APPENDIX D

STREAM CORRIDOR INVENTORY AND EVALUATION (SCIES) MODEL

APPENDIX D. STREAM CORRIDOR INVENTORY AND EVALUATION SYSTEM

1.0 INTRODUCTION

The stream corridor inventory and evaluation system (SCIES) is an indexing system developed to measure the values to fish and wildlife of the various conditions found in stream corridors. These values are rated from 0 to 100 and provide an index of habitat suitability. The information can be used to understand the needs of species and the trade-offs associated with altering flow in streams. Since different species (and different life stages of the same species) have different habitat requirements, optimal conditions for one species or life stage may be sub-optimal for another. To optimize habitat and temperature conditions for several species of fish, trade-offs have to be made. Several flow scenarios have been proposed to manage the Lower Mokelumne River fishery (Table D.1).

When applied to the LMRMP, SCIES can be used to compare a range of scenarios for chinook salmon and steelhead trout. Habitat and temperature conditions are both affected by flow and, consequently, are critical considerations. To understand the influence of flow on the stream and its inhabitants, complex models such as the Instream Flow Incremental Methodology (IFIM) and Stream Network Temperature Model (SNTEMP) are used. SCIES is used to compare the results of these complex models with respect to habitat values for different species and life stages. These values can then be synthesized across the species and their life stages to compare different management options. Trade-offs between species and life stages are explicit.

Not all areas within a stream provide suitable fish habitat. For example, some areas may be too deep or shallow, too slow or too swift. Ideal conditions for one species are rarely ideal for others. Ideal conditions for one life stage may not be suitable for another. To quantify areas of usable habitat for different species of fish, fisheries biologists have developed a measure called weighted usable area (WUA) which represents the number of square feet of suitable habitat per linear foot of stream. WUA is calculated by application of the IFIM. WUA is determined by factors such as water velocity, depth, and substrate conditions.

Similarly, temperature is critical to fish. Even small variations in temperature can represent the difference between a suitable and unsuitable environment. Fish need temperatures within a limited range to survive. For chinook salmon, this range extends from near freezing to about 24° C (75° F) for juvenile fish. Within this range, a more limited range is optimal for growth and survival. Optimal temperature ranges vary according to life stage.

SCIES represents habitat (WUA) and temperature conditions on a scale from 0 to 100. Values are scored according to their importance to the species. High scores, up to 100, are given to optimum temperature conditions and maximum WUA; low scores, starting from zero, are given to temperature and WUA conditions that are within the required range but less than optimum. Conditions incompatible with the long term survival of the fish are

scored at 0. To arrive at an overall score for a species, scores for individual life stages are combined (each life stage may be given a different weight). Also, scores for several species can be combined to give an overall value for the stream. This overall value is the measure by which different management alternatives are compared. Realistically, the minimum score in any life stage of one species represents the minimum overall stream score since the success of the species may be regulated by this limiting condition.

Figure D-1 is a diagram of how temperature and habitat values are combined in the SCIES model to give an overall value for chinook salmon. In this example, five life stages are evaluated: adult migration, spawning, fry rearing, juvenile rearing, and smolt migration. Habitat values were calculated for a flow of 100 cfs using curves relating temperature and WUA to flow and scores were calculated (this step is described in more detail below).

In this example, only temperature is an important factor during both migratory life stages. Depth and velocity are probably also important, but there were no flow/habitat relationships available for migration.

A score is generated for each life-stage by combining the temperature and habitat scores. In this case the scores were combined multiplicatively. This is because conditions with optimal temperature but suboptimal physical habitat features are still more valuable than conditions with suboptimal values for both.

Finally, the minimum life-stage score is selected to represent conditions for the species at that flow. In this case, smolt migration is the lowest scoring life-stage. Even if all other conditions are optimal, the population may be regulated by the difficulty smolts have emigrating from the river.

2.0 SCIES AND THE FISHERIES MANAGEMENT PLAN IN DETAIL

The SCIES analysis used flow and habitat relationships generated by CDFG. The relationship between habitat and flow for each species and its life stages were taken from the CDFG Plan (CDFG 1991). Areas of suitable habitat (WUA) were calculated for spawning, juvenile, and fry life stages. The SCIES scores were derived by simply converting these figures into percentages of the maximum suitable habitat given the flow. For instance, a flow that yields 50 percent of the maximum observed habitat (for that life stage and river reach) gives a score of 50 percent. Figure D-2 and Table D.2 show the relationship between suitable habitat for chinook salmon spawning, juveniles, and fry versus flow. For each flow in Figure D-2 and Table D.2, a separate WUA and SCIES score can be read from the graph for each of the three life stages.

Flow also affects water temperature. The relationship between flow and water temperature at different points in the Lower Mokelumne River was developed using the USFWS's SNTEMP model. Table D.3 gives the results of this model. For any level of flow, river temperatures are calculated during each two-week time period. Temperatures are calculated at several locations (nodes) between Camanche Dam and the Cosumnes River. Mackville Road was assumed to represent the downstream limit of spawning; Elliott Road represented the downstream limit for fry and juvenile rearing; temperature at Bruella Road was used to represent conditions for smolts migrating out of Camanche Reach; and temperature at Ray Road was used to represent conditions for smolts migrating out of the Woodbridge reach. The temperatures were then scored for in-migration, spawning, fry, juveniles, and out-migration.

Scoring curves were generated from temperature tolerance relationships. Temperature tolerance information for each species and life stage was taken from the published scientific literature. Figure D-3 and Table D.4 show the temperature scoring curves for three life stages of chinook salmon. Below 18° C (65° F), juvenile fish grow and survive well. As the temperature increases, the juveniles become stressed and at 24° C (75° F), approximately 50 percent will die if the temperature is maintained for more than 96 hours. For juvenile chinook salmon SCIES scores, all river temperatures below 18° C receive a score of 100 percent and all river temperatures above 24° C receive a 0 percent.

This process was applied to each life stage of chinook salmon and steelhead trout to establish SCIES scores for each flow scenario in each reach of the Mokelumne River and for each month of the year. The temperature score is multiplied by the habitat score to give a combined score for each life stage. Table D.5 contains the output generated by SCIES.

The flow scenario evaluated is shown by monthly discharge values (cfs) in the shaded area of Table D.5. Discharge is different for the Camanche Reach (Camanche Dam to Lake Lodi) and the Woodbridge reach (Woodbridge Dam to the Cosumnes River). All five life-stages of

chinook salmon and steelhead occur in the Camanche Reach while only adult in-migration and smolt out-migration occur in the Woodbridge reach.

Combined temperature and WUA scores are shown for each life-stage in the months when that life-stage occurs in the Mokelumne River. The average score for each life-stage is shown in the far right hand column. The life-stage averages are useful as they provide a means of analyzing the overall effect of a flow scenario on a particular life stage of a species. The life-stage average score is a weighted average. The weights are determined by the importance (abundance) of each month to that life-stage. Weighting factors for each month and life-stage are shown in Table D.6.

Since most of the flow scenarios specify different flow requirements depending on runoff year type (i.e, dry, normal, wet) SCIES tables were calculated for each year type. Flow management scenarios were ultimately evaluated by combining the year type scores into an overall score. Scores for each year type were combined by weighting each year type score by its frequency of occurrence. A summary of overall scores is provided in Table D.7.

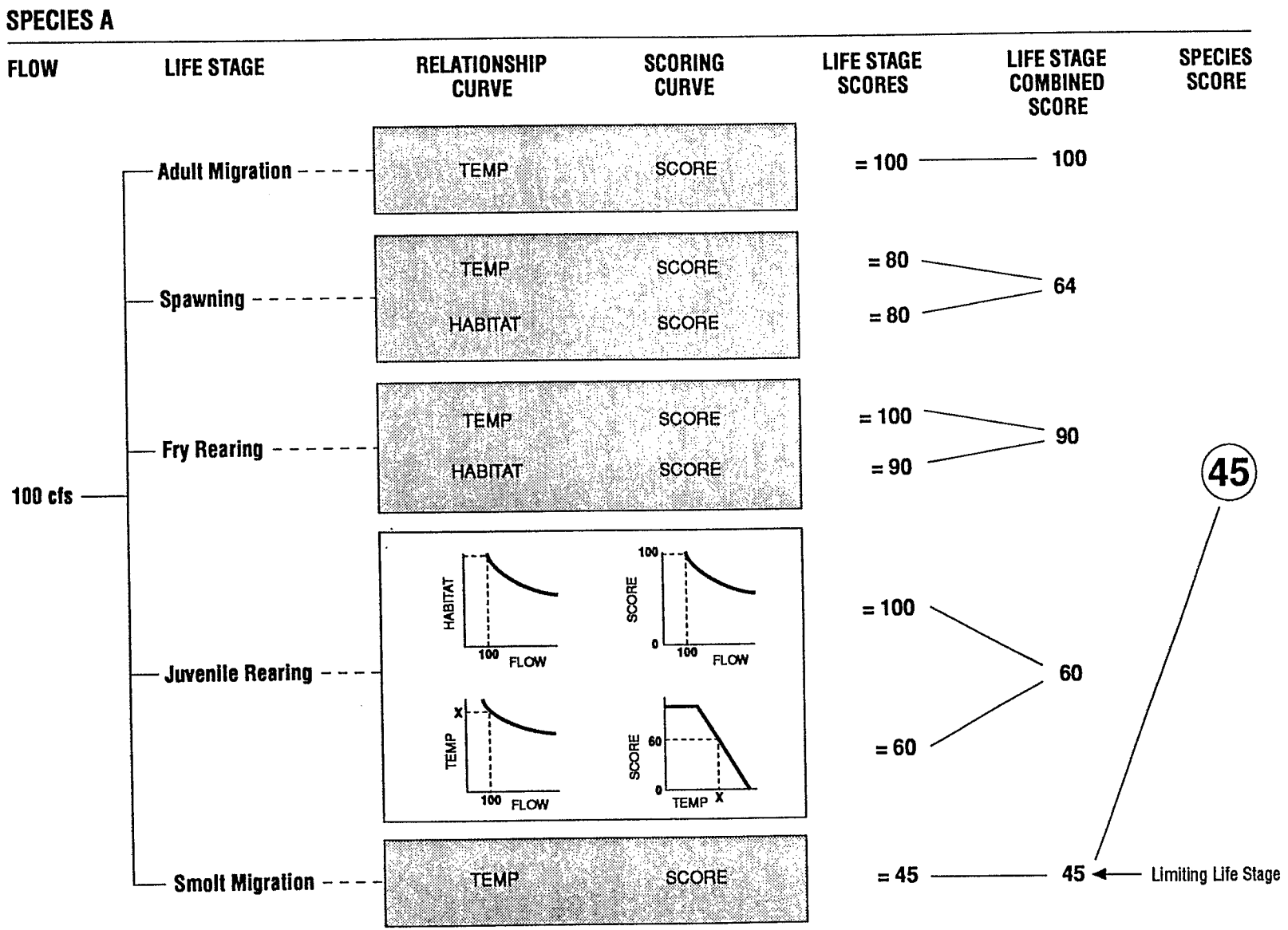

Figure D-1. SCIES model schematic.

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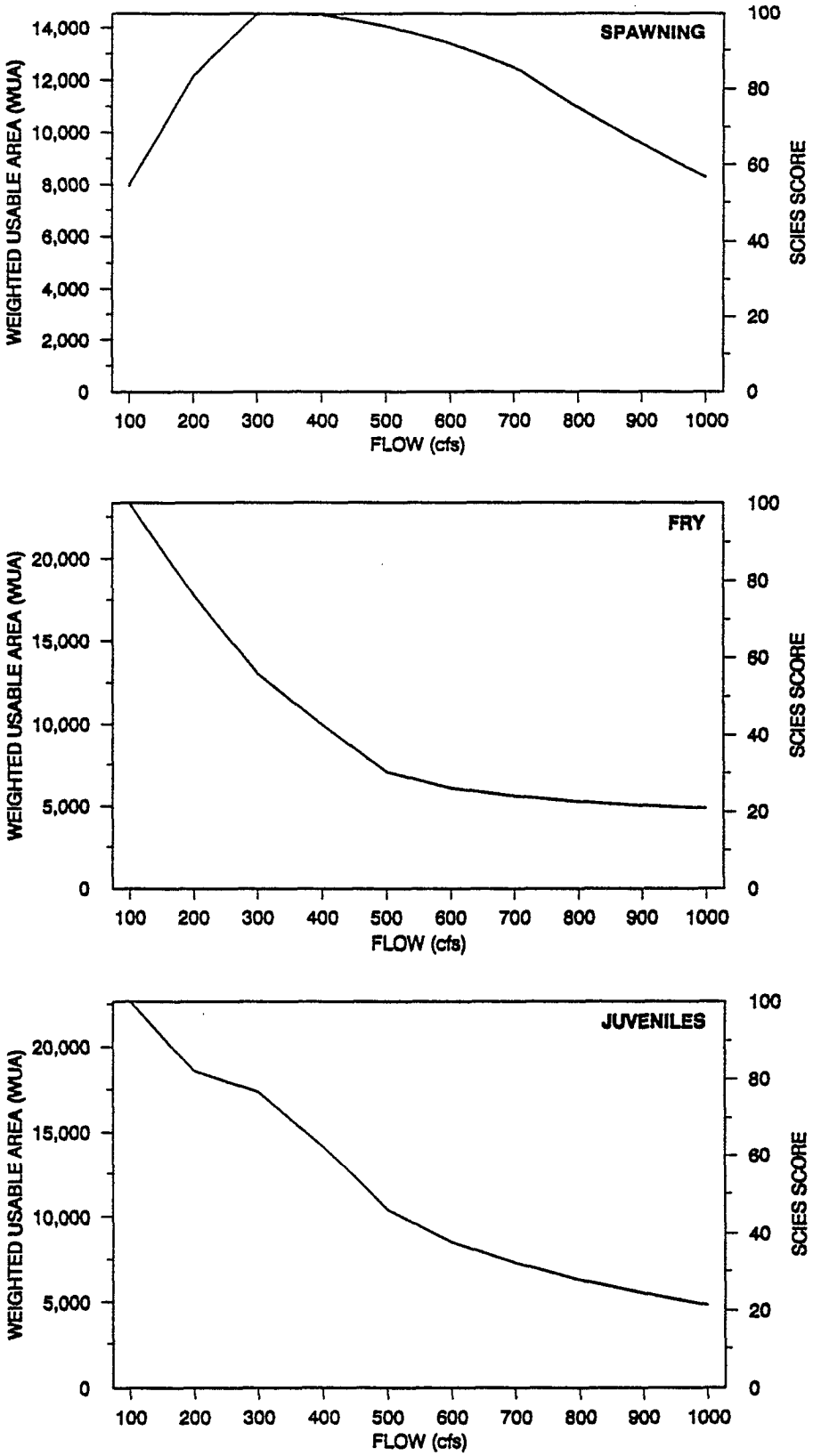

Figure D-2. WUA SCIES score, chinook salmon.

