

California Department of Water Resources Climate Change Vulnerability Assessment



Artwork by Qinqin Liu

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California Water Commission
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Climate Action Plan

DWR's Comprehensive Response to Climate Change

Phase I: Greenhouse Gas Emissions Reduction Plan

Phase II: Climate Change Analysis Guidance

Phase III: **Vulnerability Assessment** and Adaptation Plan

Vulnerability Categories

- Wildfire
- Extreme Heat
- Sea Level Rise
- Long-term Persistent Hydrologic Changes
- Short-Term Extreme Hydrologic Changes
- Habitat and Ecosystem Services Impacts



Vulnerability Assessment Scope

DWR staff, facilities, operations, and managed lands

Mid-century time horizon (2030-2070)



Vulnerability Assessment Scope

Assessed

- Infrastructure (Facilities and Lands)
 - State Water Project
 - Flood facilities
 - Regional/field division offices
 - Managed lands
- Staff Activities
 - O&M of SWP
 - Biological surveys/monitoring
- SWP Operations
 - Hydrologic changes and effects on snowpack, streamflow, and deliveries

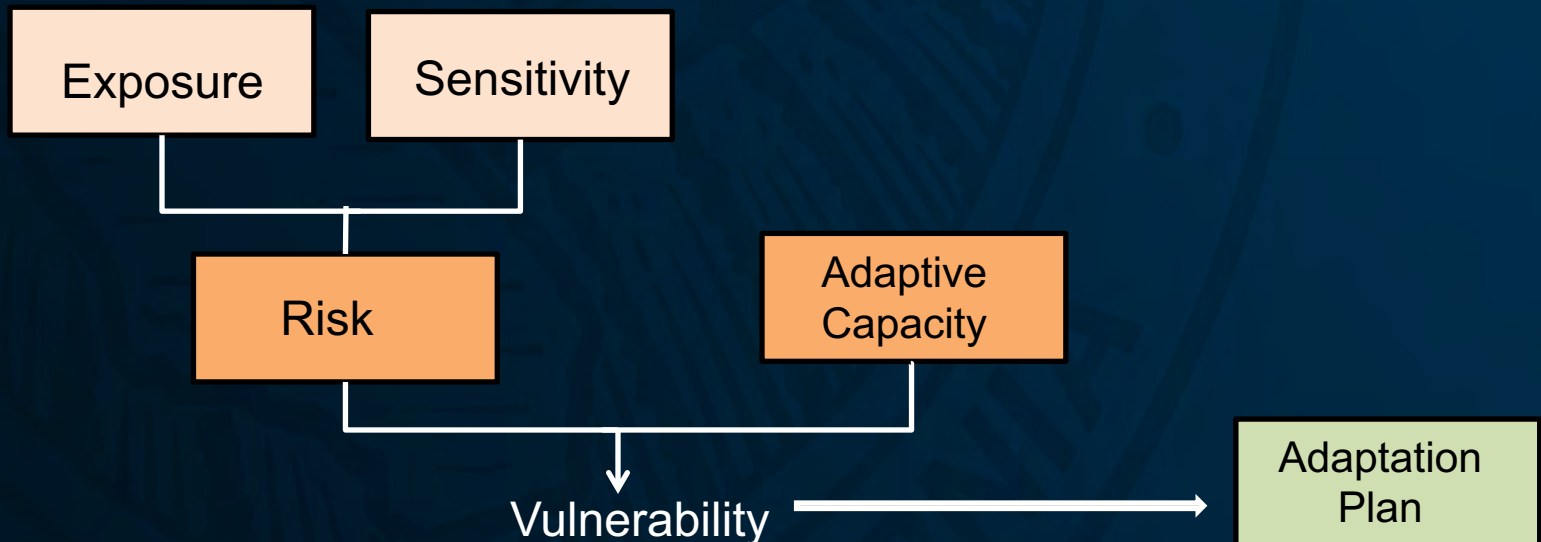
Not Assessed

- Delta levees (including seismic risk)
- Subsidence
- Electrical grid (due to wildfire or extreme heat)
- Sedimentation behind dams (due to post-wildfire erosion)

Climate Action Plan, Phase III

Vulnerability Assessment

- ❑ Identified the **vulnerabilities** to climate change that could affect DWR's staff, facilities, and operations by:
 - ✓ Assessing the level of **exposure and sensitivity** associated with each to determine overall **risk** ($E + S = R$)
 - ✓ Considering **adaptive capacity** for moderately or highly exposed facilities and operations



Vulnerabilities

Findings

Extreme Heat



Some areas have high risk, but most places also have adequate adaptive capacity (i.e. existing DWR safety plans and programs could keep the vulnerability of staff at current levels).

