Exhibit F

EDT Proof of Concept

Fisheries Management Plan:
A Framework for Adaptive Management in the San Joaquin River Restoration Program

SAN JOAQUIN RIVER RESTORATION PROGRAM

November 2010

Table of Contents

Tables

Figures

Abbreviations and Acronyms

DFG	California Department of Fish and Game
EDT	Ecosystem Diagnosis and Treatment
FMWG	Fisheries Management Work Group
PTA	Patient-Template Analysis
SJRRP	San Joaquin River Restoration Program

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1.0 Background

The Ecosystem Diagnosis and Treatment (EDT) model is a framework that views salmon as the indicator of the condition of the ecosystem (Lichatowich et al. 1995). The EDT framework was designed so that analyses made at different spatial scales (i.e., from tributary watersheds to successively larger watersheds) might be related and linked. Biological performance is a central feature of the framework and is defined in terms of three elements: life-history diversity, productivity, and capacity. These elements of performance are characteristics of the ecosystem that describe persistence, abundance, and the distribution potential of a population. The analytical model is the tool used to analyze environmental information and draw conclusions about the ecosystem. The model incorporates an environmental attributes database and a set of mathematical algorithms that compute productivity and capacity parameters for the diagnostic species (Lestelle et al. 2004).

The first step in an EDT analysis of a watershed is to diagnose the stream with respect to the target species. The EDT diagnosis is based on a concept called Patient-Template Analysis (PTA) (Lichatowich and Mobrand 1995). PTA compares potential fish performance under existing conditions (Patient) against a diagnostic reference condition (Template). The Template can be a reconstruction of historic or normative conditions. In this case, the diagnostic reference captures the unique characteristics and limitations of the watershed due to its combination of climate, geography, geomorphology, and history and provides a basis for assessing the current condition of the habitat. Although the normative Template is frequently used for EDT analysis, other diagnostic reference conditions are possible. The diagnosis forms a clear statement of understanding about the present conditions of the watershed as related to the diagnostic species.

Following the diagnosis, EDT may be used to evaluate and compare restoration alternatives. The diagnosis serves as a roadmap for construction of restoration alternatives, as well as assessing the relative importance of actions to reduce the effects of limiting factors. Alternatives can be compared in terms of progress toward an identified population goal or achievement of environmental goals for limiting factors.

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2.0 San Joaquin Ecosystem Diagnosis and Treatment

Development of the San Joaquin EDT tool is being conducted as part of the San Joaquin River Restoration Program (SJRRP). The Fisheries Management Work Group (FMWG) is charged with coordinating activities related to the Restoration Goal of the Stipulation of Settlement (Settlement). The FMWG elected to develop a computer model to assist them in developing fish restoration alternatives in the San Joaquin River. The FMWG reviewed several existing model systems and selected EDT (Exhibit G). Efforts began on the model during the summer of 2008. Initial work was described as development of a “Proof-of-Concept” version of the model. This proof-of-concept model employed the conventional EDT model and was intended to demonstrate the utility of the model and to identify issues that will need to be addressed to develop the complete San Joaquin-EDT tool.

This report summarizes the completion of the proof-of-concept San Joaquin EDT model. The task is described below:

Develop a demonstration model for salmon based on the existing SJRRP subreach designations and populate input with estimated values in collaboration with the FMWG. The proof-of-concept model will rely on existing EDT species-habitat relationships for Chinook salmon. Run the EDT model using the coarse structure to assist the FMWG in understanding the model structure and how EDT can be used to compare draft SJRRP alternatives, and assist in the development of the Fisheries Management Plan. Work with the FMWG to develop needs for the full application of EDT to the San Joaquin River Restoration Reach (i.e., San Joaquin River between Friant Dam and the confluence with the Merced River).

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3.0 Progress Summary

The proof-of-concept San Joaquin EDT model has been constructed. The completed model is available on-line at *http://edt.jonesandstokes.com*. The proof-of-concept model will serve as a prototype of the final San Joaquin-EDT tool. As a demonstration of the model, we have completed a preliminary diagnosis of the San Joaquin River (Friant Dam to Merced River) and estimated spring-run Chinook performance under Current and Template conditions.

