FALL-RUN CHINOOK ADULT UPSTREAM MIGRATION

PREFERRED CONDITION (Late Sep-Dec; Entire LSR below GDW)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Instream Flow (depth and velocity)	> 0.78 ft.; ≤ 7.9 ft/s[a]	Entire LSR below GDW	Assumed within range[b]	Late Sep-Dec	100%	-	-	-	-	**None**
Instream Flow (attraction)	See table for Fall-run Chinook Adult Upstream Migration in the San Joaquin River and Delta									
Water Temperature	< 59°F [c]	GDW to KF	48.8°F-58.8°F[d]	Late Sep-Dec	100%	-	-	-	-	**None**
		OBB to Oakdale	48.1°F-67.1°F	Late Sep Oct Nov-Dec	18.2% 61.2% 100%	Late Sep Oct -	81.8% 38.8% -	- Physiological stress - Egg mortality -Developmental defects - Small eggs and alevins	**-Reservoir operations** and/or seasonally high ambient air temperatures	**L[e]**
		McHenry to Caswell	45.5°F-74.5°F	- Oct Nov-Dec	- 34.8% 99.9%	Late Sep Oct Nov-Dec	100% 65.2% 0.1%			
Dissolved Oxygen	≥ 7 mg/L[f]	Ripon[g]	4.5-12.2 mg/L[h]	Late Sep-Dec	98.5%	Late Sep-Dec during run-off events or pulse flows [g]	1.5%	-Physiological stress	-High turbidity and/or contaminants from storm runoff from urban development (especially below KF) and agricultural land use (low impact below GDW) - **Reservoir operations** and/or other unknown factors	**L**

[a] Allen and Hassler 1986.

[b] Based on flow release from Goodwin Dam, flows assumed to be within preferred range in most, if not all of river.

[c] Physiological stress for adults may occur between 59°F and 68°F (Marine and Cech 1992); poor egg viability > 60°F (Hinze 1959); lethality at 80.6 °F (Cramer and Hammack 1952; CDFG 1998b).

[d] 7-day moving average of daily maximum water temperatures at Caswell, OBB, Oakdale, McHenry, Caswell, GDW, and KF, January 1998-August 2005.

[e] Based on daily weir counts from 2003, 2004, and 2005, approximately 5% or less of the run migrates prior to October 1. Specifically, 5.1% (n=245) migrated during September 2003, 1.7% (n=74) during September 2004, and 3.1% (n=113) during September 2005.

[f] Minimum DO objective for Stanislaus River according to Basin Plan is 7 mg/L (CRWQCB 2004).

[g] Ripon is the only location where continuous DO readings are recorded. DO levels are potentially higher (i.e., more suitable) further upstream due to lower temperatures and/or increased turbulence from higher gradient.

[h] Daily minimum DO at Ripon, 1999-2004.

FALL-RUN CHINOOK ADULT UPSTREAM MIGRATION

PREFERRED CONDITION (Late Sep-Dec; Entire LSR below GDW)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Water Clarity	<547 NTU[i]	Weir[j]	0.1 – 33.0 NTU	Late Sep-Dec	100%	-	-	-	-	None
Passage (unobstructed)	No structural barriers	Below Goodwin Dam	Passage barrier (GDW) above historical fall-run spawning area at RM 58.3	Late Sep-Dec	100%	-	-	-	-	None
Harvest	Zero to moderate legal harvest	Entire LSR below GDW	Moderate legal harvest late Sep-Oct (i.e., one salmon bag limit below HWY 120 and zero bag limit above[k]); no fishing Nov-Dec; unknown rate of poaching[l]	Late Sep-Oct[m]	Unknown proportion of adults	Late Sep-Dec	Unknown proportion of adults	- Excessive harvest and/or pre-spawning mortality - Genetic loss - Reduced nutrient inputs from spawned adult salmon	-Illegal harvest	Unknown
Disease	Zero to low level pathogens	Entire LSR below GDW	No evidence of disease[n]	Unknown	Unknown	Unknown	Unknown	- Physiological stress - Pre-spawn mortality	- Increased susceptibility due to high water temperatures resulting from **reservoir operations** and/or seasonally high ambient air temperatures	**Unknown**

[i] Avoidance behavior was documented for adult Chinook salmon in Washington when total suspended sediment concentrations (TSS) were 350 mg/l (547 NTU; Brannon and others 1981 as cited in Bash and others 2001). NTU= (TSS-10.7)/0.62

[j] Instantaneous daily turbidity measurements recorded at the Stanislaus River Weir, 2003-2005.

[k] CDFG 2005 Freshwater Sportfishing Regulations Booklet, effective March 1, 2005 to February 28, 2006.

[l] Poaching is defined as harvest by illegal methods (i.e., traps, nets, spears), in closed reaches or during closed seasons, or in excess of stated bag limits.

[m] Regulated harvest is believed to have no impact since the number of spawners in recent years (i.e., since 1998) exceeds the apparent spawning capacity of approximately 2,540 Chinook or 1,270 spawning pairs (see Fall-run Chinook Spawning table).

