California Adaptation Forum Workshop

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Workshop Learning Objectives

Upon completion of this workshop, attendees will be able to:

1. Describe the basic science and challenges of climate change that requires a renewed focus and assessment of contaminated sites and clean up management;
2. Understand DTSC guidelines, basic requirements for a SLRVA, an adaptation plan, and required data;
3. Identify additional resources on climate change and contaminated sites, including WA DOE guidelines and EPA and ITRC technical resources.

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Workshop Outline

- Module 1: Climate Resilient Remediation
- Module 2: Challenges to Traditional Cleanup Management
- Module 3: DTSC Guidance Overview
- Module 4: Examples from EPA, Washington State

Climate Resilient Remediation – what does it mean for a cleanup site?

Module 1

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Climate Resilient Remediation

- Why
  - Protects remedy
  - Protect environment and human health
  - Protects investment
  - Saves money
- What is climate resilient remediation?
  - Identify climate change impacts and risks
  - Implement resilience measures
  - Increase environmental and community benefits
  - Reduce environmental impacts

Climate Change & Site Cleanup

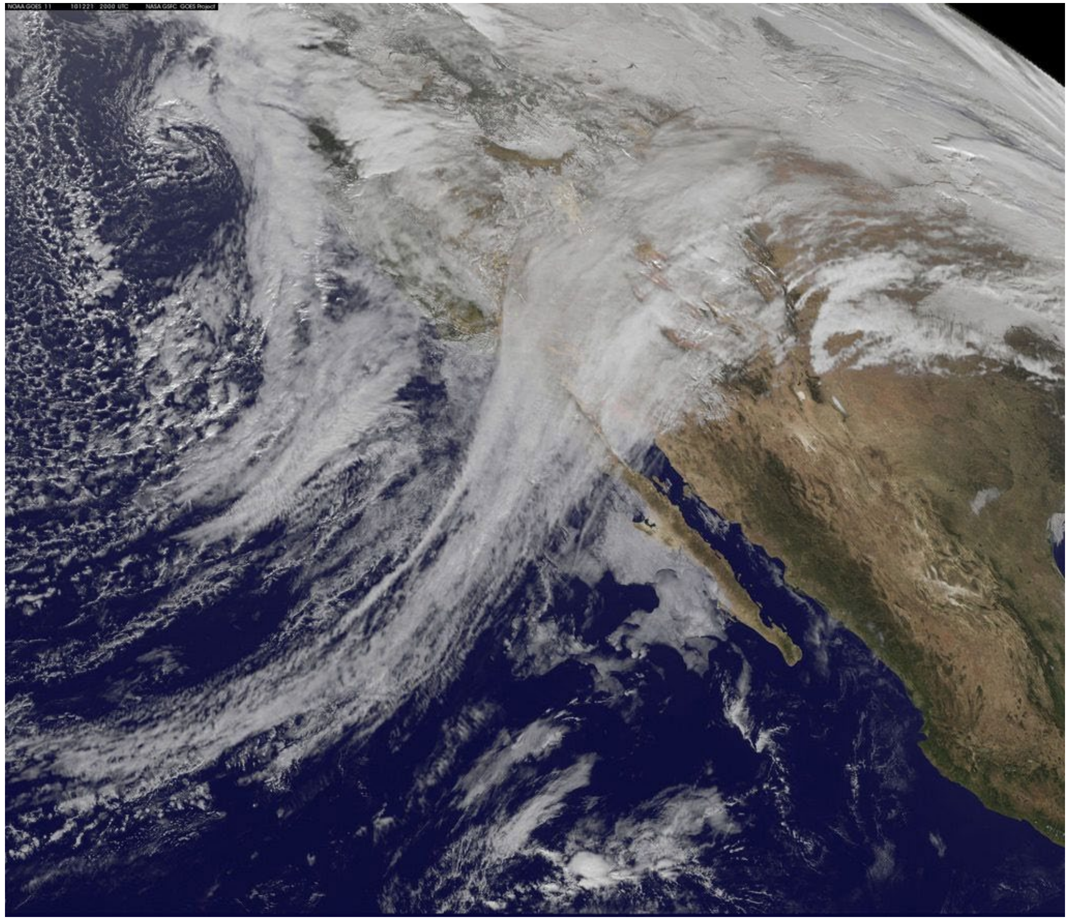
- Already witnessing impacts
- Past is no longer a prologue
- Climate change projections
- Unplanned repair
- Unplanned maintenance & costs
- Complex environmental interactions
- Remedies may no longer protect

California climate trends

	CLIMATE IMPACT	DIRECTION	SCIENTIFIC CONFIDENCE FOR FUTURE CHANGE
	TEMPERATURE	WARMING ↗	Very High
	SEA LEVELS	RISING ↗	Very High
	SNOWPACK	DECLINING ↘	Very High
	HEAVY PRECIPITATION EVENTS	INCREASING ↗	Medium-High
	DROUGHT	INCREASING ↗	Medium-High
	AREA BURNED BY WILDFIRE	INCREASING ↗	Medium High

California Fourth Climate Change Assessment, 2018

Extreme precipitation



An atmospheric river is shown off the coast of California from NASA's GOES satellite.

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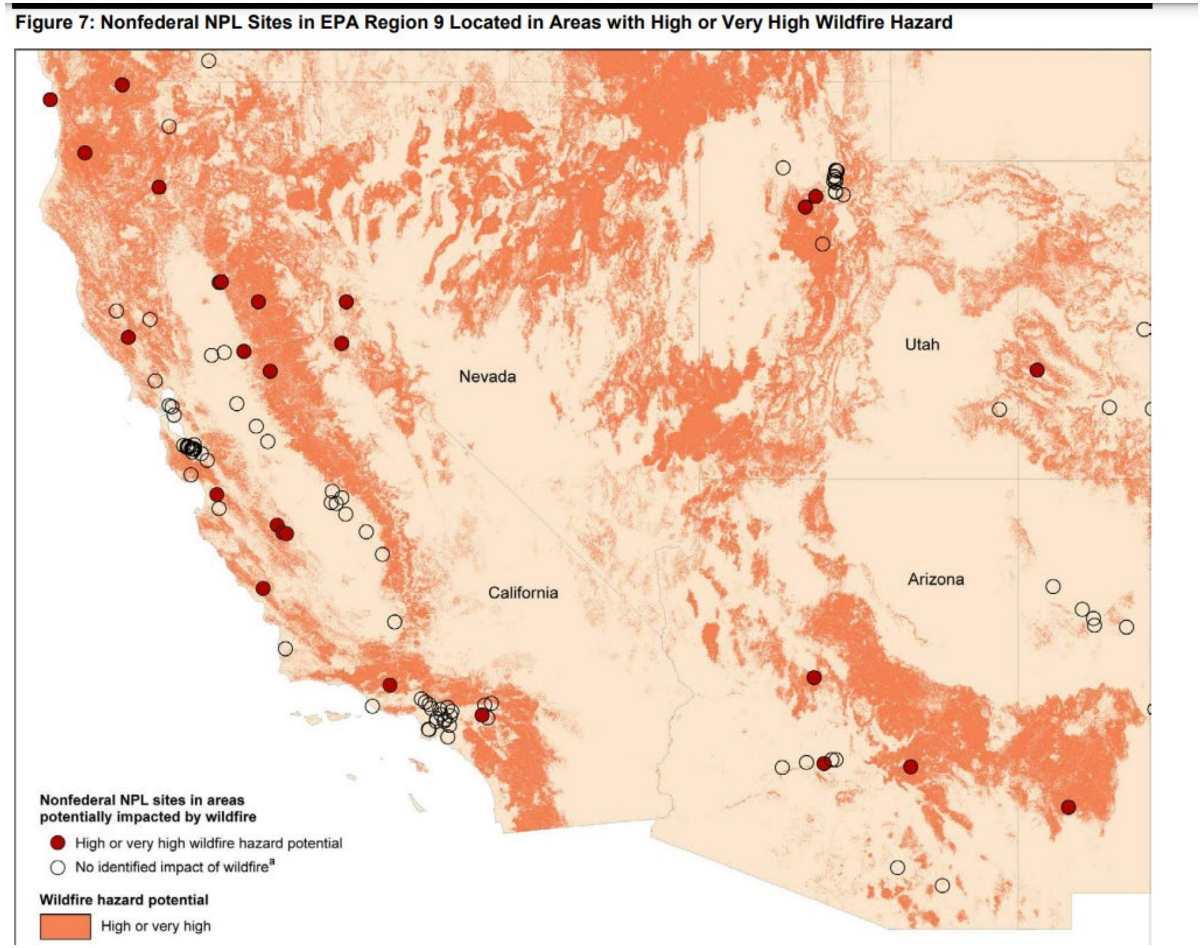
Heavy precipitation events
Groundwater – soil – sediment – surface water impacted

