk (\$)	Annualized Project Life Cycle Cost (\$)	Annualized Risk/Annualized Project Life Cycle Cost	Prioritization Ranking
Middlefield Road	5.02 M	0.72 M	7.0	1
El Camino Real / Alto Lane	2.63 M	0.49 M	5.4	2
Arbor Road	1.01 M	0.35 M	2.9	3
Chrysler Drive	0.31 M	0.11 M	2.8	4
O'Brien Drive	0.09 M	0.06 M	1.5	5

Risk-Based Prioritization

Benefit Cost Analysis

- To support grant funding applications
- Flood damages are analyzed for a benefit-cost ratio to compare project costs with anticipated annual flood mitigation benefits.



Flood Scenario Parameters

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name: Marin_Ex2014_10
 Scenario Name: Ex2014_10
 Return Period Analyzed: 10
 Analysis Options Analyzed: No What-ifs

Study Region Overview Map

Illustrating scenario flood extent, as well as exposed essential facilities and total exposure



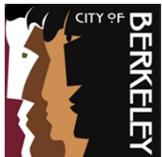
FEMA

Benefit-Cost Calculator

V.6.0 (Build 20220729.1959 | Release Notes)

+ Add Project ← Import Projects → Export Projects 📄 Batch Processing 🗑 Delete Projects

Select	Project Title	County, State	Benefits (B)	Costs (C)	BCR (B/C)	Copy
<input checked="" type="checkbox"/>	Marin City Drainage Improvements	Marin, CA	\$ 18,450,744	\$ 12,813,605	1.44	
TOTAL (SELECTED)			\$ 18,450,744	\$ 12,813,605	1.44	
TOTAL			\$ 18,450,744	\$ 12,813,605	1.44	

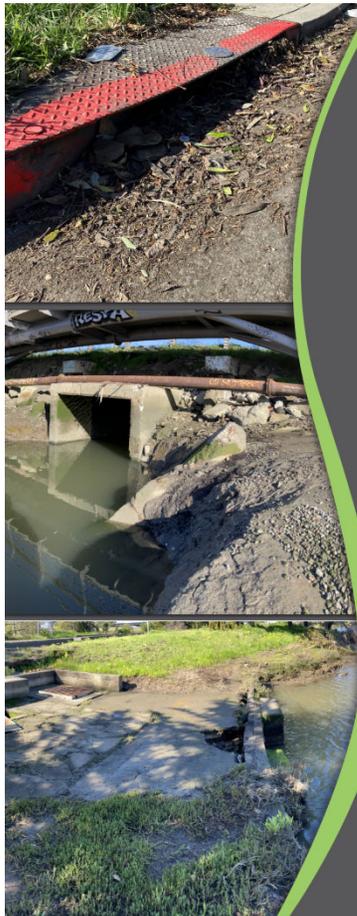


Financial Analysis

- Analyze the current funding environment and the funding requirements
- Evaluate new funding mechanisms for both short- and long-term funding of the City's storm drainage system
- Support enhanced operations and maintenance and some capital improvements

SWMP Report

The Stormwater Master Plan Report will document all findings in the study and present a Capital Improvement Program for short-term and long-term implementation.