[n] Pathological evaluations have only been conducted on juvenile Chinook salmon in the Stanislaus River and not on adults. *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease, was the only pathogen detected in juveniles caught in rotary screw traps; however, no gross clinical signs of BKD were seen in any of the fish examined (Nichols and Foott 2002). The absence of clinical signs of infection in juveniles, combined with a low occurrence of adult pre-spawn mortality suggests that pathogen levels during adult upstream migration are not likely to be outside of preferred range.

FALL-RUN CHINOOK ADULT UPSTREAM MIGRATION

PREFERRED CONDITION (Late Sep-Dec; Entire LSR below GDW)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Contaminants	Zero to low level contaminants	At or near Ripon[o]	No data collected during the upstream migration period; limited sampling has been conducted near Ripon between Jan-Aug[p]	Unknown	Unknown	Unknown	Unknown	- Physiological stress - Pre-spawning mortality	- Stormwater discharge - Illegal waste disposal -Ag return discharge - Streamside land use practices including pesticide application	Unknown

[o] Data collected at Ripon near Patterson during June 1994 (Brown and others 2004) or at Caswell State Park near Ripon during January-February 2001 (Zamora and others 2003; Brown and others 2004) and April-August 2001(Domagalski and Munday 2003).

[p] Limited studies of contaminants have been conducted in the Stanislaus River near Ripon. Readily available data were obtained from studies conducted during June 1994 (Brown and others 2004), January-February 2001 (Zamora and others 2003; Brown and others 2004), and April-August 2001 (Domagalski and Munday 2003). Since these studies targeted periods coinciding with agricultural pesticide use in the winter through summer, it is anticipated that levels during Oct-Dec would be similar or potentially lower than those identified under incubation, rearing, and juvenile migration sections.

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FALL-RUN CHINOOK SPAWNING

PREFERRED CONDITION (Oct-Dec; GDW to RB)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Instream Flow (depth and velocity)	0.5-20 ft; 1.0-3.5 ft/s[a]	GDW to RB	Assumed within range[b]	Oct-Dec	100%	-	-	-	-	**None**
Water Temperature	< 57°F [c]	GDW	48.8°F-56.9°F	Oct-Dec	100%	-	-	-	-	**None**
		KF	48.8°F-58.6°F	Oct Nov-Dec	74.7% 100%	Oct	25.3%	-Physiological stress -Reduced egg viability	-**Reservoir ops** and/or seasonally high ambient air temperatures	**L**
		OBB to Oakdale	48.1°F -63.9°F	Oct Nov-Dec	40.7% 99.6%	Oct Nov-Dec	59.3% 0.4%			
Dissolved Oxygen	≥ 7 mg/L[d]	Ripon[e]	4.5-12.2 mg/l[f]	Oct-Dec	98.5%	Oct-Dec during run-off events or pulse flows	1.5%	-Physiological stress	-High turbidity and/or contaminants associated with storm runoff from urban development (especially below KF) and agricultural land use (low impact below GDW) - **Reservoir operations** and/or other unknown factors	**None-L**

[a] CDFG 1998b; Puckett and Hinton 1974.

[b] Based on flow release from Goodwin Dam, flows assumed to be within suitable range in most, if not all of the river.

[c] Water temperatures >57°F considered stressful (FERC 1996; Reiser and Bjornn 1979).

[d] Minimum DO objective for Stanislaus River according to Basin Plan is 7 mg/L (CRWQCB 2004).

[e] Ripon is the only location where continuous DO readings are recorded. DO levels are potentially higher (i.e., more suitable) further upstream, particularly in the spawning reach, due to lower temperatures and/or increased turbulence from higher gradient.

[f] Daily minimum DO at Ripon, 1999-2004.

FALL-RUN CHINOOK SPAWNING

PREFERRED CONDITION (Oct-Dec; GDW to RB)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Water Clarity	<547 NTU[g]	Weir[h]	0.1 – 33.0 NTU	Late Sep-Dec	100%	-	-	-	-	None
Gravel Quantity	At least 24 yds^2 to support per spawning pair[i]	GDW to RB	30,489 yds^2 of suitable spawning area in 2000[j]; can support 1,270 spawning pairs	When escapement is less than or equal to 1,270 spawning pairs	42.9% of years post CVPIA (i.e., 1992 to 1997)	When escapement exceeds 1,270 spawning pairs	57.1% of years post CVPIA (i.e., 1998 to 2005)	- Redd superimposition -CVPIA doubling goal not supported[k]	- Spawning gravel between GDW and RB decreased 33% from 1961 to 1972 and 40% from 1972 to 1993[l] - 40% of channel dredged GDW-OBB[m] - **Recruitment reduced by dams; reduced transport flows**; changes in streamside land use; riparian encroachment.	**H**
Gravel Quality	0.5 inches to 4.02 inches in diameter[n]	GDW to RB	25-40+% riffles armored[o]; unknown proportion of riffles cemented due to embeddedness.	-	60-75% riffles not armored	-	25-40+% riffles armored; unknown proportion of riffles cemented due to embeddedness	- Armoring -Embeddedness - Redd superimposition	- **Recruitment reduced by dams; Infrequent bed mobilization (reduced transport flows)[p]** - Floodplain loss[jp]	**H**

[g] Avoidance behavior was documented for adult Chinook salmon in Washington when total suspended sediment concentrations (TSS) were 350 mg/l (547 NTU; Brannon and others 1981 as cited in Bash and others 2001). NTU= (TSS-10.7)/0.62

[h] Instantaneous daily turbidity measurements recorded at the Stanislaus River Weir, 2003-2005.