Sea-Level Rise



Although high exposure, facilities have low sensitivity; therefore, vulnerability is considered low. (Note: SWP operations were found to be vulnerable to rising sea levels in the Delta – see hydrologic chapter)

Wildfire



Most facilities are *not* vulnerable (existing practices considered adequate for protection). However, SWP operations are vulnerable to increased wildfire risk (e.g. Upper Feather River Watershed).

Ecosystems



Climate change will exacerbate stresses on listed species and habitat types. DWR may need to act beyond what was originally intended to manage or restore lands for mitigation or other purposes.

Short-Term Extreme

Hydrologic Events



Maximum 1-day to 3-day flows are projected to increase for all watersheds evaluated leading to high risks throughout the Central Valley (especially San Joaquin Valley).

Long-Term Persistent Hydrologic Changes

High likelihood of significant reductions in SWP delivery and storage performance.



Adaptation strategies will be evaluated in DWR's Climate Change Adaptation Plan.

Extreme Heat Vulnerability Assessment Results



- Some areas in California where DWR works are projected to experience moderate increases in extreme heat levels.
- Utilizing existing DWR safety plans and programs could keep the vulnerability of staff at current levels.

Extreme Heat Findings

Mid-Century Increase in Number of Days above:		
Location Name	95 °F	105 °F
San Luis Field Division	74-87%	0-600%
South Central Region Office	35-77%	93-100%
Southern Region Office	150-300%	0-200%
San Joaquin Field Division	26-64%	100-133%
Southern Field Division	30-75%	0-233%

Climate Action Plan

DWR's Comprehensive Response to Climate Change

Phase I: Greenhouse Gas Emissions Reduction Plan

- *Featured by the California Air Resources Board in the AB 32 Scoping Plan Update (2018)*



Phase II: Climate Change Analysis Guidance

- *Methodology developed by DWR Climate Change Technical Advisory Group adopted by State's Fourth Climate Change Assessment (2018)*

Phase III: Vulnerability Assessment and Adaptation Plan

- *California Public Utilities Commission provides DWR Vulnerability Assessment as an example for the state's investor-owned energy utilities (Rulemaking 18-04-019, Decision 20-08-046; 2020)*

Climate Action Plan, Phase III, Vulnerability Assessment

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- Funding: General Fund, Proposition 84

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Vulnerability Categories

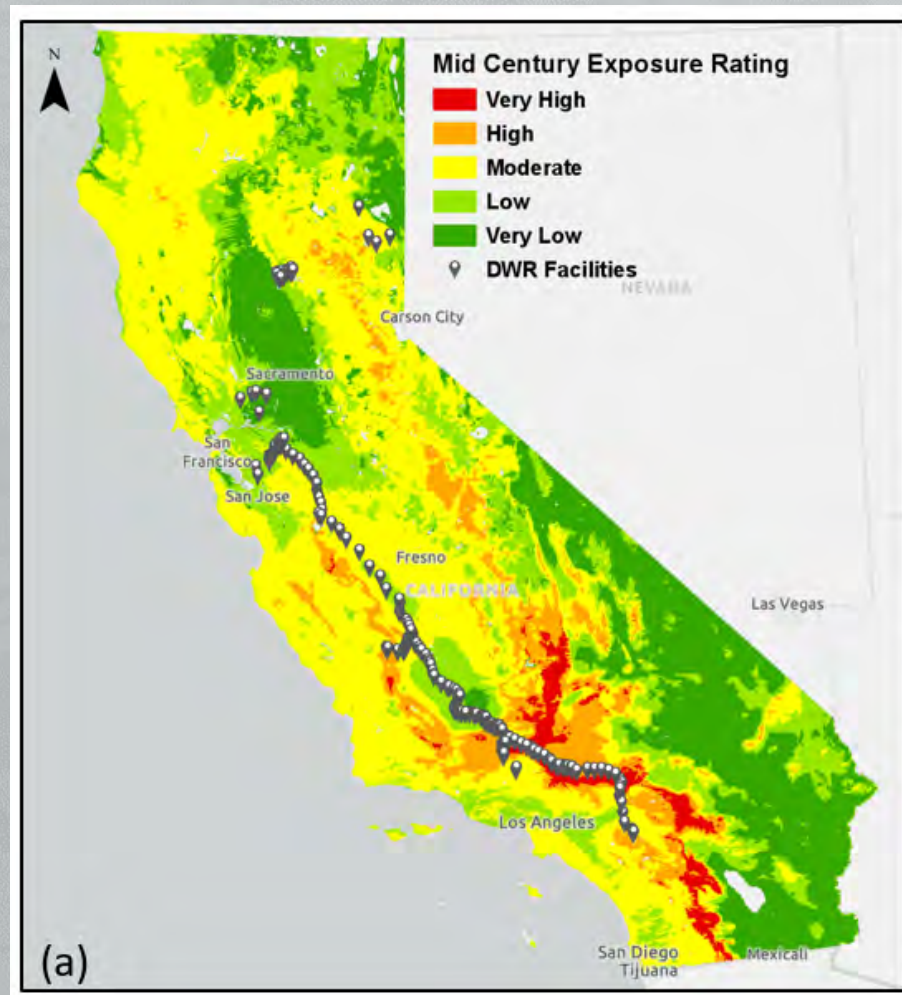
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Specific Approach to Hazards

