APPENDIX B

REFERENCE MATERIALS AND CRITERIA FOR BIOLOGICAL ASSESSMENTS

Table B.1. Estimated downstream distance of domestic-discharge impact on dissolved oxygen.

Permitted Effluent Flow (mgd)	Extent of Downstream Impact on Dissolved Oxygen (km)[a]
0–0.05	1.0
0.05–0.10	1.2
0.10–0.20	1.6
0.20–0.50	1.8
0.50–1.0	3.2
1.0–2.0	4.4
2.0–3.5	4.6
3.5–5.0	5.2
5.0–7.5	8.0
7.5–10.0	9.6
10.0–15.0	12.4
15.0–20.0	14.8
20.0–40.0	24.6

[a] Twice the estimated distance, based on a default QUAL-TX water quality simulation model with no site-specific information.

Table B.2. Dissolved-oxygen criteria, mg/L [30 TAC 307.7(b)(3)(A)(I)].

Aquatic-Life-Use Subcategory	**Freshwater Mean, Minimum**	**Springtime Freshwater Mean, Minimum**
Exceptional	6.0, 4.0	6.0, 5.0
High	5.0, 3.0	5.5, 4.5
Intermediate	4.0, 3.0	5.0, 4.0
Limited	3.0, 2.0	4.0, 3.0

- Apply dissolved-oxygen means as a minimum average over a 24-hour period.
- Daily minima are not to extend beyond 8 hours per 24-hour day. Lower dissolved-oxygen minima may apply at a specific site when natural daily fluctuations below the mean are greater than the difference between the mean and minima of the appropriate criteria.
- Apply springtime criteria to protect fish-spawning periods during that portion of the first half of the year, when water temperatures are 63.0°F to 73.0°F.
- Quantitative criteria to support aquatic-life attributes are described in *Procedures to Implement the Texas Surface Water Quality Standards*, RG-194, January 2003.
- Dissolved-oxygen analyses and computer models to establish effluent limits for permitted discharges are normally applied to mean criteria at steady-state, critical conditions.
- Determination of standards attainment for dissolved-oxygen criteria is specified in 30 TAC 307.9(e)(6).

Table B.3. Metrics for Ecoregion 24.

	Metric	Scoring Criteria		
1	**Total Number of Fish Species**	Use the graph in Figure B.1 to determine the score based on the basin size compared to the number of fish species collected (species richness)		
	Score_____	**5**	**3**	**1**
2	**Number of Native Cyprinid Species**	If there are > 4 species present	If there are 3–4 species present	If there are < 3 species present
	Score_____	**5**	**3**	**1**
3	**Number of Benthic Invertivore Species**	If there are > 1 species present	If there is 1 species present	If there are 0 species present
	Score_____	**5**	**3**	**1**
4	**Number of Sunfish Species**	If there are > 1 species present	If there is 1 species present	If there are 0 species present
	Score_____	**5**	**3**	**1**
5	**Number of Intolerant Species**	If there are > 1 species present	If there is 1 species present	If there are 0 species present
	Score_____	**5**	**3**	**1**
6	**% Individuals as Tolerant Species (excluding western mosquitofish)**	< 26 % tolerant species	26–50% tolerant species	> 50% tolerant species
	Score_____	**5**	**3**	**1**
7	**% of Individuals as Omnivores**	< 9 % omnivore species	9–16% omnivore species	> 16% omnivore species
	Score_____	**5**	**3**	**1**
8	**% of Individuals as Invertivores**	> 65 % invertivore species	33–65% invertivore species	< 33% invertivore species
	Score_____	**5**	**3**	**1**
9	**Number of Individuals in Sample**	**A. Number of individuals / seine haul**		
		> 160.4 individuals	80.2–160.4 individuals	< 80.2 individuals
		5	**3**	**1**
		B. Number of individuals / minutes of electrofishing		
	Score_____	> 26.5 individuals	13.3–26.5 individuals	< 13.32 individuals
		5	**3**	**1**
10	**% of Individuals as Non-Native Species**	< 1.4% non-native species	9–16% non-native species	> 16% non-native species
	Score_____	**5**	**3**	**1**
11	**% of Individuals with Disease or Other Anomaly**	< 9% diseased species	9–16% diseased species	> 16% diseased species
	Score_____	**5**	**3**	**1**

Aquatic-life use: ≥ 43, exceptional; 37–42, high; 35–36, intermediate; < 35 limited.

Figure B.1.

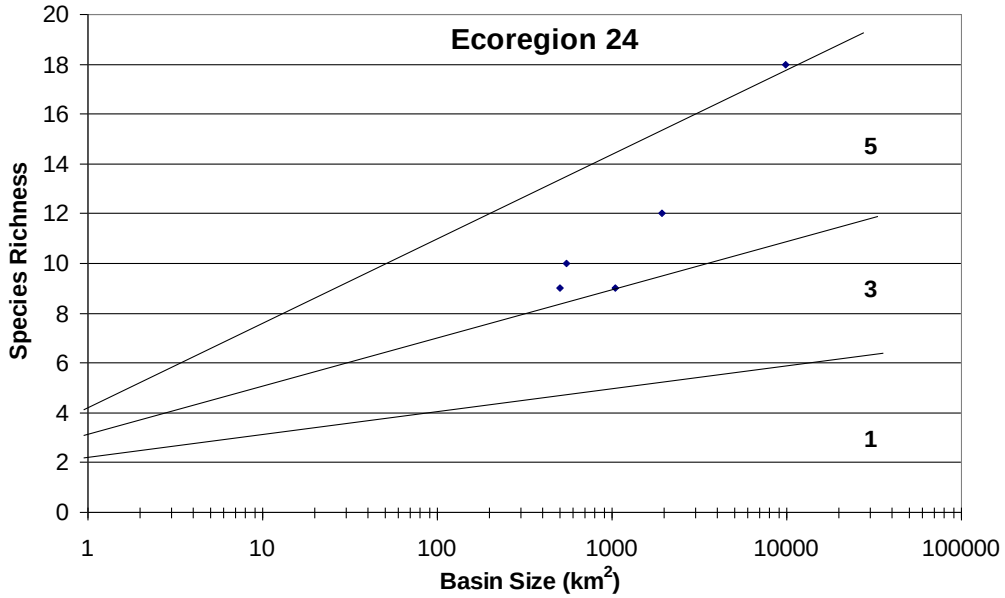

Ecoregion 24
Species Richness
Basin Size (km2)
5
3
1
0
2
4
6
8
10
12
14
16
18
20
1
10
100
1000
10000
100000

Table B.4. Metrics for Ecoregions 25 and 26.

Metric		**Scoring Criteria**		
		5	**3**	**1**
1	Total number of fish species	See Figure B.2		
2	Number of native cyprinid species	> 2	2	< 2
3	Number of sunfish species	> 1	1	0
4	% of individuals as omnivores	< 9	9–16	> 16
5	% of individuals as invertivores	> 65	33–65	< 33
6	Number of individuals/seine haul	> 41.7	20.9–41.7	< 20.9
7	% of individuals as non-native species	< 1.4	1.4–2.7	> 2.7
8	% of individuals with disease or other anomaly	< 0.6	0.6–1.0	> 1.0

Aquatic-life use: ≥ 36, exceptional; 34–35, high; 24–33, intermediate; < 24 limited.

Figure B.2.

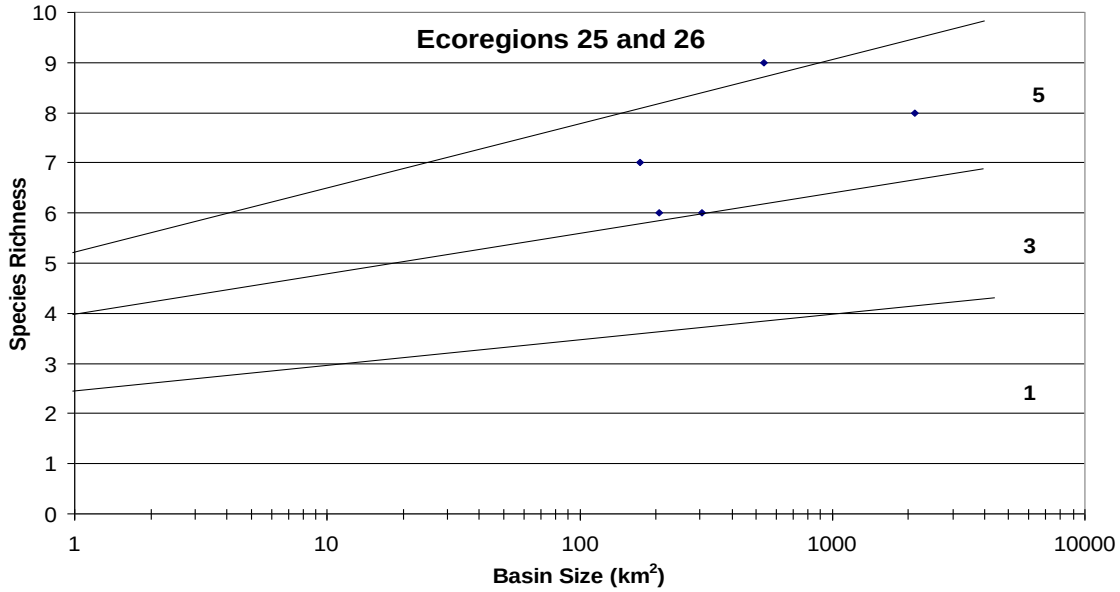

Ecoregions 25 and 26
Species Richness
Basin Size (km2)
5
3
1
0
1
2
3
4
5
6
7
8
9
10
1
10
100
1000
10000

Table B.5. Metrics for Ecoregions 27, 29, and 32.

Metric		**Scoring Criteria**		
		5	**3**	**1**
1	Total number of fish species	See Figure B.3		
2	Number of native cyprinid species	> 3	2–3	< 2
3	Number of benthic invertivore species	> 1	1	0
4	Number of sunfish species	> 3	2–3	< 2
5	% of individuals as tolerant species (excluding western mosquitofish)	< 26	26–50	> 50
6	% of individuals as omnivores	< 9	9–16	> 16
7	% of individuals as invertivores	> 65	33–65	< 33
8	% of individuals as piscivores	> 9	5–9	< 5
9	Number of individuals in sample			
	a. Number of individuals / seine haul	> 87	36–87	< 36
	b. Number of individuals / minute electrofishing	> 7.1	3.3–7.1	< 3.3
10	% of individuals as non-native species	< 1.4	1.4–2.7	> 2.7
11	% of individuals with disease or other anomaly	< 0.6	0.6–1.0	> 1.0

Aquatic-life use: ≥ 49, exceptional; 41–48, high; 35–40, intermediate; < 35, limited.

Figure B.3.

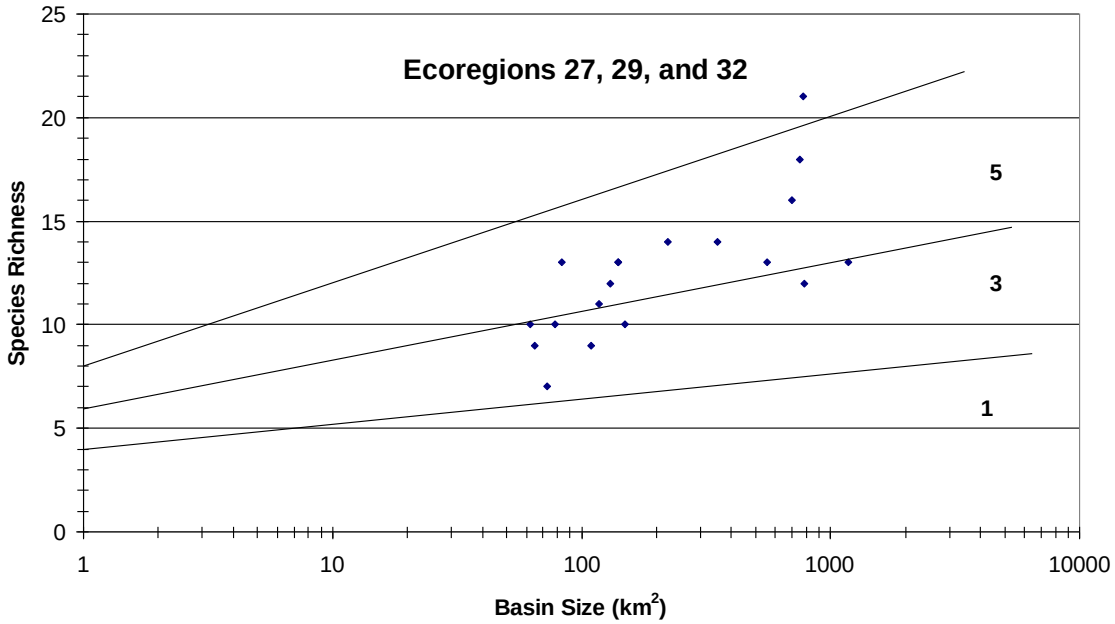

Ecoregions 27, 29, and 32
Species Richness
Basin Size (km2)
25
20
15
10
5
0
1
10
100
1000
10000
5
3
1

Table B.6. Metrics for Ecoregion 30.

