

Attachment 5: Stressors and Example Restoration Actions

Stressor Categories	Stressor Subcategories	Description of Stressors	Example Restoration Actions	Location
Alteration of Flows and Other Effects of Water Management	Hydrograph Alterations	Inadequate flow, flow variability, seasonal flow distribution, flow timing, stranding due to flow fluctuation, lack of flushing flows, lack of attraction flows, lack of channel forming flows, saltwater intrusion.	<i>Hydrograph alteration actions could include evaluation of potential water supply sources, evaluation of water needs for fisheries, or assessment/revision of water management operations. Examples include the following.</i>	
			Conduct winter rice flooding and waterfowl pilot project to assess priority locations and flow needs, in order to investigate possible waterfowl improvement benefits.	Sacto. River Mainstem - Colusa to Delta
			<b>Encourage reliance on reclaimed water for use in parks, golf courses, large landscaped areas, etc.</b>	North Bay
			<b>Consider water acquisition in the Central Valley for all species and life stages, including efforts under the AFRP.</b>	North Bay, Delta, and San Joaquin River system
			Develop a water budget for low water years.	North Bay
			Fund programs to keep needed USGS stream gages, in order to provide necessary data for water management decisions.	North Bay
			Support local water conservation organizations, water management plans, and water conservation education.	North Bay
			Conduct a flow enhancement study to evaluate potential for increased flow in the lower river.	Tuolumne River
			Study in-stream flow needs for smolt survival.	Stanislaus River
			Assessment, feasibility studies, and/or re-establishment of channel maintenance flows.	Stanislaus River, Clear Creek
			Evaluate reoperation of New Melones to mimic seasonal flow variability.	Stanislaus River
			Assess ground water management, water transfers, distribution system efficiency.	San Joaquin, Merced, Tuolumne, and Stanislaus Rivers
			Evaluate additional water exchange to ensure passage during critical migration periods.	Deer Creek, Mill Creek
			Real time flow monitoring.	Mill Creek
			<b>Land retirement to decrease the need for water diversion.</b>	Delta
			Extend and expand flow agreement with PG&E.	Battle Creek
			<b>Development and implementation of revised regulatory flow standards.</b>	American River
			Development and implementation of flow fluctuation (i.e., ramping) criteria for operation of Folsom and Nimbus dams.	American River
			Evaluation of dry year pulse flows as a tool to promote outmigration of juvenile salmonids.	American River
			<b>Water conservation actions.</b>	Delta
Manipulation of flow timing.	Delta			
<b>Study options for operations for the Old River barrier.</b>	Delta			
Study flows in the Yolo Bypass and San Joaquin River for potential splittail spawning.	Delta			

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			Study the effectiveness of pulse flows in the San Joaquin system and their relation to potential improvements in survival.	Delta
			Conduct an instream flow study, including all life stages of salmon, for possible anadromous fish use of the lower river.	Calaveras River
			Evaluate feasibility of restoring anadromous fish on lower reaches.	Calaveras River
			Study and provide channel maintenance flows, including adequate coarse sediment supply, and fine sediment transport.	Mokelumne and Calaveras rivers.
			Evaluate conjunctive use possibilities for water supply.	Mokelumne River
			<b>Provide adequate flow (&gt; minimum) for spawning habitat and rearing.</b>	<b>Sacto. River Mainstem - RBDD to Chico Landing</b>
			Convert pumps used in water exchange program from diesel to electrical power source.	Deer Creek, Mill Creek
			Support investigation of Roseville Reclamation Pipeline as a method for increasing flows in the American River, particularly in dry years.	American River
	Entrainment	Unscreened diversions, impingement, diversions not screened to current standards.	<i>Actions targeted at reducing entrainment may include new fish screens, screen rehabilitation, screen improvements, or alternatives to screening. Examples of entrainment related actions include the following.</i>	
		Consolidation or relocation of pts of diversion.	Assess feasibility, prioritize, install, upgrade, and maintain fish screens in order to decrease entrainment. Possible San Joaquin River system screening projects include El Solyo, West Stanislaus, Banta Carbona, and Patterson.	San Joaquin and Sacramento river systems, Susun Marsh, and Delta Eastside Tribs
			Conduct screen options feasibility study (consolidate diversions, construct in-gravel wells).	Sacto. River Mainstem - RBDD to Delta
			Complete fish screens and ladders at Durham-Mutual Dam, Adams Dam, Gorrill Dam, and other locations.	Butte Creek
			Site survey and engineering analysis for remaining diversion structures along lower Butte Creek (including White Mallard fish screen and ladder, and Drumheller Slough outfall culvert reconstruction).	Butte Creek
			Purchase screened portable pumps as alternative to Little Dry Creek Diversion.	Butte Creek
			Fish screen and ladder at Eagle Canyon Diversion.	Battle Creek
			Options and feasibility analysis for additional fish screens, ladders, and a flow allocation methodology above Eagle Canyon.	Battle Creek
			Implement the Daguerre Point Dam Project listed in the spring run chinook report (fish screen, fish ladder, and dam modifications).	Yuba River
			Address problems with unscreened diversions, especially on the Napa River.	North Bay
			Study the biological significance of the effects of any fish entrainment into marsh.	Suisun Marsh