	Approach	Data source
Extreme Heat 	E + S: staff/chief interviews AC: Prepared plan (HIPP) and flexibility in work scheduling	Internal survey Cal-Adapt GFDL A2 Emissions Scenario
Sea-Level Rise 	E + S: Facility inventory AC: Not assessed due to low risk	COCAT 2013 and NRC 2012 Knowles 2010
Wildfire 	E + S: Facility inventory geographically referenced to changing probability of wildfire AC: Qualitative review of existing management practices	Krawchuk and Moritz 2012
Ecosystems 	E + S: Qualitative discussion + literature review AC: Varies	Partial lands inventory Literature
Short-Term Extreme Hydrologic Events 	E + S: Study review AC: Review of existing approaches	Hydraulic/hydrologic modelling by DWR et al. CCTAG 20 Scenarios (median)
Long-Term Persistent Hydrologic Changes 	E + S: Bottom-up decision scaling AC: Will evaluate suggested strategies in forthcoming AP	"All" CMIP5 GCMs Paleo-reconstructions Livneh 2013 CalLite NRC 2012

Statewide Projected Change in Wildfire Exposure at Mid-Century

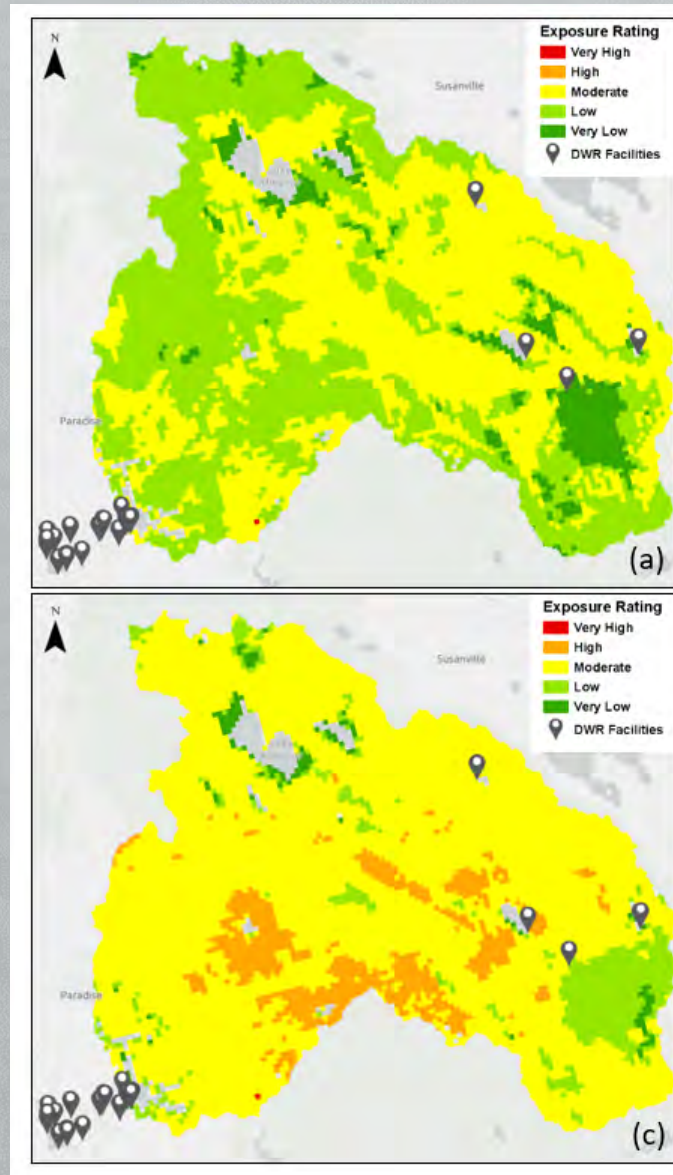


Wildfire Vulnerability Assessment Results