Wildfire

Fire at OU3 Libby Asbestos Site, USFS



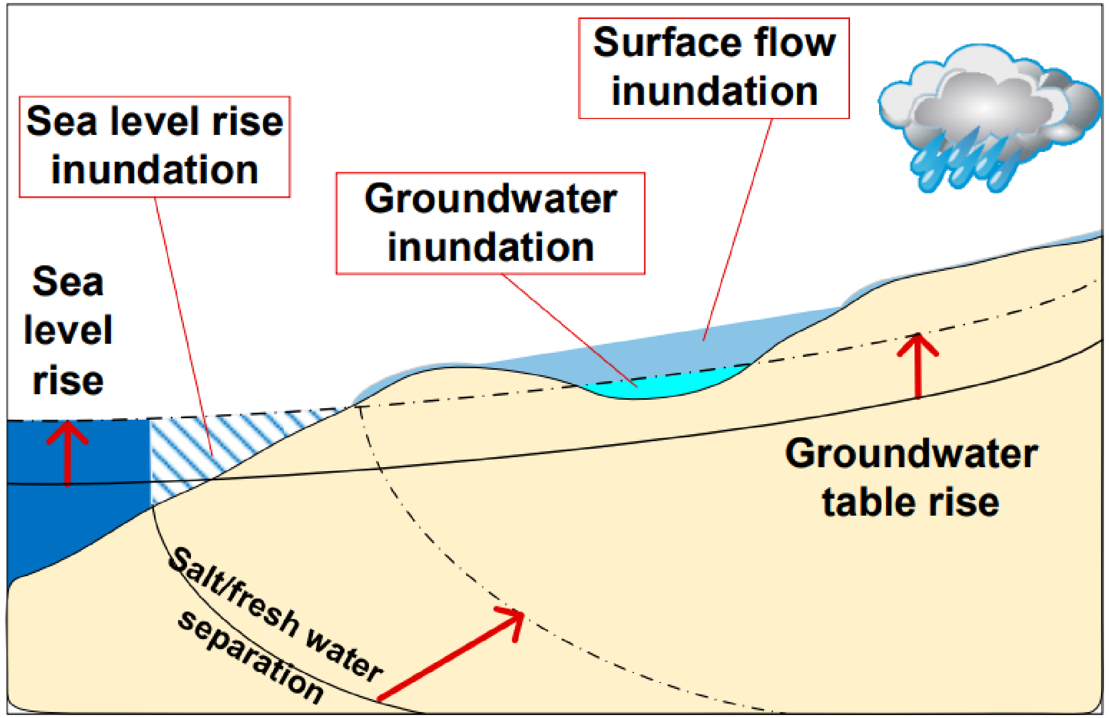
GAO 2019 Superfund and Climate Change

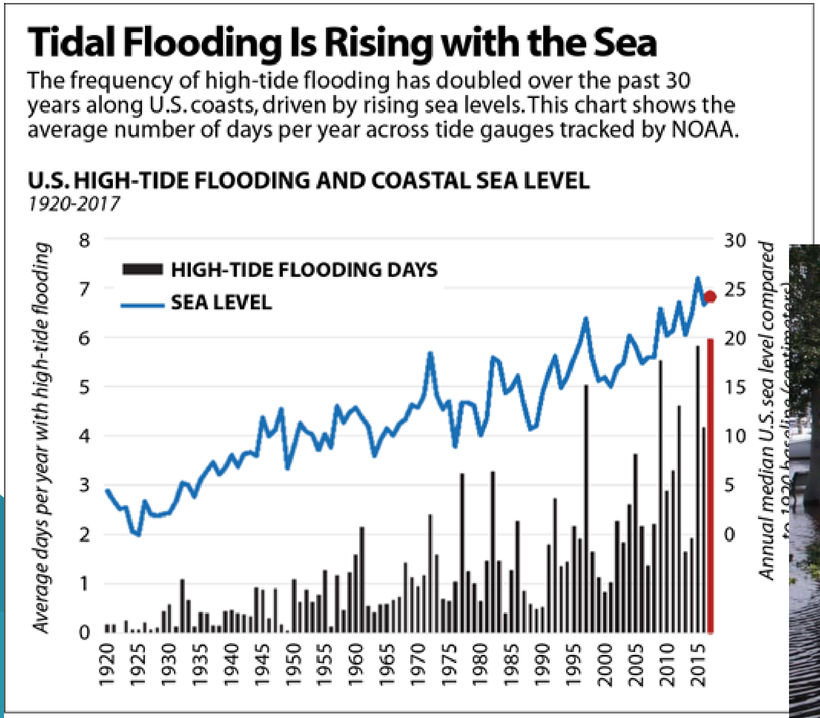
Sea level rise: erosion impacts

Custom Plywood site in Anacortez, WA. WA DOE, 2023

Sea level rise

- Sea-level rise inundation
- Groundwater inundation
- Saltwater intrusion





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Impacts of rising water table

- Aquifers exposed to contaminants
- Mobilization of contaminants in soil

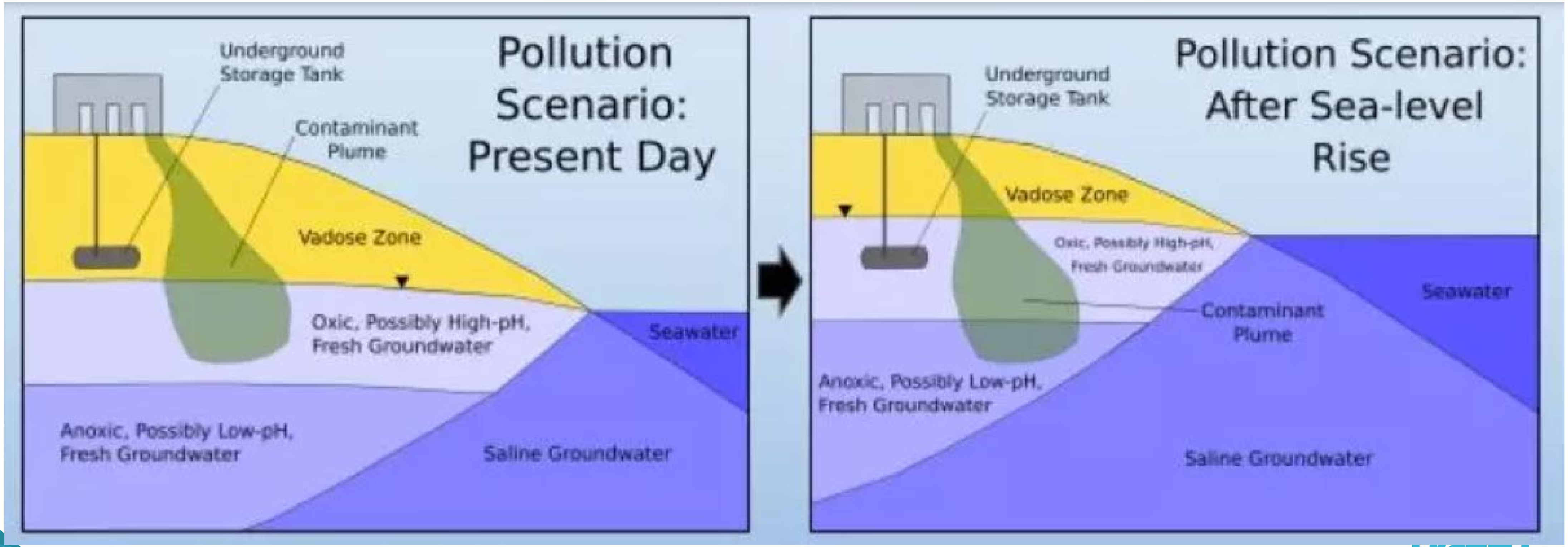

Illustration by Ben Hagedorn, CSU Long Beach

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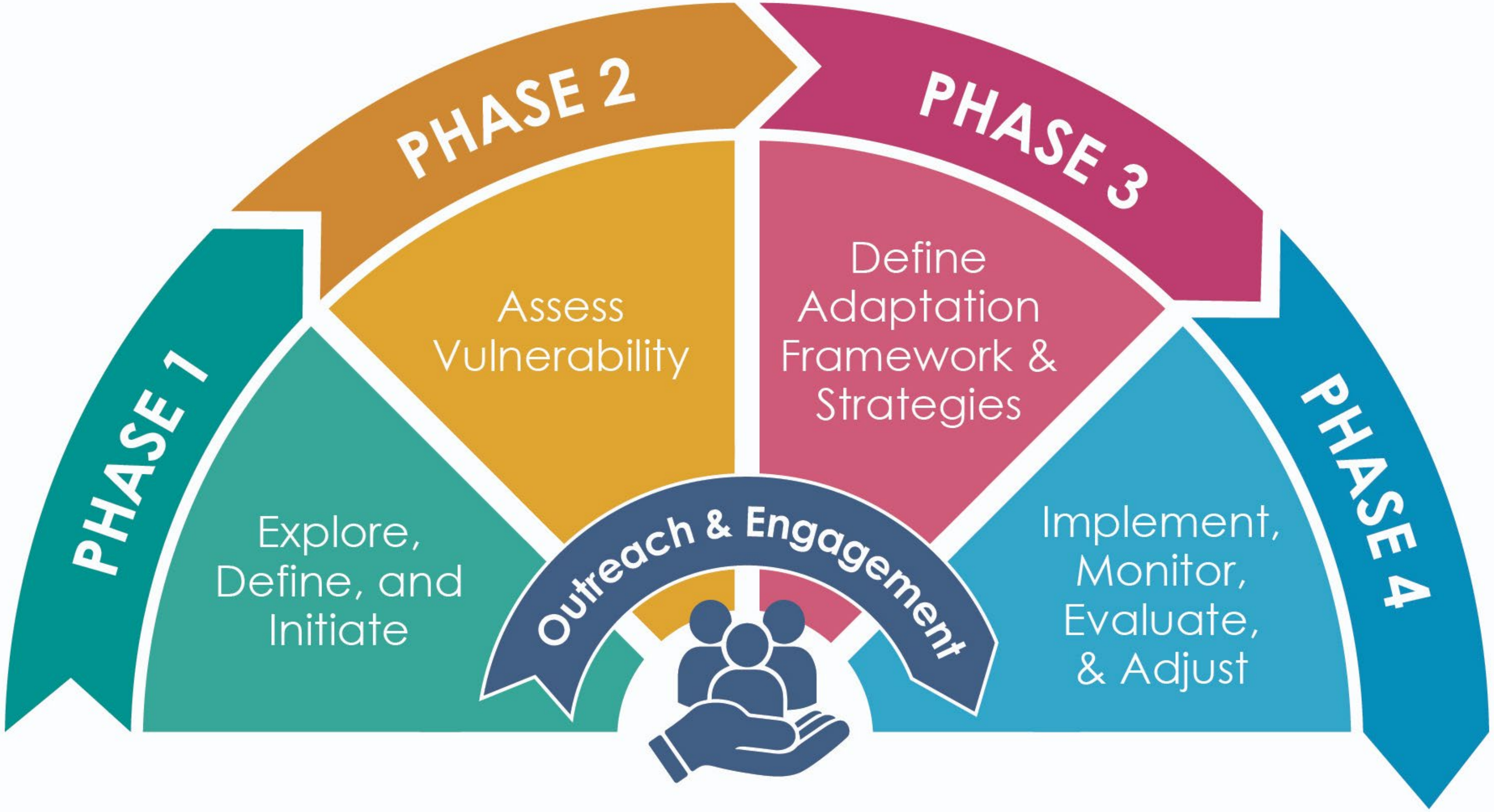
Resilience and adaptation planning