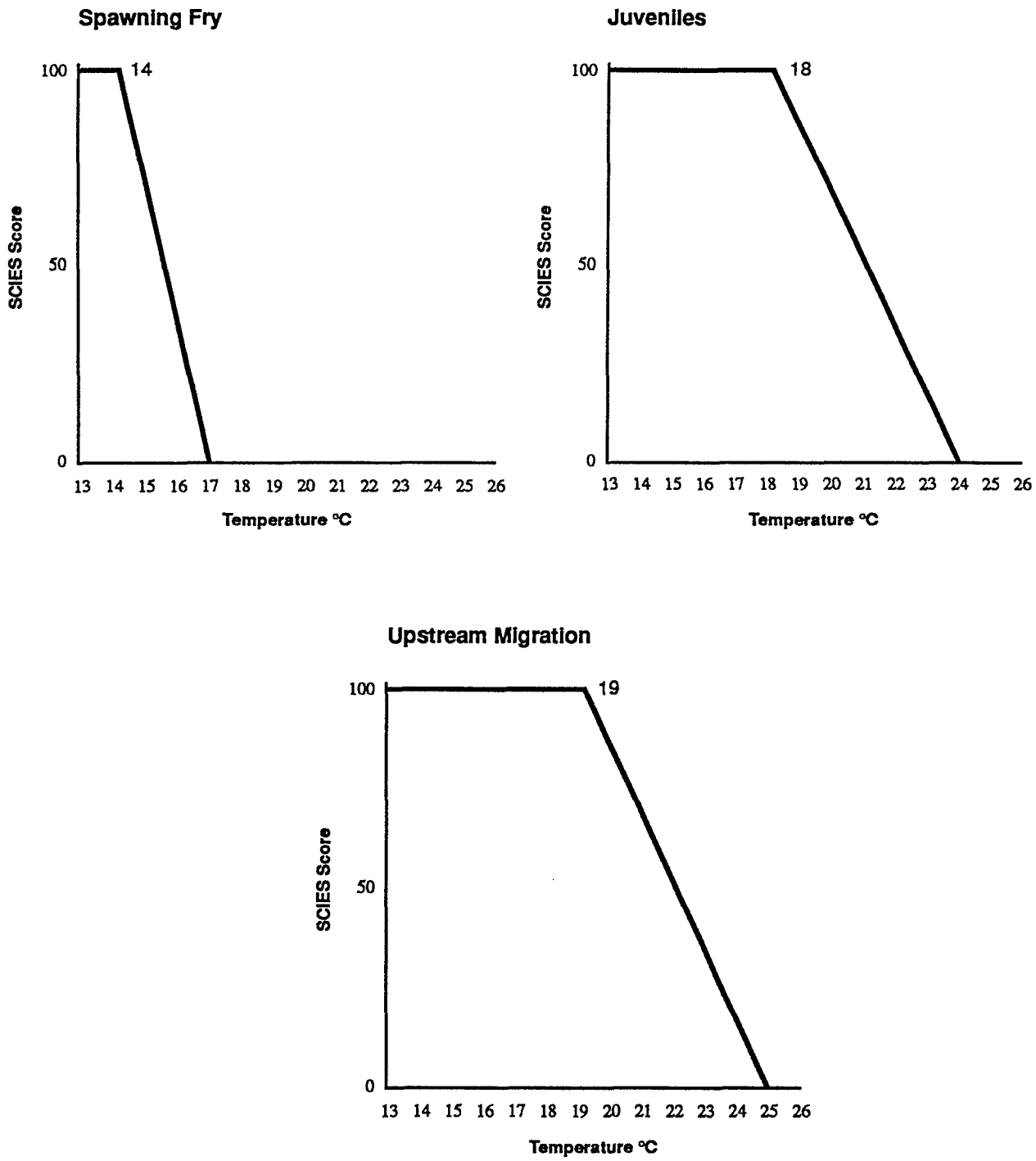

Figure D-3. Temperature suitability for chinook salmon and steelhead

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Table D.1. Input flow scenarios.

ALTERNATIVE	YEAR TYPE	REACH	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
TIME PERIODS==========>			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
CDFG	Dry	Camanche	275	275	250	250	275	275	350	400	600	600	275	275	300	300	250	250	250	250	125	350	375	250	275	275
		Woodbridge	200	200	200	200	200	200	200	250	375	375	25	25	25	25	25	25	75	75	50	275	300	200	200	200
	Normal	Camanche	375	375	350	350	425	425	550	550	750	850	925	925	600	600	475	475	350	350	625	775	575	350	375	375
		Woodbridge	300	300	300	300	350	350	400	400	450	550	500	500	150	150	100	100	100	100	475	625	525	300	300	300
	Wet	Camanche	425	425	400	400	475	475	600	600	750	750	875	875	750	750	675	675	550	550	675	725	625	400	425	425
		Woodbridge	350	350	350	350	400	400	450	450	450	450	475	475	300	300	300	300	300	300	525	575	575	350	350	350
ESCAPEMENT	Critical	Camanche	125	125	100	100	125	125	175	175	225	225	300	300	300	300	250	250	175	175	100	125	250	250	275	125
		Woodbridge	50	50	50	50	50	50	25	25	25	25	25	25	25	25	25	25	25	25	25	50	200	200	200	50
	Dry	Camanche	200	200	200	200	200	200	250	300	500	600	300	300	300	300	250	250	175	175	100	375	850	850	625	200
		Woodbridge	125	125	150	150	125	125	100	150	300	400	25	25	25	25	25	25	25	25	25	300	600	600	550	125
	Normal	Camanche	300	300	200	200	200	200	250	300	600	700	900	900	475	475	400	400	275	275	150	450	650	650	625	300
		Woodbridge	225	225	150	150	125	125	100	150	300	400	500	500	25	25	25	25	25	25	25	300	600	600	550	225
	Wet	Camanche	300	300	250	250	275	275	250	300	600	700	900	900	475	475	400	400	275	275	150	450	650	650	625	300
		Woodbridge	225	225	200	200	200	200	100	150	300	400	500	500	25	25	25	25	25	25	25	300	600	600	550	225
PRODUCTION (NATURAL)	Critical	Camanche	125	125	100	100	125	125	175	175	225	225	300	300	300	300	250	250	175	175	100	100	150	150	175	125
		Woodbridge	50	50	50	50	50	50	25	25	25	25	25	25	25	25	25	25	25	25	25	25	100	100	100	50
	Dry	Camanche	200	200	200	200	200	200	250	300	500	600	300	300	300	300	250	250	175	175	100	200	250	250	275	200
		Woodbridge	125	125	150	150	125	125	100	150	300	400	25	25	25	25	25	25	25	25	25	125	200	200	200	125
	Normal	Camanche	200	200	200	200	200	200	250	300	600	700	900	900	475	475	400	400	275	275	150	350	350	350	375	300
		Woodbridge	125	125	150	150	125	125	100	150	300	400	500	500	25	25	25	25	25	25	25	200	300	300	300	225
	Wet	Camanche	200	200	200	200	200	200	250	300	600	700	900	900	475	475	400	400	275	275	150	350	350	350	375	300
		Woodbridge	125	125	150	150	125	125	100	150	300	400	500	500	25	25	25	25	25	25	25	200	300	300	300	225
PRODUCTION (HATCHERY)	Critical	Camanche	125	125	100	100	125	125	200	200	250	250	325	325	325	325	275	275	225	225	125	125	100	100	125	125
		Woodbridge	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	All Others	Camanche	175	175	150	150	125	125	200	200	300	350	475	525	325	325	275	275	225	225	125	125	100	150	175	175
		Woodbridge	100	100	100	100	50	50	50	50	100	150	200	250	50	50	50	50	50	50	50	50	50	100	100	100
MAXIMUM HARVEST	Critical	Camanche	125	125	100	100	125	125	175	175	225	225	300	300	300	300	250	250	175	175	100	100	150	150	175	125
		Woodbridge	50	50	50	50	50	50	25	25	25	25	25	25	25	25	25	25	25	25	25	25	100	100	100	50
	Dry	Camanche	200	200	200	200	200	200	175	175	225	225	300	300	300	300	250	250	175	175	100	200	250	250	275	200
		Woodbridge	125	125	150	150	125	125	25	25	25	25	25	25	25	25	25	25	25	25	25	125	200	200	200	125
	Normal & Wet	Camanche	200	200	200	200	200	200	175	175	325	325	425	425	475	475	400	400	275	275	150	350	350	350	375	300
		Woodbridge	125	125	150	150	125	125	25	25	25	25	25	25	25	25	25	25	25	25	25	200	300	300	300	225
CDFG 1991 AGREEMENT	Dry	Camanche	175	200	200	200	200	200	200	175	325	325	425	425	375	375	325	325	200	200	125	125	500	200	225	175
		Woodbridge	100	150	150	150	125	125	50	50	100	100	150	150	100	100	75	75	50	50	50	50	450	150	150	100
	Normal	Camanche	175	200	200	200	200	200	925	925	925	925	925	925	475	475	400	400	275	275	200	200	500	200	225	175
		Woodbridge	100	150	150	150	125	125	800	800	625	625	525	525	25	25	25	25	25	25	50	50	450	150	150	100
CDFG 1961 AGREEMENT	Dry	Camanche	125	125	100	100	125	125	200	200	250	250	300	300	325	325	275	275	175	175	100	100	125	125	150	150
		Woodbridge	50	50	50	50	50	50	50	50	25	25	25	25	50	50	25	25	25	25	25	25	50	50	75	75
	Normal	Camanche	125	125	100	100	125	125	175	175	350	350	450	450	475	475	400	400	275	275	150	150	125	125	150	150
		Woodbridge	50	50	50	50	50	50	50	50	50	50	50	50	25	25	25	25	25	25	25	25	50	50	75	75
EXISTING CONDITION	Dry	Camanche	100	100	100	100	150	150	275	275	350	350	425	425	425	425	375	375	275	275	175	175	125	125	125	125
		Woodbridge	100	100	80	60	50	50	50	50	25	25	50	50	50	50	50	50	50	50	100	100	125	125	100	100
	Normal	Camanche	525	525	525	525	675	675	650	650	775	775	875	875	750	750	700	700	675	675	675	675	425	425	275	275
		Woodbridge	500	500	550	550	675	675	400	400	400	400	450	450	275	275	250	250	350	350	500	500	400	400	275	275
	Wet	Camanche	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
		Woodbridge	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	800	800	575	575	875	875	975	975	1000	1000	1000	1000

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Table D.2. Input temperature.

FLOW(cfs)	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
TIME PERIODS==>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

TEMPERATURE (•C) AT RM 57 (MACKVILLE ROAD) FOR SALMONID SPAWNING, CAMANCHE REACH.