- DWR's facilities are likely not vulnerable to increased wildfire risk because existing management and maintenance practices are adequate to protect infrastructure from current as well as future wildfire exposure levels.
- However, the Upper Feather River headwaters for the State Water Project see significant increases in wildfire by mid-century.

Projected Feather River Watershed Wildfire Exposure Resulting from Climate Change — Early and Mid-Century



Projected Feather River Watershed Wildfire Exposure Resulting from Climate Change — Early and Mid-Century



Wildfire Exposure	Early Century (2010–39)	Mid-Century (2040–69)
Very Low	6.5%	2%
Low	46%	8%
Moderate	48%	80%
High	0%	10%
Very High	0%	0%

Modeled Number of Days Exceeding Temperature Thresholds



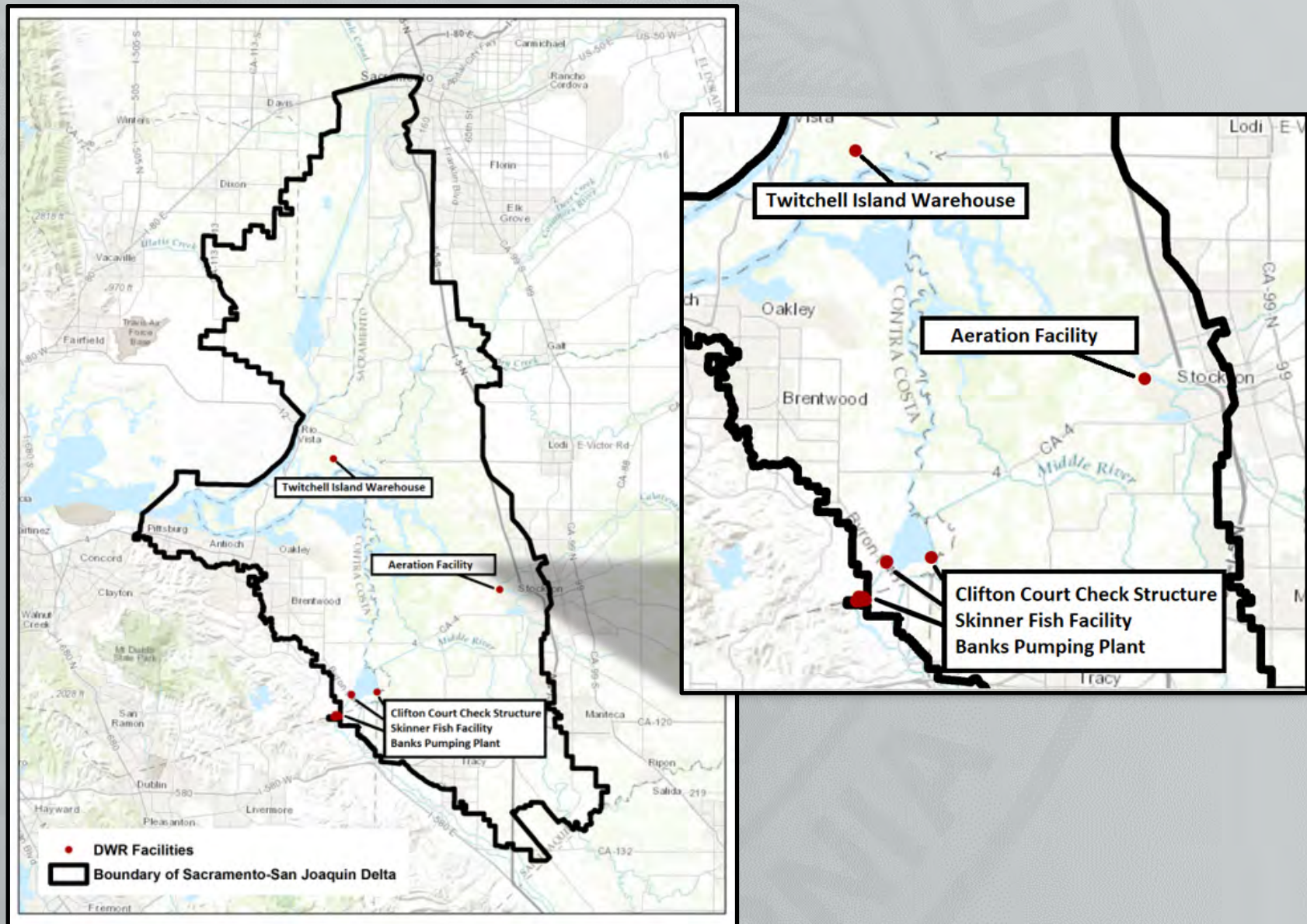
Location Name	Number of days exceeding 80 °F		Number of days exceeding 95 °F		Number of days exceeding 105 °F	
	1990–1999	2040–2049	1990–1999	2040–2049	1990–1999	2040–2049
Oroville Field Division	128–163	150–174	33–63	58–84	0–8	2–13
Delta Field Division	119–168	151–175	21–47	37–64	0–5	0–11
San Luis Field Division	121–165	146–171	15–35	28–61	0–1	0–7
San Joaquin Field Division	156–188	174–199	53–93	87–117	3–16	7–32
Southern Field Division	139–180	160–194	48–81	84–105	0–6	3–20

