

APPENDIX B
HABITAT EVALUATION PROCEDURES DATA AND ANALYSIS



Table B-1a. HSI Model Hydrology and Hydraulics Variables for Riverine Habitats Baseline Conditions

Hydrology and Hydraulics (Riverine)								
Habitat Condition	Model*	Variable	Variable Description	Optimum Range	Units	San Marcos Range	Baseline Source	Potentially Affected?
Mesohabitat	CC	V1	Percent pools during average summer flow	40-60	%	From 0 to 100 percent depending on reach, average of Reach 4 through 12 is 26 percent	Saunders et al. 2001	Yes
	SB	V2	Percent pools	50 - 75	%			Yes
	BG	V1	Percent pool area during average summer flow	> 60	%			Yes
	BK	V5	Percent riffles	30 - 70	%			Yes
Hydraulics - Velocity	SB	V15	Stream gradient within representative reach	0.9 - 4.8	m/km	From 2 to 5 in reaches 4,5,7,10,11,and12; and from 10 to 12 in reaches 6,8,and 9	Hardy 2011	Yes
	BG	V18	Stream gradient within representative reach	< 0.5	m/km			Yes
	BG	V15	Average current velocity in spawning areas (embryo)	< 9	cm/sec			Yes
	BG	V16	Average current velocity in pools and backwater areas during early summer (fry)	< 4.5	cm/sec			Yes
Hydraulics - Depth	BG	V17	Average current velocity in pools and backwater areas during the growing season (juvenile)	< 4	cm/sec	From 2 to 11 depending on reach, average of Reach 4 through 12 is 6.09	Hardy 2011	Yes
	SB	V4	Average depth of pools during midsummer	1.6 - 4.6	meter			Yes
Hydrology	BK	V4	Percent of water area that is ≤ 60 cm in depth	100	%	Average of 23 from Reach 4 through 12	Hardy 2011	Yes
	SB	V14	Water level fluctuations during spawning and for 45 days after spawning	Slow rise previous to spawning with stable levels during and afterward	index			Slow rise previous to spawning with stable levels during and afterward

*CC = Channel Catfish; SB = Smallmouth Bass; BG = Bluegill; BK = Belted Kingfisher

Table B-1b. HSI Model Water Quality Variables for Riverine Habitat Baseline Conditions

Water Quality (Riverine)										
Habitat Condition	Model*	Variable	Variable Description	Optimum Range	Units	San Marcos Range	Baseline Source	Potentially Affected?		
Turbidity	CC	V7	Maximum monthly average turbidity during summer	< 100	ppm	Assume Optimum	Assume Optimum	Yes		
	SB	V9	Maximum monthly average turbidity level during the summer	< 25	JTU			Yes		
	BG	V6	Maximum monthly average turbidity during average summer flow	< 50	ppm			Yes		
Transparency	BK	V2	Average water transparency (Secchi depth)	> 60	cm	Assume Optimum	Assume Optimum	Yes		
Dissolved Oxygen	CC	V8	Average minimum dissolved oxygen levels within pools, backwaters, or littoral areas during midsummer	>7	mg/l	6 - 11.5	Bio-West 2010	Yes		
	BG	V8	Minimum dissolved oxygen range during summer	Seldom below 5 mg/l	index			Yes		
Temperature	CC	V5	Average midsummer water temperature within pools, backwaters, or littoral areas (adult)	26 - 29	°C	23 - 25	Bio-West 2010	Yes		
	CC	V10	Average water temperature within pools, backwaters, and littoral areas during spawning and embryo development (embryo)	26 - 27.5	°C			19.9 - 22.9	Bio-West 2010	Yes
	CC	V12	Average midsummer water temperature within pools or backwaters	28 - 30	°C					Yes