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			Establish annuity/endowment for operation, maintenance, and improvement for existing fish screens.	Suisun Marsh and Delta Eastside Tribs
			Establish a cooperative effort to study and implement screening of diversions, including consolidation of diversions where appropriate and screen maintenance.	Delta and Delta Eastside Tribs
			<b>Change operations and physical facilities at the State and Federal pumps to reduce entrainment.</b>	<b>Delta and Delta Eastside Tribs</b>
			Evaluate possible changes and operations of other diversion facilities to reduce entrainment.	Delta and Delta Eastside Tribs
			Screen and redesign Stockton East diversion .	Calaveras River
			Rehabilitate and enlarge Woodbridge screen bypass pipe.	Mokelumne River
	Migration Barriers and Straying	Migration barriers or delays caused by physical structures, insufficient flow over shallow areas, inadequate attraction flows, adverse water quality conditions, delayed flooding of marshlands, or other factors.	<i>Barriers that preclude or delay migration may be physical structures, water quality constraints, or hydrological conditions. Actions to address these barriers could include bypass arrangements, barrier removal, or other actions such as those cited below.</i>	
			Structure and operation of ACID.	Sacto. River Mainstem - Keswick to RBDD
			Options for passage and reduction of predation at RBDD.	Sacto. River Mainstem - RBDD to Chico Landing
			<b>Evaluation of passage options around Englebright Dam and Reservoir.</b>	<b>Yuba River</b>
			Replace fish ladder at Iron Canyon.	Big Chico Creek
			Install discharge bypass at One Mile Recreation Area.	Big Chico Creek
			<b>Replace fish ladder at One Mile Pool.</b>	<b>Big Chico Creek</b>
			Improve fish passage at Saeltzer Dam.	Clear Creek
			Conduct an options, feasibility, and engineering analysis of fish passage problems and habitat restoration opportunities.	Antelope Creek
			<b>Evaluate feasibility of reintroduction of steelhead above Folsom Dam.</b>	<b>American River</b>
			Plan for the removal of barriers on diked bay lands which block movement of smelt.	North Bay
			Make a plan for the removal of barriers for steelhead passage. (RCD already has documents for this kind of project.)	North Bay
			Put balls on power lines to alert birds.	North Bay
			Erect wildlife passage areas on highways.	North Bay
			Operate the Delta Cross Channel gates to prevent migration delays of fish. Also consider Georgiana Slough modifications.	Delta
			<b>Fund land retirement adjacent to temporary barriers.</b>	<b>Delta</b>
			Evaluate pulse flow effects on fish migration.	Delta

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			Provide dissolved oxygen migration barrier relief through modifications at the head of Old River or other modifications to reduce magnitude or duration of the D.O. barrier.	Delta
			Modifications to Clough Dam.	Mill Creek
			Evaluate feasibility of removing checkdams.	Calaveras and Consumes rivers
			Evaluate habitat above Barrier Falls at Chimney Rock.	Butte Creek
Floodplain and Marshplain Changes	Hydrological isolation of floodplain or marshplain	Lack of flow over floodplains and marshplains, lack of return flow to main channel.	<i>Lack of flow functionally isolates the floodplain from the main channel. Reconnection of the hydrological link can be addressed through a variety of physical or hydrological changes, including the following example actions.</i>	
			Develop a channel and floodplain maintenance policy.	Stanislaus River
			Increase size of drains to the marsh lands along highway 37 to improve drainage.	North Bay
			Conduct Yolo Bypass feasibility of establishing floodplain-like conditions at a lower flow split between the bypass and the river.	Sacto. River Mainstem - Colusa to Delta
			<b>Manage hydrograph to allow maximum overbank flooding within flow peak potential.</b>	<b>Sacto. River Mainstem - RBDD to Chico Landing</b>
			Modify drainage from floodplain or bypass areas to reduce fish stranding.	Delta
	Physical isolation of floodplain or marshplain	Habitat fragmentation, loss of seasonal and tidal wetlands due to levee construction, or other land use changes.	<i>Restoration of floodplain habitat may involve reconnection of the floodplain to the river channel to allow a more natural inundation cycle, or managed flooding of historic floodplain areas. Example actions include the following.</i>	
			Establish setback levees to create shallow water habitat and other priority habitat types. Consider possible adverse trade-offs between habitat types that may be created with setback levees.	Delta
			Create a flood bypass in the southern Delta along the Cosumnes River and on the lower Mokelumne River which keeps the river channel and the floodplain directly connected. Refer to the work of the Levee Technical Committee on this action.	Delta
			Restoration of seasonal and tidal wetlands in the Yolo Bypass.	Delta
			Increase area of flooded agricultural lands. Combine with no net loss of agricultural wetlands that provide foraging habitat for migratory birds.	Delta
			Study and implement expansion of setback levees. Mokelumne River in the vicinity of Highway 99 to the Delta.	Cosumnes, Mokelumne, and Calaveras rivers
			Study the feasibility of reconnecting the incised channel to the floodplain.	Cosumnes River
			Modify levee maintenance practices to enhance habitat.	System-wide

