Exhibit A – Field Data Summary

This Exhibit to the *Phase 1 Adaptive Management Plan* (Phase 1 AM Plan):

- Describes the approach used to conduct the assessments for each habitat type;
- Describes the results of the habitat assessments conducted in 2005 in areas to be dredged in Phase 1 and associated reference areas; and
- Lists the references used to prepare this Exhibit.

A. Habitat Assessment Approach

Sampling Design and Station Selection

Four habitat types (unconsolidated river bottom, aquatic vegetation beds, shoreline, and riverine fringing wetlands) of the Upper Hudson River potentially impacted by the sediment removal activities were assessed in accordance with the procedures outlined in the *Habitat Delineation and Assessment Work Plan* (HDA Work Plan) (BBL, 2003) and *Supplemental Habitat Assessment Work Plan* (SHAWP) (BBL and Exponent, 2005b). The locations and number of target (i.e., areas to be dredged) and reference (areas that will not be dredged) stations were identified in the SHAWP.

Detailed habitat assessment activities were completed from August 29 through September 30, 2005 in Phase 1 and Phase 2 areas. Habitat assessment activities in additional suitable reference areas, offsite reference areas, and data gap areas (if necessary) will be conducted in 2006. The results of the assessments already completed in Phase 2 areas and the results of those additional assessment activities will be incorporated into the Phase 2 HA Report. The remainder of this report is specific to the data collected in 2005 in areas to be dredged in Phase 1 (target stations) and areas that will not be dredged (reference stations).

Assessment Methodology

The following describe the methods used to assess:

- *Unconsolidated River Bottom* - Methods used to assess the unconsolidated river bottom habitats in the Phase 1 areas followed the standard operating procedure (SOP) in Attachment A of the HDA Work Plan, modified as described in the Phase 1 HA Report for the 2003 and 2004 sampling. No additional modifications to habitat assessment methods were made during the 2005 sampling.

- *Aquatic Vegetation Beds* - Methods used to assess the aquatic vegetation beds in the Phase 1 areas followed the SOP in Attachment B of the HDA Work Plan modified as described in the Phase 1 HA Report for the 2003 and 2004 sampling. No additional modifications to habitat assessment methods were made during the 2005 sampling.

- *Shorelines* - Methods used to assess the shoreline habitats in the Phase 1 areas followed the SOP in Attachment C of the HDA Work Plan modified as described in the Phase 1 HA Report for the 2003 and 2004 sampling. No additional modifications to habitat assessment methods were made during the 2005 sampling.

- *Riverine Fringing Wetlands* - Methods used to assess the riverine fringing wetlands in the Phase 1 areas followed the SOP in Attachment D of the HDA Work Plan modified as described in the Phase 1 HA Report for the 2003 and 2004 sampling. No additional modifications to habitat assessment methods were made during the 2005 sampling.

- *Fish and Wildlife Observations* - From August 25, 2005 through September 13, 2005, wildlife surveys were conducted by boat in Phase 1 areas (within the areas to be dredged and adjacent to shoreline reference stations). Daily wildlife surveys were conducted by two field biologists throughout the duration of the study. Point count techniques were used to collect the field data. The primary objective of this study was to determine the species richness of the terrestrial vertebrate community (i.e., amphibians, reptiles, birds, and mammals) within the study area. When possible, additional data was collected to estimate the relative abundance of each species encountered.

Point count survey stations were pre-established and placed approximately every 0.25 mile along the study area using a hand held GARMIN® global positioning system (GPS) unit. Survey stations were located on both the east and west shorelines. A total of 14 points were established and surveyed in Phase 1 areas. Surveys were centered from the shoreline and conducted using a 100 meter (m)-radius. All individuals identified within 100 m of the sampling point were recorded and a distance was estimated to their location. Each point was sampled for a 15-minute duration. Prior to beginning each survey, an initial 5-minute "quieting period" was allowed, during which point count data was not collected. This "quieting period" was used in an attempt to lessen the disturbance caused by the approach to the station. Fifteen-minute point counts were used to allow identification of the less vocal classes of vertebrates (i.e., reptiles, and mammals). The survey period was further divided into

0- to 3-minute, 3- to 5-minute, 5- to 10-minute, and 10- to 15-minute subsample periods to have comparable data with various avian point count protocols. Each station was surveyed twice, once in the morning and once in the evening (peak periods of wildlife activity). Morning surveys commenced at sunrise and continued for approximately 5.5 hours. Evening surveys began approximately 5.5 hours prior to sunset and concluded at sunset. To eliminate the bias caused by adverse weather conditions, surveys were not conducted during times when the sustained wind was in excess of 15 miles per hour (mph) (Beaufort scale), or during periods of constant precipitation.

During each survey, every vertebrate species identified, along with the total number of individual detections for each species were recorded. The method of identification (e.g., sound, sight, or sign) was recorded. Identification by sign included tracks, scent, or other activity signs. The age and/or sex of each individual were also identified whenever it was possible. Individuals chased or flushed from the sampling point by the approach of the boat were also included in the point count data. In addition to the point count data, "species of interest" beyond the 100-m sampling distance and between survey points were recorded as interpoint data. Interpoint data was collected in a non-standardized manner, and therefore kept separate from data collected during the point counts. Human activities occurring during each sampling point (both within and beyond the 100-m radius sampling distance) judged to impact or interfere with the point counts, were also recorded. All field data was recorded into a tape recorder and on field data sheets.

B. Habitat Assessment Results

The results of the habitat assessment activities conducted at the Phase 1 areas are summarized below. Field data were collected from those locations between September 8 and October 1, 2003, September 14 through September 20, 2004, and August 29 through September 30, 2005. The specific locations are shown on Figures A-1 through A-20. Coordinates for the station locations are included in the Hudson River Habitat Assessment Database submitted to the United States Environmental Protection Agency (EPA) with the Hudson River Monthly Status Reports.

- *Unconsolidated River Bottom* - For Phase 1, habitat assessments were completed at 26 unconsolidated river bottom stations (nine target and 17 reference) in 2005 and four such stations in 2003 (all target). In 2004, two of the stations sampled in 2003 were re-sampled to evaluate interannual variability. All target stations are located in River Section 1 within areas to be dredged. Reference Stations are located River Sections 1, 2, and 3. Of the inorganic substrates, sand was commonly found at the stations, averaging 39.81% in 2003 and 14.11% in 2005. Silt was also common and averaged 34.63% in 2003 and 9.89% in 2005. Gravel averaged 15.74% in 2003 and 14.42% in 2005. Bedrock was not observed in 2003 but averaged 12.30% in 2005. Clay was the least commonly found substrate and averaged 0.93% in 2003 and 8.70% in 2005. Table A-1, below, summarizes the stations for the detailed functional assessments for unconsolidated river bottom.

Table A-1 – Unconsolidated River Bottom Stations for Detailed Functional Assessments

Station	Type[1]	Approximate Location (RS/RM[2])
1T	Target	West side of Rogers Island; east side of smaller island in the West River Channel (RS1/RM194.1)
6T	Target	East side of Roger's Island above POTW outfall (RS1/RM194)
7T	Target	West channel of Roger's Island (RS1)
8T	Target	RM 194, east channel (RS1)
9T	Target	Southern tip of Roger's Island, west channel (RS1)
10T	Target	Southern tip Roger's Island (RS1)
11T	Target	~100 yards south of 10T (RS1)
2T	Target	~300 yards south of Lock 7; west side of channel (RS1/RM193.4)
12T	Target	RM 193 (RS1)
1R	Reference	RM 193 (RS1)
2R	Reference	Mouth of Snook Kill (RS1)
3R	Reference	RM 191 (RS1)
16T	Target	Northern tip of Griffin Island (RS1)
3T	Target	Just south of north end of GI ~100 yards south, east side of channel (RS1/RM190.3)
18T	Target	RM 190 (RS1)
4R	Reference	RM 190 (RS1)
19T	Target	RM 190 (RS1)
5R	Reference	RM 189 (RS1)
6R	Reference	RM 188, east channel (RS2)
7R	Reference	RM 188, west channel (RS2)
8R	Reference	Galusha Island, west side (RS2)
9R	Reference	¼ mile south of RM 187 (RS2)
10R	Reference	RM 186 (RS2)
11R	Reference	RM 186 (RS2)
12R	Reference	RM 185 (RS2)
13R	Reference	½ mile south of RM 185 (RS2)
14R	Reference	Above Northumberland Dam (RS2)
15R	Reference	East of Lock 5 (RS3)
16R	Reference	¼ mile south of RM 182 (RS3)
17R	Reference	RM 180 (RS3)

Notes:

1. Stations are shown in the order that they occur from upriver to downriver locations in the river. The designation of the habitats as "target" or "reference" is based on the final dredge areas provided in the *Phase 1 Final Design Report* and preliminary dredge area delineations that were in production as working drafts for the *Phase 2 Dredge Area Delineation Report* and is subject to change.
2. RS = River Section; RM = River Mile

Of the organic substrate components, muck-mud and marl were most common in 2003 and averaged 32.04% and 19.26%, respectively. Averages decreased in to 5.47% and 6.24%, respectively in 2005. Detritus averaged 15.19% in 2003 and 6.47% in 2005. Mussels averaged 1.02% in 2003 and 9.87% in 2005.

Available cover provides an indication of the abundance of boulders, snags, and cobble. These components of unvegetated river bottom habitats, if present, provide structural complexity to an otherwise featureless river bottom and thus provide habitat for aquatic organisms. The results for available cover varied within, and between, stations for example, boulders averaged between 3.52% in 2003 to 12.55% in 2005; cobbles averaged 4.26% in 2003 and 13.62%. Table A-2, below, summarizes the range of conditions observed on the unconsolidated river bottoms during these assessments.

Table A-2 – Range of Conditions Observed in Unconsolidated River Bottoms in the Upper Hudson River in Areas Relevant to Phase 1 from 2003 through 2005

Parameter	Units	Minimum			Maximum			Mean			Standard Deviation		
		2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005
Inorganic Substrate													
Bedrock	percent	0	0	0	0	0	100	0	0	12.30	0	0	27.56
Boulder	percent	Trace (< 10)	0	Trace (< 10)	50	60	70	3.52	12.22	12.55	10.49	21.30	8.78
Cobble	percent	Trace (< 10)	Trace (< 10)	Trace (< 10)	50	50	50	4.26	10.56	13.62	10.75	15.52	10.68
Gravel	percent	Trace (< 10)	Trace (< 10)	Trace (< 10)	70	30	50	15.74	7.22	14.42	24.23	10.74	15.78
Sand	percent	Trace (< 10)	Trace (< 10)	Trace (< 10)	80	90	90	39.81	43.89	14.11	24.46	33.98	24.64
Silt	percent	Trace (< 10)	0	Trace (< 10)	80	70	60	34.63	24.44	9.89	24.08	22.55	16.43
Clay	percent	Trace (< 10)	0	Trace (< 10)	10	10	70	0.93	1.67	8.70	2.93	3.83	10.89
Organic Substrate													
Detritus	percent	Trace (< 10)	Trace (< 10)	Trace (< 10)	70	70	80	15.19	12.78	6.47	14.11	21.37	16.12
Muck-Mud	percent	Trace (< 10)	Trace (< 10)	Trace (< 10)	100	80	50	32.04	35.00	5.47	33.84	32.76	8.74
Marl	percent	Trace (< 10)	Trace (< 10)	Trace (< 10)	100	80	40	19.26	11.67	6.24	31.67	20.93	6.72
Mussels	percent	0	0	Trace (< 10)	4	3	70	1.02	1.17	9.87	1.02	0.92	14.46
Epifaunal Substrate													
Pool Substrate[1]	percent	<25	<25	<25	>80	55-75	>80	54.72	46.81	49.87	22.70	14.70	24.51
TOC	mg/kg	0	0	0	320,000	43,000	330,000	27,308	19,671	27,543	51,757	15,571	57,371
Percent Fines	percent	0	0	0	80	80	80	35.56	26.11	9.51	25.15	25.70	24.24

Notes:
1. Areas relevant to Phase 1 include target stations within areas to be dredged during Phase 1 and associated reference stations.
2. To calculate the mean, the mid-range value was used for the "suboptimal" and "marginal" categories. Trace was set to 5 to calculate the mean and standard deviation.
3. TOC = total organic carbon
4. mg/kg = milligram per kilogram

- *Aquatic Vegetation Beds* - For Phase 1, habitat assessments were completed at 7 aquatic vegetation bed stations (all reference) in 2005 and 5 aquatic bed stations (all target) in 2003. In 2004, one of the stations sampled in 2003 was re-sampled to evaluate interannual variability. All target stations are located in River Section 1 within areas to be dredged. Reference stations are located River Sections 1 and 2.

  With the exception of one station (11R), wild celery (*Vallisneria americana*) was the dominant submerged aquatic macrophyte species in all aquatic vegetation beds sampled (see Table A-3, below). Combined, these other species contributed from less than 1% to 17% of the total aquatic macrophyte biomass at the stations (56% at Station 11R) (see Table A-3, below). The species most commonly co-occurring with wild celery were American pondweed *(Potamogeton nodosus)*, common waterweed (*Elodea canadensis)*, redhead grass (*P. perfoliatus*), water lily (*Nymphaea odorata*), and pondweed (*Potamogeton* sp). This is consistent with the Law Environmental report (1991) and Exponent report (1998) that documented wild celery, common waterweed, and pondweeds as the most commonly occurring species in the Upper Hudson River. Aquatic vegetation beds in the Upper Hudson River have been found to range in size from less than one-tenth acre to 37 acres (see the *Habitat Delineation Report* [HD Report] [BBL and Exponent, 2005a]). The aquatic vegetation beds sampled to date for Phase 1 range from 1 to 13.9 acres as shown in Table A-3.

Table A-3 — Aquatic Vegetation Bed Stations for Detailed Functional Assessments

Station	Type[1]	Area (ac.)	Approximate Location (RS/RM)	Species Composition (% of total station biomass)
1	Target	13.9	West Channel of northern tip of Rogers Island across from Rec. park (RS1/RM194.4)	Wild celery (84%), American pondweed (12%), redhead grass (4%)
3	Target	1.4	~300 yards south of railroad bridge down to Lock 7 (RS1/RM194.1) in East River channel	Wild celery (95%), common waterweed (3%), American pondweed (2%)
2	Target	2.7	Southern end of Rogers Island, West River Channel (RS1/193.8)	Wild celery (96%), American pondweed (4%), common waterweed (<1%)
4	Target	2.0	~500 yards south of Lock 7; western side of channel (RS1/RM193.2)	Wild celery 99%), American pondweed (1%)
6	Target	7.0	~600 yards south of northern end of GI; eastern side of channel across from private airfield (RS1/RM190.1)	Wild celery (97%), common waterweed (3%)
10R	Reference	NA	NA	Wild celery (92%), pondweed (5%), redhead grass (3%),
11R	Reference	2.0	Northern tip of Roger's Island,	Wild celery (40%), pondweed (36%), redhead

Station	Type[1]	Area (ac.)	Approximate Location (RS/RM)	Species Composition (% of total station biomass)
			east channel	grass (20%),
12R	Reference	2.0	East side of Griffin Island, east shore	Wild celery (85%), pondweed (15%)
13R	Reference	4.1	RM 189 west side	Wild celery (96%), redhead grass (4%)
14R	Reference	5.5	RM 189 west side	Wild celery (83%), redhead grass (15%), pondweed (2%)
15R	Reference	7.8	Southern tip of Thompson Island	Wild celery (94%), pondweed (6%)
16R	Reference	1.0	West side, across from Galusha Island	Wild celery (85%), pondweed (15%)

Note:

1. Stations are shown in the order that they occur from upriver to downriver locations in the river. The designation of the habitats as "target" or "reference" is based on the final dredge areas provided in the *Phase 1 Final Design Report* and preliminary dredge area delineations that were in production as working drafts for the *Phase 2 Dredge Area Delineation Report* and is subject to change.

Aquatic vegetation was sampled in water from less than 0.5 m deep to greater than 3 m deep within nine or 18 quadrats (1-square-meter [m^2] sampling grid, subdivided into 25-square-centimeter [cm^2] subquadrats) depending on the station (see Table A-4 for summary of results). River flow during the sampling period ranged from 2,178 cubic feet per second (cfs) to 7,840 cfs. Aquatic vegetation was sampled from a variety of substrate types that ranged from fine sediments (64.8% fines) to coarser sediments (4.1% fines). TOC content ranged from 3,100 to 250,000 mg/kg. The quantity of nutrients available for plant growth was estimated through measures of exchangeable potassium and ammonia, and extractable phosphorus in the sediment. Extractable potassium ranged from 0.94 to 115.8 mg/kg. Exchangeable phosphorous and ammonia ranged from 4.95 to 569.74 mg/kg and 0.82 to 32.94 mg/kg, respectively.

Average aboveground biomass for each station (i.e., the average of the quadrats) ranged from 24.48 grams per square meter (g/m^2) to 2,266.32 g/m^2, with an overall average of 585.07 g/m^2 for 2005. Average shoot density (all species combined) for each station ranged from 8 (shoots per square meter [$shoots/m^2$]) to 2,464 ($shoots/m^2$), with an overall average of 694.26 ($shoots/m^2$) for the stations sampled in 2005. Percent cover for each station ranged from 10 to 100% with an overall average of 69.22% in 2005. The crown density scale shown on the habitat delineation maps also indicates percent cover, but of the entire bed, which generally covers a larger area than an assessment station.

Light availability and current velocity data were also collected inside and outside the aquatic vegetation bed at each station. Light availability (percent of surface light reaching a depth of 50 centimeters [cm]) were measured at the center of the aquatic vegetation bed. The light measurements at 0.5 m and 1.0 m were used to calculate Kd (the light extinction coefficient) following the Lambert-Beer equation:

$(I_z = I_o e^{-kdz})$

where:

Iz = light measured at a water depth of 1.0 m

Io = light measured at a water depth of 0.5 m

Kd values ranged from 0.28 m^{-1} to 2.57 m^{-1} within the aquatic vegetation beds. Light data were not collected in 2004 due to rain just prior to and during sampling. These Kd values represent light availability under low flow and low turbidity conditions that existed during the time of sampling.

Current velocity measurements were collected inside and outside the aquatic vegetation bed at each station. Within the aquatic vegetation beds, current velocity ranged from 0 to 1.15 feet per second (ft/s). At the outside edge of the aquatic vegetation beds, current velocity ranged from 0.02 to 1.25 ft/s. Overall, the current velocities were lower in the aquatic vegetation bed than current velocities taken immediately outside the bed on the channel side. However, current velocities were relatively low and showed little variability between or within stations.

Table A-4 – Range of Conditions in Aquatic Vegetation Beds in the Upper Hudson River in Relevant Phase 1 Areas from 2003 through 2005

Parameter	Units	Minimum			Maximum			Mean			Standard Deviation		
		2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005
River Flow	Cfs	2,178	2,560	2,140	3,214	7,840	5,600	2,898	5,774	3,032	341.31	1,652	1,025
Total Organic Carbon	mg/kg	0	3100	0	250,000	52,000	58,000	30,290	19,233	13,339	45,779	15,710	13,860
Percent Fines	percent	5.2	5.2	4.1	45.2	54.5	64.8	20.48	19.15	29.98	14.36	16.38	17.65
Dry Bulk Density	g/cm^3	0.12	0.37	0.39	2.70	2.7	1.60	0.97	1.11	1.13	0.55	0.65	0.28
Moisture Content	percent	15	15	12	82	67	92	41.23	37.2	30.70	18.21	14.28	18.98
Exchangeable Phosphorus	mg/l	14.6	14.2	4.95	133	14.2	569.74	38.72	14.2	70.08	36.36	-	136.40
Exchangeable Ammonia	mg/l	4.39	0.82	7.08	26.2	0.82	32.94	10.66	0.82	20.95	6.29	-	8.63

Parameter	Units	Minimum			Maximum			Mean			Standard Deviation		
Extractable Potassium	mg/l	18.7	0.94	1.42	48.3	0.94	115.8	31.68	0.94	34.14	8.46	-	31.01
Aboveground Biomass	g/m^2	24.48	38.96	108.72	561.99	127.52	2266.32	101.74	78.09	585.07	90.09	32.19	457.81
Shoot Density	number/m^2	32	120	8	1880	368	2,464	364.00	211.56	694.26	343.32	86.45	406.42
Percent Cover	percent	10	30	10	100	70	100	53.11	52.22	69.22	23.14	15.63	24.55
Light Availability - Center of Bed	light attenuation coefficient	0.38	NA	0.28	2.57	NA	2.53	1.00	NA	0.87	0.90	NA	0.76
Current – Inside Bed (Outside Bed)	ft/s	0.01 (0.02)	0.16 (0.39)	0 (0.04)	1.12 (0.86)	0.4 (0.8)	1.15 (1.25)	0.23 (0.42)	0.28 (0.59)	0.19 (0.46)	0.38 (0.30)	0.17 (0.29)	0.27 (0.41)

Notes:
1. Areas relevant to Phase 1 include target stations within areas to be dredged during Phase 1 and associated reference stations.
2. cfs = cubic feet per second
3. g/cm^3 = grams per cubic centimeter
4. mg/l = milligram per liter
5. g/m^2 = grams per square meter

- *Shorelines* - For Phase 1, habitat assessments were completed at nine shoreline stations (two target and seven reference) in 2005 and seven shoreline stations (five target and two reference) in 2003. In 2004, four of the stations sampled in 2003 were re-sampled to evaluate interannual variability. All target stations are located in River Section 1 within areas to be dredged. Reference stations are located River Sections 1 and 2.

  The dominant inorganic substrate was sand, mixed mostly with smaller fractions of silt, clay, and/or gravel. Clay was < 40% of the total sediment composition. Boulders were infrequently observed on shoreline substrates. Results are summarized below in Table A-5.

Table A-5 – Shoreline Stations for Detailed Functional Assessments

Station	Target/Reference	Approximate Location (RS/RM)	Dominant Substrate Composition	Dominant Bank Composition
SHO-01R	Reference	Upstream from road bridge across from park on Roger's Island; western shore (RS1/RM194.4)	Sand/gravel; low cobble/silt mix with trace clay; leafy detritus and muck/mud; woody debris	Stable; optimal vegetation cover
SHO-12T	Target	Immediately north of road bridge and south of park on Roger's Island; west channel (RS1/RM 194.4)	Sand; low silt/gravel/cobble/ boulder mix; low detritus	Stable to moderately stable; marginal to optimum vegetation cover
SHO-01T	Target	~50 m downstream from railroad trestle bridge at Rogers Island; western shore (RS1/RM194.1)	Sand/silt/clay mix; low leafy detritus with muck/mud; woody debris	Stable; optimal vegetation cover
SHO-04R	Reference	south of rail bridge on eastern shore of Roger's Island and north of Bond Creek (RS1/RM 194.1)	Silt/sand/gravel mix; low boulder and cobble; high detritus cover	Moderately stable to stable; optimal to suboptimal vegetative cover
SHO-03T	Target	East bank, north of Lock 7, east of Rogers Island (RS1/RM193.9)	Sand; low silt/clay mix; low leafy detritus with muck/mud; woody debris	Moderately stable; optimal vegetation cover
SHO-02T	Target	Western shore of Roger's Island Boat House; north of south tip (RS1/RM194)	Sand; low silt mix; low leafy detritus with muck/mud; low woody debris	Stable; optimal vegetation cover
SHO-04T	Target	Eastern shore of Rogers Island, ~300 m north of Lock 7 (RS1RM193.8)	Sand; low gravel/silt mix; low leafy detritus with muck/mud; low woody debris	Moderately stable – Moderately unstable; optimal vegetation cover
SHO-05R	Reference	350 m south of Lock 7 on eastern shore of river (RS1/RM 193.5)	Cobble/gravel/boulder mix; low sand, silt, and detritus	Stable to moderately stable; optimum vegetation cover; low suboptimal vegetative cover
SHO-06T	Target	Eastern shore, across channel from GI (RS1/RM 190.4)	Sand/gravel; low cobble/silt mix; mix of leafy detritus, muck/mud, shell hash; low woody debris	Stable – moderately stable; optimal vegetation cover
SHO-15T	Target	Immediately across from Griffin Island on eastern shore of river (RS1/RM 190)	Boulder/cobble/gravel/sand mix with a trace of detritus; low silt; trace marl	Stable to moderately unstable; suboptimal to poor vegetative cover
SHO-06R	Reference	Just south of entrance to channel for Lock 6 on western shore of the main river channel (RS1/RM 188.9)	Silt and clay with detritus; trace cobble	Stable to moderately stable; optimal to suboptimal vegetative cover
SHO-07R	Reference	450 m south of entrance to Lock 6 channel on the eastern shore of the main river channel (RS1/RM 188.7)	Gravel/silt/clay mix with low detritus; trace bedrock, marl and sand; low boulder and cobble	Stable to moderately unstable; optimal vegetative cover
SHO-08R	Reference	400 m north of southern tip of Thompson Island on western	Sand with detritus; low silt	Stable; low moderately stable;

Station	Target/Reference	Approximate Location (RS/RM)	Dominant Substrate Composition	Dominant Bank Composition
		shore of east channel (RS2/RM 187.9)		marginal to suboptimal vegetative cover
SHO-09R	Reference	250 m north of southern tip of Thompson Island on eastern shore of west channel (RS2/RM 187.8)	Gravel/sand/silt mix with detritus; low cobble and clay	Stable to moderately stable; suboptimal to marginal vegetative cover
SHO-10R	Reference	Immediately south of Thompson Island on eastern shore of river (RS2/RM 187.4)	Silt and sand with detritus; low gravel; trace boulder	Stable; some moderately stable; optimal to suboptimal vegetative cover
SHO-03R	Reference	½ m north of Rt. 4 Bridge; western shore (RS2/RM184)	Sand; low gravel/silt/clay; low leafy detritus; mostly shell hash and trace algae; high woody debris	Stable – unstable; vegetation cover suboptimal or marginal in sections

Notes:

1. Stations are shown in the order that they occur from upriver to downriver locations in the river. The designation of the habitats as "target" or "reference" is based on the final dredge areas provided in the *Phase 1 Final Design Report* and preliminary dredge area delineations that were in production as working drafts for the *Phase 2 Dredge Area Delineation Report* and is subject to change.

As shown in Table A-6, organic substrate components varied greatly between stations. Leafy detritus ranged from 0 to 95%. Muck/mud and marl both ranged from 0 to 100%. Small portions of vegetation in the form of an unclassified freshwater alga were found at shoreline stations ranging from 0 to 100%. Another common organic substrate component of the shoreline was large woody debris (LWD). At the assessed stations, LWD varied in area from less than 10 square feet to 58.17 square feet.

Table A-6 – Range of Conditions Observed in Shorelines in the Upper Hudson River from 2003 through 2005

Parameter	Units	Minimum			Maximum			Mean			Standard Deviation		
		2003	2004	2005	2003	2004	2005	2003	2004	2005	2003	2004	2005
Inorganic Substrate													
Bedrock	percent	0	0	0	0	0	Trace (< 10)	0	0	0.83	0	0	1.90
Boulder	percent	0	0	0	Trace (< 10)	10	45	0.00	1.11	5	0.00	3.33	10.73
Cobble	percent	0	0	0	20	50	20	1.91	5.56	5.45	5.12	16.67	5.54
Gravel	percent	0	0	0	70	100	60	12.38	22.22	15	20.95	36.67	19.88
Sand	percent	20	0	0	90	70	90	60.00	45.56	38.33	26.46	28.33	30.49
Silt	percent	0	0	Trace (< 10)	50	30	60	15.72	18.89	30.22	16.30	12.69	20.36
Clay	percent	0	0	0	40	10	40	10.00	3.34	8.48	14.49	5.00	15.18
Organic Substrate													
Detritus	percent	0	0	0	40	0	95	13.34	0	33.75	11.10	0	30.65
Muck-Mud	percent	Trace (< 10)	0	0	100	0	Trace (< 10)	63.33	0	0.21	33.81	0	1.02
Marl	percent	0	0	0	100	0	Trace (< 10)	19.05	0	0.42	37.00	0	1.41
Vegetated	percent	0	0	Trace (< 10)	30	0	100	4.29	0	65.63	8.70	0	30.30
Woody Debris	feet	Trace (< 10)	NA	Trace (< 10)	31.67	NA	58.17	19.11	NA	16.50	6.78	NA	13.75
Bank Assessment													
Stable	percent	Trace (< 10)	0	15	100	100	100	34.29	44.44	75.21	41.90	52.70	26.02
Moderately Stable	percent	Trace (< 10)	0	0	90	100	80	50.95	48.89	22.92	37.54	48.85	23.86
Moderately Unstable	percent	Trace (< 10)	0	0	80	50	15	10	6.67	1.88	18.44	16.58	4.38
Unstable	percent	Trace (< 10)	0	0	0	0	0	0	0	0	0	0	0
Bank Vegetation													
Optimal	percent	Trace (< 10)	0	0	100	100	100	92.86	55.56	46.67	23.05	52.70	42.90
Suboptimal	percent	Trace (< 10)	0	0	20	100	50	1.43	44.44	20.42	4.78	52.70	16.54
Marginal	percent	Trace (< 10)	0	0	20	0	90	0.95	0	30.42	4.36	0	35.32
Poor	percent	Trace (< 10)	0	0	0	0	30	0	0	2.5	0	0	8.47
Riparian Edge													
Canopy	percent	Trace (< 10)	20	10	100	90	85	49.05	53.33	44.58	25.08	27.84	24.40
Understory	percent	Trace (< 10)	Trace (< 10)	Trace (< 10)	80	80	95	36.67	36.67	38.33	27.26	23.45	30.13
Herbaceous	percent	10	30	20	100	100	95	67.62	81.11	63.13	24.06	23.69	22.50
Adjacent Landuse	none	Maintained Field	Residential	NA	Forested	Forested	NA	NA	NA	NA	NA	NA	NA

At Phase 1 target and reference stations, no natural shoreline banks were found to be completely unstable (i.e., 60% to 100% of the bank visibly eroding), although several stations contained small areas of exposed root mats and/or sloughing. The majority of natural shoreline banks had visible erosion in less than 30% of the area assessed. Stability did not appear to be influenced by adjacent land use: forested areas had shorelines that were as stable as shorelines adjacent to maintained lands.

In the canopy, understory, and herbaceous vegetated "layers," percent cover ranged from <10% to 100% (canopy), <10% to 95% (understory), and 20% to 100% (herbaceous).

- *Riverine Fringing Wetlands* – For Phase 1, habitat assessments were completed at one riverine fringing wetland station (target) in 2005 and one station (reference) in 2003. Both stations are in River Section 1. The riverine fringing wetlands range in size from 0.12 acres to 0.15 acres. Slope of the wetlands ranged from 9.02% to 11.4%. The assessed wetlands contained an average biomass of 334.24 g/m^2 in 2003 and 288.84 g/m^2 in 2005. Stem density averaged 65.56 stems/m^2 in 2003 and 3,044.17 stems/m^2 in 2005. The following four emergent wetland communities were identified within the sampled wetlands based on biomass (Table A-7):

1) Great burreed (*Sparganium eurycarpum)*;
2) Wild rice (*Zizania aquatica*);
3) Rice cutgrass (*Leersia oryzoides*); and
4) Creeping spikerush (*Eleocharis palustris*).

Table A-7 – Riverine Fringing Wetland Stations for Detailed Functional Assessments

Parameter	Units	Minimum		Maximum		Mean		Standard Deviation	
		2003	2005	2003	2005	2003	2005	2003	2005
Size	acre	0.32	0.12	0.32	0.12	0.32	0.12	NA	NA
Slope	percent	11.4	9.02	11.4	9.02	11.4	9.02	NA	NA
Biomass	g/m^2	169.44	184.58	507.04	349.16	334.24	288.84	133.75	57.27
Stem Density	$number/m^2$	41	1901	91	4656	65.56	3044.17	15.25	1044.35
Percent Contiguous	percent	100	100	100	100	100	100	NA	NA
Wetland Edge	feet	490	233	490	233	490	233	NA	NA

Note:

1. Stations are shown in the order that they occur from upriver to downriver locations in the river. The designation of the habitats as "target" or "reference" is based on the final dredge areas provided in the *Phase 1 Final Design Report* and preliminary dredge area delineations that were in production as working drafts for the *Phase 2 Dredge Area Delineation Report* and is subject to change.

The assessments of the riverine fringing wetlands for Phase 1 provide useful information for defining and characterizing this specific wetland system. The riverine fringing wetlands assessed for Phase 1 are small dynamic systems that lie within the river's high water mark during average summer flow conditions. Hydrology for these wetlands is primarily influenced by flow conditions of the Upper Hudson River and its tributaries; minimal hydrologic input is received from upland sources. Hydrological conditions are dominated by diurnal fluctuations in the river's water level created by periodic releases of water from Sacandaga Reservoir. Hydrologic conditions of the project area are controlled to a lesser extent by other hydroelectric facilities upstream of River Section 1, episodic flooding due to storm events, tributary input, and seasonal ice flow.

- *Fish and Wildlife Observations* - The fish and wildlife species recorded during the point counts are shown in Table A-8, below.

Table A-8 - Wildlife Species Observed For Phase 1

Common Name	Scientific Name	Code	Locations
American Crow	*Corvus brachyrhynchos*	SE, HE	HR023, HR055, HR056, HR057
American Goldfinch	*Carduelis tristis*	SE,HE	HR002, HR003, HR004, HR005, HR006, HR0023, HR024, HR053, HR054, HR055, HR056, HR057, HR058
American Redstart	*Setophaga ruticilla*	SE, HE	HR005
American Robin	*Turdus migratorius*	SE, HE	HR002,HR004, HR006, HR024, HR054
Baltimore Oriole	*Icterus galbula*	SE, HE	HR003, HR004, HR005, HR023, HR024, HR054, HR056
Bank Swallow	*Riparia riparia*	SE	HR053, HR023
Barn Swallow	*Hirundo rustica*	SE	HR001, HR005, HR054
Beaver	*Castor canadensis*	SE	HR003 HR006
Belted Kingfisher	*Ceryl alcyon*	SE, HE	HR004, HR056
Black-capped Chickadee	*Parus atricapillus*	SE, HE	HR002, HR003, HR004, HR005, HR006, HR053, HR054, HR055,HR056, HR057
Blue Jay	*Cyanocitta cristata*	SE, HE	HR002, HR003, HR004, HR005, HR006, HR053, HR054, HR055, HR056, HR057,
Broad-winged Hawk	*Buteo platypterus*	SE	HR057
Bullfrog	*Rana catesbeiana*	SE	HR024
Canada Goose	*Branta Canadensis*	SE	HR001, HR057, HR058
Canada Warbler	*Wilsonia canadensis*	SE	HR003
Carolina Wren	*Thryothorus ludovicianus*	SE, HE	HR005, HR006, HR056
Cedar Waxwing	*Bombycilla cedrorum*	SE, HE	HR001, HR002, HR003, HR004, HR005, HR006, HR023, HR053, HR054, HR057, HR058
Chimney Swift	*Chaetura pelagica*	SE	HR001, HR053
Chipmunk	*Tamias striatus*	SE, HE	HR001, HR004, HR005, HR006, HR053, HR055
Cliff Swallow	*Hirundo pyrrhonota*	SE	HR001, HR055
Coopers Hawk	*Accipiter cooperii*	SE	HR057
Double-Crested Cormorant	*Phalacrocorax auritus*	SE	HR001, HR002, HR003, HR023, HR024, HR058
Downy Woodpecker	*Picoides pubescens*	SE, HE	HR002, HR006, HR055, HR056, HR057, HR058
Eastern Bluebird	*Sialia sialis*	HE	HR055
Eastern Gray Squirrel	*Sciurus carolinensis*	SE, HE	HR055, HR056, HRO57
Eastern Gray Treefrog	*Hyla versicolor*	HE	HR053
Eastern Kingbird	*Tyrannus tyrannus*	SE, HE	HR004
Eastern Wood Pewee	*Contopus virens*	SE, HE	HR002, HROO4, HR005, HR006, HR023, HR024, HR056
European Starling	*Sturnus vulgaris*	SE, HE	HR005, HR054, HR057
Gray Catbird	*Dumetella carolinensis*	SE, HE	HR003, HR004, HR005, HR006, HR023, HR024, HR053, HR054, HR056
Great Blue Heron	*Ardea herodias*	SE, HE	HR006, HR024
Great Crested Flycatcher	*Myiarchus crinitus*	SE, HE	HR005, HR006
Green Frog	*Rana clamitans*	SE, HE	HR003 HR004
Green Heron	*Butorides striatus*	SE, HE	HR006 HR024 HR056
Hairy Woodpecker	*Picoides villosus*	SE, HE	HR004, HR053, HR056, HRO57

Common Name	Scientific Name	Code	Locations
House Finch	*Carpodacus mexicanus*	SE, HE	HR054
House Sparrow	*Passer domesticus*	SE, HE	HR002, HR005
Indigo Bunting	*Passerina cyanea*	HE	HR005
Mallard	*Anas Platyrhynchos*	SE,HE	HR001, HR005, HR006, HR053, HR055, HR056, HR057, HR058
Merlin	*Falco columbarius*	SE	HR001
Mourning Dove	*Zenaida macroura*	SE, HE	HR004, HR005, HR023, HR024, HR053, HR055, HR057, HR058
Muskrat	*Ondatra zibethicus*	SE	HR054
Northern Cardinal	*Cardinalis cardinalis*	HE	HR002, HROO3, HR004, HR006, HR053, HR055, HR057
Northern Flicker	*Colaptes auratus*	SE, HE	HR004, HR005, HR053, HR054
Northern Rough-winged swallow	*Stelgidopteryx serripennis*	SE, HE	HR001, HR003, HR004, HR024, HR054, HR055, HR058
Osprey	*Pandion haliaetus*	SE	HR053
Painted Turtle	*Chrysemys picta*	SE	HR003, HR004, HR006, HR024
Philadelphia Vireo	*Vireo philadelphicus*	SE	HR005
Pileated Woodpecker	*Dryocopus pileatus*	HE	HR056
Purple Finch	*Carpodacus purpureus*	SE	HR054
Red Squirrel	*Tamiasciurus hudsonicus*	SE, HE	HR006
Red-bellied Woodpecker	*Melanerpes carolinus*	SE, HE	HR003, HR004, HR023
Red-eyed Vireo	*Vireo olivaceus*	SE, HE	HR003, HR024
Red-winged Blackbird	*Agelaius phoeniceus*	SE, HE	HR005, HR058
Rock Pigeon	*Columba livia*	SE, HE	HR001, HR002, HR003, HR005, HR054, HR055, HR056, HR057, HR058
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	SE, HE	HR005
Sharp-shinned Hawk	*Accipiter striatus*	SE	HR053, HR058
Solitary Sandpiper	*Tringa solitaria*	SE	HR001
Song Sparrow	*Melospiza melodia*	SE, HE	HRO01, HR002, HR003, HR004, HROO5, HR006, HR24, HR053, HR054, HR055
Spotted Sandpiper	*Actitis macularia*	SE	HR001, HR024
Spring Peeper	*Pseudacris crucifer*	HE	HR024 HR053 HR054 HR055 HR023
Tree Swallow	*Tachycineta bicolor*	SE, HE	HROO1, HR003, HR005, HR006, HR023, HR024, HRO53, HR054, HRO55, HR057, HR058
Tufted Titmouse	*Parus bicolor*	SE, HE	HR003, HR004, HR005, HR055, HR056
Turkey Vulture	*Cathartes aura*	SE	HR055
Warbling Vireo	*Vireo gilvus*	SE, HE	HR005, HR006, HR023, HR024, HR056
White-breasted Nuthatch	*Sitta carolinensis*	HE	HR002
Wilsons Warbler	*Wilsonia pusilla*	SE	HR003
Wood Duck	*Aix sponsa*	SE	HR056
Wood Frog	*Rana sylvatica*	SE	HR004

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BBL. 2003a. *Remedial Design Work Plan* (RD Work Plan). Hudson River PCBs Superfund Site. Prepared for General Electric Company, Albany, NY.

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BBL and Exponent. 2005a. *Habitat Delineation Report* (HD Report). Hudson River PCBs Superfund Site. Prepared for General Electric Company, Albany, NY.

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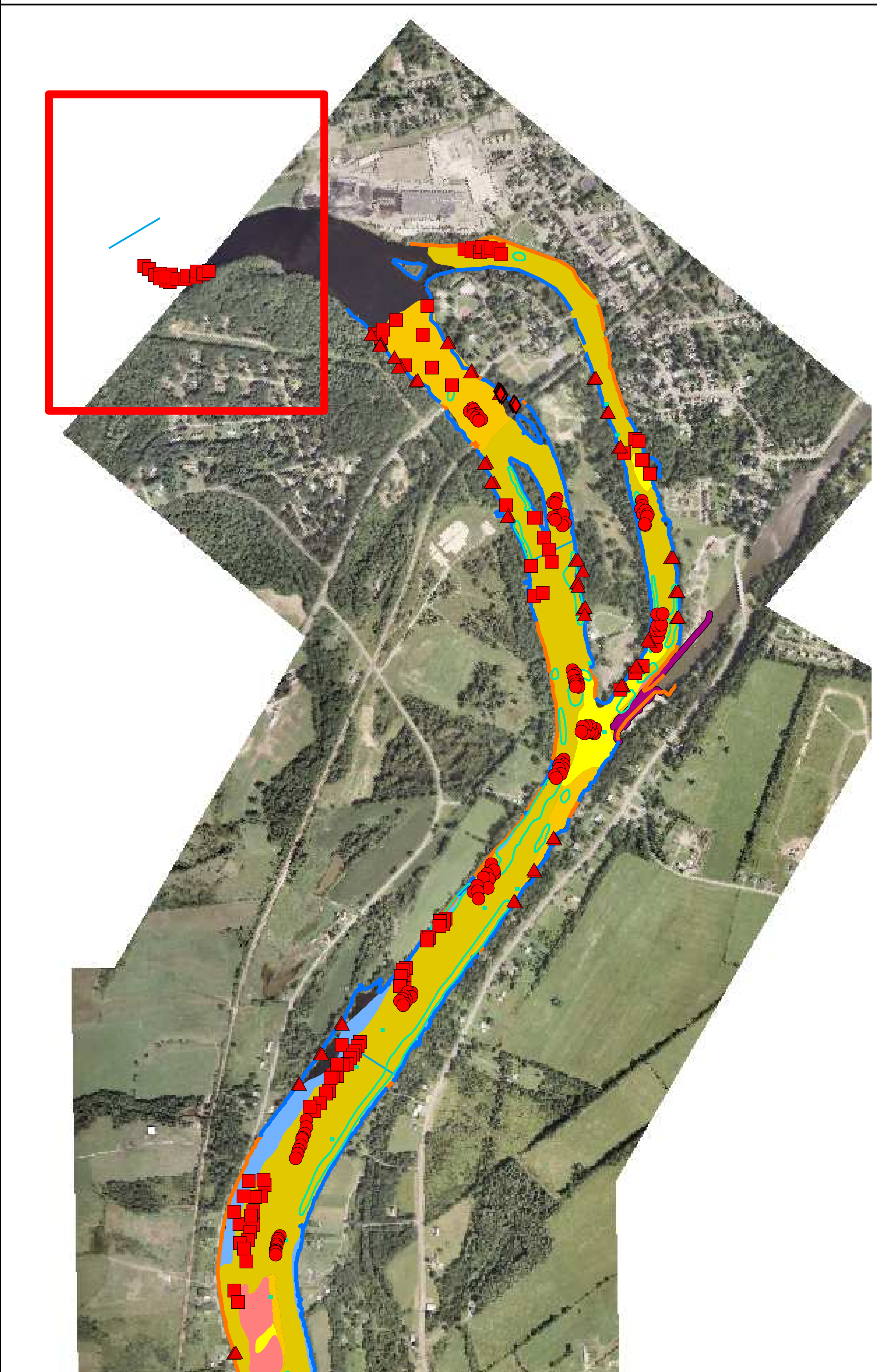
Exponent. 1998. *Data Documentation and Interpretation Report: SAV and Fish Community Analysis*. Prepared for General Electric Company, Albany, NY.