Table B-1b, continued

Water Quality (Riverine)											
Habitat Condition	Model*	Variable	Variable Description	Optimum Range	Units	San Marcos Range	Baseline Source	Potentially Affected?			
Temperature	CC	V14	Average midsummer water temperature within pools or backwaters (juvenile)	28 - 30	°C	19.9 - 22.9	Bio-West 2010	Yes			
	SB	V10	Water temperature in selected habitat during the growing season (May to October) (adults)	25 - 29	°C			Yes			
	SB	V11	Water temperature in selected habitat during spawning and for 45 days afterwards (embryo)	15 - 25	°C			Yes			
	SB	V12	Water temperature in selected habitat during the growing season (May to October) (fry)	22 - 29	°C			Yes			
	SB	V13	Water temperature in selected habitat during the growing season (May to October) (juvenile)	22 - 29	°C			Yes			
	BG	V10	Maximum midsummer temperature within pools	26 - 27	°C			Yes			
	BG	V11	Average of mean weekly water temperature within pools or littoral areas during spawning (embryo)	22 - 27	°C			Yes			
	BG	V12	Maximum early summer temperature within pools or littoral areas	24.5 - 32	°C			Yes			
	BG	V13	Maximum midsummer temperature within pools or littoral areas (juvenile)	30	°C			Yes			
	pH	SB	V6	Average pH level during the year	7.9 - 8.1			pH	7.4 - 7.7	Bio-West 2010	No
		BG	V7	pH range during growing season	6.5 - 8.5			pH index	7.4 - 7.7	Bio-West 2010	No
	Salinity	CC	V9	Maximum salinity during summer (adult)	< 1			ppt	< 1	Bio-West 2010	No
		CC	V11	Maximum salinity during spawning and embryo development	< 2			ppt	< 1		No
CC		V13	Maximum salinity during summer (fry, juvenile)	< 5	ppt	< 1	No				
BG		V9	Maximum monthly average salinity during growing season	< 2	ppt	< 1	No				

*CC = Channel Catfish; SB = Smallmouth Bass; BG = Bluegill; BK = Belted Kingfisher

Table B-1c. HSI Model Cover and Substrate Variables for Riverine Habitat Baseline Conditions

Cover and Substrate (Riverine)									
Habitat Condition	Model*	Variable	Variable Description	Optimum Range	Units	San Marcos Range	Baseline Source	Potentially Affected?	
Instream Cover	CC	V2	Percent cover of logs, boulders, cavities, brush, debris, or standing timber during summer within pools, backwater areas, and littoral areas	> 40	%	0 - 11	Field Survey	Yes	
	SB	V5	Percent cover in the form of boulders, stumps, dead trees, and crevices (adults) or vegetation and rocks (fry)	25 - 50	%			Yes	
	BG	V2	Percent cover (e.g., logs, brush, and debris) within pools during summer	20 - 60	%			Yes	
Instream Cover	BG	V3	Percent cover (aquatic vegetation, submersed, dense stands, or finely divided leaves)	15 - 30	%	6.4 – 90.7	Owens 2010	Yes	
	Hydraulics - Velocity	CC	V4	Food production potential by substrate type present during average summer flow	rubble dominant runs, >30% vegetation in pools	index	Dominated by sands and silts	Owens 2010	Yes
SB		V1	Dominant substrate type within pool or backwater	1.6 - 2.0 cm, and boulder	Index	Yes			
BG		V20	Substrate composition within pools during spawning (embryo)	finer and gravel present	index	Yes			
Riparian Vegetation	BK	V7	Distance from nearest suitable soil bank to 1-km sections of stream	0	km	Assume Optimum	Assume Optimum	Yes	
	BK	V3	Percent water surface obstruction	< 0	%			Field Survey	Yes
Riparian Vegetation	BK	V6	Average number of stream subsections that contain one or more perches	> 40	count/km	> 40	Assume Optimum	Yes	

*CC = Channel Catfish; SB = Smallmouth Bass; BG = Bluegill; BK = Belted Kingfisher