[i] Burner 1951.

[j] Kondolf and others 2001.

[k] CVPIA doubling goal for the Stanislaus River is 22,000 adult salmon produced or roughly 11,000 individuals (5,500 pairs) assuming 50% harvest.

[l] CDFG 1972. DWR 1994.

[m] Appendix 2 prepared by Carl Mesick Consultants 2003.

[n] Bell 1973, as cited in Reiser and Bjornn 1979.

[o] CMC and others 1996 reported 25% of riffles armored (i.e., consisting of cobble or bedrock rather than gravel); however, surveys conducted by Mesick during 2002 indicate that this estimate increased to at least 40% as a result of high flows in 1997 and 1998 (Carl Mesick, personal communication, 2005). The term "armored" is used to here to describe riffles where the surface layer of the streambed is covered by bedrock or large rocks which are too difficult for adults to move. The term "cemented" is used here to describe riffles that are highly embedded with sediment, especially sand, which pieces tightly (embeds) into spaces between stones and gravels in the river bed.

[p] McBain and Trush 2003.

FALL-RUN CHINOOK SPAWNING

PREFERRED CONDITION (Oct-Dec; GDW to RB)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Escape Cover	Overhanging or submerged vegetation, undercut bank, floating debris, submerged objects (e.g., logs and rocks), water depth, and turbulence[q]	GDW to RB	Unknown[r]	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Harvest	Zero to moderate legal harvest	GDW to RB	Moderate legal harvest Oct (i.e., one salmon bag limit below HWY 120 and zero bag limit above[s]); no fishing Nov-Dec; and unknown rate of poaching[t]	Oct- Dec	Unknown proportion of adults	Oct- Dec	Unknown proportion of adults	- Excessive harvest - Pre-spawning mortality - Genetic loss - Reduced nutrient inputs from spawned adult salmon	-Illegal harvest	None
Disease	Zero to low level pathogens	GDW to RB	No evidence of disease[u]	Unknown	Unknown	Unknown	Unknown	-Physiological stress -Reduced egg viability	- Increased susceptibility due to high water temperatures resulting from **reservoir operations** and/or seasonally high ambient air temperatures	**Unknown**

[q] Giger 1973 as cited in Reiser and Bjornn 1979.

[r] No surveys have been conducted to quantify escape cover.

[s] CDFG 2005 Freshwater Sportfishing Regulations Booklet, effective March 1, 2005 to February 28, 2006.

[t] Poaching is defined as harvest by illegal methods (i.e., traps, nets, spears), in closed reaches or during closed seasons, or in excess of stated bag limits.

[u] Pathological evaluations have only been conducted on juvenile Chinook salmon in the Stanislaus River and not on adults. *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease, was the only pathogen detected in juveniles caught in rotary screw traps; however, no gross clinical signs of BKD were seen in any of the fish examined ((Nichols and Foott 2002). The absence of clinical signs of infection in juveniles, combined with a low occurrence of adult pre-spawn mortality suggests that pathogen levels during spawning are not likely outside of the preferred range.

FALL-RUN CHINOOK SPAWNING

PREFERRED CONDITION (Oct-Dec; GDW to RB)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Contaminants	Zero to low level contaminants	At or near Ripon[v]	No data collected during the upstream migration period; limited sampling has been conducted near Ripon between Jan-Aug[w]	Unknown	Unknown	Unknown	Unknown	- Physiological stress - Pre-spawning mortality	- Stormwater discharge - Illegal waste disposal -Ag return discharge - Streamside land use practices including pesticide application	Unknown
Intra-race Reproduction	Segregation of races	GDW to RB	Unknown but likely low[x]	Mid Oct-Dec	100%	Early to mid-Oct	Unknown	-Hybridization	- Temporal overlap between spring-run and fall-run Chinook spawning **- Dams block access to spring run spawning habitat resulting in loss of geographic segregation of spawning areas**	**L**

[v] Data collected at Ripon near Patterson during June 1994 (Brown and others 2004) or at Caswell State Park near Ripon during January-February 2001 (Zamora and others 2003; Brown and others 2004) and April-August 2001(Domagalski and Munday 2003).