Overview



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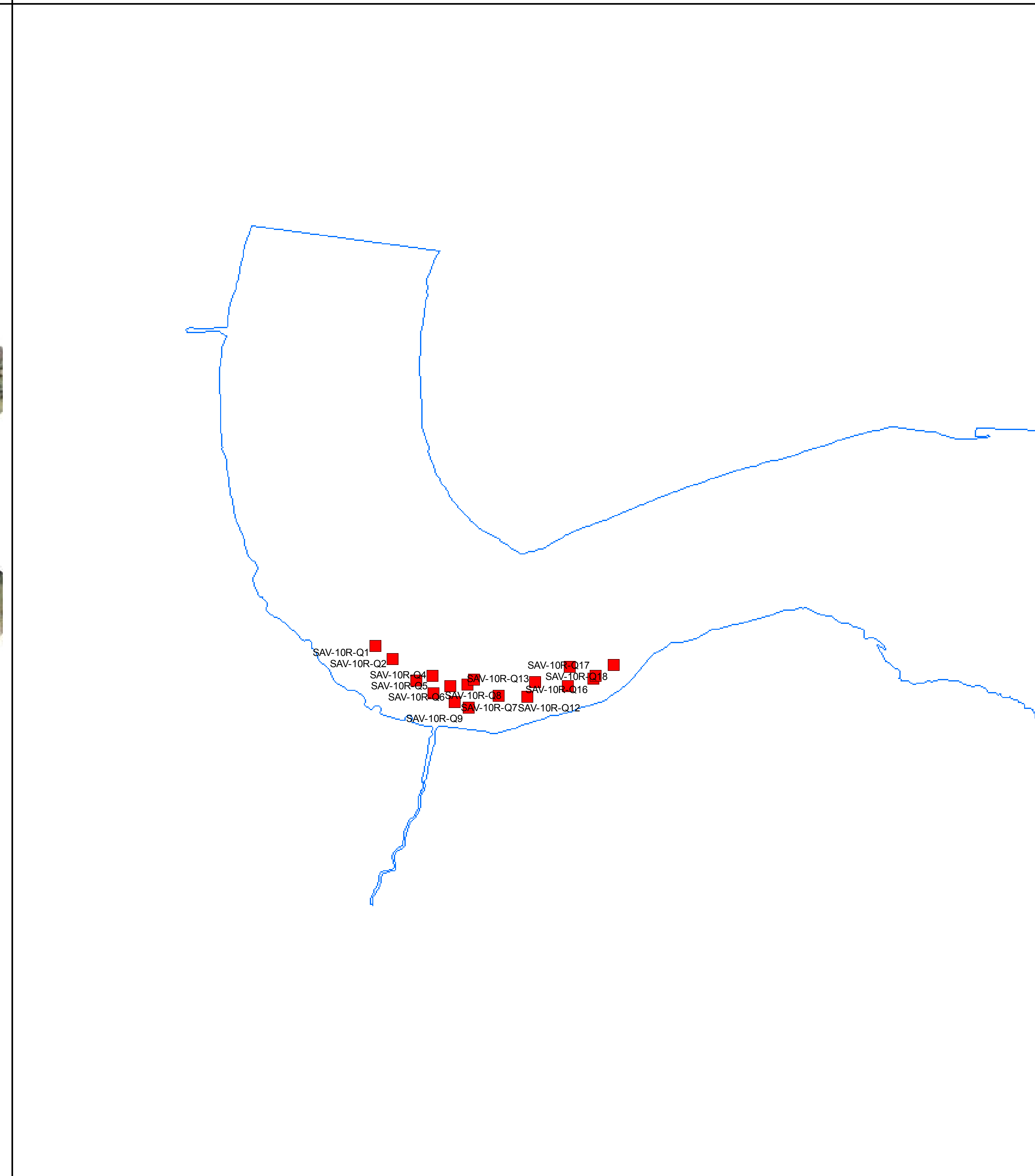
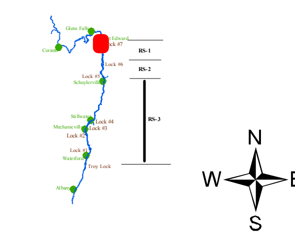


LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Figure A-1

Sampling Station Locations for Habitat Assessments 2003 through 2005

QEA Quantitative Environmental Analysis, LLC

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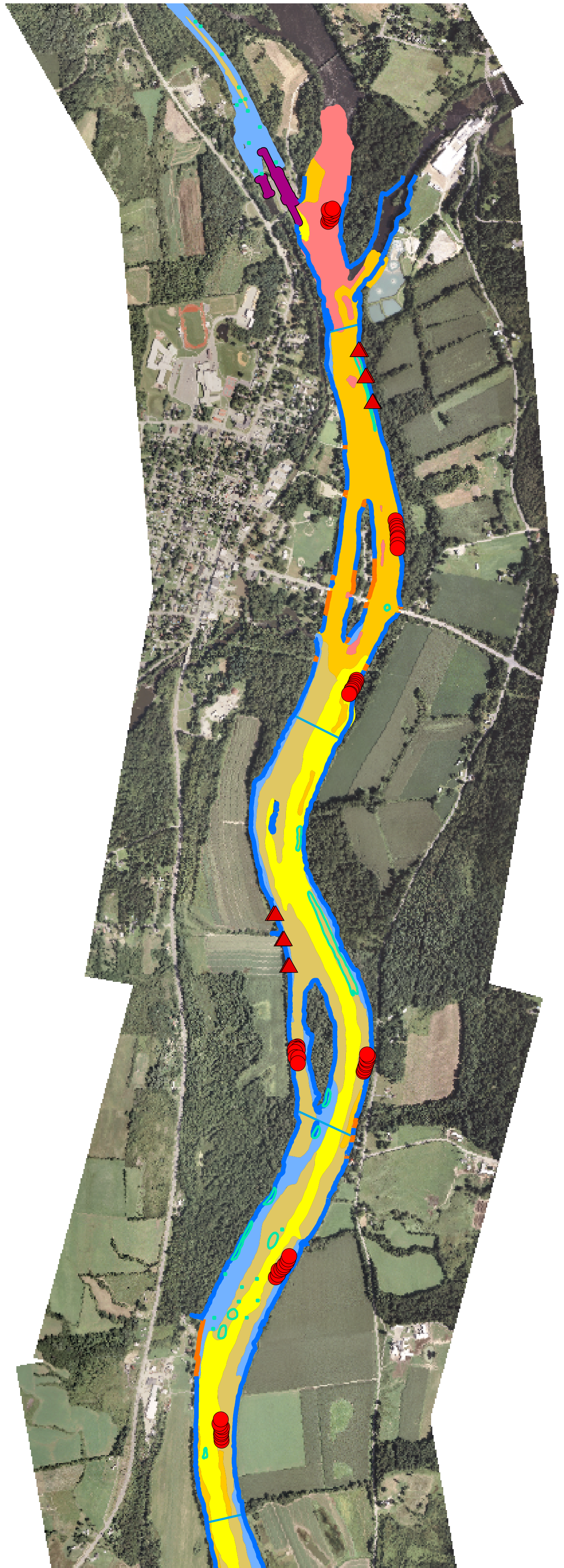
Overview



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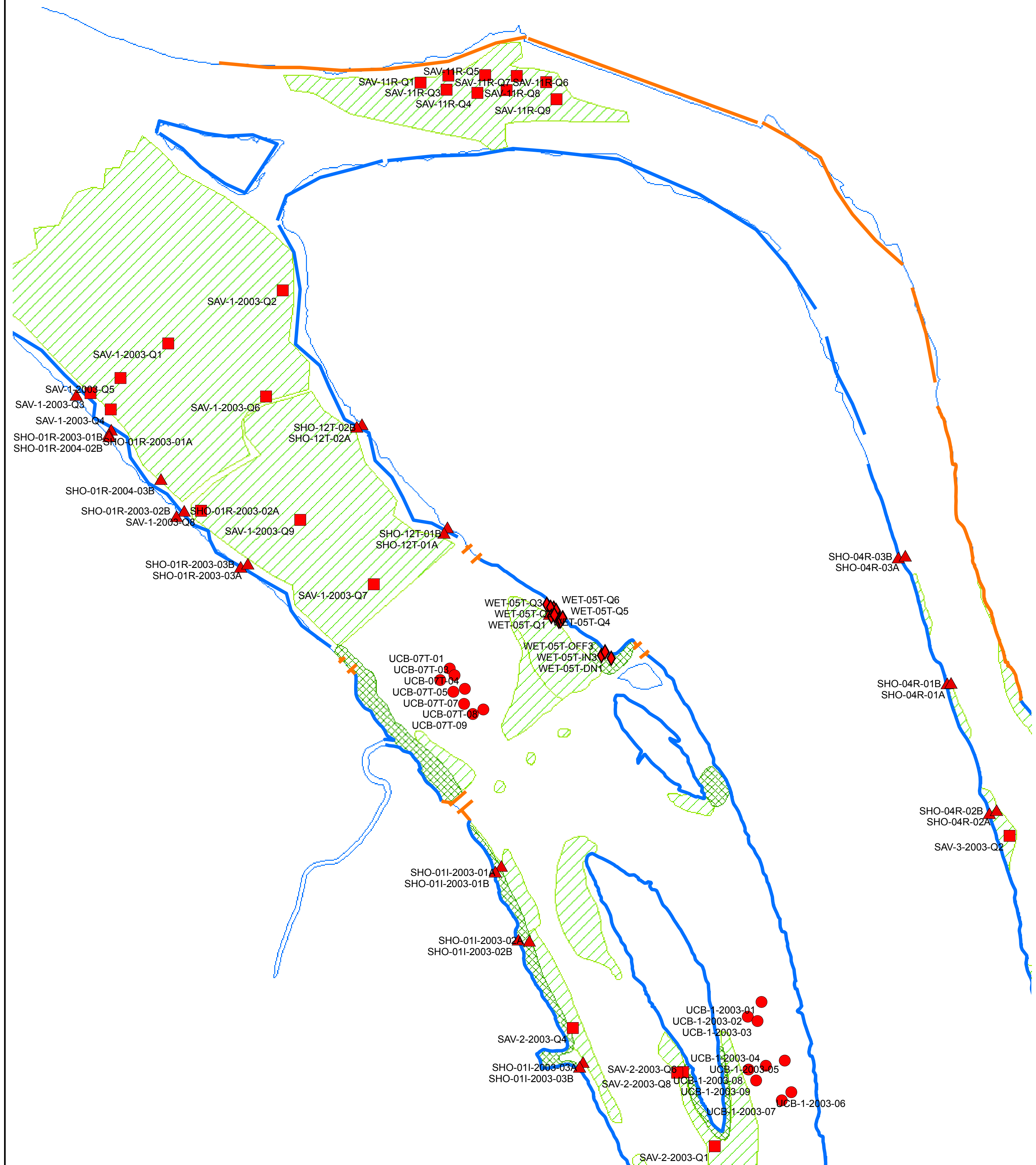
Focused Area



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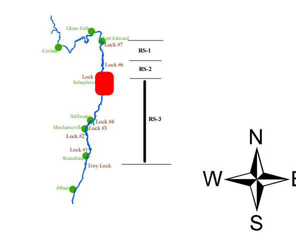
LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

General Electric Company
Hudson River Project

Figure A-2

Sampling Station Locations for Habitat Assessments 2003 through 2005

QEA Quantitative Environmental Analysis, LLC

GENhab

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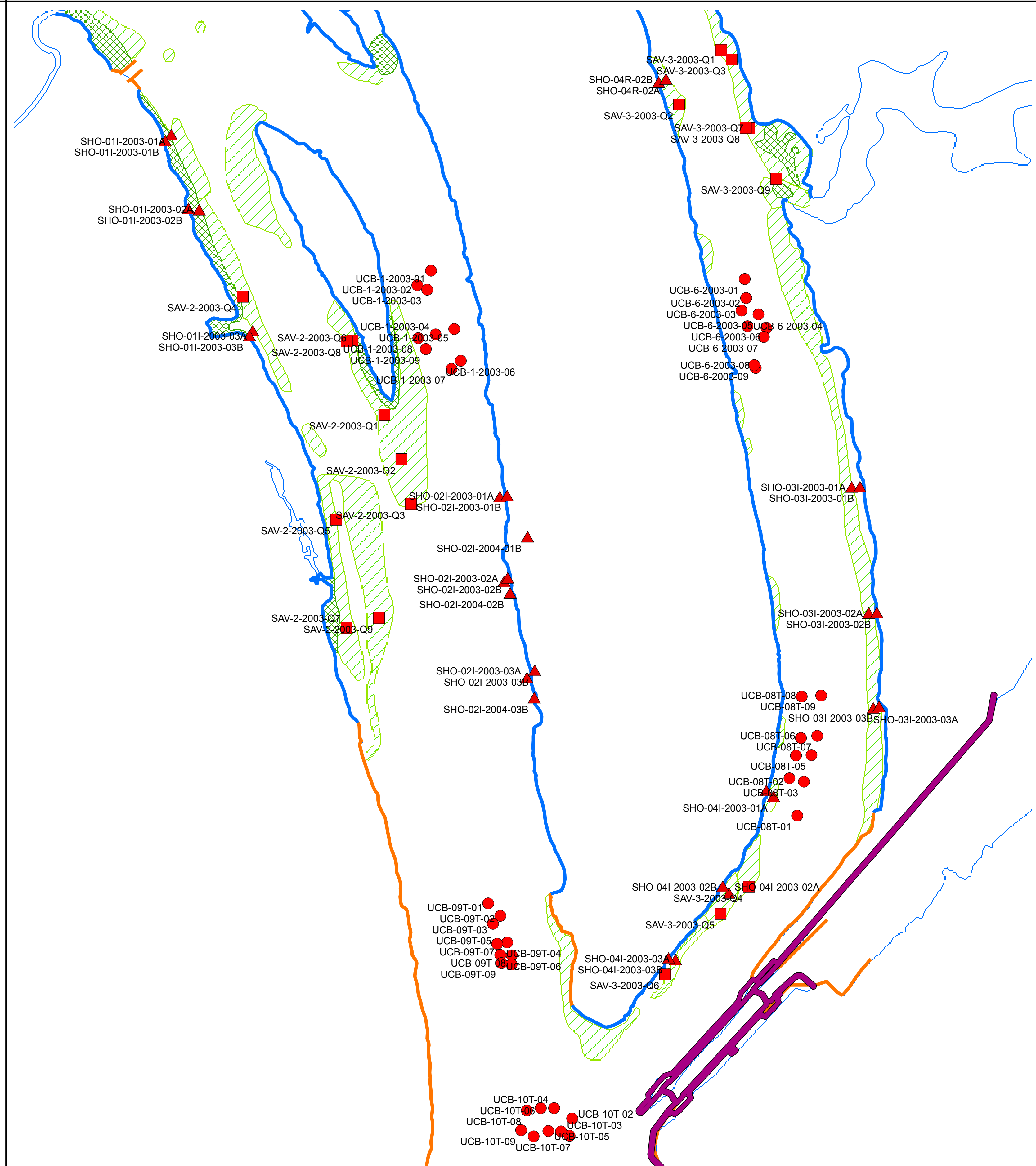
Overview

0 1,200 2,400 Feet

Focused Area



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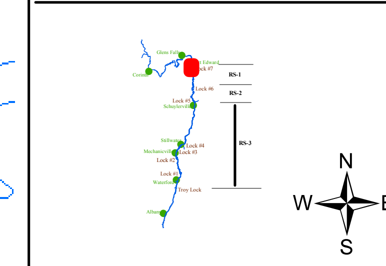
LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations
- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline
- Maintained Shore
- Natural Shore

SSS Sediment Types
- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey
- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

General Electric Company
Hudson River Project

Figure A-3

Sampling Station Locations for Habitat Assessments 2003 through 2005

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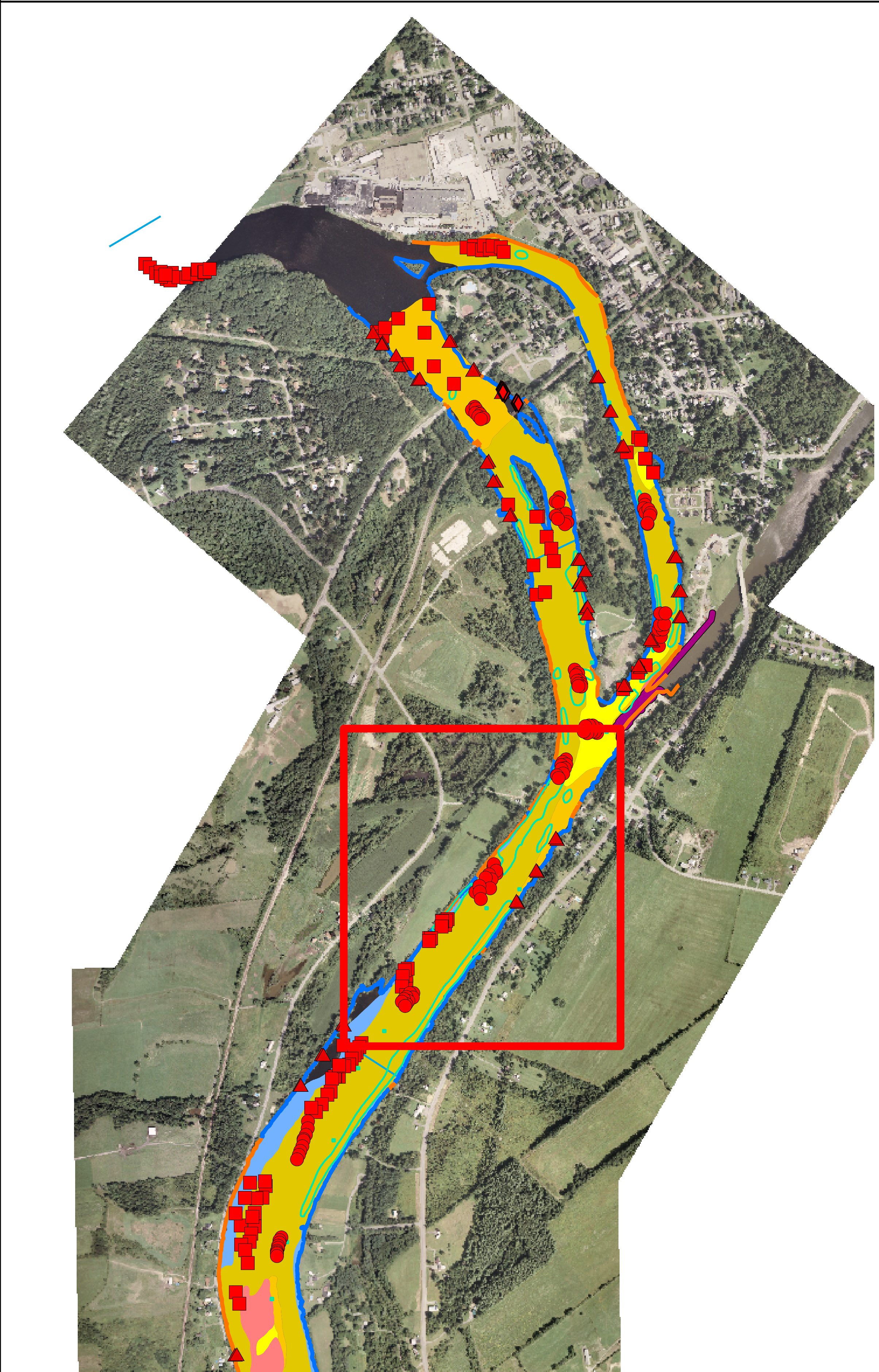
Overview



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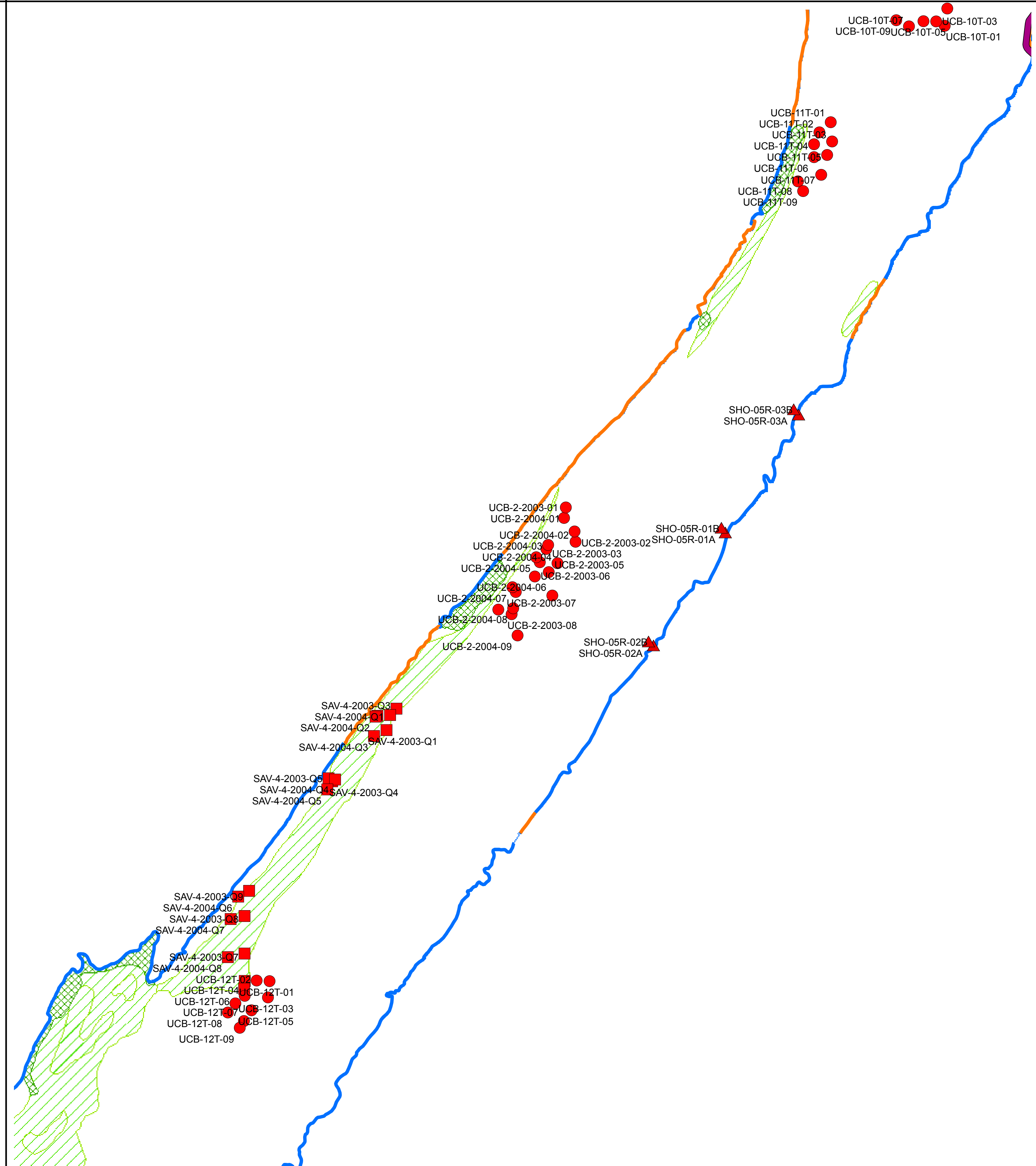
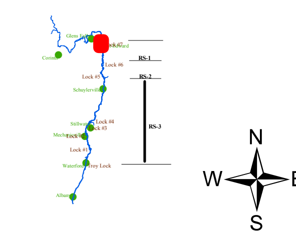


LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Figure A-4

Sampling Station Locations for Habitat Assessments 2003 through 2005

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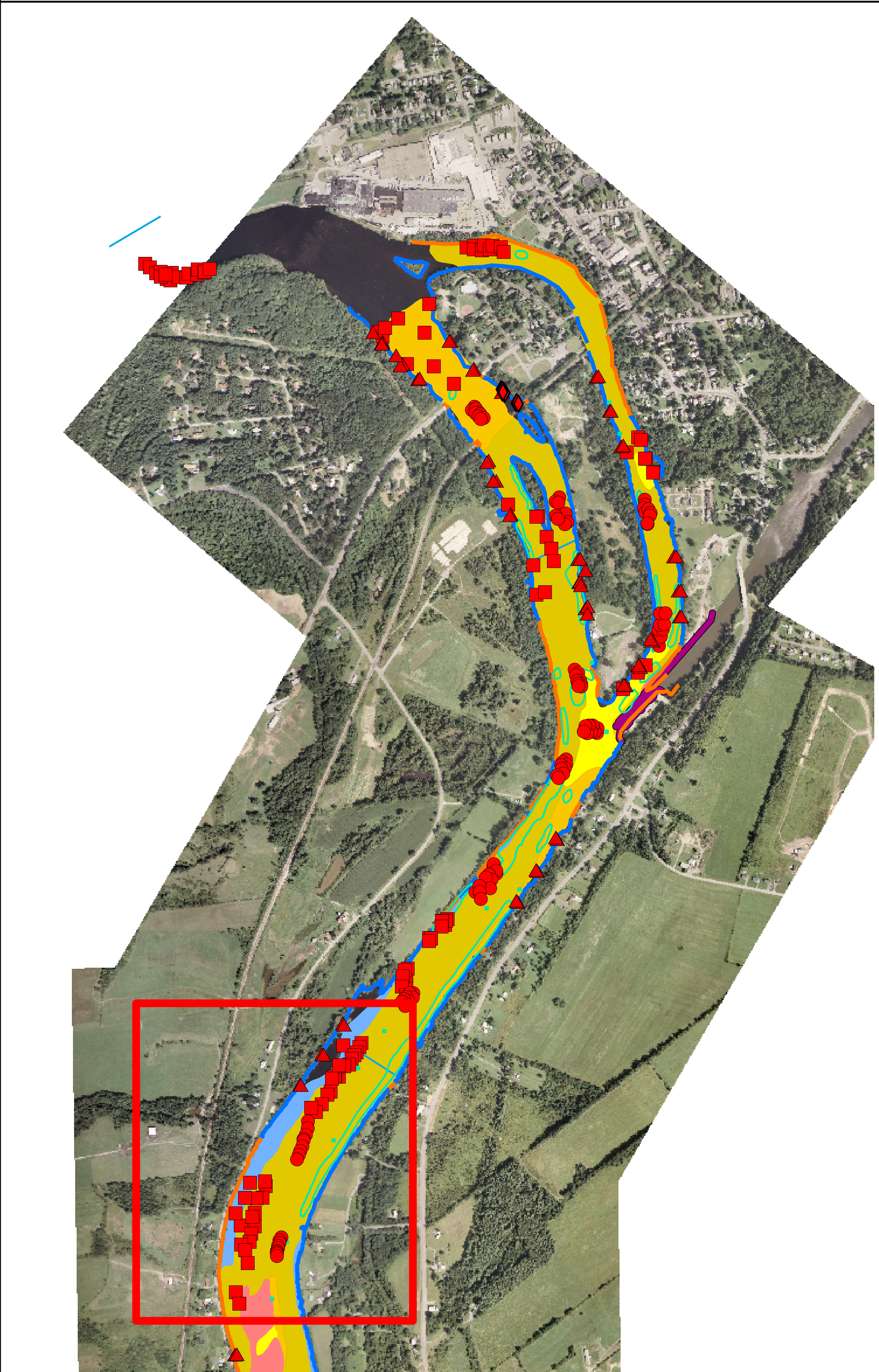
Overview	Focused Area



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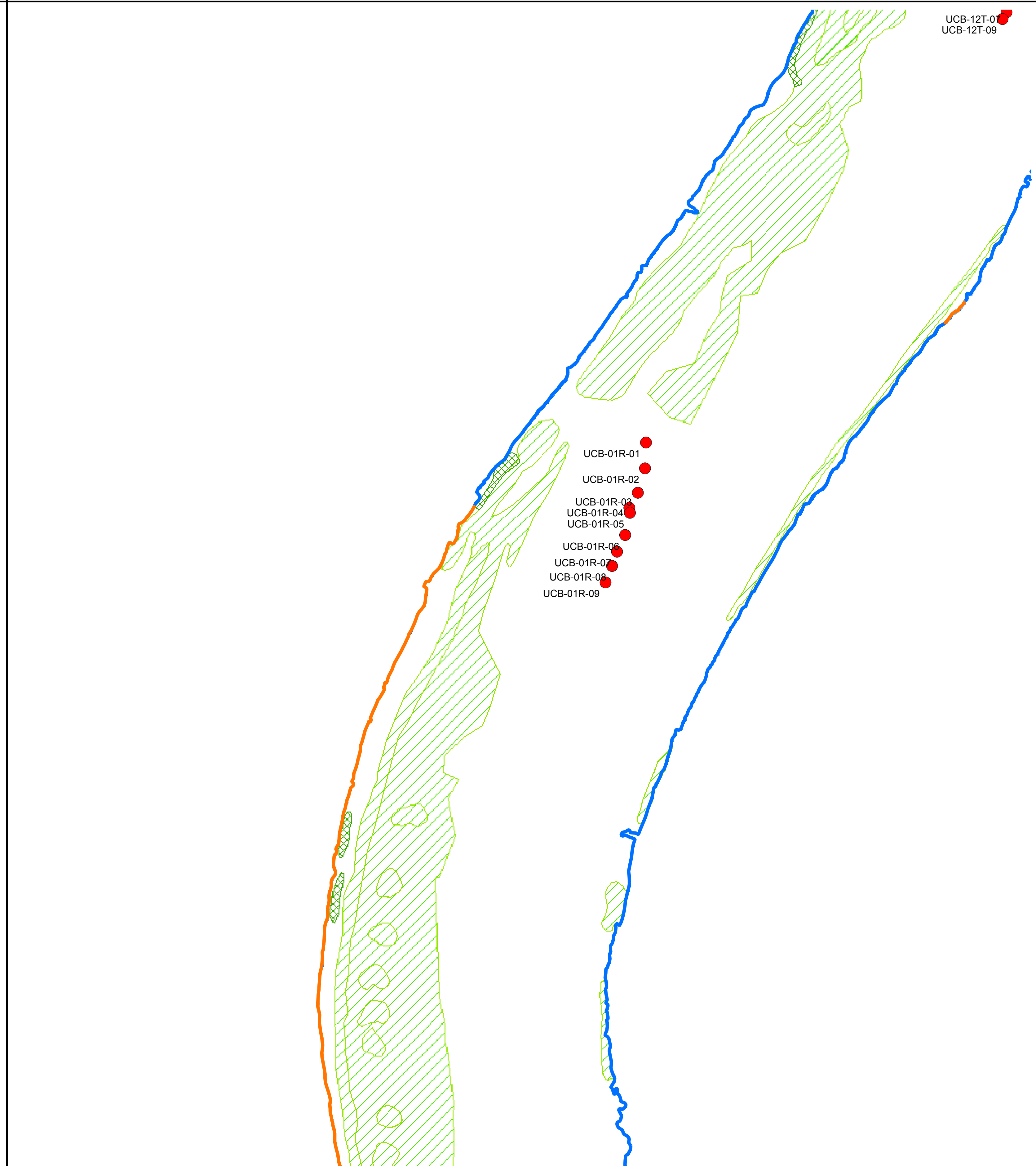

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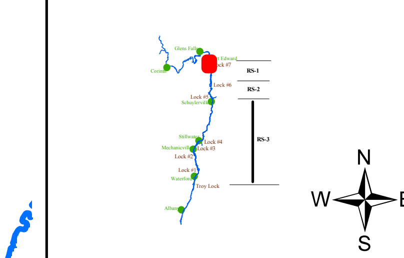
LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

General Electric Company
Hudson River Project

Figure A-5

Sampling Station Locations for Habitat Assessments 2003 through 2005

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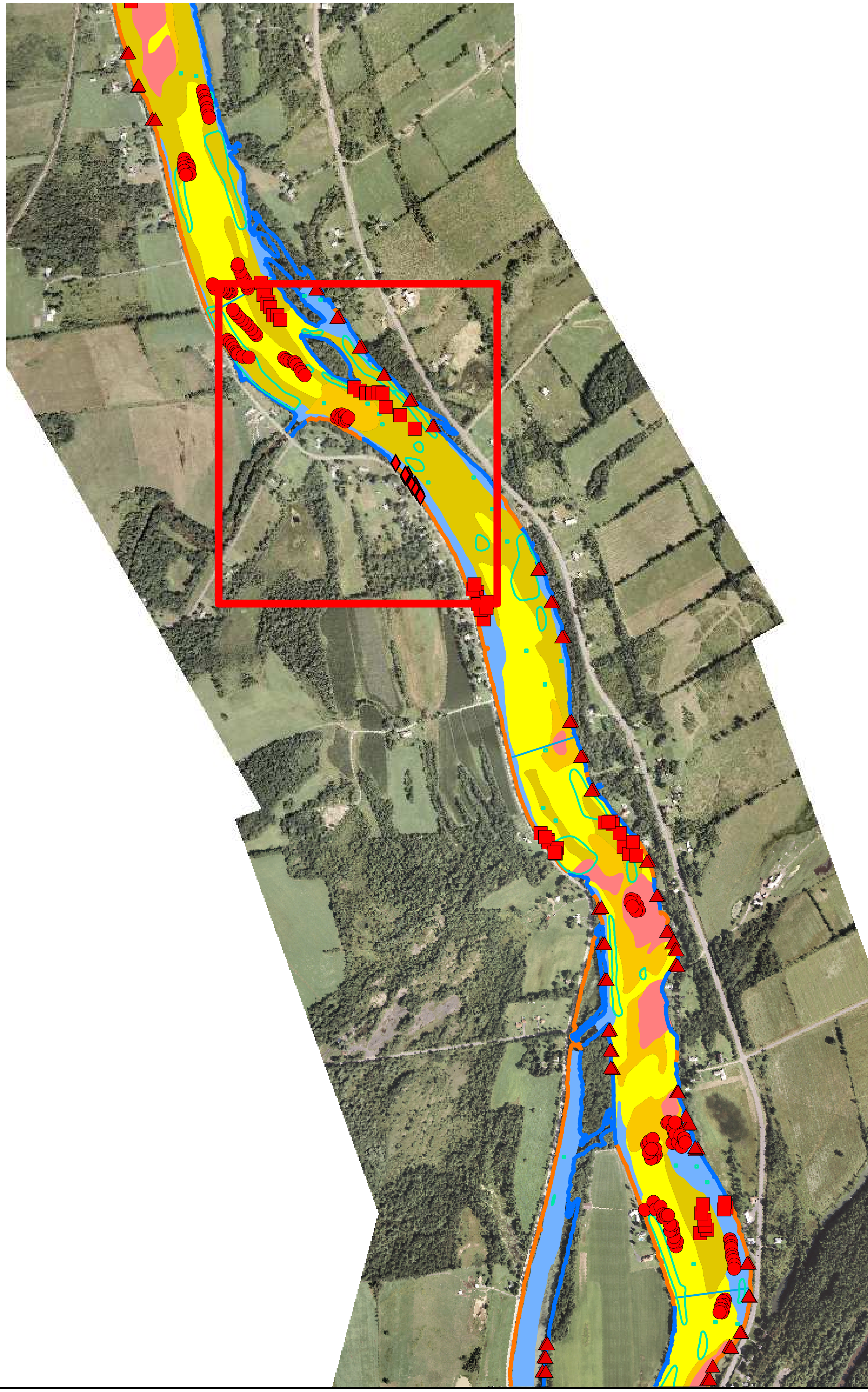
Overview



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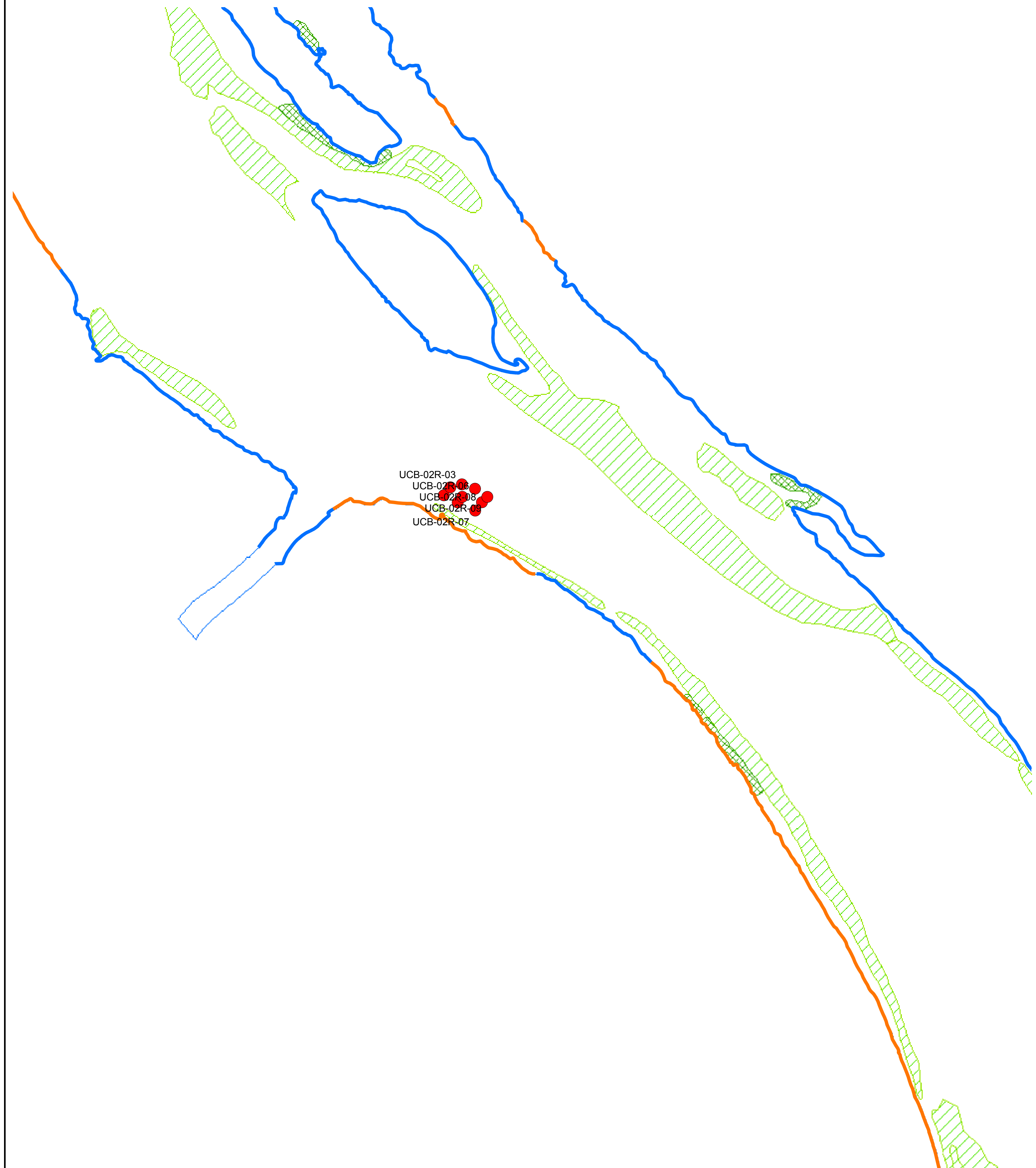
Focused Area



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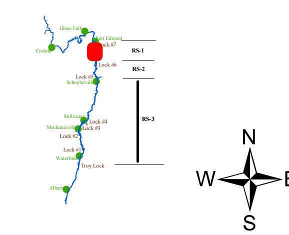
LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

General Electric Company
Hudson River Project

Figure A-6

Sampling Station Locations for Habitat Assessments 2003 through 2005

GENhab Mar 2006

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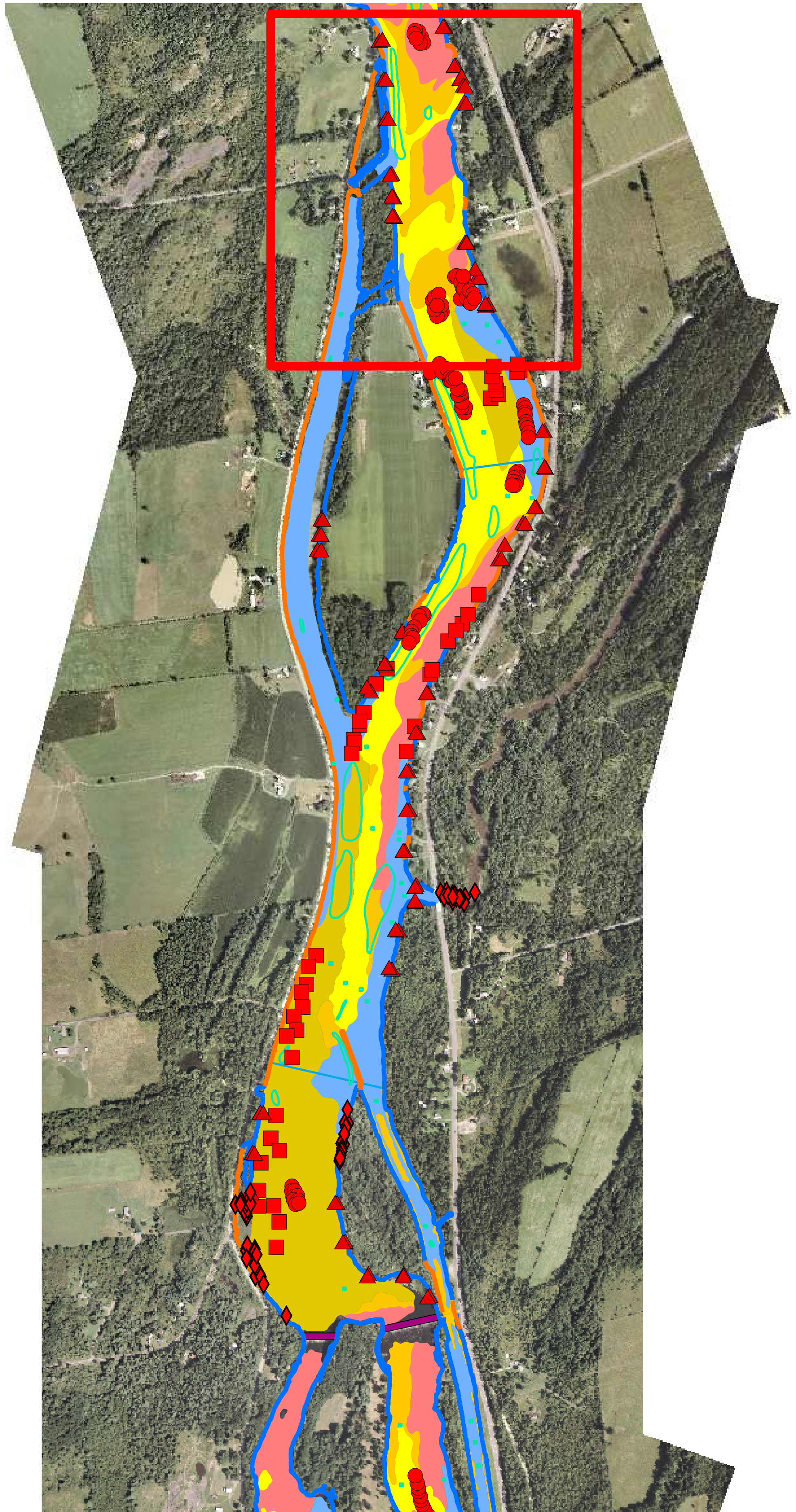
Overview



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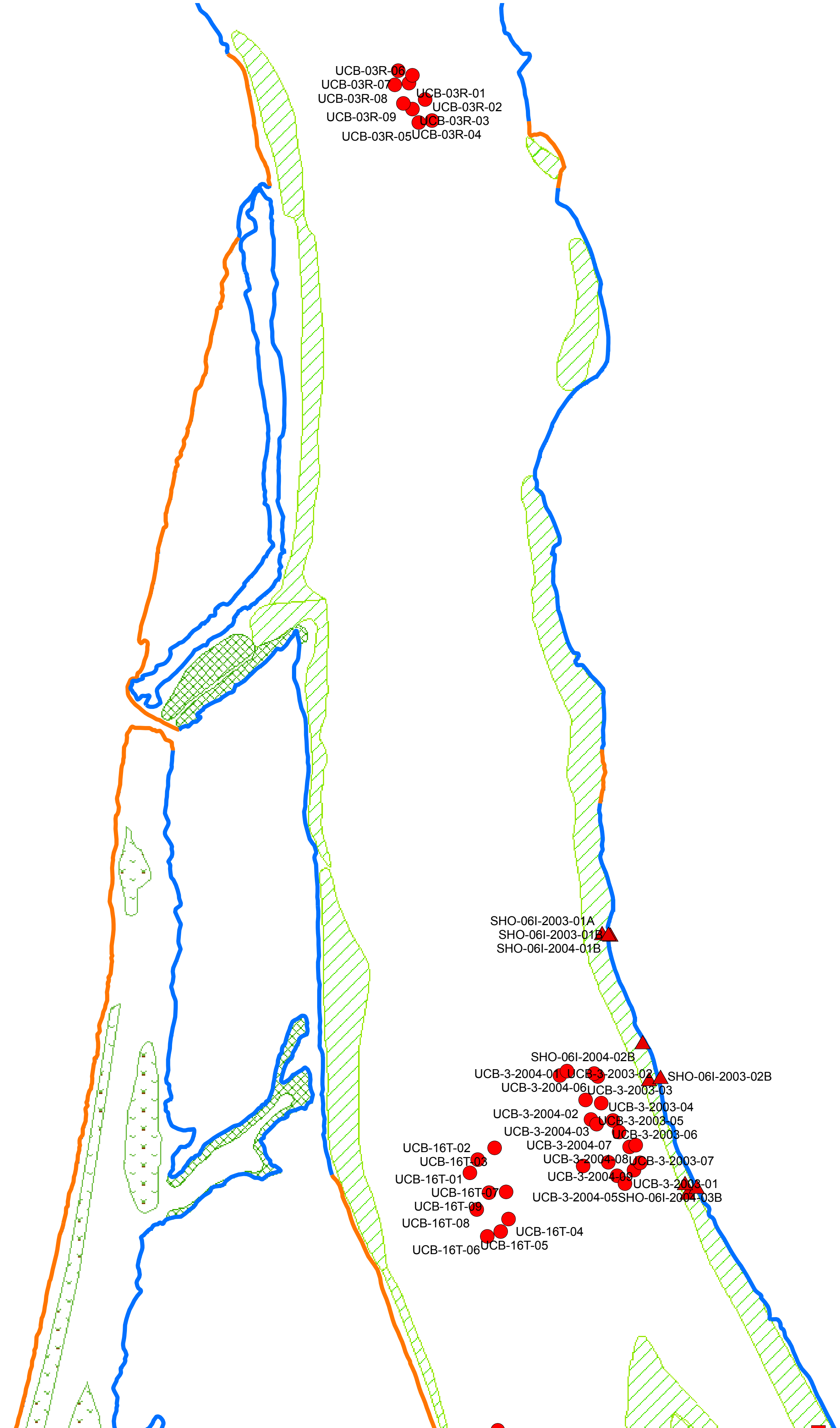
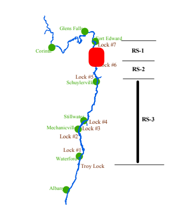
Focused Area



0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



N E S W

LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Figure A-7

Sampling Station Locations for Habitat Assessments 2003 through 2005

QEA Quantitative Environmental Analysis, LLC

GENhab

Mar 2006

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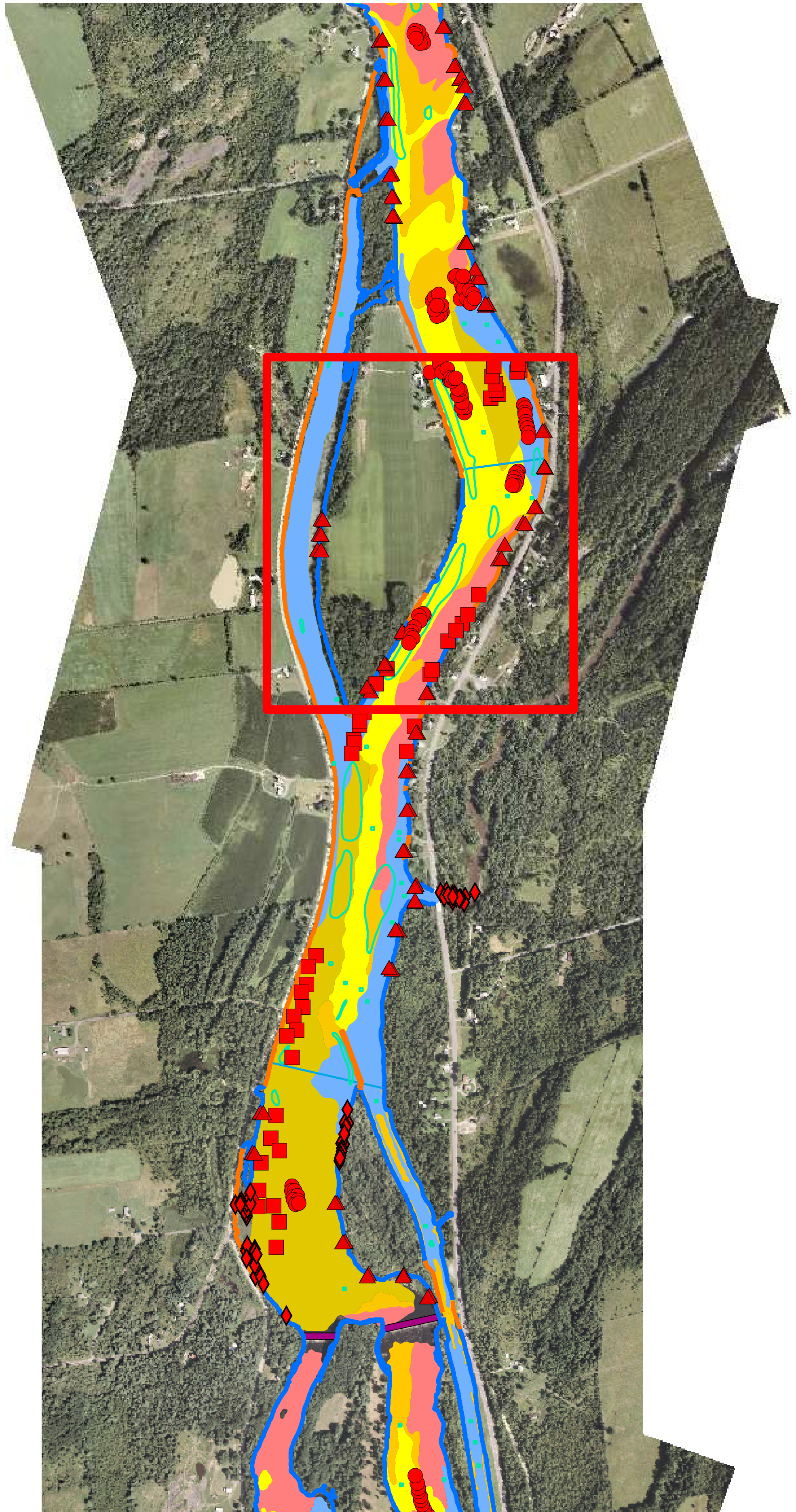
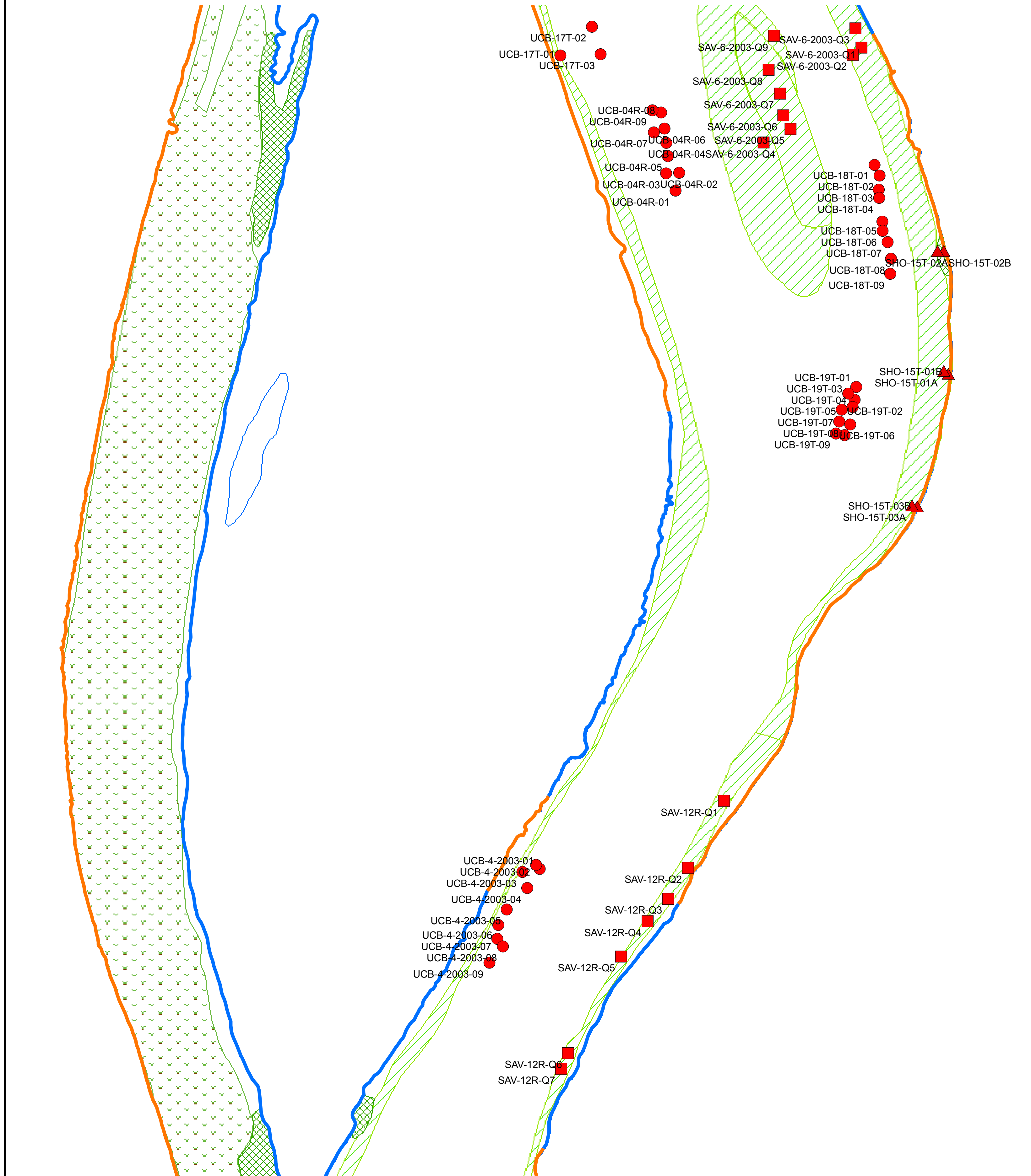
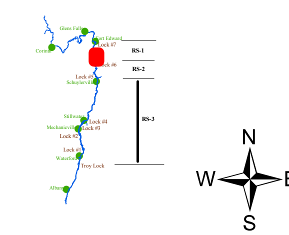
Overview