10	6.86	12.97	10.41	9.13	13.36	14.58	16.76	18.36	17.97	19.56	22.61	21.94	24.15	23.12	22.26	22.20	20.82	18.27	17.67	18.15	15.14	10.66	9.22	9.91
50	6.77	12.12	9.91	8.86	12.69	13.87	15.94	17.49	17.25	18.80	21.80	21.19	23.35	22.37	21.62	21.58	20.13	17.79	17.30	17.70	15.05	11.02	9.51	9.87
60	6.67	11.26	9.41	8.59	12.01	13.15	15.11	16.61	16.52	18.04	20.99	20.43	22.54	21.62	20.98	20.96	19.43	17.31	16.93	17.24	14.96	11.38	9.80	9.83
100	6.56	10.16	8.82	8.28	11.08	12.12	13.82	15.15	15.21	16.58	19.18	18.80	20.68	19.98	19.57	19.59	18.25	16.58	16.34	16.60	14.83	11.84	10.12	9.79
150	6.49	9.36	8.40	8.06	10.39	11.34	12.83	14.00	14.15	15.36	17.58	17.37	19.01	18.54	18.31	18.37	17.31	16.02	15.88	16.12	14.73	12.19	10.35	9.76
200	6.42	8.56	7.97	7.83	9.69	10.56	11.83	12.84	13.09	14.14	15.98	15.93	17.34	17.09	17.04	17.15	16.36	15.45	15.41	15.64	14.63	12.53	10.57	9.73
250	6.41	8.32	7.92	7.94	9.60	10.50	11.60	12.47	12.70	13.69	15.39	15.53	16.78	16.66	16.52	16.61	16.03	15.19	15.32	15.47	14.54	12.68	10.70	9.78
300	6.40	8.07	7.87	8.04	9.50	10.43	11.36	12.10	12.31	13.23	14.79	15.13	16.22	16.23	16.00	16.07	15.69	14.93	15.22	15.30	14.44	12.83	10.83	9.82
350	6.41	7.94	7.86	8.09	9.48	10.35	11.15	11.83	12.08	12.99	14.46	14.87	15.85	15.93	15.68	15.79	15.56	14.79	15.17	15.18	14.39	12.87	10.90	9.84
400	6.41	7.80	7.84	8.13	9.45	10.26	10.94	11.56	11.85	12.74	14.12	14.60	15.47	15.63	15.35	15.51	15.43	14.65	15.11	15.06	14.33	12.91	10.96	9.86
450	6.42	7.75	7.86	8.20	9.46	10.19	10.82	11.39	11.69	12.57	13.93	14.43	15.24	15.49	15.13	15.33	15.32	14.57	15.14	14.99	14.30	12.95	11.01	9.89
500	6.43	7.70	7.87	8.26	9.47	10.12	10.70	11.22	11.53	12.39	13.73	14.25	15.00	15.35	14.90	15.14	15.21	14.48	15.17	14.92	14.27	12.99	11.05	9.92
550	6.44	7.68	7.93	8.36	9.49	10.08	10.61	11.14	11.41	12.28	13.60	14.19	14.84	15.22	14.75	15.04	15.13	14.39	15.18	14.85	14.24	13.01	11.08	9.93
600	6.44	7.65	7.98	8.46	9.51	10.03	10.51	11.05	11.29	12.17	13.47	14.13	14.67	15.08	14.59	14.94	15.05	14.30	15.18	14.77	14.20	13.03	11.10	9.94
650	6.45	7.64	8.04	8.52	9.53	10.01	10.46	10.97	11.24	12.11	13.39	14.07	14.61	15.03	14.49	14.87	15.07	14.28	15.21	14.72	14.19	13.06	11.12	9.95
700	6.46	7.63	8.09	8.58	9.54	9.98	10.40	10.89	11.18	12.04	13.31	14.00	14.55	14.98	14.38	14.80	15.09	14.25	15.24	14.67	14.18	13.08	11.13	9.96
750	6.55	7.65	8.16	8.67	9.57	9.92	10.34	10.84	11.11	11.96	13.27	13.92	14.47	15.04	14.27	14.72	14.99	14.18	15.31	14.67	14.17	13.10	11.15	9.99
800	6.48	7.67	8.21	8.76	9.55	9.89	10.29	10.78	11.05	11.93	13.21	13.88	14.41	14.99	14.31	14.59	14.97	14.14	15.29	14.64	14.17	13.11	11.20	10.04
850	6.51	7.69	8.26	8.80	9.54	9.86	10.25	10.74	11.02	11.86	13.18	13.89	14.35	14.93	14.23	14.67	14.92	14.10	15.26	14.60	14.15	13.10	11.21	10.05
900	6.54	7.71	8.31	8.84	9.53	9.83	10.21	10.69	10.99	11.78	13.15	13.89	14.29	14.87	14.15	14.74	14.86	14.06	15.22	14.55	14.13	13.08	11.22	10.06
950	6.56	7.73	8.38	8.87	9.53	9.83	10.18	10.64	10.97	11.74	13.11	13.86	14.28	14.80	14.10	14.67	14.98	14.12	15.33	14.50	14.13	13.08	11.23	10.06
1000	6.57	7.75	8.45	8.89	9.53	9.83	10.14	10.58	10.94	11.69	13.06	13.83	14.26	14.73	14.05	14.59	15.10	14.18	15.44	14.45	14.12	13.07	11.23	10.06

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Table D.2. Input temperature (cont.).

FLOW(cfs)	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
TIME PERIODS==>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

TEMPERATURE (oC) AT RIVER MILE 54 (ELLIOT ROAD) FOR JUVENILE REARING, CAMANCHE REACH.

10	6.87	12.97	10.42	9.14	13.36	14.58	16.76	18.37	17.98	19.57	22.62	21.94	24.16	23.12	22.26	22.20	20.83	18.27	17.68	18.16	15.15	10.67	9.23	9.92
50	6.79	12.32	10.03	8.93	12.85	14.05	16.16	17.74	17.46	19.04	22.08	21.43	23.63	22.62	21.83	21.79	20.33	17.92	17.41	17.81	15.09	10.95	9.46	9.89
60	6.71	11.67	9.64	8.71	12.34	13.52	15.55	17.10	16.94	18.50	21.53	20.92	23.09	22.12	21.40	21.37	19.83	17.57	17.13	17.46	15.02	11.22	9.69	9.86
100	6.61	10.63	9.07	8.41	11.48	12.57	14.38	15.79	15.79	17.23	20.01	19.54	21.53	20.73	20.21	20.22	18.78	16.91	16.60	16.88	14.90	11.65	9.99	9.81
150	6.53	9.77	8.62	8.17	10.74	11.74	13.33	14.58	14.68	15.97	18.37	18.07	19.83	19.25	18.92	18.97	17.79	16.31	16.11	16.37	14.79	12.02	10.23	9.78
200	6.45	8.91	8.16	7.93	10.00	10.91	12.27	13.36	13.57	14.70	16.73	16.60	18.12	17.77	17.63	17.72	16.79	15.71	15.62	15.86	14.68	12.38	10.47	9.75
250	6.44	8.62	8.08	8.02	9.86	10.79	11.98	12.92	13.13	14.18	16.05	16.12	17.47	17.26	17.05	17.13	16.41	15.42	15.50	15.67	14.59	12.55	10.62	9.79
300	6.42	8.33	8.00	8.10	9.72	10.67	11.68	12.48	12.68	13.66	15.36	15.63	16.81	16.74	16.46	16.53	16.02	15.13	15.37	15.47	14.49	12.72	10.76	9.83
350	6.43	8.17	7.97	8.14	9.67	10.56	11.44	12.18	12.42	13.37	14.97	15.32	16.38	16.39	16.10	16.21	15.85	14.98	15.30	15.33	14.43	12.78	10.83	9.85
400	6.43	8.00	7.94	8.17	9.62	10.45	11.20	11.87	12.15	13.08	14.58	15.00	15.94	16.04	15.73	15.88	15.68	14.82	15.23	15.19	14.37	12.83	10.90	9.87
450	6.44	7.94	7.95	8.23	9.61	10.37	11.06	11.68	11.97	12.88	14.35	14.79	15.67	15.87	15.48	15.67	15.56	14.72	15.25	15.11	14.34	12.88	10.96	9.90
500	6.45	7.87	7.95	8.29	9.60	10.28	10.91	11.49	11.78	12.68	14.11	14.58	15.40	15.69	15.22	15.45	15.43	14.62	15.27	15.03	14.30	12.92	11.01	9.92
550	6.46	7.83	8.00	8.39	9.61	10.22	10.80	11.39	11.64	12.55	13.95	14.50	15.21	15.53	15.05	15.33	15.33	14.52	15.27	14.95	14.27	12.95	11.04	9.94
600	6.46	7.79	8.05	8.48	9.62	10.16	10.69	11.28	11.50	12.41	13.79	14.41	15.01	15.37	14.87	15.21	15.23	14.42	15.26	14.86	14.24	12.97	11.06	9.95
650	6.47	7.78	8.10	8.54	9.63	10.13	10.63	11.18	11.43	12.33	13.69	14.33	14.93	15.30	14.75	15.12	15.24	14.39	15.29	14.81	14.23	13.00	11.08	9.96
700	6.47	7.76	8.14	8.60	9.64	10.09	10.56	11.08	11.36	12.25	13.59	14.24	14.85	15.23	14.62	15.03	15.25	14.35	15.31	14.76	14.21	13.03	11.10	9.97
750	6.56	7.76	8.21	8.68	9.66	10.03	10.49	11.03	11.29	12.16	13.53	14.15	14.75	15.27	14.50	14.94	15.13	14.28	15.37	14.75	14.20	13.05	11.12	9.99
800	6.50	7.78	8.26	8.77	9.63	9.99	10.43	10.96	11.22	12.12	13.46	14.09	14.67	15.21	14.52	14.80	15.10	14.24	15.35	14.72	14.19	13.07	11.17	10.04
850	6.53	7.79	8.31	8.81	9.62	9.96	10.39	10.90	11.18	12.04	13.42	14.09	14.60	15.14	14.44	14.86	15.04	14.20	15.32	14.67	14.17	13.06	11.18	10.05
900	6.55	7.80	8.35	8.85	9.60	9.92	10.34	10.84	11.14	11.95	13.37	14.09	14.53	15.06	14.35	14.92	14.98	14.15	15.28	14.62	14.15	13.04	11.19	10.06
950	6.57	7.82	8.42	8.88	9.60	9.92	10.30	10.78	11.11	11.90	13.32	14.05	14.50	14.99	14.29	14.84	15.10	14.20	15.39	14.57	14.15	13.04	11.20	10.06
1000	6.58	7.84	8.48	8.90	9.60	9.91	10.26	10.72	11.08	11.85	13.26	14.00	14.47	14.91	14.23	14.76	15.21	14.25	15.49	14.51	14.14	13.04	11.21	10.06

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Table D.2. Input temperature (cont.).

FLOW(cfs)	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
TIME PERIODS==>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
TEMPERATURE (oC) AT RIVER MILE 29 (RAY ROAD) FOR ADULT UPSTREAM MIGRATION & JUVENILE DOWNSTREAM MIGRATION, WOODBRIDGE REACH																								
10	6.93	13.02	10.47	9.19	13.41	14.63	19.36	19.38	22.01	23.89	27.14	25.83	26.92	31.05	25.97	24.68	24.63	20.94	21.62	18.20	15.20	10.72	9.29	9.97
50	6.92	13.00	10.45	9.18	13.39	14.61	19.05	19.13	21.78	23.81	27.01	25.70	26.84	30.89	25.99	24.67	24.67	21.21	21.58	18.19	15.19	10.73	9.30	9.97
60	6.92	12.99	10.45	9.18	13.39	14.61	18.97	19.07	21.72	23.79	26.98	25.67	26.82	30.85	25.99	24.67	24.68	21.28	21.57	18.19	15.19	10.73	9.30	9.97
100	6.91	12.96	10.42	9.16	13.37	14.59	18.92	19.05	21.69	23.74	26.94	25.66	26.80	30.82	25.99	24.67	24.68	21.29	21.55	18.17	15.19	10.75	9.32	9.97
150	6.85	12.47	10.13	9.00	12.99	14.19	18.14	18.51	21.09	23.38	26.39	25.15	26.32	29.92	25.79	24.47	24.44	21.29	21.23	17.91	15.14	10.96	9.49	9.94
200	6.79	11.98	9.83	8.84	12.60	13.79	17.36	17.97	20.48	23.01	25.83	24.64	25.83	29.01	25.58	24.27	24.19	21.29	20.90	17.65	15.09	11.16	9.65	9.91
250	6.75	11.49	9.60	8.77	12.25	13.42	16.87	17.56	20.00	22.50	25.31	24.25	25.34	28.14	25.17	23.92	23.73	21.04	20.56	17.37	15.01	11.38	9.83	9.92
300	6.70	11.00	9.36	8.70	11.89	13.05	16.38	17.15	19.51	21.99	24.79	23.85	24.84	27.26	24.76	23.56	23.26	20.79	20.22	17.09	14.93	11.59	10.00	9.92
350	6.68	10.65	9.21	8.66	11.66	12.77	16.02	16.80	19.01	21.45	24.00	23.20	24.22	26.57	24.32	23.16	22.88	20.37	19.79	16.86	14.86	11.73	10.12	9.93
400	6.65	10.29	9.06	8.62	11.42	12.48	15.66	16.44	18.50	20.91	23.21	22.55	23.59	25.87	23.87	22.75	22.49	19.94	19.36	16.63	14.79	11.87	10.24	9.93
450	6.64	10.06	8.97	8.63	11.27	12.26	15.34	16.15	18.22	20.56	22.73	22.11	23.14	25.28	23.40	22.25	22.06	19.63	19.13	16.47	14.74	11.98	10.34	9.95
500	6.63	9.82	8.88	8.63	11.12	12.04	15.02	15.85	17.93	20.21	22.25	21.66	22.69	24.68	22.93	21.74	21.62	19.31	18.89	16.30	14.69	12.09	10.43	9.96
550	6.62	9.65	8.85	8.68	11.02	11.88	14.85	15.61	17.59	19.75	21.84	21.19	22.30	24.09	22.49	21.38	21.31	19.11	18.80	16.16	14.64	12.17	10.49	9.97
600	6.61	9.48	8.81	8.72	10.91	11.72	14.68	15.37	17.25	19.29	21.42	20.71	21.90	23.50	22.04	21.02	20.99	18.90	18.70	16.01	14.59	12.25	10.55	9.98
650	6.61	9.36	8.80	8.75	10.84	11.60	14.49	15.19	17.05	19.05	21.11	20.45	21.64	23.22	21.68	20.79	20.77	18.53	18.49	15.90	14.57	12.32	10.60	9.99
700	6.61	9.24	8.79	8.78	10.77	11.48	14.30	15.00	16.85	18.80	20.79	20.19	21.38	22.94	21.31	20.56	20.54	18.15	18.27	15.79	14.54	12.38	10.65	9.99
750	6.61	9.17	8.80	8.84	10.71	11.37	14.16	14.83	16.62	18.63	20.56	19.93	21.11	22.62	21.11	20.31	20.31	17.99	18.19	15.72	14.52	12.44	10.71	10.02
800	6.61	9.10	8.81	8.89	10.64	11.25	14.02	14.65	16.38	18.45	20.33	19.67	20.83	22.30	20.90	20.05	20.07	17.83	18.11	15.65	14.49	12.49	10.76	10.05
850	6.63	9.04	8.82	8.92	10.58	11.16	13.88	14.51	16.21	18.00	20.12	19.53	20.61	22.12	20.66	19.94	19.90	17.71	18.00	15.57	14.46	12.51	10.79	10.06
900	6.65	8.98	8.83	8.95	10.52	11.07	13.73	14.37	16.04	17.55	19.90	19.38	20.39	21.94	20.42	19.82	19.72	17.58	17.88	15.48	14.43	12.53	10.82	10.06
950	6.66	8.94	8.86	8.97	10.48	11.02	13.64	14.27	15.87	17.43	19.73	19.20	20.28	21.49	20.20	19.67	19.68	17.47	17.86	15.40	14.42	12.56	10.85	10.07
1000	6.67	8.90	8.89	8.98	10.43	10.96	13.54	14.16	15.69	17.31	19.55	19.01	20.17	21.04	19.98	19.51	19.63	17.36	17.83	15.32	14.40	12.58	10.88	10.07

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Table D.2. Input temperature (cont.).

FLOW(cfs)	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC	
TIME PERIODS==>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

TEMPERATURE (oC) AT RIVER MILE 49 (BRUELLA ROAD) FOR ADULT UPSTREAM MIGRATION & JUVENILE DOWNSTREAM MIGRATION, CAMANCHE REACH.