Table B-1d. HSI Model Variables for Palustrine and Terrestrial Habitat Baseline Conditions

Palustrine and Terrestrial									
Habitat Condition	Model*	Variable	Variable Description	Optimum Range	Units	San Marcos Range	Baseline Source	Potentially Affected?	
Vegetative Cover	AC	V1	Percent of wetland basin dominated by persistent emergent herbaceous vegetation	40 - 60	%	55	Field Survey	Yes	
	AC	V2	Edge index between emergent vegetation and open water	> 4	index	1		Yes	
	ST	V1	Percent cover of emergent and submerged vegetation	> 90	%	55	Yes		
Hydrology and Water Quality	ST	V4	Water Temperature (average of daily minimum and maximum during growing season)	25 - 30	°C	20	Estimation by Team	Yes	
	ST	V3	Water regime	Permanently Flooded	index	Permanently flooded	Field Survey	Yes	
	AC	V3	Water regime	Semipermanently Flooded	index	Permanently flooded		Yes	
Riparian Vegetation	ST	V2	Water depth	1 - 2	meters	0.7	Field Survey	Yes	
	DW	V1	Basal area	10 - 20	m ² /ha	4 - 99.8		Yes	
	DW	V2	Number of snags > 15 cm diameter breast height	> 5	count/0.4 ha	0 - 4	Field Survey	Yes	

*AC = American Coot; ST = Slider Turtle; DW = Downy Woodpecker

Table B-2. Downy Woodpecker (DW) Future Without and With Project (FWOP/FWP) Conditions

Variable	Optimum	FWOP/FWP	Forest Type							
			1	2	3	4	5			
Area										
Riparian Forest		FWOP	7.98	5.78	1.95	15.49	0.00			
(acres)		RIP1 (TY1 and TY50)	7.98	5.78	0.28	15.49	13.51			
		RIP2 (TY1 and TY50)	7.98	5.78	0.28	15.49	14.55			
		DISC (TY1 and TY50)	7.74	5.71	1.75	15.18	2.10			
		SHORE1 (TY1 and TY50)	7.98	5.77	1.95	15.26	0.24			
		SHORE2 (TY1 and TY50)	7.98	5.78	1.95	15.49	0.31			
		WET (TY1 and TY50)	7.98	4.67	1.87	15.49	0.00			
V1		FWOP (TY1 and TY15)	27.55	39.03	22.96	45.46	0.00			
(m ² /ha)		FWOP (TY25)	33.06	39.03	22.96	45.46	0.00			
		FWOP (TY50)	39.67	39.03	22.96	45.46	0.00			
		EXOT (TY1)	20.00	20.00	22.96	30.00	0.00			
		EXOT (TY50)	20.00	20.00	22.96	30.00	0.00			
		RIP (TY1)	27.55	39.03	22.96	45.46	0.00			
		RIP (TY15)	27.55	39.03	22.96	45.46	5.00			
		RIP (TY25)	33.06	39.03	22.96	45.46	10.00			
		RIP (TY50)	39.67	39.03	22.96	45.46	20.00			
V2		FWOP	4	4	1	3	0			
(no. > 6 dbh/acre)		EXOT (TY1)	5	5	1	5	0			
		EXOT (TY50)	5	5	1	5	0			
		RIP (TY1)	4	4	1	3	0			
		RIP (TY15)	4	4	1	3	0			
		RIP (TY25)	4	4	1	3	2			
		RIP (TY50)	4	4	1	3	5			

Table B-4. Smallmouth Bass (SB) Future Without and With Project (FWOP/FWP) Conditions