Focused Area



LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

General Electric Company
Hudson River Project

Figure A-8

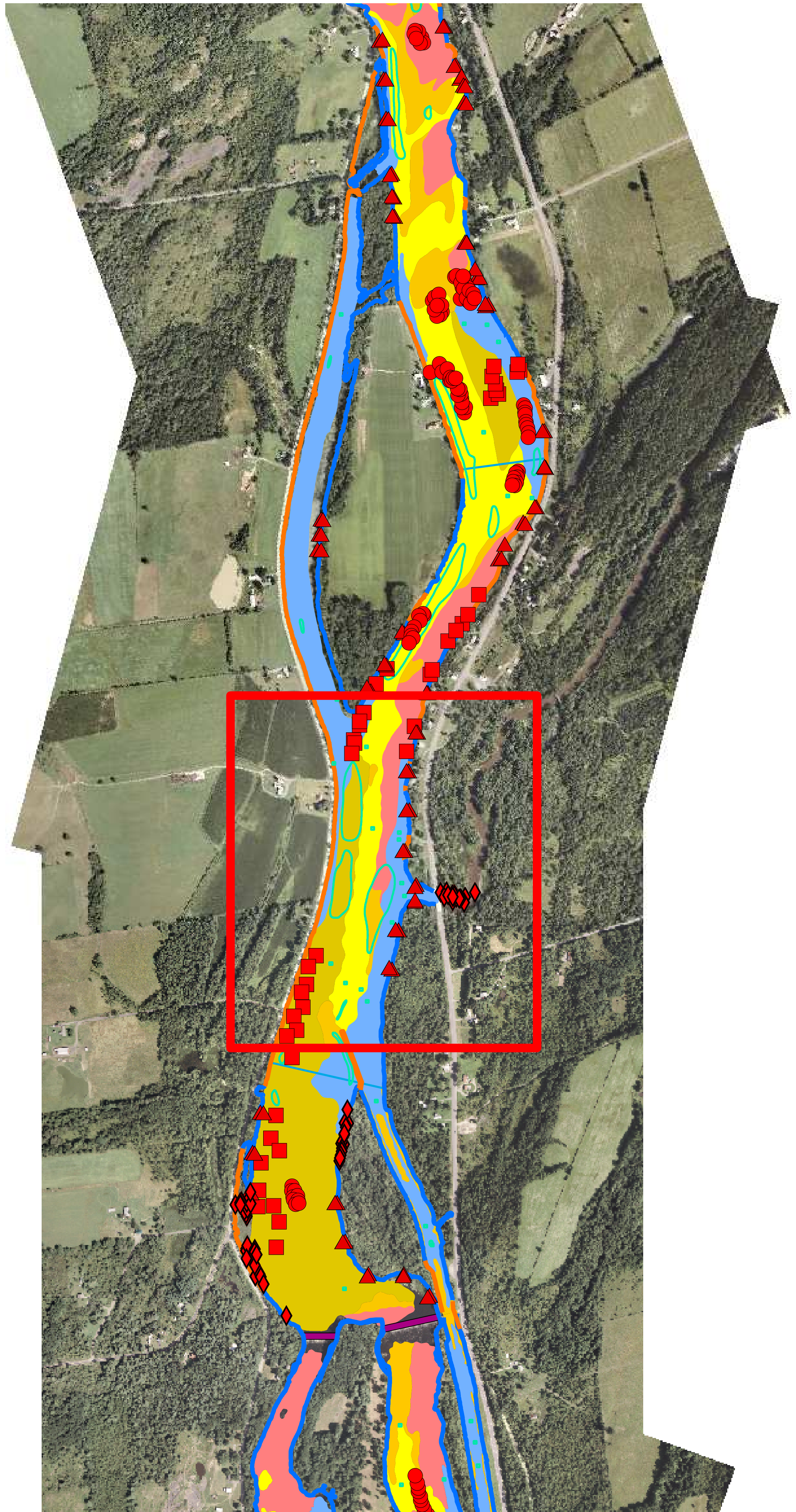
Sampling Station Locations for Habitat Assessments 2003 through 2005

GENhab

Mar 2006

CCY - \\ALGONQUIN\E_Drive\GENrem\WORKING\GIS\maps\ARCGIS8_maps\Habitat\11x17_Assessment_Maps_20060216

Overview

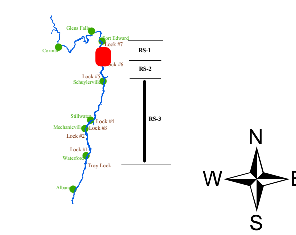


0 1,200 2,400 Feet

Focused Area

0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

General Electric Company
Hudson River Project

Figure A-9

Sampling Station Locations for Habitat Assessments 2003 through 2005

QEA Quantitative Environmental Analysis, LLC

GENhab

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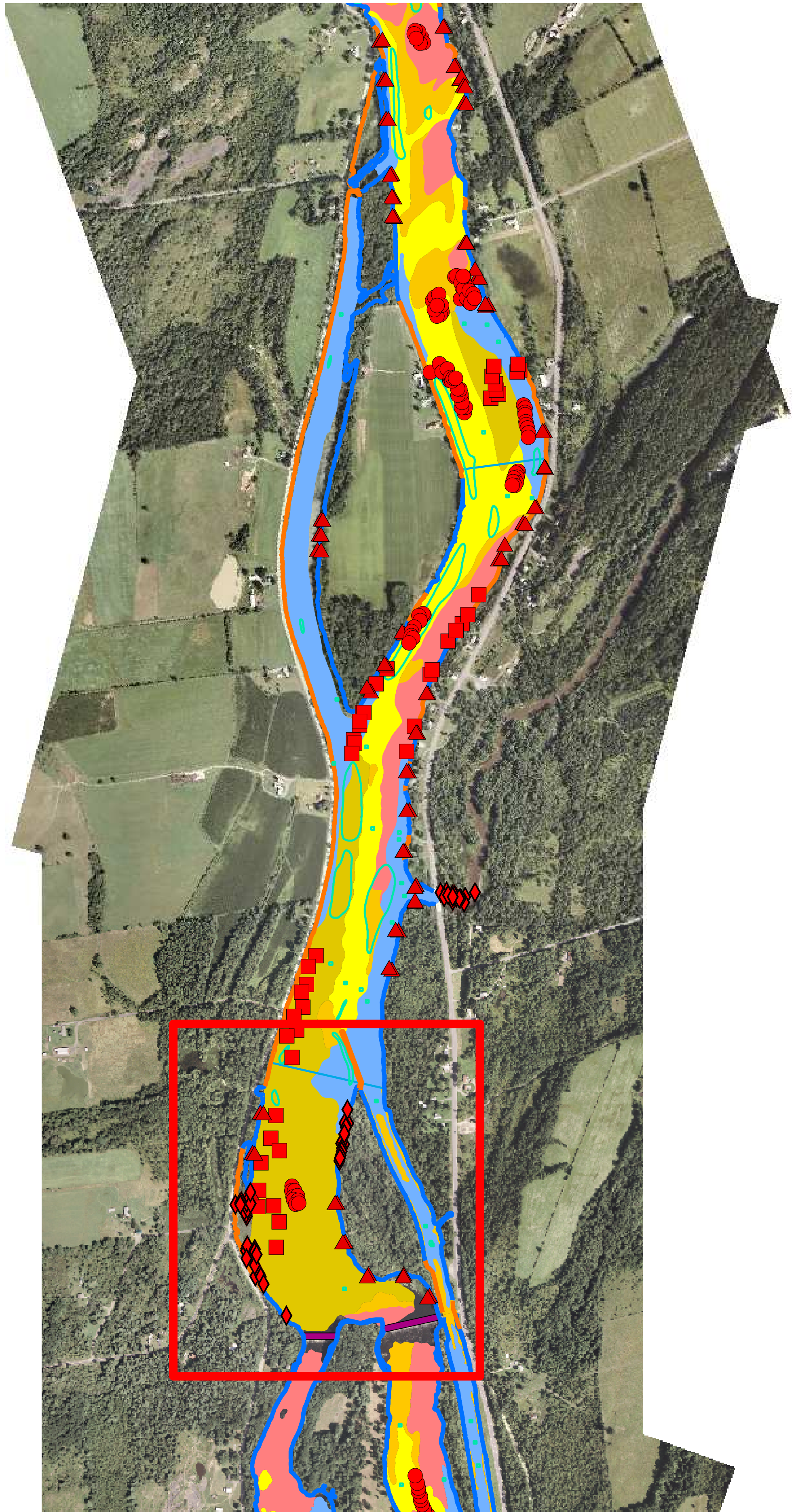
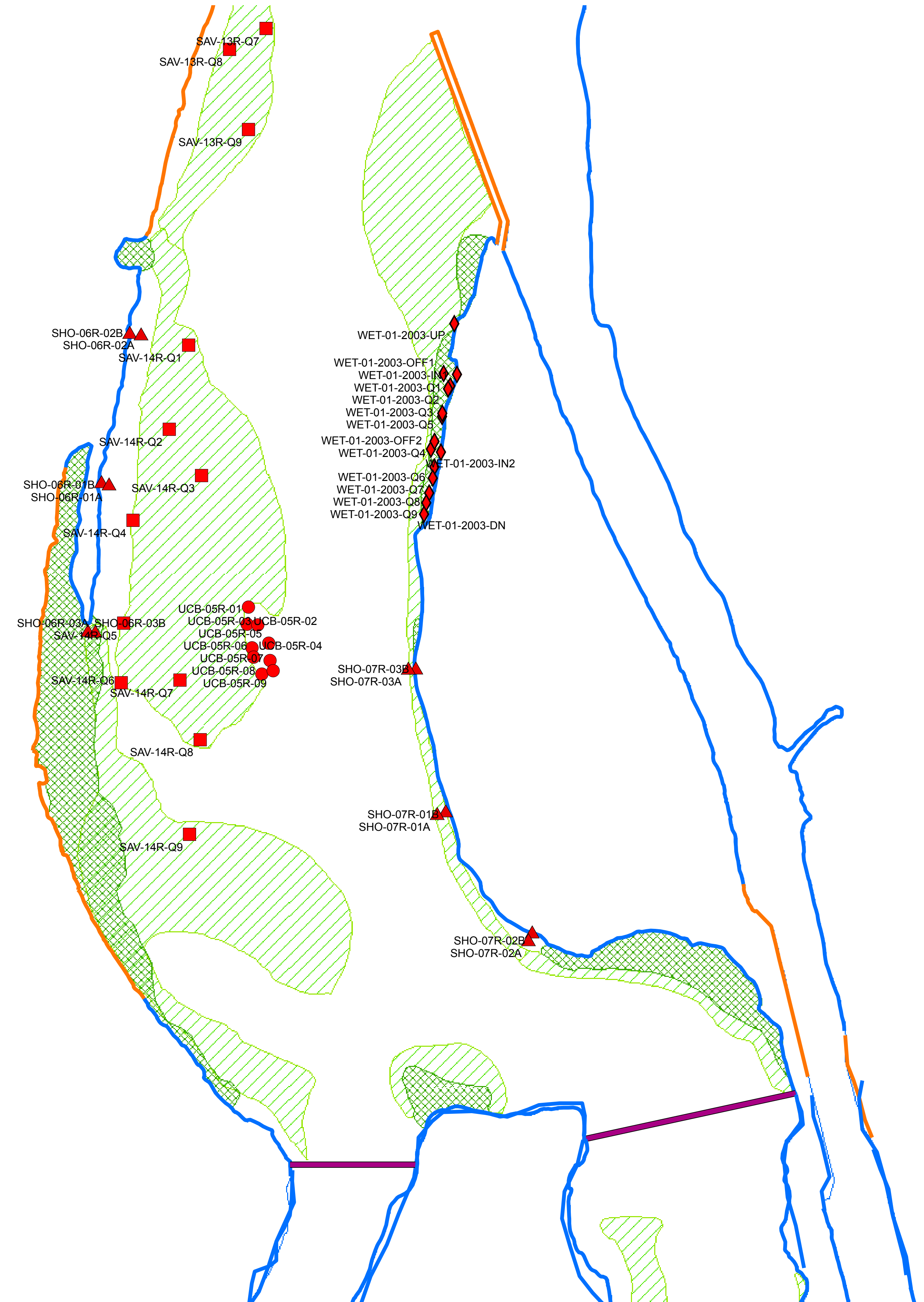
Overview



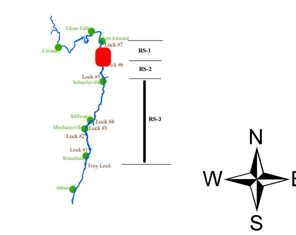
0 1,200 2,400 Feet

Focused Area



0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

General Electric Company
Hudson River Project

Figure A-10

Sampling Station Locations for Habitat Assessments 2003 through 2005

QEA Quantitative Environmental Analysis, LLC

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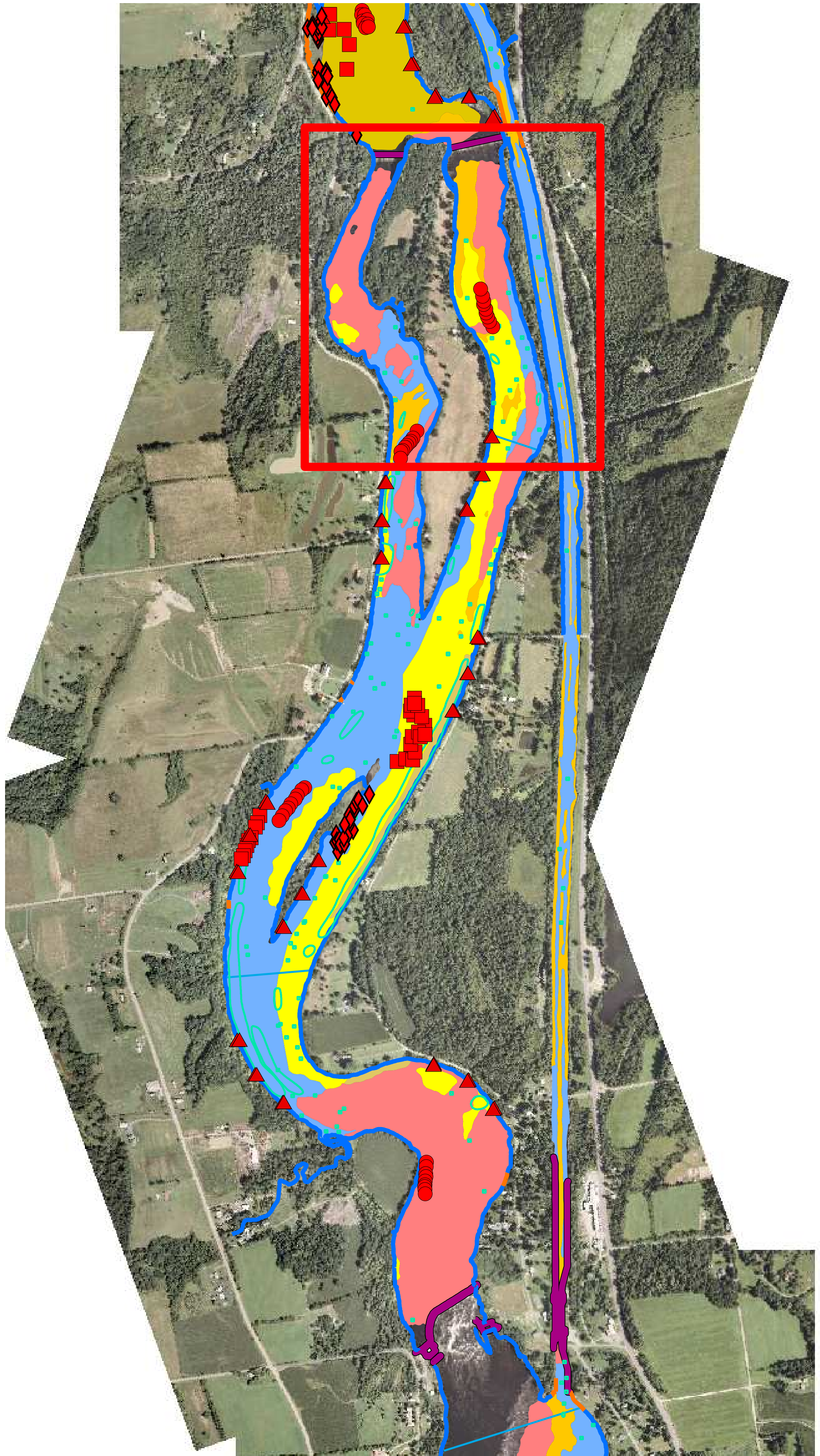
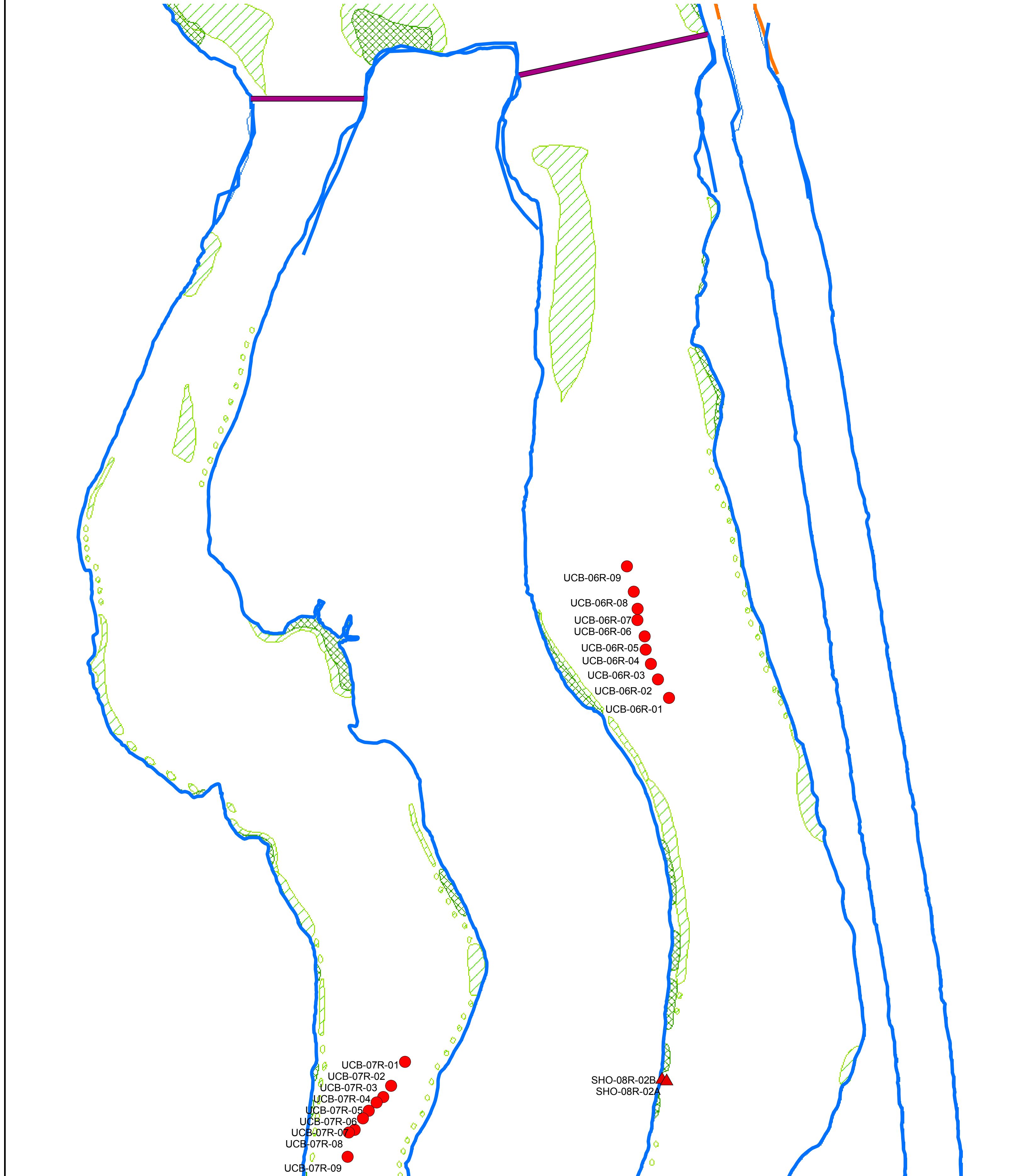
Overview



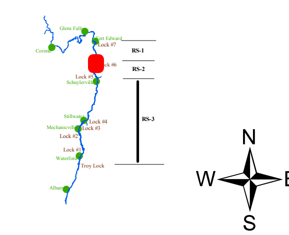
0 1,200 2,400 Feet

Focused Area



0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations
- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline
- Maintained Shore
- Natural Shore

SSS Sediment Types
- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey
- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Figure A-11

Sampling Station Locations for Habitat Assessments 2003 through 2005

QEA Quantitative Environmental Analysis, LLC

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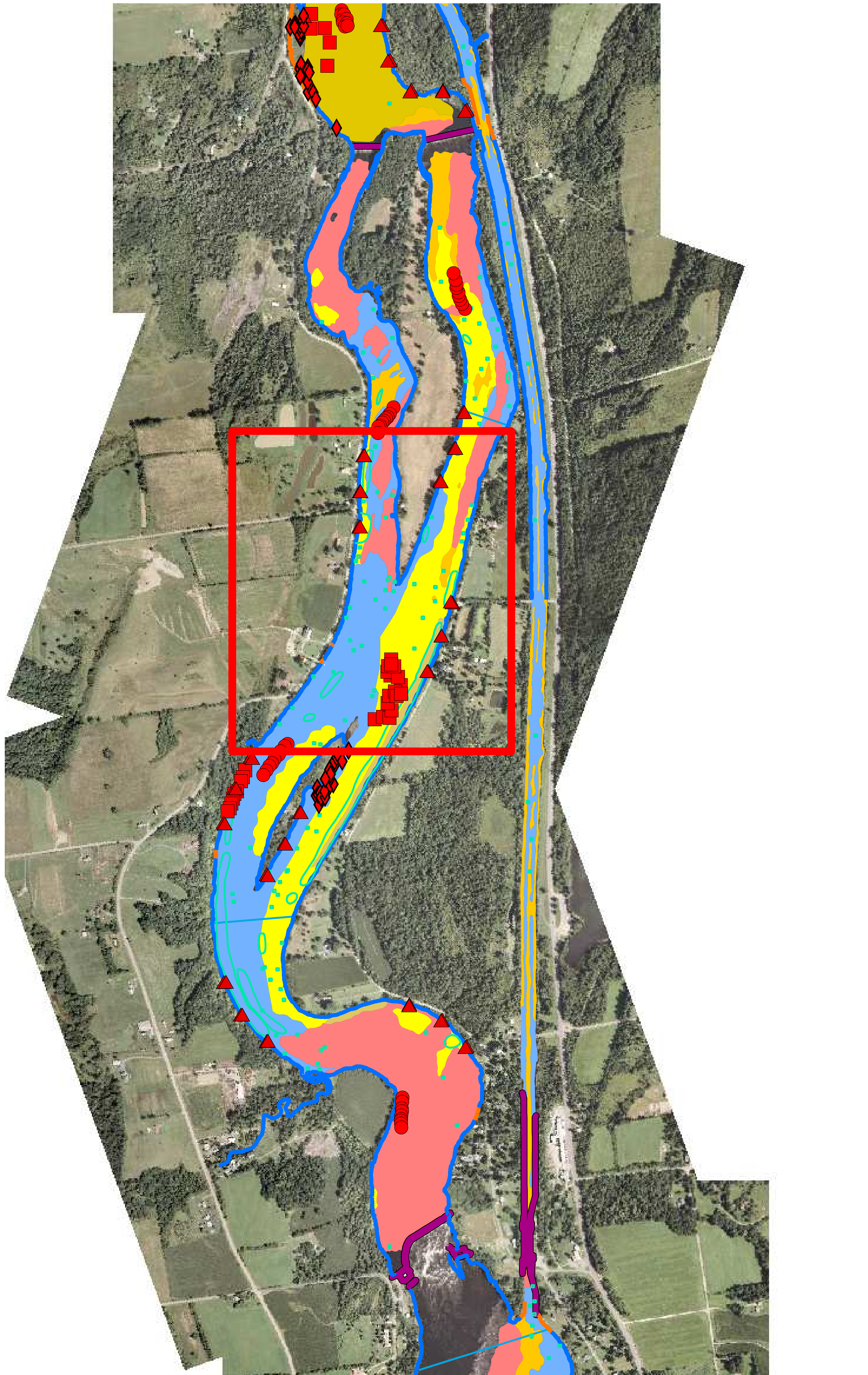
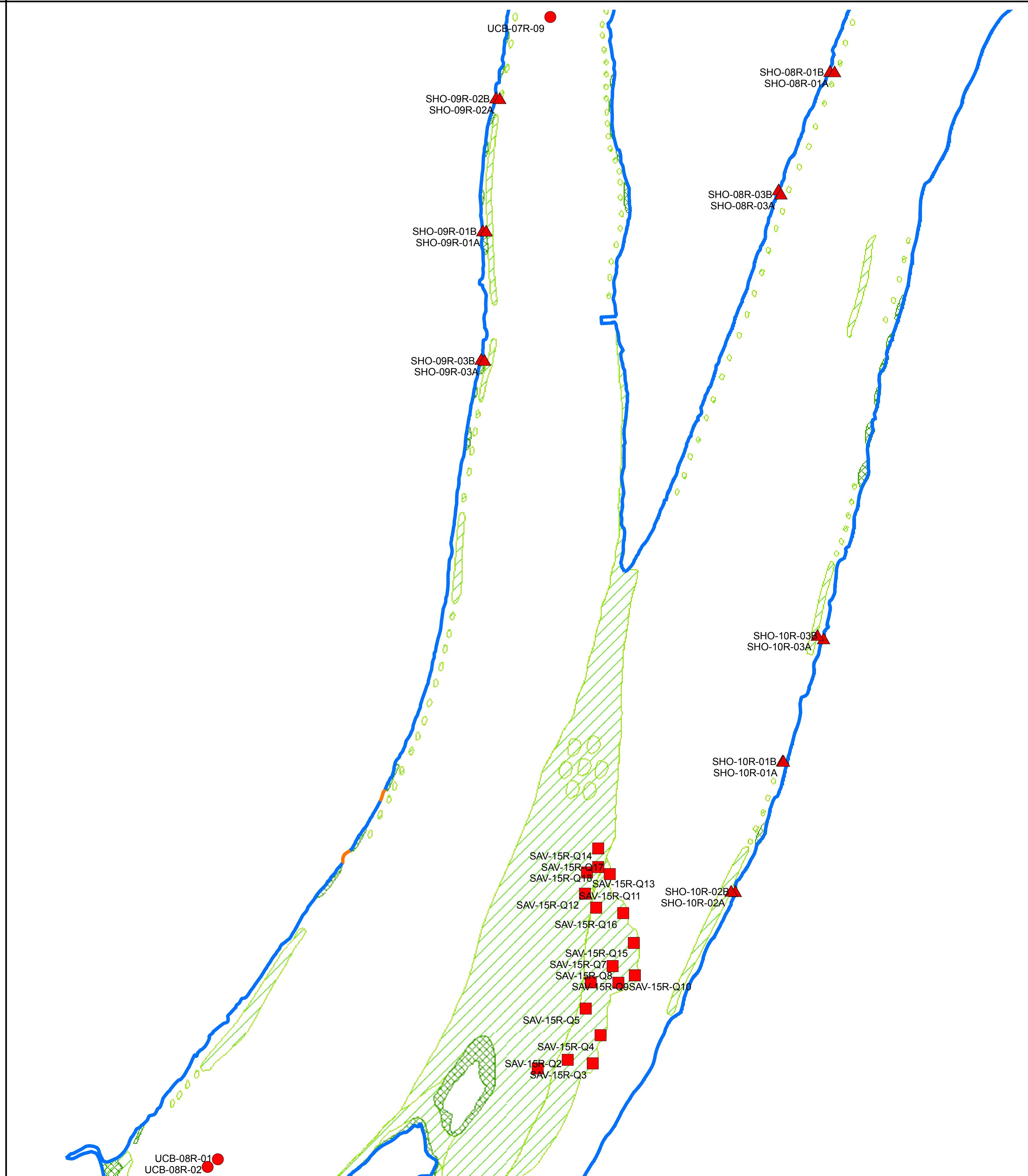
CCY - \\ALGONQUIN\E_Drive\GENrem\WORKING\GIS\maps\ARCGIS8_maps\Habitat\11x17_Assessment_Maps_20060216

Overview



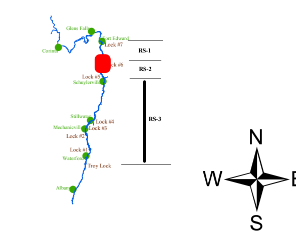
0 1,200 2,400 Feet

Focused Area



0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Hudson River Project

Figure A-12

Sampling Station Locations for Habitat Assessments 2003 through 2005

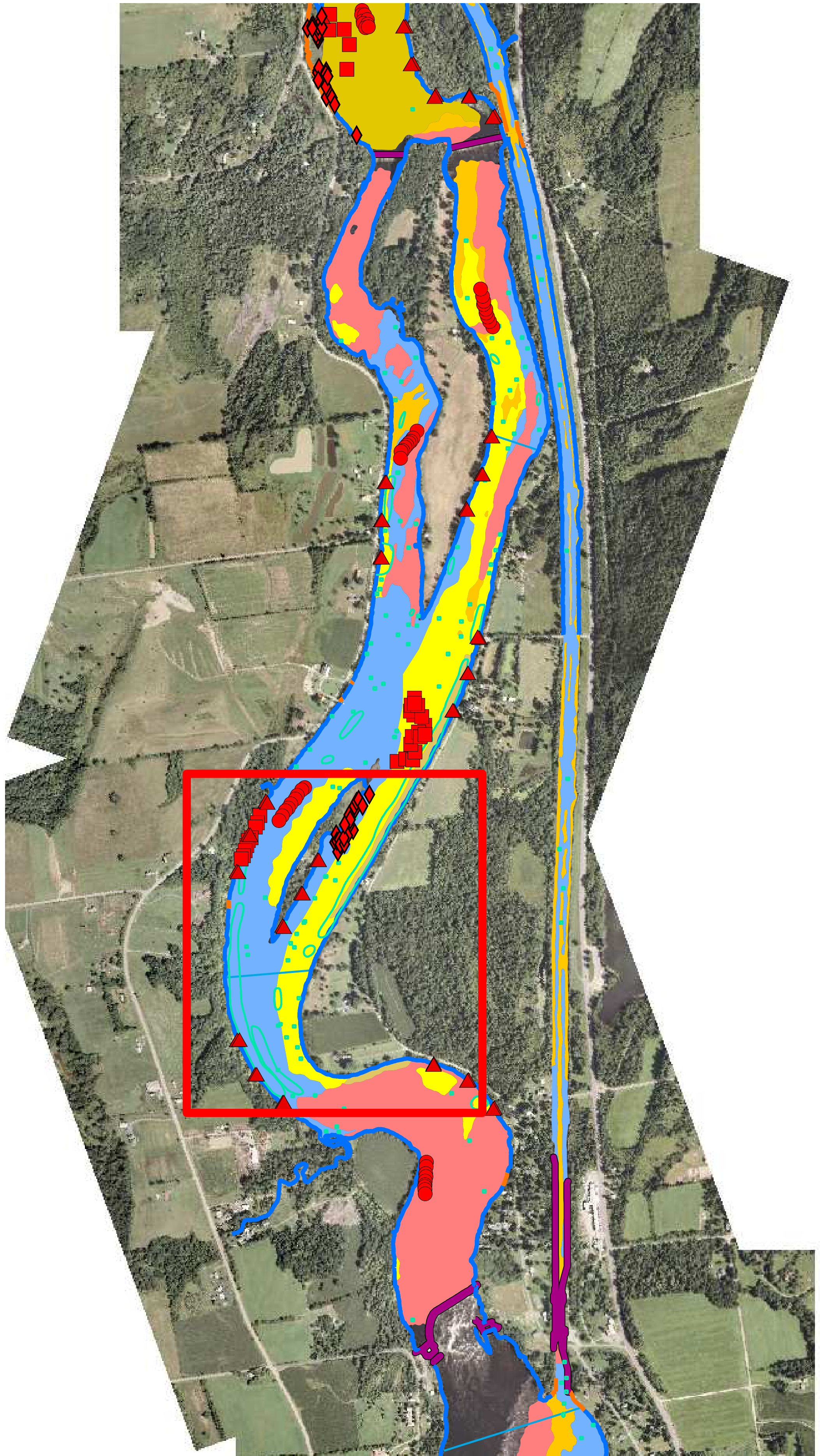
QEA Quantitative Environmental Analysis, LLC

GENhab

Mar 2006

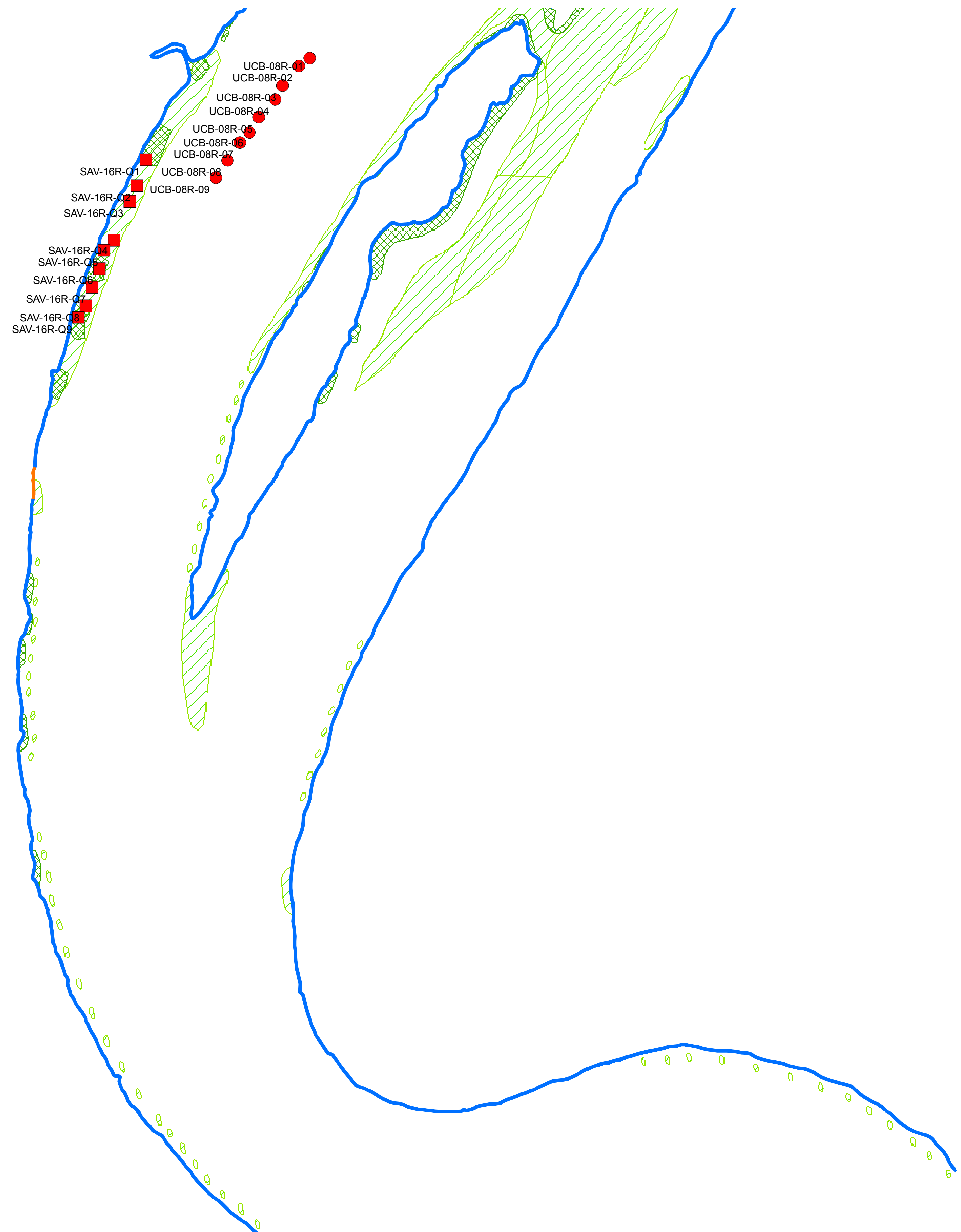
CCY - \\ALGONQUIN\E_Drive\GENrem\WORKING\GIS\maps\ARCGIS8_maps\Habitat\11x17_Assessment_Maps_20060216

Overview



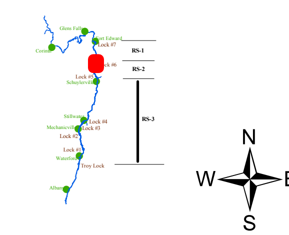
0 1,200 2,400 Feet

Focused Area



0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

General Electric Company
Hudson River Project

Figure A-13

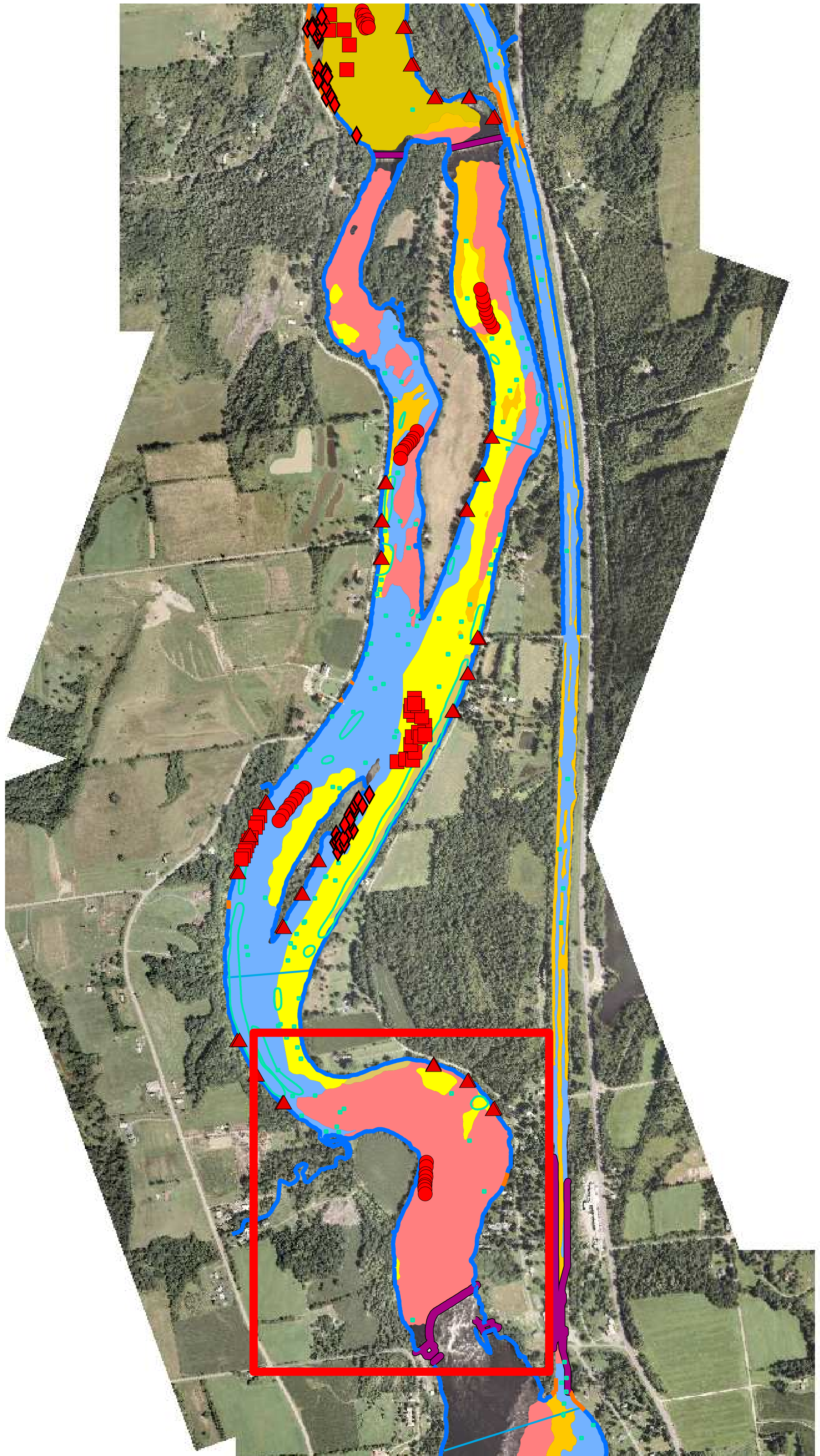
Sampling Station Locations for Habitat Assessments 2003 through 2005

QEA Quantitative Environmental Analysis, LLC

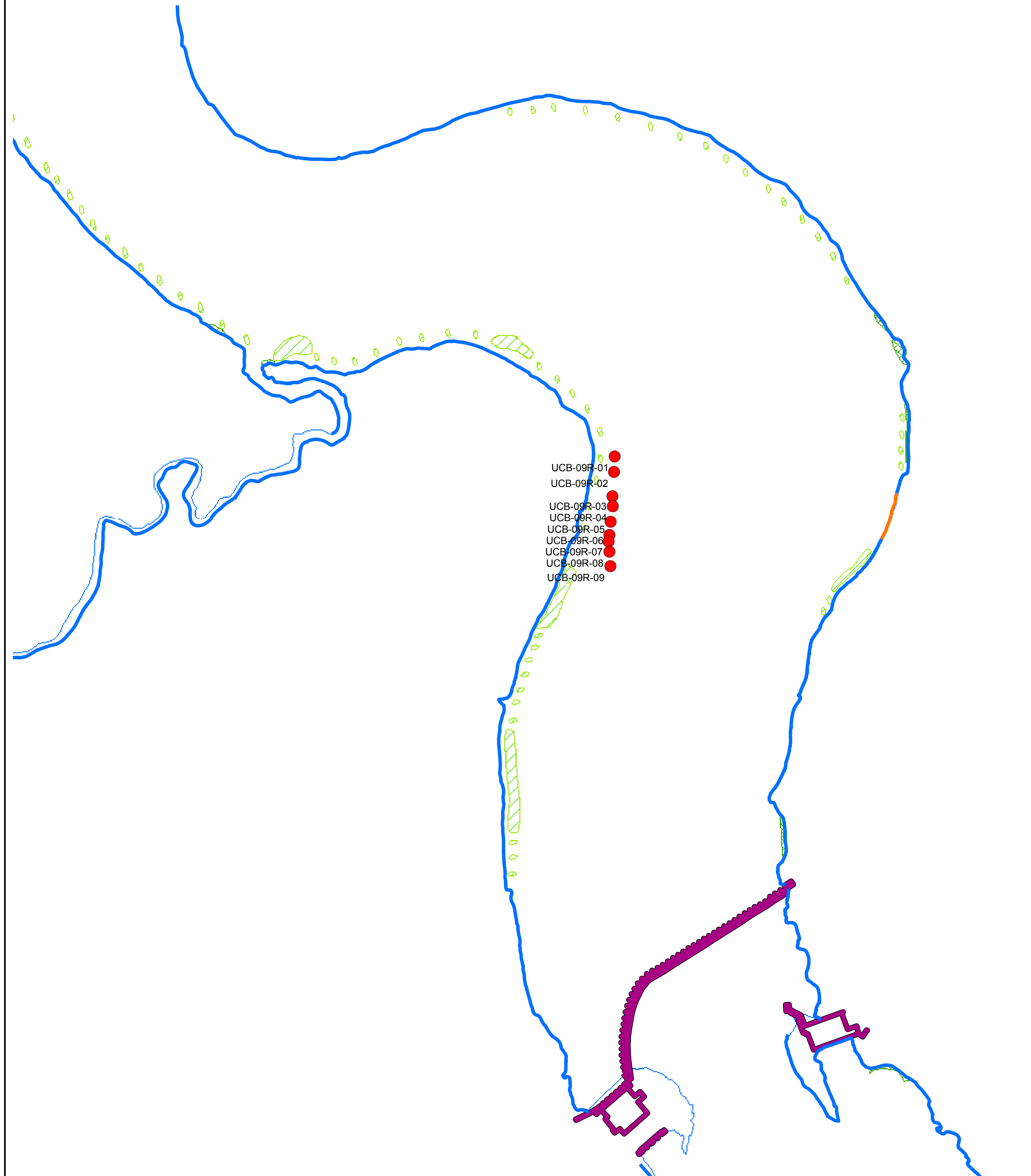
GENhab **Mar 2006**

CCY - \\ALGONQUIN\E_Drive\GENrem\WORKING\GIS\maps\ARCGIS8_maps\Habitat\11x17_Assessment_Maps_20060216

Overview	Focused Area

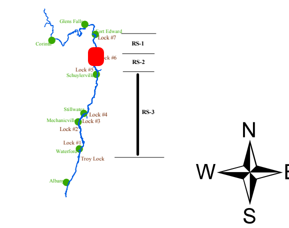


0 1,200 2,400 Feet



0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

General Electric Company
Hudson River Project

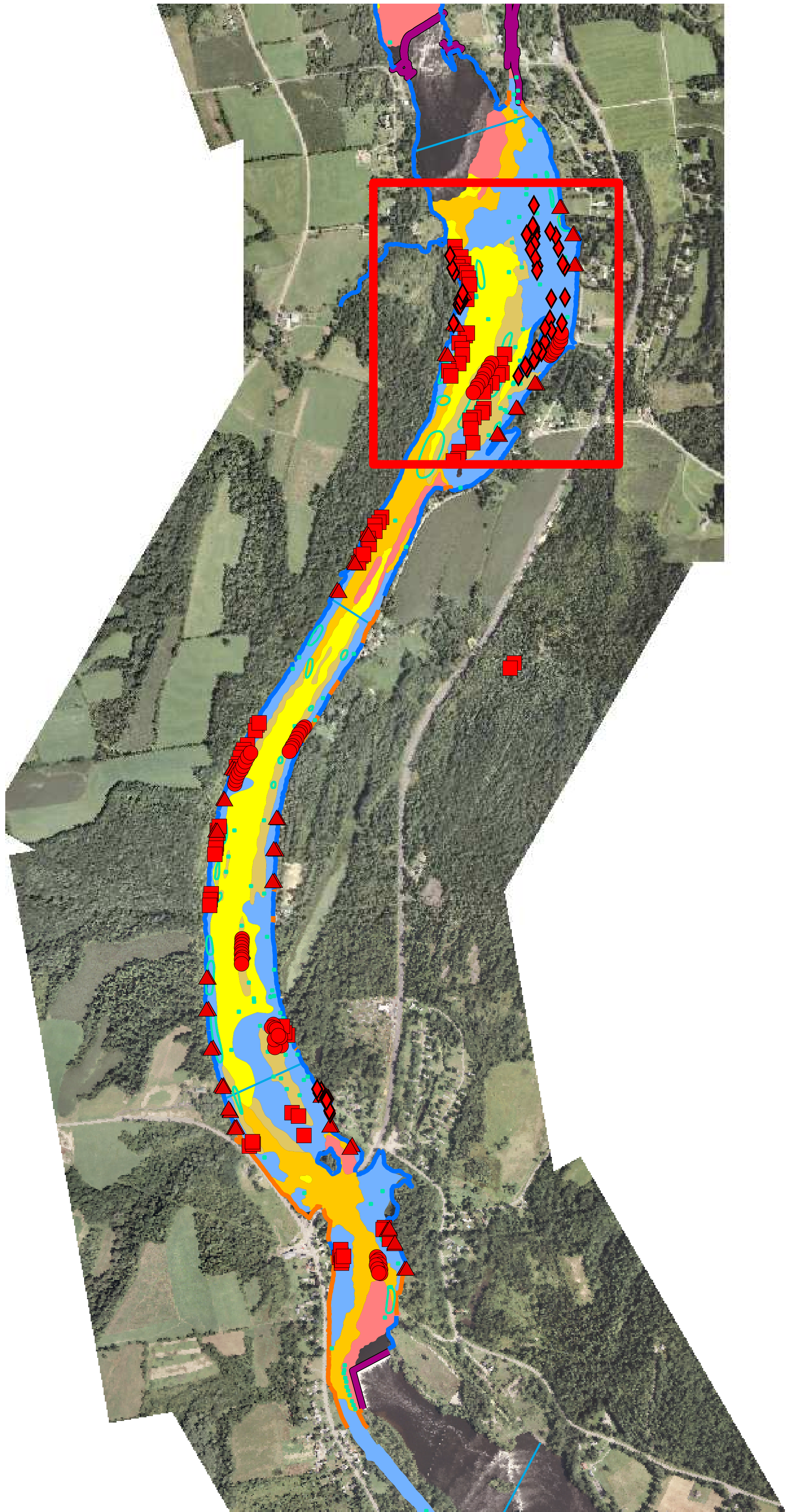
Figure A-14

Sampling Station Locations for Habitat Assessments 2003 through 2005

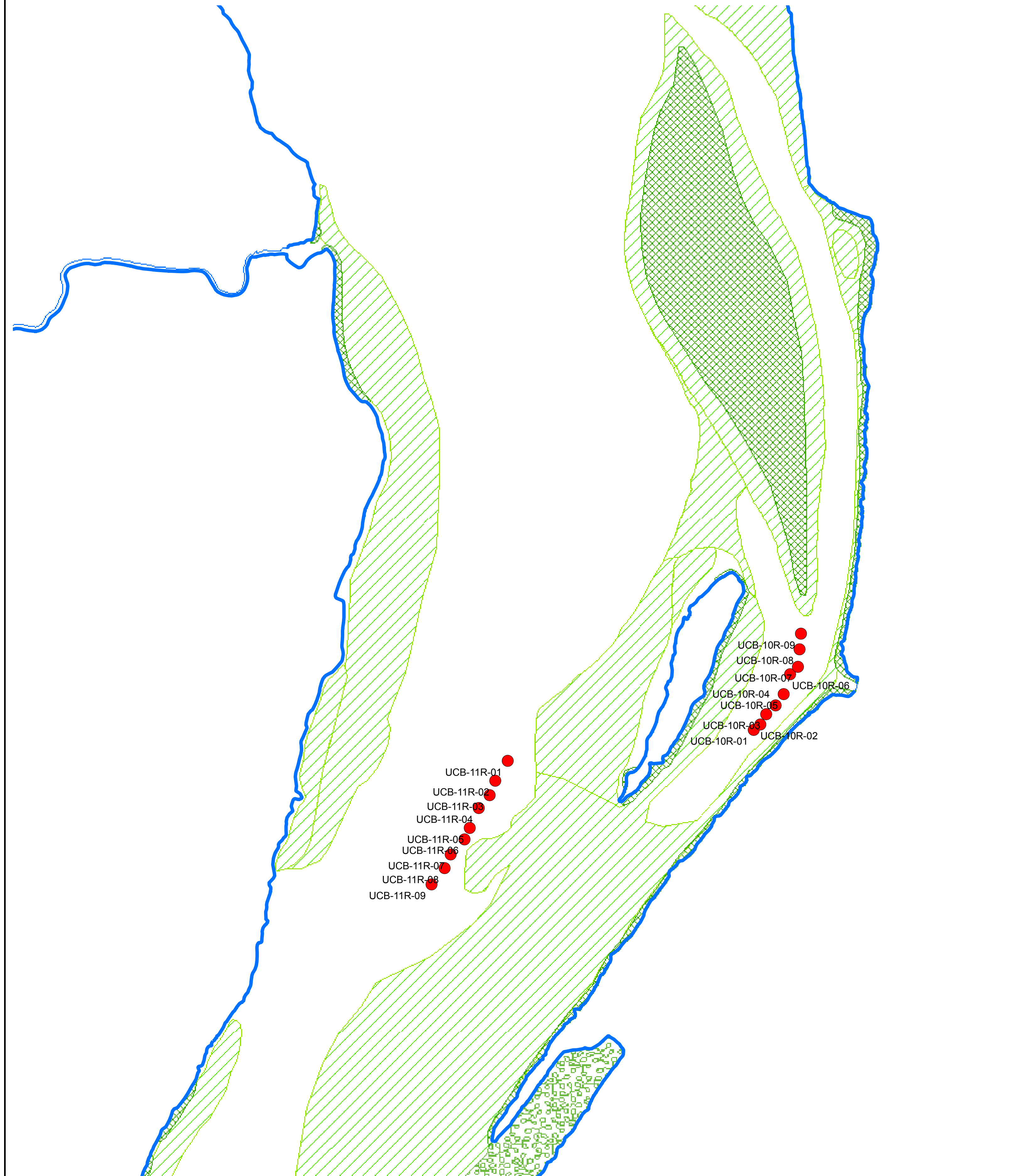
GENhab Mar 2006

CCY - \\ALGONQUIN\E_Drive\GENrem\WORKING\GIS\maps\ARCGIS8_maps\Habitat\11x17_Assessment_Maps_20060216