Metric		**Scoring Criteria**		
		5	**3**	**1**
1	Total number of fish species	See Figure B.4		
2	Number of native cyprinid species	> 4	3–4	< 3
3	Number of benthic invertivore species	> 1	1	0
4	Number of sunfish species	> 3	2–3	< 2
5	Number of intolerant species	> 1	1	0
6	% of individuals as tolerant species (excluding western mosquitofish)	< 26	26–50	> 50
7	% of individuals as omnivores	< 9	9–16	> 16
8	% of individuals as invertivores	> 65	33–65	< 33
9	% of individuals as piscivores	> 8	3.9–8.0	< 3.9
10	Number of individuals in sample			
	a. Number of individuals / seine haul	> 48	37–48	< 37
	b. Number of individuals / minute electrofishing	> 5	2.5–5	< 2.5
11	% of individuals as non-native species	< 1.4	1.4–2.7	> 2.7
12	% of individuals with disease or other anomaly	< 0.6	0.6–1.0	> 1.0

Aquatic-life use: ≥ 52, exceptional; 42–51, high; 30–41, intermediate; < 30, limited.

Figure B.4.

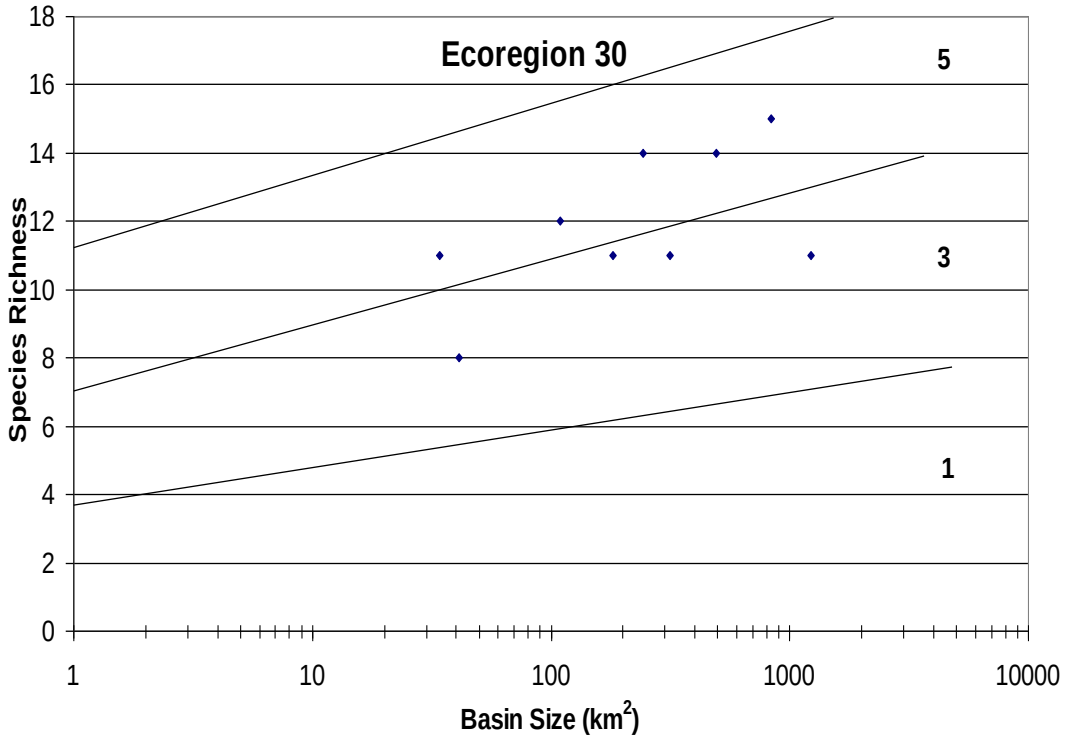

Ecoregion 30
5
3
1
Species Richness
18
16
14
12
10
8
6
4
2
0
1
10
100
1000
10000
Basin Size (km2)

Table B.7. Metrics for Ecoregion 31.

Metric		**Scoring Criteria**		
		5	**3**	**1**
1	Total number of fish species	See Figure B.5		
2	Number of native cyprinid species	> 5	3–5	< 3
3	Number of benthic species (catfish, suckers, and darters)	> 2	2	< 2
4	Number of sunfish species	> 4	3–4	< 3
5	% of individuals as tolerant species (excluding western mosquitofish)	< 26	26–50	> 50
6	% of individuals as omnivores	< 9	9–16	> 16
7	% of individuals as invertivores	> 65	33–65	< 33
8	% of individuals as piscivores	> 9	5–9	< 5
9	Number of individuals in sample			
	a. Number of individuals / seine haul	> 39.5	19.7–39.5	< 19.7
	b. Number of individuals / minute electrofishing	> 8.9	4.4–8.9	< 4.4
10	% of individuals as non-native species	< 1.4	1.4–2.7	> 2.7
11	% of individuals with disease or other anomaly	< 0.6	0.6–1.0	> 1.0

Aquatic-life use: ≥ 42, exceptional; 37–41, high; 25–36, intermediate; < 25, limited.

Figure B.5.

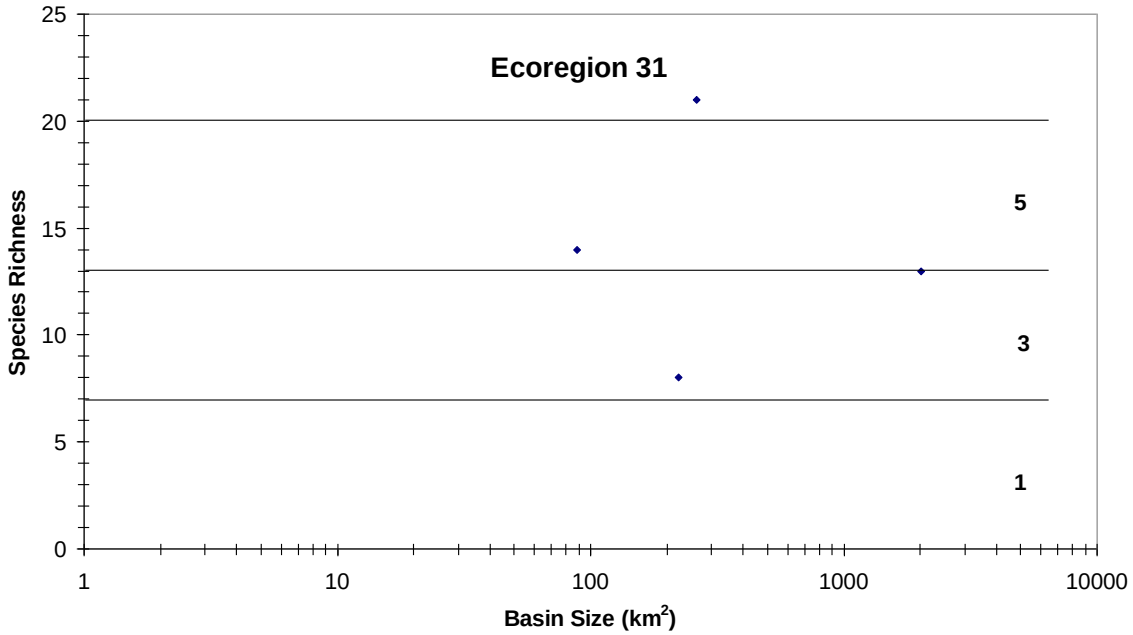

Ecoregion 31
Species Richness
Basin Size (km2)
25
20
15
10
5
0
1
10
100
1000
10000
5
3
1

Table B.8. Metrics for Ecoregions 33 and 35.

Metric		**Scoring Criteria**		
		5	**3**	**1**
1	Total number of fish species	See Figure B.6		
2	Number of native cyprinid species	> 4	2–4	< 2
3	Number of benthic invertivore species	> 4	3–4	< 3
4	Number of sunfish species	> 4	3–4	< 3
5	Number of intolerant species	> 3	2–3	< 2
6	% of individuals as tolerant species (excluding western mosquitofish)	< 26	26–50	> 50
7	% of individuals as omnivores	< 9	9–16	> 16
8	% of individuals as invertivores	> 65	33–65	< 33
9	% of individuals as piscivores	> 9	5–9	< 5
10	Number of individuals in sample			
	a. Number of individuals / seine haul	> 28	14–28	< 14
	b. Number of individuals / minute electrofishing	> 7.3	3.9–7.3	< 3.6
11	% of individuals as non-native species	< 1.4	1.4–2.7	> 2.7
12	% of individuals with disease or other anomaly	< 0.6	0.6–1.0	> 1.0

Aquatic-life use: ≥ 52, exceptional; 42–51, high; 36–41, intermediate; < 36, limited.

Figure B.6.

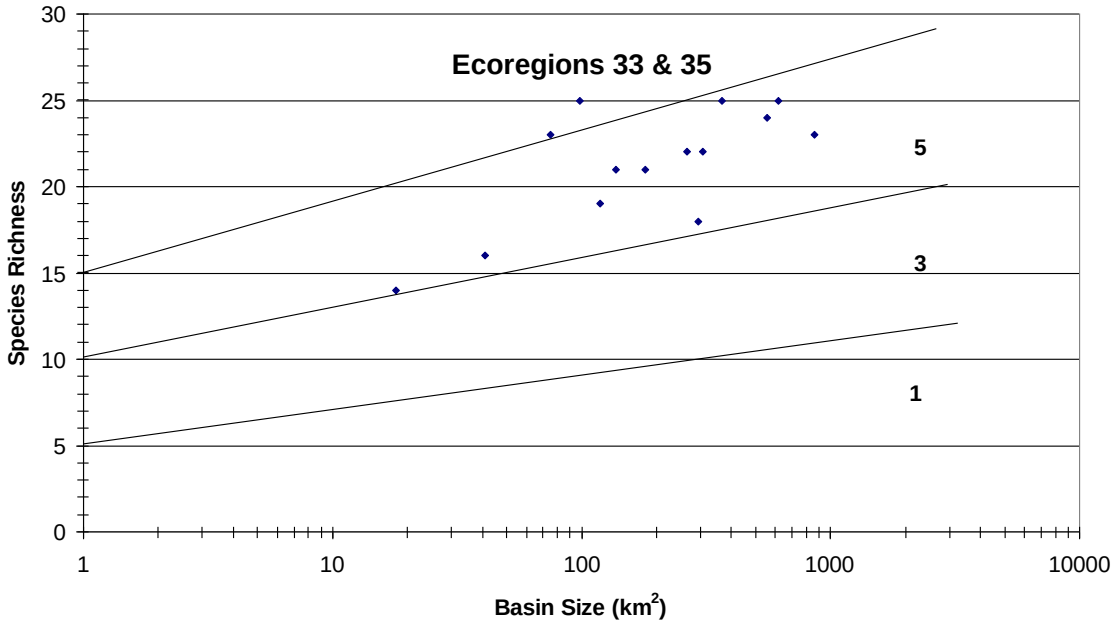

Ecoregions 33 & 35
Species Richness
Basin Size (km2)
5
3
1
30
25
20
15
10
5
0
1
10
100
1000
10000

Table B.9. Metrics for Ecoregion 34.