10	6.89	13.00	10.45	9.16	13.39	14.60	16.78	18.38	17.99	19.58	22.63	21.95	24.17	23.14	22.27	22.22	20.84	18.29	17.70	18.18	15.17	10.69	9.25	9.94
50	6.85	12.66	10.24	9.04	13.14	14.34	16.67	18.28	17.91	19.51	22.57	21.90	24.12	23.08	22.23	22.17	20.76	18.22	17.65	18.01	15.14	10.83	9.38	9.92
60	6.80	12.32	10.02	8.92	12.88	14.08	16.56	18.17	17.83	19.43	22.51	21.84	24.06	23.02	22.18	22.12	20.68	18.15	17.60	17.83	15.10	10.97	9.50	9.90
100	6.72	11.56	9.59	8.69	12.26	13.43	16.19	17.79	17.52	19.12	22.21	21.55	23.76	22.74	21.93	21.89	20.38	17.94	17.43	17.41	15.02	11.29	9.74	9.87
150	6.63	10.64	9.09	8.43	11.48	12.56	15.20	16.69	16.57	18.08	20.98	20.43	22.51	21.62	20.97	20.96	19.50	17.38	16.98	16.88	14.91	11.68	10.01	9.83
200	6.54	9.71	8.59	8.16	10.69	11.69	14.21	15.59	15.61	17.03	19.75	19.31	21.26	20.50	20.01	20.03	18.62	16.82	16.53	16.34	14.79	12.06	10.27	9.79
250	6.52	9.32	8.45	8.20	10.46	11.46	13.70	14.94	14.99	16.33	18.85	18.59	20.37	19.76	19.28	19.30	18.07	16.45	16.31	16.09	14.70	12.26	10.43	9.82
300	6.49	8.93	8.31	8.23	10.22	11.22	13.19	14.29	14.37	15.62	17.95	17.86	19.47	19.01	18.55	18.56	17.52	16.07	16.08	15.84	14.60	12.46	10.59	9.85
350	6.49	8.71	8.25	8.25	10.11	11.06	12.83	13.84	13.97	15.17	17.36	17.37	18.84	18.49	18.04	18.09	17.22	15.84	15.95	15.67	14.54	12.54	10.68	9.87
400	6.48	8.49	8.18	8.27	10.00	10.89	12.46	13.39	13.57	14.72	16.77	16.87	18.21	17.96	17.52	17.62	16.91	15.60	15.81	15.50	14.47	12.62	10.77	9.88
450	6.49	8.38	8.16	8.32	9.96	10.77	12.22	13.09	13.29	14.40	16.38	16.53	17.78	17.64	17.15	17.28	16.69	15.45	15.77	15.40	14.43	12.69	10.83	9.91
500	6.49	8.27	8.14	8.36	9.92	10.64	11.98	12.78	13.00	14.08	15.98	16.19	17.35	17.32	16.78	16.94	16.46	15.29	15.73	15.30	14.39	12.75	10.89	9.93
550	6.49	8.20	8.17	8.45	9.90	10.56	11.80	12.59	12.79	13.86	15.70	15.99	17.04	17.06	16.51	16.73	16.30	15.15	15.69	15.20	14.35	12.79	10.93	9.95
600	6.49	8.13	8.20	8.53	9.88	10.48	11.62	12.39	12.57	13.64	15.42	15.79	16.72	16.80	16.24	16.51	16.14	15.01	15.65	15.10	14.31	12.83	10.96	9.96
650	6.50	8.09	8.24	8.59	9.87	10.43	11.50	12.23	12.44	13.49	15.22	15.63	16.54	16.64	16.04	16.35	16.08	14.94	15.65	15.03	14.30	12.87	10.99	9.97
700	6.50	8.05	8.27	8.64	9.86	10.37	11.37	12.07	12.30	13.33	15.02	15.46	16.35	16.48	15.84	16.19	16.02	14.87	15.64	14.96	14.28	12.90	11.02	9.97
750	6.58	8.03	8.33	8.71	9.87	10.29	11.26	11.95	12.18	13.18	14.88	15.30	16.17	16.43	15.66	16.03	15.87	14.77	15.67	14.94	14.27	12.93	11.04	10.00
800	6.52	8.04	8.37	8.79	9.83	10.24	11.16	11.84	12.06	13.08	14.73	15.18	16.01	16.32	15.61	15.84	15.80	14.71	15.64	14.90	14.25	12.96	11.09	10.04
850	6.55	8.04	8.41	8.83	9.81	10.20	11.08	11.74	11.98	12.96	14.63	15.12	15.88	16.19	15.48	15.84	15.71	14.65	15.59	14.84	14.23	12.96	11.11	10.05
900	6.58	8.03	8.44	8.87	9.78	10.15	11.00	11.64	11.90	12.83	14.52	15.06	15.74	16.06	15.34	15.84	15.62	14.58	15.54	14.78	14.21	12.95	11.12	10.06
950	6.59	8.04	8.50	8.89	9.77	10.14	10.93	11.55	11.84	12.74	14.42	14.98	15.66	15.95	15.24	15.72	15.69	14.61	15.63	14.73	14.20	12.96	11.14	10.06
1000	6.60	8.04	8.56	8.91	9.76	10.12	10.86	11.45	11.77	12.65	14.31	14.89	15.57	15.83	15.13	15.60	15.76	14.63	15.71	14.67	14.19	12.96	11.15	10.06

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Table D.3. Physical habitat suitability (average for all study reaches).

CHINOOK SALMON

Flow	SCIES SCORE			WUA		
	Spawning	Fry	Juvenile	Spawning	Fry	Juvenile
100	54.65	100.00	100.00	7,960.33	23,324.25	22,646.50
200	83.36	76.27	82.19	12,142.67	17,789.25	18,613.00
300	100.00	55.80	76.67	14,566.33	13,015.25	17,362.50
400	99.81	42.88	62.48	14,539.33	10,001.00	14,150.00
500	96.54	30.38	46.03	14,062.33	7,086.50	10,423.50
600	92.04	26.17	37.63	13,407.00	6,103.25	8,522.00
700	85.74	24.19	32.20	12,488.67	5,643.00	7,293.25
800	75.10	22.72	27.82	10,938.67	5,298.50	6,300.50
900	65.56	21.66	24.50	9,549.00	5,051.75	5,548.25
1,000	56.74	20.97	21.48	8,265.33	4,891.25	4,864.00

STEELHEAD TROUT

Flow	SCIES SCORE			WUA		
	Spawning	Fry	Juvenile	Spawning	Fry	Juvenile
100	54.34	100.00	100.00	4,785.67	15,160.75	24,890.75
200	94.14	63.01	84.86	8,290.67	9,552.25	21,122.00
300	90.97	56.80	78.73	8,011.33	8,610.75	19,597.50
400	87.61	44.25	65.70	7,715.33	6,709.00	16,353.75
500	100.00	29.00	51.99	8,806.67	4,397.25	12,941.25
600	91.50	19.74	40.62	8,058.33	2,993.25	10,111.25
700	81.46	13.12	30.71	7,173.67	1,988.75	7,643.25
800	68.93	9.01	24.08	6,070.33	1,366.00	5,992.75
900	55.25	6.50	19.45	4,866.00	984.75	4,842.00
1,000	42.90	5.00	16.00	3,778.00	757.75	3,982.75

Table D.4. Temperature suitability for chinook salmon and steelhead trout.

Temperature (oC)	Chinook Salmon					Steelhead Trout				
	In-migration	Spawning	Fry	Juvenile	Out-migration	In-migration	Spawning	Fry	Juvenile	Out-migration
8	100	100	100	100	100	100	100	100	100	100
9	100	100	100	100	100	100	100	100	100	100
10	100	100	100	100	100	100	100	100	100	100
11	100	100	100	100	100	100	100	100	100	100
12	100	100	100	100	100	100	100	100	100	100
13	100	100	100	100	100	100	100	100	100	100
14	100	100	100	100	100	100	100	100	100	100
15	100	67	67	100	100	100	67	67	100	100
16	100	33	33	100	100	100	33	33	100	100
17	100	0	0	100	100	100	0	0	100	100
18	100	0	0	100	100	100	0	0	100	100
19	100	0	0	83	83	100	0	0	83	83
20	83	0	0	67	67	83	0	0	67	67
21	67	0	0	50	50	67	0	0	50	50
22	50	0	0	33	33	50	0	0	33	33
23	33	0	0	17	17	33	0	0	17	17
24	17	0	0	0	0	17	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0

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Table D.5. Seasonal life-cycle weighting factors.

CHINOOK SALMON

Reach	Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Average
Camanche Reach	Immigration	0.01									0.22	0.61	0.16	1.00
	Spawning	0.19	0.03								0.11	0.37	0.30	1.00
	Fry	0.13	0.44	0.32	0.11								0.00	1.00
	Juvenile			0.15	0.34	0.23	0.24	0.04						1.00
	Outmigration			0.01	0.01	0.48	0.46	0.04						1.00
Woodbridge Reach	Immigration	0.01									0.22	0.61	0.16	1.00
	Outmigration			0.01	0.01	0.48	0.46	0.04					0.00	1.00

STEELHEAD TROUT

Reach	Lifestage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Average
Camanche Reach	Immigration	0.28	0.22	0.14								0.14	0.22	1.00
	Spawning	0.22	0.22	0.17	0.11							0.11	0.17	1.00
	Fry	0.13	0.22	0.28	0.22	0.14							0.01	1.00
	Juvenile	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	1.00
	Outmigration	0.21	0.21	0.16	0.10	0.06						0.10	0.16	1.00
Woodbridge Reach	Immigration	0.28	0.22	0.14								0.14	0.22	1.00
	Outmigration	0.21	0.21	0.16	0.10	0.05	0.01					0.10	0.16	1.00

C—101317

Table D.6.1. Species and life stage SCIES scores as a function of discharge for CDFG Plan, dry water years.

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	275	250	275	375	600	275	300	250	250	238	313	275	306
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	91.68	91.68								31.94	95.79	91.68	86.63
	Fry	66.04	66.04	66.04	46.11								66.04	63.84
	Juvenile			79.43	66.03	37.63	79.43	76.67						65.15
	Out-migration			100.00	100.00	100.00	88.04	79.33						93.67
							Discharge (cfs)							
	DISCHARGE	200	200	200	225	375	25	25	25	75	163	250	200	164
Woodbridge Reach	In-migration	100.00									96.58	100.00	100.00	99.25
	Out-migration			100.00	100.00	95.50	0.00	0.00						47.84
Camanche Score		81.83	67.67	70.93	62.00	79.80	85.09	78.00			77.31	98.41	94.57	81.86
Woodbridge Score		100.00		100.00	100.00	95.50	0.00	0.00			96.58	100.00	100.00	73.54
Combined Reaches Scores		90.92	67.67	85.46	81.00	87.65	42.54	39.00			86.95	99.21	97.29	77.70
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	275	250	275	375	600	275	300	250	250	238	313	275	306
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	92.55	92.55	92.55	88.45							90.92	92.55	91.92
	Fry	59.90	59.90	59.90	47.39	19.74							59.90	51.53
	Juvenile	81.80	81.80	81.80	68.96	40.62	81.80	78.73	81.80	81.80	50.00	36.11	40.90	67.32
	Out-migration	100.00	100.00	100.00	100.00	100.00	88.04					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	200	200	200	225	375	25	25	25	75	163	250	200	164
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	95.50	0.00					100.00	100.00	98.78
Camanche Score		90.97	87.46	83.19	69.94	42.83	81.80	78.73	81.80	81.80	50.00	85.79	90.01	82.15
Woodbridge Score		100.00	100.00	100.00	100.00	95.50	0.00					100.00	100.00	99.39
Combined Reaches Scores		95.49	93.73	91.60	84.97	69.16	40.90	78.73	81.80	81.80	50.00	92.90	95.00	90.77
Combined Reaches/Species Scores		93.20	80.70	88.53	82.99	78.41	41.72	58.87	81.80	81.80	68.47	96.05	96.15	84.24

C—101318

C-101319

Table D.6.1. Species and life stage SCIES scores as a function of discharge for CDFG Plan, normal water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	375	350	425	550	800	925	600	475	350	700	463	375	532
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	99.91	99.91								59.64	97.10	99.91	94.44
	Fry	49.34	49.34	42.88	28.27								49.34	44.95
	Juvenile			62.48	41.83	28.09	24.50	37.63						37.44
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	300	300	350	400	500	500	150	100	100	550	413	300	330
Woodbridge Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Out-migration			100.00	100.00	100.00	72.67	21.67						84.29
Camanche Score		79.99	52.57	50.19	39.85	76.70	74.11	68.82			86.55	98.90	99.94	75.37
Woodbridge Score		100.00		100.00	100.00	100.00	72.67	0.00			100.00	100.00	100.00	92.15
Combined Reaches Scores		89.99	52.57	75.10	69.93	88.35	73.39	34.41			93.27	99.45	99.97	83.76
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	375	350	425	550	800	925	600	475	350	700	463	375	532
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	89.29	89.29	87.61	95.75							92.52	89.29	90.07
	Fry	50.52	50.52	44.25	24.37	9.41							50.52	37.26
	Juvenile	72.22	72.22	65.70	46.31	24.58	19.45	40.62	58.85	72.22	20.31	23.15	36.11	45.57
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	300	300	350	400	500	500	150	100	100	550	413	300	330
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	100.00	72.67					100.00	100.00	99.73
Camanche Score		88.03	83.72	75.35	58.04	32.86	19.45	40.62	58.85	72.22	20.31	83.79	88.40	74.58
Woodbridge Score		100.00	100.00	100.00	100.00	100.00	72.67					100.00	100.00	99.86
Combined Reaches Scores		94.02	91.86	87.67	79.02	66.43	46.06	40.62	58.85	72.22	20.31	91.89	94.20	87.22
Combined Reaches/Species Scores		92.01	72.21	81.39	74.47	77.39	59.73	37.52	58.85	72.22	56.79	95.67	97.08	85.49

C—101319

Table D.6.1. Species and life stage SCIES scores as a function of discharge for CDFG Plan, wet water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	425	400	475	600	750	875	750	675	550	700	513	425	595
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	99.81	99.81								59.95	95.93	99.81	93.99
	Fry	42.88	42.88	36.63	26.17								42.88	39.04
	Juvenile			54.25	37.63	30.01	26.16	30.01						35.31
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	350	350	400	450	450	475	300	300	300	550	463	350	395
Woodbridge Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Out-migration			100.00	100.00	100.00	69.67	35.63						83.47
Camanche Score		77.39	46.51	43.46	36.25	77.33	74.68	65.01			86.65	98.46	99.88	73.67
Woodbridge Score		100.00		100.00	100.00	100.00	69.67	0.00			100.00	100.00	100.00	91.74
Combined Reaches Scores		88.70	46.51	71.73	68.12	88.66	72.18	32.50			93.33	99.23	99.94	82.70
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	425	400	475	600	750	875	750	675	550	700	513	425	595
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	87.61	87.61	93.80	91.50							89.56	87.61	89.30
	Fry	44.25	44.25	36.63	19.74	11.06							44.25	32.08
	Juvenile	65.70	65.70	58.85	40.62	27.39	21.76	27.39	35.66	23.15	17.83	20.31	32.85	36.10
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	350	350	400	450	450	475	300	300	300	550	463	350	395
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	100.00	69.67					100.00	100.00	99.70
Camanche Score		86.18	81.33	73.39	54.23	34.53	21.76	27.39	35.66	23.15	17.83	82.50	87.44	71.50
Woodbridge Score		100.00	100.00	100.00	100.00	100.00	69.67					100.00	100.00	99.85
Combined Reaches Scores		93.09	90.67	86.69	77.12	67.27	45.72	27.39	35.66	23.15	17.83	91.25	93.72	85.67
Combined Reaches/Species Scores		90.89	68.59	79.21	72.62	77.96	58.95	29.95	35.66	23.15	55.58	95.24	96.83	84.19

C-101320

C-101320

C-101321

Table D.6.2. Species and life stage SCIES scores as a function of discharge for escapement alternative, critical dry water years.