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			Support Habitat Goals Project, including guidance for land acquisition and pilot study efforts.	North Bay
			Expand refuges in the San Joaquin system, including San Joaquin National Wildlife Refuge on the Tuolumne and San Joaquin rivers, and San Luis NWR on the San Joaquin River.	Tuolumne and San Joaquin rivers
			Restore tidal wetlands	Delta, North Bay, Suisun Marsh
			Restore Shaded Riverine Aquatic (SRA) habitat	System-wide
			Restore seasonal floodplain wetlands and managed seasonal wetlands which recreate key values of floodplain wetlands.	System-wide
			Encourage river corridor planning	System-wide
			Reclaim historic floodplain where feasible, within the context of the current flow hydrograph.	Sacto. River Mainstem - Keswick to Colusa
			Restore floodplain function by moving/removing private levees.	Sacto. River Mainstem - Keswick to Chico Landing
			Conserve floodplain through land acquisition or easements, and revise floodplain management to maximize habitat benefits.	Sacto. River Mainstem - RBDD to Chico Landing
			Acquire floodplain easements.	North Bay
			Work with landowners to establish easements or other mechanisms for seasonal wetland habitat creation, and incentive programs to improve value of existing seasonal wetlands.	Delta
	Elimination of fine sediment replenishment	Loss of floodplain and marshplain fine sediment deposition, decreased food production.	<i>Loss of floodplain area can result in diminished nutrient cycling due to a lack of fine sediment deposition in vegetated areas. Other example actions that address floodplain or marshplain inundation will also address this stressor.</i>	
	Land use changes in the floodplain or marshplain	Urbanization, agriculture, grazing.	<i>Actions which encourage habitat friendly changes in the historical floodplain may include land use changes or alterations in land management practices. Example restoration actions related to land use include the following.</i>	
			Fund incentives to increase area of agricultural wetlands and foraging habitat for migratory birds.	Delta
			Fund projects to restore tidal mudflats in shallow water habitat.	Delta
			Fund programs to prevent the loss of tidal mudflats and shallow water habitat.	Delta
			Encourage fish compatible project responses to flood damage.	Butte Creek
			Create aquatic habitat that will be useful for foraging.	Delta
			Conduct a post-flood assessment to consider non-structural alternatives when evaluating repairs to flood damaged areas.	San Joaquin River system and Delta Eastside Tribs

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Channel Form Changes	Alteration of channel form	Loss of shallow water habitat, channel deepening, lack of floodplain, degradation of instream habitat conditions, loss of lotic conditions.	<i>Channel form alterations are generally aimed at restoring natural physical processes within the constraints of a managed system. Projects may include streambed alterations, substrate changes, and floodplain manipulations. Examples include the following.</i>		
			Channel restoration and reconfiguration projects, including gravel pit isolation projects.	Merced, Tuolumne, Stanislaus rivers	
			Conduct project levee or other rock removal/relocation projects.	Sacto. River Mainstem - Chico Landing to Delta	
			Evaluate feasibility of reestablishing an interaction between the river and the floodplain.	Butte Creek	
			Plan and restore wetland/slough complexes including changing elevations in areas within the floodplain and implementing revegetation or other actions where necessary.	American River	
			Acquire land on Napa and Petaluma rivers from willing private land owners, restore floodplain or marshplain areas, and convert land to tidal wetlands. Focus on areas with greatest restoration potential and where future opportunities could be precluded.	North Bay	
			Evaluate restoration of riparian vegetation in areas with existing bank protection, including alternative bank protection measures.	American River	
			Site specific actions to restore channel form.	Butte Creek	
			Restore mid-channel island habitat	Delta	
	Evaluate feasibility of easements and buffer zones in the upper canyons above Hwy. 99.	Butte Creek			
	Prevention of channel meander	Channelization, loss of shallow water habitat and channel complexity, reduced gravel recruitment, riparian encroachment, bank armoring.	<i>Actions which restore channel meander and/or associated natural processes may include protection of existing riparian belts or creation of new riparian areas, increasing channel complexity through structural modification, or the following example actions.</i>		
				Establish setback levees.	North Bay
				Maintain meander belt where presently active, and allow wider meander belt where possible (by land acquisition, discontinuing levee armoring, or other actions).	Sacto. River Mainstem - Keswick to Colusa
				Endorse/partner with ACOE and Rec. Bd. study on re-evaluation of floodplain protection strategy.	Sacto. River Mainstem - Colusa to Delta
				Protect mainstream meander belt as a source of gravel.	Sacto. River Mainstem - Keswick to Chico Landing
Re-establish meander zone.				Cosumnes River	