Metric		**Scoring Criteria**		
		5	**3**	**1**
1	Total number of fish species	See Figure B.7		
2	Number of native cyprinid species	> 2	2	< 2
3	Number of benthic invertivore species	> 1	1	0
4	Number of sunfish species	> 3	2–3	< 2
5	Number of intolerant species	≥ 1	—	0
6	% of individuals as tolerant species (excluding western mosquitofish)	< 26%	26–50%	> 50%
7	% of individuals as omnivores	< 9%	9–16%	> 16%
8	% of individuals as invertivores	> 65%	33–65%	< 33%
9	Number of individuals in sample			
	a. Number of individuals / seine haul	> 174.7	87.4–174.7	< 87.4
	b. Number of individuals / minute electrofishing	> 7.7	3.9–7.7	< 3.9
10	% of individuals as non-native species	< 1.4%	1.4–2.7%	> 2.7%
11	% of individuals with disease or other anomaly	< 0.6%	0.6–1.0%	> 1.0%

Aquatic-life use: ≥ 49, exceptional; 39–48, high; 31–38, intermediate; < 31, limited.

Figure B.7.

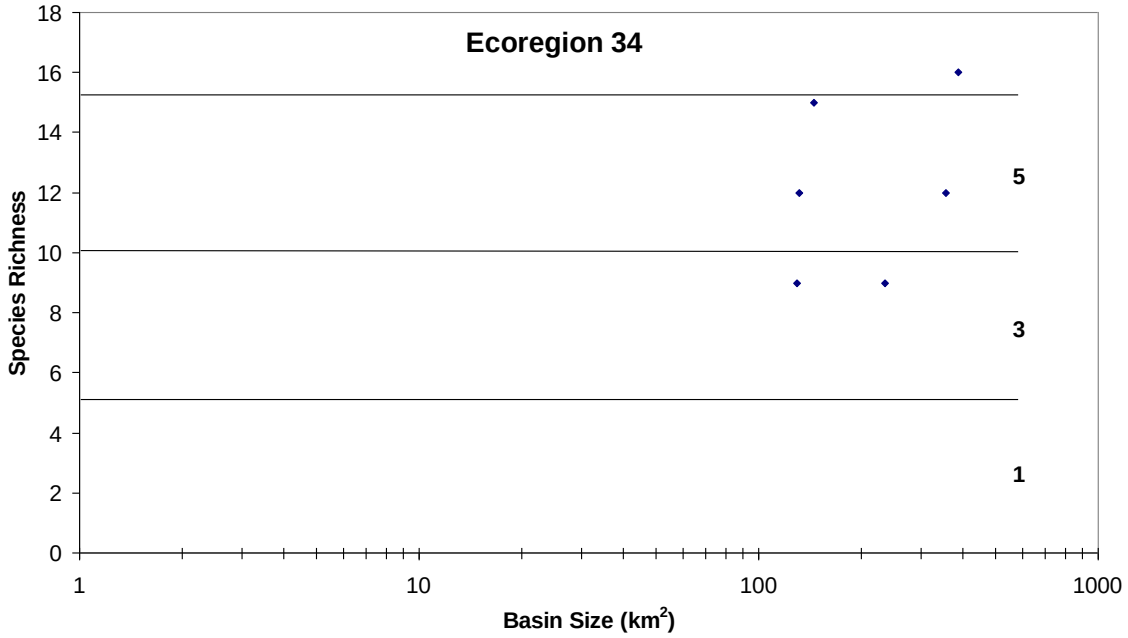

Ecoregion 34
Species Richness
Basin Size (km2)
18
16
14
12
10
8
6
4
2
0
1
10
100
1000
5
3
1

Figure B.8. Map of Texas Level IV ecoregions.

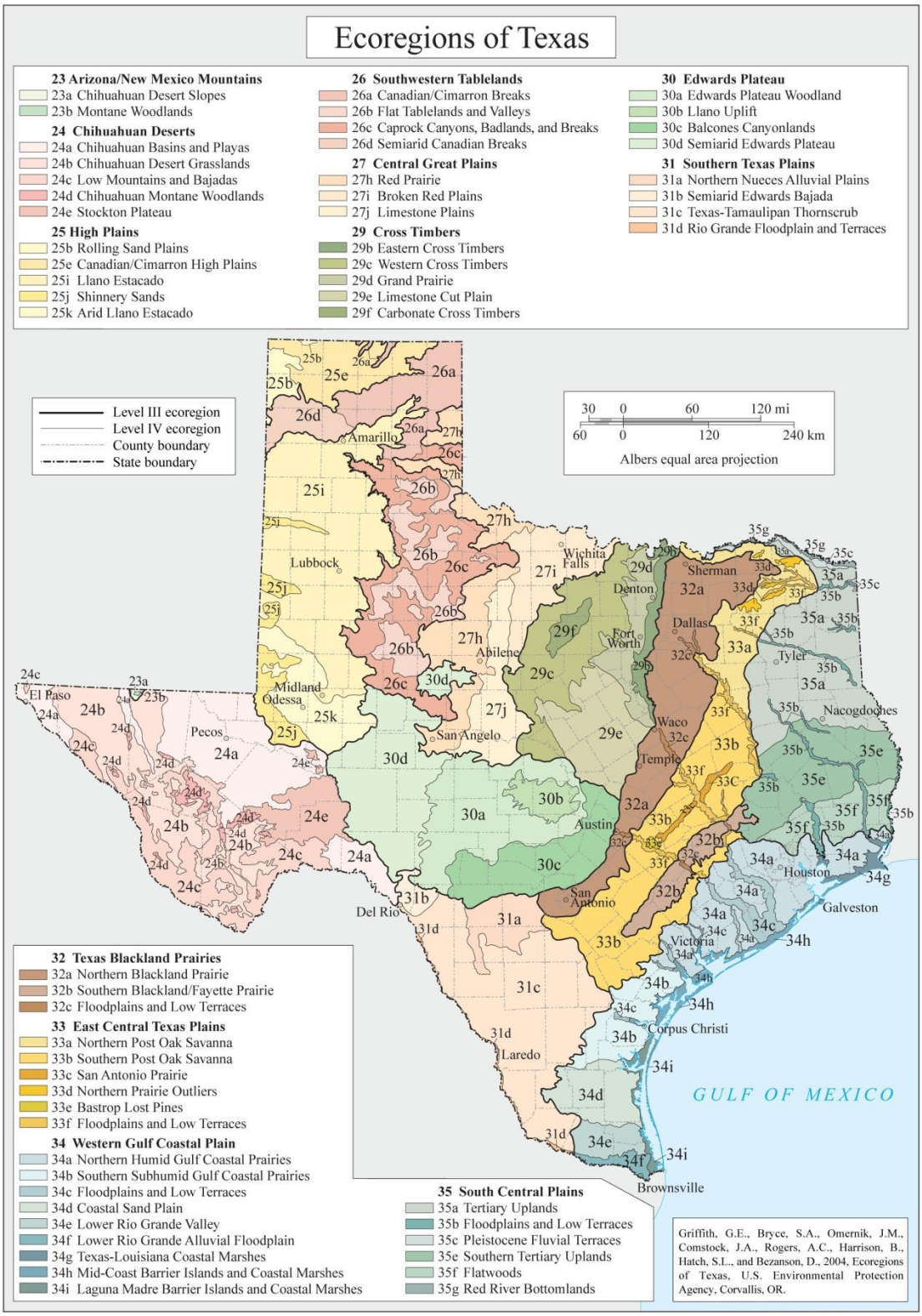


Table B.10. Classification of Texas freshwater fishes into trophic and tolerance groups. Adapted from G.W. Linam, and L.J. Kleinsasser (1998).

Trophic-group designations: IF—invertivore; P—piscivore; O—omnivore; and H—herbivore. Tolerance designations: T—tolerant; I—intolerant. Those species without a tolerance designation are considered intermediate.

Common Name	Scientific Name	Parameter Code	Trophic Group	Tolerance
Paddlefishes	**Polyodontidae**			
Paddlefish	*Polyodon spathula*	98335	O	I
Gars	**Lepisosteidae**			
Spotted gar	*Lepisosteus oculatus*	98340	P	T
Longnose gar	*Lepisosteus osseus*	98341	P	T
Shortnose gar	*Lepisosteus platostomus*	98342	P	T
Alligator gar	*Atractosteus spatula*	98344	P	T
Bowfins	**Amiidae**			
Bowfin	*Amia calva*	98347	P	T
Freshwater eels	**Anguillidae**			
American eel	*Anguilla rostrata*	98361	P	
Snake eels	**Ophichthidae**			
Speckled worm eel	*Myrophis punctatus*	98388	P	
Lampreys	**Petromyzontidae**			
Chestnut lamprey	*Ichthyomyzon castaneus*	99297	P	I
Southern brook lamprey	*Ichthyomyzon gagei*	98013	None	I
Herrings	**Clupeidae**			
Skipjack herring	*Alosa chrysochloris*	98418	P	
Finescale menhaden	*Brevoortia gunteri*	98426	O	
Gizzard shad	*Dorosoma cepedianum*	98430	O	T
Threadfin shad	*Dorosoma petenense*	98429	O	
Scaled sardine	*Harengula jaguana*	98015	IF	
Minnows	**Cyprinidae**			
Central stoneroller	*Campostoma anomalum*	98502	H	
Mexican stoneroller	*Campostoma ornatum*	98503	H	
Goldfish	*Carassius auratus*	98439	O	T
Grass carp	*Ctenopharyngodon idella*	98528	H	T
Red shiner	*Cyprinella lutrensis*	98474	IF	T
Proserpine shiner	*Cyprinella proserpina*	98480	IF	
Blacktail shiner	*Cyprinella venusta*	98487	IF	
Common carp	*Cyprinus carpio*	98437	O	T
Manantial roundnose minnow	*Dionda argentosa*		O	I
Devils River minnow	*Dionda diaboli*	98490	IF	I
Roundnose minnow	*Dionda episcopa*	98491	O	I
Nueces roundnose minnow	*Dionda serena*		IF	I
Cypress minnow	*Hybognathus hayi*	98493	O	
Mississippi silvery minnow	*Hybognathus nuchalis*	98494	O	T
Plains minnow	*Hybognathus placitus*	98495	O	T
Striped shiner	*Luxilus chrysocephalus*	98432	IF	
Ribbon shiner	*Lythrurus fumeus*	98471	IF	
Redfin shiner	*Lythrurus umbratilis*	98486	IF	
Rio Grande chub	*Gila pandora*	98451	IF	I
Speckled chub	*Macrhybopsis aestivalis*	98449	IF	

Trophic-group designations: IF—invertivore; P—piscivore; O—omnivore; and H—herbivore. Tolerance designations: T—tolerant; I—intolerant. Those species without a tolerance designation are considered intermediate.