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	125	100	125	175	225	300	300	250	175	113	250	200	195
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	54.65	54.65								9.65	91.68	73.16	68.96
	Fry	100.00	100.00	100.00	88.13								83.02	98.69
	Juvenile			100.00	91.09	82.19	76.67	76.67						86.34
	Out-migration			100.00	100.00	100.00	100.00	79.33						99.17
							Discharge (cfs)							
	DISCHARGE	50	50	50	25	25	25	25	25	25	38	200	125	55
Woodbridge Reach	In-migration	100.00									85.67	100.00	100.00	96.85
	Out-migration			100.00	94.58	37.58	0.00	0.00						19.99
Camanche Score		73.89	97.11	100.00	90.58	94.23	92.00	78.00			69.88	96.86	82.50	90.63
Woodbridge Score		100.00		100.00	94.58	37.58	0.00	0.00			85.67	100.00	100.00	58.42
Combined Reaches Scores		86.94	97.11	100.00	92.58	65.91	46.00	39.00			77.78	98.43	91.25	74.52
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	125	100	125	175	225	300	300	250	175	113	250	200	195
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	54.34	54.34	54.34	74.24							92.55	73.45	63.98
	Fry	100.00	100.00	100.00	81.50	60.17							79.95	90.15
	Juvenile	100.00	100.00	100.00	92.43	84.86	78.73	78.73	81.80	92.43	50.00	40.90	40.90	78.50
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	50	50	50	25	25	25	25	25	25	38	200	125	55
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	94.58	37.58	0.00					100.00	100.00	95.34
Camanche Score		89.08	89.43	90.65	85.28	76.07	78.73	78.73	81.80	92.43	50.00	87.10	85.25	86.53
Woodbridge Score		100.00	100.00	100.00	94.58	37.58	0.00					100.00	100.00	97.67
Combined Reaches Scores		94.54	94.71	95.32	89.93	56.83	39.37	78.73	81.80	92.43	50.00	93.55	92.62	92.10
Combined Reaches/Species Scores		90.74	95.91	97.66	91.26	61.37	42.68	58.87	81.80	92.43	63.89	95.99	91.94	83.31

C—101321

Table D.6.2. Species and life stage SCIES scores as a function of discharge for escapement alternative, dry water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	200	200	200	275	550	300	300	250	175	238	650	413	313
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	83.36	83.36								31.94	88.89	87.70	81.05
	Fry	76.27	76.27	76.27	60.92								51.22	74.58
	Juvenile			82.19	78.05	41.83	76.67	76.67						69.95
	Out-migration			100.00	100.00	100.00	100.00	79.33						99.17
							Discharge (cfs)							
	DISCHARGE	125	150	125	125	350	25	25	25	25	163	600	338	173
Woodbridge Reach	In-migration	100.00									96.58	100.00	100.00	99.25
	Out-migration			100.00	100.00	89.83	0.00	0.00						45.12
Camanche Score		81.07	76.72	78.61	74.43	81.16	92.00	78.00			77.31	95.80	91.98	84.95
Woodbridge Score		100.00		100.00	100.00	89.83	0.00	0.00			96.58	100.00	100.00	72.18
Combined Reaches Scores		90.54	76.72	89.31	87.21	85.49	46.00	39.00			86.95	97.90	95.99	78.57
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	200	200	200	275	550	300	300	250	175	238	650	413	313
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	94.14	94.14	94.14	91.76							86.48	92.82	92.81
	Fry	63.01	63.01	63.01	58.35	24.37							41.37	56.36
	Juvenile	84.86	84.86	84.86	80.27	46.31	78.73	78.73	81.80	92.43	50.00	17.83	20.31	66.93
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	125	350	25	25	25	25	163	600	338	173
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	89.83	0.00					100.00	100.00	98.49
Camanche Score		92.05	88.80	84.86	77.16	46.83	78.73	78.73	81.80	92.43	50.00	81.25	87.22	83.22
Woodbridge Score		100.00	100.00	100.00	100.00	89.83	0.00					100.00	100.00	99.25
Combined Reaches Scores		96.03	94.40	92.43	88.58	68.33	39.37	78.73	81.80	92.43	50.00	90.63	93.61	91.23
Combined Reaches/Species Scores		93.28	85.56	90.87	87.90	76.91	42.68	58.87	81.80	92.43	68.47	94.26	94.80	84.90

C-101322

C—101322

C-101323

Table D.6.2. Species and life stage SCIES scores as a function of discharge for escapement alternative, normal water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	300	200	200	275	650	900	475	400	275	300	650	463	424
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	100.00	83.36								43.68	88.89	96.02	88.00
	Fry	55.80	76.27	76.27	60.92								40.98	71.92
	Juvenile			82.19	78.05	34.92	24.50	54.25						54.95
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	225	150	125	125	350	500	25	25	25	163	600	388	225
Woodbridge Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Out-migration			100.00	100.00	99.58	72.67	0.00						83.23
Camanche Score		82.59	76.72	78.61	74.43	78.92	74.11	77.13			81.23	95.80	97.40	82.97
Woodbridge Score		100.00		100.00	100.00	99.58	72.67	0.00			100.00	100.00	100.00	91.61
Combined Reaches Scores		91.29	76.72	89.31	87.21	89.25	73.39	38.56			90.61	97.90	98.70	87.29
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	300	200	200	275	650	900	475	400	275	300	650	463	424
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	90.97	94.14	94.14	91.76							86.48	91.24	91.84
	Fry	56.80	63.01	63.01	58.35	16.43							38.27	54.41
	Juvenile	78.73	84.86	84.86	80.27	35.66	19.45	58.85	65.70	81.80	46.21	17.83	20.31	55.76
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	225	150	125	125	350	500	25	25	25	163	600	388	225
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	99.58	72.67					100.00	100.00	99.71
Camanche Score		89.89	88.80	84.86	77.16	39.69	19.45	58.85	65.70	81.80	46.21	81.25	86.75	80.40
Woodbridge Score		100.00	100.00	100.00	100.00	99.58	72.67					100.00	100.00	99.85
Combined Reaches Scores		94.94	94.40	92.43	88.58	69.64	46.06	58.85	65.70	81.80	46.21	90.63	93.37	90.13
Combined Reaches/Species Scores		93.12	85.56	90.87	87.90	79.44	59.73	48.71	65.70	81.80	68.41	94.26	96.04	88.71

C—101323

Table D.6.2. Species and life stage SCIES scores as a function of discharge for escapement alternative, wet water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON														
	DISCHARGE (Discharge (cfs))	300	250	275	275	650	900	475	400	275	300	650	463	434
Camanche Reach	In-migration	100.00												
	Spawning	100.00	91.68								100.00	100.00	100.00	100.00
	Fry	55.80	66.04	66.04	60.92						43.68	88.89	96.02	88.25
	Juvenile			79.43	78.05	34.92	24.50	54.25					40.98	64.14
	Out-migration			100.00	100.00	100.00	100.00	100.00						54.53
														100.00
	DISCHARGE (Discharge (cfs))	225	200	200	125	350	500	25	25	25	163	600	388	235
Woodbridge Reach	In-migration	100.00												
	Out-migration			100.00	100.00	99.58	72.67	0.00			100.00	100.00	100.00	100.00
														83.23
Camanche Score		82.59	67.67	70.93	74.43	78.92	74.11	77.13			81.23	95.80	97.40	81.38
Woodbridge Score		100.00		100.00	100.00	99.58	72.67	0.00			100.00	100.00	100.00	91.61
Combined Reaches Scores		91.29	67.67	85.46	87.21	89.25	73.39	38.56			90.61	97.90	98.70	86.50
STEELHEAD TROUT														
	DISCHARGE (Discharge (cfs))	300	250	275	275	650	900	475	400	275	300	650	463	434
Camanche Reach	In-migration	100.00	100.00	100.00										
	Spawning	90.97	92.55	92.55	91.76							100.00	100.00	100.00
	Fry	56.80	59.90	59.90	58.35	16.43						86.48	91.24	91.23
	Juvenile	78.73	81.80	81.80	80.27	35.66	19.45	58.85	65.70	81.80	46.21		38.27	52.85
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					17.83	20.31	55.27
												100.00	100.00	100.00
	DISCHARGE (Discharge (cfs))	225	200	200	125	350	500	25	25	25	163	600	388	235
Woodbridge Reach	In-migration	100.00	100.00	100.00										
	Out-migration	100.00	100.00	100.00	100.00	99.58	72.67					100.00	100.00	100.00
												100.00	100.00	99.71
Camanche Score		89.89	87.46	83.19	77.16	39.69	19.45	58.85	65.70	81.80	46.21	81.25	86.75	79.87
Woodbridge Score		100.00	100.00	100.00	100.00	99.58	72.67					100.00	100.00	99.85
Combined Reaches Scores		94.94	93.73	91.60	88.58	69.64	46.06	58.85	65.70	81.80	46.21	90.63	93.37	89.86
Combined Reaches/Species Scores		93.12	80.70	88.53	87.90	79.44	59.73	48.71	65.70	81.80	68.41	94.26	96.04	88.18

C-101324

C-101324

Table D.6.3. Species and life stage SCIES scores as a function of discharge for natural production alternative, critical dry water years.

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	125	100	125	175	225	300	300	250	175	100	150	150	181
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	54.65	54.65								9.65	69.01	61.83	57.16
	Fry	100.00	100.00	100.00	88.13								94.07	98.69
	Juvenile			100.00	91.09	82.19	76.67	76.67						86.34
	Out-migration			100.00	100.00	100.00	100.00	79.33						99.17
							Discharge (cfs)							
	DISCHARGE	50	50	50	25	25	25	25	25	25	25	100	75	42
Woodbridge Reach	In-migration	100.00									85.67	100.00	100.00	96.85
	Out-migration			100.00	94.58	37.58	0.00	0.00						19.99
Camanche Score		73.89	97.11	100.00	90.58	94.23	92.00	78.00			69.88	88.30	75.10	88.28
Woodbridge Score		100.00		100.00	94.58	37.58	0.00	0.00			85.67	100.00	100.00	58.42
Combined Reaches Scores		86.94	97.11	100.00	92.58	65.91	46.00	39.00			77.78	94.15	87.55	73.35
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	125	100	125	175	225	300	300	250	175	100	150	150	181
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	54.34	54.34	54.34	74.24							74.24	64.29	60.41
	Fry	100.00	100.00	100.00	81.50	60.17							90.75	90.26
	Juvenile	100.00	100.00	100.00	92.43	84.86	78.73	78.73	81.80	92.43	50.00	46.21	46.21	79.35
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	50	50	50	25	25	25	25	25	25	25	100	75	42
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	94.58	37.58	0.00					100.00	100.00	95.34
Camanche Score		89.08	89.43	90.65	85.28	76.07	78.73	78.73	81.80	92.43	50.00	83.40	83.65	86.01
Woodbridge Score		100.00	100.00	100.00	94.58	37.58	0.00					100.00	100.00	97.67
Combined Reaches Scores		94.54	94.71	95.32	89.93	56.83	39.37	78.73	81.80	92.43	50.00	91.70	91.82	91.84
Combined Reaches/Species Scores		90.74	95.91	97.66	91.26	61.37	42.68	58.87	81.80	92.43	63.89	92.93	89.69	82.59