From: Adaptation Planning Guide
https://resilientca.org/apg/intro/#purpose

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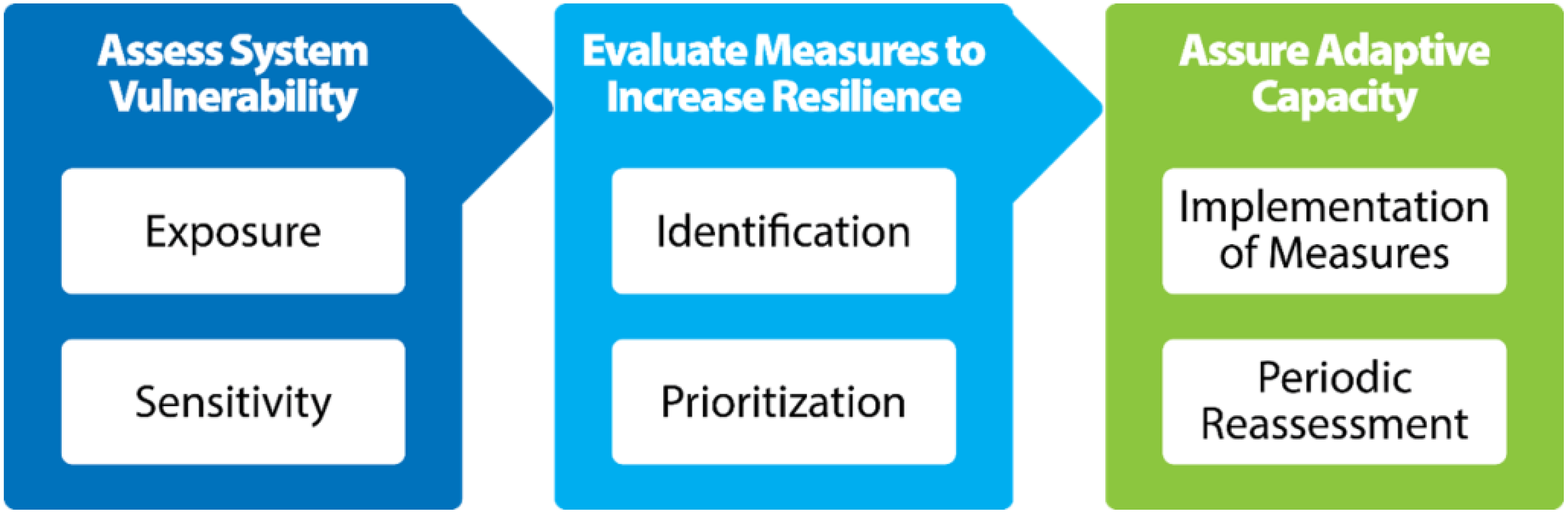
Vulnerability assessments framework for contaminated sites



Source: EPA Climate Resilience Technical Fact Sheet for Contaminated Sediment Site (EPA 2019)

Contaminated Site Cleanup Process Overview

Module 2

APEX ENVIRONMENTAL & WATER RESOURCES

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Cleanup Process for Contaminated Sites

- Phase I Environmental Site Assessments (ESA)
- Phase II ESA
- Feasibility Studies/Remedial Investigation
- SLR Impacts on Traditional Remediation

Phase I Environmental Site Assessments (ESAs)

- Environmental Due Diligence that is needed for any commercial/industrial real estate transactions
- An environmental data gathering process with a limited site visit (no sampling)
- **Purpose: To identify any Recognized Environmental Conditions (RECs) that could lead to potential contamination at the Site**

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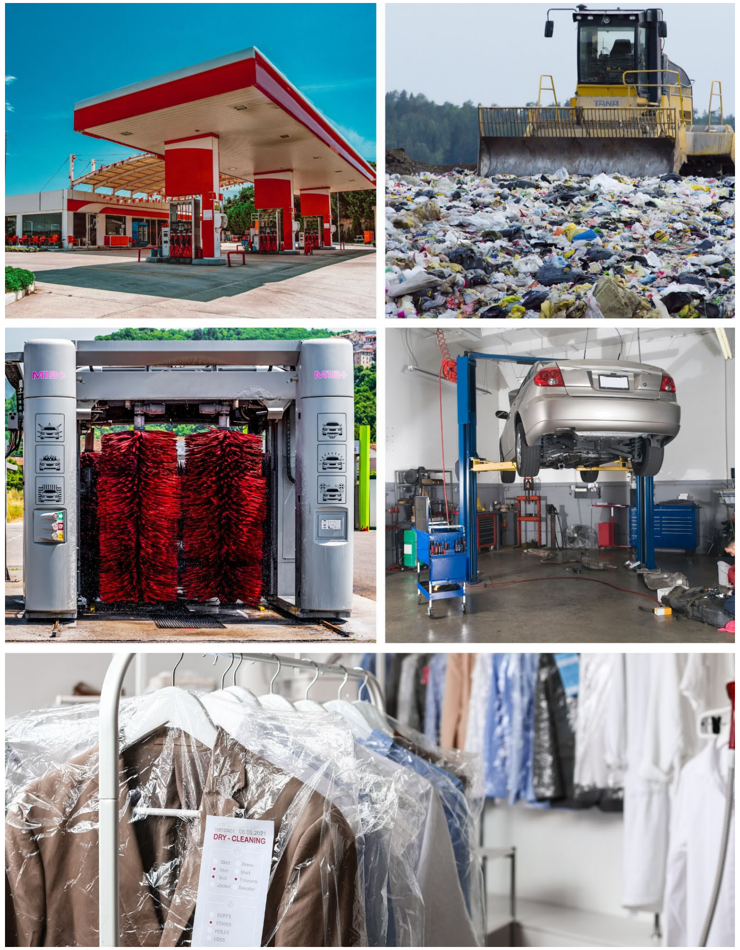
Usual Suspects

- Gas Stations
- Dry Cleaners
- Metal Plating Facilities
- Auto Shops
- Car Washes
- Landfills
- Maintenance Yards
- Sites with USTs



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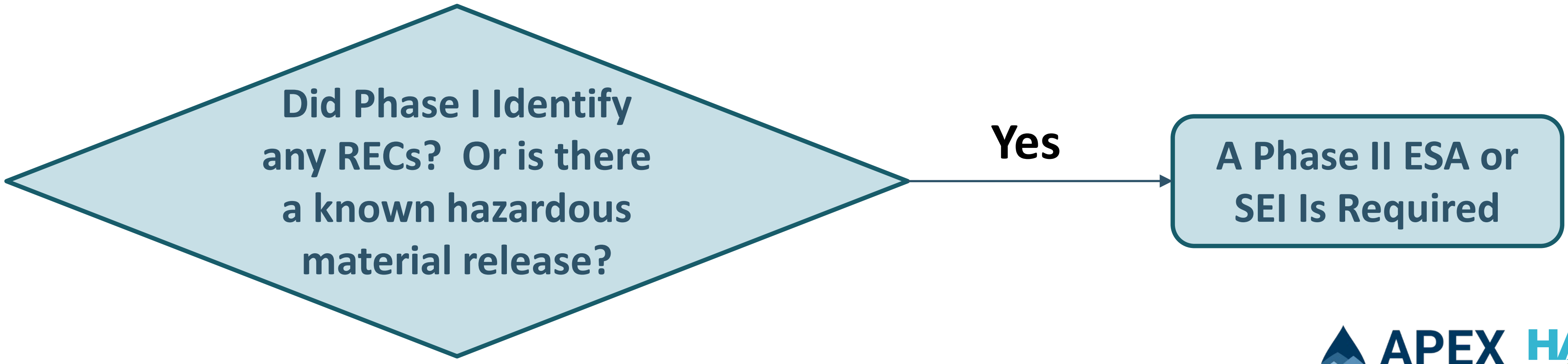
Phase II ESAs or Subsurface Environmental Investigation (SEIs)