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	Isolation or elimination of sidechannels and tributaries	Loss of woody debris recruitment, loss of rearing and spawning habitat, loss of refuge habitat, decreased food production.	<i>Actions which restore processes associated with tributaries and sidechannels could include main channel changes, structural modifications to habitat in existing channels, reconnection of isolated channels, and/or the following example actions.</i>		
			Improve rearing habitat by increasing structural complexity.	Sacto. River Mainstem - Keswick to Colusa	
			Focus restoration actions on the American River below Nimbus Dam on designs to improve tailrace habitat, including increased structural complexity.	American River	
	Reduction of gravel recruitment	Loss of spawning habitat, increased gravel armoring.		<i>Gravel recruitment actions may include gravel source identification, spawning gravel acquisition, gravel introduction, spawning gravel improvement projects, or measures to increase natural gravel recruitment. Example actions include the following.</i>	
				Purchase dredger tailings at Merced River Ranch to provide a gravel source for restoration.	Merced River
				Spawning gravel introduction near LaGrange.	Tuolumne River
				Identify gravel sources for restoration.	Stanislaus River
				Coarse sediment deficit/replenishment criteria.	Merced and Stanislaus rivers
				Identify locations to introduce gravel where natural processes (i.e., river flows) can be used to distribute it.	Merced and Tuolumne rivers
				Knights Ferry and Goodwin Canyon gravel replenishment and monitoring.	Stanislaus River
Take actions to protect gravel sources in tributaries.				Sacto. River Mainstem - Keswick to Chico Landing	
Restore and replenish spawning gravel on the North Fork, using natural processes (i.e., river flows) to distribute the gravel.				Battle Creek	
Replenish riverine gravels, monitor gravel movement, and schedule Keswick flow for gravel submergence and redistribution.				Sacto. River Mainstem - Keswick to RBDD	
Channel aggradation due to fine sediments	Accelerated erosion, changes in channel form caused by deposition of fine sediments due to increased sediment loads or decreased sediment transport capacity.		<i>Fine sediment management actions could include site-specific or watershed wide efforts to decrease sediment input, mechanically remove existing sediment, or increase sediment transport capacity. Example actions include the following.</i>		
			Gasberg Creek sediment control.	Tuolumne River	
			Pilot gravel cleaning project.	Tuolumne River	
			Develop and implement a gravel management program to improve spawning habitat.	American River	
			Restore and replace spawning gravels and habitat, using natural processes (i.e., river flows) for gravel distribution.	Mokelumne River	

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			On-farm ag drainage treatment (pilot project).	San Joaquin and Stanislaus rivers
			Sediment management plan for watershed (identify sources).	Merced River
			Pilot gravel ripping study on Stanislaus.	Stanislaus River
			Support and expand existing watershed management efforts by East Stanislaus RCD.	Stanislaus River
			Develop local watershed management efforts through establishment of Tuolumne and Calaveras counties RCD or other appropriate entities.	Tuolumne and Stanislaus rivers
			Increase tributary sediment control.	Sacto. River Mainstem - Keswick to Chico Land.
			Resolve erosion problems identified by watershed planning efforts.	Deer Creek, Mill Creek, and other tributaries
			Implement road related fixes for erosion problems identified by watershed planning efforts.	Deer Creek, Mill Creek, and other tributaries
			Fund recommendations coming out of the local watershed groups.	Battle Creek, Deer Creek, Mill Creek, and other tributaries.
			Identify sources of erosion and develop projects and actions for decreasing erosion.	Battle Creek
			Evaluate flood management practices in Lindo Channel.	Big Chico Creek
			Develop a watershed plan.	Big Chico Creek
			Reestablish channel integrity adversely affected by gravel mining or other activities.	Clear Creek
			Provide assistance to local watershed groups.	Clear Creek
			Erosion control projects.	Clear Creek
			Evaluate feasibility of off-channel and sidechannel restoration.	Yuba River
			Support local watershed analyses, including identification and implementation of restoration actions. Encourage consolidation of local efforts when reasonable.	Antelope, Cow, Cottonwood, and Little Chico creeks
			Support local watershed groups, erosion control education actions, and landowner education efforts.	North Bay
			Conduct studies on erosion containment, transport, and flow dynamics.	North Bay
			Assess and monitor sediment sources and impacts, including sediment source modeling efforts where necessary.	North Bay
			Strengthen enforcement of best management practices on land development and public and private roads.	North Bay
			Fund storm water erosion enforcement.	North Bay
			Facilitate public outreach and discussion with regulators, regulatees, and resource specialists.	North Bay
			Identify lands that have a high potential for mass landslide potential and take early action to prevent erosion.	North Bay
			Conduct watershed assessments that evaluate system-wide problems and restoration activities.	Merced and Stanislaus rivers