C-101325

C—101325

Table D.6.3. Species and life stage SCIES scores as a function of discharge for natural production alternative, dry water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	200	200	200	275	550	300	300	250	175	150	250	238	257
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	83.36	83.36								23.23	91.68	87.52	81.07
	Fry	76.27	76.27	76.27	60.92								71.15	74.58
	Juvenile			82.19	78.05	41.83	76.67	76.67						69.95
	Out-migration			100.00	100.00	100.00	100.00	79.33						99.17
							Discharge (cfs)							
	DISCHARGE	125	150	125	125	350	25	25	25	25	75	200	163	118
Woodbridge Reach	In-migration	100.00									90.00	100.00	100.00	97.80
	Out-migration			100.00	100.00	89.83	0.00	0.00						45.12
Camanche Score		81.07	76.72	78.61	74.43	81.16	92.00	78.00			74.41	96.86	91.86	84.96
Woodbridge Score		100.00		100.00	100.00	89.83	0.00	0.00			90.00	100.00	100.00	71.46
Combined Reaches Scores		90.54	76.72	89.31	87.21	85.49	46.00	39.00			82.21	98.43	95.93	78.21
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	200	200	200	275	550	300	300	250	175	150	250	238	257
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	94.14	94.14	94.14	91.76							92.55	93.35	93.57
	Fry	63.01	63.01	63.01	58.35	24.37							61.45	56.56
	Juvenile	84.86	84.86	84.86	80.27	46.31	78.73	78.73	81.80	92.43	50.00	40.90	40.90	70.43
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	125	350	25	25	25	25	75	200	163	118
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	89.83	0.00					100.00	100.00	98.49
Camanche Score		92.05	88.80	84.86	77.16	46.83	78.73	78.73	81.80	92.43	50.00	87.10	90.24	84.11
Woodbridge Score		100.00	100.00	100.00	100.00	89.83	0.00					100.00	100.00	99.25
Combined Reaches Scores		96.03	94.40	92.43	88.58	68.33	39.37	78.73	81.80	92.43	50.00	93.55	95.12	91.68
Combined Reaches/Species Scores		93.28	85.56	90.87	87.90	76.91	42.68	58.87	81.80	92.43	66.10	95.99	95.53	84.94

C-101326

C-101326

C-101327

Table D.6.3. Species and life stage SCIES scores as a function of discharge for natural production alternative, normal water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	200	200	200	275	650	900	475	400	275	250	350	338	376
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	83.36	83.36								41.45	99.91	99.95	89.85
	Fry	76.27	76.27	76.27	60.92								52.57	74.58
	Juvenile			82.19	78.05	34.92	24.50	54.25						54.95
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	125	350	500	25	25	25	113	300	263	177
Woodbridge Reach	In-migration	100.00									99.29	100.00	100.00	99.84
	Out-migration			100.00	100.00	99.58	72.67	0.00						83.23
Camanche Score		81.07	76.72	78.61	74.43	78.92	74.11	77.13			80.48	99.97	99.97	83.88
Woodbridge Score		100.00		100.00	100.00	99.58	72.67	0.00			99.29	100.00	100.00	91.54
Combined Reaches Scores		90.54	76.72	89.31	87.21	89.25	73.39	38.56			89.89	99.98	99.98	87.71
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	200	200	200	275	650	900	475	400	275	250	350	338	376
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	94.14	94.14	94.14	91.76							89.29	90.13	92.66
	Fry	63.01	63.01	63.01	58.35	16.43							53.66	55.37
	Juvenile	84.86	84.86	84.86	80.27	35.66	19.45	58.85	65.70	81.80	46.21	36.11	36.11	58.98
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	125	350	500	25	25	25	113	300	263	177
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	99.58	72.67					100.00	100.00	99.71
Camanche Score		92.05	88.80	84.86	77.16	39.69	19.45	58.85	65.70	81.80	46.21	85.37	88.67	81.40
Woodbridge Score		100.00	100.00	100.00	100.00	99.58	72.67					100.00	100.00	99.85
Combined Reaches Scores		96.03	94.40	92.43	88.58	69.64	46.06	58.85	65.70	81.80	46.21	92.69	94.33	90.63
Combined Reaches/Species Scores		93.28	85.56	90.87	87.90	79.44	59.73	48.71	65.70	81.80	68.05	96.33	97.16	89.17

C-101327

Table D.6.3. Species and life stage SCIES scores as a function of discharge for natural production alternative, wet water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	200	200	200	275	650	900	475	400	275	250	350	338	376
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	83.36	83.36								41.45	99.91	99.95	89.85
	Fry	76.27	76.27	76.27	60.92								52.57	74.58
	Juvenile			82.19	78.05	34.92	24.50	54.25						54.95
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	125	350	500	25	25	25	113	300	263	177
Woodbridge Reach	In-migration	100.00									99.29	100.00	100.00	99.84
	Out-migration			100.00	100.00	99.58	72.67	0.00						83.23
Camanche Score		81.07	76.72	78.61	74.43	78.92	74.11	77.13			80.48	99.97	99.97	83.88
Woodbridge Score		100.00		100.00	100.00	99.58	72.67	0.00			99.29	100.00	100.00	91.54
Combined Reaches Scores		90.54	76.72	89.31	87.21	89.25	73.39	38.56			89.89	99.98	99.98	87.71
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	200	200	200	275	650	900	475	400	275	250	350	338	376
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	94.14	94.14	94.14	91.76							89.29	90.13	92.66
	Fry	63.01	63.01	63.01	58.35	16.43							53.66	55.37
	Juvenile	84.86	84.86	84.86	80.27	35.66	19.45	58.85	65.70	81.80	46.21	36.11	36.11	58.98
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	125	350	500	25	25	25	113	300	263	177
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	99.58	72.67					100.00	100.00	99.71
Camanche Score		92.05	88.80	84.86	77.16	39.69	19.45	58.85	65.70	81.80	46.21	85.37	88.67	81.40
Woodbridge Score		100.00	100.00	100.00	100.00	99.58	72.67					100.00	100.00	99.85
Combined Reaches Scores		96.03	94.40	92.43	88.58	69.64	46.06	58.85	65.70	81.80	46.21	92.69	94.33	90.63
Combined Reaches/Species Scores		93.28	85.56	90.87	87.90	79.44	59.73	48.71	65.70	81.80	68.05	96.33	97.16	89.17

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C-101329

Table D.6.4. Species and life stage SCIES scores as a function of discharge for hatchery production alternative, critical dry water years.

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	125	100	125	200	250	325	325	275	225	125	100	125	192
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	54.65	54.65								9.65	54.65	54.65	49.70
	Fry	100.00	100.00	100.00	76.27								100.00	97.39
	Juvenile			100.00	82.19	79.43	76.67	76.67						82.68
	Out-migration			100.00	100.00	100.00	100.00	79.33						99.17
							Discharge (cfs)							
	DISCHARGE	50	50	50	50	50	50	50	50	50	50	50	50	50
Woodbridge Reach	In-migration	100.00									85.67	100.00	100.00	96.85
	Out-migration			100.00	100.00	45.87	0.00	0.00						24.02
Camanche Score		73.89	97.11	100.00	81.16	93.34	92.00	78.00			69.88	82.88	70.42	85.79
Woodbridge Score		100.00		100.00	100.00	45.87	0.00	0.00			85.67	100.00	100.00	60.43
Combined Reaches Scores		86.94	97.11	100.00	90.58	69.61	46.00	39.00			77.78	91.44	85.21	73.11
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	125	100	125	200	250	325	325	275	225	125	100	125	192
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	54.34	54.34	54.34	94.14							54.34	54.34	58.72
	Fry	100.00	100.00	100.00	63.01	59.90							100.00	86.25
	Juvenile	100.00	100.00	100.00	84.86	81.80	78.73	78.73	81.80	84.86	50.00	50.00	50.00	78.47
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	50	50	50	50	50	50	50	50	50	50	50	50	50
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	45.87	0.00					100.00	100.00	96.29
Camanche Score		89.08	89.43	90.65	80.40	74.99	78.73	78.73	81.80	84.86	50.00	79.02	81.62	84.69
Woodbridge Score		100.00	100.00	100.00	100.00	45.87	0.00					100.00	100.00	98.15
Combined Reaches Scores		94.54	94.71	95.32	90.20	60.43	39.37	78.73	81.80	84.86	50.00	89.51	90.81	91.42
Combined Reaches/Species Scores		90.74	95.91	97.66	90.39	65.02	42.68	58.87	81.80	84.86	63.89	90.47	88.01	82.26

C—101329

C-101330

Table D.6.4. Species and life stage SCIES scores as a function of discharge for hatchery production alternative, all other water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	175	150	125	200	325	500	325	275	225	125	125	175	227
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	69.01	69.01								9.65	61.83	69.01	59.82
	Fry	88.13	88.13	100.00	76.27								88.13	90.63
	Juvenile			100.00	82.19	73.12	50.14	76.67						74.86
	Out-migration			100.00	100.00	100.00	100.00	79.33						99.17
							Discharge (cfs)							
	DISCHARGE	100	100	50	50	125	225	50	50	50	50	75	100	85
Woodbridge Reach	In-migration	100.00									85.67	100.00	100.00	96.85
	Out-migration			100.00	100.00	58.67	30.08	0.00						44.00
Camanche Score		77.48	86.91	100.00	81.16	91.29	82.91	78.00			69.88	85.59	79.79	84.90
Woodbridge Score		100.00		100.00	100.00	58.67	30.08	0.00			85.67	100.00	100.00	70.42
Combined Reaches Scores		88.74	86.91	100.00	90.58	74.98	56.49	39.00			77.78	92.79	89.89	77.66
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	175	150	125	200	325	500	325	275	225	125	125	175	227
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	74.24	74.24	54.34	94.14							64.29	74.24	71.95
	Fry	81.50	81.50	100.00	63.01	53.66							81.50	78.72
	Juvenile	92.43	92.43	100.00	84.86	75.48	55.42	78.73	81.80	84.86	50.00	50.00	46.21	74.29
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	100	100	50	50	125	225	50	50	50	50	75	100	85
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	58.67	30.08					100.00	100.00	97.23
Camanche Score		90.57	89.11	90.65	80.40	70.02	55.42	78.73	81.80	84.86	50.00	81.56	86.15	84.99
Woodbridge Score		100.00	100.00	100.00	100.00	58.67	30.08					100.00	100.00	98.62
Combined Reaches Scores		95.28	94.56	95.32	90.20	64.34	42.75	78.73	81.80	84.86	50.00	90.78	93.07	91.80
Combined Reaches/Species Scores		92.01	90.74	97.66	90.39	69.66	49.62	58.87	81.80	84.86	63.89	91.79	91.48	84.73

C—101330

C-101331

Table D.6.5. Species and life stage SCIES scores as a function of discharge for maximum harvest alternative, critical dry water years.

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	125	100	125	175	225	300	300	250	175	100	150	150	181
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	54.65	54.65								9.65	69.01	61.83	57.16
	Fry	100.00	100.00	100.00	88.13								94.07	98.69
	Juvenile			100.00	91.09	82.19	76.67	76.67						86.34
	Out-migration			100.00	100.00	100.00	100.00	79.33						99.17
							Discharge (cfs)							
	DISCHARGE	50	50	50	25	25	25	25	25	25	25	100	75	42
Woodbridge Reach	In-migration	100.00									85.67	100.00	100.00	96.85
	Out-migration			100.00	94.58	37.58	0.00	0.00						19.99
Camanche Score		73.89	97.11	100.00	90.58	94.23	92.00	78.00			69.88	88.30	75.10	88.28
Woodbridge Score		100.00		100.00	94.58	37.58	0.00	0.00			85.67	100.00	100.00	58.42
Combined Reaches Scores		86.94	97.11	100.00	92.58	65.91	46.00	39.00			77.78	94.15	87.55	73.35
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	125	100	125	175	225	300	300	250	175	100	150	150	181
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	54.34	54.34	54.34	74.24							74.24	64.29	60.41
	Fry	100.00	100.00	100.00	81.50	60.17							90.75	90.26
	Juvenile	100.00	100.00	100.00	92.43	84.86	78.73	78.73	81.80	92.43	50.00	46.21	46.21	79.35
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	50	50	50	25	25	25	25	25	25	25	100	75	42
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	94.58	37.58	0.00					100.00	100.00	95.34
Camanche Score		89.08	89.43	90.65	85.28	76.07	78.73	78.73	81.80	92.43	50.00	83.40	83.65	86.01
Woodbridge Score		100.00	100.00	100.00	94.58	37.58	0.00					100.00	100.00	97.67
Combined Reaches Scores		94.54	94.71	95.32	89.93	56.83	39.37	78.73	81.80	92.43	50.00	91.70	91.82	91.84
Combined Reaches/Species Scores		90.74	95.91	97.66	91.26	61.37	42.68	58.87	81.80	92.43	63.89	92.93	89.69	82.59

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C-101332

Table D.6.5. Species and life stage SCIES scores as a function of discharge for maximum harvest alternative, dry water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	200	200	200	175	225	300	300	250	175	150	250	238	222
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	83.36	83.36								23.23	91.68	87.52	81.07
	Fry	76.27	76.27	76.27	88.13								71.15	77.57
	Juvenile			82.19	91.09	82.19	76.67	76.67						83.67
	Out-migration			100.00	100.00	100.00	100.00	79.33						99.17
							Discharge (cfs)							
	DISCHARGE	125	150	125	25	25	25	25	25	25	75	200	163	82
Woodbridge Reach	In-migration	100.00									90.00	100.00	100.00	97.80
	Out-migration			100.00	94.58	37.58	0.00	0.00						19.99
Camanche Score		81.07	76.72	78.61	90.58	94.23	92.00	78.00			74.41	96.86	91.86	88.30
Woodbridge Score		100.00		100.00	94.58	37.58	0.00	0.00			90.00	100.00	100.00	58.89
Combined Reaches Scores		90.54	76.72	89.31	92.58	65.91	46.00	39.00			82.21	98.43	95.93	73.60
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	200	200	200	175	225	300	300	250	175	150	250	238	222
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	94.14	94.14	94.14	74.24							92.55	93.35	91.64
	Fry	63.01	63.01	63.01	81.50	60.17							61.45	66.66
	Juvenile	84.86	84.86	84.86	92.43	84.86	78.73	78.73	81.80	92.43	50.00	40.90	40.90	74.87
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	25	25	25	25	25	25	75	200	163	82
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	94.58	37.58	0.00					100.00	100.00	95.34
Camanche Score		92.05	88.80	84.86	85.28	76.07	78.73	78.73	81.80	92.43	50.00	87.10	90.24	86.64
Woodbridge Score		100.00	100.00	100.00	94.58	37.58	0.00					100.00	100.00	97.67
Combined Reaches Scores		96.03	94.40	92.43	89.93	56.83	39.37	78.73	81.80	92.43	50.00	93.55	95.12	92.15
Combined Reaches/Species Scores		93.28	85.56	90.87	91.26	61.37	42.68	58.87	81.80	92.43	66.10	95.99	95.53	82.87