Overview	Focused Area

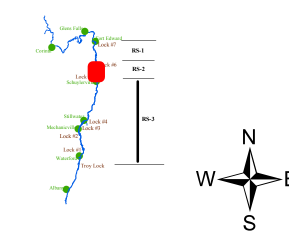


0 1,500 3,000 Feet



0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Hudson River Project

Figure A-15

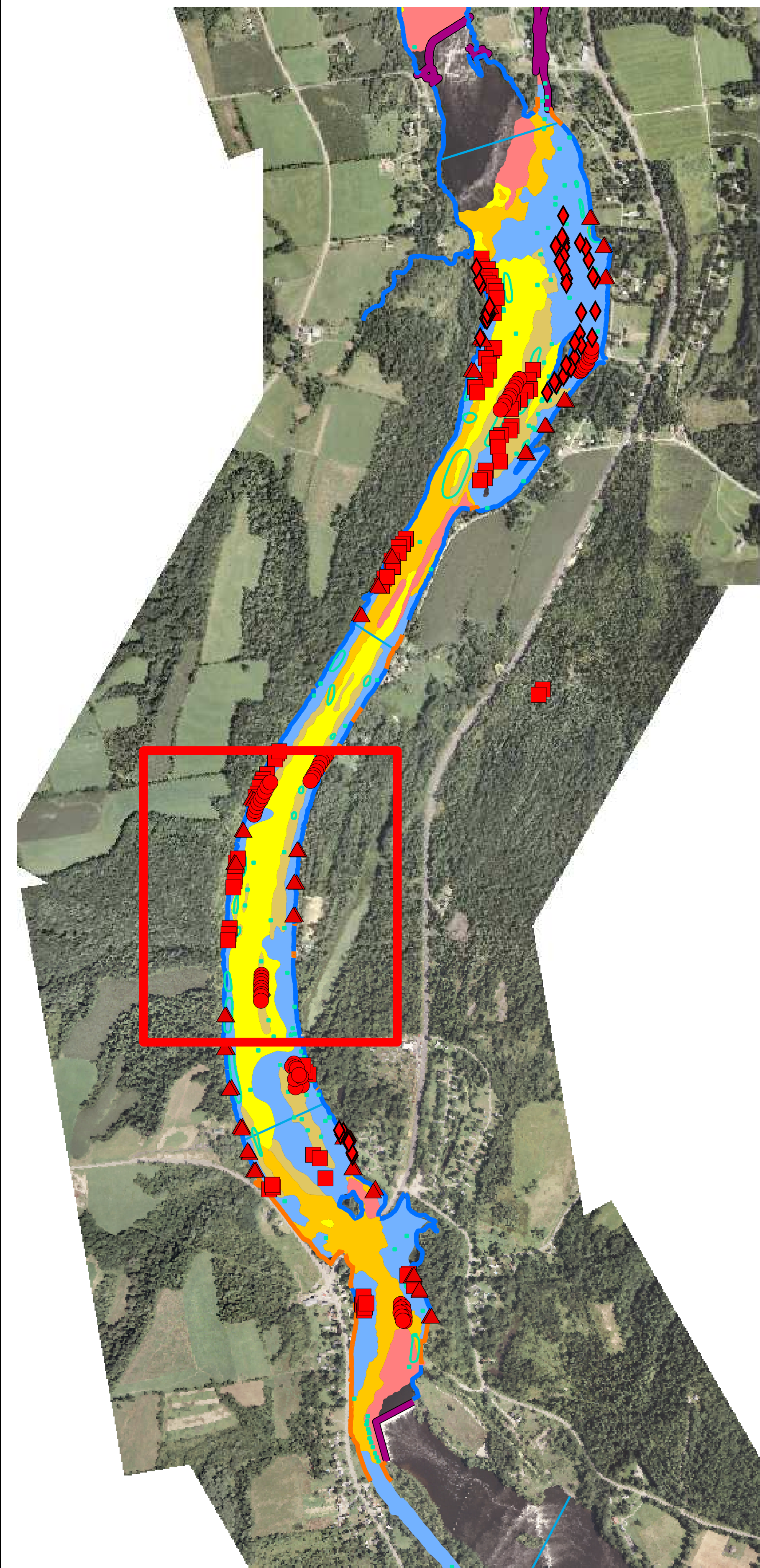
Sampling Station Locations for Habitat Assessments 2003 through 2005

QEA Quantitative Environmental Analysis, LLC

GENhab **Mar 2006**

CCY - \\ALGONQUIN\E_Drive\GENrem\WORKING\GIS\maps\ARCGIS8_maps\Habitat\11x17_Assessment_Maps_20060216

Overview

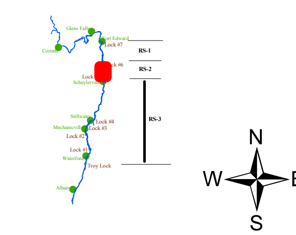


0 1,500 3,000 Feet

Focused Area

0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations
- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline
- Maintained Shore
- Natural Shore

SSS Sediment Types
- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey
- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Figure A-16

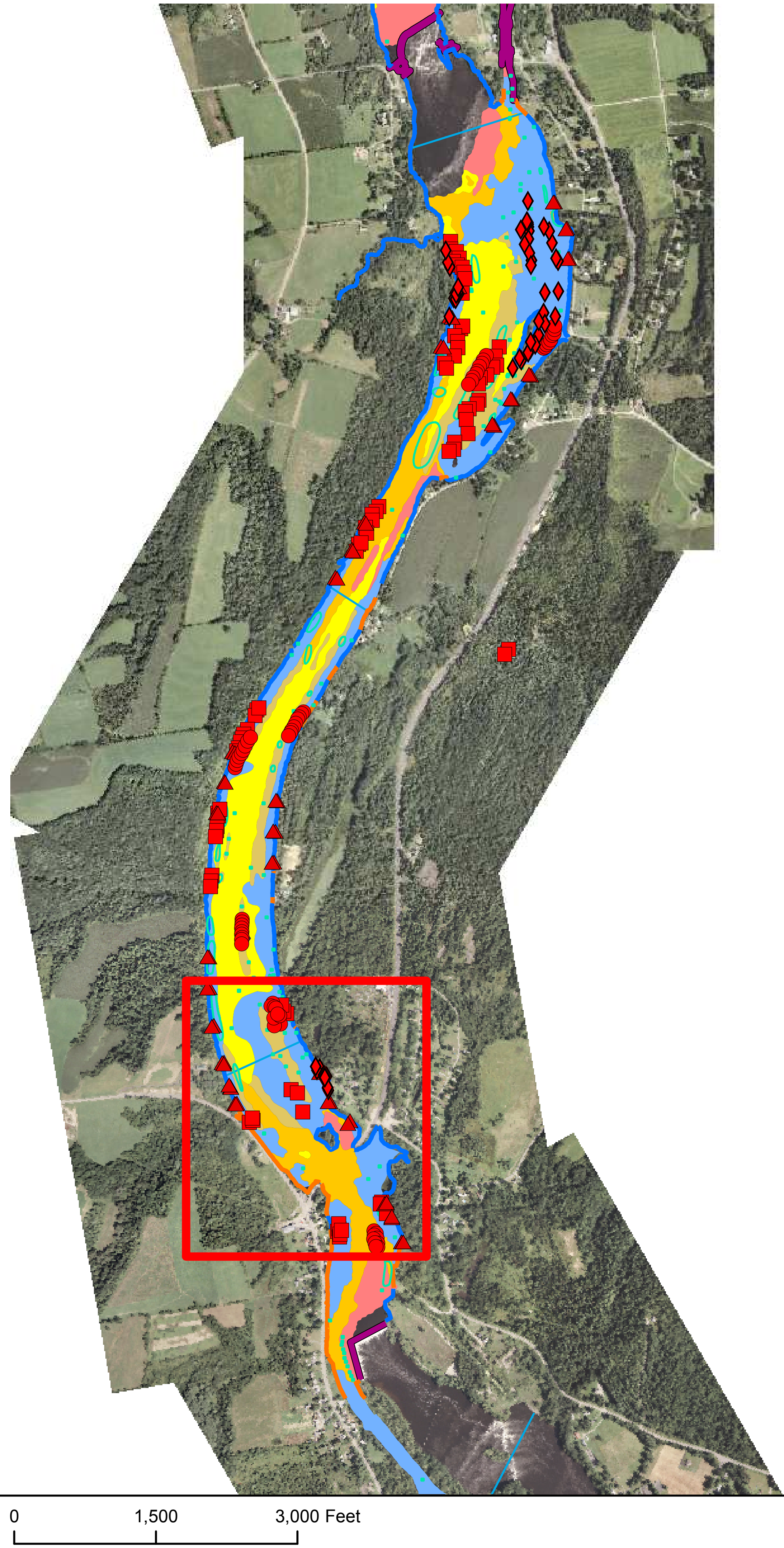
Sampling Station Locations for Habitat Assessments 2003 through 2005

QEA Quantitative Environmental Analysis, LLC

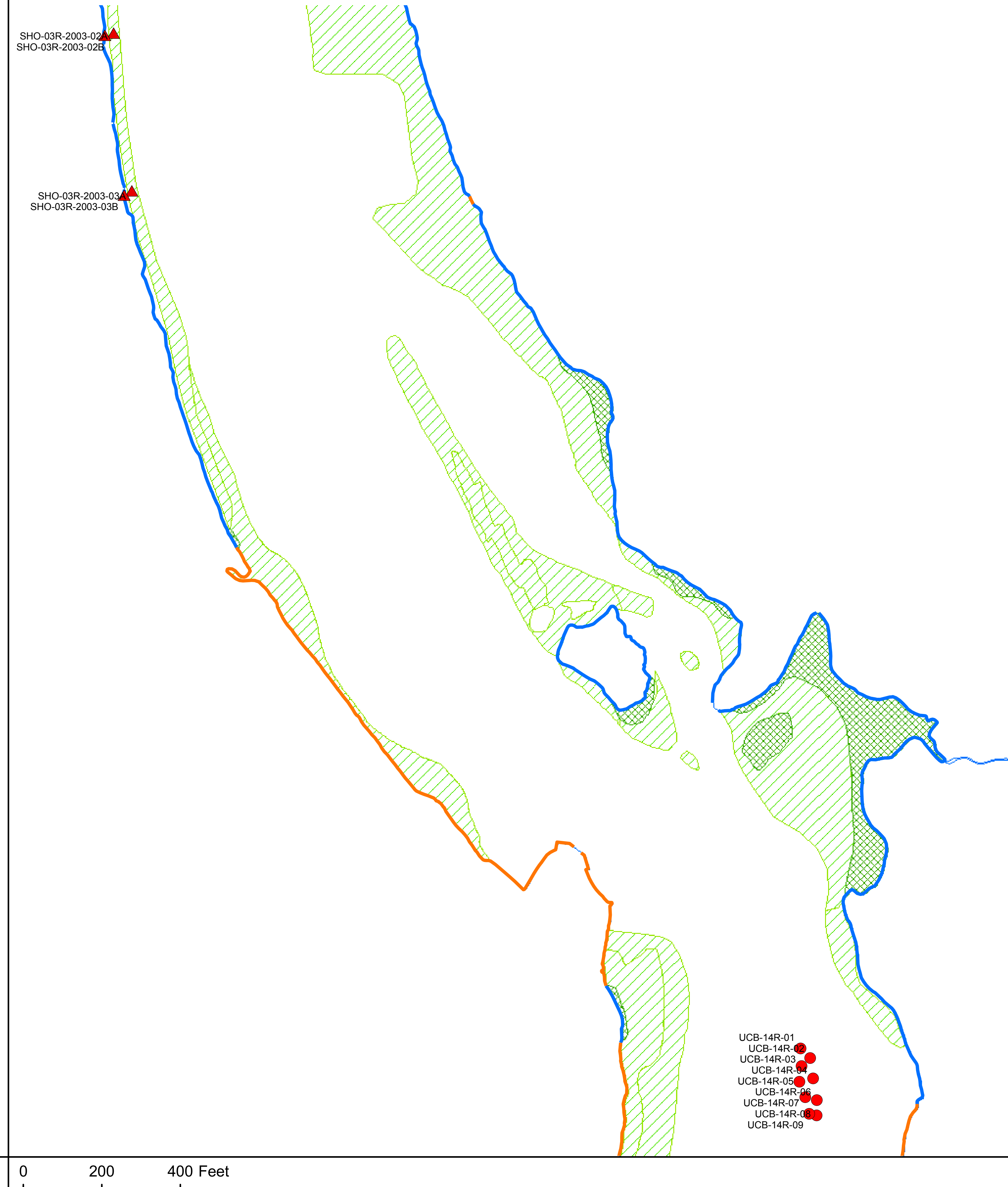
GENhab Mar 2006

CCY - \\ALGONQUIN\E_Drive\GENrem\WORKING\GIS\maps\ARCGIS8_maps\Habitat\11x17_Assessment_Maps_20060216

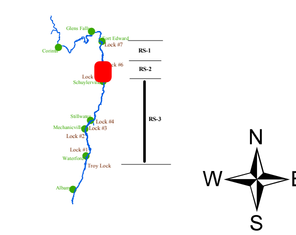
Overview



Focused Area



LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Hudson River Project

Figure A-17

Sampling Station Locations for Habitat Assessments 2003 through 2005

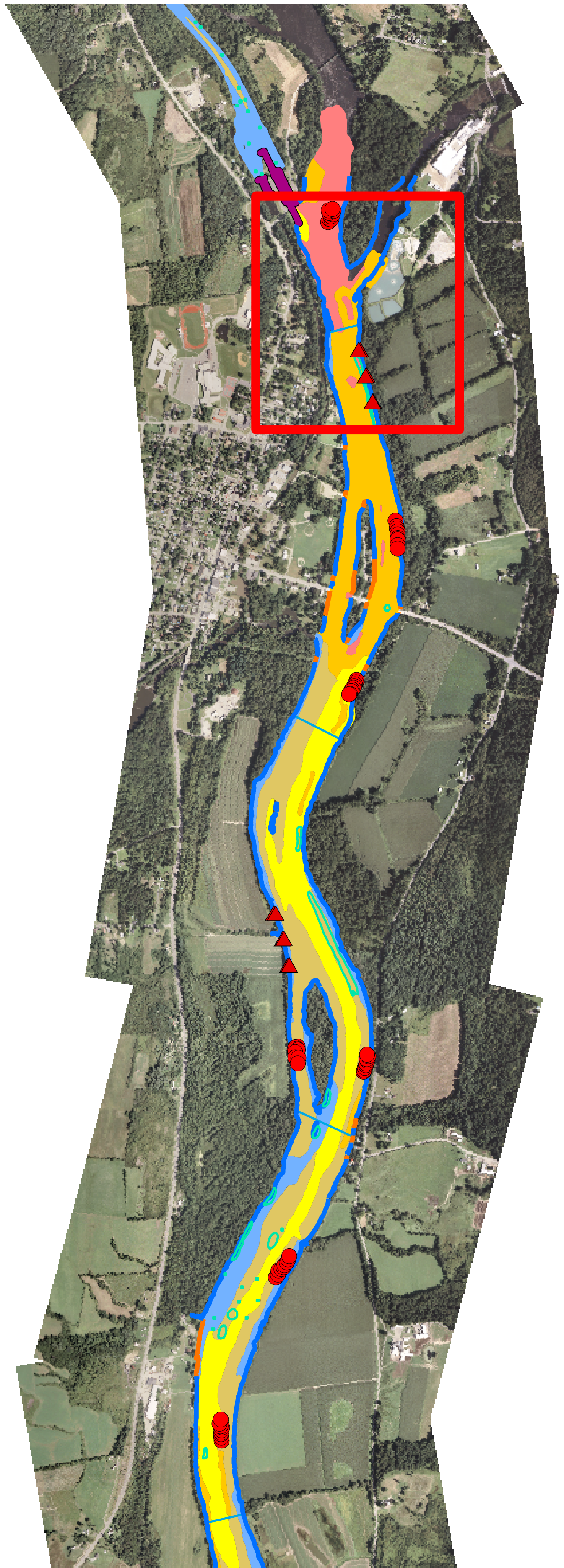
QEA Quantitative Environmental Analysis, LLC

GENhab

Mar 2006

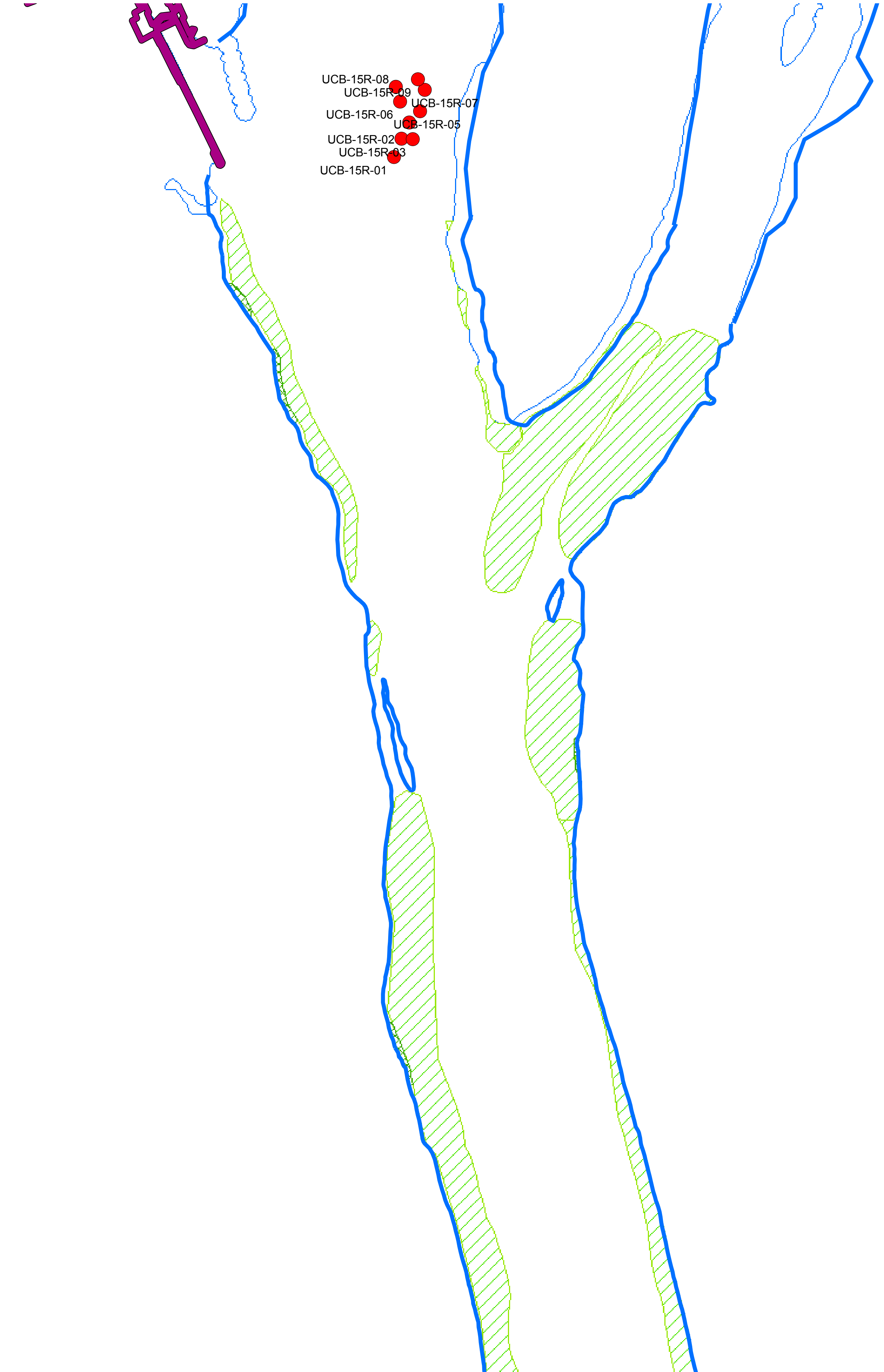
CCY - \\ALGONQUIN\E_Drive\GENrem\WORKING\GIS\maps\ARCGIS8_maps\Habitat\11x17_Assessment_Maps_20060216

Overview



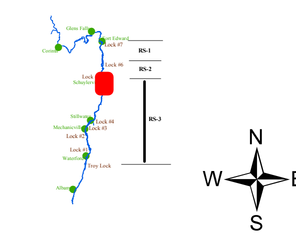
0 1,900 3,800 Feet

Focused Area



0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Hudson River Project

Figure A-18

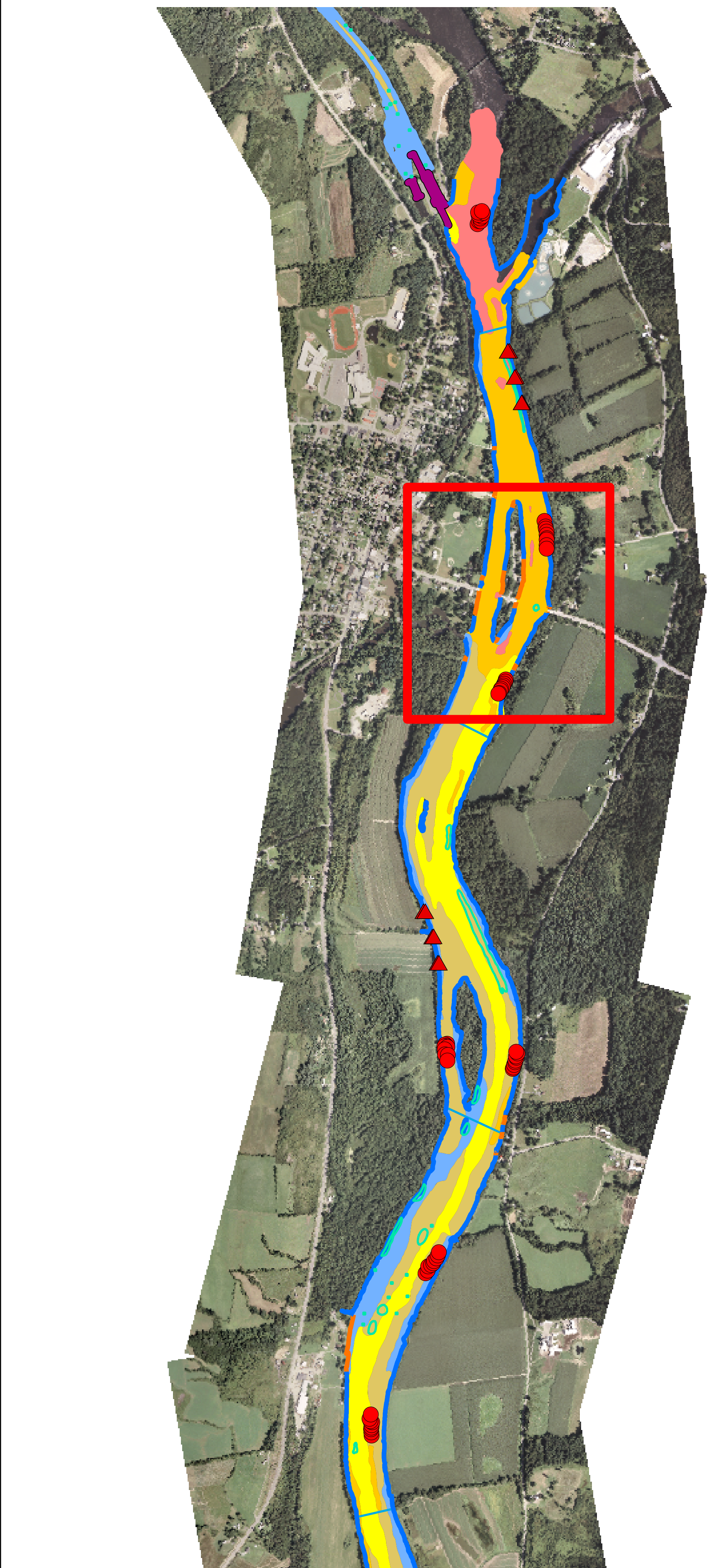
Sampling Station Locations for Habitat Assessments 2003 through 2005

QEA Quantitative Environmental Analysis, LLC

GENhab **Mar 2006**

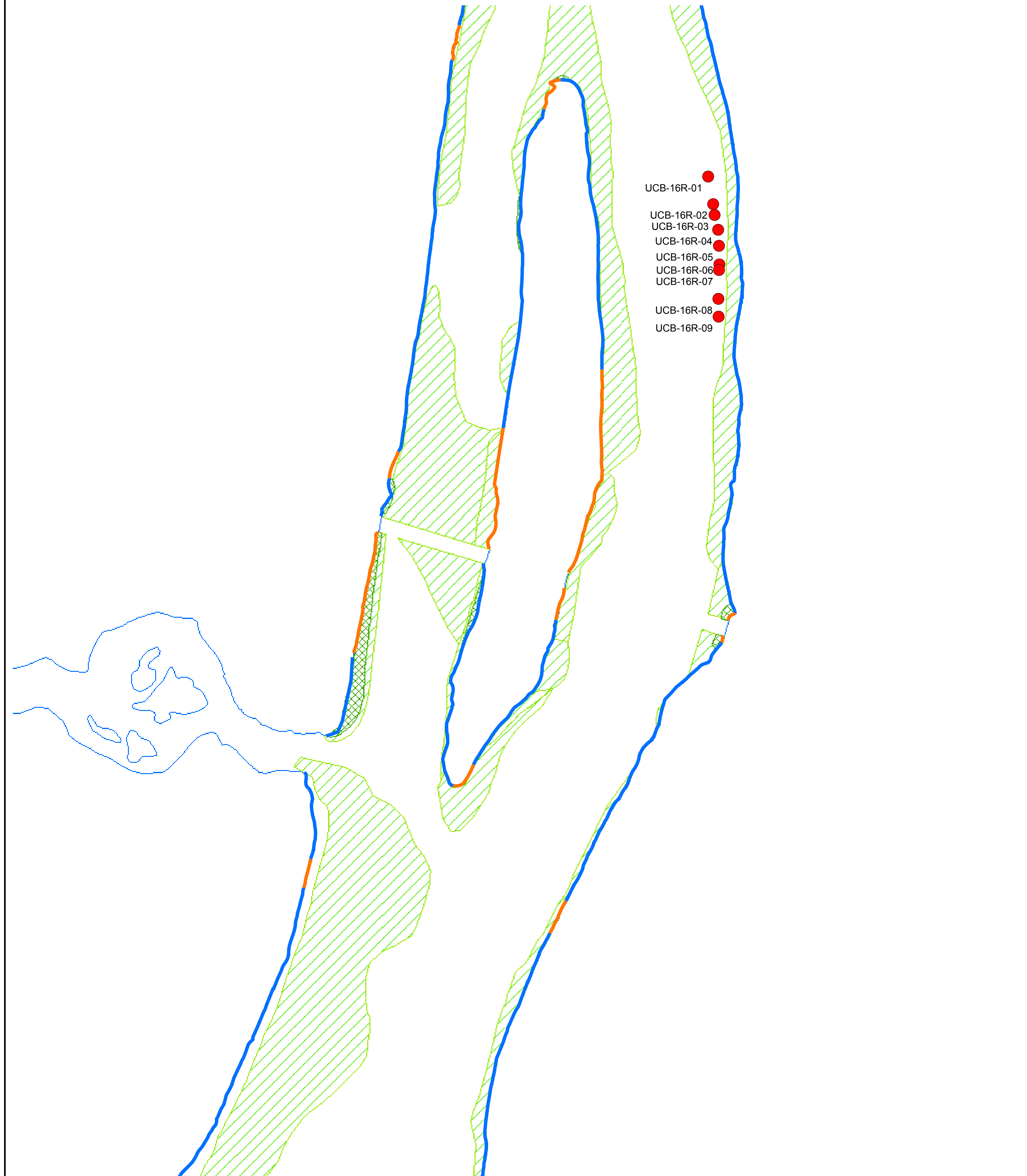
CCY - \\ALGONQUIN\E_Drive\GENrem\WORKING\GIS\maps\ARCGIS8_maps\Habitat\11x17_Assessment_Maps_20060216

Overview



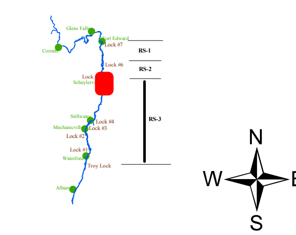
0 1,900 3,800 Feet

Focused Area



0 200 400 Feet

LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Hudson River Project

Figure A-19

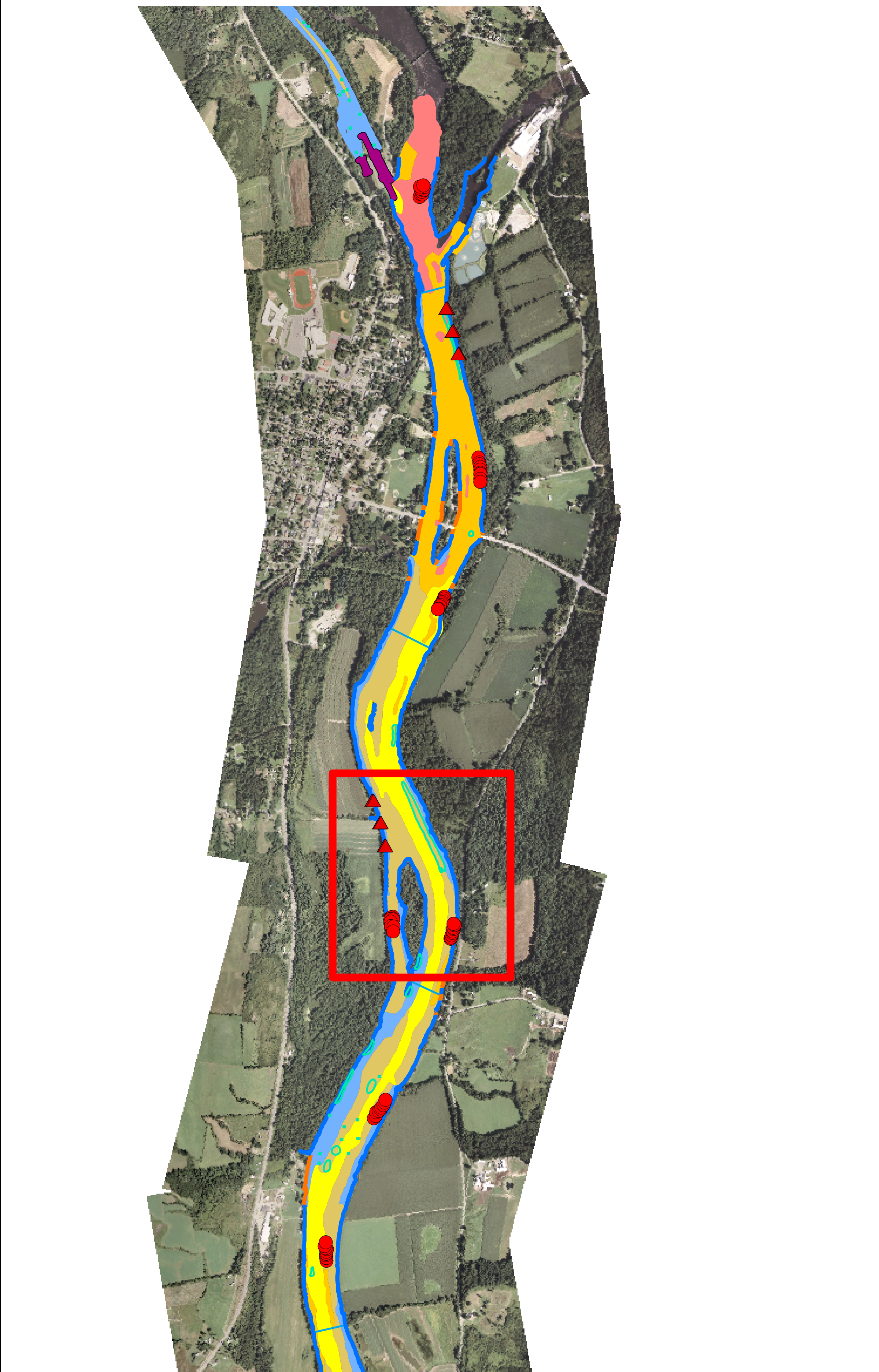
Sampling Station Locations for Habitat Assessments 2003 through 2005

GENhab

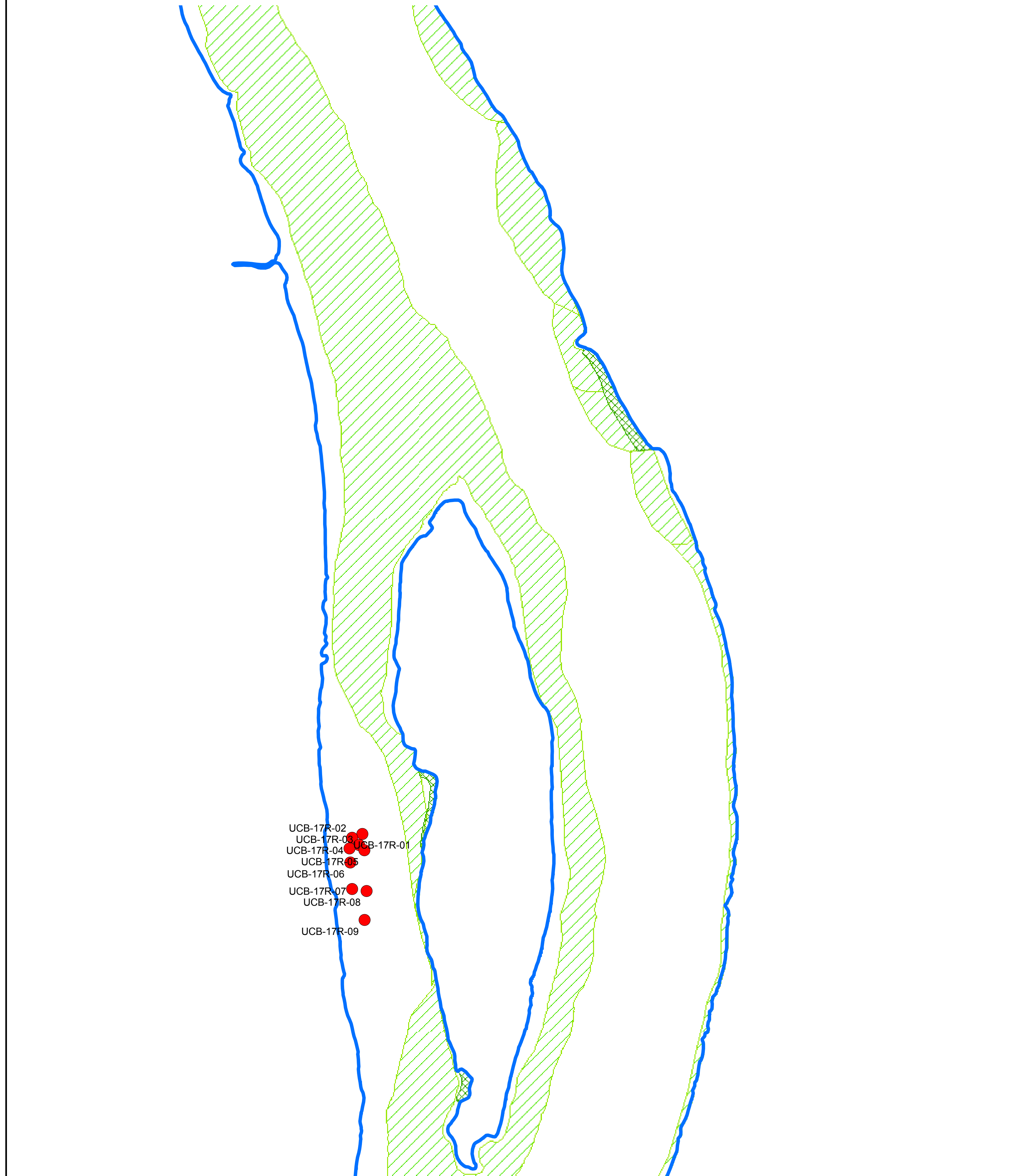
Mar 2006

CCY - \\ALGONQUIN\E_Drive\GENrem\WORKING\GIS\maps\ARCGIS8_maps\Habitat\11x17_Assessment_Maps_20060216

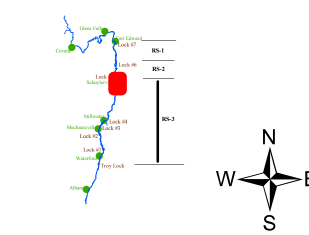
Overview



Focused Area



LOCATOR MAP OF THE HUDSON RIVER



LEGEND

Assessment Locations

- SAV
- Shoreline
- Unconsolidated Bottom
- Wetland

2003 Habitat Shoreline

- Maintained Shore
- Natural Shore

SSS Sediment Types

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment
- SSS Debris & Attributes
- River Miles
- Dams and Locks

2003 Habitat Survey

- SAV
- Backwater Wetland
- Fringe Wetland
- Trapa

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Figure A-20

Sampling Station Locations for Habitat Assessments 2003 through 2005

GENhab

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Exhibit B

Development of FCIs and HSIs

Exhibit B – FCI and HSI Development

The objectives of this Exhibit to the *Phase 1 Adaptive Management Plan* (Phase 1 AM Plan) are to:

- Document the changes to the draft Functional Capacity Index (FCI) models that were presented in the *Habitat Assessment Report for Candidate Phase 1 Areas* (Phase 1 HA Report) (Blasland, Bouck & Lee, Inc. [BBL] and Exponent, 2005b);
- Document the results of the sensitivity and correlation analysis completed for the FCI models;
- Document the transformation of field data into subindices for use in the FCI models; and
- Document the data sources used to calculate Habitat Suitability Index (HSI) model values for the representative species specified in the Phase 1 HA Report.

The associated FCI models and HSI models and associated parameters that are used in those models provide the fundamental tools that will be used to assess whether the overall program goals have been met once the habitat replacement and reconstruction designs have been implemented. This process is described in Section 4 of the Phase 1 AM Plan .

A. FCI Models

Final Phase 1 FCI Models

The FCI models described in this section are based on all field data collected from areas relevant to Phase 1 (i.e., target areas within areas to be dredged in Phase 1 and associated reference areas) from 2003 through 2005. The rationale for including specific parameters, and the mathematical combination of those parameters, was described in the Phase 1 HA Report. This subsection discusses only the changes that were made to the preliminary FCI models presented in the Phase 1 HA Report.

Unconsolidated River Bottom

There are two FCI models for unconsolidated river bottom: potential to support benthic macroinvertebrates and potential to support fish populations. Draft FCI models were described in the Phase 1 HA Report. The final FCI models are shown in Table B-1 and described below. The final FCI values are provided in Table 2-5 of the Phase 1 AM Plan.

Table B-1 – Unconsolidated River Bottom Measured Variables and FCI Models

Function (FCI Code)	Measured Variable (Units)	Variable Code
Potential to Support Benthic Macroinvertebrates **($FCI_{UNVEGBMI}$)**	TOC (percent)	V_{TOC}
	Substrate and cover (percent)	$V_{SUBCOVER}$
	Percent fines (percent)	V_{FINES}
Potential to Support Fish Populations **($FCI_{UNVEGFISH}$)**	Substrate and cover (percent)	$V_{SUBCOVER}$
	Percent fines (percent)	V_{FINES}
	Downfall (square feet)	$V_{UCBDOWN}$
Unconsolidated River Bottom Habitat FCI Models for Candidate Phase 1 Areas		
$FCI_{UNVEGBMI}$	$\left[V_{TOC} \times \frac{(V_{SUBCOVER} + V_{FINES})}{2}\right]^{1/2}$	
$FCI_{UNVEGFISH}$	$\frac{(V_{SUBCOVER} + V_{FINES} + V_{UCBDOWN})}{3}$	

The first FCI function ($FCI_{UNVEGBMI}$) for unconsolidated river bottom is the provision of habitat and food resources for macroinvertebrates. The final model is identical to the draft model. However, the subindex transformations for some of the variables that go into this model have been revised as discussed below.

The second FCI function ($FCI_{UNVEGFISH}$) is the provision of habitat and resources for fish populations. Based on reviewer comments on the draft model, downfall ($V_{UCBDOWN}$) has been added to this function. Downfall can provide structure to the river bottom and habitat for some fish species. Downfall information for the unconsolidated river bottom habitats was obtained from the side scan sonar data collected as part of the Sediment Sampling and Analysis Program (SSAP). Section D provides further details on the downfall data and subindex transformations. For the model, the amount of cover serving as fish habitat (also the potential location of prey) is assumed to contribute equally (i.e., none of the variables are weighted) with the availability of suitable spawning substrate and downfall.

Aquatic Vegetation Beds

There are four FCI models for aquatic vegetation beds: potential to support phytophilous and benthic macroinvertebrate populations, provision of habitat for fish populations, substrate stabilization, and nutrient cycling. Draft FCI models were described in the Phase 1 HA Report. The final FCI models are shown in Table B-2 and described below. The final FCI values are provided in Table 2-6 of the Phase 1 AM Plan.

As was the case with the draft FCI models, light availability and current velocity data were collected late in the growing season for a short time (September) and provide limited information on the role that these variables play in determining the functions of aquatic vegetation bed habitats. These variables were not included in the draft FCI models and are not included in the final FCI models presented here. However, these variables are being used in the aquatic vegetation model described in Section 2 of the Phase 1 AM Plan. Additionally, plant species composition (% non-native) was not included in the draft models nor is it in the final models because non-native species have not been sampled to date. The use of this variable will be reconsidered following completion of sampling in Phase 2 areas.

Lastly, one FCI model (nutrient cycling) could not be completed for SAV-10R. Sediment data (nutrients, total organic carbon and percent fines) were not available for this location because the substrate is gravel and cobble and push cores could not be collected.

Table B-2 – Aquatic Vegetation Bed Habitat Measured Variables and FCI Models

Function (FCI Code)	Measured Variable (Units)	Variable Code
Support PMI/BMI Populations **($FCI_{SAVMACROS}$)**	Shoot biomass (g/m^2)	V_{SAVBIO}
	Shoot density (number/m^2)	$V_{SAVDENSE}$
	Plant species composition (% native)	V_{SAVSPP}
	TOC (percent)	V_{SAVTOC}
Provide Habitat for Fish Populations **($FCI_{SAVFISH}$)**	Shoot biomass (g/m^2)	V_{SAVBIO}
	Shoot density (number/m^2)	$V_{SAVDENSE}$
	Plant species composition (% native)	V_{SAVSPP}
	TOC (percent)	V_{SAVTOC}
	Percent cover (percent)	$V_{SAVCOVER}$
	Downfall (square feet)	$V_{SAVDOWN}$
Stabilization of Substrate **($FCI_{SAVSTAB}$)**	Shoot density (g/m^2)	$V_{SAVDENSE}$
	Percent fines (percent)	V_{FINES}
	Percent cover (percent)	$V_{SAVCOVER}$
Nutrient Cycling **($FCI_{SAVNUTS}$)**	Shoot biomass (g/m^2)	V_{SAVBIO}
	TOC (mg/kg)	V_{SAVTOC}
	Sediment nutrient availability (mg/kg)	V_{SNN}
Aquatic Vegetation Bed Habitat FCI Models for Phase 1 Areas		
$FCI_{SAVMACROS}$	$\frac{(V_{SAVBIO} + V_{SAVTOC} + V_{SAVDENSE} + V_{SAVSPP})}{4}$	
$FCI_{SAVFISH}$	$\frac{(FCI_{SAVMACROS} + V_{SAVCOVER} + V_{SAVDOWN})}{3}$	
$FCI_{SAVSTAB}$	$\left[\frac{(V_{SAVDENSE} + V_{SAVCOVER})}{2} \times V_{FINES}\right]^{1/2}$	
$FCI_{SAVNUTS}$	$\left[V_{SAVBIO} \times \frac{(V_{SAVTOC} + V_{SNN})}{2}\right]^{1/2}$	

The first function, habitat support for benthic macroinvertebrate (BMI) and phytophilous macroinvertebrate (PMI) communities ($FCI_{SAVMACROS}$), is represented by food availability for macroinvertebrates (shoot biomass and total organic carbon [TOC]) and factors related to recruitment/settlement (shoot density and plant species composition). The draft FCI model had included water depth. However, the water depth at which the samples were collected does not represent the entire depth distribution at which aquatic vegetation is found, i.e., aquatic vegetation exists at depth intervals that have not yet been sampled. Therefore, this variable was removed from the model. Water depth is currently used in the SAV model (see Section 2 of the Phase 1 AM Plan). The four variables in the final FCI model are assumed to contribute equally and independently to the function.

The second function, habitat support for fish populations ($FCI_{SAVFISH}$), is represented by food availability (the PMI/BMI support function, which includes shoot biomass) and provision of nursery areas and protection from predation (percent cover). Based on reviewer comments on the draft model, downfall ($V_{SAVDOWN}$) has been added to this function. Downfall can provide structure to the river bottom and habitat for some fish species. Downfall information for the aquatic vegetation beds was obtained from the side scan sonar data collected as part of the SSAP. However, downfall was not present in the aquatic vegetation beds assessed for Phase 1 and does not influence model results. All three variables in the model are assumed to contribute equally and independently to the function, although it should be noted that the PMI/BMI support function is composed of four separate variables.

Natural Shoreline

There are three FCI models for natural shoreline habitats: shoreline stability, provision of shade and cover, and wildlife habitat. Draft FCI models were described in the Phase 1 HA Report. The final FCI models are shown in Table B-3 and described below. The final FCI values are provided in Table 2-7 of the Phase 1 AM Plan.

Table B-3 – Shoreline Habitat Measured Variables and FCI Models

Function (FCI Code)	Measured Variable (Units)	Variable Code
Shoreline Stability **($FCI_{SHORESTAB}$)**	Bank stability (percent)	$V_{BANKSTAB}$
	Bank vegetation protection	$V_{BANKVEG}$
Shade and Cover **($FCI_{SHORECOV}$)**	Downfall (trees/m^2)	V_{DOWN}
	Bank vegetation protection (percent)	$V_{BANKVEG}$
	Riparian edge cover (percent)	$V_{RIPARIAN}$
Wildlife Habitat (Habitat Suitability) **($FCI_{SHOREHAB}$)**	Downfall (trees/m^2)	$V_{SHODOWN}$
	Bank stability (percent)	$V_{BANKSTAB}$
	Bank vegetation protection (percent)	$V_{BANKVEG}$
	Riparian edge cover (percent)	$V_{RIPARIAN}$
Aquatic Vegetation Bed Habitat FCI Models for Phase 1 Areas		
$FCI_{SHORESTAB}$	$\frac{(V_{BANKSTAB} + V_{BANKVEG})}{2}$	
$FCI_{SHORECOV}$	$\frac{(V_{SHODOWN} + V_{BANKVEG} + V_{RIPARIAN})}{3}$	
$FCI_{SHOREHAB}$	$\frac{(V_{SHODOWN} + V_{BANKSTAB} + V_{BANKVEG} + V_{RIPARIAN})}{4}$	

The first FCI function, shoreline stability ($FCI_{SHORESTAB}$), is represented by two measurement variables ($V_{BANKSTAB}$ and $V_{BANKVEG}$) that correspond to stable banks (low percentage of eroded area), and protective vegetation (percentage of all vegetative layers present), respectively. Both variables are assumed to contribute equally and independently to the function and are averaged. The final model is identical to the draft model.

The second FCI function, shade and cover ($FCI_{SHORECOV}$), is represented by three measurement variables ($V_{BANKVEG}$, $V_{RIPARIAN}$, and V_{DOWN}). Bank vegetation protection ($V_{BANKVEG}$) provides shade and cover as habitat for terrestrial wildlife. Riparian edge cover ($V_{RIPARIAN}$) provides in-water cover and cooling to shallow water areas of the river. Also, deciduous species along the riparian edge that drop leaves into the river during the fall provide an organic food source to aquatic organisms. Downfall (V_{DOWN}) provides cover for wildlife that forage along the shoreline, and cover for fish that use submerged portions of the tree. All three variables are assumed to contribute equally and independently to the function and are averaged. The final model is identical to the draft model.

The third FCI function, wildlife habitat suitability ($FCI_{SHOREHAB}$), depends on the nature and type of vegetation present (downfall, riparian vegetation, bank vegetation) and stability of the habitat (bank stability). All four variables are assumed to contribute equally and independently to the function and are averaged. The final model is identical to the draft model.

Riverine Fringing Wetlands

There are five FCI models for riverine fringing wetland habitats: surface-water exchange, energy dissipation, nutrient and organic cycling, maintenance of characteristic plant communities, and wildlife habitat. Draft FCI models were described in the Phase 1 HA Report. The final FCI models are shown in Table B-4 and described below. The final FCI values are provided in Table 2-8 of the Phase 1 AM Plan.