3.1 Basic Model Structure

The EDT proof-of-concept model for spring-run Chinook salmon in the San Joaquin River has four major components:

1. **Spatial Structure –** The San Joaquin EDT model is based on stream reach structure. Stream reaches are the basic data record in the model and constitute the “pixels” of the picture developed by the model.
2. **Stream Reach Data –** This is a reach-level description of environmental conditions in the river between Friant Dam and the Merced River. Attribute data were assembled from existing stream habitat surveys, flow modeling, and other sources.
3. **Species-Habitat Rules –** EDT uses a library of species-habitat rules to relate reach-level conditions to life-stage performance of the target species. For the proof-of-concept model, we used the existing EDT rules for spring-run Chinook salmon developed over many years for streams in the Pacific Northwest.
4. **Fish Population Life History –** An EDT model constructs fish life-history trajectories to evaluate the environment. Trajectories link the reaches and life stages to complete the spring-run Chinook salmon life history. These trajectories are controlled by features of the life history such as timing, age distribution, fecundity and so on.

3.1.1 San Joaquin EDT Reach Structure

The FMWG had previously delineated the 150 miles between Friant Dam and the Merced River into five “super-reaches.” These were judged to be too coarse for the EDT model. In consultation with the work group, these super-reaches were subdivided into a total of 21 EDT reaches that describe the historic channel, the East Side Bypass and connecting bypass reaches (Table F-1). The completed reach structure for San Joaquin EDT is shown in Figure F-1.

Table F-1.
Reach Structure of the San Joaquin EDT Model

Super Reach	Sub Reach	EDT Reach	Upstream Point	RM	Downstream Point	RM	Length (miles)
1	1A	1A1	Friant Dam	267.5	Highway 41	255.2	12.3
		1A2	Highway 41	255.2	Highway 99	243.2	12
	1B	1B1	Highway 99	243.2	Highway 145	234.1	9.1
		1B2	Highway 145	234.1	Gravelly Ford	229	5.1
2	2A	2A	Gravelly Ford	229	Bifurcation Structure	216.1	12.9
	2B	2B	Bifurcation Structure	216.1	Mendota Dam	204.8	11.3
3	3	3A	Mendota Dam	204.8	Mendota Bypass Return (proposed)	201	3.8
		3B	Mendota Bypass Return	201	Avenue 7.5 (Firebaugh)	195.2	5.8
		3C	Avenue 7.5 (Firebaugh)	195.2	Sack Dam	182	13.2
4	4A	4A1	Sack Dam	182	Highway 152	173.9	8.1
		4A2	Highway 152	173.9	Sand Slough CS	168.5	5.4
	4B	4B1	Sand Slough CS	168.5	Poso Drain (Turner Is. Rd.)	157.2	11.3
		4B2	Turner Is. Road	157.2	Mariposa	147.2	10
		4B3	Mariposa	147.2	Bear Creek	135.8	11.4
5	5	5A	Bear Creek	135.8	Salt Slough	127.7	8.1
		5B	Salt Slough	127.7	Mud Slough	121.2	6.5
		5C	Mud Slough	121.2	Merced River	118	3.2
	ESB	B1	Sand Slough CS		Mariposa		
		B2	Mariposa		Bear Creek		
		Bear Creek	Reach B2		Reach 5A		
		Mariposa	Cross Connection				