Sea Level Rise Vulnerability Assessment Results



- State Water Project (SWP) operations and performance are found to be vulnerable to rising sea levels in the Delta.
- Few DWR facilities are sensitive to rising sea levels, and so overall vulnerability is considered low.

DWR Facilities in the Delta with High Exposure to Sea-Level Rise



Sea Level Rise Vulnerability Assessment Results



- The Suisun Marsh will likely be impacted by increasing inundation of mud flats and low-lying areas and greater variation in environmental conditions.
- Rising sea level coupled with storm surge and storm-driven stream flow into the Delta could result in substantial increases in stage elevation in the Delta (technical report in the State's Fourth Assessment)

Long-term Persistent Hydrologic Changes

- Co-production of DWR and the University of Massachusetts, Amherst
- Included in the State's Fourth Assessment
- Improves planning for the uncertain effects of climate change
- **Integrates vulnerability-based analysis with traditional risk-based assessment methods**



Long-term Persistent Hydrologic Changes Vulnerability Assessment Results



- High likelihood of significant reductions in SWP delivery and storage performance as the climate warms.
- While SWP operations thus are at risk to climate change, SWP facilities and operations can be adapted to ameliorate losses in performance.

Long-term Persistent Hydrologic Changes

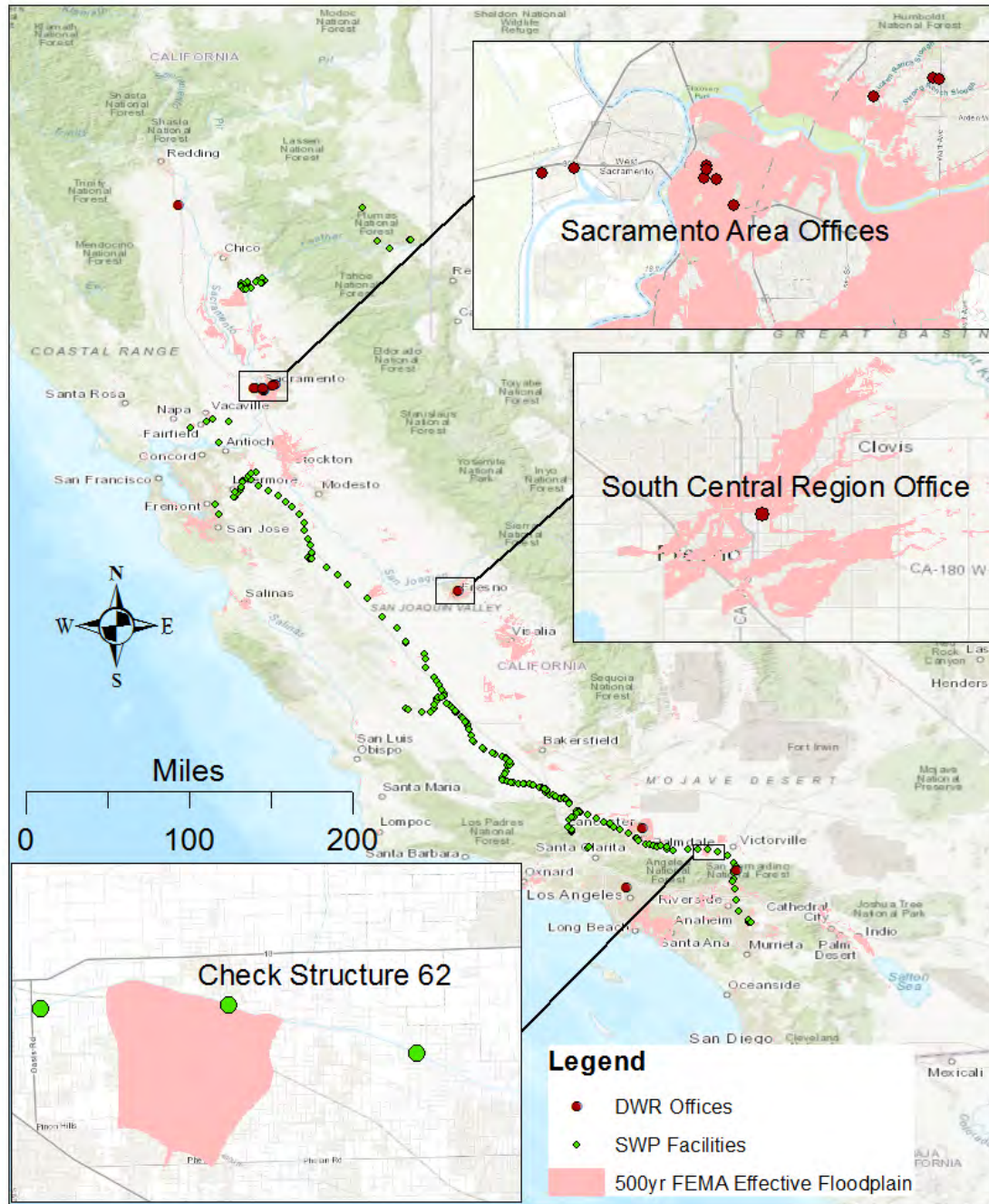


Performance Metric	Probability that Mid-Century (2050) Performance will be Less than Current Performance
Oroville April Storage	76%
Oroville Carryover Storage	95%
Winter Net Delta Outflow	63%
Spring Net Delta Outflow	65%
Summer Net Delta Outflow	21%
Fall Net Delta Outflow	40%
SWP Deliveries	87%
System Shortages	76%