[w] Limited studies of contaminants have been conducted in the Stanislaus River near Ripon. Readily available data were obtained from studies conducted during June 1994 (Brown and others 2004), January-February 2001 (Zamora and others 2003; Brown and others 2004), and April-August 2001 (Domagalski and Munday 2003). Since these studies targeted periods coinciding with agricultural pesticide use in the winter through summer, it is anticipated that levels during Oct-Dec would be similar or potentially lower than those identified under incubation, rearing, and juvenile migration sections.

[x] Few "spring" run have been observed in the river during the summer months, so the likelihood of interbreeding with fall-run is low.

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FALL-RUN CHINOOK INCUBATION

PREFERRED CONDITION (Oct-Mar; GDW to RB)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Instream Flow	Flowing water (i.e., no dewatering of redds); no scouring flows (i.e., >5,000 cfs)[a]	GDW to RB	100 cfs - 8,270 cfs at OBB between 1984 and 2005; Generally <1,500 cfs	Oct-Dec	99.8%	Late Dec	0.2%	-	-	**None**
				Jan-Mar	94.6%	Jan-Mar	5.4%	-Pre-emergent mortality	-**Reservoir operations** for flood control	**L**
Water Temperature	<58°F [b]	GDW to KF	48.2°F-58.6°F	Oct-Mar	99.4%	Early Oct	0.6%	-	-	**None**
		OBB to Oakdale	47.9°F-63.9°F	Nov-Feb Oct Mar	100% 50.8% 88.6%	- Oct Mar	- 49.2% 11.4%	-Physiological stress -Pre-emergent mortality	-**Reservoir operations** and/or seasonally high ambient air temperatures	**L**
Dissolved Oxygen	≥7 mg/L[c]	Ripon[d]	0-13.0 mg/L[g]	Oct-Mar	96.9%	Oct-Mar during run-off events or pulse flows	2.7%	-Physiological stress -Pre-emergent mortality	-High turbidity and/or contaminants associated with storm runoff from urban development (especially below KF) and agricultural land use (low impact below GDW) - **Reservoir operations** and/or other unknown factors	**None-L**
						Oct-Mar[e]	0.4%			

[a] Bed mobilization estimated to occur at flows in excess of 5,000 to 8,000 cfs (Kondolf and others 2001).

[b] Reduced viability and increased mortality at temperatures >58°F, and 100% mortality >65° F (Seymour 1956; Boles and others 1988).

[c] Minimum DO objective for Stanislaus River according to Basin Plan is 7 mg/L (CRWQCB 2004).

[d] Ripon is the only location where continuous DO readings are recorded. DO levels are potentially higher (i.e., more suitable) further upstream, particularly in the incubation reach, due to lower temperatures and/or increased turbulence from higher gradient.

[e] Short periods unrelated to run-off events, pulse flows, or any other readily apparent cause.

FALL-RUN CHINOOK INCUBATION

PREFERRED CONDITION (Oct-Mar; GDW to RB)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Gravel Quantity	At least 24 yds^2 to support one redd[f]	GDW to RB	30,489 yds^2 of suitable spawning/ incubation area in 2000[g]; can support 1,270 redds	When there are fewer than 1,270 redds	42.9% of years post CVPIA (i.e., 1992 to 1997)[h]	When the number of redds exceeds 1,270	57.1% of years post CVPIA (i.e., 1998 to 2005)	- Redd superimposition -CVPIA doubling goal not supported[i]	- Incubation area (gravel) from GDW to RB decreased 33% from 1961 to 1972 and 40% from 1972 to 1993[j] - 40% of channel dredged from GDW to OBB[k] - **Recruitment/transport reduced by dams, altered flows**, changes in streamside land use, and encroachment.	**H**
Gravel Quality	1"-4" diameter; <15% fines of <1mm (incubation)	GDW to RB	0.1-33.4% fines that are <1mm[l]	When there is no fine sediment re-suspension due to spawning activities (i.e., Jan-Mar) and when flows are low and there is no run-off	<50% of incubation time period[m]	When fine sediments are re-suspended during spawning activities (i.e., Oct-Dec) and/or turbid conditions occur from high flows or run-off events	>50%of incubation time period	-Reduced intragravel permeability - Entombment due to fine sediment intrusion	-Re-suspension of fine sediments by spawning adults -Turbid storm runoff from urban development (especially below KF) and agricultural land use (low impact below GDW) - Fines that are stored in dredged areas and then mobilized during high flows[n]	L-M
	<25% fines of <6.4 mm (emergence)[o]	GDW to RB, particularly below KF	>0.1-50.6% fines that are <4 mm[p]							

[f] Area required per spawning pair (Burner 1951).

[g] Kondolf and others 2001.

[h] Based on CDFG escapement estimates and the assumption that each spawning pair produces one redd.

[i] CVPIA doubling goal for the Stanislaus River is 22,000 adult salmon produced or roughly 11,000 individuals (5,500 pairs) assuming 50% harvest.

[j] CDFG 1972. DWR 1994.

[k] Appendix 2 prepared by Carl Mesick Consultants 2003.