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			Channel maintenance flow assessment.	Stanislaus River
	Loss of existing riparian zone or lack of regeneration potential	Loss of food supply, loss of Shaded Riverine Aquatic (SRA) habitat, loss of channel complexity.	<i>Riparian restoration projects could include riparian corridor easements, rehabilitation of riparian areas, riparian protection plans, land use changes, or restoration of adjacent land for buffer zones, foraging, and nesting habitat. Examples include:</i>	
			Assist RCDs to do outreach to land owners for riparian fencing and range land management training.	North Bay
			Fund vegetation and maintenance in riparian urban corridors.	North Bay
			Develop setbacks for every acquisition.	North Bay
			Support vineyard disease research on Pierces disease in a riparian friendly way.	North Bay
			Study the extent of the Napa riparian zone.	North Bay
			Restore vegetation and complexity to the riparian systems to help cool the water and provide protection for steelhead.	North Bay
			Purchase and restore land at Basso Bridge.	Tuolumne River
			Manage post-flood land use for riparian growth.	San Joaquin, Merced, Tuolumne, and Stanislaus rivers
			Riparian restoration and revegetation projects.	San Joaquin, Merced, Tuolumne, and Stanislaus rivers
			Protect, restore, and re-establish SRA where possible.	Sacto. River Mainstem - Keswick to Colusa
			Conduct feasibility study on revegetation of project levees or rocked levees.	Sacto. River Mainstem - Chico Landing to Delta
			Protect/restore riparian forest habitats.	Sacto. River Mainstem - Keswick to Chico Land.
			Protect and restore riparian habitat and reevaluate practice of clearing trees or other cover producing vegetative debris from the river.	American River
			Restore and increase riparian vegetation by re-establishing and revegetating riparian areas and corridors.	Deer, Mill and Big Chico creeks; Feather and Yuba rivers and Delta Eastside Tribs
			Initiate a replanting program for cottonwood, valley oak, and other large riparian species.	Delta Eastside Tribs
			Implement a landowner education program on impacts of land management activities on SRA.	Delta Eastside Tribs
Water Quality	Increased Contaminants	Acute or chronic toxicity caused by urban runoff, agricultural runoff, mine drainage, refineries, wastewater treatment plants, and other point or non-point pollution sources.	<i>Contaminant control actions may include identification of pollutant sources, evaluation of effects, remediation, monitoring, or education in order to identify and reduce impacts on salmonids and other resources. Example actions include the following.</i>	

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			Expand Real-time Water Quality Management Network	San Joaquin, Merced, Tuolumne, and Stanislaus rivers
			Establish a comprehensive water quality monitoring and assessment program to identify problems and assess the effectiveness of corrective measures.	Delta, Suisun Marsh, North Bay, Delta Eastside Tribs, San Joaquin River system
			Establish the ecosystem significance of pesticides in the Sacto. and SJ rivers and Delta from surface ag drainage, and undertake actions as appropriate to prevent, treat, or otherwise reduce impacts including public education and similar activities.	Sacramento and San Joaquin river systems, Delta
			Inventory urban stormwater drains, establish the ecosystem significance of nutrients, salinity, turbidity, oxygen demand, and metals in runoff. Undertake actions as appropriate to prevent, treat, or otherwise reduce impacts including education, etc.	Sacramento and San Joaquin river systems, Delta
			Establish the ecosystem significance of copper, zinc, and cadmium in the Sacto River above Hamilton City from active or inactive mines, and undertake action as appropriate to prevent, treat, or otherwise reduce impacts.	Sacramento River Mainstem
			Establish the ecosystem significance of selenium in the San Joaquin River and Delta from subsurface ag drainage in the Grasslands area, and undertake action as appropriate to prevent, treat, or otherwise reduce impacts.	San Joaquin River and Delta
			Establish the ecosystem significance of mercury from active or inactive mines and gold mining activities, and undertake action as appropriate to prevent, treat, or otherwise reduce impacts.	Sacramento and San Joaquin River systems, Delta Eastside Tribs
			Coordinate watershed water quality activities related to toxic contaminant reduction, and develop watershed-wide solutions to water quality problems affecting the ecosystem.	System-wide
			Incorporate Tuolumne model with RTWQMN.	Tuolumne River
			Non-point source agricultural runoff: use BMPs, expand riparian buffer zone.	Sacto. River Mainstem - RBDD to Delta
			Establish the ecosystem significance of agricultural chemicals in the Colusa Drain and undertake management actions as appropriate.	Sacto. River Mainstem - Colusa to Delta
			Develop a toxic spill contingency plan for highways near sensitive resources..	Deer Creek, other locations
			Evaluate need to fund pathogen control for private aquacultural facilities. Review status with CVPIA programs.	Battle Creek
			Negotiate cooperative agreement with refineries to reduce selenium.	Suisun Marsh
			Expand and broaden BIOS program funded under Category III.	Delta, Suisun Marsh, and Delta Eastside Tribs
	Increased Salinity	Increased salinity due to water management, operation of diversions or structures, runoff, etc.	<i>Actions to decrease salinity in freshwater areas could include revised land use practices, flow alterations, runoff control, or other measures. Examples include the following.</i>	