Table B-4 – Wetland Habitat Measured Variables and FCI Models

Function (FCI Code)	Measured Variable (Units)	Variable Code
Surface-Water Exchange **($FCI_{WATEREX}$)**	Wetland Edge (m)	$V_{WETEDGE}$
	Stem density (number/m²)	$V_{WETDENSE}$
	Slope (percent)	V_{SLOPE}
Energy Dissipation **(FCI_{ED})**	Wetland Edge (m)	$V_{WETEDGE}$
	Slope (percent)	$V_{WETSLOPE}$
	Stem density (number/m²)	$V_{WETDENSE}$
	Stem thickness (mm)	$V_{WETTHICK}$
	Stem length (cm)	$V_{WETLENGTH}$
Nutrient and Organic Cycling **($FCI_{WETCYCLING}$)**	Aboveground biomass (g/m²)	V_{WETBIO}
	Stem length (cm)	$V_{WETLENGTH}$
	Stem thickness (mm)	$V_{WETTHICK}$
	Stem density (number/m²)	$V_{WETDENSE}$
	Wetland Edge (m)	$V_{WETEDGE}$
	Slope (percent)	$V_{WETSLOPE}$
Maintain Character Plant Community **($FCI_{MAINTAINSPP}$)**	Plant species composition (percent)	V_{WETSPP}
	Nuisance species (percent)	$V_{WETNUISANCE}$
Wildlife Habitat (habitat suitability) **(FCI_{WETHAB})**	Wetland Edge (m)	$V_{WETEDGE}$
	Contiguous with other habitats (percent)	V_{CONTIG}
	Downfall (square feet)	$V_{WETDOWN}$
	Plant species composition (percent)	V_{WETSPP}
	Stem density (number/m²)	$V_{WETDENSE}$
Wetland Habitat FCI Models for Candidate Phase 1 Areas		
$FCI_{WATEREX}$	$\frac{(V_{WETEDGE} + V_{SLOPE} + V_{WETDENSE})}{3}$	
FCI_{ED}	$\left[FCI_{WATEREX} \times \frac{(V_{WETLENGTH} + V_{WETTHICK})}{2}\right]^{1/2}$	
$FCI_{WETCYCLING}$	$\left[FCI_{WATEREX} \times \frac{(V_{WETLENGTH} + V_{WETTHICK} + V_{WETBIO})}{3}\right]^{1/2}$	
$FCI_{MAINTAINSPP}$	$\frac{(V_{WETSPP} + V_{WETNUISANCE})}{2}$	
FCI_{WETHAB}	$\left[\frac{(V_{WETEDGE} + V_{CONTIG} + V_{WETDOWN})}{3} \times \frac{(V_{WETSPP} + V_{WETDENSE})}{2}\right]^{1/2}$	

The first function, surface-water exchange ($FCI_{WATEREX}$), can be represented by the extent of the surface-water interface (wetland edge), the inundation period and impedance to flow (stem density). In the draft FCI model, inundation period was represented by wetland slope. As stated in the Phase 1 HA Report, inundation period was identified as a data need for the riverine fringing wetlands and was determined for each river reach using water level data collected by the New York State Canal Corporation. Because it is calculated for each river reach, the inundation period is identical for the two Phase 1 riverine fringing wetland stations in River Section 1 and , if included in the model, would not result an in any difference in their calculated FCI values. Therefore, slope remains in the model. Inundation period is used in the riverine fringing wetland habitat construction designs as discussed in Section 3 of the Phase 1 AM Plan. The variables are assumed to contribute equally and independently to the function and are averaged in the equation.

The second function, energy dissipation (FCI_{ED}), is the conversion of water's energy into other forms as it flows through a wetland. The energy dissipation function limits erosion along the banks of the river and induces deposition of suspended sediment. Sediment accretion increases the area available for future development of riverine fringing wetlands. A riverine fringing wetland provides this function as a result of vegetation structure provided by stem density, stem thickness, and stem length. The function of energy dissipation also depends on the amount of flowing water in contact with the wetland (represented by the surface-water exchange function described above). In the first part of the equation, the components of vegetation structure contribute equally and independently and are averaged. The two parts of the equation are combined using the geometric mean to indicate that both vegetation structure and water exchange must be present for the function to occur. The final model is identical to the draft model.

The third function, nutrient and organic carbon cycling ($FCI_{WETCYCLING}$). As described in the Phase 1 HA Report, the nutrient and organic carbon cycling function primarily depends on biological and hydrological wetland characteristics. Surface-water exchange ($FCI_{WATEREX}$) drives nutrient and organic carbon cycling by allowing interaction between the wetland edge and river flow. Nutrient and organic carbon cycling is proportional to the size of the vegetation community (aboveground biomass, stem length, stem thickness) because vegetation provides surface area for microbial populations, which play a large role in cycling, and influences the quantity of detritus produced (Shafer and Yozzo, 1998). For the second part of the equation, the components of the vegetation community contribute equally and independently and are averaged. The two parts of the equation are combined using the geometric mean to indicate that both vegetation community and water exchange must be present for the function to occur. The final model is identical to the draft model.

The fourth function, maintenance of characteristic plant community ($FCI_{MAINTAINSPP}$), is related to the ability of the wetland to provide characteristic species composition (plant species composition). This function generally decreases when exotic or invasive species comprise a higher proportion of plants present (nuisance species). Both variables contribute equally and independently to the function and are averaged. The final model is identical to the draft model.

The fifth function, wildlife habitat (FCI_{WETHAB}), is the potential use by resident and migratory invertebrates, avifauna, herptofauna, nekton, and mammals. Wetland habitat can also be important to terrestrial wildlife due to trophic links or cohabitation between upland and wetland areas (Shafer and Yozzo, 1998). Thus, the wildlife habitat function depends on the structure and composition of the vegetation community (plant species composition, stem density), the size of the wetland interface with the river (wetland edge), and connectivity between upland and wetland areas (contiguous with other habitats). Based on reviewer comments on the draft model, downfall ($V_{WETDOWN}$) has been added to this function. However, downfall was not present at the two riverine fringing wetlands assessed for Phase 1 and does not influence model results. The two parts of the equation are combined using the geometric mean to indicate that both contiguous habitats and the vegetation community must be present for the function to occur.

B. Sensitivity and Correlation Analysis of Final FCI Models

Performance of the final FCI models was assessed through completion of a sensitivity analysis and correlation analysis in accordance with the procedures outlined in Wakeley and Smith (2001). The sensitivity analysis was completed to evaluate how FCI values varied under incremental changes to the input variables. The sensitivity analysis evaluates the mathematical combinations of the FCI formulas to evaluate the degree of influence each variable has on the model score. Variables with little influence on the model score can either be removed from the model or weighted to increase their influence. To complete the sensitivity analysis, the Microsoft® Excel® files on the Environmental Laboratory’s website (http://el.erdc.usace.army.mil/wetlands/datanal.html) were downloaded and updated with the project-specific FCIs. The spreadsheet program was used to vary one variable at a time from 0.0 to 1.0 in increments of 0.1, while the other variables in the model were fixed at subindex values of 0.1, 0.5 and 1.0. The graphical output of the sensitivity analysis is provided at the end of this exhibit. No models were revised on based on the results of the sensitivity analysis.

The correlation analysis is used to identify potential redundancies among variables. If two or more variables are highly correlated, it may be possible to remove a variable without significant loss of information (Wakeley and Smith, 2001). The results of the correlation analysis indicate that for certain functions, one or more variables can be removed from the model and the resultant model is strongly correlated with the full model (see Tables B-7 through B-20 at the end of this exhibit). The correlation analysis will be repeated following dredging when only reference station data will be used to establish the optimal condition for completing the subindex transformations. At that time, variable(s) will be removed from the models when the correlation coefficient between the simplified model and the full model is greater than 0.7 (Wakeley and Smith, 2001).

C. Transformation of Field Data to Subindices

Field data were collected from unconsolidated river bottom, aquatic vegetation bed, shoreline, and riverine fringing wetland habitats in the Phase 1 areas of the Upper Hudson River in accordance with the standard operating procedures (SOPs) provided in the *Habitat Delineation and Assessment Work Plan* (HDA Work Plan) (BBL, 2003). These data were collected using different units and scales of measurement and were therefore transformed into comparable unitless measures ranging from 0.0 to 1.0 for integration into the FCI models (Smith and Wakeley, 2001). For the purposes of developing the FCI models, all stations are currently considered “reference stations” since they represent current conditions prior to disturbance by remediation, and since the goal of the habitat replacement and reconstruction program is to replace the functions of the habitats of the Upper Hudson River to within the range of functions found in similar physical settings in the Upper Hudson River, not to improve those functions. As a result, all Phase 1 data are included in the development of the subindices.

The process of transforming field data to subindices for each of the four habitats is described below. In addition, graphs depicting the transformed data are provided. For each variable, a subindex value of 1.0 has been assigned to the measured value that represents the “optimal” condition among all stations. In some cases, this “optimal” value is the highest measured value (e.g., aboveground biomass), while in others it is the lowest value measured (e.g., percent nuisance species), and in others it is a mid-range value (e.g., percent fines in unconsolidated river bottom). Using this approach, it is unlikely that any one assessment station will have optimal conditions for each parameter. Following the completion of Phase 1 dredging, post-dredging data will be collected from target and reference stations. At that time, reference stations only will be used to define the “optimal” condition (i.e., a subindex of 1.0) and used to scale the values for that parameter at all other stations.

In general, subindex values vary linearly from 0 to 1.0 for values greater than or less than the optimal value in accordance with the national and regional guidance documents (Ainslie et al., 1999; Smith and Wakeley, 2001). Two subindex values are varied using a step-function (for example, see Vsubcover below). These methods of subindex transformations (i.e., linear and stepped) are consistent with the guidelines for developing regional guidebooks (Smith and Wakeley, 2001) and several completed regional guidebooks including Ainslie et al. (1999), Smith and Klimas (2002), Wilder and Roberts (2002) and Noble et al. (2004). Graphs of the subindex transformations are provided at the end of this exhibit.

Unconsolidated River Bottom

SUBSTRATE, EPIFAUNAL AND POOL (Vsubcover) – Input data are the classification of the epifaunal substrate/available cover and pool substrate characterization as optimal, suboptimal, marginal, or poor. These categories were tranformed into numerical subindex values using a step-function based on the range of percentages from the Barbour et al. (1999) tables for epifaunal substrate and cover, and pool substrate. For example, poor epifaunal substrate (<10%) transforms to 0.0; marginal epifaunal substrate (10% to 30%) transforms to 0.33, suboptimal epifaunal substrate (30% to 50%) transforms to 0.67, and optimal epifaunal substrate (>50%) transforms to 1.0. The subindex values are set at 0.0, 0.33, 0.67, and 1.0.

TOC (Vtoc) – Input data are the measured TOC, in milligrams per kilogram (mg/kg), from the SSAP data nearest the sampling station. When multiple SSAP data existed, the values were then averaged by station. Vtoc is a one-sided index with no upper limit. Vtoc has a value of 1 for TOC concentrations equal to (or above) the maximum station average (169,250 mg/kg) and is linear from 0 to 1 for values less than the maximum station average.

FINES (Vfines) – Input data are the percent fines from the SSAP data (from within the top 12 inches) nearest the sampling quadrats. Vfines is a two-sided index with no lower limits. Vfines has a value of 1 for percent fines equal to the average percent fines of all Phase 1 UCB stations (22.1%). It is linear from 0 to 1 for values less then 22.1% and linear from 1 to 0 for values greater than 22.1%. The subindex for percent fines was completed in this manner because fine sediments are more suitable as spawning substrates for some species, such as largemouth bass (Stuber et al., 1982), but less suitable for others species, such as smallmouth bass (Graves and Anderson, 1987) and common shiner (Trial et al., 1983). As such, mid-range values for percent fines likely provide suitable substrate for the greatest number of species.

DOWNFALL (Vucbdown) – Input data are the debris information collected under the SSAP using side scan sonar for the locations nearest the sampling quadrats. Vucbdown is a one-sided index with no lower limit. Vucbdown has a value of 1 for downfall values equal to the maximum station average measured (10,850 square feet). Vucbdown is linear from 0 to 1 for downfall values less than the maximum station average.

Aquatic Vegetation Beds

BIOMASS (Vsavbio) – Aboveground biomass was measured for each species within each quadrat at each station. The biomass of each species within the quadrat was totaled and converted to grams per square meter (g/m^2) by multiplying by 8. Quadrat totals were then averaged by station. Vsavbio is a one-sided index with no upper limit. Vsavbio has a value of 1 for biomass values equal to (or greater than) the maximum station average (297.9 g/m^2) and is linear from 0 to 1 for values less than the maximum station average.

K, NH4, PO4 (Vsnn) – These three nutrients were measured in sediment collected for each vegetation strata (determined by dominant species) at those stations where push cores could be collected. Each nutrient-specific subindex has a value of 1 for station concentrations equal to (or greater than) the maximum station average measured (86.3 mg/kg for K, 28.9 mg/kg for NH4, and 309.4 mg/kg for PO4) and is linear from 0 to 1 for lower concentrations. The final subindex (Vsnn) used in FCI calculations is the average of the three nutrient-specific subindex values.

DENSITY/NUMBER OF STEMS (Vsavdense) – Input data are the number of stems by species per quadrat per station. These measurements were summed for all species within each quadrat, converted to stems/m^2 (by multiplying by 8), then averaged across quadrats to calculate an average shoot density measurement for each station. The subindex receives a value of 1 for shoot density values equal to (or greater than) the maximum station average (872 shoots/m^2). Vsavdense is linear from 0 to 1 for densities less than the maximum station average.

TOC (Vtoc) – Input data are the measured TOC, in mg/kg, from the SSAP data nearest the sampling station. When multiple SSAP data existed, the values were then averaged by station. Vtoc is a one-sided index with no upper limit. Vtoc has a value of 1 for TOC concentrations equal to (or above) the maximum station average (52,277 mg/kg) and is linear from 0 to 1 for values less than the maximum station average.

FINES (Vfines) – Input data are the percent fines from the SSAP data (from the top 2 inches of the core) nearest the sampling quadrats. Vfines is a one-sided index with no lower limit. Vfines has a value of 1 for percent fines equal to (or below) the minimum station average measured (33.6%) and is linear from 1 to 0 for values greater than the minimum station average. Unlike percent fines in the unconsolidated river bottom habitat, higher values for percent fine in aquatic vegetation beds can indicate increased deposition and sediment stabilization provided by the presence of the aquatic vegetation (Madsen et al., 2001).

PERCENT COVER (Vsavcover) – Input data are the percent cover of the aquatic vegetation (and does not include debris, rocks, logs, etc.) measured for each quadrat at each station. Percent cover is determined by visual observation of the sampling quadrat using SCUBA. Values were averaged across quadrats to obtain station averages. The subindex value is 1 for percent cover equal to the maximum station average (85.6%). Vsavcover is linear from 0 to 1 for percent cover less than the maximum station average, and linear from 1 to 0.7 for percentages between the maximum and 100%. The subindex decreases from 1 for percent cover values greater than the maximum station average because aquatic vegetation that is too dense can impede fish access and movement (Stuber et al., 1982). However, the subindex does not fall to 0 for higher percent cover values because there is still value associated with the presence of aquatic vegetation.

Natural Shorelines

DOWNFALL/WOODY DEBRIS (Vdown) – Input data are the number, diameter, and length of fallen trees. The total area of woody debris was calculated for each sample, and then averaged by station. Vdown is a one-sided index with no upper limit. Vdown has a value of 1 for downfall values equal to (or above) the maximum station average measured (478.6 square meters). Vdown is linear from 0 to 1 for downfall values less than the maximum station average.

BANK ASSESSMENT (Vbankstab) – Input data are the percent of the bank that is stable, moderately stable, moderately unstable, or unstable. Each category has an associated weight to enable a weighted sum to be calculated for each sample. The following weights, derived from the percent of erosion present for each category from Barbour et al. (1999) were used:

- Stable = 0;
- Moderately stable = 0.05;
- Moderately unstable = 0.3; and
- Unstable = 0.6.

The weighted sum was subtracted from 1 so that higher values indicate more preferable conditions to be consistent with the other subindices. Using these values, an average value was calculated for each station. Vbankstab is a one-sided index with no upper limit. Vbankstab has a value of 1 for stability values equal to the maximum station average measured (100%) and is linear from 0 to 1 for values less than the 100%.

BANK VEGETATION (Vbankveg) – Input data recorded onsite is the percent of the bank that is covered by vegetation. Each category has an associated weight to enable a weighted sum to be calculated for each sample. The following weights were derived from the percent cover for each category from Barbour et al. (1999):

- Optimal = 1;
- Suboptimal = 0.9;
- Marginal = 0.7; and
- Poor = 0.5.

The weighted sum was calculated for each sample, and then averaged by station. Vbankveg is a one-sided index with no upper limit. Vbankveg has a value of 1 for bank vegetation values equal to (or greater than) the maximum station average measured (100%) and is linear from 0 to 1 for values less than the maximum station average.

RIPARIAN (Vdown) – Input data are the percent cover of the riparian edge in the canopy, understory, and herbaceous layers. Vriparian is a one-sided index with no upper limit. Each of the three cover-type subindices has a value of 1 for values equal to (or greater than) the maximum station average measured (70%, 85%, and 100%, respectively). Each subindex is linear from 0 to 1 for values less than the maximum station average value. The riparian subindex (Vriparian) value used in FCI calculations is the average of the three riparian subindex values for the canopy, understory, and herbaceous layers.

<u>Riverine Fringing Wetlands</u>

SLOPE (Vwetslope) – Input data are slope measurements derived from three transects in each wetland. Distance from shore and elevation was used to estimate the slope along each transect. The slopes from each transect were combined to obtain an average slope for each wetland. Vwetslope is a two-sided index with no lower limits. Vwetslope has a value of 1 for slopes equal to and between the slopes at Phase 1 riverine fringing wetland stations (9.02 and 11.4). The subindex is linear from 0 to 1 for slope estimates below the existing wetland slopes, and from 1 to 0 for slope estimates greater than existing wetland slopes.

CONTIGUOUS (Vcontig) – Input data are the percent of each wetland edge that is contiguous with adjacent undisturbed habitat(s). The percentage is based on the entire wetland edge and includes both the upland edge of the wetland which may be contiguous with terrestrial habitats and the riverine edge of the wetland which may be contiguous with aquatic vegetation beds. Vcontig has a value of 1 for contiguous values equal to (or greater than) the maximum measurement (100%) and is linear from 0 to 1 for values less than that.

WETLAND EDGE (Vwetedge) – Input data are the length of each wetland edge in feet. Vwetedge has a value of 1 for edge lengths equal to (or greater than) the maximum measured wetland edge (437 feet) and is linear from 0 to 1 for values less than that.

Wetlands, By Vegetation Community

The following transformations are completed using data obtained from the vegetation communities that exist within each of the riverine fringing wetlands sampled for Phase 1. Transformations are performed for each vegetation community within the wetland and then averaged to provide a single value to represent the entire wetland as described by Shafer and Yozzo (1998).

BIOMASS (Vwetbio) – Input data are the amount of live and dead aboveground biomass by species for each quadrat in each vegetation community strata in each wetland. Biomass was summed across all species to get total biomass by quadrat within each vegetation community strata in each wetland. Vwetbio has a value of 1 for quadrat biomass values equal to (or greater than) the maximum quadrat biomass measurement in the vegetation community strata and is linear from 0 to 1 for values less than that. A separate biomass subindex was calculated for each vegetation community strata present. The maximum vegetation community biomass values ranged from 171.3 grams per square meter (g/m^2) for great burreed to 288.1 g/m^2 for rice cutgrass. The final biomass subindex value used in FCI calculations is the average of the applicable vegetation community strata-specific subindices.

DENSITY/NUMBER OF STEMS (Vwetdense) – Input data are the number of live stems by species for each quadrat in each vegetation community strata of each wetland. The number of stems was averaged across species within each quadrat in each vegetation community strata of each wetland. Vwetdense has a value of 1 for quadrat density values equal to (or greater than) the maximum quadrat density measurement and is linear from 0 to 1 for values less than that. A separate density subindex was calculated for each vegetation community strata present. The maximum vegetation community stem density ranged from 16.8 stems per square meter ($stems/m^2$) for great burreed to 237.6 $stems/m^2$ for creeping spikerush. The final density subindex value used in FCI calculations is the average of the applicable vegetation community strata-specific subindices.

STEM LENGTH (Vwetlength) – Input data are the measured stem lengths for each species in each quadrat in each vegetation community strata of each wetland. The replicates were averaged for each species within each quadrat of each wetland. Vwetlength has a value of 1 for quadrat stem length values equal to (or greater than) the maximum quadrat measurement and is linear from 0 to 1 for values less than that. A separate stem length subindex was calculated for each vegetation community strata. The maximum quadrat average stem length ranged from 32.1 centimeters (cm) for creeping spikerush to 96.2 cm for great burreed. The final stem length subindex value used in FCI calculations is the average of the applicable vegetation community strata-specific subindices.

STEM DIAMETER (Vwetthick) – Input data are the measured stem diameters for each species in each quadrat in each vegetation community strata of each wetland. The replicates were averaged for each species within each quadrat of each wetland. Vwetthick has a value of 1 for quadrat stem diameter values equal to (or greater than) the maximum quadrat measurement and is linear from 0 to 1 for values less than that. A separate stem diameter subindex was calculated for each vegetation community strata. The maximum quadrat average stem diameter ranged from 0.12 cm for rice cutgrass to 1.1 cm for great burreed. The final stem diameter subindex value used in FCI calculations is the average of the applicable vegetation community strata-specific subindices.

% COMPOSITION OF DOMINANT SPECIES (Vwetspp) – Input data are the proportion of quadrat total biomass that is from the dominant species (determined by aboveground biomass) for each vegetation community strata. The ratio of dominant species to total quadrat biomass was calculated for each quadrat in each vegetation community strata of each wetland. Each strata subindex has a value of 1 for percentages equal to the minimum quadrat average percentage, and is linear from 0 to 1 for values below that minimum and from 1 to 0.20 for values above that minimum. The subindex does not fall to 0 when the wetlands are dominated by one species because, although it is not as preferable as a diverse vegetation community, there is still value associated with the presence of vegetation. Minimum percent compositions ranged from 14% for rice cutgrass to 99% for great burreed. The final percent composition subindex value used in FCI calculations is the average of the applicable vegetation community strata-specific subindices.

% NUISANCE SPECIES (Vwetnuisance) – Input data are the proportion of quadrat total biomass that is from nuisance species (determined by aboveground biomass) for each vegetation community strata. Nuisance species were purple loosestrife and reed canary grass. The ratio of nuisance species to total quadrat biomass was calculated for each quadrat in each vegetation community strata of each wetland. Each strata subindex has a value of 1 for percentages equal to the minimum quadrat average percentage and is linear from 1 down to 0 for percentages greater than the minimum. Percent nuisance species was 0% (subindex = 1) for all vegetation communities except rice cutgrass which was approximately 10% (subindex = 0.975) nuisance species. The final percent composition subindex value used in FCI calculations is the average of the applicable vegetation community strata-specific subindices.

D. Habitat Suitability Index (HSI) Models

Data were collected under various programs to calculate HSI model scores for River Section 1 (Thompson Island Pool). HSI values were calculated for the entire reach and separately for target and reference areas and are reported in Section 2 of the Phase 1 AM Plan.

Selected Species

The representative species for which HSI models have been calculated are shown in Table B-5 below. The rationale for the selection of these representative species was provided in the Phase 1 HA Report.

Where models exist for both lacustrine and riverine environments, the riverine models were used. In some cases, such as with the great blue heron, only one index of the overall HSI will be used (the foraging index) as the remaining variables are specific to habitats unlikely to be impacted by remedial activities (i.e., forested wetlands off the river). A rationale for the exclusion of certain variables from the HSI models was provided in Appendix I of the Phase 1 HA Report.

Table B-5 – List of Species for HSI Models

Species (Scientific Name)	Associated Habitat	Rationale
Birds		
Belted Kingfisher (*Ceryle alcyon*)	SHO, UCB	• Habitat potentially impacted by dredging • Forested habitat along edge of the river provides foraging and nesting • River likely provides suitable prey population
Great Blue Heron (*Ardea herodius*)	SHO, UCB, WET, SAV	• Habitat within range of nesting sites • River likely provides suitable prey population • HSI model for Upper Hudson River will only use the foraging index within the overall HSI
Wood Duck (*Aix sponsa*)	SHO, UCB, WET, SAV	• Forested wetlands along river provide potential nesting sites • Overhang and downfall along natural shorelines provide potential cover
Mammals		
Mink (*Mustela vison*)	SHO, WET	• Portions of potential mink habitat in near-shore areas could be impacted by remedial activities; therefore mink has been retained as requested by the United States Environmental Protection Agency (EPA)
Muskrat (*Ondatra zibethicus*)	SHO, WET, SAV	• Abundant herbaceous vegetation on shoreline and in wetlands • Low flow conditions of Upper Hudson River still provide surface water

Species (Scientific Name)	Associated Habitat	Rationale
		• Tracks frequently observed during assessment of fringing wetlands
Fish		
Yellow Perch (*Perca flavescens*)	UCB, SAV	• Habitat potentially impacted by dredging • Recreational species • Predator/invertivore
Largemouth Bass (*Micropterus salmoides)*	UCB, WET, SAV	• Habitat potentially impacted by dredging • Recreational species • Top predator
Smallmouth Bass (*Micropterus dolomieui*)	UCB. SAV	• Habitat potentially impacted by dredging • Predator/invertivore
Common Shiner (*Notropis cornutus*)	UCB, WET, SAV	• Habitat potentially impacted by dredging • Representative HSI species for Cyprinidae • Forage base for predatory fish and fish-eating birds
Bluegill (*Lepomis macrochirus*)	UCB, WET, SAV	• Large woody debris and SAV provide cover
Reptiles/Amphibians		
Snapping Turtle (*Chelydra serpentina*)	SHO, UCB, WET, SAV	• Small tributaries and backwaters present along river edge • Depths in river exceed ice depth; provides overwintering

Notes:
1. UCB = Unconsolidated river bottom
2. SAV = Submerged aquatic vegetation
3. SHO = Shoreline
4. WET = Wetland

Data Sources

In accordance with the EPA-approved *Supplemental Habitat Assessment Work Plan* (SHAWP) (BBL and Exponent, 2005c), data collected as part of ongoing monitoring programs were used to complete the HSI models for the selected species. Data sources included: water quality data from the Hudson River Baseline Monitoring Program (QEA, 2004), water quality and habitat assessment data from the Habitat Delineation and Assessment Program (BBL and Exponent, 2005a), bathymetric survey data (QEA, 2003), habitat delineation data (BBL and Exponent, 2005b), and aerial photography (Sanborn, Inc., 2003). Some suitability indices were determined based on defined categories (such as soil type or specific pH range); while others were based on calculated values (i.e. mean temperature). Once variables were calculated, the suitability index for that variable was obtained by interpolation using curves provided in each HSI model. The suitability indices for individual variables were then used to compute component suitability indices (e.g., food, cover, reproduction) from which the final HSIs were calculated. A summary of final HSI values for all species is shown in Table B-6 (attached).

Some of the HSI values may be biased by spatial and temporal data limitations. For example, the calculated HSI for yellow perch for River Section 1 is 0.0. However, based on the Baseline Monitoring Program (BMP) fish sampling data, yellow perch are common in River Section 1. The low HSI value is the result of the winter degree days variable (number of days with water temperature between 4 and 10^{O}C during the winter). The only temperature data available, from the Upper Hudson River BMP, is sparse during the winter due to ice cover, thus giving an estimate of winter degree days that is likely biased low. A potential solution to this problem is to calculate the HSI models using only those variables that will, or are likely to be altered by the remediation project. This approach has been used for the application of HSI models elsewhere (Madsen et al., 1998).

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Table B-6 - Suitability Indices Calculations for Representative Fish Indicator Species

	Target Areas		Reference Areas		All Areas					
Variable	**Value**	**SI**	**Value**	**SI**	**Value**	**SI**	**Description**	**Calculation**	**Data Source**	**Comments**
Yellow Perch										
V2	99.77	0.31	96.25	0.39	97.20	0.37	% pool and backwater during average summer flow	Determined in GIS: pool area as a % of reach area	Summer 2003 aerial photography	
V3	30.71	1.00	25.34	1.00	26.82	1.00	% cover during summer within pools and backwaters	Determined in GIS: vegetative and nonvegetative cover as % of pool and backwater area	2003 habitat survey and OSI RS1 SSS debris* data	
V4	22.00	1.00	22.00	1.00	22.00	1.00	Most suitable temperature (°C) during midsummer - adults, juveniles, and fry	Find the temperature closest to 22°C between July 1 and August 31	BMP and Habitat Assessment data (2003 - 2005)	
V5	11.13	1.00	11.13	1.00	11.13	1.00	Most suitable temperature (°C) during spawning and embryo development within pools and backwaters	Find the temperature closest to 10.5°C in April to June	BMP data	
V6	8.76	1.00	8.76	1.00	8.76	1.00	Minimum D.O. (mg/L) during the growing season at the locations where the most suitable temperatures were observed	Find minimum D.O. between May 1 and October 1 - at the same locations as the most suitable temperature observations (V4 & V5)	BMP and Habitat Assessment data (2003 - 2005)	
V7	215.20	0.00	215.20	0.00	215.20	0.00	Degree days (4-10°C) from October 30 to April 1	Multiply average of weekly temperature measurements in RS1, between 4 and 10°C, by 7 days; calculate total	BMP data	Limited sites and dates during the winter may lead to a low estimate of degree days
V8		1.00		1.00		1.00	pH range throughout year	Determine max and min pH and 2 standard errors (stderr) from the mean: SI = 1.0 if mean-2stderr > 6.5 and mean+2stderr < 8.5; SI = 0.5 if pH is 5.5 - 6.5 or 8.5 - 9.5; SI = 0.25 if mean+2 stderr < 6.5 and mean-2stderr > 4.5 and min <4.5 or mean+2 stderr < 9.5 and mean-2stderr ge 8.5 and max > 9.5; SI = 0.1 if mean-2stderr < 4.5 or mean+2stderr > 9.5	BMP data	Excluded extreme low measurement on 5/16/05 and values > 12; Habitat Assessment data was not used due to pH probe issues
HSI		0.00		0.00		0.00	Habitat suitability index	Minimum SI value		
Largemouth Bass										
V1	99.77	1.00	96.25	1.00	97.20	1.00	% pool and backwater during summer	Determined in GIS: pool area as a % of reach area	Summer 2003 aerial photography	
V3	30.71	0.81	25.34	0.71	26.82	0.74	% bottom cover during summer - vegetative and non-vegetative for adults and juveniles	Determined in GIS: vegetative and non-vegetative area as % of pool area	2003 Habitat delineation and OSI SSS debris data	

Table B-6 - Suitability Indices Calculations for Representative Fish Indicator Species

Variable	Target Areas		Reference Areas		All Areas		Description	Calculation	Data Source	Comments
	Value	SI	Value	SI	Value	SI				
V4	30.71	0.77	25.34	0.63	26.82	0.67	% bottom cover - vegetative and non-vegetative for fry	Determined in GIS: vegetative and non-vegetative area as % of pool area	2003 Habitat delineation and OSI SSS debris data	
V6		1.00		1.00		1.00	Minimum D.O. during midsummer	Examine D.O. values during July and August: SI = 0.1 if more than 5 measurements are < 2.0; SI = 0.4 if 75% of D.O. measurements are between 2 and 5 ; SI = 0.4 if 75% of D.O. measurements are between 5 and 8; SI = 1.0 87.5% of measurements are greater than 8	BMP data	Assumed values < 4.0 were erroneous and the river was not anoxic during these periods (C. Yates)
V7		1.00		1.00		1.00	pH range throughout the growing season	Find whether 85% of pH measurements fall within the following ranges: SI = 0.1 if pH < 5.0 or pH > 10.0; SI = 0.5 if range is 5.0 < pH < 6.5 or 8.5 < pH < 10.0; SI = 1.0 if range is 6.5 < pH < 8.5	BMP data	Habitat Assessment data was not used due to pH probe issues
V8	20.35	0.59	20.39	0.60	20.38	0.60	Average water temperature during growing season (adult and juvenile)	Mean temperature between May and October	BMP and Habitat Assessment data (2003 - 2005)	
V9	16.24	0.46	16.24	0.46	16.24	0.46	Mean weekly average water temperature during spawning and incubation (embryo)	Mean weekly average water temperature between May 1 and June 15	BMP data	
V10	20.35	0.49	20.39	0.49	20.38	0.49	Average water temperature during growing season (fry)	Mean temperature between May 1 and October 1	BMP and Habitat Assessment data (2003 - 2005)	
V11		0.30		0.30		0.30	Maximum monthly average turbidity during growing season	Maximum of monthly average turbidity between May and October: SI = 1.0 if max >= 5 ppm and max <= 25 ppm; SI = 0.7 if max > 25 ppm and max <= 100 ppm; SI = 0.3 if max < 5 ppm or max > 100 ppm	BMP and Habitat Assessment data (2003 - 2005)	Converted from turbidity units NTU to ppm according to Dahlgren et al. (2004)*. 1 ppm = 1-2 NTU
V12	0.99	1.00	0.99	1.00	0.99	1.00	Maximum salinity during summer (adult and juvenile)	Maximum salinity between June 15 to September 15	BMP and Habitat Assessment data (2003 - 2005)	
V13	0.99	1.00	0.99	1.00	0.99	1.00	maximum salinity during summer (fry)	Maximum salinity between June 15 to September 15	BMP and Habitat Assessment data (2003 - 2005)	

Table B-6 - Suitability Indices Calculations for Representative Fish Indicator Species

	Target Areas		Reference Areas		All Areas					
Variable	Value	SI	Value	SI	Value	SI	Description	Calculation	Data Source	Comments
V14	0.11	1.00	0.11	1.00	0.11	1.00	maximum salinity during spawning and incubation (fry)	Maximum salinity between May 1 to June 15	BMP data	
V15		0.30		0.30		0.30	Substrate composition within pools and backwaters (embryo)	Looked at overall description and primary sediment type data in top segment of cores: SI = 0.3 if predominant sediment type is rock; SI = 0.5 if predominant sediment type was sand; SI = 0.8 if predominant sediment type is silt or clay; SI = 1.0 if predominant sediment type is gravel	SSAP sediment data (in Locations (probing data) and Description tables)	only found which primary sediment type was most prevalent, not necessarily > 50%
V16	1.68	0.83	1.68	0.83	1.68	0.83	Average water level fluctuation (m) during growing season (adult and juvenile)	Average maximum water level fluctuation between May 1 and October 1	water level data from Canal Corp. (2001 - 2003)	
V17	1.23	0.96	1.23	0.96	1.23	0.96	Max water level fluctuation (m) during spawning (embryo)	Maximum water level fluctuation between May 1 and June 15	water level data from Canal Corp. (2001 - 2003)	
V18	1.68	1.00	1.68	1.00	1.68	1.00	Average water level fluctuation (m) during growing season (fry)	Average maximum water level fluctuation between May 1 and October 1	water level data from Canal Corp. (2001 - 2003)	
V19	0.27	1.00	0.32	1.00	0.31	1.00	Average current velocity at 60% depth during summer (adults and juveniles)	Average current at 60% depth between June 15 and Sept. 15	Habitat Assessment data (2003 - 2005)	
V20	1.22	1.00	1.22	1.00	1.22	1.00	Maximum current velocity at 80% depth during spawning in pools and backwaters (embryo)	Maximum current at 80% depth between May 1 and June 15	Habitat Assessment data (2003 - 2005)	Not from spawning period
V21	0.27	1.00	0.32	1.00	0.31	1.00	Average current velocity at 60% depth during summer (fry)	Average current at 60% depth between June 15 and September 15	Habitat Assessment data (2003 - 2005)	
V22	0.27	1.00	0.27	1.00	0.27	1.00	Stream gradient in reach (m/km)	Determined in GIS: measured elevation difference from north of reach to south of reach (m) and total reach length (km): gradient in m/km	2001 OSI RS1 bathymetry data	
SIF		0.89		0.82		0.84	Food Suitability Index	(SI1 * ((SI3+SI4)/2)^(1/2)		
SIC		0.90		0.85		0.86	Cover Suitability Index	(SI1 * ((SI3+SI4)/2) * ((SI16+SI18)/2))^(1/3)		

Table B-6 - Suitability Indices Calculations for Representative Fish Indicator Species

Variable	Target Areas		Reference Areas		All Areas		Description	Calculation	Data Source	Comments
	Value	SI	Value	SI	Value	SI				
SIWQ		0.71		0.71		0.71	Water Quality Suitability Index	((2 * SI6) + SI7 +(2 * SI8) + SI10 +SI11)/7		SI12 or SI13 = 1.0
								((2 * SI6) + SI7 +(2 * SI8) + SI10 +SI11 + ((SI12 + SI13)/2))/8		SI12 and SI13 < 1.0
								minimum(SI6, SI8, SI10, SIWQ)		SI6, SI7, SI8, or SI10 < 0.4
SIR		0.67		0.67		0.67	Reproduction Suitability Index	(SI1 *SI9 * SI15 * SI17 * SI20)^ (1/5)		SI4 = 1.0
								(SI1 *SI9 * SI14 * SI15 * SI17 * SI20)^ (1/6)		SI4 < 1.0
SIO		1.00		1.00		1.00	Other Suitability Index	SI22		
HSI		0.82		0.80		0.81	Habitat Suitability Index	(SIF * SIC * SIWQ * SIR * SIO)^(1/5)		
Smallmouth Bass										
V1		0.20		0.20		0.20	Dominant substrate type within pools and backwaters	Looked at overall description and primary type sediment data in top segment of cores: SI = 0.2 if predominant sediment type is silt or sand; SI = 0.3 if predominant sediment type is pebbles; SI = 1.0 if predominant sediment type is gravel; SI = 0.2 if predominant sediment type is rock	SSAP sediment data in Locations and Description tables	Predominant sediment type only means the most common, not necessarily > 50%
V2	99.77	0.21	96.25	0.32	97.20	0.29	% pools	Determined in GIS: pool area as % of reach area	Summer 2003 aerial photography	
V4	3.05	1.00	2.90	1.00	2.93	1.00	Average depth (m) of pools during midsummer	Determined in GIS: mean of all bathymetry grid cells in reach at 3,661 cfs	QEA hydrodynamic model grid	
V5	30.71	1.00	25.34	1.00	26.82	1.00	% cover nonvegetative (adults) or vegetative (fry)	Determined in GIS: vegetative and nonvegetative cover as % of reach area	2003 Habitat delineation and OSI side-scan sonar debris data*	
V6	7.57	0.91	7.57	0.91	7.57	0.91	Average pH during year	Average of all pH measurements	BMP data	Excluded extreme low value on 5/16/05 and values > 12; Habitat Assessment data was not used due to pH probe issues

Table B-6 - Suitability Indices Calculations for Representative Fish Indicator Species

Variable	Target Areas Value	Target Areas SI	Reference Areas Value	Reference Areas SI	All Areas Value	All Areas SI	Description	Calculation	Data Source	Comments
V8	4.18	0.47	4.18	0.47	4.18	0.47	Minimum D.O. (ppm) throughout the year	Minimum D.O. (ppm) measurement	BMP and Habitat Assessment Data (2003 - 2005)	Assumed values < 4.0 were erroneous and the river was not anoxic during these periods (C. Yates)
V9	3.64	1.00	3.64	1.00	3.64	1.00	Maximum monthly average turbidity (JTU) during summer	Maximum of monthly average turbidity between June 15 and Sept 15	BMP and Habitat Assessment Data (2003 - 2005)	BMP and Habitat data are in NTU; JTU is approximately equal to NTU
V10	21.26	0.91	21.21	0.91	21.15	0.90	Water temperature (^{o}C) in selected habitat during May-Oct. (adults)	Mean water temperature May 1 to Oct 1	BMP and Habitat Assessment Data (2003 - 2005)	Temperature measurements were not all collected in the specific habitat
V11	20.08	1.00	20.08	1.00	20.08	1.00	Water temp. (^{o}C) in selected habitat during spawning and 45 after (embryo)	Mean water temp between April 15 and July 31	BMP data	Due to limited temperature data measurements are not all taken in selected areas
V12	21.26	0.92	21.21	0.92	21.15	0.92	water temperature in selected habitat during May-Oct. (fry)	Mean water temp May 1 to Oct 1	BMP and Habitat Assessment Data (2003 - 2005)	
V13	21.26	0.93	21.21	0.93	21.15	0.93	Water temperature (^{o}C) in selected habitat during May-Oct. (juvenile)	Mean water temp May 1 to Oct 1	BMP and Habitat Assessment Data (2003 - 2005)	
V14		1.00		1.00		1.00	Water level fluctuation (m) during spawning and 45 days afterward	Determined water level difference between beginning and end of three time periods: (prior to May 1 = before); during spawning (May 1 - June 15 = spawn); after spawning (June 15 - July 31 = after). SI = 0.3 if spawn >= 1m and spawn <= 2 m; SI = 0.0 if spawn <= -0.5 m and after <= -0.5 m; SI = 1.0 if (0.5 m < before < 1.0 m) and -1.0 m < spawn < 1.0 m and -1.0 m < after < 1.0 m	Water level data from Canal Corp (2001 - 2003)	
V15	0.27	0.41	0.27	0.41	0.27	0.41	Stream gradient in reach (m/km)	Determined in GIS: measured elevation difference from north of reach to south of reach (m) and total reach length (km): gradient in m/km	2001 OSI RS1 bathymetry data	
SIF		0.35		0.40		0.39	Food Suitability Index	(SI1 * SI2 * SI5)^(1/3)		
SIC		0.60		0.63		0.62	Cover Suitability Index	(SI1 + SI2 + SI4 + SI5)/4		
SIWQ		0.84		0.84		0.84	Water Quality Suitability Index	((SI6 + SI8 + SI9 + (2 * ((SI10 * SI12 * SI13)^(1/3))))/5		

Table B-6 - Suitability Indices Calculations for Representative Fish Indicator Species

Variable	Target Areas Value	Target Areas SI	Reference Areas Value	Reference Areas SI	All Areas Value	All Areas SI	Description	Calculation	Data Source	Comments
SIR		0.71		0.71		0.71	Reproduction Suitability Index	((SI11^2) * SI14 * SI1 * SI5 * SI8 * SI9)^(1/7)		
SIO		0.41		0.41		0.41	Other Suitability Index	SI15		
HSI		0.55		0.57		0.57	Habitat Suitability Index	(SIF * SIC * SIWQ * SIR * SIO)^(1/5)		SIWQ and SIR > 0.6
								Minimum(SIWQ, SIR, HSI)		SIWQ or SIR < 0.6
Bluegill										
V1	99.77	1.00	96.25	1.00	97.20	1.00	Percent pool area during average summer flow	Determined in GIS; pool area as % of the reach area	Summer 2003 aerial photography	
V2	6.77	0.47	8.23	0.53	7.82	0.51	Percent cover - nonvegetative	Determined in GIS; nonvegetative cover as % of pool area	OSI side-scan sonar debris data	
V3	24.71	1.00	17.86	1.00	19.75	1.00	Percent cover - vegetative only	Determined in GIS; vegetative cover as % of pool area	2003 habitat survey GIS data	
V6	2.44	1.00	2.44	1.00	2.44	1.00	Maximum monthly average turbidity (ppm) during average summer flows	Maximum of monthly average turbidity between June 15 and Sept. 15	BMP data	Converted from NTU to ppm by multiplying by 0.67. (1-2 NTU/ ppm (Dahlgren et al. 2004))
V7		1.00		1.00		1.00	pH range during growing season	Find whether 85% of pH measurements (May 1 to Oct. 1) fall within the following ranges: SI = 0.1 if pH < 5.0 or pH > 10.0; SI = 0.2 if range is 5.0 < pH < 6.0 or 9.0 < pH < 10.0; SI = 0.5 if range is 6.0 < pH < 6.5 or 8.5 < pH < 9.0; SI = 1.0 if range is 6.5 < pH < 8.5	BMP data	Eliminated extreme low values from 5/16/05 and values > 12; Habitat Assessment data was not used due to pH probe issues
V8		1.00		1.00		1.00	D.O. (ppm) range during summer	Determined +/- 2 stderr of the mean from June 15 to Sept. 15: SI = 1.0 if -2stderr ge 5; SI = 0.7 if -stderr < 3 and +stderr > 5; SI = 0.25 if -stderr < 1.5 and +stderr > 3; SI = 0.1 if +stderr < 1.5	BMP and Habitat Assessment Data (2003 - 2005)	
V9	0.10	1.00	0.10	1.00	0.10	1.00	Maximum average monthly salinity (ppm) during growing season	Maximum of monthly average salinity between May 1 and October 1	BMP and Habitat Assessment Data (2003 - 2005)	Optional
V10	26.56	0.99	26.56	0.99	26.56	0.99	Maximum midsummer temperature (^{o}C) (adults)	Maximum temperature between July 1 and August 31	BMP data	

Table B-6 - Suitability Indices Calculations for Representative Fish Indicator Species

Variable	Target Areas		Reference Areas		All Areas		Description	Calculation	Data Source	Comments
	Value	SI	Value	SI	Value	SI				
V11	20.60	0.65	20.60	0.65	20.60	0.65	Average mean weekly water temperature (°C) during spawning (embryo)	Mean weekly temperature between May 15 to July 15	BMP data	
V12	24.45	0.96	24.45	0.96	24.45	0.96	Maximum early summer temperature (°C) (fry)	Maximum temp between June 1 and July 1	BMP data	
V13	26.56	0.79	26.56	0.79	26.56	0.79	Maximum midsummer temperature (°C) (juveniles)	Maximum temp between July 1 and August 31	BMP data	
V14	0.32	1.00	0.35	1.00	0.33	1.00	Average current velocity (cm/s) during growing season in pools and backwaters (adult)	Average current velocity throughout water column (May 1 to Oct. 1)	Habitat Assessment Data (2003 - 2005)	Habitat data is from late summer
V15	0.32	1.00	0.35	1.00	0.33	1.00	Average current velocity (cm/s) in spawning areas (embryo)	Average current velocity throughout water column May 15 to July 15	Habitat Assessment Data (2003 - 2005)	Habitat data is from late summer
V16	0.32	1.00	0.35	1.00	0.33	1.00	Average current velocity (cm/s) in pools during early summer (fry)	Average current velocity throughout water column June 1 to July 1	Habitat Assessment Data (2003 - 2005)	Habitat data is from late summer
V17	0.32	1.00	0.35	1.00	0.33	1.00	Average current velocity (cm/s) during the growing season (juvenile)	Average current velocity throughout water column May 1 to Oct. 1	Habitat Assessment Data (2003 - 2005)	Habitat data is from late summer
V18	0.27	1.00	0.27	1.00	0.27	1.00	Stream gradient in reach (m/km)	Determined in GIS: measured elevation difference from north of reach to south of reach (m) and total reach length (km): gradient in m/km	2001 OSI RS1 bathymetry	
V20		1.00		1.00		1.00	Substrate composition within pools (embryo)	SI = 1.0 b/c gravel and fines are present in all river sections		
SIF		0.78		0.81		0.80	Food Suitability Index	(SI1 * SI2 * SI3)^(1/3)		
SIC		0.74		0.76		0.76	Cover Suitability Index	(SI2 + SI3)/2		
SIWQ		0.97		0.97		0.97	Water Quality Suitability Index	(SI6 + SI7 + (2 * SI8) + SI9 + (2 * [(SI10 * SI12 * SI13)^(1/3)]))/7		SI8 or (2 * [(SI10 * SI12 * SI13)^(1/3)]) > 0.4
								Minimum(SI8, (2 * [(SI10 * SI12 * SI13)^(1/3)]), SI9)		SI8 or (2 * [(SI10 * SI12 * SI13)^(1/3)]) < 0.4
SIR		0.87		0.87		0.87	Reproduction Suitability Index	(SI11 * SI15 * SI20)^(1/3)		
SIO		1.00		1.00		1.00	Other Suitability Index	(((SI14 + SI16 + SI17)/3) + SI18)/2)		
HSI		0.88		0.89		0.89	Habitat Suitability Index	(SIF * SIC * (SIWQ^2) * SIR * SIO)^(1/6)		SIWQ or SIR > 0.4
								Minimum(SIF, SIC, SIWQ, SIR, SIO)		SIWQ or SIR < 0.4

Table B-6 - Suitability Indices Calculations for Representative Fish Indicator Species

Variable	Target Areas		Reference Areas		All Areas		Description	Calculation	Data Source	Comments
	Value	SI	Value	SI	Value	SI				
Common Shiner										
V1	26.00	0.30	26.00	0.30	26.00	0.30	Maximum summer temp. persisting for > 1 week	Determined the first and last day within each year where the temperature was > each unique temperature and found the maximum temperature with a duration greater than 7 days	BMP data	Could not use Habitat data because dates were not kept in data, just years
V2	8.57	1.00	8.57	1.00	8.57	1.00	Least suitable pH occurring during year	Determined the pH with the greatest absolute difference from 7.5	BMP data	Excluded 5/16/05 extreme low values and values > 12; Habitat Assessment data was not used due to pH probe issues
V3	1.74	1.00	1.71	1.00	1.75	1.00	Average turbidity in JTU	Mean of turbidity throughout year	BMP and Habitat Assessment Data (2003 - 2005)	BMP and Habitat data are in NTU; JTU is approximately equal to NTU
V4		0.10		0.50		0.50	Predominant substrate in riffles or shoals	Examined overall description and sediment type data in top 12 inches of cores in riffle areas masked out in GIS: SI = 0.1 if predominant sediment is silt or organic; SI = 0.5 if predominant sediment type is fine sand; SI = 1.0 if sediment is predominantly gravel and sand; SI = 0.8 if predominant sediment type is rubble; SI = 0.2 if predominant sediment type is rock	SSAP sediment data in Locations and Description tables	Predominant sediment type only means the most common, not necessarily > 50%
V5	99.77	0.60	96.25	0.64	97.20	0.63	Percent pools	Determined in GIS: pool area as a % of reach area	Summer 2003 aerial photography	
V6	8.26	0.97	9.90	1.00	9.34	0.99	Average current velocity at 60% of depth in pools	Average current velocity at 60% of depth in pools	Habitat Assessment data (2003-2005)	
V7		0.40		0.40		0.40	Predominant pool class	SI = 0.4 b/c the predominant pool class is large and deep		
V8	18.02	0.89	18.02	0.89	18.02	0.89	Average water temp. (^{o}C) in spawn habitat during spawn	Average temperature from May 1 to July 1	BMP data	Data are not specifically from spawning habitat
V9	14.49	0.90	16.22	1.00	13.27	0.65	Average current velocity (cm/s) just above substrate in riffle	Used average current velocity from 10 cm above the substrate in UCB stations where water depth was less	Habitat Assessment data (2003-2005)	There was no velocity data from riffle areas; UCB stations with water depth < 200 cm were used as an approximation

Table B-6 - Suitability Indices Calculations for Representative Fish Indicator Species

Variable	Target Areas		Reference Areas		All Areas		Description	Calculation	Data Source	Comments
	Value	SI	Value	SI	Value	SI				
SIFC		0.10		0.63		0.63	Food and Cover Suitability Index	(SI4 + SI5 + SI6 + SI7)/4		All suitability indices are > 0.4
								Minimum(SI4,SI5,SI6,SI7)		Any of the suitability indices are < 0.4
SIWQ		0.30		0.30		0.30	Water Quality Suitability Index	(SI1 * SI2 * SI3)^(1/3)		All suitability indices are > 0.4
								Minimum(SI1,SI2,SI3)		Any of the suitability indices are < 0.4
SIR		0.52		0.79		0.71	Reproduction Suitability Index	((SI8^2) * SI4 * SI9)^(1/4)		All suitability indices are > 0.4
								Minimum(SI4,SI8,SI9)		Any of the suitability indices are < 0.4
HSI		0.10		0.30		0.30	Habitat Suitability Index	(SIFC * SIWQ * SIR)^(1/3)		SIFC, SIWQ or SIR > 0.4
								Minimum(SIFC,SIWQ,SIR)		SIFC, SIWQ or SIR < 0.4

Notes:

1. * Dahlgren, R.. E. VanNieuwenhuyse, and G. Litton. July-September 2004. "Transparency tube provides reliable water quality measurements". California Agriculture. University of California Division of Agriculture and Natural Resources. http://CaliforniaAgriculture.ucop.edu.