Variable	Optimum	FWOP/FWP	Reach										
			4	5	6	7	8	9	10	11			
Area (acres)			4.50	3.19	2.61	4.32	2.63	1.12	3.83	3.22			
		FWOP											
		EXOE (TY3)	4.83	4.30	2.78	4.80	2.67	1.12	4.27	3.26			
		EXOE (TY50)	4.83	4.30	2.78	4.80	2.67	1.12	4.27	3.26			
		SHORE2 (TY1 and TY50)	4.52	3.19	2.61	4.32	2.63	1.12	3.83	3.22			
V1 (Index)	C	FWOP	A	A	A	A	A	A	A	A	A	A	
		DISC (TY1)	B	B	B	B	B	B	B	B	B	B	
		DISC (TY50)	B	B	B	B	B	B	B	B	B	B	
		SED (TY3)	B	B	B	B	B	B	B	B	B	B	
		SED (TY50)	B	B	B	B	B	B	B	B	B	B	
		DISC/SED (TY3)	C	C	C	C	C	C	C	C	C	C	
		DISC/SED (TY50)	C	C	C	C	C	C	C	C	C	C	
V2 (%)	50 - 75	FWOP/FWP	7.34	15.67	61.38	44.00	50.53	0.00	25.05	12.10			
V4 (meter)	1.6 - 4.6	FWOP/FWP	0.24	0.31	0.35	0.38	0.41	0.00	0.33	0.31			
V5 (%)	25 - 50	FWOP/FWP	70.35	91.25	71.82	30.66	53.69	94.50	28.44	5.84			
		EXOE (TY3)	62.87	56.34	65.17	19.47	52.21	94.21	17.12	4.89			
		EXOE (TY50)	62.87	56.34	65.17	19.47	52.21	94.21	17.12	4.89			
V6 (pH)	7.9 - 8.1	FWOP/FWP	7.7	7.8	7.7	7.6	7.6	7.5	7.5	7.6			
V8 (ppb)	6-8	FWOP/FWP	7	7	6	6	6	6	7	6			
V9 (JTU)	< 25	FWOP/FWP	15	15	15	15	15	15	15	15			
V10 (°C)	25 - 29	FWOP/FWP	22	21	21	21	21	20	20	21			
V11 (°C)	15 - 25	FWOP/FWP	22	21	21	21	21	20	20	21			
V12 (°C)	22 - 29	FWOP/FWP	22	21	21	21	21	20	20	21			
V13 (°C)	22 - 29	FWOP/FWP	22	21	21	21	21	20	20	21			
V14 (index)	C	FWOP/FWP	C	C	C	C	C	C	C	C			
V15 (m/km)	0.9 - 4.8	FWOP/FWP	2.72	5.03	12.12	3.33	9.96	10.09	2.26	4.63			

Table B-5. Belted Kingfisher (BK) Future Without and With Project (FWOP/FWP) Conditions

Area	Variable	Optimum	Reach							
			4	5	6	7	8	9	10	11
(acres)	Riverine		4.50	3.19	2.61	4.32	2.63	1.12	3.83	3.22
	FWOP		4.83	4.30	2.78	4.80	2.67	1.12	4.27	3.26
	EXOE		4.52	3.19	2.61	4.32	2.63	1.12	3.83	3.22
V2	Average water transparency (Secchi depth)	> 60	75	75	75	75	75	75	75	75
(cm)										
V3	Percent water surface obstruction	< 0	6.98	26.52	6.30	11.95	3.38	1.11	10.42	1.34
(%)			0.02	0.65	0.06	1.89	1.93	0.82	0.25	0.39
	EXOE (TY3)		0.02	0.65	0.06	1.89	1.93	0.82	0.25	0.39
V4	Percent of water area that is <= 60 cm in depth	> 100	30.36	32.42	26.02	22.99	11.8	21.65	28.16	21.43
(%)										
V5	Percent riffles	30 - 70	70.35	91.25	71.82	30.7	53.7	94.5	28.4	5.8
(%)										
V6	Average number of stream subsections that contain one or more perches	> 40	50	50	50	50	50	50	50	50
(count/km)										
V7	Distance from nearest suitable soil bank from 1-km sections of stream	0	0	0	0	0	0	0	0	0
(km)										