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			Encourage farm management actions to reduce irrigation runoff, focusing on high salinity load areas.	Delta, San Joaquin system
			Determine alternative methods for discharging salts back into bay from salt ponds in order to restore areas to tidal wetlands.	North Bay
			Develop physical infrastructure to remove salt (if necessary) in order to restore areas to tidal wetlands.	North Bay
	Increased Nutrient or Carbon Input	Increased input of nutrients from ag runoff, wastewater treatment, and other sources. Includes low dissolved oxygen conditions.	Actions which limit the deleterious input of large quantities of natural nutrients may include ag runoff control, wastewater treatment, flow management in critical areas, or other measures.	
	Increased Mobilization of Contaminants due to Dredging	Increased turbidity, contaminant mobilization, dredge spoil disposal.	Dredging related actions may address methods for controlling turbidity effects, preventing mobilization of toxic compounds, facilitating safe dredge spoil disposal, developing beneficial uses for dredge spoil, or improving associated regulatory processes.	
			Assess and consider streamlined regulatory process and permit coordination on dredging to facilitate maintenance dredging.	Delta Eastside Tribes
Water Temperature		High water temperatures due to lack of riparian shade, lack of flow, increased surface area, warm water inflow, or other factors.	Water temperature related actions not included in other restoration categories may include increased modeling or monitoring work, and evaluation of additional temperature management options. Examples of actions include the following.	
			Change water management practices in Grasslands Water District to benefit water temperatures in March and April.	San Joaquin River
			Take actions to ease water demand from New Melones to dilute agricultural drainage so that additional carryover storage is available for temperature management.	Stanislaus River
			Temperature management feasibility studies, models, and operations development.	Merced and Stanislaus rivers
			Install and operate a Folsom Temperature Control Device (TCD) to preserve a coldwater pool for use in downstream water temperature control.	American River
			Develop Folsom Reservoir Cold Water Pool Management protocol to optimize operations of reconfigured shutters on outlet and Folsom TCD, and provide necessary information on thermal characteristics of Folsom Reservoir and Lake Natoma.	American River
			Investigate possible utilization of deep pool thermal refugia by juvenile steelhead, and effects of flow fluctuations on these	American River
			Conduct a pilot flow study to model relationship between flow and water temperature.	Clear Creek
			Evaluate options for addressing Colusa Drain water temperature effects on the Sacramento River.	Sacto. River Mainstem, Colusa to Delta
			Evaluate potential temperature benefits of increasing SRA habitat in the Delta.	Delta
			Evaluate the effect of a water temperature control device at Englebright Dam.	Yuba River

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Undesirable Species Interactions	Introduction of new exotic species	Introduction of exotic species from ballast water, inadvertent release of exotic species, intentional introduction of species for other reasons.	<i>Actions which address introduction of exotic species may be regulatory or educational in nature, and may include specific actions aimed at preventing new exotic species introductions. Example restoration actions include the following.</i>	
			Establish education programs regarding existing exotic species problems and the need to prevent future exotic species introductions.	System-wide
			Implement a program to prevent introduction of exotic species into areas that are currently supporting native species.	System-wide
			Provide additional resources to increase the enforcement of ballast discharge regulations in areas where introduction of exotic species is a risk.	Delta
			Provide additional zebra mussel control (refer to the California Task Force for zebra mussel control).	Delta
			Establish exotic species control programs in tidal and seasonal wetlands.	Suisun Marsh
	Elevated predation/competition losses	Striped bass predation, other introduced predatory species, competition for nest sites by introduced bird species, competition for food resources by introduced fish or mollusk species. etc.	<i>Predator or competitor control actions may include control or eradication programs, habitat modifications to decrease unnaturally high predation, or research projects related to exotic species control. Example actions include the following.</i>	
			Investigate potential for physical removal of predators from gravel pits, including an assessment of impacts on salmon	Merced, Tuolumne, and Stanislaus rivers
			Evaluate the magnitude of predation problems and potential restoration actions to decrease predation in areas with unnaturally high predation mortality.	Sacto. River Mainstem - RBDD to Delta
			Fund studies to better understand the biology of exotic species in order to support control or eradication efforts.	Delta
			Fund additional study of the effects of striped bass on salmonid species.	Delta
			Form a group of cooperating entities into an exotic species "SWAT" team who can target individual species for control efforts over a broad geographical area.	Delta and Suisun Marsh
			Study the effects of inland silverside predation on delta smelt.	Delta
			Prioritize and implement programs for Asian clams, Chinese mitten crabs, and all other exotic species.	Suisun Marsh
Establish control program for inland silversides and yellow perch (see similar Delta actions).	Suisun Marsh			
Conduct research to determine effects, distribution, and best control methods for introduced exotic species.	North Bay			
Fund pilot exotic species eradication programs.	North Bay			
Community education and manuals to help homeowners to identify and remove exotic species.	North Bay			
Develop a control strategy for red fox.	North Bay			