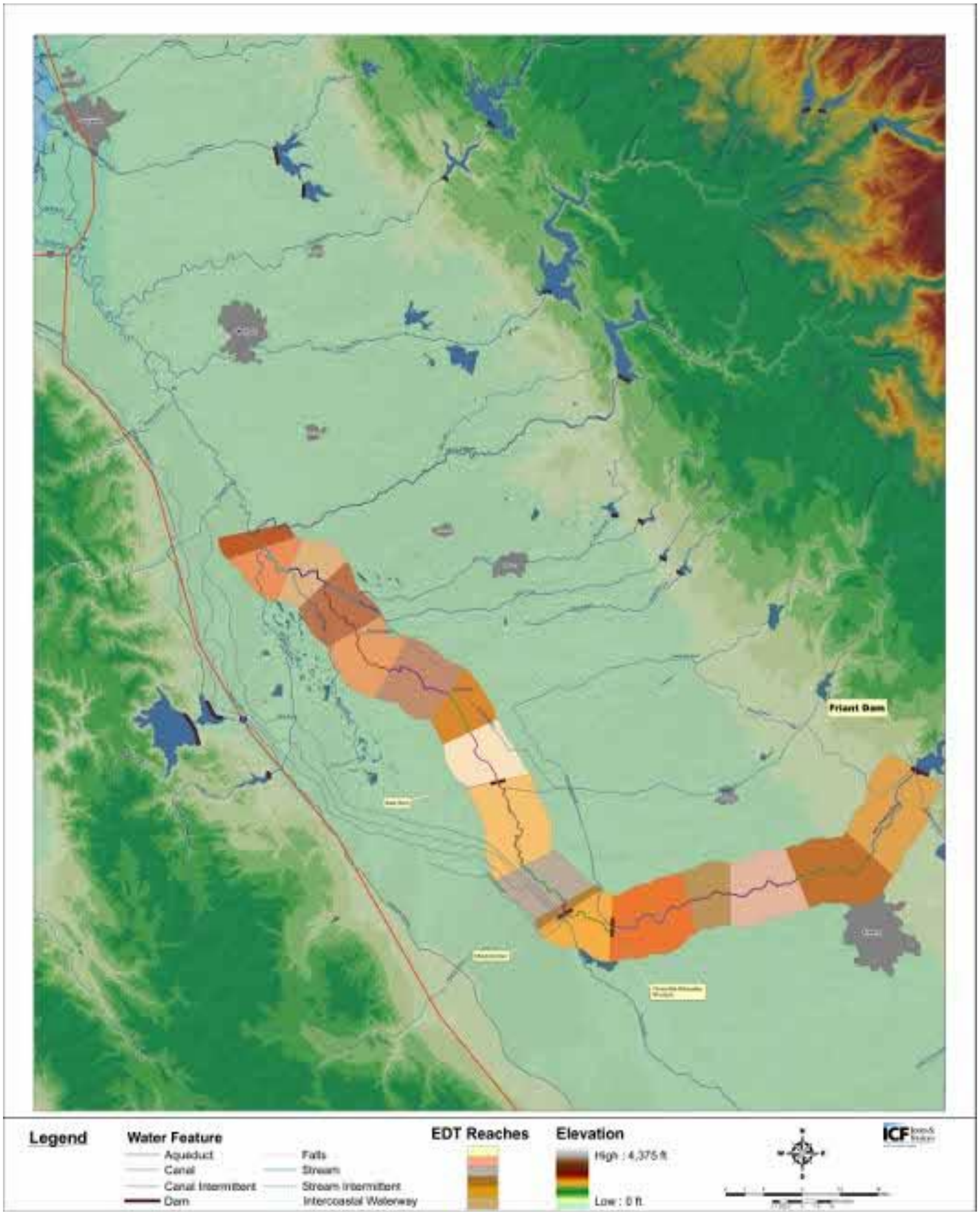


Figure F-1.
Reach Structure of the San Joaquin EDT Model

3.1.2 Stream Reach Data

EDT environmental attributes are listed and described in Table F-2. Many of these attributes were shaped monthly across the year in response to flow and temperature patterns. Reach data was assembled and organized in the San Joaquin Stream Reach Editor, an off-line tool that creates the EDT input file. The San Joaquin Stream Reach Editor and all EDT input data are available at the EDT Web site: *http://edt.jonesandstokes.com*.

Environmental attributes of each reach described in Table F-1 were estimated from available sources of information such as (Jones & Stokes 2002) and California Department of Fish and Game (DFG) reports. Documentation for all stream reach data can be found in the San Joaquin Stream Reach Editor.

3.1.3 Species-Habitat Rules

Species-habitat rules in EDT relate the condition of the environmental attributes in Table F-2 to life stage survival and capacity in each reach. Thus, the rules are the basis of viewing the environment "through the eyes of salmon" (Mobrand et al. 1997). The proof-of-concept San Joaquin EDT model used the existing EDT rules for spring-run Chinook salmon described in Lestelle et al. (2004). These rules are based on extensive review of the scientific literature and application to streams in the Pacific Northwest. Development of the San Joaquin EDT model will include review of the habitat-rating rules and possible revision to reflect genetic differences in southern Chinook salmon, if necessary.