Short-Term Extreme Hydrologic Changes Vulnerability Assessment Results



- Maximum annual 1-day and 3-day flows are projected to increase for all watersheds evaluated.
 - Flood operations are considered to have high risks throughout the Central Valley
 - Risks are even higher, particularly for large events, in the San Joaquin Valley compared to Sacramento Valley.
- Analysis draws from the Central Valley Flood Protection Plan (CVFPP) 2017 Update: Climate Change Analysis Technical Memorandum



Habitat and Ecosystem Services

DWR managed land includes:
mitigation properties, right-of-way
easements, and restoration projects

For this report, the following was
assessed:

- Habitat and ecosystem services by ecoregion
- Facilities and lands vulnerable to ecosystem services impacts
- Operational vulnerability to ecosystem services impacts



Habitat and Ecosystem Services

Potential Implications for DWR

- Climate change will impact species/habitat in some regions more than others, and in unpredictable ways
 - Sacramento-San Joaquin Delta properties at risk include the Yolo Bypass, Prospect Island, Twitchell/Sherman Island, and multiples sites within the Suisun Marsh
 - California Aqueduct Right-of-Way habitat
- Mitigation and restoration parcels may not be suitable for target species under future conditions
 - A complete managed lands inventory is needed for future site-specific analyses
- Impacts to Operations
 - Salmon species and freshwater fisheries impacts will be exacerbated



Next Steps: Adaptation Planning

- The Vulnerability Assessment serves as a foundation for the development of an Adaptation Plan.
- The Adaptation Plan will help prioritize DWR climate resiliency efforts such as infrastructure improvements, enhanced maintenance and operation procedures, revised health and safety procedures, and improved habitat management.