Attachment 5: Stressors and Example Restoration Actions

Stressor Categories	Stressor Subcategories	Description of Stressors	Example Restoration Actions	Location
			Establish a trapping program for brown headed cowbirds and starlings which compete with native species in riparian areas.	Delta
	Competition from introduced plants	Invasive aquatic plants such as Hydrilla, invasive riparian zone plants such as Arundo, invasive salt marsh plants.	<i>Minimizing deleterious impacts from exotic plant species may involve control efforts, eradication programs, education programs, or other measures . Example actions include the following</i>	
			Remove non-native plants from the riparian zone, re-establish natives.	Sacto. River Mainstem
			Implement projects to reclaim priority habitats from exotic plant species.	Delta
Adverse Fish and Wildlife Harvest Impacts		Ocean and freshwater overharvest, poaching, inadequate fishing regulations,	<i>Potential restoration actions may be related to either legal or illegal harvest, and could include research projects, increased law enforcement, modified angling regulations, or improved management tools or techniques. Example actions include:</i>	
			Implement a programmatic approach to strategically increasing law enforcement and assessing the effectiveness of the efforts.	San Joaquin River system and Sacto. River tributaries
			<b>Modify angling regulations.</b>	San Joaquin (below Merced), Merced, Tuolumne, and Stanislaus rivers
			Develop feasible, cost-effective techniques to decrease effects of ocean harvest on wild stocks.	Ocean
			Estimate rate of repeat hookings, in order to better estimate hooking mortality effects at the population level for salmon subject to harvest management.	Ocean
			Estimate ocean distribution of spring-run to assist with ocean harvest management.	Ocean
			Evaluate cost effective mass marking techniques	System wide
			<b>Evaluate and/or revise angling regulations.</b>	American River
Population Management		Migratory pathway changes, inadequate reproductive capacity due to small or non-existent spawning populations.	<i>Population management actions could include genetic investigations related to wild stocks; actions to improve monitoring, sampling, or management of stocks; and establishing or supplementing salmon populations. Example actions include the following</i>	
			Eliminate inappropriate attraction flow.	Sacto. River Mainstem - Keswick to Chick Landing
			Evaluate need to establish founding population of spring run.	Battle Creek, Clear Creek
			Provide input to genetic monitoring of the fish population.	Big Chico Creek
			Evaluate potential for creating more separation of fall and spring-run spawning habitat to reduce or eliminate hybridization.	Yuba River
			Improve estimation of number of returning adult salmon through use of counting structures, hydroacoustics, or other methods.	San Joaquin (below Merced), Merced, Tuolumne, Stanislaus

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Attachment 5: Stressors and Example Restoration Actions

Stressor Categories	Stressor Subcategories	Description of Stressors	Example Restoration Actions	Location
			Scale analysis and otolith evaluation for racial and age composition of chinook salmon.	San Joaquin (below Merced), Merced, Tuolumne, and Stanislaus rivers
			Smolt mortality study.	Stanislaus River
			Verification and calibration of screw-trap estimates of Stan. River outmigrants: Feasibility of using hydroacoustics for smolt survival.	Stanislaus River
			Develop techniques and equipment to sample outmigrants at high flows.	System wide
			Evaluate relative survival rates for smolts and fry during outmigration.	System wide
			Purchase Hills Ferry Barrier land to ensure access and reduce straying.	San Joaquin, Merced, Tuolumne, and Stanislaus rivers
Land Use	Grazing	Loss of riparian habitat, increased erosion, decreased water quality.	<i>Actions addressing problems related to grazing may include land use changes, fencing, erosion control projects, development of easements, water quality control actions, watershed planning and management, or other measures.</i>	
	Gravel mining	Decreased gravel recruitment, increased fine sediments, channel instability,	<i>Actions addressing impacts associated with gravel mining could include channel stabilization measures, spawning gravel augmentation, erosion control measures, land use changes, alteration of mining practices, preventing gravel pit capture, etc.</i>	
	Urbanization	Urbanization of the watershed that leads to loss of riparian habitat, habitat fragmentation, wetland drainage, and other impacts.	<i>Restoration measures aimed at urbanization impacts may be regulatory, educational, planning oriented, or related to land acquisition. Example actions include the following.</i>	
			Educate local governments on the value of natural habitat and improved planning to protect these areas. Help local governments develop appropriate tools for protecting important habitat areas.	System-wide
			Model planned buildout based on master planning at UC Berkeley Urban Planning Institute.	North Bay
			Identify way to preserve land with less than fee acquisition.	System-wide
			Present riparian core areas as amenities and educate developers to their value.	System-wide
			Evaluate feasibility and appropriateness of restoration/enhancement opportunities which could complement any mitigation for other projects such as bank protection work by SAFCA.	American River
			Develop a monitoring plan for enhancement measures in the American River, including biological and physical/chemical sampling.	American River