3.1.4 Fish Population Life History

The assessment of environmental conditions in the San Joaquin study area from the perspective of spring-run Chinook salmon reflects the movement and duration of life stages across the species life history. Control of the shape and range of Chinook salmon life-history trajectories is controlled by the species life history table in EDT. For the proof-of-concept model, this table was based on previous EDT development on Butte Creek (Sacramento system) and on description of the probable spring-run Chinook salmon life-history developed by the FMWG Exhibit A).

3.1.5 Summary of Progress

The proof-of-concept San Joaquin EDT model has been completed. Input data has been reviewed and revised by the FMWG. It is emphasized that, as a proof-of-concept model, the current San Joaquin EDT model is provisional and the results described below are preliminary.

Table F-2.
Environmental Attributes and Survival Factors Used in the Proof-of-Concept EDT Model for the San Joaquin River

Environmental Attributes (Level 2)		Species Survival Factors (Level 3)
1 Hydrologic Characteristics		
1.1 Flow variation	High Flow – change from normative Low Flow – change from normative Flow – Intra-daily (diel) variation Flow – intra-annual flow pattern	Flow Withdrawals (entrainment)
1.2 Hydrologic regime	Hydrologic regime – natural	
2 Stream Corridor Structure		
2.1 Channel morphometry	Channel length Channel width – month maximum width Channel width – month minimum width Gradient	Channel length Channel stability Channel width Habitat diversity Key habitat Obstructions Sediment load
2.2 Confinement	Confinement – artificial Confinement – natural	
2.3 Habitat type	Habitat type – backwater pools Habitat type – beaver ponds Habitat type – glides Habitat type – large cobble/boulder riffles Habitat type – off-channel habitat factor Habitat type – pool tailouts Habitat type – primary pools Habitat type – small cobble/gravel riffles	
2.4 Obstruction	Obstructions to fish migration Water withdrawals	
2.5 Riparian and channel integrity	Bed scour Icing Riparian function Wood	
2.6 Sediment type	Embeddedness Fine sediment (intragravel) Turbidity (suspended sediment)	

Table F-2.
Environmental Attributes and Survival Factors Used in the Proof-of-Concept EDT Model for the San Joaquin River (contd.)

Environmental Attributes (Level 2)		Species Survival Factors (Level 3)
3 Water Quality		
3.1 Chemistry	Alkalinity Dissolved oxygen Metals – in water column Metals/Pollutants – in sediments/soils Miscellaneous toxic pollutants - water column Nutrient enrichment	Chemicals (toxic substances) Oxygen Temperature
3.2 Temperature variation	Temperature – daily maximum (by month) Temperature – daily minimum (by month) Temperature – spatial variation	
4 Biological Community		
4.1 Community effects	Fish community richness Fish pathogens Fish species introductions Harassment Hatchery fish outplants Predation risk Salmonid carcasses	Competition with hatchery fish Competition with other fish Food Harassment Pathogens Predation
4.2 Macroinvertebrates	Benthos diversity and production	

4.0 Proof-of-Concept San Joaquin-EDT Model

Spring-run Chinook salmon was extirpated from most of historic production areas of the San Joaquin River by construction of Friant Dam in the 1940s (Exhibit A). Since that time, flow restrictions below the dam as well as additional irrigation development eliminated or degraded habitat below Friant Dam. The San Joaquin River spring-run Chinook salmon population within the Restoration Area is considered extirpated (Yoshiyama et al. 2001).

EDT modeling of the present system results in the obvious conclusion that current habitat will not support spring-run Chinook salmon. To perform an EDT diagnosis, it was necessary to remove the effect of existing barriers and allow fish to move within the study area. With this important proviso, the proof-of-concept model was used to estimate habitat potential within the 150 river miles between Friant Dam and the Merced River under the current habitat condition and a provisional diagnostic reference condition (Template). Because of the preliminary nature of the data (including assumptions about survival below the Merced River, Bay/Delta, and ocean), the results are valuable as illustrations of the model capabilities but should not be considered useful estimates of habitat potential at this time.