C—101332

C-101333

Table D.6.5. Species and life stage SCIES scores as a function of discharge for maximum harvest alternative, normal and wet water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	200	200	200	175	325	425	475	400	275	250	350	338	301
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	83.36	83.36								41.45	99.91	99.95	89.85
	Fry	76.27	76.27	76.27	88.13								52.57	77.57
	Juvenile			82.19	91.09	76.67	62.48	54.25						78.10
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	25	25	25	25	25	25	113	300	263	102
Woodbridge Reach	In-migration	100.00									99.29	100.00	100.00	99.84
	Out-migration			100.00	94.58	54.17	18.67	0.00						36.53
Camanche Score		81.07	76.72	78.61	90.58	92.44	87.14	77.13			80.48	99.97	99.97	89.11
Woodbridge Score		100.00		100.00	94.58	54.17	18.67	0.00			99.29	100.00	100.00	68.19
Combined Reaches Scores		90.54	76.72	89.31	92.58	73.30	52.90	38.56			89.89	99.98	99.98	78.65
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	200	200	200	175	325	425	475	400	275	250	350	338	301
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	94.14	94.14	94.14	74.24							89.29	90.13	90.74
	Fry	63.01	63.01	63.01	81.50	56.80							53.66	66.11
	Juvenile	84.86	84.86	84.86	92.43	78.73	65.70	58.85	65.70	81.80	46.21	36.11	36.11	67.99
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	25	25	25	25	25	25	113	300	263	102
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	94.58	54.17	18.67					100.00	100.00	96.35
Camanche Score		92.05	88.80	84.86	85.28	72.54	65.70	58.85	65.70	81.80	46.21	85.37	88.67	84.97
Woodbridge Score		100.00	100.00	100.00	94.58	54.17	18.67					100.00	100.00	98.18
Combined Reaches Scores		96.03	94.40	92.43	89.93	63.35	42.18	58.85	65.70	81.80	46.21	92.69	94.33	91.57
Combined Reaches/Species Scores		93.28	85.56	90.87	91.26	68.33	47.54	48.71	65.70	81.80	68.05	96.33	97.16	85.11

C-101333

C-101334

Table D.6.6. Species and life stage SCIES scores as a function of discharge for 1991 CDFG Plan, dry water years.

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	188	200	200	188	325	425	375	325	200	125	350	200	258
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	76.18	83.36								9.65	89.95	76.18	74.17
	Fry	82.20	76.27	76.27	82.20								82.20	77.69
	Juvenile			82.19	86.64	76.67	62.48	69.57						77.20
	Out-migration			100.00	100.00	100.00	100.00	88.96						99.56
							Discharge (cfs)							
	DISCHARGE	125	150	125	50	100	150	100	75	50	50	300	125	117
Woodbridge Reach	In-migration	100.00									85.67	100.00	100.00	96.85
	Out-migration			100.00	100.00	54.17	18.67	0.00						36.59
Camanche Score		79.28	76.72	78.61	85.87	92.44	87.14	79.27			69.88	96.21	84.47	85.72
Woodbridge Score		100.00		100.00	100.00	54.17	18.67	0.00			85.67	100.00	100.00	66.72
Combined Reaches Scores		89.64	76.72	89.31	92.94	73.30	52.90	39.63			77.78	98.10	92.23	76.22
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	188	200	200	188	325	425	375	325	200	125	350	200	258
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	84.19	94.14	94.14	84.19							97.07	84.19	89.49
	Fry	72.25	63.01	63.01	72.25	56.80							72.25	65.47
	Juvenile	88.64	84.86	84.86	88.64	78.73	65.70	72.22	78.73	84.86	50.00	26.00	42.43	70.61
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	50	100	150	100	75	50	50	300	125	117
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	54.17	18.67					100.00	100.00	96.90
Camanche Score		91.31	88.80	84.86	82.84	72.54	65.70	72.22	78.73	84.86	50.00	85.48	88.17	85.11
Woodbridge Score		100.00	100.00	100.00	100.00	54.17	18.67					100.00	100.00	98.45
Combined Reaches Scores		95.66	94.40	92.43	91.42	63.35	42.18	72.22	78.73	84.86	50.00	92.74	94.09	91.78
Combined Reaches/Species Scores		92.65	85.56	90.87	92.18	68.33	47.54	55.93	78.73	84.86	63.89	95.42	93.16	84.00

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C-101335

Table D.6.6. Species and life stage SCIES scores as a function of discharge for 1991 CDFG Plan, normal water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	188	200	200	925	925	925	475	400	275	200	350	200	439
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	76.18	83.36								40.99	89.95	76.18	77.62
	Fry	82.20	76.27	76.27	21.66								82.20	71.03
	Juvenile			82.19	24.50	24.50	24.50	54.25						34.34
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	800	625	525	25	25	25	50	300	125	242
Woodbridge Reach	In-migration	100.00									95.42	100.00	100.00	98.99
	Out-migration			100.00	100.00	100.00	72.67	0.00						83.43
Camanche Score		79.28	76.72	78.61	25.46	75.54	74.11	77.13			80.33	96.21	84.47	76.60
Woodbridge Score		100.00		100.00	100.00	100.00	72.67	0.00			95.42	100.00	100.00	91.21
Combined Reaches Scores		89.64	76.72	89.31	62.73	87.77	73.39	38.56			87.87	98.10	92.23	83.90
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	188	200	200	925	925	925	475	400	275	200	350	200	439
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	84.19	94.14	94.14	55.25							97.07	84.19	86.31
	Fry	72.25	63.01	63.01	6.50	6.50							72.25	43.96
	Juvenile	88.64	84.86	84.86	19.45	19.45	19.45	58.85	65.70	81.80	42.43	26.00	42.43	52.35
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	800	625	525	25	25	25	50	300	125	242
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	100.00	72.67					100.00	100.00	99.73
Camanche Score		91.31	88.80	84.86	37.38	29.86	19.45	58.85	65.70	81.80	42.43	85.48	88.17	76.52
Woodbridge Score		100.00	100.00	100.00	100.00	100.00	72.67					100.00	100.00	99.86
Combined Reaches Scores		95.66	94.40	92.43	68.69	64.93	46.06	58.85	65.70	81.80	42.43	92.74	94.09	88.19
Combined Reaches/Species Scores		92.65	85.56	90.87	65.71	76.35	59.73	48.71	65.70	81.80	65.15	95.42	93.16	86.05

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Table D.6.6. Species and life stage SCIES scores as a function of discharge for 1991 CDFG Plan, wet water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	175	200	200	925	925	925	425	350	225	100	350	175	415
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	76.18	83.36								9.65	89.95	76.18	74.17
	Fry	82.20	76.27	76.27	21.66								82.20	71.03
	Juvenile			82.19	24.50	24.50	24.50	62.48						34.67
	Out-migration			100.00	100.00	100.00	100.00	98.58						99.94
							Discharge (cfs)							
	DISCHARGE	125	125	100	700	550	475	25	25	25	50	275	125	217
Woodbridge Reach	In-migration	100.00									85.67	100.00	100.00	96.85
	Out-migration			100.00	100.00	100.00	72.67	0.00						83.43
Camanche Score		79.28	76.72	78.61	25.46	75.54	74.11	80.53			69.88	96.21	84.47	75.96
Woodbridge Score		100.00		100.00	100.00	100.00	72.67	0.00			85.67	100.00	100.00	90.14
Combined Reaches Scores		89.64	76.72	89.31	62.73	87.77	73.39	40.27			77.78	98.10	92.23	83.05
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	175	200	200	925	925	925	425	350	225	100	350	175	415
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	84.19	94.14	94.14	55.25							97.07	84.19	86.31
	Fry	72.25	63.01	63.01	6.50	6.50							72.25	43.96
	Juvenile	88.64	84.86	84.86	19.45	19.45	19.45	65.70	72.22	84.86	50.00	26.00	42.43	54.40
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	125	125	100	700	550	475	25	25	25	50	275	125	217
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	100.00	72.67					100.00	100.00	99.73
Camanche Score		91.31	88.80	84.86	37.38	29.86	19.45	65.70	72.22	84.86	50.00	85.48	88.17	76.93
Woodbridge Score		100.00	100.00	100.00	100.00	100.00	72.67					100.00	100.00	99.86
Combined Reaches Scores		95.66	94.40	92.43	68.69	64.93	46.06	65.70	72.22	84.86	50.00	92.74	94.09	88.40
Combined Reaches/Species Scores		92.65	85.56	90.87	65.71	76.35	59.73	52.98	72.22	84.86	63.89	95.42	93.16	85.72

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Table D.6.6. Species and life stage SCIES scores as a function of discharge for 1991 CDFG Plan, normal water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	188	200	200	925	925	925	475	400	275	200	350	200	439
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	76.18	83.36								40.99	89.95	76.18	77.62
	Fry	82.20	76.27	76.27	21.66								82.20	71.03
	Juvenile			82.19	24.50	24.50	24.50	54.25						34.34
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	800	625	525	25	25	25	50	300	125	242
Woodbridge Reach	In-migration	100.00									95.42	100.00	100.00	98.99
	Out-migration			100.00	100.00	100.00	72.67	0.00						83.43
Camanche Score		79.28	76.72	78.61	25.46	75.54	74.11	77.13			80.33	96.21	84.47	76.60
Woodbridge Score		100.00		100.00	100.00	100.00	72.67	0.00			95.42	100.00	100.00	91.21
Combined Reaches Scores		89.64	76.72	89.31	62.73	87.77	73.39	38.56			87.87	98.10	92.23	83.90
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	188	200	200	925	925	925	475	400	275	200	350	200	439
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	84.19	94.14	94.14	55.25							97.07	84.19	86.31
	Fry	72.25	63.01	63.01	6.50	6.50							72.25	43.96
	Juvenile	88.64	84.86	84.86	19.45	19.45	19.45	58.85	65.70	81.80	42.43	26.00	42.43	52.35
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	125	150	125	800	625	525	25	25	25	50	300	125	242
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	100.00	72.67					100.00	100.00	99.73
Camanche Score		91.31	88.80	84.86	37.38	29.86	19.45	58.85	65.70	81.80	42.43	85.48	88.17	76.52
Woodbridge Score		100.00	100.00	100.00	100.00	100.00	72.67					100.00	100.00	99.86
Combined Reaches Scores		95.66	94.40	92.43	68.69	64.93	46.06	58.85	65.70	81.80	42.43	92.74	94.09	88.19
Combined Reaches/Species Scores		92.65	85.56	90.87	65.71	76.35	59.73	48.71	65.70	81.80	65.15	95.42	93.16	86.05

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C-101338

Table D.6.7. Species and life stage SCIES scores as a function of discharge for 1961 CDFG agreement, dry water years.

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	125	100	125	200	250	300	325	275	175	100	125	150	188
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	54.65	54.65								9.65	54.65	69.01	54.01
	Fry	100.00	100.00	100.00	76.27								88.13	97.39
	Juvenile			100.00	82.19	79.43	76.67	76.67						82.68
	Out-migration			100.00	100.00	100.00	100.00	79.33						99.17
							Discharge (cfs)							
	DISCHARGE	50	50	50	50	25	25	50	25	25	25	50	75	42
Woodbridge Reach	In-migration	100.00									85.67	100.00	100.00	96.85
	Out-migration			100.00	100.00	45.87	0.00	0.00						24.02
Camanche Score		73.89	97.11	100.00	81.16	93.34	92.00	78.00			69.88	82.88	79.79	86.65
Woodbridge Score		100.00		100.00	100.00	45.87	0.00	0.00			85.67	100.00	100.00	60.43
Combined Reaches Scores		86.94	97.11	100.00	90.58	69.61	46.00	39.00			77.78	91.44	89.89	73.54
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	125	100	125	200	250	300	325	275	175	100	125	150	188
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	54.34	54.34	54.34	94.14							54.34	74.24	62.10
	Fry	100.00	100.00	100.00	63.01	59.90							81.50	86.06
	Juvenile	100.00	100.00	100.00	84.86	81.80	78.73	78.73	81.80	92.43	50.00	50.00	46.21	78.78
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	50	50	50	50	25	25	50	25	25	25	50	75	42
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	45.87	0.00					100.00	100.00	96.29
Camanche Score		89.08	89.43	90.65	80.40	74.99	78.73	78.73	81.80	92.43	50.00	79.02	86.15	85.39
Woodbridge Score		100.00	100.00	100.00	100.00	45.87	0.00					100.00	100.00	98.15
Combined Reaches Scores		94.54	94.71	95.32	90.20	60.43	39.37	78.73	81.80	92.43	50.00	89.51	93.07	91.77
Combined Reaches/Species Scores		90.74	95.91	97.66	90.39	65.02	42.68	58.87	81.80	92.43	63.89	90.47	91.48	82.65

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Table D.6.7. Species and life stage SCIES scores as a function of discharge for 1961 CDFG agreement, normal water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	125	100	125	175	350	450	475	400	275	150	125	150	242
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	54.65	54.65								23.06	54.65	69.01	55.48
	Fry	100.00	100.00	100.00	88.13								88.13	98.69
	Juvenile			100.00	91.09	69.57	54.25	54.25						77.17
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	50	50	50	50	50	50	25	25	25	25	50	75	44
Woodbridge Reach	In-migration	100.00									90.54	100.00	100.00	97.92
	Out-migration			100.00	94.58	62.87	26.37	0.00						44.26
Camanche Score		73.89	97.11	100.00	90.58	90.14	84.32	77.13			74.35	82.88	79.79	86.27
Woodbridge Score		100.00		100.00	94.58	62.87	26.37	0.00			90.54	100.00	100.00	71.09
Combined Reaches Scores		86.94	97.11	100.00	92.58	76.51	55.35	38.56			82.45	91.44	89.89	78.68
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	125	100	125	175	350	450	475	400	275	150	125	150	242
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	54.34	54.34	54.34	74.24							54.34	74.24	59.91
	Fry	100.00	100.00	100.00	81.50	50.52							81.50	88.82
	Juvenile	100.00	100.00	100.00	92.43	72.22	58.85	58.85	65.70	81.80	46.21	50.00	46.21	72.34
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	50	50	50	50	50	50	25	25	25	25	50	75	44
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	94.58	62.87	26.37					100.00	100.00	96.87
Camanche Score		89.08	89.43	90.65	85.28	67.49	58.85	58.85	65.70	81.80	46.21	79.02	86.15	84.21
Woodbridge Score		100.00	100.00	100.00	94.58	62.87	26.37					100.00	100.00	98.43
Combined Reaches Scores		94.54	94.71	95.32	89.93	65.18	42.61	58.85	65.70	81.80	46.21	89.51	93.07	91.32
Combined Reaches/Species Scores		90.74	95.91	97.66	91.26	70.85	48.98	48.71	65.70	81.80	64.33	90.47	91.48	85.00