Common Name	Scientific Name	Parameter Code	Trophic Group	Tolerance
Prairie chub	*Macrhybopsis australis*		IF	
Shoal chub	*Macrhybopsis hyostoma*		IF	
Burrhead chub	*Macrhybopsis marconis*		IF	
Peppered chub	*Macrhybopsis tetranema*		IF	
Silver chub	*Macrhybopsis storeriana*	98448	IF	
Golden shiner	*Notemigonus crysoleucas*	98441	IF	T
Texas shiner	*Notropis amabilis*	98459	IF	
Pallid shiner	*Hybopsis amnis*	98460	IF	
Emerald shiner	*Notropis atherinoides*	98461	IF	
Blackspot shiner	*Notropis atrocaudalis*	98462	IF	
Red River shiner	*Notropis bairdi*	98463	IF	
River shiner	*Notropis blennius*	98464	IF	
Tamaulipas shiner	*Notropis braytoni*	98465	IF	
Smalleye shiner	*Notropis buccula*	98466	IF	
Ghost shiner	*Notropis buchanani*	98467	IF	
Ironcolor shiner	*Notropis chalybaeus*	98468	IF	I
Chihuahua shiner	*Notropis chihuahua*	98469	IF	
Arkansas River shiner	*Notropis girardi*	98472	IF	
Bluehead shiner	*Pteronotropis hubbsi*	99136	IF	
Rio Grande shiner	*Notropis jemezanus*	98473	IF	
Taillight shiner	*Notropis maculatus*	98475	IF	
Sharpnose shiner	*Notropis oxyrhynchus*	98477	IF	
Chub shiner	*Notropis potteri*	98479	IF	
Sabine shiner	*Notropis sabinae*	98481	IF	
Silverband shiner	*Notropis shumardi*	98482	IF	
Sand shiner	*Notropis stramineus*	98484	IF	
Weed shiner	*Notropis texanus*	98485	IF	
Mimic shiner	*Notropis volucellus*	98488	IF	I
Pugnose minnow	*Opsopoeodus emiliae*	98452	IF	
Suckermouth minnow	*Phenacobius mirabilis*	98457	IF	
Fathead minnow	*Pimephales promelas*	98497	O	T
Bullhead minnow	*Pimephales vigilax*	98498	IF	
Flathead chub	*Platygobio gracilis*	98447	IF	
Longnose dace	*Rhinichthys cataractae*	98455	IF	
Rudd	*Scardinius erythrophthalmus*	98414	O	T
Creek chub	*Semotilus atromaculatus*	98443	P	
Suckers	**Catostomidae**			
River carpsucker	*Carpiodes carpio*	98511	O	T
Blue sucker	*Cycleptus elongatus*	98505	IF	I
Creek chub sucker	*Erimyzon oblongus*	98519	O	
Lake chubsucker	*Erimyzon sucetta*	98520	O	
Smallmouth buffalo	*Ictiobus bubalus*	98507	O	
Bigmouth buffalo	*Ictiobus cyprinellus*	98508	IF	T
Black buffalo	*Ictiobus niger*	98509	O	
Spotted sucker	*Minytrema melanops*	98517	IF	
Mexican redhorse	*Moxostoma austrinum*	98500	IF	

Trophic-group designations: IF—invertivore; P—piscivore; O—omnivore; and H—herbivore. Tolerance designations: T—tolerant; I—intolerant. Those species without a tolerance designation are considered intermediate.

Common Name	Scientific Name	Parameter Code	Trophic Group	Tolerance
Gray redhorse	*Moxostoma congestum*	98513	IF	
Golden redhorse	*Moxostoma erythrurum*	98514	IF	
Blacktail redhorse	*Moxostoma poecilurum*	98515	IF	
Characins	**Characidae**			
Mexican tetra	*Astyanax mexicanus*	98435	IF	
Bullhead catfishes	**Ictaluridae**			
Black bullhead	*Ameiurus melas*	98563	O	T
Yellow bullhead	*Ameiurus natalis*	98564	O	
Blue catfish	*Ictalurus furcatus*	98562	P	
Headwater catfish	*Ictalurus lupus*	98554	O	
Channel catfish	*Ictalurus punctatus*	98561	O	T
Tadpole madtom	*Noturus gyrinus*	98574	IF	I
Freckled madtom	*Noturus nocturnus*	98575	IF	I
Flathead catfish	*Pylodictus olivaris*	98570	P	
Widemouth blindcat	*Satan eurystomus*	98572	IF	
Toothless blindcat	*Trogloglanis pattersoni*	98568	O	
Suckermouth catfishes	**Loricariidae**			
Suckermouth catfish	*Hypostomus plecostomus*	98553	H	T
Southern sailfin catfish	*Pterygoplichthys anisitsi*		H	T
Sea catfishes	**Ariidae**			
Gafftopsail catfish	*Bagre marinus*	98557	P	T
Hardhead catfish	*Ariopsis felis*	98559	IF	T
Thorny catfishes	**Doradidae**			
Southern striped Raphael	*Platydoras armatulus*			
Pikes	**Esocidae**			
Redfin pickerel	*Esox americanus*		P	
Northern pike	*Esox lucius*	98406	P	I
Chain pickerel	*Esox niger*	98405	P	
Salmons	**Salmonidae**			
Rainbow trout	*Oncorhynchus mykiss*	98527	IF-Lotic	I
		98527	P-Lentic	I
Pirate perch	**Aphredoderidae**			
Pirate perch	*Aphredoderus sayanus*	98773	IF	
Killifishes	**Cyprinodontidae**			
Leon Springs pupfish	*Cyprinodon bovinus*	98705	O	
Comanche Springs pupfish	*Cyprinodon elegans*	98706	O	
Conchos pupfish	*Cyprinodon eximius*	98707	O	
Pecos River pupfish	*Cyprinodon pecosensis*	98769	O	T
Red River pupfish	*Cyprinodon rubrofluviatilis*	98708	O	T
Sheepshead minnow	*Cyprinodon variegatus*	98709	O	T
Diamond killifish	*Adinia xenica*	98691	O	T
Western starhead topminnow	*Fundulus blairae*		IF	
Golden topminnow	*Fundulus chrysotus*	98694	IF	
Gulf killifish	*Fundulus grandis*	98695	O	
Saltmarsh topminnow	*Fundulus jenkinsi*	98696	IF	
Blackstripe topminnow	*Fundulus notatus*	98677	IF	

Trophic-group designations: IF—invertivore; P—piscivore; O—omnivore; and H—herbivore. Tolerance designations: T—tolerant; I—intolerant. Those species without a tolerance designation are considered intermediate.

Common Name	Scientific Name	Parameter Code	Trophic Group	Tolerance
Blackspotted topminnow	*Fundulus olivaceus*	98678	IF	I
Bayou killifish	*Fundulus pulvereus*	98699	IF	
Longnose killifish	*Fundulus similis*	98700	O	I
Plains killifish	*Fundulus zebrinus*	98729	IF	T
Least killifish	*Heterandria formosa*	98832	IF	
Rainwater killifish	*Lucania parva*	98689	IF	
Livebearers	**Poeciliidae**			
Western mosquitofish	*Gambusia affinis*	98713	IF	T
Big Bend gambusia	*Gambusia gaigei*	98715	IF	
Largespring gambusia	*Gambusia geiseri*	98716	IF	
Clear Creek gambusia	*Gambusia heterochir*	98718	IF	
Pecos gambusia	*Gambusia nobilis*	98719	IF	
Tex-Mex gambusia	*Gambusia speciosa*		IF	
Amazon molly	*Poecilia formosa*	98725	O	
Sailfin molly	*Poecilia latipinna*	98724	O	T
Guppy	*Poecilia reticulata*	97770	IF	T
Silversides	**Atherinidae**			
Brook silverside	*Labidesthes sicculus*	98734	IF	I
Rough silverside	*Membras martinica*	98732	IF	
Inland silverside	*Menidia beryllina*	98728	IF	
Texas silverside	*Menidia clarkhubbsi*	98796	IF	
Tidewater silverside	*Menidia peninsulae*	98658	IF	
Temperate basses	**Percichthyidae**			
White bass	*Morone chrysops*	99163	P	
Yellow bass	*Morone mississippiensis*	99164	P	
Striped bass	*Morone saxatilis*	99165	P	
Sunfishes	**Centrarchidae**			
Rock bass	*Ambloplites rupestris*	99106	P	I
Flier	*Centrarchus macropterus*	99111	IF	
Banded pygmy sunfish	*Elassoma zonatum*	99113	IF	
Redbreast sunfish	*Lepomis auritus*	99093	IF	
Green sunfish	*Lepomis cyanellus*	99094	P	T
Warmouth	*Lepomis gulosus*	99095	P	T
Orangespotted sunfish	*Lepomis humilis*	99096	IF	
Bluegill	*Lepomis macrochirus*	99097	IF	T
Dollar sunfish	*Lepomis marginatus*	99098	IF	
Longear sunfish	*Lepomis megalotis*	99099	IF	
Redear sunfish	*Lepomis microlophus*	99100	IF	
Redspotted sunfish	*Lepomis miniatus*	99101	IF	
Bantam sunfish	*Lepomis symmetricus*	99102	IF	
Smallmouth bass	*Micropterus dolomieu*	99091	P	I
Spotted bass	*Micropterus punctulatus*	99089	P	
Largemouth bass	*Micropterus salmoides*	99090	P	
Guadalupe bass	*Micropterus treculii*	99086	P	I
White crappie	*Pomoxis annularis*	99108	P	
Black crappie	*Pomoxis nigromaculatus*	99109	P	

Trophic-group designations: IF—invertivore; P—piscivore; O—omnivore; and H—herbivore. Tolerance designations: T—tolerant; I—intolerant. Those species without a tolerance designation are considered intermediate.

Common Name	Scientific Name	Parameter Code	Trophic Group	Tolerance
Percidae	Perches			
Western sand darter	*Ammocrypta clara*	99071	IF	
Scaly sand darter	*Ammocrypta vivax*	99072	IF	
Redspot darter	*Etheostoma artesiae*		IF	
Mud darter	*Etheostoma asprigene*	99074	IF	
Bluntnose darter	*Etheostoma chlorosoma*	99075	IF	
Fountain darter	*Etheostoma fonticola*	99076	IF	I
Swamp darter	*Etheostoma fusiforme*	99077	IF	
Slough darter	*Etheostoma gracile*	99078	IF	
Rio Grande darter	*Etheostoma grahami*	99079	IF	
Harlequin darter	*Etheostoma histrio*	99080	IF	
Greenthroat darter	*Etheostoma lepidum*	99081	IF	I
Goldstripe darter	*Etheostoma parvipinne*	99082	IF	I
Cypress darter	*Etheostoma proeliare*	99083	IF	I
Orangebelly darter	*Etheostoma radiosum*	99084	IF	I
Orangethroat darter	*Etheostoma spectabile*	99085	IF	
Yellow perch	*Perca flavescens*	99062	P	
Logperch	*Percina caprodes*	99068	IF	I
Texas logperch	*Percina carbonaria*	99060	IF	I
Bigscale logperch	*Percina macrolepida*	99069	IF	I
Blackside darter	*Percina maculata*	98540	IF	I
Dusky darter	*Percina sciera*	98541	IF	I
River darter	*Percina shumardi*	99168	IF	
Sauger	*Sander canadensis*	99057	P	I
Walleye	*Sander vitreus*	99058	P	
Drums	**Sciaenidae**			
Freshwater drum	*Aplodinotus grunniens*	98958	IF	T
Silver perch	*Bairdiella chrysoura*	98960	IF	
Sand seatrout	*Cynoscion arenarius*	98973	P	I
Spotted seatrout	*Cynoscion nebulosus*	98974	P	I
Spot	*Leiostomus xanthurus*	98964	O	
Atlantic croaker	*Micropogonias undulatus*	98968	IF	I
Black drum	*Pogonias cromis*	98970	IF	
Red drum	*Sciaenops ocellatus*	98962	P	
Cichlids	**Cichlidae**			
Rio Grande cichlid	*Cichlasoma cyanoguttatum*	98953	IF	
Blue tilapia	*Oreochromis aureus*	98583	O	T
Mozambique tilapia	*Oreochromis mossambicus*	98565	O	
Redbelly tilapia	*Tilapia zillii*	98584	O	
Sleepers	**Eleotridae**			
Fat sleeper	*Dormitator maculatus*		O	
Largescaled spinycheek sleeper	*Eleotris amblyopsis*		O	
Emerald sleeper	*Erotelis smaragdus*		IF	
Bigmouth sleeper	*Gobiomorus dormitor*		IF	
Mullets	**Mugilidae**			
Mountain mullet	*Agonostomus monticola*	98797	O	

Trophic-group designations: IF—invertivore; P—piscivore; O—omnivore; and H—herbivore. Tolerance designations: T—tolerant; I—intolerant. Those species without a tolerance designation are considered intermediate.