[l] CMC and others 1996

[m] Spawning activity, and therefore re-suspension due to redd building can occur during 50% of the incubation period (i.e., Oct-Dec). Outside of the spawning period, deposition of fines due to storm run-off or high flows occurs in at least some years, and this increases the estimated frequency of conditions outside of the preferred range to greater than 50%. Studies conducted during fall 2000 indicate that 21% of early redds were buried by fines re-suspended by spawning activity (CMC 2002b).

[n] CMC 2002a.

[o] Reiser and Bjornn 1979; CDFG 1998b.

[p] CMC and others 1996 did not report values for particles less than 6.4 mm and the closest comparison is particles less than 4 mm. The percentage of fines less than 6.4 mm would be higher than the range reported for 4 mm particles.

FALL-RUN CHINOOK INCUBATION

PREFERRED CONDITION (Oct-Mar; GDW to RB)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Disease	Zero to low level pathogens	Entire LSR below GDW	No evidence of disease[q]	Unknown	Unknown	Unknown	Unknown	- Physiological stress - Pre-emergent mortality	- Increased susceptibility due to high water temperatures resulting from **reservoir operations** and/or seasonally high ambient air temperatures	**Unknown**
Contaminants	Zero to low level contaminants[r]	Caswell State Park near Ripon[s]	Diazinon <0.005-0.083 µg/L	Jan-Feb 2001	90.5%[t]	Jan-Feb 2001	9.5%[o]	- Physiological stress, - Increased susceptibility to predation and disease	- Agriculture and home pesticide use	L
			Chlorpyrifos <0.005-0.038	Jan-Feb 2001	95.2%[o]	Jan-Feb 2001	4.8%[o]			
			Misc. other contaminants	Oct-Mar	100%[o]	-	-	-	-	None

[q] Pathological evaluations have only been conducted on juvenile Chinook salmon in the Stanislaus River and not on incubating lifestage. *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease, was the only pathogen detected in juveniles caught in rotary screw traps; however, no gross clinical signs of BKD were seen in any of the fish examined (Nichols and Foott 2002).

[r] Proposed California Maximum Concentration for Diazinon= 0.08 µg/L; Chlorpyrifos = 0.02 µg/L; miscellaneous other contaminants= varies. Source: Zamora and others 2003.

[s] Data collected at Caswell State Park near Ripon during January-February 2001 sampling (Zamora and others 2003; Brown and others 2004).

[t] Twenty-one days sampled between January and February 2001 (Zamora and others 2003).

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FALL-RUN CHINOOK JUVENILE REARING

PREFERRED CONDITION (Jan-Dec; Entire LSR below GDW[a])		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Instream Flow	0-1.51 ft/s; 0.49- 4.0 ft.[b]	Entire LSR below GDW	Low, stable flows during most BN, D, and C years	Unknown	Unknown	Unknown	Unknown	-Low flows may result in increased susceptibility to predation; less space and increased competition	- **Reservoir operations** - Lack of storm run-off (BN, D, C years)	**Unknown**
			High, variable flows during W and AN years					-High flows (run-off event >750 cfs or pulse flow >1,000 cfs) may result in downstream dispersal into areas with unsuitable habitat conditions	- **Reservoir operations** - High run-off (W and AN years)	
Water Temperature	<65°F[c]	GDW to OBB	47.9°F-66.3°F[d]	Jan-Dec	99.7%	Aug-Sep	0.3%	-	-	**None**
		Oakdale	48.2°F – 79.3°F	Oct-Jun Jul-Sep	98.9% 41.9%	Oct-Jun Jul-Sep	1.1% 58.1%	- Physiological stress - Mortality	-**Reservoir operations** and/or seasonally high ambient air temperatures	**L-M**
		McHenry	43.8°F -77.6°F	Oct 16-May Jun Jul-Oct 15	98.8% 64.4% 26.7%	Oct 16-May Jun Jul-Oct 15	0.2% 35.6% 73.3%			

[a] Rearing primarily occurs from mid December-May between GDW and RB; however, rearing may occur throughout the entire lower river below GDW. In addition, some juveniles may continue to rear throughout the summer and fall and then migrate the following winter. Oversummering juveniles have been observed primarily between GDW and OBB where temperatures rarely exceed the preferred range..

[b] Everest and Chapman 1972, Stuehrenberg 1975, and Thomson 1972; as cited in Reiser and Bjornn 1979.

[c] Water temperatures >65°F considered stressful and >77°F lethal (FERC 1996).

[d] Range of 7-day moving average of daily maximum water temperatures at GDW, KF, OBB, Oak, McHenry, and Caswell, 1998-2004.