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Table B-6 - Suitability Indices Calculations for Non-Fish Representative Indicator Species

Variable	Target Areas		Reference Areas		All Areas		Description	Calculation	Data Source	Comments
	Value	SI	Value	SI	Value	SI				
Mink										
V1		1.00		1.00		1.00	% of year with surface water present	SI = 1.0 b/c surface water is always present in the Upper Hudson		
V2	100.00	1.00	89.00	0.89	96.00	0.96	% shoreline cover within 1 m of shoreline	Estimated using photography from 2005 habitat assessment	2005 field photos	Pertinent transect data was not taken in the field; photos were used as a substitute
V3	46.30	0.66	68.40	0.92	58.00	0.80	% tree and/or shrub canopy cover within 100 m of water's edge	Determined in GIS: visual estimate	Summer 2003 aerial photography and QEA Hudson River shoreline	
SIW		1.00		1.00		1.00	Water Suitability Index	SI1		
SIC		0.81		0.91		0.87	Cover Suitability Index	(SI2 * SI3)^(1/2)		
HSI		0.81		0.91		0.87	Habitat Suitability Index	Minimum SIW and SIC		
Wood Duck										
V3	1419.83	1.00	1419.83	1.00	1419.83	1.00	Density of potential nesting sites per 0.4 ha (1 acre)	((0.18*cavities)+(0.95*nest boxes)/nesting area)*100	Habitat Assessment data (2005)	
V4	8.46	0.17	9.73	0.19	9.39	0.19	% of water surface covered by potential brood cover	Determined in GIS: area of wetlands and overhanging trees as a percent of total reach area	Summer 2003 aerial photography and QEA Hudson River shoreline at 5000 cfs	
HSI		0.17		0.19		0.19	Habitat Suitability Index	Minimum(SI3,SI4)		
Snapping Turtle										
V1	21.97	0.77	21.84	0.76	21.73	0.74	Water temp at mid-depth during summer	Mean water temperature between June 15 and September 15	BMP data and habitat assessment data (2003 - 2005)	Used 60% depth measurements from Habitat Assessment Data
V2	8.26	0.88	9.90	0.85	9.34	0.86	Mean current velocity at mid-depth during mid-summer (cm/s)	Current velocity at 60% of depth	Habitat assessment data (2003 - 2005)	
V3	30.81	0.31	25.65	0.26	27.04	0.27	% aquatic vegetation in littoral zone	Calculated the % cover of aquatic vegetation for the entire reach	2003 Habitat delineation GIS data	See Section III E. of Attachment A of SHAWP
V4		1.00		1.00		1.00	Maximum water depth greater than ice depth during winter	SI = 1.0 b/c water depth is always greater than ice depth		
V5	24.01	0.24	24.01	0.24	24.01	0.24	% silt in substrate	Average % silt in top 12" of cores within the reach	SSAP Results_NonPCBs table	
V6	4.42	0.56	4.61	0.54	4.54	0.55	Distance to small stream	Determined in GIS: mean of measured distances to small streams from wetlands and shoreline stations	2003 Habitat delineation and shoreline transect GIS data	
V7		1.00		1.00		1.00	Distance to permanent water	SI = 1.0 b/c Hudson River is permanent water		

Table B-6 - Suitability Indices Calculations for Non-Fish Representative Indicator Species

Variable	Target Areas		Reference Areas		All Areas		Description	Calculation	Data Source	Comments
	Value	SI	Value	SI	Value	SI				
SIF		0.59		0.55		0.56	Food Suitability Index	(SI1 * SI2 * SI3)^(1/3)		
SIWC		0.24		0.24		0.24	Winter Cover Suitability Index	SIWC = SI4 * SI5		
SIR		0.56		0.54		0.55	Reproduction Suitability Index	SIR = SI6		
SII		1.00		1.00		1.00	Interspersion Suitability Index	SII = SI7		
HSI		0.43		0.41		0.42	Habitat Suitability Index	((SIF*SIWC*SIR)^(1/3))*SII		
Muskrat										
V2		1.00		1.00		1.00	% of year with surface water present	SI = 1 because surface water is present in the Hudson River year-round		
V3	0.27	1.00	0.27	1.00	0.27	1.00	Percent stream gradient	Determined in GIS: measured elevation diff. from north of reach to south of reach (m) and total reach length (km): gradient in m/km	2001 OSI RS1 bathymetry	
V4		1.00		1.00		1.00	% of river channel with water present during typical minimum flow	SI = 1 because there are no large drawdowns in the Hudson River		
V5	1.09	0.23	1.46	0.25	1.36	0.24	% of river channel dominated by emergent herbaceous veg	Determined in GIS (wetland cover as a % of total reach area)	2003 Habitat delineation	
V6	66.86	0.67	70.94	0.71	69.29	0.69	% herbaceous veg. cover within 10 m of water's edge	Mean % herbaceous cover of all shoreline stations in reach	Habitat Assessment Shoreline Data (2003 - 2005)	
SIF		0.62		0.62		0.62	Food Suitability Index	(((SI2 * SI3 * SI4)^(1/3)) + SI5)/2		
SIC		0.57		0.60		0.59	Cover Suitability Index	(SI6 + 2(SI5)) / 2		if SIF gt 1.0 then SIF = 1.0
HSI		0.57		0.60		0.59	Habitat Suitability Index	Minimum(SIF,SIC)		
Great Blue Heron										
V1	7.15	0.39	8.34	0.27	7.76	0.32	Distance between heronry areas and foraging sites	Calculated average distance between heronries and potential forage areas within reach	NYSDEC et al. 2004	
V2		1		1		1.00	Presence of water body with suitable prey population and foraging substrate	SI set to 1.0 because the Upper Hudson is assumed to support a suitable fish population and foraging substrate		

Table B-6 - Suitability Indices Calculations for Non-Fish Representative Indicator Species

Variable	Target Areas		Reference Areas		All Areas		Description	Calculation	Data Source	Comments
	Value	SI	Value	SI	Value	SI				
V3		1		1		1.00	A disturbance free zone up to 100 m around potential foraging areas	Determined in GIS areas within the reach with water depth < 0.5 meters and a 100 m exclusion zone were identified	2001 OSI RS1 Bathymetry, Spring 2002 aerial photos	Suitable foraging areas were identified in RS1 therefore variable was set to 1.0
SIF		0.39		0.27		0.32	Forage Suitability Index	SI1 *SI2 * SI3		
HSI		0.39		0.27		0.32	Habitat Suitability Index	SIF		
Belted Kingfisher										
V2	273.66	1.00	258.93	1.00	261.63	1.00	Average water transparency (secchi depth in cm)	Average of secchi depth readings for all stations in reach	Habitat Assessment Shoreline Data (2003 - 2005)	
V3	25.89	0.74	25.35	0.75	24.46	0.76	% water surface obstruction	Average percent of water surface obstruction for all stations in reach	Habitat Assessment Shoreline Data (2003 - 2005)	Obstructions are areas covered by emergent and floating vegetation, logs, leaves, or overhanging shore vegetation < 1.0 m above the water's surface
V4	6.21	0.29	8.12	0.30	7.61	0.30	% of water area that is < 60 cm	Determined in GIS by creating polygons of areas where water depth < 60 cm during the breeding season (May 1 to June 31) and calculating its percentage of the total reach	OSI 2001 RS1 bathymetry and QEA Hudson River shoreline at 5000 cfs	
V6	64.58	1.00	33.79	0.88	62.15	1.00	Average number of stream subsections that contain one or more perches	Calculated the # of perches per km of shoreline sampled	Habitat Assessment Shoreline Data (2003 - 2005)	
V7	0.00	1.00	0.00	1.00	0.00	1.00	Distance to nearest suitable soil bank from river	Measured the distance from the reach to the nearest soil bank suitable for kingfisher nesting in GIS	NYSDEC et al 2004	
SIW		0.40		0.41		0.41	Water Suitability Index	((SI2 * SI4)^(1/2)) * SI3		Note - The equation for SIW that included % riffles (SI5) was not used because that variable was deemed to be not applicable for the Upper Hudson.
SIC		1.00		0.88		1.00	Cover Suitability Index	SI6		
SIR		1.00		1.00		1.00	Reproduction Suitability Index	SI7		
HSI		0.40		0.41		0.41	Habitat Suitability Index	Minimum(SIW,SIC,SIR)		

Table B-7 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{UNVEGBMI}$

Total Organic Carbon	Epifaunal Substrate	Pool Substrate	Sediment Percent Fines	Correlation to Full Model
0	0	0	1	0.38
0	0	1	0	-0.01
0	0	1	1	0.37
0	1	0	0	0.04
0	1	0	1	0.40
0	1	1	0	-0.01
0	1	1	1	0.35
1	0	0	0	0.91
1	0	0	1	0.94
1	0	1	0	0.90
1	0	1	1	0.98
1	1	0	0	0.86
1	1	0	1	0.98
1	1	1	0	0.87
1	1	1	1	1.00

Table B-8 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{UNVEGFISH}$

Epifaunal Substrate	Pool Substrate	Sediment Percent Fines	Correlation to Full Model
0	0	1	0.74
0	1	0	0.51
0	1	1	0.89
1	0	0	0.56
1	0	1	0.95
1	1	0	0.58
1	1	1	1.00

Note:

1. A value of 1 in a variable column indicates that the variable was included in FCI calculation; 0 indicates that it was not.

Table B-9 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{SAVMACROS}$

SAV Biomass	SAV Density	SAV Plant Species Composition	SAV Total Organic Carbon	Correlation to Full Model
0	0	0	1	-0.20
0	0	1	0	NA
0	0	1	1	-0.20
0	1	0	0	0.71
0	1	0	1	0.75
0	1	1	0	0.71
0	1	1	1	0.75
1	0	0	0	0.66
1	0	0	1	0.71
1	0	1	0	0.66
1	0	1	1	0.71
1	1	0	0	0.73
1	1	0	1	1.00
1	1	1	0	0.73
1	1	1	1	1.00

Table B-10 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{SAVFISH}$

SAV Biomass	SAV Density	SAV Plant Species Composition	SAV Total Organic Carbon	SAV Percent Cover	Correlation to Full Model
0	0	0	0	1	0.92
0	0	0	1	0	-0.32
0	0	0	1	1	0.89
0	0	1	0	0	-NaN
0	0	1	0	1	0.92
0	0	1	1	0	-0.32
0	0	1	1	1	0.89
0	1	0	0	0	0.44
0	1	0	0	1	0.95
0	1	0	1	0	0.43
0	1	0	1	1	0.98
0	1	1	0	0	0.44
0	1	1	0	1	0.95
0	1	1	1	0	0.43
0	1	1	1	1	0.98
1	0	0	0	0	0.65
1	0	0	0	1	0.95
1	0	0	1	0	0.56
1	0	0	1	1	0.96
1	0	1	0	0	0.65
1	0	1	0	1	0.95
1	0	1	1	0	0.56
1	0	1	1	1	0.96
1	1	0	0	0	0.44
1	1	0	0	1	0.93
1	1	0	1	0	0.59
1	1	0	1	1	1.00
1	1	1	0	0	0.44
1	1	1	0	1	0.93
1	1	1	1	0	0.59
1	1	1	1	1	1.00

Table B-11 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{SAVSTAB}$

SAV Density	SAV Percent Cover	Sediment Percent Fines	Correlation to Full Model
0	0	1	0.76
0	1	0	0.40
0	1	1	0.95
1	0	0	-0.20
1	0	1	0.86
1	1	0	0.02
1	1	1	1.00

Table B-12 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{SAVNUTS}$

SAV Biomass	SAV Total Organic Carbon	Potassium Concentration	Phosphate Concentration	Ammonium Concentration	Correlation to Full Model
0	0	0	0	1	0.53
0	0	0	1	0	0.33
0	0	0	1	1	0.67
0	0	1	0	0	0.29
0	0	1	0	1	0.52
0	0	1	1	0	0.41
0	0	1	1	1	0.71
0	1	0	0	0	-0.21
0	1	0	0	1	-0.08
0	1	0	1	0	-0.08
0	1	0	1	1	0.09
0	1	1	0	0	-0.20
0	1	1	0	1	0.01
0	1	1	1	0	-0.01
0	1	1	1	1	0.10
1	0	0	0	0	0.83
1	0	0	0	1	0.89
1	0	0	1	0	0.85
1	0	0	1	1	0.93
1	0	1	0	0	0.85
1	0	1	0	1	0.87
1	0	1	1	0	0.90
1	0	1	1	1	0.92
1	1	0	0	0	0.92
1	1	0	0	1	0.95
1	1	0	1	0	0.95
1	1	0	1	1	0.99
1	1	1	0	0	0.94
1	1	1	0	1	0.92
1	1	1	1	0	0.99
1	1	1	1	1	1.00

Note:

1. A value of 1 in a variable column indicates that the variable was included in FCI calculation; 0 indicates that it was not.

Table B-13 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{SHORESTAB}$

Bank Stability	Bank Vegetation Protection	Correlation to Full Model
0	1	0.62
1	0	0.26
1	1	1.00

Table B-14 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{SHORECOV}$

Downfall	Bank Vegetation Protection	Riparian Canopy Cover	Riparian Understory Cover	Riparian Herbaceous Cover	Correlation to Full Model
0	0	0	0	1	-0.11
0	0	0	1	0	0.66
0	0	0	1	1	0.51
0	0	1	0	0	0.44
0	0	1	0	1	0.35
0	0	1	1	0	0.64
0	0	1	1	1	0.58
0	1	0	0	0	0.30
0	1	0	0	1	0.16
0	1	0	1	0	0.56
0	1	0	1	1	0.48
0	1	1	0	0	0.43
0	1	1	0	1	0.28
0	1	1	1	0	0.57
0	1	1	1	1	0.48
1	0	0	0	0	0.53
1	0	0	0	1	0.62
1	0	0	1	0	0.84
1	0	0	1	1	0.82
1	0	1	0	0	0.85
1	0	1	0	1	0.78
1	0	1	1	0	0.91
1	0	1	1	1	0.86
1	1	0	0	0	0.94
1	1	0	0	1	0.90
1	1	0	1	0	0.97
1	1	0	1	1	0.96
1	1	1	0	0	0.98
1	1	1	0	1	0.96
1	1	1	1	0	0.99
1	1	1	1	1	1.00

Table B-15 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{SHOREHAB}$

Downfall	Bank Stability	Bank Vegetation Protection	Riparian Canopy Cover	Riparian Understory Cover	Riparian Herbaceous Cover	Correlation to Full Model
0	0	0	0	0	1	-0.15
0	0	0	0	1	0	0.62
0	0	0	0	1	1	0.39
0	0	0	1	0	0	0.50
0	0	0	1	0	1	0.39
0	0	0	1	1	0	0.67
0	0	0	1	1	1	0.55
0	0	1	0	0	0	0.28
0	0	1	0	0	1	0.09
0	0	1	0	1	0	0.48
0	0	1	0	1	1	0.37
0	0	1	1	0	0	0.44
0	0	1	1	0	1	0.22
0	0	1	1	1	0	0.55
0	0	1	1	1	1	0.40
0	1	0	0	0	0	0.40
0	1	0	0	0	1	0.32
0	1	0	0	1	0	0.64
0	1	0	0	1	1	0.75
0	1	0	1	0	0	0.60
0	1	0	1	0	1	0.53
0	1	0	1	1	0	0.78
0	1	0	1	1	1	0.79
0	1	1	0	0	0	0.63
0	1	1	0	0	1	0.68
0	1	1	0	1	0	0.73
0	1	1	0	1	1	0.69
0	1	1	1	0	0	0.74
0	1	1	1	0	1	0.74
0	1	1	1	1	0	0.77
0	1	1	1	1	1	0.77
1	0	0	0	0	0	0.48
1	0	0	0	0	1	0.55
1	0	0	0	1	0	0.75
1	0	0	0	1	1	0.72
1	0	0	1	0	0	0.82
1	0	0	1	0	1	0.72
1	0	0	1	1	0	0.86
1	0	0	1	1	1	0.80
1	0	1	0	0	0	0.88
1	0	1	0	0	1	0.82
1	0	1	0	1	0	0.89
1	0	1	0	1	1	0.87
1	0	1	1	0	0	0.94

Table B-15 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{SHOREHAB}$

Downfall	Bank Stability	Bank Vegetation Protection	Riparian Canopy Cover	Riparian Understory Cover	Riparian Herbaceous Cover	Correlation to Full Model
1	0	1	1	0	1	0.88
1	0	1	1	1	0	0.95
1	0	1	1	1	1	0.93
1	1	0	0	0	0	0.61
1	1	0	0	0	1	0.62
1	1	0	0	1	0	0.76
1	1	0	0	1	1	0.78
1	1	0	1	0	0	0.77
1	1	0	1	0	1	0.75
1	1	0	1	1	0	0.85
1	1	0	1	1	1	0.85
1	1	1	0	0	0	0.90
1	1	1	0	0	1	0.88
1	1	1	0	1	0	0.97
1	1	1	0	1	1	0.95
1	1	1	1	0	0	0.99
1	1	1	1	0	1	0.98
1	1	1	1	1	0	0.99
1	1	1	1	1	1	1.00

Note:

1. A value of 1 in a variable column indicates that the variable was included in FCI calculation; 0 indicates that it was not.

Table B-16 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{WATEREX}$

Wetland Edge	Wetland Slope	Stem Density	Correlation to Full Model
0	0	1	0.68
0	1	0	0.85
0	1	1	0.97
1	0	0	0.85
1	0	1	1.00
1	1	0	0.85
1	1	1	1.00

Table B-17 - Results of FCI Spearman Rank Coefficient Correlation Analysis for FCI_{ED}

Wetland Edge	Wetland Slope	Stem Density	Stem Length	Stem Thickness	Correlation to Full Model
0	0	0	0	1	0.33
0	0	0	1	0	0.37
0	0	0	1	1	0.65
0	0	1	0	0	0.32
0	0	1	0	1	0.58
0	0	1	1	0	0.38
0	0	1	1	1	0.52
0	1	0	0	0	0.79
0	1	0	0	1	0.71
0	1	0	1	0	0.76
0	1	0	1	1	0.89
0	1	1	0	0	0.59
0	1	1	0	1	0.85
0	1	1	1	0	0.63
0	1	1	1	1	0.88
1	0	0	0	0	0.79
1	0	0	0	1	0.79
1	0	0	1	0	0.89
1	0	0	1	1	0.89
1	0	1	0	0	0.81
1	0	1	0	1	0.93
1	0	1	1	0	0.83
1	0	1	1	1	0.96
1	1	0	0	0	0.79
1	1	0	0	1	0.79
1	1	0	1	0	0.89
1	1	0	1	1	0.89
1	1	1	0	0	0.89
1	1	1	0	1	0.91
1	1	1	1	0	0.90
1	1	1	1	1	1.00

Table B-18 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{WETCYCLING}$

Wetland Edge	Wetland Slope	Stem Density	Stem Length	Stem Thickness	Aboveground Biomass	Correlation to Full Model
0	0	0	0	0	1	0.37
0	0	0	0	1	0	0.19
0	0	0	0	1	1	0.46
0	0	0	1	0	0	0.37
0	0	0	1	0	1	0.34
0	0	0	1	1	0	0.50
0	0	0	1	1	1	0.48
0	0	1	0	0	0	0.45
0	0	1	0	0	1	0.45
0	0	1	0	1	0	0.65
0	0	1	0	1	1	0.61
0	0	1	1	0	0	0.53
0	0	1	1	0	1	0.50
0	0	1	1	1	0	0.67
0	0	1	1	1	1	0.61
0	1	0	0	0	0	0.60
0	1	0	0	0	1	0.51
0	1	0	0	1	0	0.55
0	1	0	0	1	1	0.83
0	1	0	1	0	0	0.66
0	1	0	1	0	1	0.80
0	1	0	1	1	0	0.67
0	1	0	1	1	1	0.90
0	1	1	0	0	0	0.68
0	1	1	0	0	1	0.53
0	1	1	0	1	0	0.83
0	1	1	0	1	1	0.86
0	1	1	1	0	0	0.71
0	1	1	1	0	1	0.69
0	1	1	1	1	0	0.89
0	1	1	1	1	1	0.83
1	0	0	0	0	0	0.60
1	0	0	0	0	1	0.84
1	0	0	0	1	0	0.60
1	0	0	0	1	1	0.84
1	0	0	1	0	0	0.72
1	0	0	1	0	1	0.90
1	0	0	1	1	0	0.66
1	0	0	1	1	1	0.84
1	0	1	0	0	0	0.81
1	0	1	0	0	1	0.76
1	0	1	0	1	0	0.85
1	0	1	0	1	1	0.93
1	0	1	1	0	0	0.85
1	0	1	1	0	1	0.86
1	0	1	1	1	0	0.88
1	0	1	1	1	1	0.96
1	1	0	0	0	0	0.60
1	1	0	0	0	1	0.83
1	1	0	0	1	0	0.60
1	1	0	0	1	1	0.86
1	1	0	1	0	0	0.72

Table B-18 - Results of FCI Spearman Rank Coefficient Correlation Analysis for $FCI_{WETCYCLING}$

Wetland Edge	Wetland Slope	Stem Density	Stem Length	Stem Thickness	Aboveground Biomass	Correlation to Full Model
1	1	0	1	0	1	0.91
1	1	0	1	1	0	0.66
1	1	0	1	1	1	0.88
1	1	1	0	0	0	0.79
1	1	1	0	0	1	0.76
1	1	1	0	1	0	0.79
1	1	1	0	1	1	0.98
1	1	1	1	0	0	0.87
1	1	1	1	0	1	0.87
1	1	1	1	1	0	0.86
1	1	1	1	1	1	1.00

Table B-19. Results of FCI Spearman rank coefficient correlation analysis for $FCI_{MAINTAINSPP}$

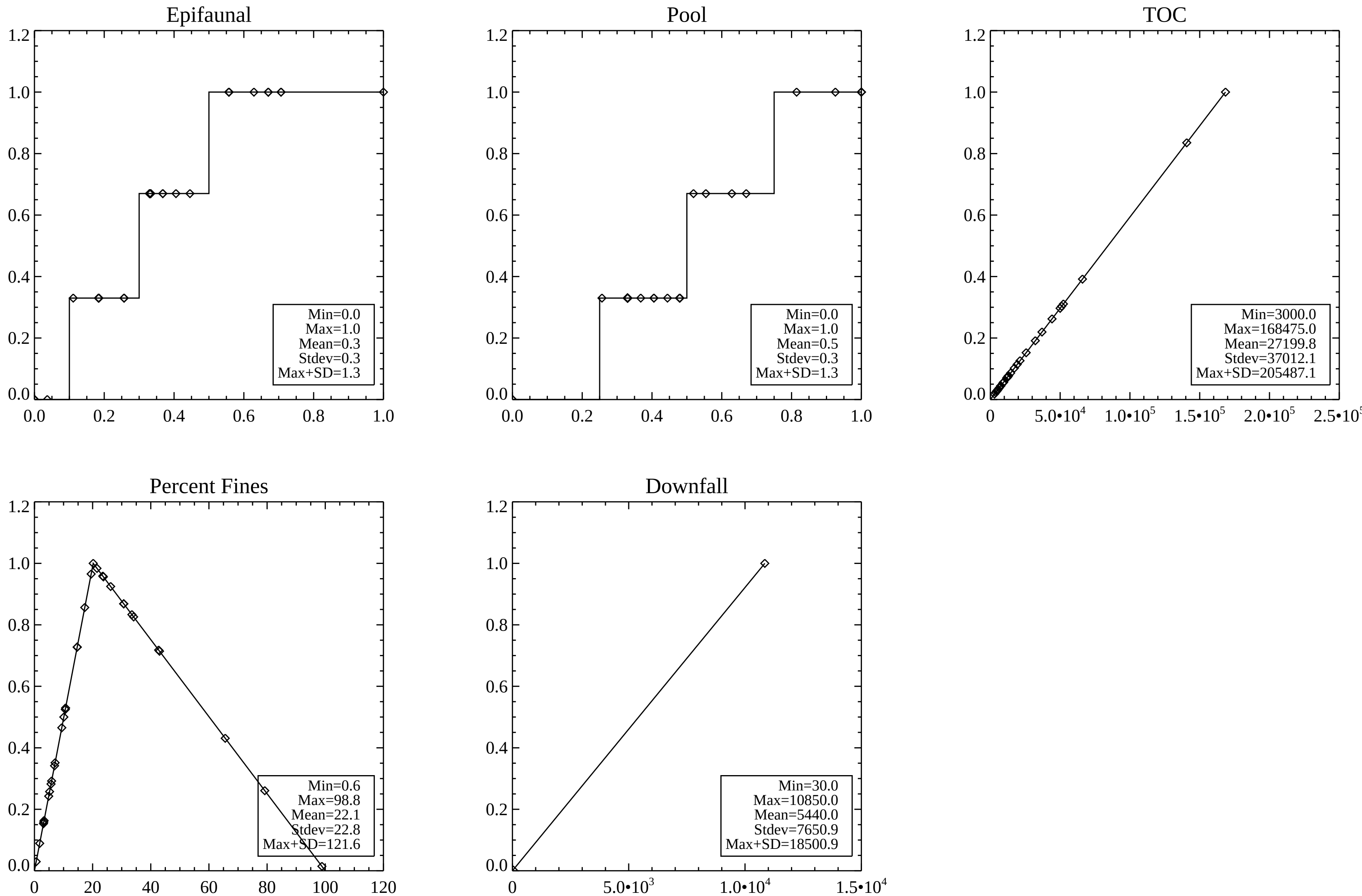
Plant Species Composition	Nuisance Species	Correlation to Full Model
0	1	-0.19
1	0	1.00
1	1	1.00

Table B-20. Results of FCI Spearman rank coefficient correlation analysis for FCI_{WETHAB}

Wetland Edge	Contiguous with Other Habitats	Plant Species Composition	Stem Density	Correlation to Full Model
0	0	0	1	0.65
0	0	1	0	0.50
0	0	1	1	0.77
0	1	0	0	NA
0	1	0	1	0.65
0	1	1	0	0.50
0	1	1	1	0.77
1	0	0	0	0.09
1	0	0	1	0.49
1	0	1	0	0.68
1	0	1	1	0.76
1	1	0	0	0.09
1	1	0	1	0.60
1	1	1	0	0.60
1	1	1	1	1.00

Note:

1. A value of 1 in a variable column indicates that the variable was included in FCI calculation; 0 indicates that it was not.



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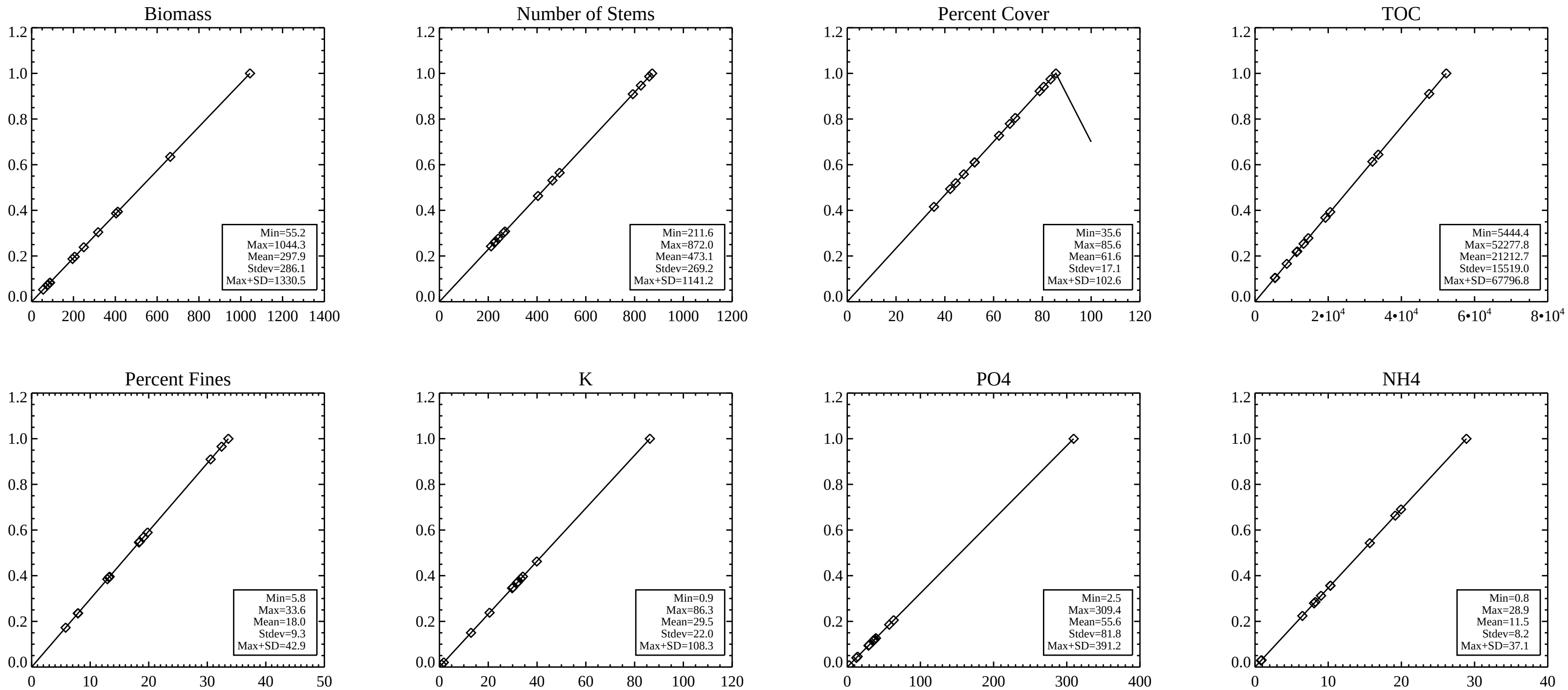

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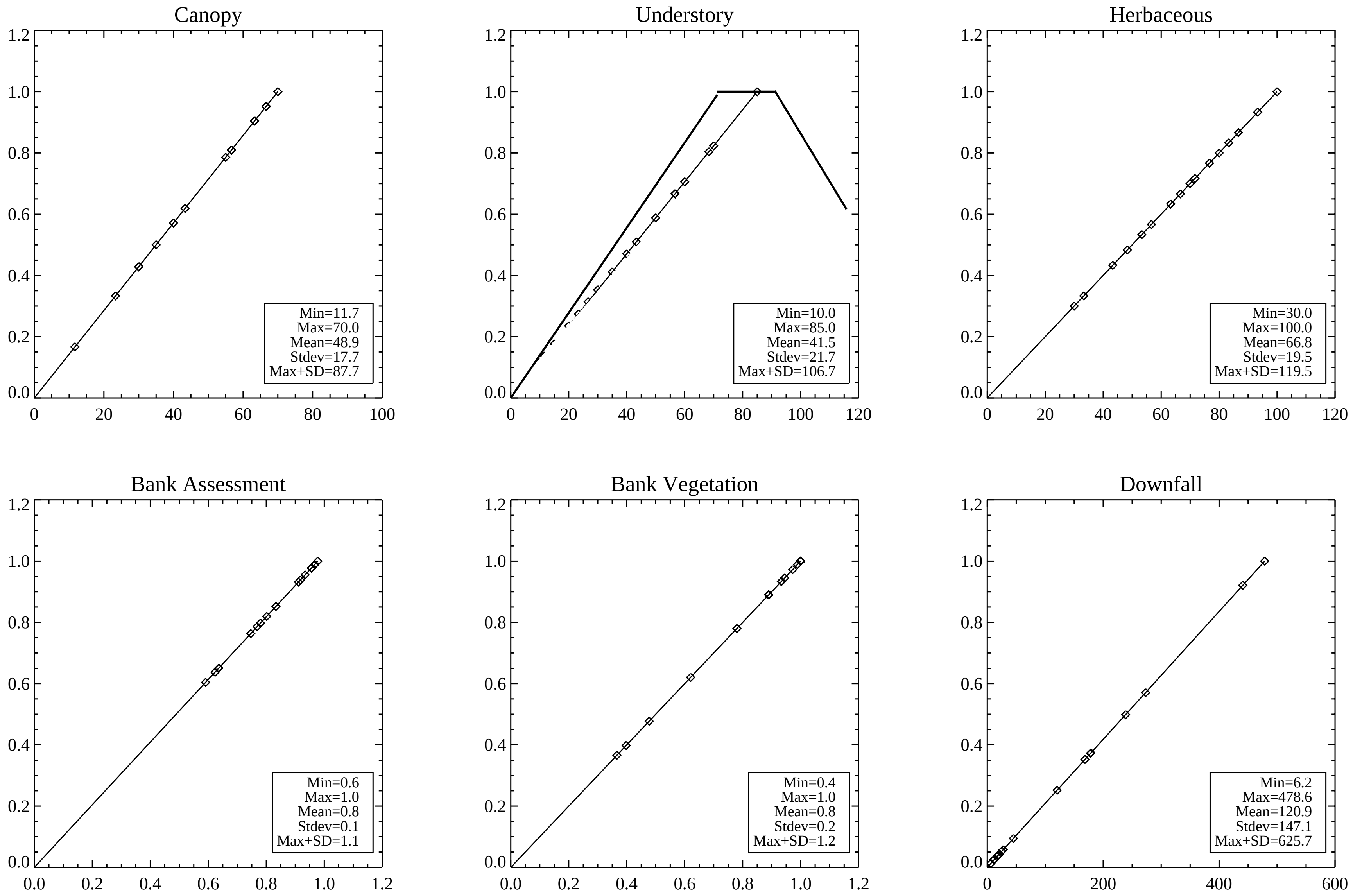

SHO Subindicies

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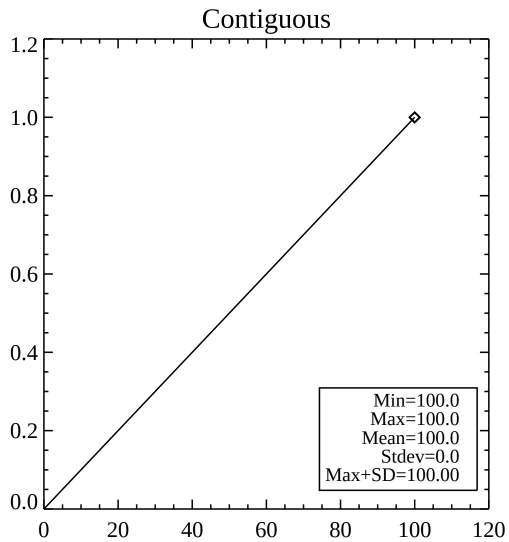

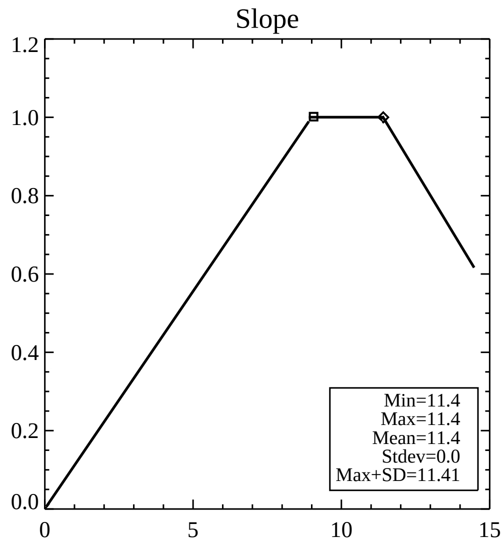

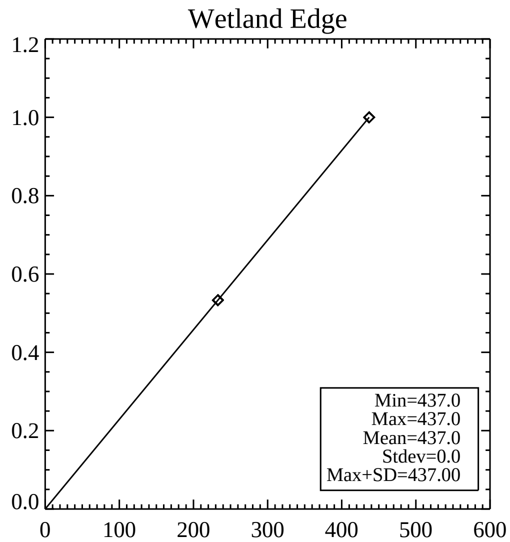

Wetland Subindicies

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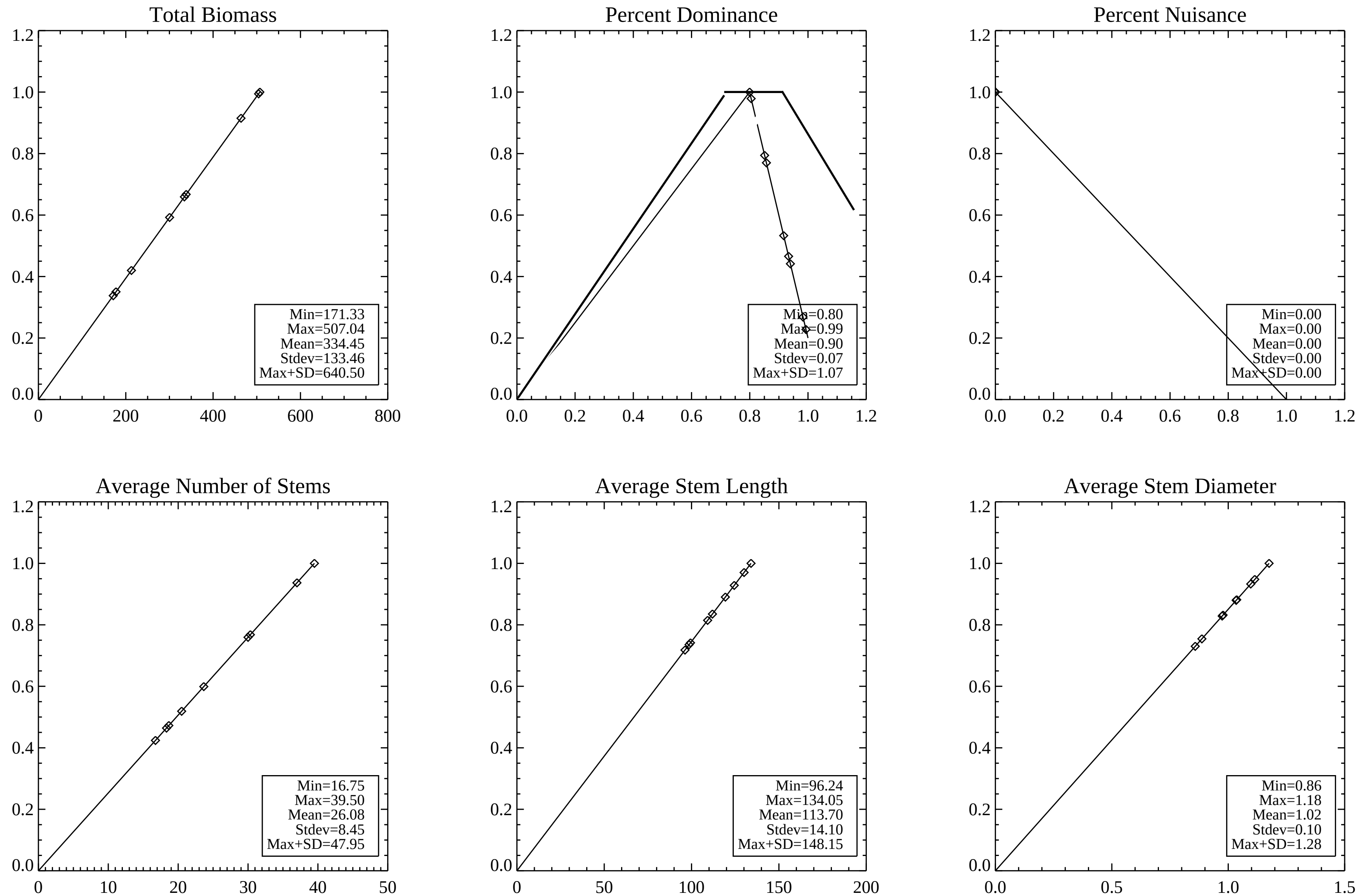

Wetland Subindicies

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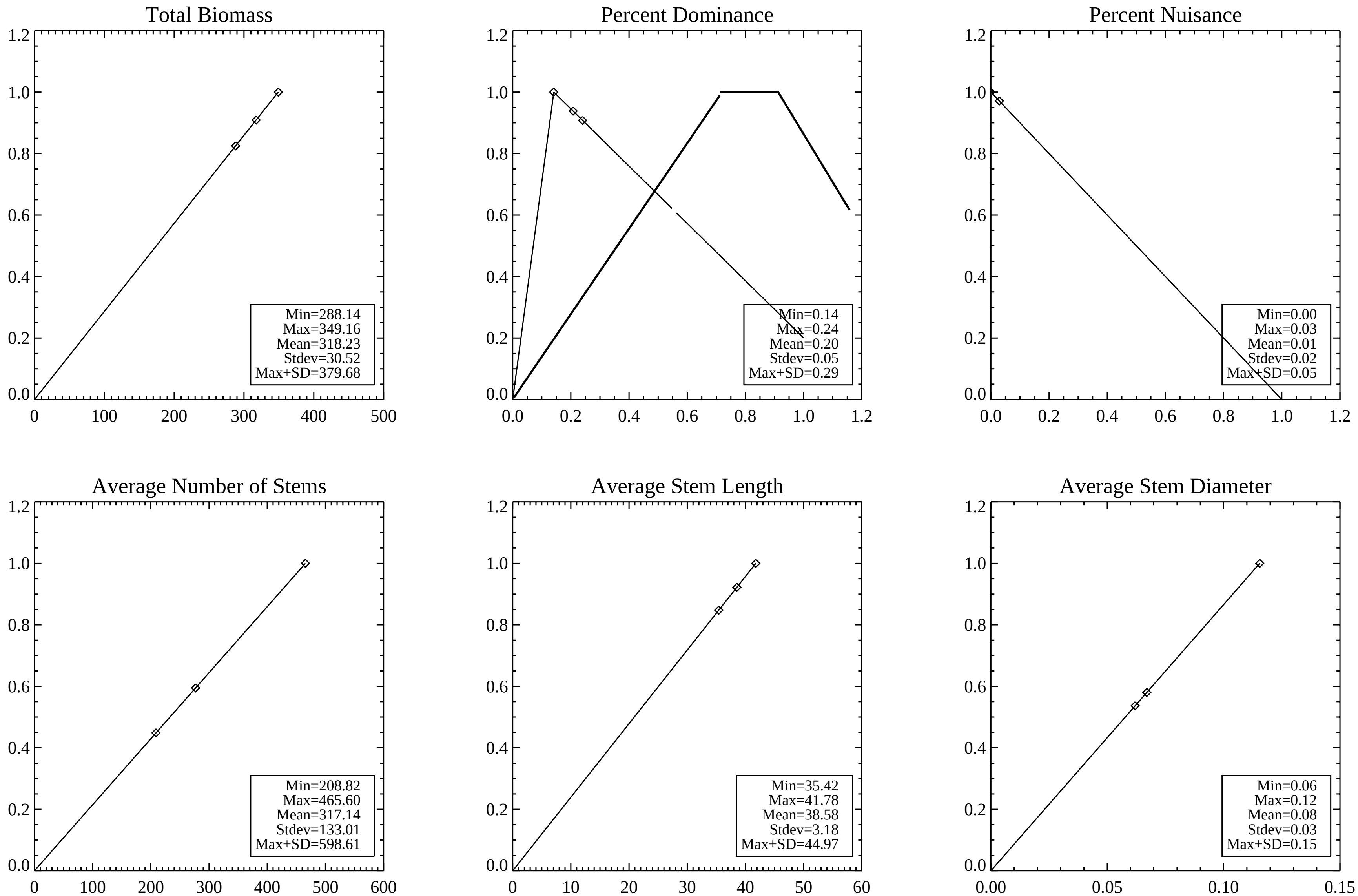
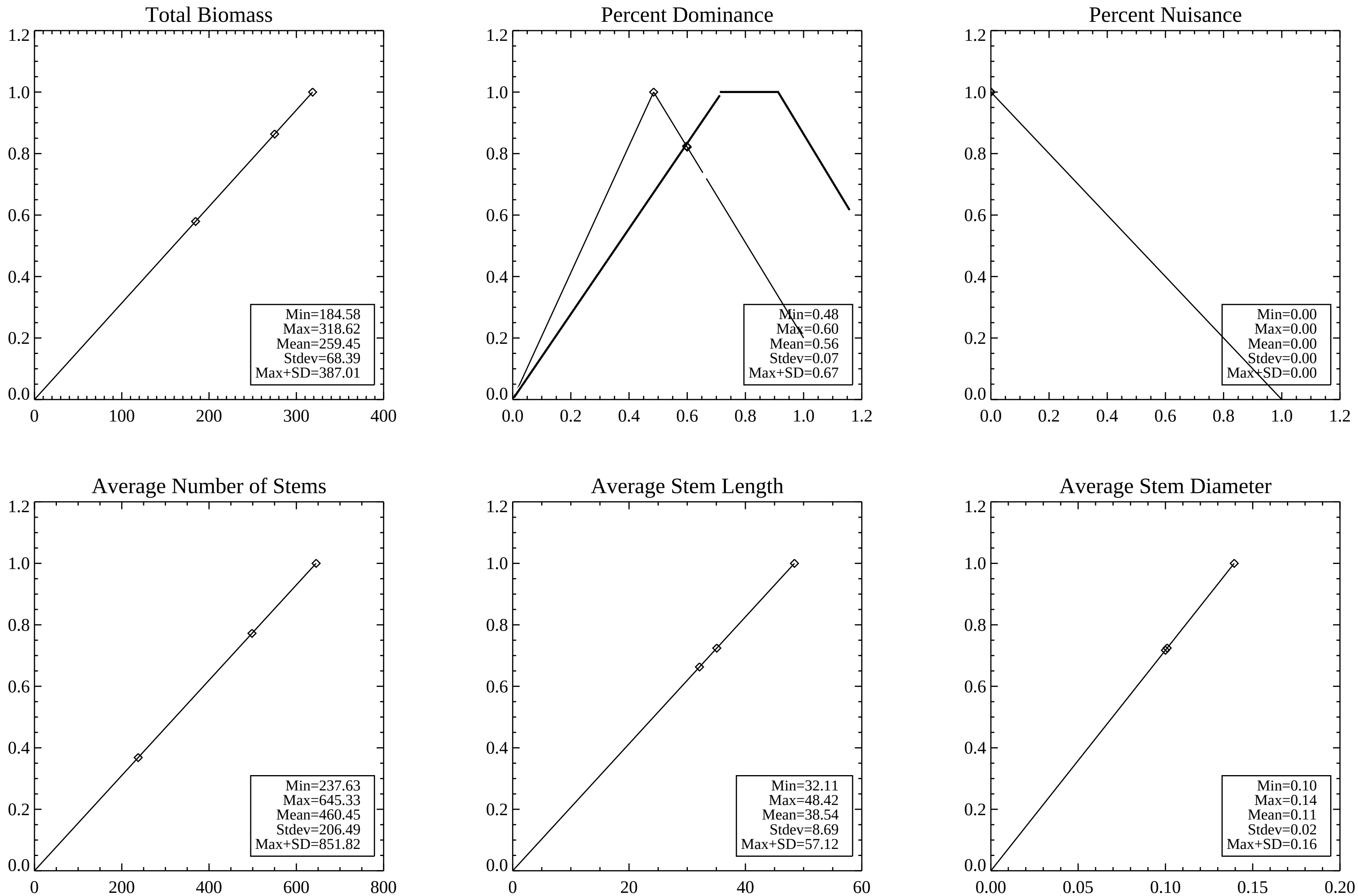