- If Phase I ESA identifies RECs, then a Phase II ESA is required to further assess those RECs
- Sometimes a SEI is initiated without a Phase I ESA
- This is the actual sampling portion, we collect samples from soil, soil gas, and groundwater.
- Common Chemicals of Potential Concern (COPCs): PCBs, TPH, VOCs, Semi-VOCs, CA Title 22 Metals, OCPs, OPPs, CHs, and emerging PFAS
- If we confirm the presence of contamination, then:



Feasibility Studies, Remedial Action Planning and Implementation

- Regulatory agency oversees the work and issues the no-further-action (NFA) letter to release liability from the Site owner
- With negotiations with the agency, sometimes in cases of low contaminations a risk assessment is accepted in lieu of a full remediation. A risk assessment also sets the practical remediation goals (RLs) to protect the human health from the known contamination
- Feasibility studies of various available treatment options, examples: Granular Activated Carbon (GAC), Ion-Exchange Resins (IX), In-Situ Chemical Oxidation (ISCO), Soil Vapor Extraction (SVE), Monitored Natural Attenuation (MNA), etc.
- Based on cost and practicality the most viable option is selected for design and implementation

APEX ENVIRONMENTAL & WATER RESOURCES
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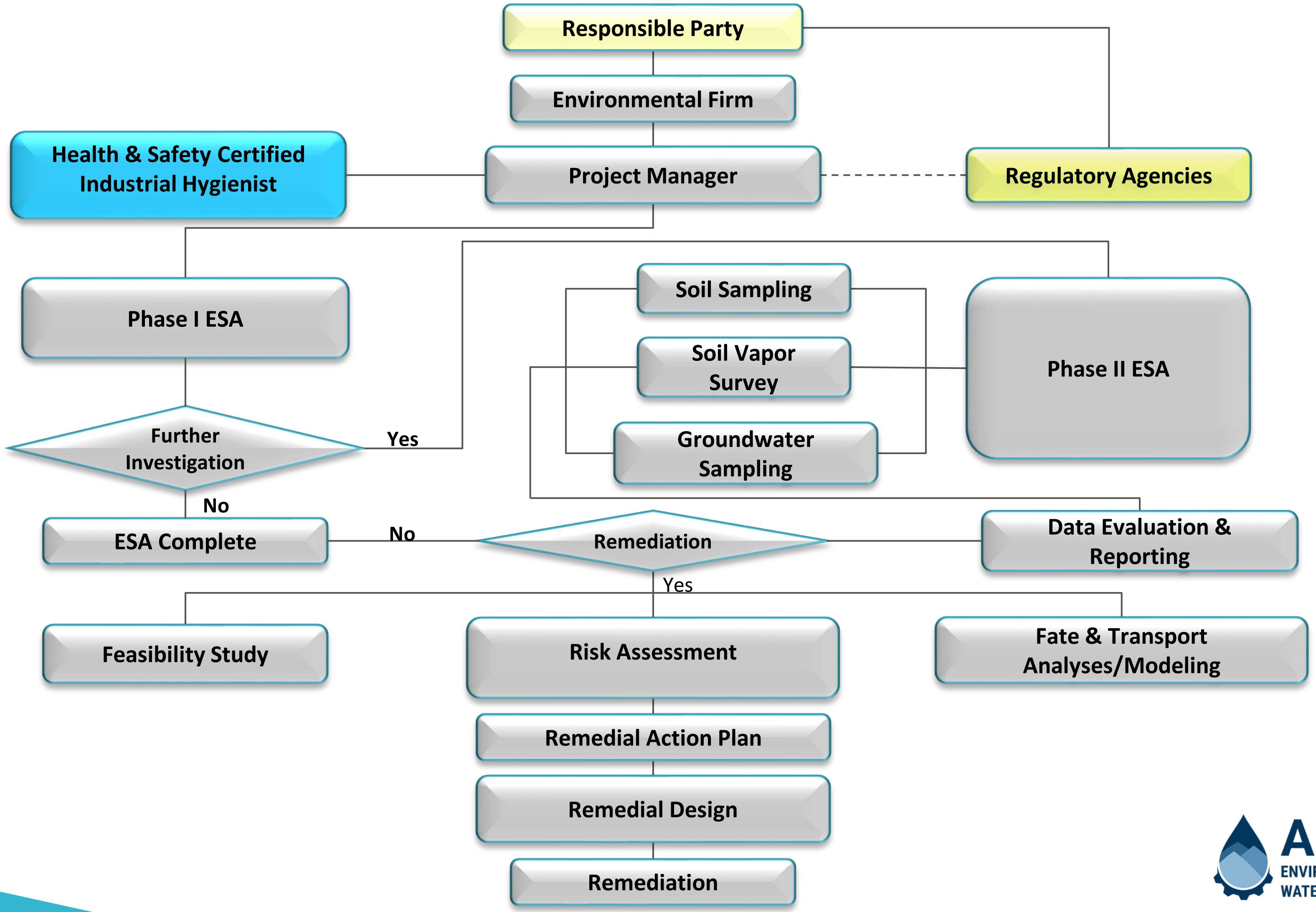
Process of a complete ESA/ Remediation Project



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SLR Impacts

- Direct and indirect impacts
  - Inundate the site and cease remediation operations
  - Raise groundwater levels, salinity and alter geochemical conditions
  - Mobilize contaminants beyond the Site
  - Increases vapor intrusion risk
- Cost of rebuilding damaged remedial infrastructure could be higher than designing for anticipated SLR during the Feasibility Study phase

DTSC Draft SLR Guidance

Module 3

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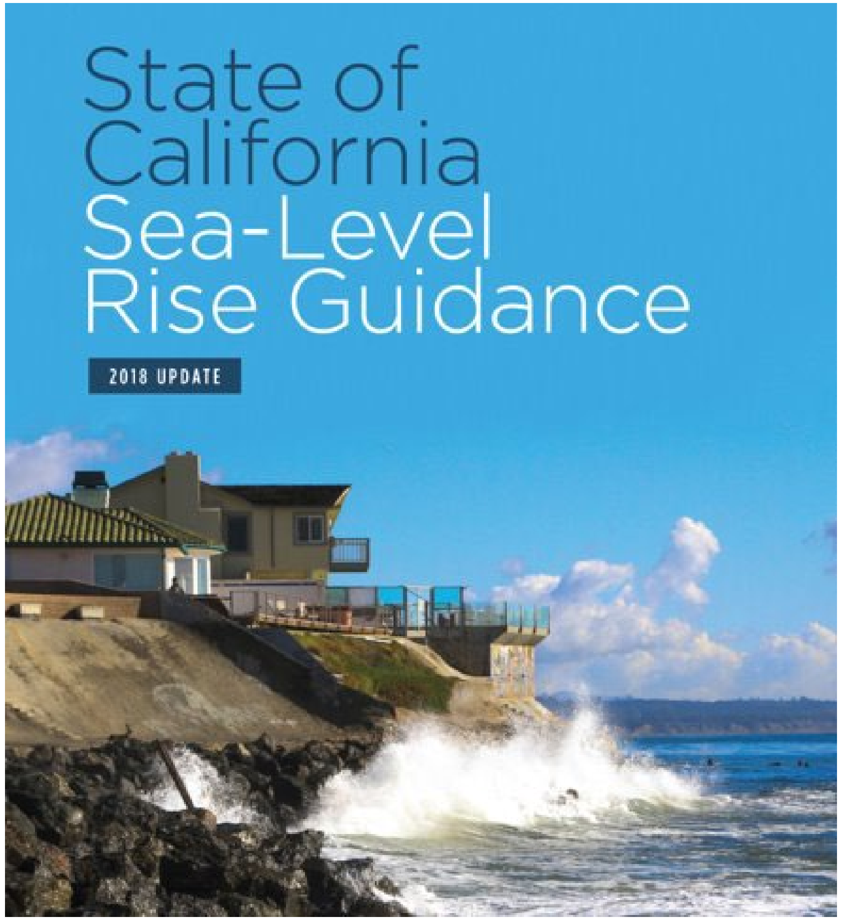
Ocean Protection Council SLR Action Plan

OCEAN PROTECTION COUNCIL
CALIFORNIA COASTAL COMMISSION
Caltrans
Coastal Conservancy
CALIFORNIA Water Boards
bcdc
California Department of Insurance
CALIFORNIA ENERGY COMMISSION
GOVERNOR'S OFFICE OF PLANNING AND RESEARCH, STATE OF CALIFORNIA
Delta Stewardship Council, A CALIFORNIA STATE AGENCY
CALIFORNIA DEPARTMENT OF WATER RESOURCES
CALIFORNIA DEPARTMENT OF FISH & WILDLIFE
CALIFORNIA STATE PARKS, SINCE 1864
DTSC Department of Toxic Substances Control
CALIFORNIA STATE LANDS COMMISSION, STATE OF CALIFORNIA

SLRVA Process



>> **STEP 1:** *Identify the nearest tide gauge.*

>> **STEP 2:** *Evaluate project lifespan.*

>> **STEP 3:** *For the nearest tide gauge and project lifespan, identify range of sea-level rise projections.*