FALL-RUN CHINOOK JUVENILE REARING

PREFERRED CONDITION (Jan-Dec; Entire LSR below GDW[a])		EXISTING CONDITION						RESTORATION OPPORTUNITY		
				IN PREFERRED RANGE		OUTSIDE PREFERRED RANGE				
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*TIMING*	*FREQUENCY*	*TIMING*	*FREQUENCY*	*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
Dissolved Oxygen	≥ 7 mg/L[e]	Ripon[f]	0-13.0 mg/L[g]	Jan-Dec	95.2%	Jan-Dec[h] Jan-Dec during runoff events or pulse flows	1.6% 3.2%	- Physiological stress - Mortality	-High turbidity and/or contaminants associated with storm runoff from urban development (especially below KF) and agricultural land use (low impact below GDW) - **Reservoir operations** and/or other unknown factors	**None-L[i]**
		Gravel Pits	Limited Data[j]	Unknown	Unknown	Unknown	Unknown		-Decaying organic material in gravel pits in combination with virtually no flow turbulence	Unknown

[e] Minimum DO objective for Stanislaus River according to Basin Plan is 7 mg/L (CRWQCB 2004).

[f] Ripon is the only location where continuous DO readings are recorded. DO levels are potentially higher (i.e., more suitable) further upstream due to lower temperatures and/or increased turbulence from higher gradient.

[g] Daily minimum DO at Ripon, 1999-2004.

[h] Short periods unrelated to run-off events, pulse flows, or any other readily apparent cause.

[i] Although extremely low DO would be expected to be lethal, the dips observed are short term and may not be representative of levels throughout the river. No fish kills were observed in the Stanislaus River over the period that these DO measurements were recorded.

[j] No consistent measurements of DO have been recorded in gravel pits; however, a decline in DO at the Oakdale Recreation Pond relative to a site 3 miles upstream (i.e., 11.0 mg/L above the pond and 9.5 mg/L within the pond) was observed during two surveys in November 1995 (CMC and others 1996).

FALL-RUN CHINOOK JUVENILE REARING

PREFERRED CONDITION (Jan-Dec; Entire LSR below GDW[a])		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Water Clarity	<18 NTU[k]	Oakdale, Caswell, and Weir[l]	18.0-55.2 NTU (storm level) <10 NTU typical (background)	Jan-Dec[m]	98.2% of days rated	Dec-Mar during runoff events	1.8% of days rated	-Gill trauma -Reduced foraging ability -Avoidance of suspended sediment plumes	Turbid storm runoff from urban development (especially below KF) and ag land use (low impact below GDW)	None-L
Space, Refuge from Predators, and Food Availability	Abundant instream and overhead cover (i.e., logs, roots, other woody debris, shallow riffles, undercut banks, and submergent, emergent, and dense overhead vegetation); floodplain habitat	Entire LSR below GDW	Inundated floodplain habitat substantially reduced; short strips remain that are only inundated at flows ≥ 1,200 cfs[n]; relatively high concentrations of fines in riffles[o]	Unknown	Unknown	Unknown	Unknown	- Increased susceptibility to predation - Reduced floodplain habitat -Reduced food production and availability	- Nonnative species introduction - Altered channel morphology due to gravel mining, **reservoir operations**, and changes in streamside land use	**M-H**
Disease	Zero to low level pathogens	Entire LSR below GDW	No evidence of disease[p]	Jan-Dec	100%	-	-	-	-	None

[k] Gregory 1992 as cited in Bash and others 2001.

[l] Instantaneous daily turbidity measurements recorded at Oakdale and Caswell during December through July, 1996-2004; and during September through March at the Stanislaus River Weir, 2003-2005.

[m] Only a few recordings were made during July 1998, and no data exists for turbidity during August. With storm run-off absent during the summer, it was assumed that turbidity is at typical background levels during these months.

[n] SRFG 2003.

[o] DWR 1994; Mesick 2001a; CMC 2001.

[p] Pathological evaluations have been conducted on juvenile Chinook salmon in the Stanislaus River. *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease (BKD), was the only pathogen detected in juveniles caught in rotary screw traps; however, no gross clinical signs of BKD were seen in any of the fish examined (Nichols and Foott 2002).

FALL-RUN CHINOOK JUVENILE REARING

PREFERRED CONDITION (Jan-Dec; Entire LSR below GDW[a])		EXISTING CONDITION						RESTORATION OPPORTUNITY		
				IN PREFERRED RANGE		OUTSIDE PREFERRED RANGE				
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*TIMING*	*FREQUENCY*	*TIMING*	*FREQUENCY*	*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
Contaminants	Zero to low level contaminants[q]	Ripon near Patterson or Caswell State Park near Ripon [r]	Diazinon <0.005-0.083 µg/L	June 1994 Jan-Feb 2001; Apr-Aug 2001	100% 95.1%[s]	- Jan-Feb 2001; Apr-Aug 2001	- 4.9%[o]	- Physiological stress - Increased susceptibility to predation and disease	- Agriculture and home pesticide use	L
			Chlorpyrifos <0.005-0.038	June 1994 Jan-Feb 2001; Apr-Aug 2001	100% 95.1% [o]	- Jan-Feb 2001; Apr-Aug 2001	- 4.9% [o]			
			Misc. other contaminants	June 1994 Jan-Feb 2001; Apr-Aug 2001	100% [o]	-	-	-	-	None
Movement (unhindered)	Diversions screened in compliance with agency criteria	Below KF	46 unscreened diversions; 3 diversions with gravel filters	Jan-Dec	6.1% screened	Jan-Dec	93.9% unscreened; unknown proportion of juvenile population entrained	- Entrainment	Forty-nine small to moderately sized unscreened diversions in lower reach[t]	Unknown
		GDW to KF	No diversion facilities	-	100%	-	-			None

[q] Proposed California Maximum Concentration for Diazinon= 0.08 µg/L; Chlorpyrifos = 0.02 µg/L; miscellaneous other contaminants= varies. Source: Zamora and others 2003.