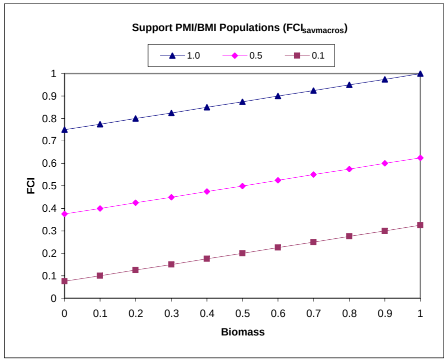
Wetland Subindicies

rice cutgrass

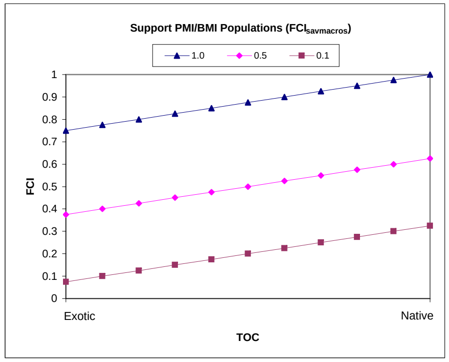


Wetland Subindicies

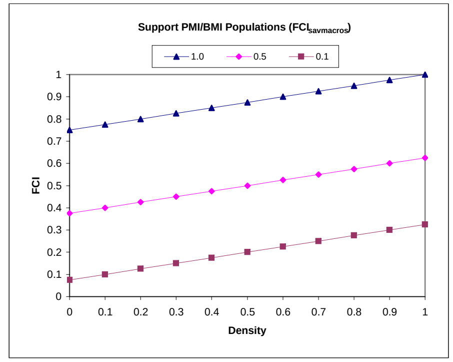
Creeping Spikerush



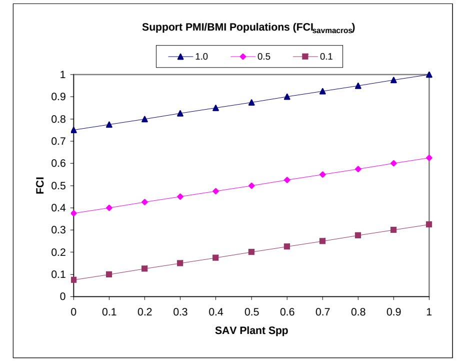
FCI input	Subindices			FCI
Biomass	TOC	Density	PlantSpp	Support PMI/BMI Populations
V_{savbio}	V_{savtoc}	$V_{savdense}$	V_{savspp}	$FCI_{savmacros}$
0.000	0.100	0.100	0.100	0.075
0.100	0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.100	0.125
0.300	0.100	0.100	0.100	0.150
0.400	0.100	0.100	0.100	0.175
0.500	0.100	0.100	0.100	0.200
0.600	0.100	0.100	0.100	0.225
0.700	0.100	0.100	0.100	0.250
0.800	0.100	0.100	0.100	0.275
0.900	0.100	0.100	0.100	0.300
1.000	0.100	0.100	0.100	0.325
0.000	0.500	0.500	0.500	0.375
0.100	0.500	0.500	0.500	0.400
0.200	0.500	0.500	0.500	0.425
0.300	0.500	0.500	0.500	0.450
0.400	0.500	0.500	0.500	0.475
0.500	0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.500	0.525
0.700	0.500	0.500	0.500	0.550
0.800	0.500	0.500	0.500	0.575
0.900	0.500	0.500	0.500	0.600
1.000	0.500	0.500	0.500	0.625
0.000	1.000	1.000	1.000	0.750
0.100	1.000	1.000	1.000	0.775
0.200	1.000	1.000	1.000	0.800
0.300	1.000	1.000	1.000	0.825
0.400	1.000	1.000	1.000	0.850
0.500	1.000	1.000	1.000	0.875
0.600	1.000	1.000	1.000	0.900
0.700	1.000	1.000	1.000	0.925
0.800	1.000	1.000	1.000	0.950
0.900	1.000	1.000	1.000	0.975
1.000	1.000	1.000	1.000	1.000



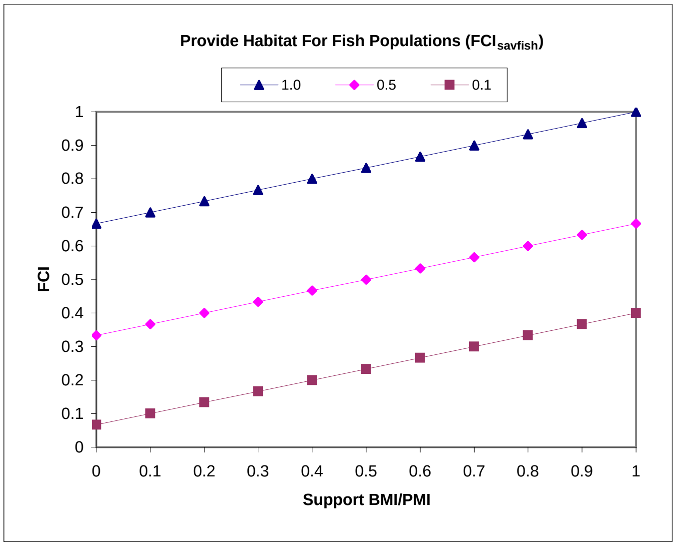
FCI input	Subindices			FCI
Biomass	TOC	Density	PlantSpp	Support PMI/BMI Populations
V_{savbio}	V_{savtoc}	$V_{savdense}$	V_{savspp}	$FCI_{savmacros}$
0.100	0.000	0.100	0.100	0.075
0.100	0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.100	0.125
0.100	0.300	0.100	0.100	0.150
0.100	0.400	0.100	0.100	0.175
0.100	0.500	0.100	0.100	0.200
0.100	0.600	0.100	0.100	0.225
0.100	0.700	0.100	0.100	0.250
0.100	0.800	0.100	0.100	0.275
0.100	0.900	0.100	0.100	0.300
0.100	1.000	0.100	0.100	0.325
0.500	0.000	0.500	0.500	0.375
0.500	0.100	0.500	0.500	0.400
0.500	0.200	0.500	0.500	0.425
0.500	0.300	0.500	0.500	0.450
0.500	0.400	0.500	0.500	0.475
0.500	0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.500	0.525
0.500	0.700	0.500	0.500	0.550
0.500	0.800	0.500	0.500	0.575
0.500	0.900	0.500	0.500	0.600
0.500	1.000	0.500	0.500	0.625
1.000	0.000	1.000	1.000	0.750
1.000	0.100	1.000	1.000	0.775
1.000	0.200	1.000	1.000	0.800
1.000	0.300	1.000	1.000	0.825
1.000	0.400	1.000	1.000	0.850
1.000	0.500	1.000	1.000	0.875
1.000	0.600	1.000	1.000	0.900
1.000	0.700	1.000	1.000	0.925
1.000	0.800	1.000	1.000	0.950
1.000	0.900	1.000	1.000	0.975
1.000	1.000	1.000	1.000	1.000

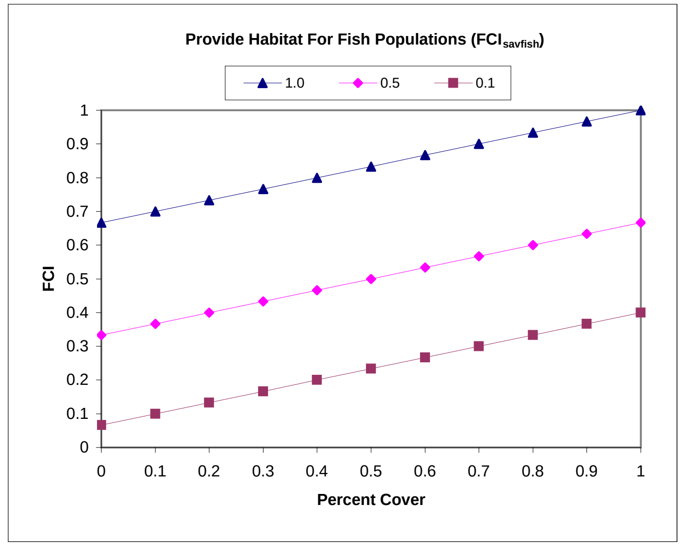


FCI input	Subindices			FCI
Biomass	TOC	Density	PlantSpp	Support PMI/BMI Populations
V_{savbio}	V_{savtoc}	$V_{savdense}$	V_{savspp}	$FCI_{savmacros}$
0.100	0.100	0.000	0.100	0.075
0.100	0.100	0.100	0.100	0.100
0.100	0.100	0.200	0.100	0.125
0.100	0.100	0.300	0.100	0.150
0.100	0.100	0.400	0.100	0.175
0.100	0.100	0.500	0.100	0.200
0.100	0.100	0.600	0.100	0.225
0.100	0.100	0.700	0.100	0.250
0.100	0.100	0.800	0.100	0.275
0.100	0.100	0.900	0.100	0.300
0.100	0.100	1.000	0.100	0.325
0.500	0.500	0.000	0.500	0.375
0.500	0.500	0.100	0.500	0.400
0.500	0.500	0.200	0.500	0.425
0.500	0.500	0.300	0.500	0.450
0.500	0.500	0.400	0.500	0.475
0.500	0.500	0.500	0.500	0.500
0.500	0.500	0.600	0.500	0.525
0.500	0.500	0.700	0.500	0.550
0.500	0.500	0.800	0.500	0.575
0.500	0.500	0.900	0.500	0.600
0.500	0.500	1.000	0.500	0.625
1.000	1.000	0.000	1.000	0.750
1.000	1.000	0.100	1.000	0.775
1.000	1.000	0.200	1.000	0.800
1.000	1.000	0.300	1.000	0.825
1.000	1.000	0.400	1.000	0.850
1.000	1.000	0.500	1.000	0.875
1.000	1.000	0.600	1.000	0.900
1.000	1.000	0.700	1.000	0.925
1.000	1.000	0.800	1.000	0.950
1.000	1.000	0.900	1.000	0.975
1.000	1.000	1.000	1.000	1.000



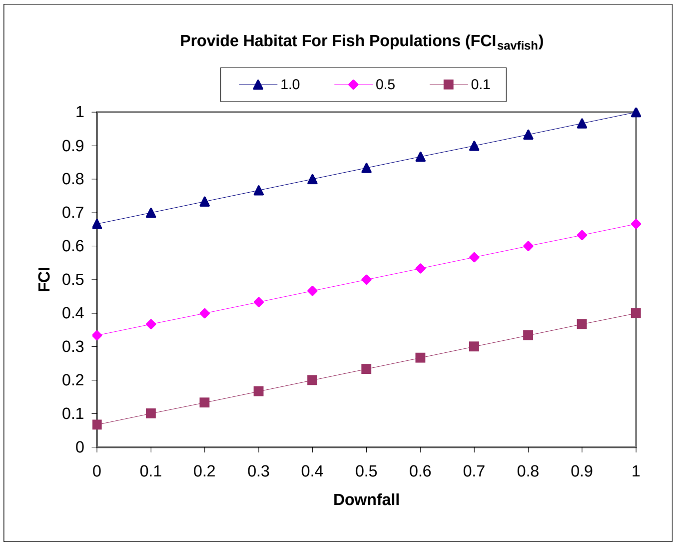
FCI input	Subindices			FCI
Biomass	TOC	Density	PlantSpp	Support PMI/BMI Populations
V_{savbio}	V_{savtoc}	$V_{savdense}$	V_{savspp}	$FCI_{savmacros}$
0.100	0.100	0.100	0.000	0.075
0.100	0.100	0.100	0.100	0.100
0.100	0.100	0.100	0.200	0.125
0.100	0.100	0.100	0.300	0.150
0.100	0.100	0.100	0.400	0.175
0.100	0.100	0.100	0.500	0.200
0.100	0.100	0.100	0.600	0.225
0.100	0.100	0.100	0.700	0.250
0.100	0.100	0.100	0.800	0.275
0.100	0.100	0.100	0.900	0.300
0.100	0.100	0.100	1.000	0.325
0.500	0.500	0.500	0.000	0.375
0.500	0.500	0.500	0.100	0.400
0.500	0.500	0.500	0.200	0.425
0.500	0.500	0.500	0.300	0.450
0.500	0.500	0.500	0.400	0.475
0.500	0.500	0.500	0.500	0.500
0.500	0.500	0.500	0.600	0.525
0.500	0.500	0.500	0.700	0.550
0.500	0.500	0.500	0.800	0.575
0.500	0.500	0.500	0.900	0.600
0.500	0.500	0.500	1.000	0.625
1.000	1.000	1.000	0.000	0.750
1.000	1.000	1.000	0.100	0.775
1.000	1.000	1.000	0.200	0.800
1.000	1.000	1.000	0.300	0.825
1.000	1.000	1.000	0.400	0.850
1.000	1.000	1.000	0.500	0.875
1.000	1.000	1.000	0.600	0.900
1.000	1.000	1.000	0.700	0.925
1.000	1.000	1.000	0.800	0.950
1.000	1.000	1.000	0.900	0.975
1.000	1.000	1.000	1.000	1.000



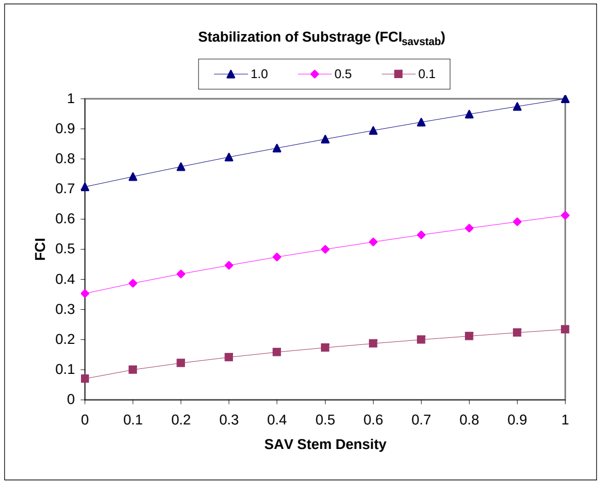


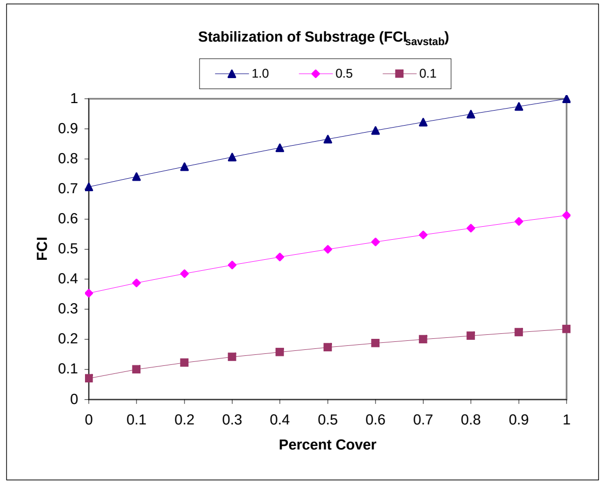
Subindices			FCI
Support BMI/PMI	%Cover	Downfall	Support Fish Populations
$FCI_{savmacros}$	V_{cover}	$V_{savdown}$	$FCI_{savfish}$
0.000	0.100	0.100	0.067
0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.133
0.300	0.100	0.100	0.167
0.400	0.100	0.100	0.200
0.500	0.100	0.100	0.233
0.600	0.100	0.100	0.267
0.700	0.100	0.100	0.300
0.800	0.100	0.100	0.333
0.900	0.100	0.100	0.367
1.000	0.100	0.100	0.400
0.000	0.500	0.500	0.333
0.100	0.500	0.500	0.367
0.200	0.500	0.500	0.400
0.300	0.500	0.500	0.433
0.400	0.500	0.500	0.467
0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.533
0.700	0.500	0.500	0.567
0.800	0.500	0.500	0.600
0.900	0.500	0.500	0.633
1.000	0.500	0.500	0.667
0.000	1.000	1.000	0.667
0.100	1.000	1.000	0.700
0.200	1.000	1.000	0.733
0.300	1.000	1.000	0.767
0.400	1.000	1.000	0.800
0.500	1.000	1.000	0.833
0.600	1.000	1.000	0.867
0.700	1.000	1.000	0.900
0.800	1.000	1.000	0.933
0.900	1.000	1.000	0.967
1.000	1.000	1.000	1.000

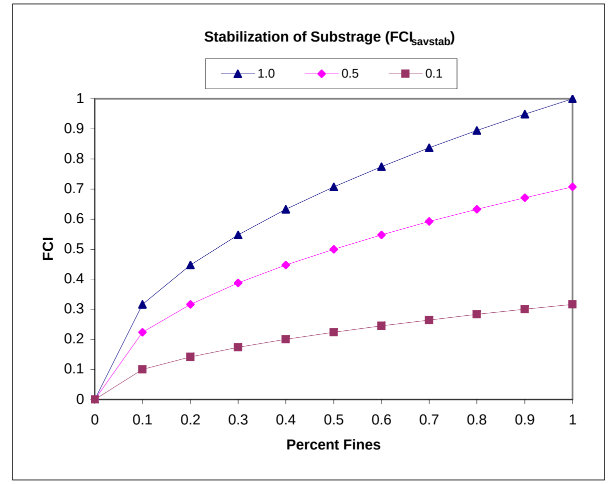
Subindices			FCI
Support BMI/PMI	%Cover	Downfall	Support Fish Populations
$FCI_{savmacros}$	V_{cover}	$V_{savdown}$	$FCI_{savfish}$
0.100	0.000	0.100	0.067
0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.133
0.100	0.300	0.100	0.167
0.100	0.400	0.100	0.200
0.100	0.500	0.100	0.233
0.100	0.600	0.100	0.267
0.100	0.700	0.100	0.300
0.100	0.800	0.100	0.333
0.100	0.900	0.100	0.367
0.100	1.000	0.100	0.400
0.500	0.000	0.500	0.333
0.500	0.100	0.500	0.367
0.500	0.200	0.500	0.400
0.500	0.300	0.500	0.433
0.500	0.400	0.500	0.467
0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.533
0.500	0.700	0.500	0.567
0.500	0.800	0.500	0.600
0.500	0.900	0.500	0.633
0.500	1.000	0.500	0.667
1.000	0.000	1.000	0.667
1.000	0.100	1.000	0.700
1.000	0.200	1.000	0.733
1.000	0.300	1.000	0.767
1.000	0.400	1.000	0.800
1.000	0.500	1.000	0.833
1.000	0.600	1.000	0.867
1.000	0.700	1.000	0.900
1.000	0.800	1.000	0.933
1.000	0.900	1.000	0.967
1.000	1.000	1.000	1.000



Subindices			FCI
Support BMI/PMI	%Cover	Downfall	Support Fish Populations
$FCI_{savmacros}$	V_{cover}	$V_{savdown}$	$FCI_{savfish}$
0.100	0.100	0.000	0.067
0.100	0.100	0.100	0.100
0.100	0.100	0.200	0.133
0.100	0.100	0.300	0.167
0.100	0.100	0.400	0.200
0.100	0.100	0.500	0.233
0.100	0.100	0.600	0.267
0.100	0.100	0.700	0.300
0.100	0.100	0.800	0.333
0.100	0.100	0.900	0.367
0.100	0.100	1.000	0.400
0.500	0.500	0.000	0.333
0.500	0.500	0.100	0.367
0.500	0.500	0.200	0.400
0.500	0.500	0.300	0.433
0.500	0.500	0.400	0.467
0.500	0.500	0.500	0.500
0.500	0.500	0.600	0.533
0.500	0.500	0.700	0.567
0.500	0.500	0.800	0.600
0.500	0.500	0.900	0.633
0.500	0.500	1.000	0.667
1.000	1.000	0.000	0.667
1.000	1.000	0.100	0.700
1.000	1.000	0.200	0.733
1.000	1.000	0.300	0.767
1.000	1.000	0.400	0.800
1.000	1.000	0.500	0.833
1.000	1.000	0.600	0.867
1.000	1.000	0.700	0.900
1.000	1.000	0.800	0.933
1.000	1.000	0.900	0.967
1.000	1.000	1.000	1.000



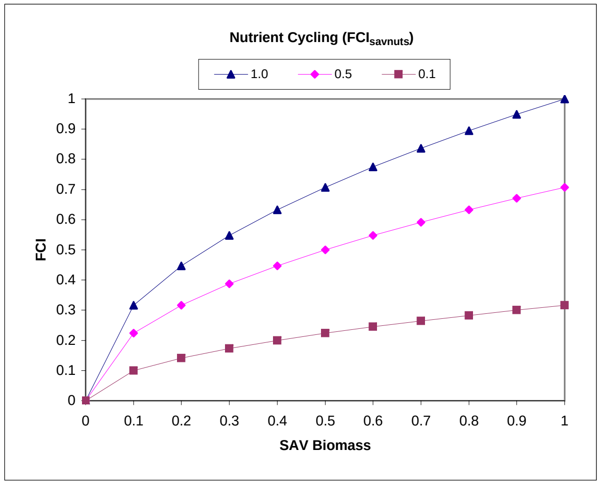


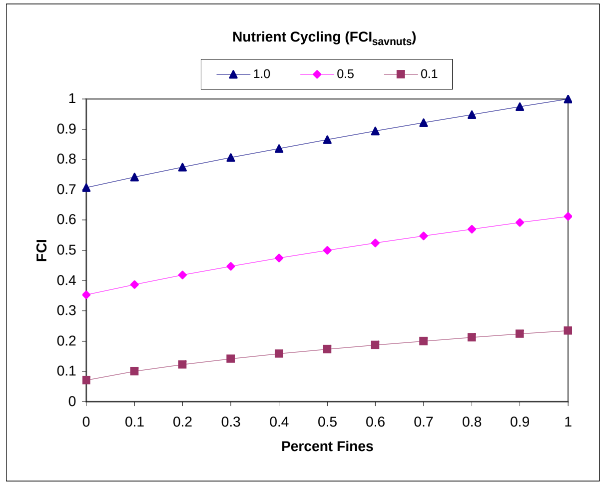


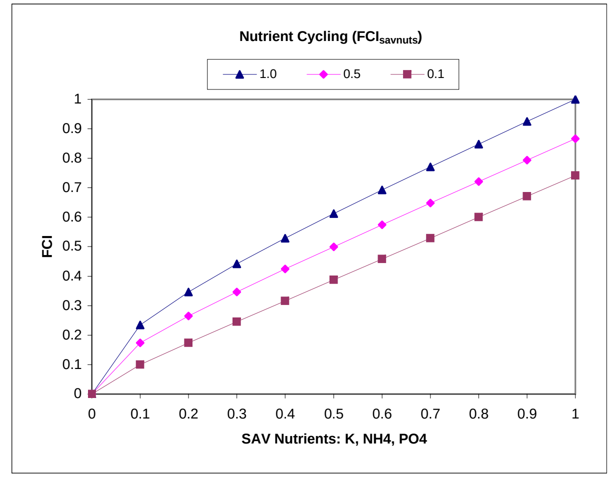
Subindices			FCI
No. Stems	%Cover	%Fines	Stabilization of Substrate
$V_{savdense}$	V_{cover}	V_{fines}	$FCI_{savstab}$
0.000	0.100	0.100	0.071
0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.122
0.300	0.100	0.100	0.141
0.400	0.100	0.100	0.158
0.500	0.100	0.100	0.173
0.600	0.100	0.100	0.187
0.700	0.100	0.100	0.200
0.800	0.100	0.100	0.212
0.900	0.100	0.100	0.224
1.000	0.100	0.100	0.235
0.000	0.500	0.500	0.354
0.100	0.500	0.500	0.387
0.200	0.500	0.500	0.418
0.300	0.500	0.500	0.447
0.400	0.500	0.500	0.474
0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.524
0.700	0.500	0.500	0.548
0.800	0.500	0.500	0.570
0.900	0.500	0.500	0.592
1.000	0.500	0.500	0.612
0.000	1.000	1.000	0.707
0.100	1.000	1.000	0.742
0.200	1.000	1.000	0.775
0.300	1.000	1.000	0.806
0.400	1.000	1.000	0.837
0.500	1.000	1.000	0.866
0.600	1.000	1.000	0.894
0.700	1.000	1.000	0.922
0.800	1.000	1.000	0.949
0.900	1.000	1.000	0.975
1.000	1.000	1.000	1.000

Subindices			FCI
No. Stems	%Cover	%Fines	Stabilization of Substrate
$V_{savdense}$	V_{cover}	V_{fines}	$FCI_{savstab}$
0.100	0.000	0.100	0.071
0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.122
0.100	0.300	0.100	0.141
0.100	0.400	0.100	0.158
0.100	0.500	0.100	0.173
0.100	0.600	0.100	0.187
0.100	0.700	0.100	0.200
0.100	0.800	0.100	0.212
0.100	0.900	0.100	0.224
0.100	1.000	0.100	0.235
0.500	0.000	0.500	0.354
0.500	0.100	0.500	0.387
0.500	0.200	0.500	0.418
0.500	0.300	0.500	0.447
0.500	0.400	0.500	0.474
0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.524
0.500	0.700	0.500	0.548
0.500	0.800	0.500	0.570
0.500	0.900	0.500	0.592
0.500	1.000	0.500	0.612
1.000	0.000	1.000	0.707
1.000	0.100	1.000	0.742
1.000	0.200	1.000	0.775
1.000	0.300	1.000	0.806
1.000	0.400	1.000	0.837
1.000	0.500	1.000	0.866
1.000	0.600	1.000	0.894
1.000	0.700	1.000	0.922
1.000	0.800	1.000	0.949
1.000	0.900	1.000	0.975
1.000	1.000	1.000	1.000

Subindices			FCI
No. Stems	%Cover	%Fines	Stabilization of Substrate
$V_{savdense}$	V_{cover}	V_{fines}	$FCI_{savstab}$
0.100	0.100	0.000	0.000
0.100	0.100	0.100	0.100
0.100	0.100	0.200	0.141
0.100	0.100	0.300	0.173
0.100	0.100	0.400	0.200
0.100	0.100	0.500	0.224
0.100	0.100	0.600	0.245
0.100	0.100	0.700	0.265
0.100	0.100	0.800	0.283
0.100	0.100	0.900	0.300
0.100	0.100	1.000	0.316
0.500	0.500	0.000	0.000
0.500	0.500	0.100	0.224
0.500	0.500	0.200	0.316
0.500	0.500	0.300	0.387
0.500	0.500	0.400	0.447
0.500	0.500	0.500	0.500
0.500	0.500	0.600	0.548
0.500	0.500	0.700	0.592
0.500	0.500	0.800	0.632
0.500	0.500	0.900	0.671
0.500	0.500	1.000	0.707
1.000	1.000	0.000	0.000
1.000	1.000	0.100	0.316
1.000	1.000	0.200	0.447
1.000	1.000	0.300	0.548
1.000	1.000	0.400	0.632
1.000	1.000	0.500	0.707
1.000	1.000	0.600	0.775
1.000	1.000	0.700	0.837
1.000	1.000	0.800	0.894
1.000	1.000	0.900	0.949
1.000	1.000	1.000	1.000



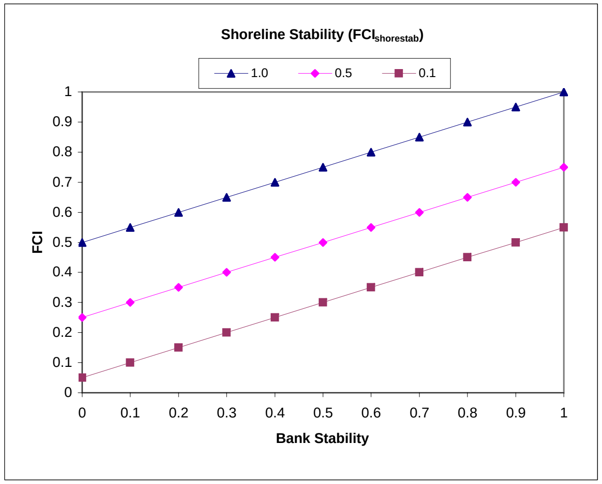


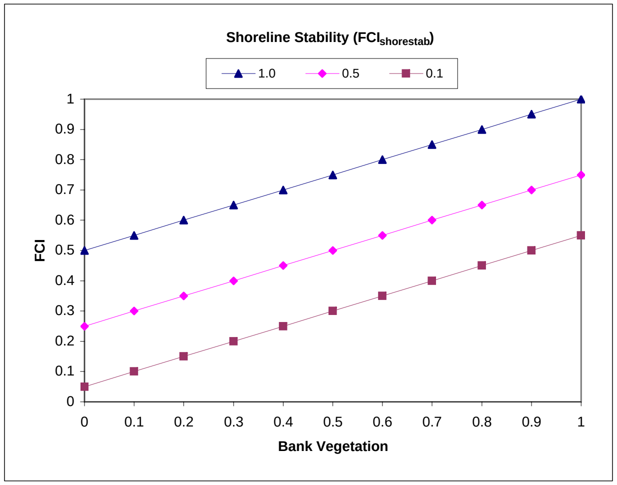


Subindices			FCI
Biomass	%Fines	Nutrients (K, NH4, PO4)	Nutrient Cycling
V_{savbio}	V_{fines}	$V_{savnuts}$	$FCI_{savnuts}$
0.000	0.100	0.100	0.000
0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.141
0.300	0.100	0.100	0.173
0.400	0.100	0.100	0.200
0.500	0.100	0.100	0.224
0.600	0.100	0.100	0.245
0.700	0.100	0.100	0.265
0.800	0.100	0.100	0.283
0.900	0.100	0.100	0.300
1.000	0.100	0.100	0.316
0.000	0.500	0.500	0.000
0.100	0.500	0.500	0.224
0.200	0.500	0.500	0.316
0.300	0.500	0.500	0.387
0.400	0.500	0.500	0.447
0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.548
0.700	0.500	0.500	0.592
0.800	0.500	0.500	0.632
0.900	0.500	0.500	0.671
1.000	0.500	0.500	0.707
0.000	1.000	1.000	0.000
0.100	1.000	1.000	0.316
0.200	1.000	1.000	0.447
0.300	1.000	1.000	0.548
0.400	1.000	1.000	0.632
0.500	1.000	1.000	0.707
0.600	1.000	1.000	0.775
0.700	1.000	1.000	0.837
0.800	1.000	1.000	0.894
0.900	1.000	1.000	0.949
1.000	1.000	1.000	1.000

Subindices			FCI
Biomass	%Fines	Nutrients (K, NH4, PO4)	Nutrient Cycling
V_{savbio}	V_{fines}	$V_{savnuts}$	$FCI_{savnuts}$
0.100	0.000	0.100	0.071
0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.122
0.100	0.300	0.100	0.141
0.100	0.400	0.100	0.158
0.100	0.500	0.100	0.173
0.100	0.600	0.100	0.187
0.100	0.700	0.100	0.200
0.100	0.800	0.100	0.212
0.100	0.900	0.100	0.224
0.100	1.000	0.100	0.235
0.500	0.000	0.500	0.354
0.500	0.100	0.500	0.387
0.500	0.200	0.500	0.418
0.500	0.300	0.500	0.447
0.500	0.400	0.500	0.474
0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.524
0.500	0.700	0.500	0.548
0.500	0.800	0.500	0.570
0.500	0.900	0.500	0.592
0.500	1.000	0.500	0.612
1.000	0.000	1.000	0.707
1.000	0.100	1.000	0.742
1.000	0.200	1.000	0.775
1.000	0.300	1.000	0.806
1.000	0.400	1.000	0.837
1.000	0.500	1.000	0.866
1.000	0.600	1.000	0.894
1.000	0.700	1.000	0.922
1.000	0.800	1.000	0.949
1.000	0.900	1.000	0.975
1.000	1.000	1.000	1.000

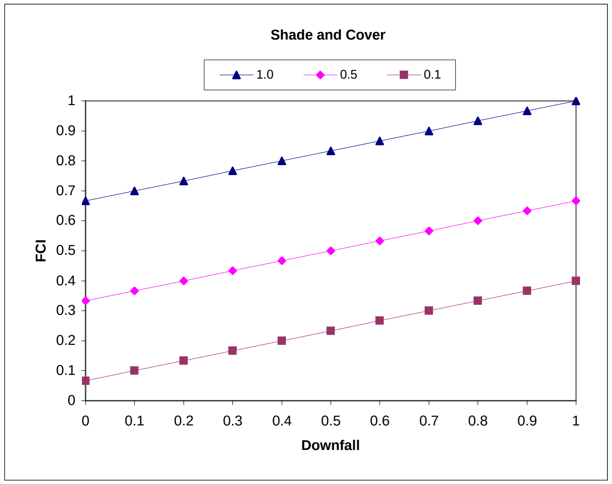
Subindices			FCI
Biomass	%Fines	Nutrients (K, NH4, PO4)	Nutrient Cycling
V_{savbio}	V_{fines}	$V_{savnuts}$	$FCI_{savnuts}$
0.000	0.100	0.000	0.000
0.100	0.100	0.100	0.100
0.200	0.100	0.200	0.173
0.300	0.100	0.300	0.245
0.400	0.100	0.400	0.316
0.500	0.100	0.500	0.387
0.600	0.100	0.600	0.458
0.700	0.100	0.700	0.529
0.800	0.100	0.800	0.600
0.900	0.100	0.900	0.671
1.000	0.100	1.000	0.742
0.000	0.500	0.000	0.000
0.100	0.500	0.100	0.173
0.200	0.500	0.200	0.265
0.300	0.500	0.300	0.346
0.400	0.500	0.400	0.424
0.500	0.500	0.500	0.500
0.600	0.500	0.600	0.574
0.700	0.500	0.700	0.648
0.800	0.500	0.800	0.721
0.900	0.500	0.900	0.794
1.000	0.500	1.000	0.866
0.000	1.000	0.000	0.000
0.100	1.000	0.100	0.235
0.200	1.000	0.200	0.346
0.300	1.000	0.300	0.442
0.400	1.000	0.400	0.529
0.500	1.000	0.500	0.612
0.600	1.000	0.600	0.693
0.700	1.000	0.700	0.771
0.800	1.000	0.800	0.849
0.900	1.000	0.900	0.925
1.000	1.000	1.000	1.000

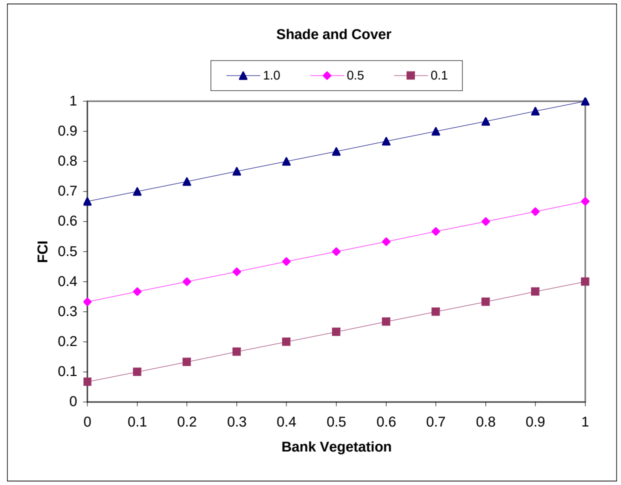


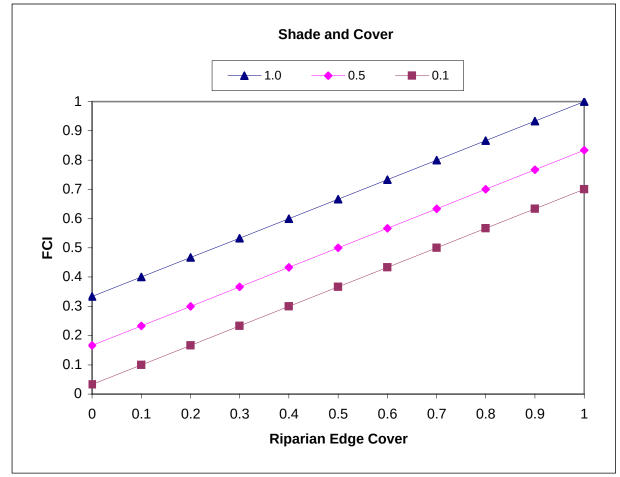


Subindices		FCI
Bank Stability	Bank Vegetation	Shoreline Stability
$V_{bankstab}$	$V_{bankveg}$	$FCI_{shorestab}$
0.000	0.100	0.050
0.100	0.100	0.100
0.200	0.100	0.150
0.300	0.100	0.200
0.400	0.100	0.250
0.500	0.100	0.300
0.600	0.100	0.350
0.700	0.100	0.400
0.800	0.100	0.450
0.900	0.100	0.500
1.000	0.100	0.550
0.000	0.500	0.250
0.100	0.500	0.300
0.200	0.500	0.350
0.300	0.500	0.400
0.400	0.500	0.450
0.500	0.500	0.500
0.600	0.500	0.550
0.700	0.500	0.600
0.800	0.500	0.650
0.900	0.500	0.700
1.000	0.500	0.750
0.000	1.000	0.500
0.100	1.000	0.550
0.200	1.000	0.600
0.300	1.000	0.650
0.400	1.000	0.700
0.500	1.000	0.750
0.600	1.000	0.800
0.700	1.000	0.850
0.800	1.000	0.900
0.900	1.000	0.950
1.000	1.000	1.000

Subindices		FCI
Bank Stability	Bank Vegetation	Shoreline Stability
$V_{bankstab}$	$V_{bankveg}$	$FCI_{shorestab}$
0.100	0.000	0.050
0.100	0.100	0.100
0.100	0.200	0.150
0.100	0.300	0.200
0.100	0.400	0.250
0.100	0.500	0.300
0.100	0.600	0.350
0.100	0.700	0.400
0.100	0.800	0.450
0.100	0.900	0.500
0.100	1.000	0.550
0.500	0.000	0.250
0.500	0.100	0.300
0.500	0.200	0.350
0.500	0.300	0.400
0.500	0.400	0.450
0.500	0.500	0.500
0.500	0.600	0.550
0.500	0.700	0.600
0.500	0.800	0.650
0.500	0.900	0.700
0.500	1.000	0.750
1.000	0.000	0.500
1.000	0.100	0.550
1.000	0.200	0.600
1.000	0.300	0.650
1.000	0.400	0.700
1.000	0.500	0.750
1.000	0.600	0.800
1.000	0.700	0.850
1.000	0.800	0.900
1.000	0.900	0.950
1.000	1.000	1.000



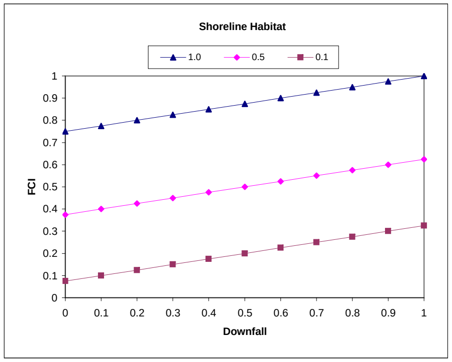


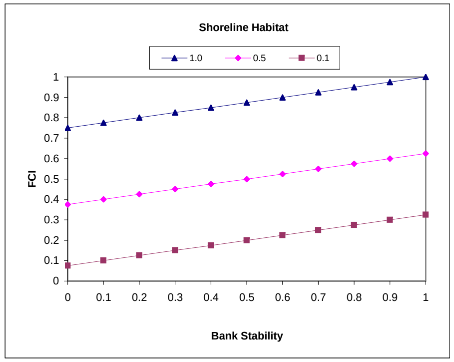


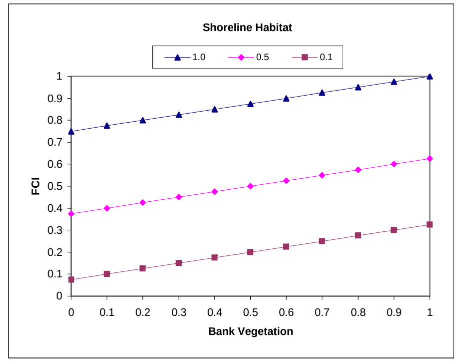
Subindices			FCI
Downfall	Bank Vegetation	Riparian Edge Cover	Shade and Cover
V_{down}	$V_{bankveg}$	$V_{riparian}$	$FCI_{shorecov}$
0.000	0.100	0.100	0.067
0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.133
0.300	0.100	0.100	0.167
0.400	0.100	0.100	0.200
0.500	0.100	0.100	0.233
0.600	0.100	0.100	0.267
0.700	0.100	0.100	0.300
0.800	0.100	0.100	0.333
0.900	0.100	0.100	0.367
1.000	0.100	0.100	0.400
0.000	0.500	0.500	0.333
0.100	0.500	0.500	0.367
0.200	0.500	0.500	0.400
0.300	0.500	0.500	0.433
0.400	0.500	0.500	0.467
0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.533
0.700	0.500	0.500	0.567
0.800	0.500	0.500	0.600
0.900	0.500	0.500	0.633
1.000	0.500	0.500	0.667
0.000	1.000	1.000	0.667
0.100	1.000	1.000	0.700
0.200	1.000	1.000	0.733
0.300	1.000	1.000	0.767
0.400	1.000	1.000	0.800
0.500	1.000	1.000	0.833
0.600	1.000	1.000	0.867
0.700	1.000	1.000	0.900
0.800	1.000	1.000	0.933
0.900	1.000	1.000	0.967
1.000	1.000	1.000	1.000

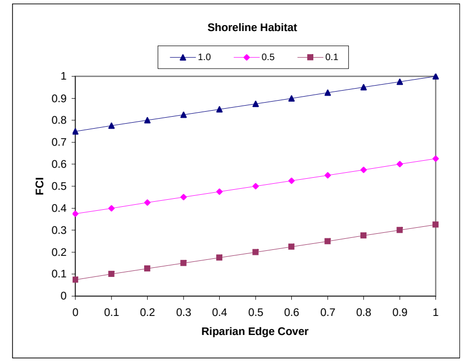
Subindices			FCI
Downfall	Bank Vegetation	Riparian Edge Cover	Shade and Cover
V_{down}	$V_{bankveg}$	$V_{riparian}$	$FCI_{shorecov}$
0.100	0.000	0.100	0.067
0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.133
0.100	0.300	0.100	0.167
0.100	0.400	0.100	0.200
0.100	0.500	0.100	0.233
0.100	0.600	0.100	0.267
0.100	0.700	0.100	0.300
0.100	0.800	0.100	0.333
0.100	0.900	0.100	0.367
0.100	1.000	0.100	0.400
0.500	0.000	0.500	0.333
0.500	0.100	0.500	0.367
0.500	0.200	0.500	0.400
0.500	0.300	0.500	0.433
0.500	0.400	0.500	0.467
0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.533
0.500	0.700	0.500	0.567
0.500	0.800	0.500	0.600
0.500	0.900	0.500	0.633
0.500	1.000	0.500	0.667
1.000	0.000	1.000	0.667
1.000	0.100	1.000	0.700
1.000	0.200	1.000	0.733
1.000	0.300	1.000	0.767
1.000	0.400	1.000	0.800
1.000	0.500	1.000	0.833
1.000	0.600	1.000	0.867
1.000	0.700	1.000	0.900
1.000	0.800	1.000	0.933
1.000	0.900	1.000	0.967
1.000	1.000	1.000	1.000

Subindices			FCI
Downfall	Bank Vegetation	Riparian Edge Cover	Shade and Cover
V_{down}	$V_{bankveg}$	$V_{riparian}$	$FCI_{shorecov}$
0.000	0.100	0.000	0.033
0.100	0.100	0.100	0.100
0.200	0.100	0.200	0.167
0.300	0.100	0.300	0.233
0.400	0.100	0.400	0.300
0.500	0.100	0.500	0.367
0.600	0.100	0.600	0.433
0.700	0.100	0.700	0.500
0.800	0.100	0.800	0.567
0.900	0.100	0.900	0.633
1.000	0.100	1.000	0.700
0.000	0.500	0.000	0.167
0.100	0.500	0.100	0.233
0.200	0.500	0.200	0.300
0.300	0.500	0.300	0.367
0.400	0.500	0.400	0.433
0.500	0.500	0.500	0.500
0.600	0.500	0.600	0.567
0.700	0.500	0.700	0.633
0.800	0.500	0.800	0.700
0.900	0.500	0.900	0.767
1.000	0.500	1.000	0.833
0.000	1.000	0.000	0.333
0.100	1.000	0.100	0.400
0.200	1.000	0.200	0.467
0.300	1.000	0.300	0.533
0.400	1.000	0.400	0.600
0.500	1.000	0.500	0.667
0.600	1.000	0.600	0.733
0.700	1.000	0.700	0.800
0.800	1.000	0.800	0.867
0.900	1.000	0.900	0.933
1.000	1.000	1.000	1.000







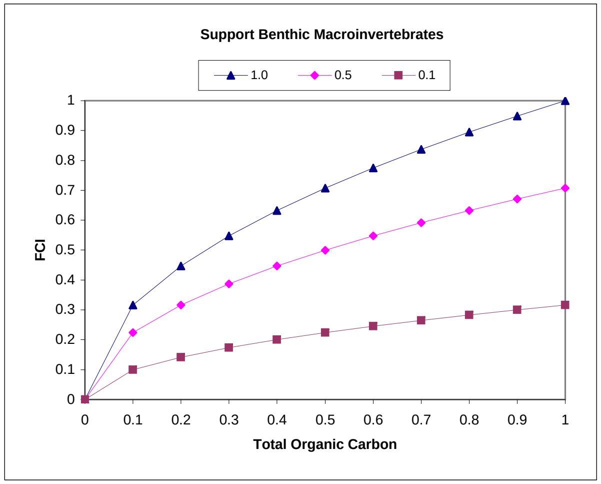


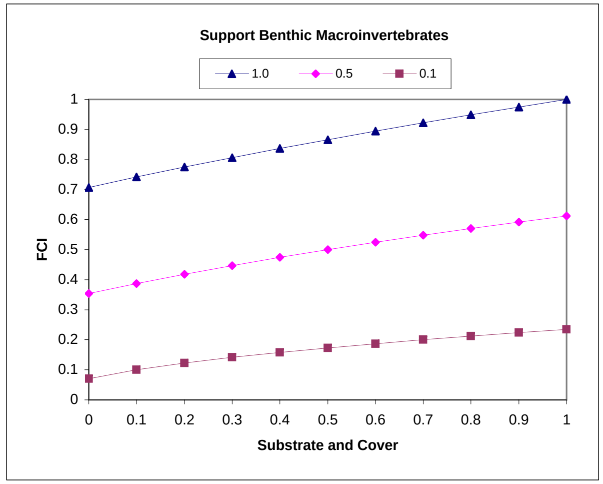
FCI input	Subindices			FCI
Downfall	Bank Stability	Bank Vegetation	Riparian Edge Cover	Shoreline Habitat
V_{down}	$V_{bankstab}$	$V_{bankveg}$	$V_{riparian}$	$FCI_{shorehab}$
0.000	0.100	0.100	0.100	0.075
0.100	0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.100	0.125
0.300	0.100	0.100	0.100	0.150
0.400	0.100	0.100	0.100	0.175
0.500	0.100	0.100	0.100	0.200
0.600	0.100	0.100	0.100	0.225
0.700	0.100	0.100	0.100	0.250
0.800	0.100	0.100	0.100	0.275
0.900	0.100	0.100	0.100	0.300
1.000	0.100	0.100	0.100	0.325
0.000	0.500	0.500	0.500	0.375
0.100	0.500	0.500	0.500	0.400
0.200	0.500	0.500	0.500	0.425
0.300	0.500	0.500	0.500	0.450
0.400	0.500	0.500	0.500	0.475
0.500	0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.500	0.525
0.700	0.500	0.500	0.500	0.550
0.800	0.500	0.500	0.500	0.575
0.900	0.500	0.500	0.500	0.600
1.000	0.500	0.500	0.500	0.625
0.000	1.000	1.000	1.000	0.750
0.100	1.000	1.000	1.000	0.775
0.200	1.000	1.000	1.000	0.800
0.300	1.000	1.000	1.000	0.825
0.400	1.000	1.000	1.000	0.850
0.500	1.000	1.000	1.000	0.875
0.600	1.000	1.000	1.000	0.900
0.700	1.000	1.000	1.000	0.925
0.800	1.000	1.000	1.000	0.950
0.900	1.000	1.000	1.000	0.975
1.000	1.000	1.000	1.000	1.000

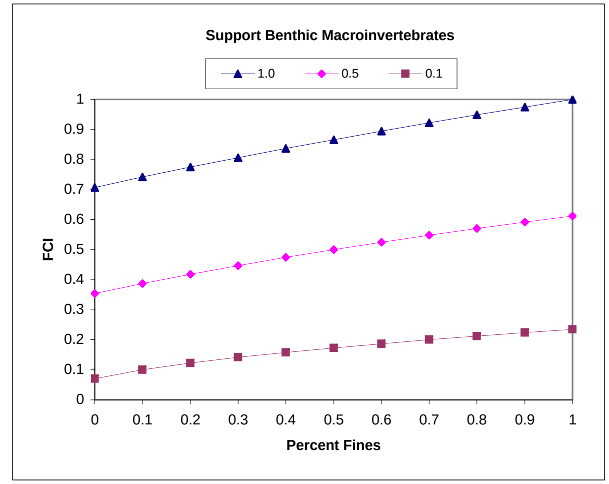
FCI input	Subindices			FCI
Downfall	Bank Stability	Bank Vegetation	Riparian Edge Cover	Shoreline Habitat
V_{down}	$V_{bankstab}$	$V_{bankveg}$	$V_{riparian}$	$FCI_{shorehab}$
0.100	0.000	0.100	0.100	0.075
0.100	0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.100	0.125
0.100	0.300	0.100	0.100	0.150
0.100	0.400	0.100	0.100	0.175
0.100	0.500	0.100	0.100	0.200
0.100	0.600	0.100	0.100	0.225
0.100	0.700	0.100	0.100	0.250
0.100	0.800	0.100	0.100	0.275
0.100	0.900	0.100	0.100	0.300
0.100	1.000	0.100	0.100	0.325
0.500	0.000	0.500	0.500	0.375
0.500	0.100	0.500	0.500	0.400
0.500	0.200	0.500	0.500	0.425
0.500	0.300	0.500	0.500	0.450
0.500	0.400	0.500	0.500	0.475
0.500	0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.500	0.525
0.500	0.700	0.500	0.500	0.550
0.500	0.800	0.500	0.500	0.575
0.500	0.900	0.500	0.500	0.600
0.500	1.000	0.500	0.500	0.625
1.000	0.000	1.000	1.000	0.750
1.000	0.100	1.000	1.000	0.775
1.000	0.200	1.000	1.000	0.800
1.000	0.300	1.000	1.000	0.825
1.000	0.400	1.000	1.000	0.850
1.000	0.500	1.000	1.000	0.875
1.000	0.600	1.000	1.000	0.900
1.000	0.700	1.000	1.000	0.925
1.000	0.800	1.000	1.000	0.950
1.000	0.900	1.000	1.000	0.975
1.000	1.000	1.000	1.000	1.000