>> **STEP 4:** *Evaluate potential impacts and adaptive capacity across a range of sea-level rise projections and emissions scenarios.*

>> **STEP 5:** *Select sea-level rise projections based on risk tolerance and, if necessary, develop adapation pathways that increase resiliency to sea-level rise and include contingency plans if projections are exceeded.*

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SLR Data and Projections

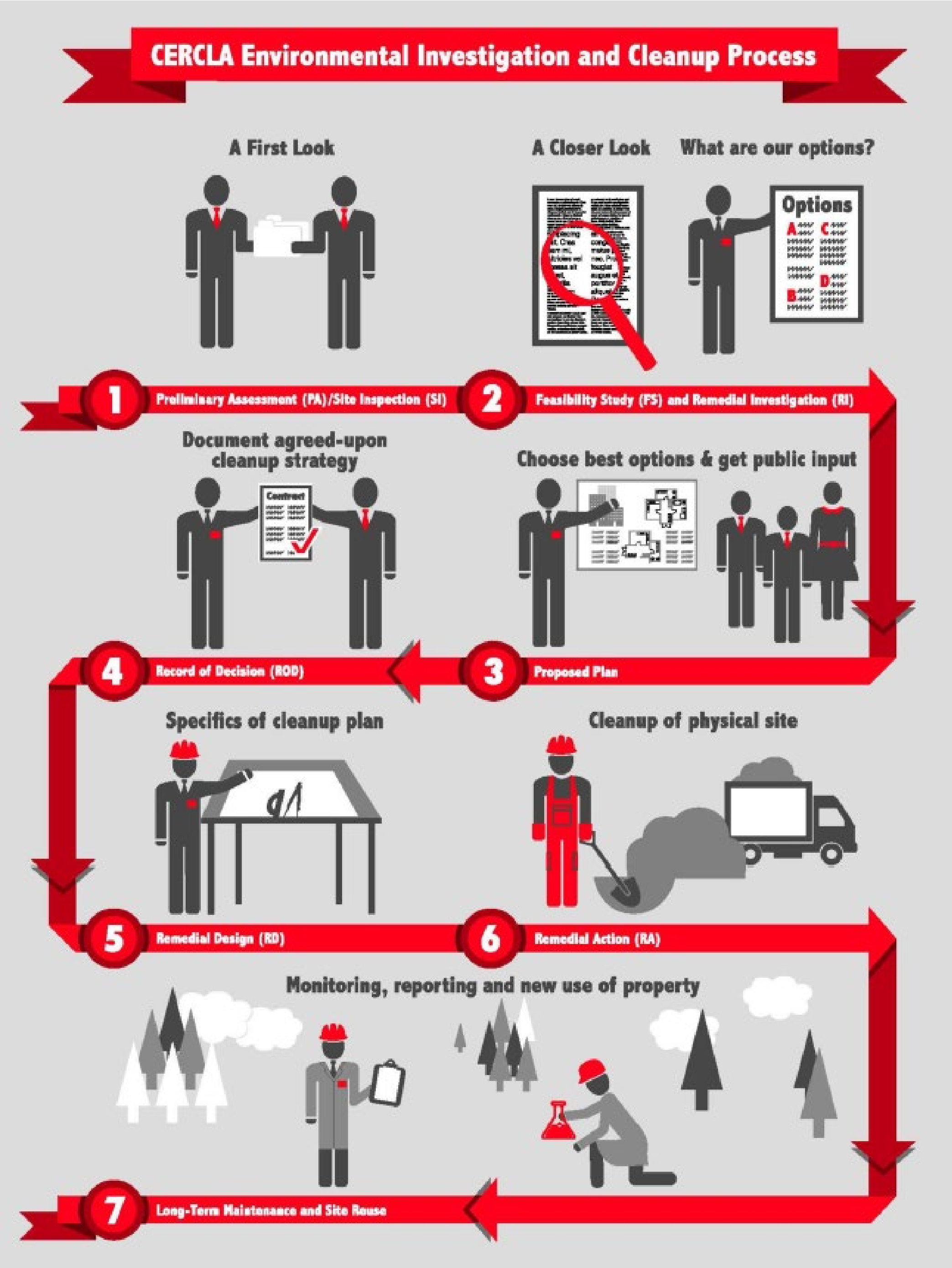
		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...		5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.4	0.3 -	0.5	0.6	0.8	1.0
	2040	0.6	0.5 -	0.8	1.0	1.3	1.8
	2050	0.9	0.6 -	1.1	1.4	1.9	2.7
Low emissions	2060	1.0	0.6 -	1.3	1.6	2.4	
High emissions	2060	1.1	0.8 -	1.5	1.8	2.6	3.9
Low emissions	2070	1.1	0.8 -	1.5	1.9	3.1	
High emissions	2070	1.4	1.0 -	1.9	2.4	3.5	5.2
Low emissions	2080	1.3	0.9 -	1.8	2.3	3.9	
High emissions	2080	1.7	1.2 -	2.4	3.0	4.5	6.6
Low emissions	2090	1.4	1.0 -	2.1	2.8	4.7	
High emissions	2090	2.1	1.4 -	2.9	3.6	5.6	8.3
Low emissions	2100	1.6	1.0 -	2.4	3.2	5.7	
High emissions	2100	2.5	1.6 -	3.4	4.4	6.9	10.2
Low emissions	2110*	1.7	1.2 -	2.5	3.4	6.3	
High emissions	2110*	2.6	1.9 -	3.5	4.5	7.3	11.9
Low emissions	2120	1.9	1.2 -	2.8	3.9	7.4	
High emissions	2120	3	2.2 -	4.1	5.2	8.6	14.2
Low emissions	2130	2.1	1.3 -	3.1	4.4	8.5	
High emissions	2130	3.3	2.4 -	4.6	6.0	10.0	16.6
Low emissions	2140	2.2	1.3 -	3.4	4.9	9.7	
High emissions	2140	3.7	2.6 -	5.2	6.8	11.4	19.1
Low emissions	2150	2.4	1.3 -	3.8	5.5	11.0	
High emissions	2150	4.1	2.8 -	5.8	7.7	13.0	21.9

SLRVA as defined in DTSC Guidance

- SLRVA should be conducted at each stage of the remediation assessment
- SLRVA can be stand-alone document or other submittals – determined by DTSC PM
  - Simple & focused analysis where it is unclear whether SLR is an impact
  - progressively more robust analyses *maybe* required based on results of evaluation
  - SLRVA *may* include consideration of community resilience infrastructure and plans

Adaptation Plan following a SLRVA

- Based on the SLRVA, an adaptation plan *may be* required
- DTSC prefers *full action now*, will consider phased adaptation approach on a case-by-case basis
  - Future phased work requires financial assurance – 22 CCR 66265.140; HSC 25355.2
- Adaptation plan can be stand-alone document or other submittals – determined by DTSC PM