[r] Data collected at Ripon near Patterson during June 1994 (Brown and others 2004) and at Caswell State Park near Ripon during January-February 2001 (Zamora and others 2003; Brown and others 2004) and April-August 2001(Domagalski and Munday 2003).

[s] Total of 41 days sampled in 2001: 21 days between January and February (Zamora and others 2003) and 20 days between April and August (Domagalski and Munday 2003).

[t] DWR unpublished diversion inventory data collected during 1996 and 1998.

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FALL-RUN CHINOOK JUVENILE MIGRATION

PREFERRED CONDITION (Jan-June[a]; Entire LSR below GDW)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
				IN PREFERRED RANGE		OUTSIDE PREFERRED RANGE				
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*TIMING*	*FREQUENCY*	*TIMING*	*FREQUENCY*	*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
Instream Flow (Fry; Jan-Mar)	Flowing water, unknown magnitude; migration importance unknown[b]	Entire LSR below GDW	Low, stable flows during most BN, D, and C years High, variable flows during W and AN years	Unknown	Unknown	Unknown	Unknown	-Low flows may result in increased susceptibility to predation -High flows (run-off event >750 cfs or pulse flow >1,000 cfs) may result in downstream dispersal into areas with unsuitable habitat conditions	- **Reservoir operations** - Lack of storm run-off (BN, D, C years) -High run-off (W and AN years)	**Unknown**
Instream Flow (Smolts; Apr-Jun)	Dynamic flow regime and high flow event(s) of unknown magnitude[c]	Entire LSR below GDW	Generally 550 cfs to 1,500 cfs[de] Generally 400 cfs to 1,500 cfs[e]	Unknown	Unknown	Unknown	Unknown	-Low and/or stable flows may not stimulate or maintain migration	- **Reservoir operations** - Reservoir release ceiling generally at 1,500 cfs due to agricultural concerns	**Unknown**
Water Temperature	<62.6°F[f]	GDW to Oakdale	47.9°F -73.9°F [g]	Jan-Jun	98.4%	Jan-Jun	1.6%	-Physiological stress -Smoltification altered or inhibited	**Reservoir operations** and/or seasonally high ambient air temperatures	**L-M**
		McHenry to Caswell	43.8°F -75.7°F	Jan-Jun	84.7%	Jan-Jun	15.3%			

[a] Migration primarily occurs from January through May with some occurring as late as June. Fry migration generally occurs from January-March, followed by smolt migration in April and May.

[b] Although fry are observed in downstream migrant traps throughout California, it is unknown whether fry migration is a successful lifestage strategy.

[c] Minimum flow requirements for smolt migration are stream-specific and data from Stanislaus River studies are presently insufficient to determine a suitable minimum flow.

[d] Determined by VAMP study requirements under the SJRA.

[e] Flood control releases excluded.

[f] Water temperatures >62.6°F considered stressful (Marine 1997).

[g] 7-day moving average of daily maximum water temperatures at GDW, and KF, OBB, Oakdale, McHenry, and Caswell 1998-2004.

FALL-RUN CHINOOK JUVENILE MIGRATION

PREFERRED CONDITION (Jan-June[a]; Entire LSR below GDW)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
				IN PREFERRED RANGE		OUTSIDE PREFERRED RANGE				
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*TIMING*	*FREQUENCY*	*TIMING*	*FREQUENCY*	*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
Dissolved Oxygen	≥ 7 mg/L[h]	Ripon[i]	0-6.9 mg/L[j]	Jan-Jun	95.7%	Jan-Jun[k] Jan-Jun during run-off events	1.7% 2.6%	- Physiological stress - Mortality	- High turbidity and/or contaminants associated with storm runoff from urban development (especially below KF) and agricultural land use (low impact below GDW) - **Reservoir operations** and/or other unknown factors	**None-L[l]**
		Gravel pits	Limited Data[m]	Unknown	Unknown	Unknown	Unknown		- Decaying organic material in gravel pits in combination with virtually no flow turbulence	Unknown

[h] Minimum DO objective for Stanislaus River according to Basin Plan is 7 mg/L (CRWQCB 2004).

[i] Ripon is the only location where continuous DO readings are recorded. DO levels are potentially higher (i.e., more suitable) further upstream due to lower temperatures and/or increased turbulence from higher gradient.

[j] Daily minimum DO at Ripon, 1999-2004.

[k] Short periods unrelated to run-off events or any other readily apparent cause.