All measures of spawning adult performance under the current habitat condition are considerably lower than Template conditions. Current modeled values for productivity, capacity, and abundance ranged from 3 to 17 percent of Template conditions (Table F-3). Current juvenile outmigrant performance is considerably higher relative to Template conditions than spawning adults, but is still well below Template conditions. For example, after including harvest effects, current habitat capacity is 42 percent of Template conditions, productivity is 57 percent of Template conditions, and abundance is 13 percent of Template conditions (Table F-4).

Table F-3.
Baseline Spawning Adult Population Performance Parameters for San Joaquin River Spring-Run Chinook Salmon

Scenario	Productivity	Capacity	Abundance
Current without harvest	2.4	2,614	1,539
Current with harvest	1.8	1,756	798
Template	14.3	30,272	28,148

Note: Results are preliminary and are based on proof-of-concept EDT model.

Table F-4.
Baseline Juvenile Outmigrant Population Performance Parameters for San Joaquin River Spring-Run Chinook Salmon

Scenario	Productivity	Capacity	Abundance
Current without harvest	87	185,885	78,022
Current with harvest	97	187,992	54,853
Template	169	449,067	410,230

Notes:
Model revisions based on FMWG comments.
Results are preliminary and are based on proof-of-concept EDT model.

The proof-of-concept model was revised based on comments received from the FMWG at the January 28, 2009, meeting in Sacramento. The FMWG reviewed the habitat ratings from the initial model and made changes as appropriate or identified data that could be used to populate the attributes. Major changes made to the initial model included:

1. Stream reaches downstream of the Merced River were deleted. Fish survival through these reaches will be based on empirical estimates of juvenile, and possibly adult, survival rates.

2. Edgewater habitat area was removed from the analysis as the group noted that this habitat type is a subcomponent of other habitat types (runs, glides, etc.).

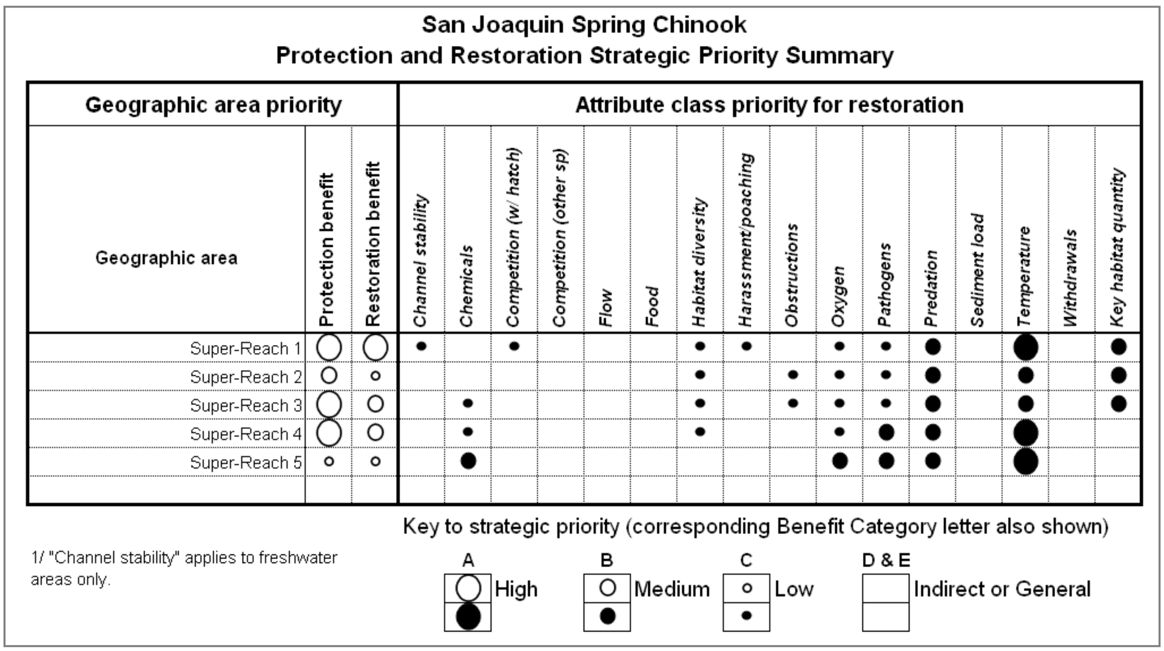
3. Temperature-maximum ratings and patterns were based SJR5Q model results using an average temperature value based on inflow and outflow to each reach.