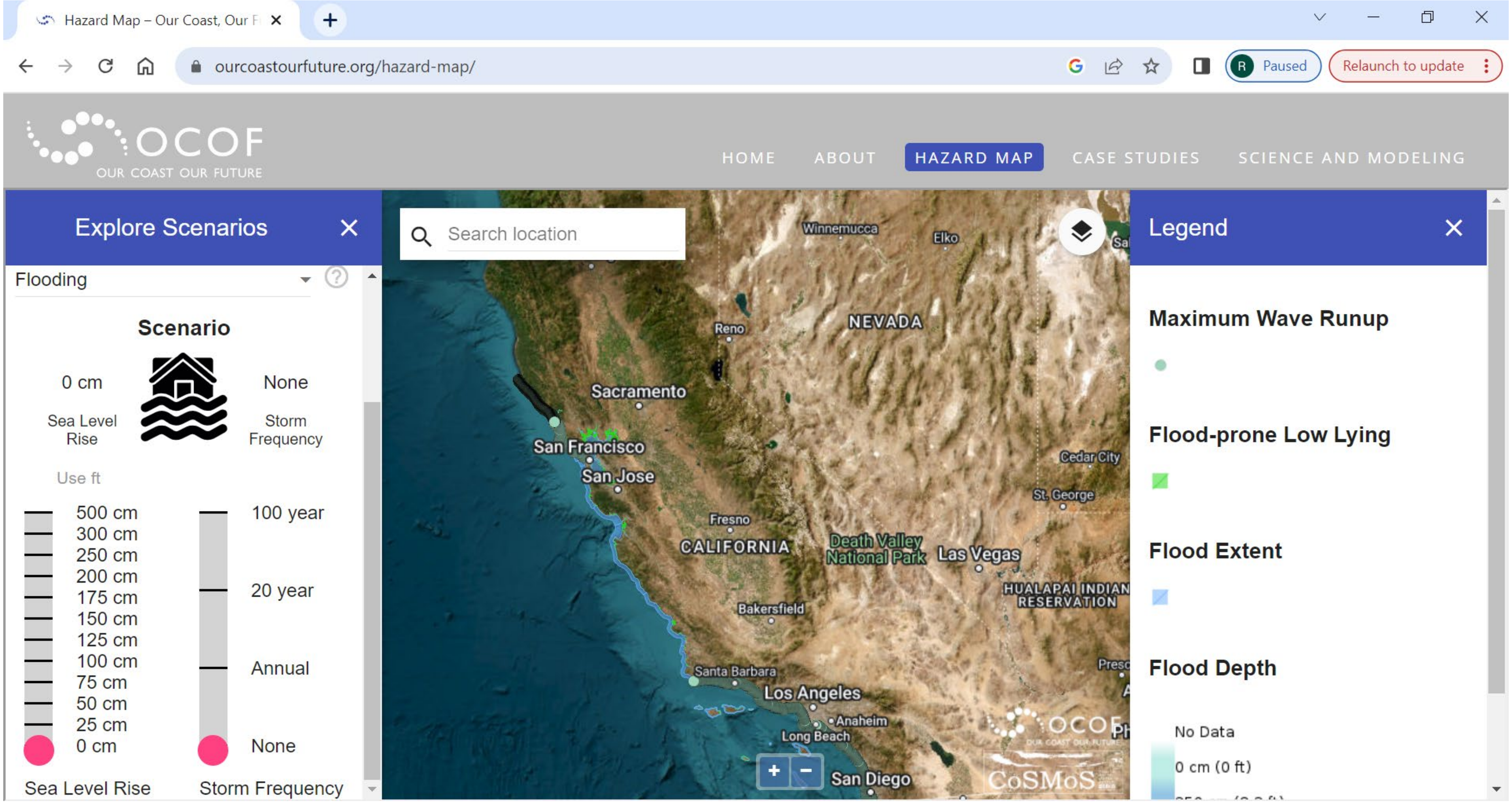


- Remedial Investigation
- Feasibility Study
- Remedy Selection
- Remedy Design
- Remedial Action
- Cost Estimate & Financial Assurance
- Operation Maintenance & Monitoring
- 5-Year Review

Conducting SLRVA

>> **STEP 1:** *Identify the nearest tide gauge.*	12 Tide Gauges, Region-specific SLR projections table
>> **STEP 2:** *Evaluate project lifespan.*	Minimum lifespan 30 years
>> **STEP 3:** *For the nearest tide gauge and project lifespan, identify range of sea-level rise projections.*	Medium-High Risk Aversion is baseline
>> **STEP 4:** *Evaluate potential impacts and adaptive capacity across a range of sea-level rise projections and emissions scenarios.*	Re-evaluation of conceptual site model SLR-impacted hydraulics, exposure pathways
>> **STEP 5:** *Select sea-level rise projections based on risk tolerance and, if necessary, develop adapation pathways that increase resiliency to sea-level rise and include contingency plans if projections are exceeded.*	Remedy selected: review at 5-Yr Review Remedy not selected: include mitigative measures, adaptive management considered

Data Demo



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Case-Studies and Discussion

Module 4

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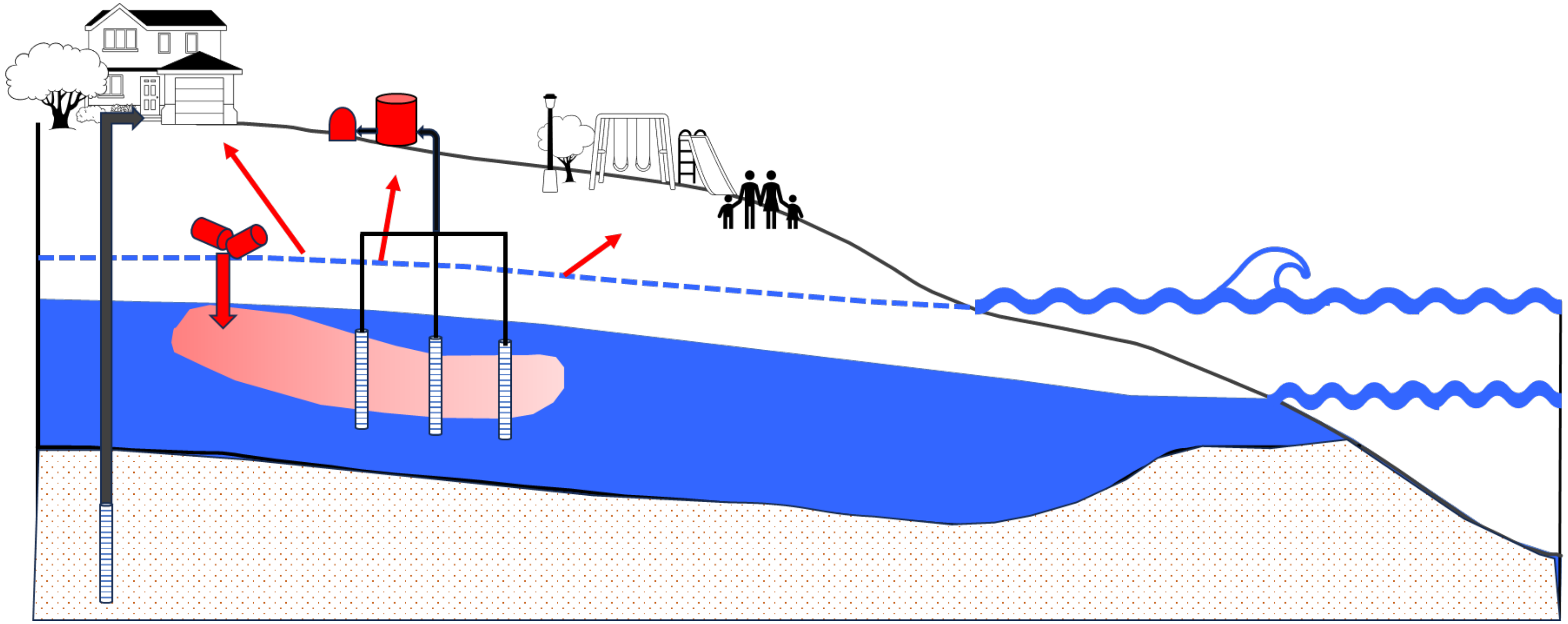
Case-Studies & Discussion

- Examples
- Questions
  - Conceptual model Re-evaluation
  - Adaptive management
  - Community engagement

Case Study Exercise



- Conceptual Site Model
- Receptor Pathways
- Treatment System
- Regional Groundwater

Sustainable Remediation: Climate Change Resiliency and Green Remediation

A guide for Cleanup Project Managers to:

Increase resiliency of cleanup remedies to climate change impacts
-and-
Increase benefits and reduce impacts from the MTCA Cleanup Process

Toxics Cleanup Program
Washington State Department of Ecology
Olympia, Washington

Revised: January 2023
First published: November 2017

Publication 17-09-052

DEPARTMENT OF ECOLOGY
State of Washington

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

June 30, 2021

OFFICE OF
LAND AND EMERGENCY
MANAGEMENT

OLEM Dir. No. 9355.1-120

MEMORANDUM

SUBJECT: Consideration of Climate Resilience in the Superfund Cleanup Process for Non-Federal National Priorities List Sites

FROM: Larry Douchand, Director Douchand, Larry Digitally signed by Douchand, Larry Date: 2021.06.30 15:54:34 -04'00'
Office of Superfund Remediation and Technology Innovation

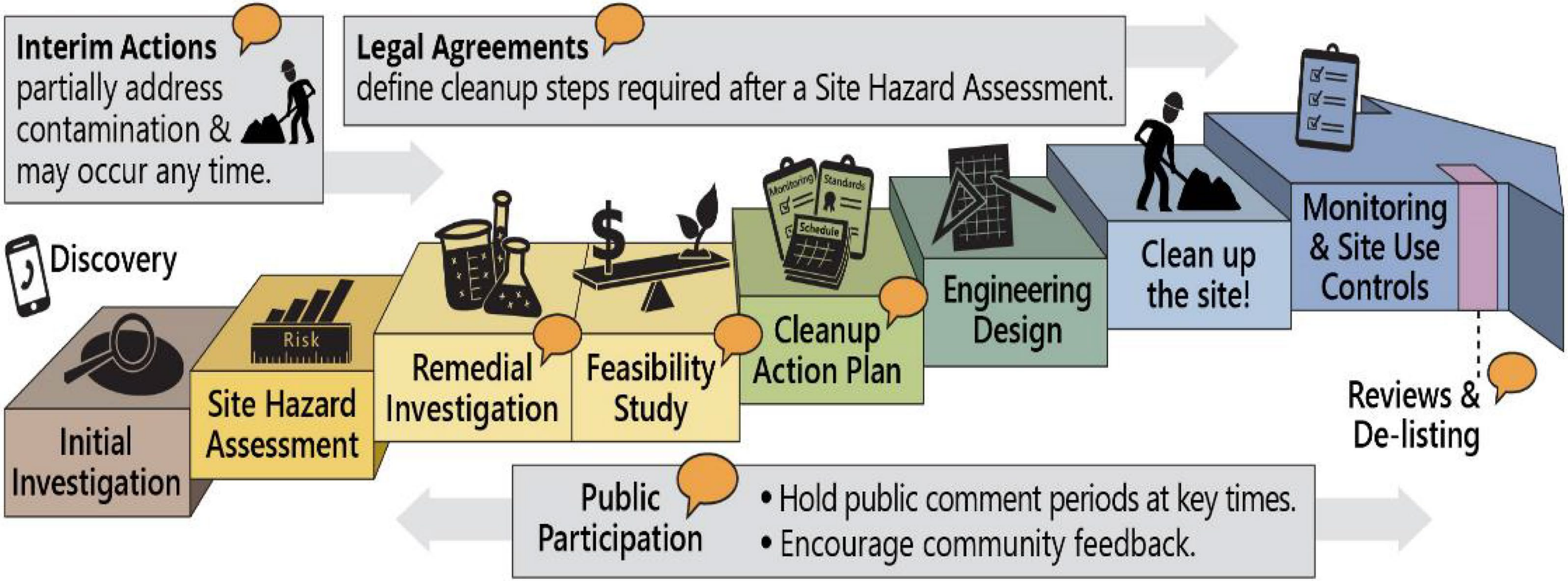
TO: Regional Superfund National Program Managers, Regions 1-10

PURPOSE

This memorandum[1] recommends approaches for U.S. Environmental Protection Agency (EPA or Agency) regions to consider when evaluating climate resilience throughout the remedy selection and implementation process for sites proposed or currently listed on the National Priorities List (NPL) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA).[2]

Consideration of climate resilience in the Superfund cleanup process should be carried out in a manner consistent with CERCLA as well as the National Oil and Hazardous Substances Pollution Contingency Plan (NCP)[3] and EPA policy and guidance documents. This memorandum[4] supplements the Agency's existing policy statements addressing climate resilience activities, tools, considerations and technical information found in fact sheets;[5] however, it does not amend or modify the NCP in any way. Consideration of climate resilience should not be treated as a new criterion under 40 CFR §300.430(e)(9)(iii)).