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[m] No consistent measurements of DO have been recorded in gravel pits; however, a decline in DO at the Oakdale Recreation Pond relative to a site 3 miles upstream (i.e., 11.0 mg/L above the pond and 9.5 mg/L within the pond) was observed during two surveys in November 1995 (CMC and others 1996).

FALL-RUN CHINOOK JUVENILE MIGRATION

PREFERRED CONDITION (Jan-June[a]; Entire LSR below GDW)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*IN PREFERRED RANGE*		*OUTSIDE PREFERRED RANGE*		*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
				TIMING	*FREQUENCY*	*TIMING*	*FREQUENCY*			
Water Clarity	<18 NTU[n]	Oakdale, Caswell, and Weir[o]	18.0-55.2 NTU (storm level) <10 NTU (background)	Jan-Jun	97.9% of days rated	Jan-Mar during run-off events	2.1% of days rated	-Gill trauma -Reduced foraging ability	- Turbid storm runoff from urban development (especially below KF) and agricultural land use (low impact below GDW)	None –L
Space, Refuge from Predators, and Food Availability	Abundant instream and overhead cover (i.e., logs, roots, other woody debris, shallow riffles, undercut banks, and submergent, emergent and dense overhead vegetation); floodplain habitat	Entire LSR below GDW	Inundated floodplain habitat substantially reduced; short strips remain that are only inundated at flows ≥ 1,200 cfs[p]	Unknown	Unknown	Unknown	Unknown	- Increased susceptibility to predation - Reduced floodplain habitat -Reduced food production and availability	- Nonnative species introduction - Altered channel morphology due to gravel mining, **reservoir operations**, and changes in streamside land use	**M-H**
Disease	Zero to low level pathogens	Entire LSR below GDW	No evidence of disease[q]	Unknown	Unknown	Unknown	Unknown	-	-	None

[n] Gregory 1992 as cited in Bash and others 2001.

[o] Instantaneous daily turbidity measurements recorded at Oakdale and Caswell during December through July, 1996-2004; and during September through March at the Stanislaus River Weir, 2003-2005.

[p] SRFG 2003.

[q] Pathological evaluations have been conducted on juvenile Chinook salmon in the Stanislaus River. *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease (BKD), was the only pathogen detected in juveniles caught in rotary screw traps; however, no gross clinical signs of BKD were seen in any of the fish examined (Nichols and Foott 2002).

FALL-RUN CHINOOK JUVENILE MIGRATION

PREFERRED CONDITION (Jan-June[a]; Entire LSR below GDW)		EXISTING CONDITION						RESTORATION OPPORTUNITY		
				IN PREFERRED RANGE		OUTSIDE PREFERRED RANGE				
FACTOR	*RANGE*	*LOCATION*	*OBSERVED RANGE*	*TIMING*	*FREQUENCY*	*TIMING*	*FREQUENCY*	*POTENTIAL PROBLEM(S)*	*POTENTIAL CAUSE(S)*	*IMPACT*
Contaminants	Zero to low level contaminants[r]	At or near Ripon [s]	Diazinon <0.005-0.083 µg/L	June 1994 Jan-Feb 2001; Apr-Aug 2001	100% 95.1%[t]	- Jan-Feb 2001; Apr-Aug 2001	- 4.9%[o]	- Physiological stress - Increased susceptibility to predation and disease	- Agriculture and home pesticide use	L
			Chlorpyrifos <0.005-0.038	June 1994 Jan-Feb 2001; Apr-Aug 2001	100% 95.1% [o]	- Jan-Feb 2001; Apr-Aug 2001	- 4.9% [o]			
			Misc. other contaminants	June 1994 Jan-Feb 2001; Apr-Aug 2001	100% [o]	-	-	-	-	None
Passage (unhindered)	Diversions screened in compliance with agency criteria	Below KF	27 unscreened diversions operated year-round and 19 operated at various intervals Feb-Dec; 3 diversions with gravel filters	Jan-Jun	6.1% screened	Jan-Jun	93.9% unscreened; unknown proportion of juvenile population entrained	- Entrainment	- Forty-six small to moderately sized unscreened diversions in lower reach[u]	Unknown
		GDW to KF	No diversion facilities	Jan-Jun	100%	-	-			None

[r] Proposed California Maximum Concentration for Diazinon= 0.08 µg/L; Chlorpyrifos = 0.02 µg/L; miscellaneous other contaminants= varies. Source: Zamora and others 2003.

[s] Data collected at Ripon near Patterson during June 1994 (Brown and others 2004) and at Caswell State Park near Ripon during January-February 2001 (Zamora and others 2003; Brown and others 2004) and April-August 2001(Domagalski and Munday 2003).

[t] Total of 41 days sampled in 2001: 21 days between January and February (Zamora and others 2003) and 20 days between April and August (Domagalski and Munday 2003).

[u] DWR unpublished diversion inventory data collected during 1996 and 1998. Known intake diameters range from 2-24 inches and known maximum capacities range from 0.4-72 cfs.