City of Berkeley

Stormwater Master Plan

Prepared by

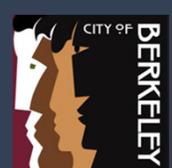
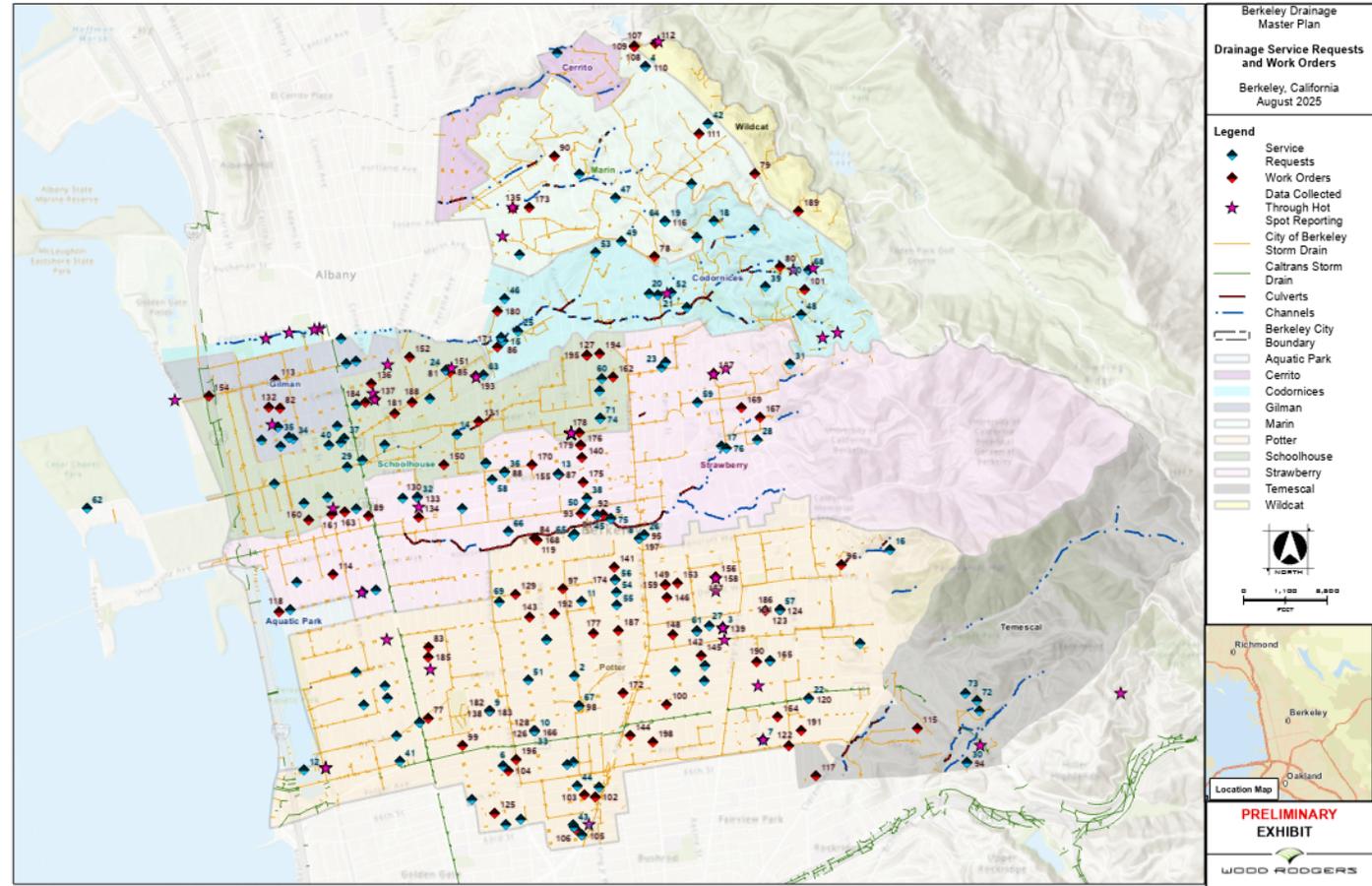


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Public Input Opportunities

- Hot Spot Reporting Survey
- Workshops and Presentations and Surveys
- Future surveys to gather public input to help shape watershed specific priorities.



Project Schedule



City of Berkeley Stormwater Master Plan Schedule (updated June 2025)

CY 2024												CY 2025												CY 2026					
Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4			Q1			Q2		
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Data Collection									<i>Data Colleciton: Public input - On-line surveys</i>																				
			Geodatabase Refinement																										
			Data Gap Assessment																										
			Flow monitoring												Field Inspections														
			Hydraulic/hydrologic Model Development												Model Calibration						Climate Change Analysis								
																		Design Storms and Tidal Boundary											
															CIP Development														
																		Financial Analysis											
																		Report Drafting and Delivery											



Q&A

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rsalcedo@berkeleyca.gov

More Info:

Watershed Management Plan:

- <https://berkeleyca.gov/your-government/our-work/adopted-plans/watershed-management-plan>

Green Infrastructure Plan:

- <https://berkeleyca.gov/your-government/our-work/adopted-plans/green-infrastructure-plan>