Common Name	Scientific Name	Parameter Code	Trophic Group	Tolerance
Striped mullet	*Mugil cephalus*	98793	O	
White mullet	*Mugil curema*		O	
Requiem sharks	**Carcharhinidae**			
Fine tooth shark	*Carcharhinus isodon*	98014	P	
Bull shark	*Carcharhinus leucas*	98280	P	
Sawfishes	**Pristidae**			
Small tooth sawfish	*Pristis pectinata*	98299	P	
Stingrays	**Dasyatidae**			
Atlantic stingray	*Dasyatis sabina*	98318	IF	
Sturgeons	**Acipenseridae**			
Shovelnose sturgeon	*Scaphirynchus platorynchus*	98337	IF	
Goldeyes	**Hiodontidae**			
Goldeye	*Hiodon alosoides*	98408	IF	
Tarpons	**Elopidae**			
Ladyfish	*Elops saurus*	98352	P	
Tarpon	*Megalops atlanticus*	98356	P	T
Anchovies	**Engraulidae**			
Striped anchovy	*Anchoa hepsetus*	98410	IF	
Bay anchovy	*Anchoa mitchilli*	98412	IF	
Needlefishes	**Belonidae**			
Atlantic needlefish	*Strongylura marina*	98663	P	
Pipefishes	**Syngnathidae**			
Opposum pipefish	*Microphis brachyurus*	98857	IF	
Chain pipefish	*Syngnathus louisianae*	98757	IF	
Gulf pipefish	*Syngnathus scovelli*	98761	IF	
Snooks	**Centropomidae**			
Smallscale fat snook	*Centropomus parallelus*	98806	P	
Common snook	*Centropomus undecimalis*	98989	P	I
Jacks	**Carangidae**			
Crevalle jack	*Caranx hippos*	98900	P	I
Mojarras	**Gerreidae**			
Irish pompano	*Diapterus auratus*	99047	IF	
Spotfin mojarra	*Eucinostomus argenteus*	99044	IF	
Flagfin mojarra	*Eucinostomus melanopterus*	98578	IF	
Grunts	**Haemulidae**			
Barred grunt	*Conodon nobilis*	98993	IF	
Burro grunt	*Pomodasys crocro*		IF	
Porgies	**Sparidae**			
Sheepshead	*Archosargus probatocephalus*	99155	O	
Pinfish	*Lagodon rhomboides*	99153	O	
Threadfins	**Polynemidae**			
Atlantic threadfin	*Polydactylus octonemus*		IF	
Soles	**Soleidae**			
Hogchoker	*Trinectes maculatus*	99218	IF	
Lined sole	*Achirus lineatus*		IF	
Lefteye flounders	**Bothidae**			

Trophic-group designations: IF—invertivore; P—piscivore; O—omnivore; and H—herbivore. Tolerance designations: T—tolerant; I—intolerant. Those species without a tolerance designation are considered intermediate.

Common Name	Scientific Name	Parameter Code	Trophic Group	Tolerance
Bay whiff	*Citharichthys spilopterus*		IF	
Southern flounder	*Paralichthys lethostigma*	99246	P	
Fringed flounder	*Etropus crossotus*		IF	
Gobies	**Gobiidae**			
River goby	*Awaous banana*		O	
Frillfin goby	*Bathygobius soporator*		IF	T
Darter goby	*Ctenogobius boleosoma*		O	
Mexican goby	*Ctenogobius claytonii*		O	
Freshwater goby	*Ctenogobius shufeldti*		IF	
Marked goby	*Ctenogobius stigmaticus*		O	
Lyre goby	*Evorthodus lyricus*		H	
Violet goby	*Gobioides broussonetii*		O	
Highfin goby	*Gobionellus oceanicus*		O	
Naked goby	*Gobiosoma bosc*		IF	T
Code goby	*Gobiosoma robustum*		IF	
Clown goby	*Microgobius gulosus*		IF	
Puffers	**Tetraodontidae**			
Least puffer	*Sphoeroides parvus*		IF	

Table B.11. Benthic Index of Biotic Integrity metrics and scoring criteria for kick samples, rapid bioassessment protocol—benthic macroinvertebrates (Harrison 1996).

METRIC	SCORING CRITERIA			
	4	**3**	**2**	**1**
Taxa richness	> 21	15–21	8–14	< 8
EPT taxa abundance	> 9	7–9	4–6	< 4
Biotic index (HBI)	< 3.77	3.77–4.52	4.53–5.27	>5.27
% Chironomidae	0.79–4.10	4.11–9.48	9.49–16.19	< 0.79 or > 16.19
% Dominant taxon	< 22.15	22.15–31.01	31.02–39.88	> 39.88
% Dominant FFG	< 36.50	36.50–45.30	45.31–54.12	> 54.12
% Predators	4.73–15.20	15.21–25.67	25.68–36.14	< 4.73 or >36.14
Ratio of intolerant : tolerant taxa	> 4.79	3.21–4.79	1.63–3.20	< 1.63
% of total Trichoptera as Hydropsychidae	< 25.50	25.51–50.50	50.51–75.50	> 75.50 or no Trichoptera
# of non-insect taxa	> 5	4–5	2–3	< 2
% Collector-gatherers	8.00–19.23	19.24–30.46	30.47–41.68	< 8.00 or > 41.68
% of total number as Elmidae	0.88–10.04	10.05–20.08	20.09–30.12	< 0.88 or > 30.12
Aquatic-life-use point-score ranges:	Exceptional: High: Intermediate: Limited:	> 36 29–36 22–28 < 22		

Table B.12. Metrics and scoring criteria for Surber samples—benthic macroinvertebrates (Davis, 1997).

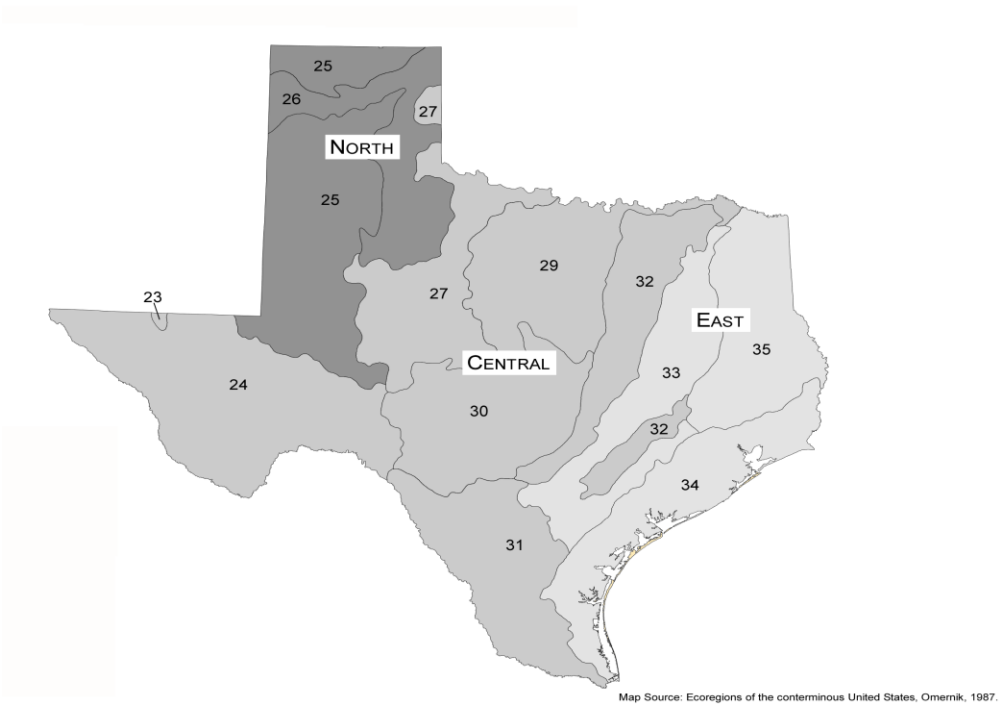
	METRIC	SCORING CRITERIA		
		5	**3**	**1**
Central bioregion	Total taxa	> 32	32–18	< 18
	Diptera taxa	> 7	7–4	< 4
	Ephemeroptera taxa	> 4	4–2	< 2
(Ecoregions: 23, 24, 27, 29, 30, 31, and 32)	Intolerant taxa	> 8	8–4	< 4
	% EPT taxa	> 30	30.0–17.4	< 17.4
	% Chironomidae	(*a*)	< 22.3	≥ 22.3
	% Tolerant taxa	(*a*)	< 10.0	≥ 10.0
	% Grazers	> 14.9	14.9–8.7	< 8.7
	% Gatherers	> 15.2	15.2–8.8	< 8.8
	% Filterers	(*a*)	> 11.9	≤ 11.9
	% Dominance (3 taxa)	< 54.6	54.6–67.8	> 67.8
East bioregion	Total taxa	> 30	30–17	< 17
	Diptera taxa	> 10	10–6	< 6
(Ecoregions: 33, 34, and 35)	Ephemeroptera taxa	(*b*)	> 3	≤ 3
	Intolerant taxa	> 4	4–2	< 2
	% EPT taxa	> 18.9	18.9–10.8	< 10.8
	% Chironomidae	(*a*)	< 40.2	≥ 40.2
	% Tolerant taxa	< 16.0	16.0–24.3	> 24.3
	% Grazers	> 9.0	9.0–5.2	< 5.2
	% Gatherers	> 12.5	12.5–7.3	< 7.3
	% Filterers	(*a*)	> 16.3	≤ 16.3
	% Dominance (3 taxa)	< 57.7	57.7–71.6	> 71.6

	METRIC	SCORING CRITERIA		
		5	**3**	**1**
North bioregion (Ecoregions 25 and 26)	Total taxa	> 33	33–19	< 19
	Diptera taxa	> 14	14–8	< 8
	Ephemeroptera taxa	(*b*)	> 2	≤ 2
	Intolerant taxa	> 3	3–2	< 2
	% EPT taxa	> 14.4	14.4–8.2	< 8.2
	% Chironomidae	< 36.9	36.9–56.2	> 56.2
	% Tolerant taxa	< 14.1	14.1–21.5	> 21.5
	% Grazers	(*b*)	> 5.4	≤ 5.4
	% Gatherers	(*a*)	> 14.9	≤ 14.9
	% Filterers	> 12.2	12.2–7.1	< 7.1
	% Dominance (3 taxa)	< 68.1	68.1–84.5	> 84.5

(*a*) The discriminatory power was less than optimal for this bioregion, so the metric was assigned only two scoring categories.

(*b*) The median value for this bioregion was less than the metric-selection criterion (< 5.5 for taxa richness metrics; < 12 for percentage metrics expected to decrease with disturbance), so the metric was assigned only two categories.

Figure B.9. Macrobenthic bioregions (North, Central, East) and ecoregions of Texas for use in Surber metric calculations using Table B.12. (Davis 1997.)



Ecoregions of Texas

23 Arizona–New Mexico Mountains

24 Southern Deserts

25 Western High Plains

26 Southwestern Tablelands

27 Central Great Plains

29 Central Oklahoma–Texas Plains

30 Central Texas Plateau

31 Southern Texas Plains

32 Texas Blackland Prairies

33 East Central Texas Plains

34 Western Gulf Coastal Plain

35 South Central Plains

Table B.13. Tolerance values and functional group classification for benthic macroinvertebrates.

Aquatic macroinvertebrates commonly collected in Texas streams. Shaded cells indicate tolerance values or functional classification taken from higher taxonomic levels (or both).