[1] This document provides recommendations to regional staff and management regarding how the Agency interprets and implements the NCP, which provides the blueprint for CERCLA implementation, with respect to climate resilience. However, this document does not substitute for those provisions or regulations, nor is it a regulation itself. Thus, it cannot impose legally binding requirements on EPA, states, or the regulated community and may not apply to a particular situation based upon the circumstances. Any decisions regarding a particular situation will be made based on the statute and the regulations, and EPA decision makers retain the discretion to adopt approaches on a site-specific basis that differ from the recommendations where appropriate.
[2] 42 USC §9601 et seq.
[3] 40 CFR Part 300.
[4] The scope of this document is consistent with recommendations 3 and 4 of the U.S. Government Accountability Office report released on November 18, 2019 (GAO-20-73), https://www.gao.gov/products/gao-20-73.
[5] For additional information, see https://www.epa.gov/superfund/superfund-climate-resilience.



Courtesy of Washington State Department of Ecology

Landfill Cleanup Site: Cornwall Avenue, Bellingham Bay

- Groundwater: Tannins and lignins associated with wood waste-breakdown products, elevated nitrogen compounds, elevated dissolved metals, and volatile organics.
- Sediment: Mercury, phthalates, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, phenols, and diesel and oil-range petroleum hydrocarbons.
- Soil: Petroleum hydrocarbons, pentachlorophenol, carcinogenic PAHs, and other municipal landfill contaminants.

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Climate Resilient Cleanup Remedy

- Design Metric: SLR of 2.4 feet over 100 years
- Combination of
  - upland multi-layer cap
  - shoreline stabilization system, and
  - enhanced natural recovery in deeper subtidal areas
- Accounting for SLR
  - Increase height of shoreline stabilization system
  - Sloping area of upland cap

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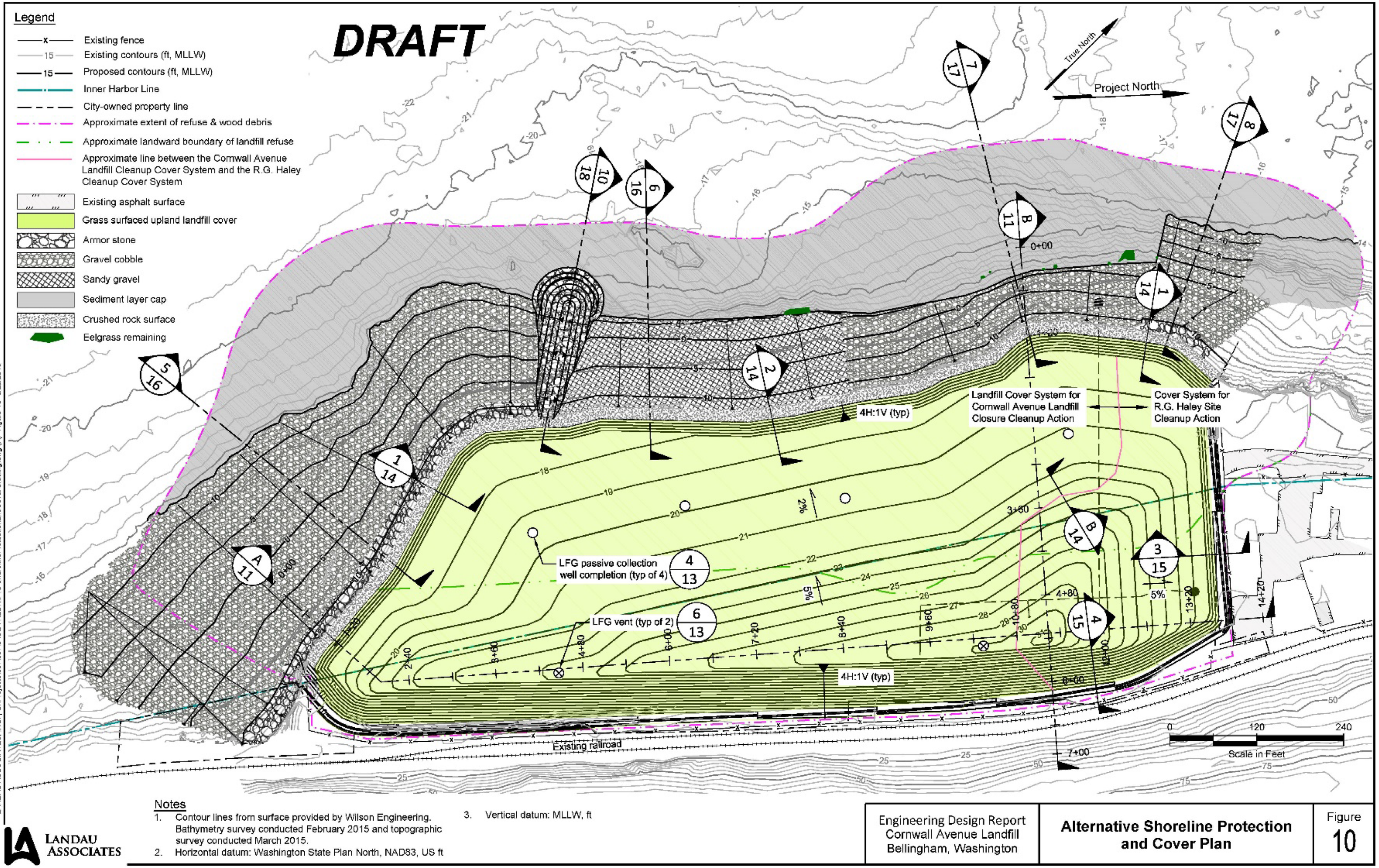
Module 4


DRAFT
Legend
Existing fence
Existing contours (ft, MLLW)
Proposed contours (ft, MLLW)
Inner Harbor Line
City-owned property line
Approximate extent of refuse & wood debris
Approximate landward boundary of landfill refuse
Approximate line between the Cornwall Avenue Landfill Cleanup Cover System and the R.G. Haley Cleanup Cover System
Existing asphalt surface
Grass surfaced upland landfill cover
Armor stone
Gravel cobble
Sandy gravel
Sediment layer cap
Crushed rock surface
Eelgrass remaining
True North
Project North
Landfill Cover System for Cornwall Avenue Landfill Closure Cleanup Action
Cover System for R.G. Haley Site Cleanup Action
4H:1V (typ)
LFG passive collection well completion (typ of 4)
LFG vent (typ of 2)
Existing railroad
Scale in Feet
0
120
240
LANDAU ASSOCIATES, INC. | G:\Projects\001\037\040\041\EDR\F10 ShorelineProtectionandCoverGrading.dwg (A) "Figure 10" 3/29/2016
Notes
1. Contour lines from surface provided by Wilson Engineering. Bathymetry survey conducted February 2015 and topographic survey conducted March 2015.
2. Horizontal datum: Washington State Plan North, NAD83, US ft
3. Vertical datum: MLLW, ft
LANDAU ASSOCIATES
Engineering Design Report
Cornwall Avenue Landfill
Bellingham, Washington
Alternative Shoreline Protection and Cover Plan
Figure
10

EPA Climate Resilience Technical Fact Sheets

Groundwater Remediation Systems

Examples of System Components		Potential Vulnerabilities Due to Extreme Weather			
		Power Interruption	Physical Damage	Water Damage	Reduced Access
Groundwater Extraction or Containment System	Wells		◆		◆
	Extraction or aeration pumps	◆	◆	◆	◆
	Vertical barriers		◆		◆
	Pipe systems		◆	◆	◆
	Monitoring equipment	◆	◆	◆	◆
Aboveground Components of the Treatment System	Electrical controls	◆	◆	◆	◆
	Transfer pumps	◆	◆	◆	
	Pipe systems		◆		
	Equipment powered by electricity, natural gas or diesel, such as heaters, air blowers or generators	◆	◆	◆	
	Flow-through treatment units such as carbon vessels, clarifiers, and tray strippers	◆	◆	◆	
	Chemical storage containers		◆	◆	◆
	Treatment residuals disposal system		◆	◆	◆
	Treated water discharge system	◆	◆	◆	
Site Operations and Infrastructure	Buildings, sheds or housing	◆	◆	◆	◆
	Electricity and natural gas lines	◆	◆	◆	◆
	Liquid fuel storage and transfer	◆	◆	◆	◆
	Water supplies	◆	◆	◆	◆
	Exposed machinery and vehicles		◆	◆	◆
	Surface water drainage systems		◆	◆	◆