The revised data set was uploaded to the EDT Web site and registered.

4.1 Preliminary Results of Proof-of-Concept Model

An EDT Diagnostic Report assessing the environmental factors affecting spring-run Chinook salmon production was based on the inputs from the proof-of-concept model. These results are highly preliminary because considerable model refinement is necessary based on data needs and assignment of an appropriate Template condition (see below). The model assumed successful fish passage at all potential obstructions (e.g., dams). Given these caveats, the proof-of-concept model indicated that maximum temperature, key habitat quantity, and predation were the primary factors limiting spring-run Chinook salmon habitat within the study area (Figure F-2). Increasing circle diameters in Figure F-2 indicate an increasing priority for restoration. Restoration strategies should therefore primarily focus on these three attributes, although other attributes are locally important (e.g., dissolved oxygen and chemicals in super-Reach 5 (Bear Creek to Merced River)). The large white circles in Figure F-2 indicate that super-Reach 1 (Friant Dam to Gravelly Ford) has the highest restoration potential of the five super-reaches modeled to date. In other words, improving habitat in this reach has the highest potential to increase spring-run Chinook salmon production.

The life-stage impacts are computed as the decline in productivity of the life stage under the current condition as compared to the diagnostic reference condition. In our preliminary analysis, the life stages most impacted by current habitat conditions are prespawning holding (-64.5 percent) and spawning (-40.9 percent), as shown in Figure F-3. The two environmental factors responsible for decreasing productivity in these life stages is again temperature and predation, as indicated by the diameter of the black circles. For the juvenile stage, 0-age migrant productivity has been reduced by 33.5 percent for similar reasons as for the adult life stages. Juvenile migrants are leaving the system at a time when stream temperatures are elevated and predators are active. Impacts would have been higher if stream reaches downstream from the study area were included in this run.



Note:

Increasing circle diameters indicate an increasing priority for restoration. Results are highly preliminary and are based on proof-of-concept EDT model.

Figure F-2.
San Joaquin Spring-Run Chinook Salmon Protection and Restoration Strategic Priority Summary

San Joaquin Spring Chinook
Life Stage Summary Across All Geographic Areas

Life stage	Relevant months	Productivity change (%)	Life Stage Rank	Change in attribute impact on survival: Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Spawning	Sep	-40.9%	2							●	●		●	•	⬤	•	⚫		•
Egg incubation	Sep-Apr	-3.0%	7	◯									•				●		•
Fry colonization	Mar-May	-6.0%	4	●			•	•	•	●			•		⬤		•		●
0-age active rearing	Mar-Oct	-13.0%	3	•	•	•				●		•	•	●	●		⬤		∘
0-age migrant	Oct-Nov	-33.5%	8							●			•	•	⬤		⬤		
0-age inactive	Oct-Mar	-16.2%	9	•				•	•	●			•		●				•
1-age active rearing	Mar-May	-2.7%	10							•					•				•
1-age migrant	Mar-Jun	-2.4%	11		●					●		•	●	•	⬤		•		
1-age transient rearing	Jan-Dec	0.0%	12																
2+-age transient rearing	Jan-Dec	0.0%	12																
Prespawning migrant	Apr-Aug	-3.8%	6		•					•		•	•		●		●		
Prespawning holding	May-Sep	-64.5%	1							●	●		•	•	⬤	•	⬤		•

1/ Ranking based on effect over entire geographic area. 2/ Value shown is for overall population performance.

Notes: Changes in key habitat can be caused by either a change in percent key habitat or in stream width.

Potential % changes in performance measures for reaches upstream of dams were computed with full passage allowed at dams (though reservoir effects still in place).

NA = Not applicable

KEY

	Loss	Gain
None		
Small	•	∘
Moderate	●	○
High	⬤	◯
Extreme	⚫	◎

Note:
Increasing circle diameters indicate an increasing effect of an environmental attribute. Results are highly preliminary and are based on proof-of-concept EDT model.