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Table D.6.7. Species and life stage SCIES scores as a function of discharge for 1961 CDFG agreement, wet water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	100	100	100	175	350	450	425	350	225	100	100	125	217
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	54.65	54.65								9.65	54.65	54.65	49.70
	Fry	100.00	100.00	100.00	88.13								100.00	98.69
	Juvenile			100.00	91.09	69.57	54.25	62.48						77.49
	Out-migration			100.00	100.00	100.00	100.00	98.58						99.94
							Discharge (cfs)							
	DISCHARGE	50	50	50	10	25	25	25	25	25	10	50	75	35
Woodbridge Reach	In-migration	100.00									85.67	100.00	100.00	96.85
	Out-migration			100.00	94.58	62.87	26.37	0.00						44.26
Camanche Score		73.89	97.11	100.00	90.58	90.14	84.32	80.53			69.88	82.88	70.42	85.17
Woodbridge Score		100.00		100.00	94.58	62.87	26.37	0.00			85.67	100.00	100.00	70.55
Combined Reaches Scores		86.94	97.11	100.00	92.58	76.51	55.35	40.27			77.78	91.44	85.21	77.86
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	100	100	100	175	350	450	425	350	225	100	100	125	217
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	54.34	54.34	54.34	74.24							54.34	54.34	56.53
	Fry	100.00	100.00	100.00	81.50	50.52							100.00	89.00
	Juvenile	100.00	100.00	100.00	92.43	72.22	58.85	65.70	72.22	84.86	50.00	50.00	50.00	74.39
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	50	50	50	10	25	25	25	25	25	10	50	75	35
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	94.58	62.87	26.37					100.00	100.00	96.87
Camanche Score		89.08	89.43	90.65	85.28	67.49	58.85	65.70	72.22	84.86	50.00	79.02	81.62	83.99
Woodbridge Score		100.00	100.00	100.00	94.58	62.87	26.37					100.00	100.00	98.43
Combined Reaches Scores		94.54	94.71	95.32	89.93	65.18	42.61	65.70	72.22	84.86	50.00	89.51	90.81	91.21
Combined Reaches/Species Scores		90.74	95.91	97.66	91.26	70.85	48.98	52.98	72.22	84.86	63.89	90.47	88.01	84.53

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Table D.6.8. Species and life stage SCIES scores as a function of discharge for existing conditions (1967-1987 calendar years), dry water years.

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	100	100	150	275	350	425	425	375	275	175	125	125	242
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	54.65	54.65								23.06	54.65	54.65	51.17
	Fry	100.00	100.00	88.13	66.04								100.00	92.47
	Juvenile			91.09	79.43	69.57	62.48	62.48						74.17
	Out-migration			100.00	100.00	100.00	100.00	98.58						99.94
							Discharge (cfs)							
	DISCHARGE	100	60	50	50	25	50	50	50	50	100	125	100	68
Woodbridge Reach	In-migration	100.00									90.54	100.00	100.00	97.92
	Out-migration			100.00	100.00	62.87	18.67	0.00						40.77
Camanche Score		73.89	97.11	89.31	76.67	90.14	87.14	80.53			74.35	82.88	70.42	83.55
Woodbridge Score		100.00		100.00	100.00	62.87	18.67	0.00			90.54	100.00	100.00	69.34
Combined Reaches Scores		86.94	97.11	94.65	88.34	76.51	52.90	40.27			82.45	91.44	85.21	76.45
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	100	100	150	275	350	425	425	375	275	175	125	125	242
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	54.34	54.34	74.24	92.55							54.34	54.34	61.93
	Fry	100.00	100.00	81.50	59.90	50.52							100.00	79.07
	Juvenile	100.00	100.00	92.43	81.80	72.22	65.70	65.70	72.22	81.80	46.21	50.00	50.00	73.00
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	100	60	50	50	25	50	50	50	50	100	125	100	68
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	62.87	18.67					100.00	100.00	97.33
Camanche Score		89.08	89.43	87.75	78.24	67.49	65.70	65.70	72.22	81.80	46.21	79.02	81.62	82.80
Woodbridge Score		100.00	100.00	100.00	100.00	62.87	18.67					100.00	100.00	98.67
Combined Reaches Scores		94.54	94.71	93.88	89.12	65.18	42.18	65.70	72.22	81.80	46.21	89.51	90.81	90.73
Combined Reaches/Species Scores		90.74	95.91	94.27	88.73	70.85	47.54	52.98	72.22	81.80	64.33	90.47	88.01	83.59

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Table D.6.8. Species and life stage SCIES scores as a function of discharge for existing conditions (1967-1987 calendar years), normal water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	525	525	675	650	775	875	750	700	675	675	425	275	627
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	96.54	96.54								60.30	99.81	91.68	92.31
	Fry	30.38	30.38	25.18	25.18								66.04	28.15
	Juvenile			34.92	34.92	30.01	26.16	30.01						31.49
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	500	550	675	400	400	450	275	250	350	500	400	275	419
Woodbridge Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Out-migration			100.00	100.00	100.00	69.67	35.63						83.47
Camanche Score		70.58	34.61	29.78	34.00	77.33	74.68	65.01			86.77	99.93	94.57	70.39
Woodbridge Score		100.00		100.00	100.00	100.00	69.67	0.00			100.00	100.00	100.00	91.74
Combined Reaches Scores		85.29	34.61	64.89	67.00	88.66	72.18	32.50			93.38	99.97	97.29	81.06
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	525	525	675	650	775	875	750	700	675	675	425	275	627
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	100.00	100.00	86.48	86.48							87.61	92.55	93.59
	Fry	29.00	29.00	16.43	16.43	11.06							59.90	20.51
	Juvenile	51.99	51.99	35.66	35.66	27.39	21.76	27.39	30.71	17.83	17.83	32.85	40.90	32.43
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	500	550	675	400	400	450	275	250	350	500	400	275	419
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	100.00	69.67					100.00	100.00	99.70
Camanche Score		85.79	79.52	62.84	50.94	34.53	21.76	27.39	30.71	17.83	17.83	84.34	90.01	69.31
Woodbridge Score		100.00	100.00	100.00	100.00	100.00	69.67					100.00	100.00	99.85
Combined Reaches Scores		92.90	89.76	81.42	75.47	67.27	45.72	27.39	30.71	17.83	17.83	92.17	95.00	84.58
Combined Reaches/Species Scores		89.09	62.18	73.15	71.24	77.96	58.95	29.95	30.71	17.83	55.61	96.07	96.15	82.82

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Table D.6.8. Species and life stage SCIES scores as a function of discharge for existing conditions (1967-1987 calendar years), wet water years (cont.).

SPECIES/REACH	LIFESTAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE
CHINOOK SALMON							Discharge (cfs)							
	DISCHARGE	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Camanche Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Spawning	56.74	56.74								38.87	56.74	56.74	54.78
	Fry	20.97	20.97	20.97	20.97								20.97	20.97
	Juvenile			21.48	21.48	21.48	21.48	21.48						21.48
	Out-migration			100.00	100.00	100.00	100.00	100.00						100.00
							Discharge (cfs)							
	DISCHARGE	1000	1000	1000	1000	1000	1000	800	575	675	975	1000	1000	919
Woodbridge Reach	In-migration	100.00									100.00	100.00	100.00	100.00
	Out-migration			100.00	100.00	100.00	78.67	56.58						88.45
Camanche Score		43.96	23.25	22.78	23.06	74.56	73.08	60.74			79.62	83.67	71.79	59.45
Woodbridge Score		100.00		100.00	100.00	100.00	78.67	0.00			100.00	100.00	100.00	94.23
Combined Reaches Scores		71.98	23.25	61.39	61.53	87.28	75.87	30.37			89.81	91.83	85.89	76.84
STEELHEAD TROUT							Discharge (cfs)							
	DISCHARGE	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Camanche Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Spawning	42.90	42.90	42.90	42.90							42.90	42.90	42.90
	Fry	5.00	5.00	5.00	5.00	5.00							5.00	5.00
	Juvenile	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	8.00	8.00	8.00	8.00	13.44
	Out-migration	100.00	100.00	100.00	100.00	100.00	100.00					100.00	100.00	100.00
							Discharge (cfs)							
	DISCHARGE	1000	1000	1000	1000	1000	1000	800	575	675	975	1000	1000	919
Woodbridge Reach	In-migration	100.00	100.00	100.00								100.00	100.00	100.00
	Out-migration	100.00	100.00	100.00	100.00	100.00	78.67					100.00	100.00	99.79
Camanche Score		65.62	57.70	48.16	33.53	28.07	16.00	16.00	16.00	8.00	8.00	68.28	71.85	52.27
Woodbridge Score		100.00	100.00	100.00	100.00	100.00	78.67					100.00	100.00	99.89
Combined Reaches Scores		82.81	78.85	74.08	66.76	64.03	47.33	16.00	16.00	8.00	8.00	84.14	85.92	76.08
Combined Reaches/Species Scores		77.39	51.05	67.73	64.15	75.66	61.60	23.19	16.00	8.00	48.91	87.99	85.91	76.46

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Table D.7.1. Summary of SCIES scores for chinook salmon.

ALTERNATIVE	YEAR TYPE	LIMITING REACH	LIMITING LIFESTAGE	YEAR TYPE FREQUENCY	SCIES SCORES		
					MINIMUM	COMBINED REACH	ALTERNATIVE WEIGHTED AVERAGE*
CDFG	Dry	Woodbridge	Outmigration	0.14	48	78	38
	Normal	Camanche	Juvenile	0.47	37	84	
	Wet	Camanche	Juvenile	0.39	35	83	
ESCAPEMENT	Critical Dry	Woodbridge	Outmigration	0.20	20	75	45
	Dry	Woodbridge	Outmigration	0.27	45	79	
	Normal	Camanche	Juvenile	0.11	55	87	
	Wet	Camanche	Juvenile	0.41	55	87	
PRODUCTION (NATURAL)	Critical Dry	Woodbridge	Outmigration	0.16	20	60	46
	Dry	Woodbridge	Outmigration	0.34	45	78	
	Normal	Camanche	Juvenile	0.36	55	88	
	Wet	Camanche	Juvenile	0.14	55	88	
PRODUCTION (HATCHERY)	Critical Dry	Woodbridge	Outmigration	0.46	24	73	35
	All Others	Woodbridge	Outmigration	0.54	44	78	
MAXIMUM HARVEST	Critical Dry	Woodbridge	Outmigration	0.16	20	73	28
	Dry	Woodbridge	Outmigration	0.34	20	74	
	Normal & Wet	Woodbridge	Outmigration	0.50	37	79	
1991 CDFG PLAN	Dry	Woodbridge	Outmigration	0.14	37	76	35
	Normal	Camanche	Juvenile	0.47	34	84	
	Wet	Camanche	Juvenile	0.39	34	84	
CDFG 1961 AGREEMENT	Dry	Woodbridge	Outmigration	0.14	24	74	41
	Normal	Woodbridge	Outmigration	0.47	44	79	
	Wet	Woodbridge	Outmigration	0.39	44	79	
EXISTING CONDITION	Dry	Woodbridge	Outmigration	0.14	41	76	27
	Normal	Camanche	Fry	0.47	28	81	
	Wet	Camanche	Fry	0.39	21	77	

* Year type minimum scores weighted by frequency of occurrence.

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Table D.7.2. Summary of SCIES scores for steelhead trout.

STEELHEAD ALTERNATIVE	YEAR TYPE	LIMITING REACH	LIMITING LIFESTAGE	YEAR TYPE FREQUENCY	SCIES SCORES		
					MINIMUM	COMBINED REACH	ALTERNATIVE WEIGHTED AVERAGE*
CDFG	Dry	Camanche	Fry	0.14	52	91	37
	Normal	Camanche	Fry	0.47	37	87	
	Wet	Camanche	Fry	0.39	32	86	
ESCAPEMENT	Critical Dry	Camanche	Spawning	0.20	64	92	56
	Dry	Camanche	Fry	0.27	56	91	
	Normal	Camanche	Fry	0.11	54	90	
	Wet	Camanche	Fry	0.41	53	90	
PRODUCTION (NATURAL)	Critical Dry	Camanche	Spawning	0.16	60	92	57
	Dry	Camanche	Fry	0.34	57	92	
	Normal	Camanche	Fry	0.36	55	91	
	Wet	Camanche	Fry	0.14	55	97	
PRODUCTION (HATCHERY)	Critical Dry	Camanche	Spawning	0.46	59	91	66
	All Others	Camanche	Spawning	0.54	72	92	
MAXIMUM HARVEST	Critical Dry	Camanche	Spawning	0.16	60	92	65
	Dry	Camanche	Fry	0.34	67	92	
	Normal & Wet	Camanche	Juvenile	0.50	66	92	
1991 CDFG PLAN	Dry	Camanche	Fry	0.14	65	92	47
	Normal	Camanche	Fry	0.47	44	88	
	Wet	Camanche	Fry	0.39	44	88	
CDFG 1961 AGREEMENT	Dry	Camanche	Spawning	0.14	62	92	60
	Normal	Camanche	Spawning	0.47	60	91	
	Wet	Camanche	Spawning	0.39	60	91	
EXISTING CONDITION	Dry	Camanche	Spawning	0.14	62	91	20
	Normal	Camanche	Fry	0.47	21	85	
	Wet	Camanche	Fry	0.39	5	76	

* Year type minimum scores weighted by frequency of occurrence.

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