Elephant Ears										
Acres	0.34	1.11	0.17	0.48	0.04	0.00	0.43	0.03		
%	6.96	25.87	6.24	10.06	1.45	0.29	10.17	0.95		

Table B-6. Slider Turtle (ST) Future Without and With Project (FWOP/FWP) Conditions

Variable	Assumptions	Optimum	FWP/FWOP
Area (acres)	Wetland		FWOP
			WET
V1	Percent cover of emergent and submerged vegetation	> 90%	FWOP
(%)			WET
V2	Water Depth	1 to 2	FWOP
(m)			WET
V3	Water Regime	A - permanently flooded	FWOP
(index)			WET
V4	Water Temperature	C - 25 to 30 °C	FWOP
(index)			WET

Table B-7. American Coot (AC) Future Without and With Project (FWOP/FWP) Conditions

Variable		Optimum	FWP/FWOP
Area (acres)	Lacustrine/Riverine/Herbaceous Wetland		FWOP WET
			0.00 1.19
V1 (%)	Percent of wetland basin dominated by persistent emergent herbaceous vegetation	40 - 60	FWOP WET
			55 55
V2 (index)	Edge index between emergent vegetation and open water	> 4	FWOP WET
			1 1
V3 (index)	Water regime	3	FWOP WET
			1 1

Table B-8. AAHUs by Habitat Type for Example Alternative Plans'

Alternative Plan #	Description	Measure										AAHUs					
		EXOT	RIP	EXOA	SHORE	DISC	SED	DUCK	WET	EDU	Riverine	Wetland	Riparian	Total			
No Action Plan	no measures	0	0	0	0	0	0	0	0	0	0	0	0	15.16	0.00	15.40	30.56
2	EXOT1 only	1	0	0	0	0	0	0	0	0	0	0	0	15.16	0.00	21.83	36.99
3	RIP1 only	0	1	0	0	0	0	0	0	0	0	0	0	15.16	0.00	20.34	35.50
4	RIP2 only	0	2	0	0	0	0	0	0	0	0	0	0	15.16	0.00	20.75	35.91
7	EXOA1 only	0	0	1	0	0	0	0	0	0	0	0	0	17.57	0.00	15.40	32.98
13	SHORE1 only	0	0	0	1	0	0	0	0	0	0	0	0	15.16	0.00	15.50	30.66
14	SHORE2 only	0	0	0	2	0	0	0	0	0	0	0	0	15.18	0.00	15.52	30.70
37	DISC1 only	0	0	0	0	1	0	0	0	0	0	0	0	15.40	0.00	15.86	31.26
73	SED1 only	0	0	0	0	0	1	0	0	0	0	0	0	15.38	0.00	15.40	30.79
343	DUCK1 only	0	0	0	0	1	1	0	0	0	0	0	0	16.40	0.76	15.86	33.03
388	WET1 only	0	0	1	0	1	0	0	0	0	0	0	0	17.82	0.00	15.86	33.69
544	EDU1 only	0	0	0	1	0	0	1	1	0	0	0	0	15.16	0.76	15.50	31.42
1149	All measures at scale1	1	2	1	2	0	1	1	1	1	1	1	1	17.83	0.76	27.30	45.89
1150	RIP2 all other measures scale1	0	0	0	0	1	1	1	1	1	1	1	1	16.40	0.76	15.86	33.03
1151	SHORE2 all other measures scale1	1	0	0	0	1	1	1	1	1	1	1	1	16.40	0.76	22.15	39.31
1152	Maximum scale of all measures	1	2	1	2	1	1	1	1	1	1	1	1	18.95	0.76	27.61	47.33

*measures were coded by scale to track plan combinations; a 0 means no implementation, a 1 means implementation at scale 1, and a 2 means implementation at scale 2; all 1,152 plan combinations were evaluated