Figure F-3.
San Joaquin Spring-Run Chinook Salmon Life-Stage Summary Across All Geographic Areas

An example of a similar analysis for a single reach (SJR-A1: Friant Dam to Highway 41) is shown in Figure F-4. Similar results are available for each of the study reaches in Table F-1. Of interest here is the large white circle for temperature. This open circle indicates that current stream temperatures are improved for spawning and egg incubation compared to the historic condition for this reach. This results from the presence of the dam and reservoir that discharges cold water to the reach. Additionally, in the upper right corner of Figure F-4 it can be seen that restoring this reach (plus all other subreaches in super-reach 1) to Template conditions results in a 343-percent increase in abundance and a 53.8-percent increase in population productivity. Figure F-4 also shows that if this area was further degraded, there would be a 100-percent loss in all population parameters. This occurs because this reach is important for prespawn holding, spawning, and egg incubation.

Species/Component:	Spring Chinook
Restoration Potential:	Current Conditions versus Historic Potential
Restoration Emphasis:	Restoration or maintenance/improvement of historic life histories

San Joaquin March 2009 - Spring Chinook

Geographic Area:	Super-Reach 1	**Stream:**	San Joaquin River
Reach:	Friant Dam to Hwy 41	**Reach Length (mi):**	12.30
		Reach Code:	SJR 1 - A1

Restoration Benefit Category:1/	A	**Productivity Rank:1/**	2	**Potential % change in productivity:2/**	53.8%
Overall Restoration Potential Rank:1/	1	**Average Abundance (Neq) Rank:1/**	1	**Potential % change in Neq:2/**	343.1%
(lowest rank possible - with ties)1/	5	**Life History Diversity Rank:1/**	1	**Potential % change in diversity:2/**	162.8%
Preservation Benefit Category:1/	A	**Productivity Rank:1/**	1	**oss in productivity with degradation:2/**	-100.0%
Overall Preservation Rank:1/	1	**Average Abundance (Neq) Rank:1/**	1	**% loss in Neq with degradation:2/**	-100.0%
(lowest rank possible - with ties)1/	5	**Life History Diversity Rank:1/**	1	**% loss in diversity with degradation:2/**	-100.0%

Life stage	Relevant months	% of life history trajectories affected	Productivity change (%)	Life Stage Rank	Change in attribute impact on survival															
					Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Spawning	Sep	41.6%	10.5%								●	●			•	⬤		◯		
Egg incubation	Sep-Apr	41.6%	21.5%		◯													◯		
Fry colonization	Mar-May	41.6%	-8.1%	2	●			•	•	•	●					⬤		•		•
0-age active rearing	Mar-Oct	11.0%	-14.2%	6	•		●	•		•	●					●				•
0-age migrant	Oct-Nov	3.5%	-22.2%	4							●					⬤		●		
0-age inactive	Oct-Mar	3.5%	-19.1%	5	•				•	•	●					●				•
1-age active rearing	Mar-May	3.5%	-3.2%	9							•					•				
1-age migrant	Mar-Jun	3.5%	-4.1%	8							●					⬤		•		
1-age transient rearing																				
2+-age transient rearing																				
Prespawning migrant	Apr-Aug	41.6%	-0.8%	6							•	•				●		•		
Prespawning holding	May-Sep	41.6%	-38.1%	1							⬤	●				⬤		○		●
All Stages Combined		41.6%																		

1/ Ranking based on effect over entire geographic area. 2/ Value shown is for overall population performance.

Notes: Changes in key habitat can be caused by either a change in percent key habitat or in stream width.

Potential % changes in performance measures for reaches upstream of dams were computed with full passage allowed at dams (though reservoir effects still in place).

NA = Not applicable

KEY

	Loss	Gain
None		
Small	•	∘
Moderate	●	○
High	⬤	◯
Extreme	⬤	◯

Note:
Increasing circle diameters indicate an increasing effect of an environmental attribute. Results are highly preliminary and are based on proof-of-concept EDT model.