Attachment 5: Stressors and Example Restoration Actions

Stressor Categories	Stressor Subcategories	Description of Stressors	Example Restoration Actions	Location
			Establish a consultation and technical assistance team of fisheries and water resources experts to identify, guide, and oversee restoration actions and enhancement measures on the American River.	American River
	Forestry and agricultural practices	Forestry and agricultural practices in the watershed that lead to conversion of floodplain to ag use, subsidence, increased erosion, loss of habitat complexity, and water quality degradation.	<p><i>Restoration actions related to these processes may be site-specific or watershed wide, and may include planning efforts, educational programs, acquiring easements or buffer zones, or developing technical management practices. Example actions include:</i></p> <p><b>Encourage USFS, CDF, and BLM to be part of the overall CALFED effort on a programmatic level.</b></p> <p><b>Improve agency and public education on forestry issues on a programmatic level.</b></p> <p><b>Coordinate forestry agency management plans with other agencies and conservancies.</b></p> <p>Fund local conservancy or other planning efforts to develop watershed plans to improve watershed health.</p> <p>Encourage continued outreach activities with agricultural interests.</p> <p>Fund watershed plan and conservation easements.</p> <p>Encourage coordination between local groups, Park Service, BLM, and USFS.</p> <p>Provide buffer zones around habitat restoration areas.</p> <p>Public education on Best Management Practices (BMP) approach to development.</p> <p>Support local efforts for sustainable agriculture.</p> <p>Match funding for private landowner actions (for example, "Partners for Wildlife").</p> <p>Support demonstration farm sites.</p> <p>Develop a GIS database of habitat and fluvial elements for Stanislaus.</p> <p>Prioritize areas for use of dredge material or other mechanisms on subsided islands (refer to the work of the Levee Technical Committee).</p> <p>Fund a cooperative effort with landowners to restore areas adjacent to Suisun Bay entrapment zone to tidal action. This action would address subsidence issues.</p> <p>Analyze potential changes in the maintenance of Suisun Marsh to provide habitat for fish species. The project would also address land subsidence issues. This would be a cooperative pilot project with a monitoring component.</p>	<p>Deer and Mill creeks</p> <p>Deer and Mill creeks</p> <p>Deer and Mill creeks</p> <p>Deer, Mill, Butte Creeks</p> <p>Butte Creek</p> <p>Butte Creek</p> <p>Clear Creek</p> <p>North Bay</p> <p>System-wide</p> <p>North Bay</p> <p>North Bay</p> <p>North Bay</p> <p>Stanislaus River</p> <p>Delta</p> <p>Suisun Marsh</p> <p>Suisun Marsh</p>

Attachment 5: Stressors and Example Restoration Actions

Stressor Categories	Stressor Subcategories	Description of Stressors	Example Restoration Actions	Location
Artificial Propagation of Fish		Genetic changes due to hatchery management, hybridization, altered timing of runs, effects of smolt releases on wild populations, introduction of pathogens, incidental spring run mortality, increased striped bass populations, and other factors	<i>Restoration actions related to artificial propagation could include evaluation of existing hatchery operations, assessment of new hatchery needs, or studies of hatchery impacts and benefits. Example actions include the following.</i>	
			Implement an interim artificial propagation program to provide smolts for study or research purposes.	San Joaquin (below Merced), Merced, Tuolumne, and Stanislaus rivers
			Hatchery fish marking program.	Merced River
			Develop a hatchery strategy for the SJR.	San Joaquin, Merced, Tuolumne, and Stanislaus rivers
			Review and revise operation plan for Merced River Fish Facility.	Merced River
			<b>Tuolumne River Hatchery Plan.</b>	<b>Tuolumne River</b>
			Hatchery operation modification.	Sacto. River Mainstem - Keswick to Chico Landing
			Evaluate options to provide an isolated water supply for Coleman National Fish Hatchery.	Battle Creek
			Evaluate Battle Creek plan (AFRP).	Battle Creek
			Evaluate hatchery practices at Feather River Hatchery.	Feather River
Climate		Global warming and ocean conditions.	<i>Actions related to climate change or ocean conditions may include development of resource management responses to minimize adverse impacts on fish and wildlife resources, or development of other predictive or response tools.</i>	
Human Disturbance		Direct disturbance of fish and wildlife populations or habitat by anglers, boaters, and other recreational users.	<i>Restoration actions can be made more effective by implementing associated education projects to increase overall public awareness or to target particular audiences to modify behavior. Example actions include the following:</i>	
			<b>Tuolumne River Environmental Education Center.</b>	<b>Tuolumne River</b>
			<b>Tuolumne River Interpretive Center Conceptual Plan.</b>	<b>Tuolumne River</b>
			<b>Resources education program.</b>	<b>San Joaquin, Merced, Tuolumne, and Stanislaus rivers</b>
			Public and angler education programs.	San Joaquin, Merced, Tuolumne, and Stanislaus rivers
			Educate public and enforce boat speed in critical areas to prevent bank erosion.	North Bay
Apply biotechnology techniques to prevent bank erosion.	North Bay			

Attachment 5: Stressors and Example Restoration Actions

Stressor Categories	Stressor Subcategories	Description of Stressors	Example Restoration Actions	Location
			Information sharing network for the San Joaquin watershed.	San Joaquin, Merced, Tuolumne, and Stanislaus rivers
Wildfire		Habitat management through use of fire; increased frequency of fire near urban areas.	<p><i>Restoration actions related to fire management may include development of alternatives to use of fire for levee maintenance, and control of fire within riparian corridors (particularly in urban areas).</i></p> <p>Fire management along the parkway to decrease loss of riparian vegetation due to human-caused fires.</p>	American River