Functional groups: SCR = scraper; CG = collector gatherer; FC = filtering collector; P = predator; SHR = shredder. For different feeding habits for larvae and adult: L = larvae; A = Adult

Parameter Code	Genus or Species	Tolerance Value	Functional Group	Order	Family
91645	*Acentrella* sp.	4	SCR/CG	Ephemeroptera	Baetidae
91632	*Acerpenna* sp.	4	SCR/CG	Ephemeroptera	Baetidae
91646	*Baetis* sp.	4	SCR/CG	Ephemeroptera	Baetidae
91642	*Baetodes* sp.	4	SCR	Ephemeroptera	Baetidae
91650	*Callibaetis* sp.	4	CG	Ephemeroptera	Baetidae
91644	*Centroptilum* sp.	2	SCR/CG	Ephemeroptera	Baetidae
91648	*Cloeon* sp.	4	SCR/CG	Ephemeroptera	Baetidae
91649	*Dactylobaetis* sp.	4	SCR/CG	Ephemeroptera	Baetidae
91651	*Fallceon quilleri*	4	SCR/CG	Ephemeroptera	Baetidae
91579	*Labiobaetis* sp.	4	SCR/CG	Ephemeroptera	Baetidae
91656	*Paracloeodes* sp.	9	SCR/CG	Ephemeroptera	Baetidae
91654	*Pseudocloeon* sp.	4	SCR/CG	Ephemeroptera	Baetidae
91598	*Brachycercus* sp.	3	CG	Ephemeroptera	Caenidae
91600	*Caenis* sp.	7	SCR/CG	Ephemeroptera	Caenidae
91570	*Hexagenia* sp.	6	CG	Ephemeroptera	Ephemeridae
91590	*Isonychia* sp.	3	FC	Ephemeroptera	Oligoneuriidae
91619	*Stenacron* sp.	4	SCR/CG	Ephemeroptera	Heptageniidae
91620	*Stenonema* sp.	4	SCR/CG	Ephemeroptera	Heptageniidae
91596	*Leptohyphes* sp.	2	CG	Ephemeroptera	Tricorythidae
91594	*Tricorythodes* sp.	5	CG	Ephemeroptera	Tricorythidae
91549	*Leptophlebiidae*	2	CG/SCR	Ephemeroptera	Leptophlebiidae
91554	*Choroterpes* sp.	2	CG/SCR	Ephemeroptera	Leptophlebiidae
91661	*Farrodes texanus*	2	CG/SCR	Ephemeroptera	Leptophlebiidae
91550	*Paraleptophlebia* sp.	2	CG/SHR	Ephemeroptera	Leptophlebiidae
91562	*Thraulodes* sp.	2	CG/SCR	Ephemeroptera	Leptophlebiidae
91552	*Traverella* sp.	2	FC	Ephemeroptera	Leptophlebiidae
91628	*Eurylophella* sp.	4	CG	Ephemeroptera	Ephemerellidae
91896	*Isoperla* sp.	2	P	Plecoptera	Perlodidae
91861	*Allocapnia* sp.	2	SHR	Plecoptera	Capniidae
91879	*Anacroneuria* sp.	1	P	Plecoptera	Perlidae
91891	*Paragnetina* sp.	3.5	P	Plecoptera	Perlidae
91881	*Neoperla* sp.	1	P	Plecoptera	Perlidae
91883	*Perlesta* sp.	0	P	Plecoptera	Perlidae
91887	*Perlinella* sp.	2	P	Plecoptera	Perlidae
91871	*Taeniopteryx* sp.	2	SHR/CG	Plecoptera	Taeniopterygidae
91859	*Zealeuctra* sp.	0	FC	Plecoptera	Leuctridae
92292	*Cheumatopsyche* sp.	6	FC	Trichoptera	Hydropsychidae
92294	*Diplectrona* sp.	2	FC	Trichoptera	Hydropsychidae
92296	*Hydropsyche* sp.	5	FC	Trichoptera	Hydropsychidae
92302	*Macrostemum* sp. = *Macrostema*	4	C	Trichoptera	Hydropsychidae
92305	*Potamyia* sp.	4	FC	Trichoptera	Hydropsychidae
92308	*Smicridea* sp.	4	FC	Trichoptera	Hydropsychidae
92376	*Helicopsyche* sp.	2	SCR	Trichoptera	Helicopsychidae
92371	*Pycnopsyche* sp.	2	SHR	Trichoptera	Limnophilidae
92268	*Chimarra* sp.	2	FC	Trichoptera	Philopotamidae

Aquatic macroinvertebrates commonly collected in Texas streams. Shaded cells indicate tolerance values or functional classification taken from higher taxonomic levels (or both).

Functional groups: SCR = scraper; CG = collector gatherer; FC = filtering collector; P = predator; SHR = shredder. For different feeding habits for larvae and adult: L = larvae; A = Adult

Parameter Code	Genus or Species	Tolerance Value	Functional Group	Order	Family
92334	*Dolophilodes* sp.	3	FC	Trichoptera	Philopotamidae
92324	*Hydroptila* sp.	2	SCR	Trichoptera	Hydroptilidae
92326	*Ithytrichia* sp.	4	SCR	Trichoptera	Hydroptilidae
92327	*Leucotrichia* sp.	3	CG/SCR	Trichoptera	Hydroptilidae
92329	*Mayatrichia* sp.	4	SCR	Trichoptera	Hydroptilidae
92332	*Ochrotrichia* sp.	4	CG	Trichoptera	Hydroptilidae
92335	*Oxyethira* sp.	2	CG/SCR	Trichoptera	Hydroptilidae
92337	*Stactobiella* sp.	3	SHR	Trichoptera	Hydroptilidae
92304	*Nectopsyche* sp.	3	SHR/CG/P	Trichoptera	Leptoceridae
92391	*Oecetis* sp.	5	P/SHR	Trichoptera	Leptoceridae
92365	*Setodes* sp.	2	CG/P	Trichoptera	Leptoceridae
92395	*Trianodes* sp.	3	P	Trichoptera	Leptoceridae
92274	*Cernotina* sp.	6	P	Trichoptera	Polycentropodidae
92278	*Neureclipsis* sp.	4	FC/SHR/P	Trichoptera	Polycentropodidae
92279	*Nyctiophylax* sp.	1	FC/P	Trichoptera	Polycentropodidae
92284	*Phylocentropus* sp.	5	FC	Trichoptera	Polycentropodidae
92281	*Polycentropus* sp.	3	FC/P	Trichoptera	Polycentropodidae
92539	*Polyplectropus* sp.	6	FC/P	Trichoptera	Polycentropodidae
92378	*Marilia* sp.	0	SHR	Trichoptera	Odontoceridae
92293	*Brachycentrus* sp.	1	FC/SCR	Trichoptera	Brachycentridae
92319	*Protoptila* sp.	1	SCR	Trichoptera	Glossosomatidae
92311	*Atopsyche* sp.	0	P	Trichoptera	Hydrobiosidae
92313	*Rhyacophila* sp.	0	P	Trichoptera	Rhyacophilidae
92076	*Corydalus cornutus*	6	P	Megaloptera	Corydalidae
92072	*Chauliodes* sp.	4	P	Megaloptera	Corydalidae
92069	*Sialis* sp.	4	P	Megaloptera	Sialidae
92731	*Acentria* sp.	1	SHR	Lepidoptera	Pyralidae
92726	*Crambus* sp.	5	SHR	Lepidoptera	Pyralidae
92659	*Paraponyx* sp.	5	SHR	Lepidoptera	Pyralidae
92686	*Petrophila* sp.	5	SCR	Lepidoptera	Pyralidae
92226	*Ancyronyx* sp.	2	SCR/CG	Coleoptera	Elmidae
92230	*Dubiraphia* sp.	5	SCR/CG	Coleoptera	Elmidae
92232	*Elsianus* sp.	2	SCR/CG	Coleoptera	Elmidae
92233	*Heterelmis* sp.	4	SCR/CG	Coleoptera	Elmidae
92235	*Hexacylloepus* sp.	2	SCR/CG	Coleoptera	Elmidae
92232	*Macrelmis* sp.	4	SCR/CG	Coleoptera	Elmidae
92240	*Macronychus* sp.	2	SCR/CG	Coleoptera	Elmidae
92243	*Microcylloepus* sp.	2	SCR/CG	Coleoptera	Elmidae
92244	*Narpus* sp.	2	SCR/CG	Coleoptera	Elmidae
92246	*Neoelmis* sp.	2	SCR/CG	Coleoptera	Elmidae
92253	*Stenelmis* sp.	7	SCR/CG	Coleoptera	Elmidae
92217	*Helichus* sp.	4	SCR/CG	Coleoptera	Dryopidae
92209	*Eubrianax* sp.	4	SCR	Coleoptera	Psephenidae
92211	*Psephenus* sp.	4	SCR	Coleoptera	Psephenidae
92090	*Dineutus* sp.	5	P	Coleoptera	Gyrinidae
92092	*Gyretes* sp.	6	P	Coleoptera	Gyrinidae

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Parameter Code	Genus or Species	Tolerance Value	Functional Group	Order	Family
92093	*Gyrinus* sp.	6	P	Coleoptera	Gyrinidae
92153	Hydrophilidae	5	L = P; A = CG	Coleoptera	Hydrophilidae
92154	*Berosus* sp.	9	CG	Coleoptera	Hydrophilidae
92161	*Enochrus* sp.	8	CG	Coleoptera	Hydrophilidae
92166	*Helochares* sp.	5	CG	Coleoptera	Hydrophilidae
92168	*Helophorus* sp.	8	SHR	Coleoptera	Hydrophilidae
92147	*Hydrobiomorpha sp*		CG	Coleoptera	Hydrophilidae
92142	*Hydrocanthus* sp.	7	L = P/CG; A = P	Coleoptera	Noteridae
92165	*Hydrochus* sp.		SHR	Coleoptera	Hydrochidae
92173	*Lacobius* sp.	8	L = P; A = CG	Coleoptera	Hydrophilidae
92143	*Sperchopsis* sp.	5	L = P; A = CG	Coleoptera	Hydrophilidae
92180	*Tropisternus* sp.	10	L = P; A = CG	Coleoptera	Hydrophilidae
92223	*Lutrochus* sp.		SHR/CG	Coleoptera	Lutrochidae
92108	*Agabus* sp.	5	P	Coleoptera	Dytiscidae
92086	*Bidessonotus* sp.	5	P	Coleoptera	Dytiscidae
92085	*Brachyvatus* sp.	5	P	Coleoptera	Dytiscidae
92111	*Celina* sp.	5	P	Coleoptera	Dytiscidae
92114	*Copelatus* sp.	9	P	Coleoptera	Dytiscidae
92119	*Deronectes* sp.	5	P	Coleoptera	Dytiscidae
92118	*Derovatellus* sp.	5	P	Coleoptera	Dytiscidae
92126	*Hydaticus* sp.	5	P	Coleoptera	Dytiscidae
92128	*Hydroporus* sp.	9	P	Coleoptera	Dytiscidae
92130	*Hydrovatus* sp.	5	P	Coleoptera	Dytiscidae
92083	*Laccophilus*	10	P	Coleoptera	Dytiscidae
92136	*Laccodytes* sp.	5	P	Coleoptera	Dytiscidae
92112	*Liodessus* sp.	5	P	Coleoptera	Dytiscidae
92129	*Oreodytes* sp.	5	P	Coleoptera	Dytiscidae
92127	*Uvarus* sp.	5	P	Coleoptera	Dytiscidae
92729	Scirtidae		SCR/CG/SHR	Coleoptera	Scirtidae
92198	*Cyphon* sp.	7	SCR/CG/SHR	Coleoptera	Scirtidae
92206	*Scirtes* sp.		SHR	Coleoptera	Scirtidae
92182	Curculionidae		SHR	Coleoptera	Curculionidae
92199	*Listronotus* sp.		SHR	Coleoptera	Curculionidae
92141	*Lixus* sp.		SHR	Coleoptera	Curculionidae
92095	Haliplidae	7	SHR/P	Coleoptera	Haliplidae
92098	*Haliplus* sp.	7	SHR/P		
92100	*Peltodytes* sp.	8	SHR/P	Coleoptera	Haliplidae
92193	Staphylinidae		P	Coleoptera	Staphylinidae
92196	*Stenus* sp.		P	Coleoptera	Staphylinidae
92146	*Suphisellus* sp.		P	Coleoptera	
91683	*Argia* sp.	6	P	Odonata	Coenagrionidae
91685	*Chromagrion* sp.	9	P	Odonata	Coenagrionidae
91687	*Enallagma* sp.	6	P	Odonata	Coenagrionidae
91695	*Ischnura* sp.	9	P	Odonata	Coenagrionidae
91667	*Calopteryx* sp.	5	P	Odonata	Calopterygidae