Figure F-4.
San Joaquin Spring-Run Chinook Salmon Life-Stage Summary Across a Single Reach
(SJR-A1: Friant Dam to Highway 41)

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5.0 Conclusion

The use of the proof-of-concept EDT model to perform a preliminary diagnosis shows its potential to address important issues associated with restoration of San Joaquin spring-run Chinook salmon. We have developed a spatial framework, parameterized the model with existing data, and produced a preliminary set of stream diagnostics. In the next phase, the San Joaquin EDT model will be considerably refined to address the complex hydrology of the study area and a custom interface will be developed to facilitate use by the FMWG. The data inputs will continue to be refined and the model adjusted to accommodate the flow and restoration alternatives.

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6.0 Data Needs and Further Model Refinements

In creating the proof-of-concept model for spring-run Chinook salmon in the Restoration Area, several data needs and model refinements have been identified.

6.1 Definition of Template Condition

The FMWG and others involved in the SJRRP must decide what condition the EDT model Template represents. The 'true' Template—environmental attributes based on historic, unaltered conditions—may be difficult to document, impossible to achieve, and of questionable relevance given the magnitude of changes that have occurred in the system. At the January 2009 meeting, the FMWG was leaning toward the use of an idealized future condition. What environmental attributes this condition is likely to have must be defined. This should be done as soon as possible, as ratings for the current condition are partially based on the definition of the Template.

6.2 Reach Routing

The nature of the study area necessitates consideration of multiple migration routes. Classic EDT modeling assumes a single main corridor for migration, but the San Joaquin River has numerous bifurcations to bypasses that require modeling as additional routes. This will require considerable model refinement beyond what is possible in a standard EDT. For example, the FMWG thought that another reach just below Mendota Dam may be needed. Additionally, at some flows fish may actually enter the Mendota Reservoir, rather than being bypassed around. Associated with incorporation of bypass reaches is the need for habitat data for each bypass reach.

6.3 Data Needs

Data needs are summarized in Table F-5.

Table F-5.
Data Refinement Needs for the San Joaquin EDT Model

Data need	Source
Flood flow data to allow calculation of maximum flows. Graphs of the 1-, 2-, 5-, and 10-year flood flows would be adequate.	MWH flood flow group
Fish species diversity and richness	DFG 2007 report, to be provided by MWH[1]
Hatchery fish planting information	DFG[2]
Fine sediment data, summarized in millimeters (EDT uses fines less than 0.85 mm for fine sediment)	MWH to provide 2003 gravel permeability study and data
Metals in water column	MWH

Notes:
[1] Report has apparently since been provided.
[2] ICF Jones & Stokes will verify whether data already existing for CDFG Hatchery EIS/EIR are adequate.
Key:
DFG = California Department of Fish and Game
EDT = Ecosystem Diagnosis and Treatment

7.0 References

Jones & Stokes. 2002. San Joaquin River Restoration Plan Background Report (Draft). Prepared by Jones and Stokes Associates for Friant Water Users Authority and Natural Resources Defense Council, Sacramento, California.

Lestelle, L., L. Mobrand, and W. McConnaha. 2004. Information structure of Ecosystem Diagnosis and Treatment (EDT) and habitat rating rules for Chinook salmon, coho salmon and steelhead trout. Mobrand Biometrics, Inc., Available at www.Mobrand.com, 50 pages.

Lichatowich, J.A., and L.E. Mobrand. 1995. Analysis of Chinook salmon in the Columbia River from an ecosystem perspective. Bonneville Power Administration, DOE/BP-25105-2,102 pages.

Lichatowich, J.A., L.E. Mobrand, L. Lestelle, and T. Vogel. 1995. An approach to the diagnosis and treatment of depleted Pacific salmon populations in freshwater ecosystems. Fisheries 20: 10-18.

Mobrand, L.E., J.A. Lichatowich, L.C. Lestelle, and T.S. Vogel. 1997. An approach to describing ecosystem performance "through the eyes of salmon." Canadian Journal of Fisheries and Aquatic Sciences 54: 2964-2973.

San Joaquin Fisheries Management Work Group. 2007. Chinook salmon temporal occurrence and environmental requirements: preliminary tables. San Joaquin River Restoration program, 16 pages.

Yoshiyama, R.M., E.R. Gertstung, F.W. Fisher, and P.B. Moyle. 2001. Historical and present distribution of Chinook salmon in the Central Valley of California. Fish Bulletin 179: 71-176.

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