Contaminated Sediment Sites

Examples of Remedy Components		Potential Vulnerabilities Due to Extreme Weather			
		Physical Damage	Water Damage	Power Interruption	Reduced Access
Submerged Components	Geotextile layer(s) and armor of an in situ cap	◆			◆
	Activated carbon in the insulation layer of a reactive cap	◆			
	Clean sediment layer overlaying contaminated sediment for EMNR	◆			
Upland Components	Dikes enclosing an engineered unit that stores dredged or excavated material	◆			◆
	Bank or slope stabilization structures such as riprap revetment, steel nets or terrace stoplogs	◆	◆		◆
	Subsurface barriers made of cement slurry or sheet piles	◆	◆		◆
Site Operations and Infrastructure	Temporary piers or water containment booms	◆			
	Barges and tugs used to dredge contaminated sediment	◆	◆		◆
	Exposed construction machinery and vehicles	◆	◆		◆
	Monitoring equipment	◆	◆	◆	◆
	Sediment dewatering and treatment facilities	◆	◆	◆	◆
	Fencing and signs for controlling access or use	◆			
	Access roads	◆			◆
	Buildings, sheds or housing	◆	◆	◆	◆
	Liquid fuel storage units	◆	◆		◆
	Water supplies	◆	◆	◆	◆

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Contaminated Waste Containment Systems

Examples of System Components		Potential Vulnerabilities Due to Extreme Weather			
		Physical Damage	Water Damage	Power Interruption	Reduced Access
Underground and At-Grade Components	Synthetic materials such as geomembrane in a composite liner or cover system, geonet for drainage, or geotextile for leachate filtration	◆	◆		
	Bottom layer of unlined waste		◆		
	Vegetative layer integral to an evapotranspiration cover or overlaying a conventional cover	◆	◆		
	Vertical and horizontal wells for LFG extraction	◆			◆
	Pipe networks for leachate and/or LFG collection	◆	◆		◆
	Wells for monitoring groundwater or LFG	◆			◆
	Vertical barriers	◆			◆
Aboveground Components	Electrical controls for leachate and LFG management systems	◆	◆	◆	◆
	Pipe systems for leachate treatment and disposal and for LFG collection and transfer	◆			◆
	Transfer pumps for leachate and LFG	◆	◆	◆	◆
	Flow-through units for leachate treatment processes such as coagulation/flocculation, chemical precipitation or ozonation	◆	◆	◆	◆
	Leachate treatment or evaporation pond	◆			◆
	LFG pre-treatment equipment such as blowers, coolers and condensers	◆	◆	◆	◆
	LFG flares	◆	◆	◆	◆
	LFG-to-energy turbines	◆	◆	◆	◆
	Chemical storage containers	◆	◆		◆
	Treatment residuals disposal system	◆	◆		◆
	Treated leachate discharge system	◆	◆	◆	◆
	Auxiliary equipment powered by electricity, natural gas or diesel fuel	◆	◆	◆	◆
	Monitoring equipment	◆	◆	◆	◆
Site Operations and Infrastructure	Buildings, sheds or housing	◆	◆	◆	◆
	Electricity and natural gas lines	◆	◆		◆
	Liquid fuel storage and transfer	◆	◆	◆	◆
	Water supplies	◆	◆	◆	◆
	Exposed machinery and vehicles	◆	◆		◆
	Surface water drainage systems	◆	◆		◆
	Fencing for access control and litter prevention	◆			◆

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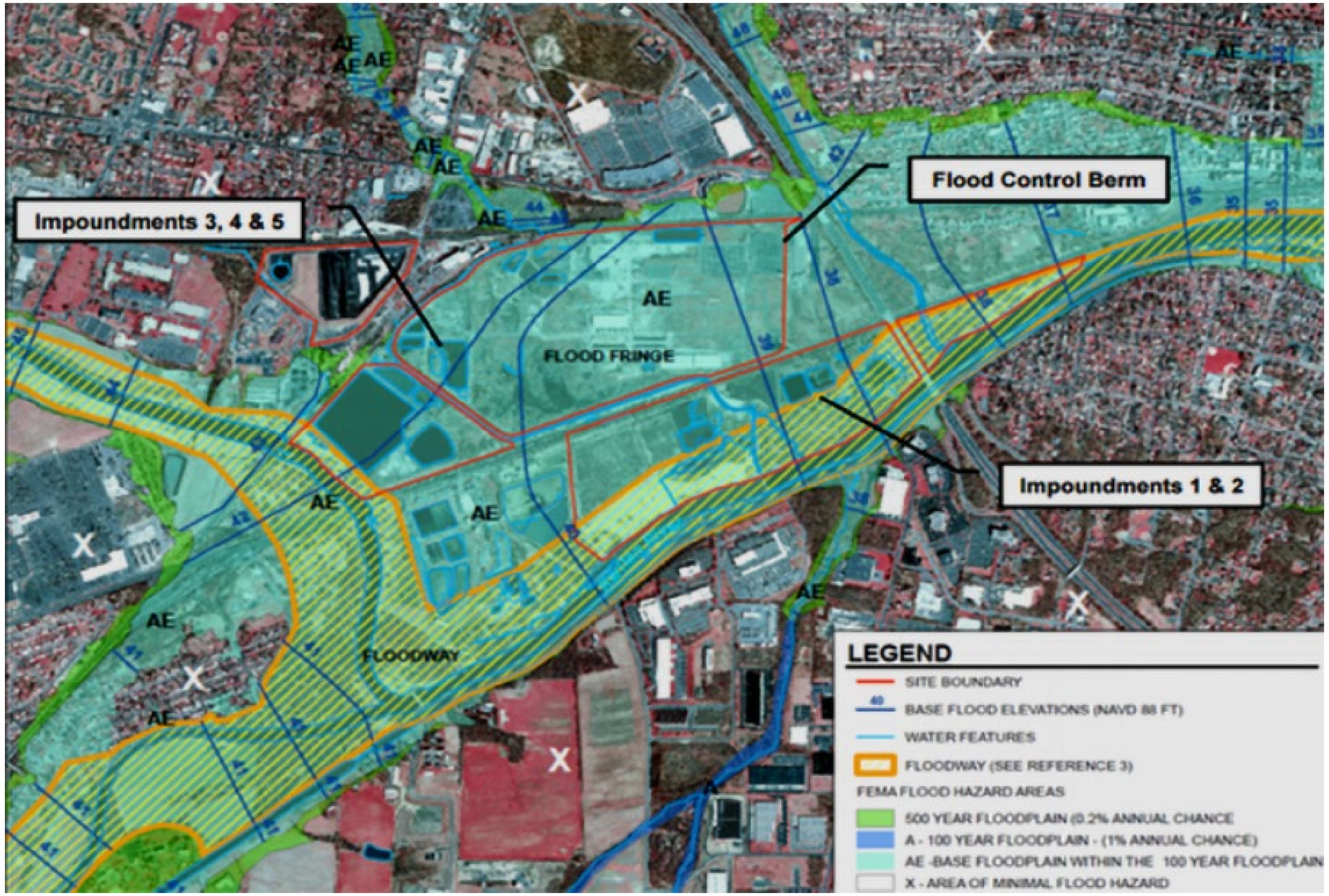
EPA Superfund Site Example

American Cyanamid Co.

- 435-acre formerly chemical manufacturing facility, along Raritan River, NJ
- Impoundments and lagoons used for disposal of chemical sludge and other wastes
- Onsite soil and groundwater are contaminated with volatile organic compounds (VOCs), semi-volatile VOCs and metals.



Vulnerability to Climate Change Impacts

- Extremely vulnerable to flooding, located within the 100-year floodplain
- Impacts of tropical storms associated with hurricanes along the U.S. East Coast
  - Standing floodwaters
  - destruction at office trailers
  - loss of electricity needed to extract contaminated groundwater

Climate Resilient Cleanup Remedy

Elevated electrical controls for full-scale groundwater extraction

Onsite flood-resistant enclosure & bollards on concrete foundations

Supplementary Information

Themes for organizing slides

- California SLR overview – guidance document from Ocean Protection Council
- EPA Superfund Climate Resilience Resources and Technical Fact Sheets
- DTSC Draft Guidance
  - How to do SLRVA
  - What data is out there
  - What to expect in SLRVA reviews
  - What needs additional clarifications/discussion
  - What should you ask your consultants
- Example from WA-DoE Sustainable Remediation Document
- Example from EPA Superfund Climate Resilience

Any topics you want your audience to discuss before or after your talk?

- Topic 1 – how does the guidance affect brownfield projects?
- Topic 2 – do sites farther inland from the coastline also have to perform SLRVAs
- Topic 3 – what are some of the successful implementations of Adaptation Plans considering SLR

Poll Questions

- How many of you here have background in urban/environmental planning
- What technologies do you think are most resilient to SLR?
  - Pump & Treat, and Ex-situ treatment
  - In-situ treatment
- What conceptual site model elements need to re-evaluated for a site with potential impacts from SLR
  - Hydrogeology
  - Geochemistry
  - Exposure pathways

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