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Parameter Code	Genus or Species	Tolerance Value	Functional Group	Order	Family
91669	*Hetaerina* sp.	6	P	Odonata	Calopterygidae
91769	*Macromia* sp.	3	P	Odonata	Corduliidae
91741	*Aeshna* sp.	4	P	Odonata	Aeschnidae
91745	*Basiaeschna* sp.	2	P	Odonata	Aeschnidae
91747	*Boyeria* sp.	3	P	Odonata	Aeschnidae
91793	*Epiaeschna* sp.	1	P	Odonata	Aeschnidae
91757	*Nasiaeschna pentacantha*	8	P	Odonata	Aeschnidae
91764	*Cordulegaster* sp.	2	P	Odonata	Cordulegasteridae
91791	*Epitheca* sp.	4	P	Odonata	Corduliidae
91786	*Dorocordulia* sp.	5	P	Odonata	Corduliidae
91817	*Neurocordulia* sp.	3	P	Odonata	Corduliidae
91837	*Somatochlora* sp.	1	P	Odonata	Corduliidae
91843	*Tetragoneuria* sp.	8.5	P	Odonata	Libellulidae
91772	*Belonia* sp.	9	P	Odonata	Libellulidae
91776	*Brechmorhoga* sp.	6	P	Odonata	Libellulidae
91792	*Erythemis* sp.	5	P	Odonata	Libellulidae
91794	*Erythrodiplax* sp.	5	P	Odonata	Libellulidae
91806	*Libellula* sp.	8	P	Odonata	Libellulidae
91813	*Miathyria* sp.	9	P	Odonata	Libellulidae
91811	*Macrothemis* sp.	9	P	Odonata	Libellulidae
91819	*Orthemis* sp.	9	P	Odonata	Libellulidae
91822	*Pachydiplax longipennis*	10	P	Odonata	Libellulidae
91827	*Perithemis* sp.	4	P	Odonata	Libellulidae
91838	*Sympetrum* sp.	7	P	Odonata	Libellulidae
91706	Gomphidae	1	P	Odonata	Gomphidae
91709	*Arigomphus* sp.	1	P	Odonata	Gomphidae
91711	*Dromogomphus* sp.	4		Odonata	Gomphidae
91713	*Erpetogomphus* sp.	1	P	Odonata	Gomphidae
91715	*Gomphoides* sp.	1	P	Odonata	Gomphidae
91718	*Gomphus* sp.	7	P	Odonata	Gomphidae
91721	*Hagenius* sp.	3	P	Odonata	Gomphidae
91728	*Ophiogomphus* sp.	6	P	Odonata	Gomphidae
91696	*Phyllogomphoides* sp.	1	P	Odonata	Gomphidae
91730	*Progomphus* sp.	5	P	Odonata	Gomphidae
92016	Corixidae	9	P/CG	Hemiptera	Corixidae
92009	*Palmacorixa* sp.	9	P/CG	Hemiptera	Corixidae
92044	*Trichocorixa* sp.	5	P/CG	Hemiptera	Corixidae
92053	Naucoridae	5	P	Hemiptera	Naucoridae
92054	*Ambrysus* sp.	5	P	Hemiptera	Naucoridae
92057	*Cryphocricos* sp.	5	P	Hemiptera	Naucoridae
92060	*Limnocoris* sp.	5	P	Hemiptera	Naucoridae
92059	*Pelocoris* sp.	5	P	Hemiptera	Naucoridae
91953	*Mesovelia* sp.		P	Hemiptera	Mesoveliidae
91919	*Microvelia* sp.		P	Hemiptera	Veliidae
91923	*Rhagovelia* sp.		P	Hemiptera	Veliidae
91951	*Aquarius* sp.	5	P	Hemiptera	Gerridae

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91944	*Rheumatobates* sp.	5	P	Hemiptera	Gerridae
91946	*Trepobates* sp.	5	P	Hemiptera	Gerridae
91986	*Abedus* sp.		P	Hemiptera	Belostomatidae
91988	*Belostoma* sp.	10	P	Hemiptera	Belostomatidae
91994	*Lethocerus* sp.		P	Hemiptera	Belostomatidae
92002	*Ranatra* sp.	7	P	Hemiptera	Nepidae
91955	Hebridae		P	Hemiptera	Hebridae
91957	*Lipogomphus* sp.		P	Hemiptera	Hebridae
92051	*Notonecta* sp.		P	Hemiptera	Notonectidae
91913	*Hydrometra* sp.		P	Hemiptera	Hydrometridae
92008	*Neoplea* sp.		P	Hemiptera	Pleidae
92491	Chironomidae	6	P/CG/FC	Diptera	Chironomidae
Chironominae: Chironomini					
92507	Chironominae	6	CG/FC/P	Diptera	Chironomidae
92508	*Chironomus* sp.	10	CG/SHR	Diptera	Chironomidae
92522	*Cryptochironomus* sp.	8	P	Diptera	Chironomidae
92516	*Dicrotendipes* sp.	7	CG/FC	Diptera	Chironomidae
92512	*Einfeldia* sp.	10	CG	Diptera	Chironomidae
92520	*Endochironomus* sp.	6	SHR/CG/FC	Diptera	Chironomidae
92531	*Glyptotendipes* sp.	8	SHR/FC/CG	Diptera	Chironomidae
92525	*Goeldichironomus* sp.	8	CG	Diptera	Chironomidae
92524	*Harnischia* sp.	8	CG	Diptera	Chironomidae
92514	*Kiefferulus* sp.	10	CG	Diptera	Chironomidae
92535	*Lauterborniella* sp.	8	CG	Diptera	Chironomidae
91497	*Microchironomus* sp.	8	CG	Diptera	Chironomidae
92542	*Microtendipes* sp.	6	CG/FC	Diptera	Chironomidae
92544	*Paratendipes* sp.	5	CG	Diptera	Chironomidae
92526	*Parachironomus* sp.	9	P/CG	Diptera	Chironomidae
92528	*Paracladopelma* sp.	6	CG	Diptera	Chironomidae
92537	*Phaenopsectra* sp.	8	SCR/CG	Diptera	Chironomidae
92534	*Polypedilum* sp.	6	SHR/CG/P	Diptera	Chironomidae
91007	*Robackia* sp.	6	CG	Diptera	Chironomidae
92469	*Saetheria* sp.	8	CG	Diptera	Chironomidae
92547	*Stictochironomus* sp.	8	CG/SHR	Diptera	Chironomidae
91495	*Sergentia* sp.	6	SCR/CG	Diptera	Chironomidae
91901	*Stelechomyia* sp.	6	CG	Diptera	Chironomidae
92540	*Stenochironomus* sp.	6	CG/SHR	Diptera	Chironomidae
92511	*Tribelos* sp.	5	CG	Diptera	Chironomidae
Chironominae: Pseudochironomini					
92538	*Pseudochironomus* sp.	5	CG	Diptera	Chironomidae
Chironominae: Tanytarsini					
90996	Tanytarsini	6	CG/FC	Diptera	Chironomidae
92551	*Micropsectra* sp.	2	CG	Diptera	Chironomidae
92552	*Cladotanytarsus* sp.	7	CG/FC	Diptera	Chironomidae
91899	*Nimbocera* sp.	6	CG/FC	Diptera	Chironomidae
92441	*Paratanytarsus* sp.	8	CG/FC	Diptera	Chironomidae

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92555	*Rheotanytarsus* sp.	6	FC	Diptera	Chironomidae
92554	*Tanytarsus* sp.	7	CG/FC	Diptera	Chironomidae
92429	*Virgatanytarsus* sp.	6	CG/FC	Diptera	Chironomidae
Orthocladiinae: Corynoneurini					
92569	Orthocladiinae	6	CG	Diptera	Chironomidae
92573	*Corynoneura* sp.	6	CG	Diptera	Chironomidae
92588	*Thienemanniella* sp.	2	CG	Diptera	Chironomidae
Orthocladiinae: Orthocladiini					
91897	*Acricotopus* sp.	6	CG	Diptera	Chironomidae
92570	*Brillia* sp.	5	SHR/CG	Diptera	Chironomidae
91892	*Chaetocladius* sp.	6	CG	Diptera	Chironomidae
92575	*Cricotopus* sp.	8	CG	Diptera	Chironomidae
92579	*Eukiefferiella* sp.	4	CG/SCR/P	Diptera	Chironomidae
92614	*Hydrobaenus* sp.	10	SCR/CG	Diptera	Chironomidae
92444	*Lopescladius* sp.	2	CG	Diptera	Chironomidae
92581	*Metriocnemus* sp.	6	CG/P	Diptera	Chironomidae
91686	*Nanocladius* sp.	7	CG	Diptera	Chironomidae
92584	*Orthocladius* sp.	4	CG	Diptera	Chironomidae
91890	*Parakiefferiella* sp.	6	CG	Diptera	Chironomidae
92583	*Parametriocnemus* sp.	4	CG	Diptera	Chironomidae
91885	*Pseudosmittia* sp.	6	CG	Diptera	Chironomidae
91920	*Rheocricotopus* sp.	6	CG/SHR/P	Diptera	Chironomidae
91869	*Thienemannia* sp.	6	CG	Diptera	Chironomidae
Tanypodinae: Coelotanypodini					
90984	Tanypodinae	6	P	Diptera	Chironomidae
92374	*Alotanypus* sp.		P	Diptera	Chironomidae
92498	*Clinotanypus* sp.	6	P	Diptera	Chironomidae
92500	*Coelotanypus* sp.	6	P	Diptera	Chironomidae
Tanypodinae: Macropelopiini					
91866	*Fittkauimyia* sp.	6	P	Diptera	Chironomidae
92505	*Psectrotanypus* sp.	8	P	Diptera	Chironomidae
Tanypodinae: Procladiin					
91864	*Djalmabatista* sp.	6	P	Diptera	Chironomidae
92495	*Procladius* sp.	9	CG/P	Diptera	Chironomidae
Tanypodinae: Natarsini					
91862	*Natarsia* sp.	10	P	Diptera	Chironomidae
Tanypodinae: Pentaneurini					
92503	*Ablabesmyia* sp.	6	P/CG	Diptera	Chironomidae
92834	*Guttipelopia* sp.		P	Diptera	Chironomidae
92805	*Krenopelopia* sp.		P	Diptera	Chironomidae
91854	*Labrundinia* sp.	4	P	Diptera	Chironomidae
92678	*Larsia* sp.	6	P	Diptera	Chironomidae
92501	*Pentaneura* sp.	5	CG/P	Diptera	Chironomidae
92496	*Nilotanypus* sp.	4	P	Diptera	Chironomidae
92637	*Telopelopia* sp.	6	P	Diptera	Chironomidae
90976	*Thienemannimyia* sp.	6	P	Diptera	Chironomidae

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		Tanypodinae: Tanypodini			
92493	*Tanypus* sp.	10	P/CG	Diptera	Chironomidae
92474	Ceratopogonidae	5	P/CG	Diptera	Ceratopogonidae
91008	*Alluaudomyia* sp.	5	P	Diptera	Ceratopogonidae
92478	*Bezzia* sp.	7	P	Diptera	Ceratopogonidae
92480	*Culicoides* sp.	7	P/CG	Diptera	Ceratopogonidae
92369	*Forcipomyia* sp.	6	CG	Diptera	Ceratopogonidae
92367	*Sphaeromias* sp.	5	P/CG	Diptera	Ceratopogonidae
92481	*Dasyhelea* sp.	5	CG/SCR	Diptera	Ceratopogonidae
92840	*Serromyia* sp.		P	Diptera	Ceratopogonidae
92603	*Bittacomorpha* sp.	8	CG	Diptera	Ptychopteridae
91853	*Ptychoptera* sp.	8	CG/SHR	Diptera	Ptychopteridae
92445	*Anopheles* sp.	9	FC	Diptera	Culicidae
92442	Culicidae	8	FC/CG	Diptera	Culicidae
92447	*Chaoborus* sp.	4	P	Diptera	Chaoboridae
92564	*Cnephia* sp.	4	FC	Diptera	Simuliidae
92385	*Prosimulium* sp.	2	FC	Diptera	Simuliidae
92596	*Simulium* sp.	4	FC	Diptera	Simuliidae
92421	*Antocha* sp.	5	CG	Diptera	Tipulidae
92424	*Erioptera* sp.	3	CG	Diptera	Tipulidae
92425	*Helius* sp.	3	SHR/CG/P	Diptera	Tipulidae
92747	*Cryptolabis* sp.	3	SHR/CG	Diptera	Tipulidae
92427	*Hexatoma* sp.	4	P	Diptera	Tipulidae
92428	*Limnophila* sp.	4	P	Diptera	Tipulidae
91852	*Lipsothrix* sp.	3	SHR	Diptera	Tipulidae
92439	*Pseudolimnophila* sp.	7	SHR/P/CG	Diptera	Tipulidae
92440	*Tipula* sp.	8	SHR/CG	Diptera	Tipulidae
92625	*Atherix* sp.	4	P	Diptera	Athericidae
92722	*Chlorotabanus* sp.	7	P	Diptera	Tabanidae
92619	*Chrysops* sp.	7	P	Diptera	Tabanidae
92622	*Tabanus* sp.	7	P	Diptera	Tabanidae
91851	*Ochthera* sp.	8	P	Diptera	Ephydridae
92627	Empididae	8	P	Diptera	Empididae
92628	*Hemerodromia* sp.	6	P/CG	Diptera	Empididae
92470	*Pericoma* sp.	10	CG	Diptera	Psychodidae
92609	*Euparyphus* sp.		SCR/CG	Diptera	Stratiomyidae
92611	*Nemotelus* sp.		CG	Diptera	Stratiomyidae
92613	*Odontomyia* sp.	7	CG	Diptera	Stratiomyidae
91530	Collembola		CG	Collembola	
91839	*Ellipes minuta*		SHR	Orthoptera	Tridactylidae
91265	*Gammarus* sp.	3	CG/SHR	Amphipoda	Gammaridae
91267	*Gammarus lacustrus*		CG/SHR	Amphipoda	Gammaridae
91241	*Hyallela azteca*	8	CG/SHR	Amphipoda	Taltridae
91224	*Asellus* sp.	9	CG/SHR	Isopoda	Asellidae
91260	*Cragonyx*	8	CG/SHR	Isopoda	Asellidae
91227	*Lirceus* sp.	9	CG/SHR	Isopoda	Asellidae

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91056	Ostracoda		CG/SCAV	Podocopa	
91397	*Palaemonetes* sp.	4	CG	Decapoda	Palaemonidae
91400	*Palaemonetes kadiakensis*	4	CG	Decapoda	Palaemonidae
91401	*Palaemonetes paludosis*	4	CG	Decapoda	Palaemonidae
91392	*Macrobrachium ohione*	4	CG	Decapoda	Palaemonidae
91409	Cambaridae	5	CG	Decapoda	Cambaridae
91419	*Cambarellus* sp.	5	CG	Decapoda	Cambaridae
91423	*Cambarus* sp.	8	CG	Decapoda	Cambaridae
91428	*Orconectes* sp.	3	CG	Decapoda	Cambaridae
91433	*Procambarus* sp.	9	CG	Decapoda	Cambaridae
93037	*Corbicula fluminea*	6	FC	Heterodonta	Corbiculidae
93026	*Eupera cubensis*		SCR	Heterodonta	Sphaeridae
93030	*Pisidium* sp.	7	FC	Heterodonta	Sphaeriidae
93032	*Sphaerium* sp.	5	FC	Heterodonta	Sphaeriidae
92900	*Ferrisia* sp.	7	SCR	Limnophila	Ancylidae
92905	*Ferrisia rivularis*	7	SCR	Limnophila	Ancylidae
92915	*Hebetancylus excentricus*		SCR	Limnophila	Ancylidae
92879	*Pseudosuccinea* sp.	7	SCR	Limnophila	Lymnaeidae
92894	*Pseudosuccinea columella*	7	SCR	Limnophila	Lymnaeidae
92920	*Stagnicola* sp.	7	SCR	Limnophila	Lymnaeidae
92885	*Gyraulus* sp.		SCR	Limnophila	Planorbidae
92887	*Helisoma* sp.	7	SCR	Limnophila	Planorbidae
92892	*Planorbella* sp.		SCR	Limnophila	Planorbidae
92891	*Planorbula* sp.	7	SCR	Limnophila	Planorbidae
92874	*Physella* sp.	9	SCR	Limnophila	Physidae
92783	Hydrobiidae	7	SCR	Mesogastropoda	Hydrobiidae
92763	*Amnicola* sp.	5	SCR	Mesogastropoda	Hydrobiidae
92779	*Somatogyrus* sp.	6	SCR	Mesogastropoda	Hydrobiidae
92780	*Elimia* sp.	2	SCR	Mesogastropoda	Pleuroceridae
92795	*Leptoxis* sp.	2	SCR	Mesogastropoda	Pleuroceridae
92898	*Melanoides tuberculata*		SCR	Mesogastropoda	Thiaridae
92760	*Valvata* sp.	2	SCR	Mesogastropoda	Valvatidae
92756	*Campeloma* sp.		SCR	Mesogastropoda	Viviparidae
92757	*Viviparus* sp.	1	SCR	Mesogastropoda	Viviparidae
91525	Hydracarina	6	P		
90913	Hirudinea	8	P		
90967	*Erpobdella* sp.	8	P	Erpobdelliformes	Erpobdellidae
93095	*Mooreobdella* sp.	7.8	P	Arhynchobdellida	Erpobdellidae
90931	*Placobdella* sp.	6	P	Rhynchobdellida	Glossiphoniidae
90382	Oligochaeta	8	CG		
90075	*Dugesia* sp.	7.5	P	Tricladida	Dugesiidae
90291	*Nematomorpha* sp.		P		
90196	Nematoda	5	P		

Site and Reach Selection for RWAs

Figure B.10. Example of **existing** 3.6 mgd discharge to intermittent and perennial stream. Extent of downstream impact on DO is 4.5 miles. Impact extends below second confluence.

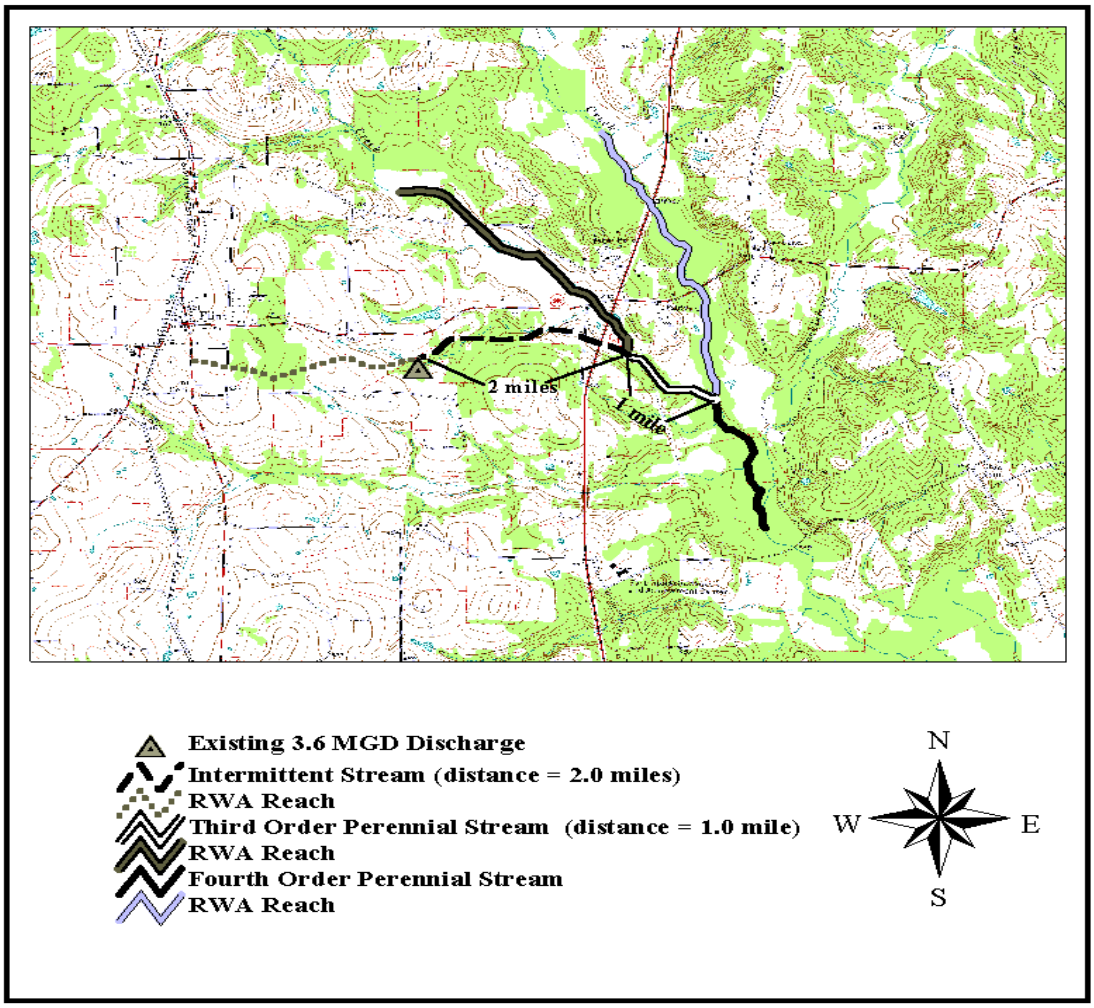
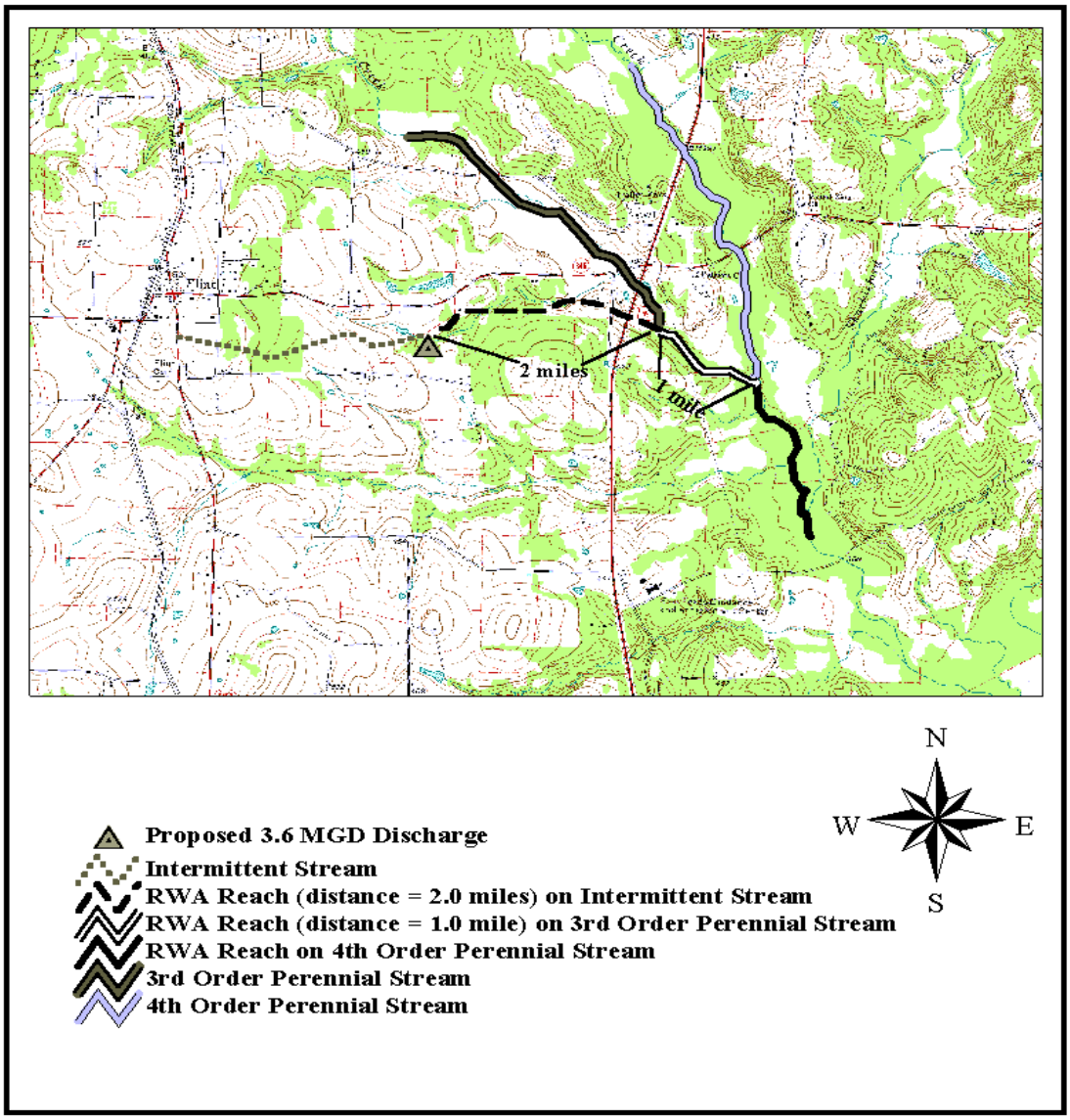
Figure B.11. Example of **proposed** 3.6 mgd discharge to intermittent and perennial stream. Extent of downstream impact on DO is 4.5 miles. Impact extends below second confluence.