FCI input	Subindices			FCI
Downfall	Bank Stability	Bank Vegetation	Riparian Edge Cover	Shoreline Habitat
V_{down}	$V_{bankstab}$	$V_{bankveg}$	$V_{riparian}$	$FCI_{shorehab}$
0.100	0.100	0.000	0.100	0.075
0.100	0.100	0.100	0.100	0.100
0.100	0.100	0.200	0.100	0.125
0.100	0.100	0.300	0.100	0.150
0.100	0.100	0.400	0.100	0.175
0.100	0.100	0.500	0.100	0.200
0.100	0.100	0.600	0.100	0.225
0.100	0.100	0.700	0.100	0.250
0.100	0.100	0.800	0.100	0.275
0.100	0.100	0.900	0.100	0.300
0.100	0.100	1.000	0.100	0.325
0.500	0.500	0.000	0.500	0.375
0.500	0.500	0.100	0.500	0.400
0.500	0.500	0.200	0.500	0.425
0.500	0.500	0.300	0.500	0.450
0.500	0.500	0.400	0.500	0.475
0.500	0.500	0.500	0.500	0.500
0.500	0.500	0.600	0.500	0.525
0.500	0.500	0.700	0.500	0.550
0.500	0.500	0.800	0.500	0.575
0.500	0.500	0.900	0.500	0.600
0.500	0.500	1.000	0.500	0.625
1.000	1.000	0.000	1.000	0.750
1.000	1.000	0.100	1.000	0.775
1.000	1.000	0.200	1.000	0.800
1.000	1.000	0.300	1.000	0.825
1.000	1.000	0.400	1.000	0.850
1.000	1.000	0.500	1.000	0.875
1.000	1.000	0.600	1.000	0.900
1.000	1.000	0.700	1.000	0.925
1.000	1.000	0.800	1.000	0.950
1.000	1.000	0.900	1.000	0.975
1.000	1.000	1.000	1.000	1.000

FCI input	Subindices			FCI
Downfall	Bank Stability	Bank Vegetation	Riparian Edge Cover	Shoreline Habitat
V_{down}	$V_{bankstab}$	$V_{bankveg}$	$V_{riparian}$	$FCI_{shorehab}$
0.100	0.100	0.100	0.000	0.075
0.100	0.100	0.100	0.100	0.100
0.100	0.100	0.100	0.200	0.125
0.100	0.100	0.100	0.300	0.150
0.100	0.100	0.100	0.400	0.175
0.100	0.100	0.100	0.500	0.200
0.100	0.100	0.100	0.600	0.225
0.100	0.100	0.100	0.700	0.250
0.100	0.100	0.100	0.800	0.275
0.100	0.100	0.100	0.900	0.300
0.100	0.100	0.100	1.000	0.325
0.500	0.500	0.500	0.000	0.375
0.500	0.500	0.500	0.100	0.400
0.500	0.500	0.500	0.200	0.425
0.500	0.500	0.500	0.300	0.450
0.500	0.500	0.500	0.400	0.475
0.500	0.500	0.500	0.500	0.500
0.500	0.500	0.500	0.600	0.525
0.500	0.500	0.500	0.700	0.550
0.500	0.500	0.500	0.800	0.575
0.500	0.500	0.500	0.900	0.600
0.500	0.500	0.500	1.000	0.625
1.000	1.000	1.000	0.000	0.750
1.000	1.000	1.000	0.100	0.775
1.000	1.000	1.000	0.200	0.800
1.000	1.000	1.000	0.300	0.825
1.000	1.000	1.000	0.400	0.850
1.000	1.000	1.000	0.500	0.875
1.000	1.000	1.000	0.600	0.900
1.000	1.000	1.000	0.700	0.925
1.000	1.000	1.000	0.800	0.950
1.000	1.000	1.000	0.900	0.975
1.000	1.000	1.000	1.000	1.000



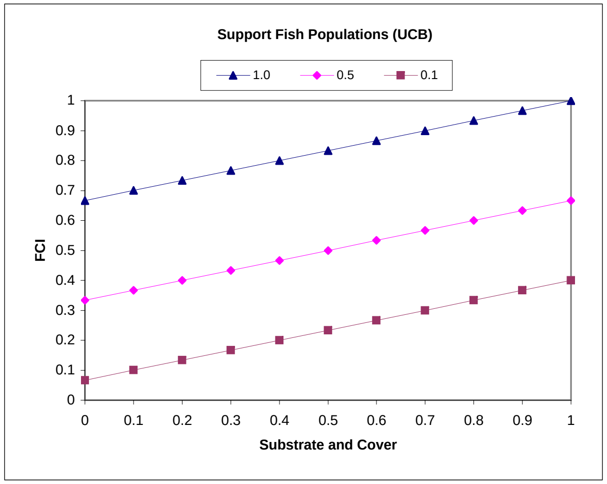


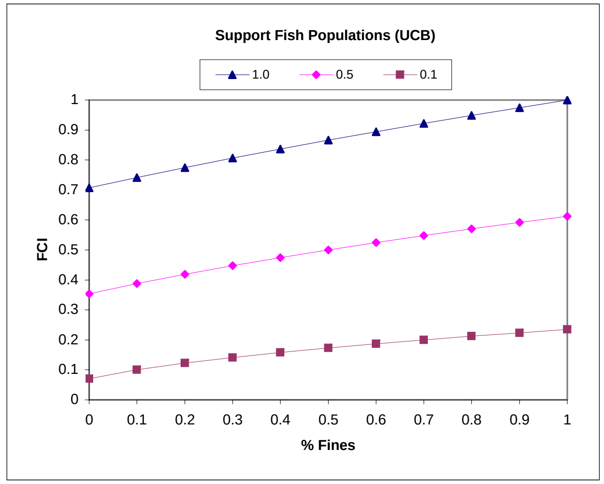


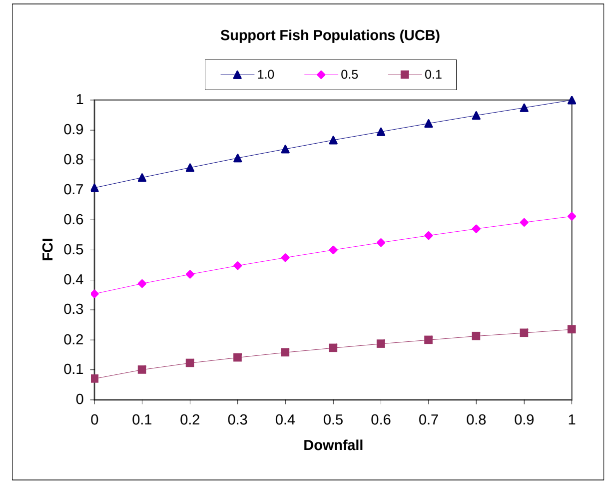
Subindices			FCI
TOC	Substrate and Cover	%Fines	Support Benthic Macroinverts
V_{TOC}	$V_{subcover}$	V_{fines}	FCI_{ucbbmi}
0.000	0.100	0.100	0.000
0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.141
0.300	0.100	0.100	0.173
0.400	0.100	0.100	0.200
0.500	0.100	0.100	0.224
0.600	0.100	0.100	0.245
0.700	0.100	0.100	0.265
0.800	0.100	0.100	0.283
0.900	0.100	0.100	0.300
1.000	0.100	0.100	0.316
0.000	0.500	0.500	0.000
0.100	0.500	0.500	0.224
0.200	0.500	0.500	0.316
0.300	0.500	0.500	0.387
0.400	0.500	0.500	0.447
0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.548
0.700	0.500	0.500	0.592
0.800	0.500	0.500	0.632
0.900	0.500	0.500	0.671
1.000	0.500	0.500	0.707
0.000	1.000	1.000	0.000
0.100	1.000	1.000	0.316
0.200	1.000	1.000	0.447
0.300	1.000	1.000	0.548
0.400	1.000	1.000	0.632
0.500	1.000	1.000	0.707
0.600	1.000	1.000	0.775
0.700	1.000	1.000	0.837
0.800	1.000	1.000	0.894
0.900	1.000	1.000	0.949
1.000	1.000	1.000	1.000

Subindices			FCI
TOC	Substrate and Cover	%Fines	Support Benthic Macroinverts
V_{TOC}	$V_{subcover}$	V_{fines}	FCI_{ucbbmi}
0.100	0.000	0.100	0.071
0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.122
0.100	0.300	0.100	0.141
0.100	0.400	0.100	0.158
0.100	0.500	0.100	0.173
0.100	0.600	0.100	0.187
0.100	0.700	0.100	0.200
0.100	0.800	0.100	0.212
0.100	0.900	0.100	0.224
0.100	1.000	0.100	0.235
0.500	0.000	0.500	0.354
0.500	0.100	0.500	0.387
0.500	0.200	0.500	0.418
0.500	0.300	0.500	0.447
0.500	0.400	0.500	0.474
0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.524
0.500	0.700	0.500	0.548
0.500	0.800	0.500	0.570
0.500	0.900	0.500	0.592
0.500	1.000	0.500	0.612
1.000	0.000	1.000	0.707
1.000	0.100	1.000	0.742
1.000	0.200	1.000	0.775
1.000	0.300	1.000	0.806
1.000	0.400	1.000	0.837
1.000	0.500	1.000	0.866
1.000	0.600	1.000	0.894
1.000	0.700	1.000	0.922
1.000	0.800	1.000	0.949
1.000	0.900	1.000	0.975
1.000	1.000	1.000	1.000

Subindices			FCI
TOC	Substrate and Cover	%Fines	Support Benthic Macroinverts
V_{TOC}	$V_{subcover}$	V_{fines}	FCI_{ucbbmi}
0.100	0.100	0.000	0.071
0.100	0.100	0.100	0.100
0.100	0.100	0.200	0.122
0.100	0.100	0.300	0.141
0.100	0.100	0.400	0.158
0.100	0.100	0.500	0.173
0.100	0.100	0.600	0.187
0.100	0.100	0.700	0.200
0.100	0.100	0.800	0.212
0.100	0.100	0.900	0.224
0.100	0.100	1.000	0.235
0.500	0.500	0.000	0.354
0.500	0.500	0.100	0.387
0.500	0.500	0.200	0.418
0.500	0.500	0.300	0.447
0.500	0.500	0.400	0.474
0.500	0.500	0.500	0.500
0.500	0.500	0.600	0.524
0.500	0.500	0.700	0.548
0.500	0.500	0.800	0.570
0.500	0.500	0.900	0.592
0.500	0.500	1.000	0.612
1.000	1.000	0.000	0.707
1.000	1.000	0.100	0.742
1.000	1.000	0.200	0.775
1.000	1.000	0.300	0.806
1.000	1.000	0.400	0.837
1.000	1.000	0.500	0.866
1.000	1.000	0.600	0.894
1.000	1.000	0.700	0.922
1.000	1.000	0.800	0.949
1.000	1.000	0.900	0.975
1.000	1.000	1.000	1.000



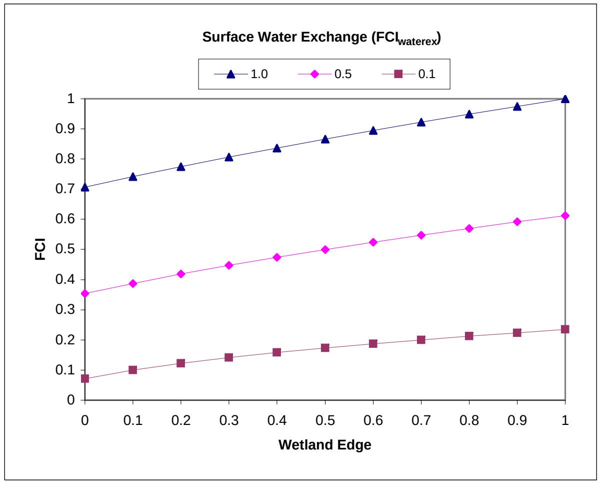


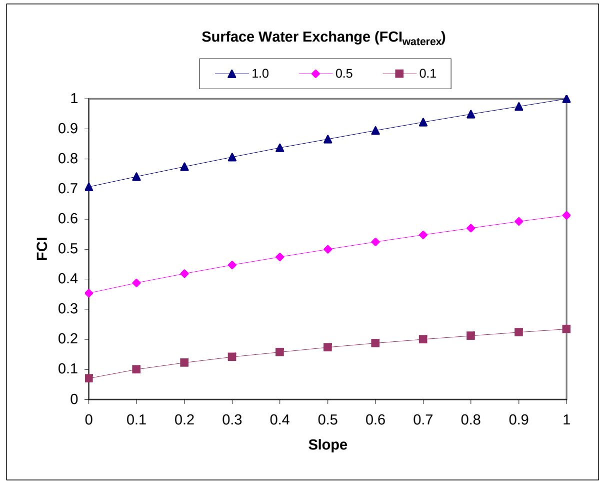


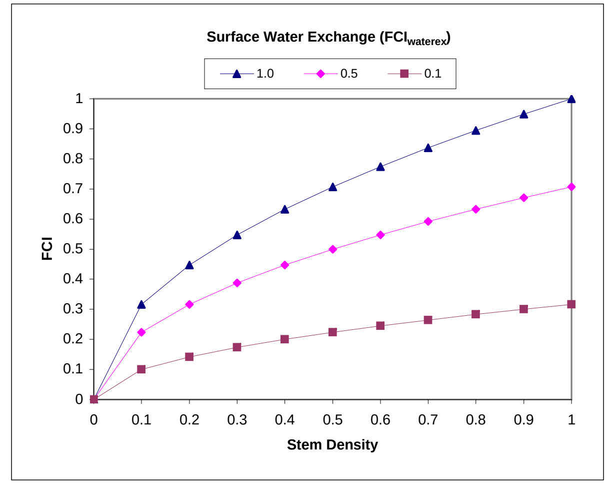
Subindices			FCI
Substrate and Cover	% Fines	Downfall	Support Fish Populations
$V_{subcover}$	V_{fines}	$V_{ucbdown}$	FCI_{ucbbmi}
0.000	0.100	0.100	0.067
0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.133
0.300	0.100	0.100	0.167
0.400	0.100	0.100	0.200
0.500	0.100	0.100	0.233
0.600	0.100	0.100	0.267
0.700	0.100	0.100	0.300
0.800	0.100	0.100	0.333
0.900	0.100	0.100	0.367
1.000	0.100	0.100	0.400
0.000	0.500	0.500	0.333
0.100	0.500	0.500	0.367
0.200	0.500	0.500	0.400
0.300	0.500	0.500	0.433
0.400	0.500	0.500	0.467
0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.533
0.700	0.500	0.500	0.567
0.800	0.500	0.500	0.600
0.900	0.500	0.500	0.633
1.000	0.500	0.500	0.667
0.000	1.000	1.000	0.667
0.100	1.000	1.000	0.700
0.200	1.000	1.000	0.733
0.300	1.000	1.000	0.767
0.400	1.000	1.000	0.800
0.500	1.000	1.000	0.833
0.600	1.000	1.000	0.867
0.700	1.000	1.000	0.900
0.800	1.000	1.000	0.933
0.900	1.000	1.000	0.967
1.000	1.000	1.000	1.000

Subindices			FCI
Substrate and Cover	% Fines	Downfall	Support Fish Populations
$V_{subcover}$	V_{fines}	$V_{ucbdown}$	FCI_{ucbbmi}
0.100	0.000	0.100	0.071
0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.122
0.100	0.300	0.100	0.141
0.100	0.400	0.100	0.158
0.100	0.500	0.100	0.173
0.100	0.600	0.100	0.187
0.100	0.700	0.100	0.200
0.100	0.800	0.100	0.212
0.100	0.900	0.100	0.224
0.100	1.000	0.100	0.235
0.500	0.000	0.500	0.354
0.500	0.100	0.500	0.387
0.500	0.200	0.500	0.418
0.500	0.300	0.500	0.447
0.500	0.400	0.500	0.474
0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.524
0.500	0.700	0.500	0.548
0.500	0.800	0.500	0.570
0.500	0.900	0.500	0.592
0.500	1.000	0.500	0.612
1.000	0.000	1.000	0.707
1.000	0.100	1.000	0.742
1.000	0.200	1.000	0.775
1.000	0.300	1.000	0.806
1.000	0.400	1.000	0.837
1.000	0.500	1.000	0.866
1.000	0.600	1.000	0.894
1.000	0.700	1.000	0.922
1.000	0.800	1.000	0.949
1.000	0.900	1.000	0.975
1.000	1.000	1.000	1.000

Subindices			FCI
Substrate and Cover	% Fines	Downfall	Support Benthic Macroinverts
$V_{subcover}$	V_{fines}	$V_{ucbdown}$	FCI_{ucbbmi}
0.100	0.100	0.000	0.071
0.100	0.100	0.100	0.100
0.100	0.100	0.200	0.122
0.100	0.100	0.300	0.141
0.100	0.100	0.400	0.158
0.100	0.100	0.500	0.173
0.100	0.100	0.600	0.187
0.100	0.100	0.700	0.200
0.100	0.100	0.800	0.212
0.100	0.100	0.900	0.224
0.100	0.100	1.000	0.235
0.500	0.500	0.000	0.354
0.500	0.500	0.100	0.387
0.500	0.500	0.200	0.418
0.500	0.500	0.300	0.447
0.500	0.500	0.400	0.474
0.500	0.500	0.500	0.500
0.500	0.500	0.600	0.524
0.500	0.500	0.700	0.548
0.500	0.500	0.800	0.570
0.500	0.500	0.900	0.592
0.500	0.500	1.000	0.612
1.000	1.000	0.000	0.707
1.000	1.000	0.100	0.742
1.000	1.000	0.200	0.775
1.000	1.000	0.300	0.806
1.000	1.000	0.400	0.837
1.000	1.000	0.500	0.866
1.000	1.000	0.600	0.894
1.000	1.000	0.700	0.922
1.000	1.000	0.800	0.949
1.000	1.000	0.900	0.975
1.000	1.000	1.000	1.000



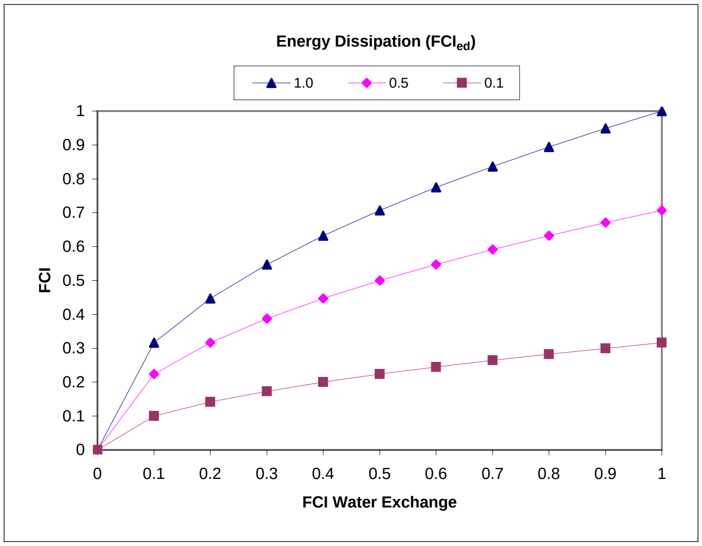


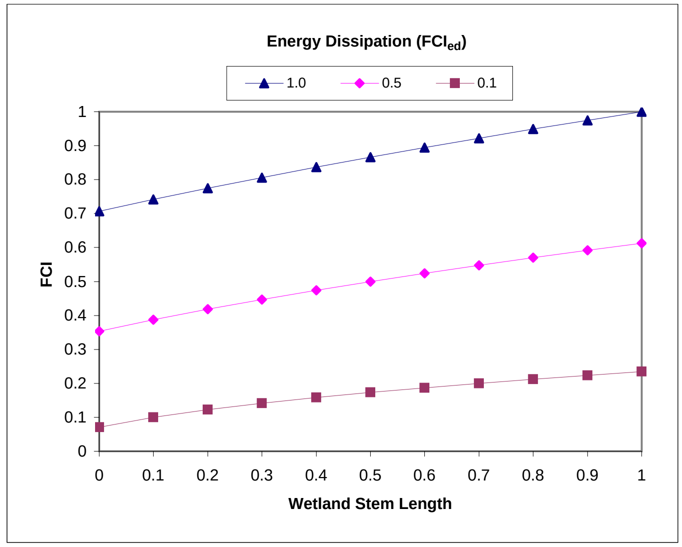


Subindices			FCI
Wetland Edge	Slope (%)	Stem Density	Surface Water Exchange
$V_{wetedge}$	V_{slope}	$V_{wetdense}$	$FCI_{waterex}$
0.000	0.100	0.100	0.071
0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.122
0.300	0.100	0.100	0.141
0.400	0.100	0.100	0.158
0.500	0.100	0.100	0.173
0.600	0.100	0.100	0.187
0.700	0.100	0.100	0.200
0.800	0.100	0.100	0.212
0.900	0.100	0.100	0.224
1.000	0.100	0.100	0.235
0.000	0.500	0.500	0.354
0.100	0.500	0.500	0.387
0.200	0.500	0.500	0.418
0.300	0.500	0.500	0.447
0.400	0.500	0.500	0.474
0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.524
0.700	0.500	0.500	0.548
0.800	0.500	0.500	0.570
0.900	0.500	0.500	0.592
1.000	0.500	0.500	0.612
0.000	1.000	1.000	0.707
0.100	1.000	1.000	0.742
0.200	1.000	1.000	0.775
0.300	1.000	1.000	0.806
0.400	1.000	1.000	0.837
0.500	1.000	1.000	0.866
0.600	1.000	1.000	0.894
0.700	1.000	1.000	0.922
0.800	1.000	1.000	0.949
0.900	1.000	1.000	0.975
1.000	1.000	1.000	1.000

Subindices			FCI
Wetland Edge	Slope (%)	Stem Density	Surface Water Exchange
$V_{wetedge}$	V_{slope}	$V_{wetdense}$	$FCI_{waterex}$
0.100	0.000	0.100	0.071
0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.122
0.100	0.300	0.100	0.141
0.100	0.400	0.100	0.158
0.100	0.500	0.100	0.173
0.100	0.600	0.100	0.187
0.100	0.700	0.100	0.200
0.100	0.800	0.100	0.212
0.100	0.900	0.100	0.224
0.100	1.000	0.100	0.235
0.500	0.000	0.500	0.354
0.500	0.100	0.500	0.387
0.500	0.200	0.500	0.418
0.500	0.300	0.500	0.447
0.500	0.400	0.500	0.474
0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.524
0.500	0.700	0.500	0.548
0.500	0.800	0.500	0.570
0.500	0.900	0.500	0.592
0.500	1.000	0.500	0.612
1.000	0.000	1.000	0.707
1.000	0.100	1.000	0.742
1.000	0.200	1.000	0.775
1.000	0.300	1.000	0.806
1.000	0.400	1.000	0.837
1.000	0.500	1.000	0.866
1.000	0.600	1.000	0.894
1.000	0.700	1.000	0.922
1.000	0.800	1.000	0.949
1.000	0.900	1.000	0.975
1.000	1.000	1.000	1.000

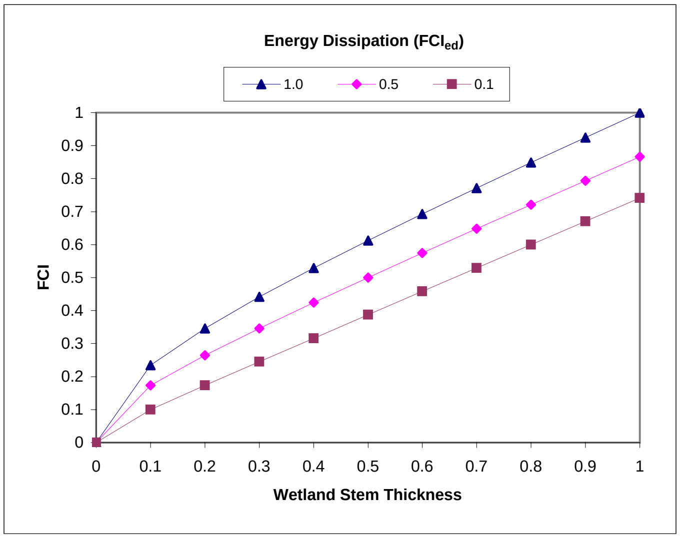
Subindices			FCI
Wetland Edge	Slope (%)	Stem Density	Surface Water Exchange
$V_{wetedge}$	V_{slope}	$V_{wetdense}$	$FCI_{waterex}$
0.100	0.100	0.000	0.000
0.100	0.100	0.100	0.100
0.100	0.100	0.200	0.141
0.100	0.100	0.300	0.173
0.100	0.100	0.400	0.200
0.100	0.100	0.500	0.224
0.100	0.100	0.600	0.245
0.100	0.100	0.700	0.265
0.100	0.100	0.800	0.283
0.100	0.100	0.900	0.300
0.100	0.100	1.000	0.316
0.500	0.500	0.000	0.000
0.500	0.500	0.100	0.224
0.500	0.500	0.200	0.316
0.500	0.500	0.300	0.387
0.500	0.500	0.400	0.447
0.500	0.500	0.500	0.500
0.500	0.500	0.600	0.548
0.500	0.500	0.700	0.592
0.500	0.500	0.800	0.632
0.500	0.500	0.900	0.671
0.500	0.500	1.000	0.707
1.000	1.000	0.000	0.000
1.000	1.000	0.100	0.316
1.000	1.000	0.200	0.447
1.000	1.000	0.300	0.548
1.000	1.000	0.400	0.632
1.000	1.000	0.500	0.707
1.000	1.000	0.600	0.775
1.000	1.000	0.700	0.837
1.000	1.000	0.800	0.894
1.000	1.000	0.900	0.949
1.000	1.000	1.000	1.000



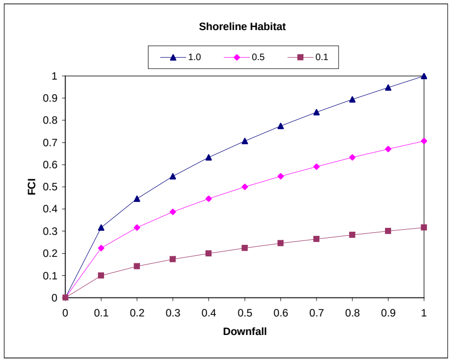


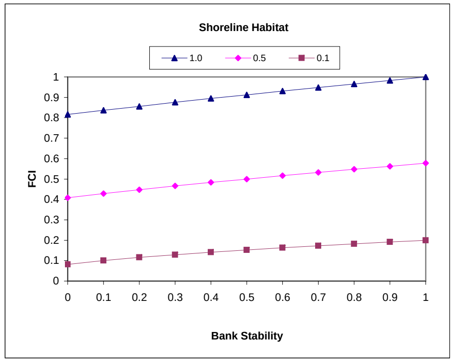
Subindices			FCI
FCIwaterex	Stem Length	Stem Thickness	Energy Dissipation
V_{savbio}	V_{fines}	$V_{savnuts}$	$FCI_{savnuts}$
0.000	0.100	0.100	0.000
0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.141
0.300	0.100	0.100	0.173
0.400	0.100	0.100	0.200
0.500	0.100	0.100	0.224
0.600	0.100	0.100	0.245
0.700	0.100	0.100	0.265
0.800	0.100	0.100	0.283
0.900	0.100	0.100	0.300
1.000	0.100	0.100	0.316
0.000	0.500	0.500	0.000
0.100	0.500	0.500	0.224
0.200	0.500	0.500	0.316
0.300	0.500	0.500	0.387
0.400	0.500	0.500	0.447
0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.548
0.700	0.500	0.500	0.592
0.800	0.500	0.500	0.632
0.900	0.500	0.500	0.671
1.000	0.500	0.500	0.707
0.000	1.000	1.000	0.000
0.100	1.000	1.000	0.316
0.200	1.000	1.000	0.447
0.300	1.000	1.000	0.548
0.400	1.000	1.000	0.632
0.500	1.000	1.000	0.707
0.600	1.000	1.000	0.775
0.700	1.000	1.000	0.837
0.800	1.000	1.000	0.894
0.900	1.000	1.000	0.949
1.000	1.000	1.000	1.000

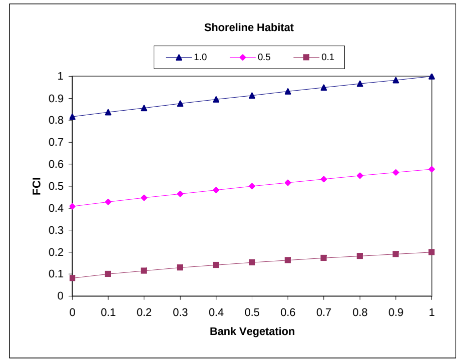
Subindices			FCI
FCIwaterex	Stem Length	Stem Thickness	Energy Dissipation
V_{savbio}	V_{fines}	$V_{savnuts}$	$FCI_{savnuts}$
0.100	0.000	0.100	0.071
0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.122
0.100	0.300	0.100	0.141
0.100	0.400	0.100	0.158
0.100	0.500	0.100	0.173
0.100	0.600	0.100	0.187
0.100	0.700	0.100	0.200
0.100	0.800	0.100	0.212
0.100	0.900	0.100	0.224
0.100	1.000	0.100	0.235
0.500	0.000	0.500	0.354
0.500	0.100	0.500	0.387
0.500	0.200	0.500	0.418
0.500	0.300	0.500	0.447
0.500	0.400	0.500	0.474
0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.524
0.500	0.700	0.500	0.548
0.500	0.800	0.500	0.570
0.500	0.900	0.500	0.592
0.500	1.000	0.500	0.612
1.000	0.000	1.000	0.707
1.000	0.100	1.000	0.742
1.000	0.200	1.000	0.775
1.000	0.300	1.000	0.806
1.000	0.400	1.000	0.837
1.000	0.500	1.000	0.866
1.000	0.600	1.000	0.894
1.000	0.700	1.000	0.922
1.000	0.800	1.000	0.949
1.000	0.900	1.000	0.975
1.000	1.000	1.000	1.000

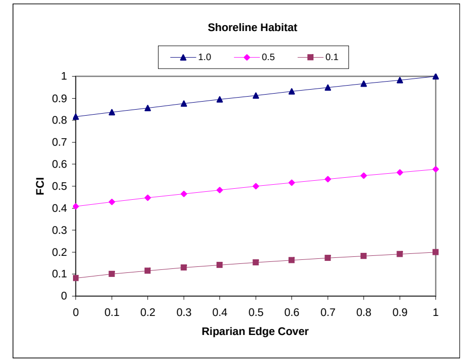


Subindices			FCI
FCIwaterex	Stem Length	Stem Thickness	Energy Dissipation
V_{savbio}	V_{fines}	$V_{savnuts}$	$FCI_{savnuts}$
0.000	0.100	0.000	0.000
0.100	0.100	0.100	0.100
0.200	0.100	0.200	0.173
0.300	0.100	0.300	0.245
0.400	0.100	0.400	0.316
0.500	0.100	0.500	0.387
0.600	0.100	0.600	0.458
0.700	0.100	0.700	0.529
0.800	0.100	0.800	0.600
0.900	0.100	0.900	0.671
1.000	0.100	1.000	0.742
0.000	0.500	0.000	0.000
0.100	0.500	0.100	0.173
0.200	0.500	0.200	0.265
0.300	0.500	0.300	0.346
0.400	0.500	0.400	0.424
0.500	0.500	0.500	0.500
0.600	0.500	0.600	0.574
0.700	0.500	0.700	0.648
0.800	0.500	0.800	0.721
0.900	0.500	0.900	0.794
1.000	0.500	1.000	0.866
0.000	1.000	0.000	0.000
0.100	1.000	0.100	0.235
0.200	1.000	0.200	0.346
0.300	1.000	0.300	0.442
0.400	1.000	0.400	0.529
0.500	1.000	0.500	0.612
0.600	1.000	0.600	0.693
0.700	1.000	0.700	0.771
0.800	1.000	0.800	0.849
0.900	1.000	0.900	0.925
1.000	1.000	1.000	1.000







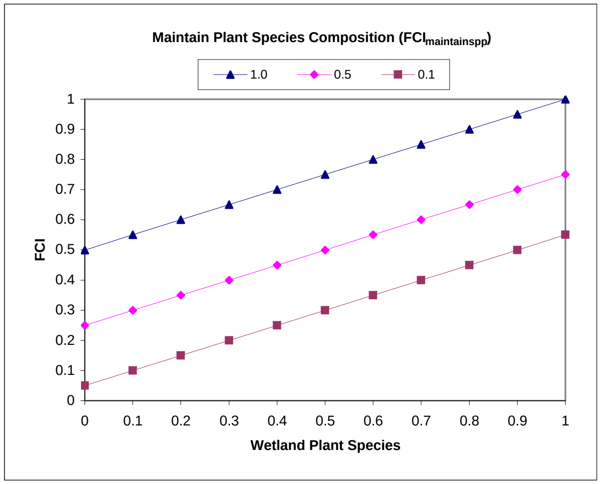


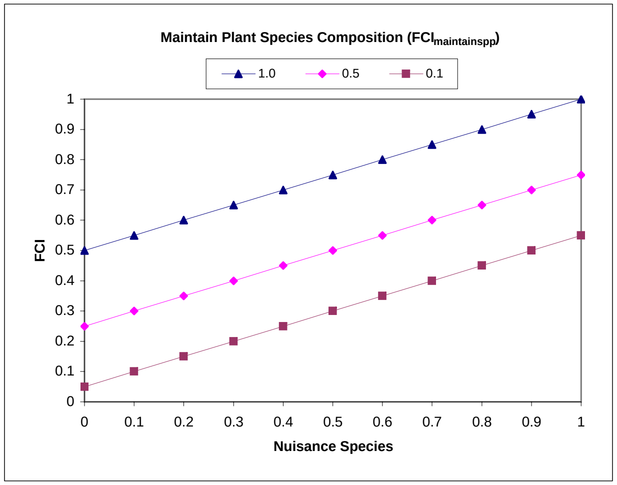
FCI input	Subindices			FCI
Surface Water Exchange	Wetland Stem Length	Wetland Stem Thickness	Wetland Biomass	Shoreline Habitat
$FCI_{waterex}$	$V_{wetlength}$	$V_{wetthick}$	V_{wetbio}	$FCI_{wetcycling}$
0.000	0.100	0.100	0.100	0.000
0.100	0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.100	0.141
0.300	0.100	0.100	0.100	0.173
0.400	0.100	0.100	0.100	0.200
0.500	0.100	0.100	0.100	0.224
0.600	0.100	0.100	0.100	0.245
0.700	0.100	0.100	0.100	0.265
0.800	0.100	0.100	0.100	0.283
0.900	0.100	0.100	0.100	0.300
1.000	0.100	0.100	0.100	0.316
0.000	0.500	0.500	0.500	0.000
0.100	0.500	0.500	0.500	0.224
0.200	0.500	0.500	0.500	0.316
0.300	0.500	0.500	0.500	0.387
0.400	0.500	0.500	0.500	0.447
0.500	0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.500	0.548
0.700	0.500	0.500	0.500	0.592
0.800	0.500	0.500	0.500	0.632
0.900	0.500	0.500	0.500	0.671
1.000	0.500	0.500	0.500	0.707
0.000	1.000	1.000	1.000	0.000
0.100	1.000	1.000	1.000	0.316
0.200	1.000	1.000	1.000	0.447
0.300	1.000	1.000	1.000	0.548
0.400	1.000	1.000	1.000	0.632
0.500	1.000	1.000	1.000	0.707
0.600	1.000	1.000	1.000	0.775
0.700	1.000	1.000	1.000	0.837
0.800	1.000	1.000	1.000	0.894
0.900	1.000	1.000	1.000	0.949
1.000	1.000	1.000	1.000	1.000

FCI input	Subindices			FCI
Surface Water Exchange	Wetland Stem Length	Wetland Stem Thickness	Wetland Biomass	Shoreline Habitat
$FCI_{waterex}$	$V_{wetlength}$	$V_{wetthick}$	V_{wetbio}	$FCI_{wetcycling}$
0.100	0.000	0.100	0.100	0.082
0.100	0.100	0.100	0.100	0.100
0.100	0.200	0.100	0.100	0.115
0.100	0.300	0.100	0.100	0.129
0.100	0.400	0.100	0.100	0.141
0.100	0.500	0.100	0.100	0.153
0.100	0.600	0.100	0.100	0.163
0.100	0.700	0.100	0.100	0.173
0.100	0.800	0.100	0.100	0.183
0.100	0.900	0.100	0.100	0.191
0.100	1.000	0.100	0.100	0.200
0.500	0.000	0.500	0.500	0.408
0.500	0.100	0.500	0.500	0.428
0.500	0.200	0.500	0.500	0.447
0.500	0.300	0.500	0.500	0.465
0.500	0.400	0.500	0.500	0.483
0.500	0.500	0.500	0.500	0.500
0.500	0.600	0.500	0.500	0.516
0.500	0.700	0.500	0.500	0.532
0.500	0.800	0.500	0.500	0.548
0.500	0.900	0.500	0.500	0.563
0.500	1.000	0.500	0.500	0.577
1.000	0.000	1.000	1.000	0.816
1.000	0.100	1.000	1.000	0.837
1.000	0.200	1.000	1.000	0.856
1.000	0.300	1.000	1.000	0.876
1.000	0.400	1.000	1.000	0.894
1.000	0.500	1.000	1.000	0.913
1.000	0.600	1.000	1.000	0.931
1.000	0.700	1.000	1.000	0.949
1.000	0.800	1.000	1.000	0.966
1.000	0.900	1.000	1.000	0.983
1.000	1.000	1.000	1.000	1.000

FCI input	Subindices			FCI
Surface Water Exchange	Wetland Stem Length	Wetland Stem Thickness	Wetland Biomass	Shoreline Habitat
$FCI_{waterex}$	$V_{wetlength}$	$V_{wetthick}$	V_{wetbio}	$FCI_{wetcycling}$
0.100	0.100	0.000	0.100	0.082
0.100	0.100	0.100	0.100	0.100
0.100	0.100	0.200	0.100	0.115
0.100	0.100	0.300	0.100	0.129
0.100	0.100	0.400	0.100	0.141
0.100	0.100	0.500	0.100	0.153
0.100	0.100	0.600	0.100	0.163
0.100	0.100	0.700	0.100	0.173
0.100	0.100	0.800	0.100	0.183
0.100	0.100	0.900	0.100	0.191
0.100	0.100	1.000	0.100	0.200
0.500	0.500	0.000	0.500	0.408
0.500	0.500	0.100	0.500	0.428
0.500	0.500	0.200	0.500	0.447
0.500	0.500	0.300	0.500	0.465
0.500	0.500	0.400	0.500	0.483
0.500	0.500	0.500	0.500	0.500
0.500	0.500	0.600	0.500	0.516
0.500	0.500	0.700	0.500	0.532
0.500	0.500	0.800	0.500	0.548
0.500	0.500	0.900	0.500	0.563
0.500	0.500	1.000	0.500	0.577
1.000	1.000	0.000	1.000	0.816
1.000	1.000	0.100	1.000	0.837
1.000	1.000	0.200	1.000	0.856
1.000	1.000	0.300	1.000	0.876
1.000	1.000	0.400	1.000	0.894
1.000	1.000	0.500	1.000	0.913
1.000	1.000	0.600	1.000	0.931
1.000	1.000	0.700	1.000	0.949
1.000	1.000	0.800	1.000	0.966
1.000	1.000	0.900	1.000	0.983
1.000	1.000	1.000	1.000	1.000

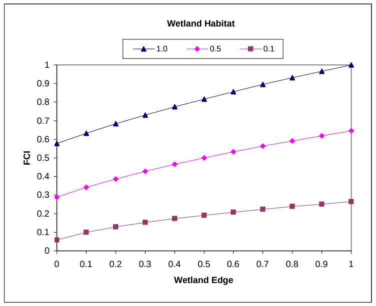
FCI input	Subindices			FCI
Surface Water Exchange	Wetland Stem Length	Wetland Stem Thickness	Wetland Biomass	Shoreline Habitat
$FCI_{waterex}$	$V_{wetlength}$	$V_{wetthick}$	V_{wetbio}	$FCI_{wetcycling}$
0.100	0.100	0.100	0.000	0.082
0.100	0.100	0.100	0.100	0.100
0.100	0.100	0.100	0.200	0.115
0.100	0.100	0.100	0.300	0.129
0.100	0.100	0.100	0.400	0.141
0.100	0.100	0.100	0.500	0.153
0.100	0.100	0.100	0.600	0.163
0.100	0.100	0.100	0.700	0.173
0.100	0.100	0.100	0.800	0.183
0.100	0.100	0.100	0.900	0.191
0.100	0.100	0.100	1.000	0.200
0.500	0.500	0.500	0.000	0.408
0.500	0.500	0.500	0.100	0.428
0.500	0.500	0.500	0.200	0.447
0.500	0.500	0.500	0.300	0.465
0.500	0.500	0.500	0.400	0.483
0.500	0.500	0.500	0.500	0.500
0.500	0.500	0.500	0.600	0.516
0.500	0.500	0.500	0.700	0.532
0.500	0.500	0.500	0.800	0.548
0.500	0.500	0.500	0.900	0.563
0.500	0.500	0.500	1.000	0.577
1.000	1.000	1.000	0.000	0.816
1.000	1.000	1.000	0.100	0.837
1.000	1.000	1.000	0.200	0.856
1.000	1.000	1.000	0.300	0.876
1.000	1.000	1.000	0.400	0.894
1.000	1.000	1.000	0.500	0.913
1.000	1.000	1.000	0.600	0.931
1.000	1.000	1.000	0.700	0.949
1.000	1.000	1.000	0.800	0.966
1.000	1.000	1.000	0.900	0.983
1.000	1.000	1.000	1.000	1.000

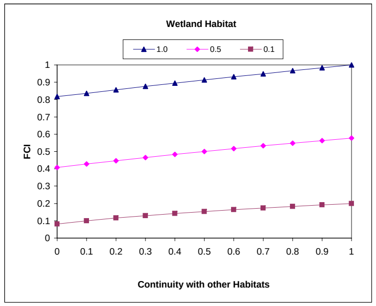


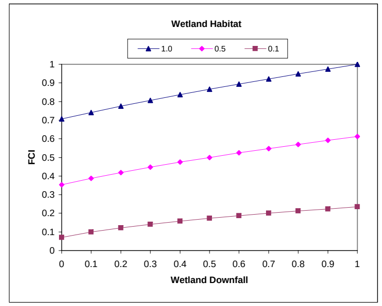


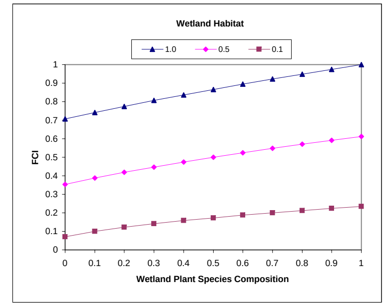
Subindices		FCI
Wetland Plant Species	Nuisance Species	Maintain Plant Species Composition
V_{wetspp}	$V_{wetnuisance}$	$FCI_{maintainspp}$
0.000	0.100	0.050
0.100	0.100	0.100
0.200	0.100	0.150
0.300	0.100	0.200
0.400	0.100	0.250
0.500	0.100	0.300
0.600	0.100	0.350
0.700	0.100	0.400
0.800	0.100	0.450
0.900	0.100	0.500
1.000	0.100	0.550
0.000	0.500	0.250
0.100	0.500	0.300
0.200	0.500	0.350
0.300	0.500	0.400
0.400	0.500	0.450
0.500	0.500	0.500
0.600	0.500	0.550
0.700	0.500	0.600
0.800	0.500	0.650
0.900	0.500	0.700
1.000	0.500	0.750
0.000	1.000	0.500
0.100	1.000	0.550
0.200	1.000	0.600
0.300	1.000	0.650
0.400	1.000	0.700
0.500	1.000	0.750
0.600	1.000	0.800
0.700	1.000	0.850
0.800	1.000	0.900
0.900	1.000	0.950
1.000	1.000	1.000

Subindices		FCI
Wetland Plant Species	Nuisance Species	Maintain Plant Species Composition
V_{wetspp}	$V_{wetnuisance}$	$FCI_{maintainspp}$
0.100	0.000	0.050
0.100	0.100	0.100
0.100	0.200	0.150
0.100	0.300	0.200
0.100	0.400	0.250
0.100	0.500	0.300
0.100	0.600	0.350
0.100	0.700	0.400
0.100	0.800	0.450
0.100	0.900	0.500
0.100	1.000	0.550
0.500	0.000	0.250
0.500	0.100	0.300
0.500	0.200	0.350
0.500	0.300	0.400
0.500	0.400	0.450
0.500	0.500	0.500
0.500	0.600	0.550
0.500	0.700	0.600
0.500	0.800	0.650
0.500	0.900	0.700
0.500	1.000	0.750
1.000	0.000	0.500
1.000	0.100	0.550
1.000	0.200	0.600
1.000	0.300	0.650
1.000	0.400	0.700
1.000	0.500	0.750
1.000	0.600	0.800
1.000	0.700	0.850
1.000	0.800	0.900
1.000	0.900	0.950
1.000	1.000	1.000









l input	Subindices			FCI
Continuity with Other Habitats	Wetland Downfall	Wetland Plant Species	Wetland Stem Density	Wetland Habitat
V_{contig}	$V_{wetdown}$	V_{wetspp}	$V_{wetdense}$	FCI_{wethab}
0.000	0.100	0.100	0.100	0.058
0.100	0.100	0.100	0.100	0.100
0.200	0.100	0.100	0.100	0.129
0.300	0.100	0.100	0.100	0.153
0.400	0.100	0.100	0.100	0.173
0.500	0.100	0.100	0.100	0.191
0.600	0.100	0.100	0.100	0.208
0.700	0.100	0.100	0.100	0.224
0.800	0.100	0.100	0.100	0.238
0.900	0.100	0.100	0.100	0.252
1.000	0.100	0.100	0.100	0.265
0.000	0.500	0.500	0.500	0.289
0.100	0.500	0.500	0.500	0.342
0.200	0.500	0.500	0.500	0.387
0.300	0.500	0.500	0.500	0.428
0.400	0.500	0.500	0.500	0.465
0.500	0.500	0.500	0.500	0.500
0.600	0.500	0.500	0.500	0.532
0.700	0.500	0.500	0.500	0.563
0.800	0.500	0.500	0.500	0.592
0.900	0.500	0.500	0.500	0.619
1.000	0.500	0.500	0.500	0.645
0.000	1.000	1.000	1.000	0.577
0.100	1.000	1.000	1.000	0.632
0.200	1.000	1.000	1.000	0.683
0.300	1.000	1.000	1.000	0.730
0.400	1.000	1.000	1.000	0.775
0.500	1.000	1.000	1.000	0.816
0.600	1.000	1.000	1.000	0.856
0.700	1.000	1.000	1.000	0.894
0.800	1.000	1.000	1.000	0.931
0.900	1.000	1.000	1.000	0.966
1.000	1.000	1.000	1.000	1.000

FCI input		Subindices			FCI
Wetland Edge	Continuity with Other Habitats	Wetland Downfall	Wetland Plant Species	Wetland Stem Density	Wetland Habitat
$V_{wetedge}$	V_{contig}	$V_{wetdown}$	V_{wetspp}	$V_{wetdense}$	FCI_{wethab}
0.100	0.100	0.000	0.100	0.100	0.082
0.100	0.100	0.100	0.100	0.100	0.100
0.100	0.100	0.200	0.100	0.100	0.115
0.100	0.100	0.300	0.100	0.100	0.129
0.100	0.100	0.400	0.100	0.100	0.141
0.100	0.100	0.500	0.100	0.100	0.153
0.100	0.100	0.600	0.100	0.100	0.163
0.100	0.100	0.700	0.100	0.100	0.173
0.100	0.100	0.800	0.100	0.100	0.183
0.100	0.100	0.900	0.100	0.100	0.191
0.100	0.100	1.000	0.100	0.100	0.200
0.500	0.500	0.000	0.500	0.500	0.408
0.500	0.500	0.100	0.500	0.500	0.428
0.500	0.500	0.200	0.500	0.500	0.447
0.500	0.500	0.300	0.500	0.500	0.465
0.500	0.500	0.400	0.500	0.500	0.483
0.500	0.500	0.500	0.500	0.500	0.500
0.500	0.500	0.600	0.500	0.500	0.516
0.500	0.500	0.700	0.500	0.500	0.532
0.500	0.500	0.800	0.500	0.500	0.548
0.500	0.500	0.900	0.500	0.500	0.563
0.500	0.500	1.000	0.500	0.500	0.577
1.000	1.000	0.000	1.000	1.000	0.816
1.000	1.000	0.100	1.000	1.000	0.837
1.000	1.000	0.200	1.000	1.000	0.856
1.000	1.000	0.300	1.000	1.000	0.876
1.000	1.000	0.400	1.000	1.000	0.894
1.000	1.000	0.500	1.000	1.000	0.913
1.000	1.000	0.600	1.000	1.000	0.931
1.000	1.000	0.700	1.000	1.000	0.949
1.000	1.000	0.800	1.000	1.000	0.966
1.000	1.000	0.900	1.000	1.000	0.983
1.000	1.000	1.000	1.000	1.000	1.000

FCI input		Subindices			FCI
Wetland Edge	Continuity with Other Habitats	Wetland Downfall	Wetland Plant Species	Wetland Stem Density	Wetland Habitat
$V_{wetedge}$	V_{contig}	$V_{wetdown}$	V_{wetspp}	$V_{wetdense}$	FCI_{wethab}
0.100	0.100	0.100	0.000	0.100	0.071
0.100	0.100	0.100	0.100	0.100	0.100
0.100	0.100	0.100	0.200	0.100	0.122
0.100	0.100	0.100	0.300	0.100	0.141
0.100	0.100	0.100	0.400	0.100	0.158
0.100	0.100	0.100	0.500	0.100	0.173
0.100	0.100	0.100	0.600	0.100	0.187
0.100	0.100	0.100	0.700	0.100	0.200
0.100	0.100	0.100	0.800	0.100	0.212
0.100	0.100	0.100	0.900	0.100	0.224
0.100	0.100	0.100	1.000	0.100	0.235
0.500	0.500	0.500	0.000	0.500	0.354
0.500	0.500	0.500	0.100	0.500	0.387
0.500	0.500	0.500	0.200	0.500	0.418
0.500	0.500	0.500	0.300	0.500	0.447
0.500	0.500	0.500	0.400	0.500	0.474
0.500	0.500	0.500	0.500	0.500	0.500
0.500	0.500	0.500	0.600	0.500	0.524
0.500	0.500	0.500	0.700	0.500	0.548
0.500	0.500	0.500	0.800	0.500	0.570
0.500	0.500	0.500	0.900	0.500	0.592
0.500	0.500	0.500	1.000	0.500	0.612
1.000	1.000	1.000	0.000	1.000	0.707
1.000	1.000	1.000	0.100	1.000	0.742
1.000	1.000	1.000	0.200	1.000	0.775
1.000	1.000	1.000	0.300	1.000	0.806
1.000	1.000	1.000	0.400	1.000	0.837
1.000	1.000	1.000	0.500	1.000	0.866
1.000	1.000	1.000	0.600	1.000	0.894
1.000	1.000	1.000	0.700	1.000	0.922
1.000	1.000	1.000	0.800	1.000	0.949
1.000	1.000	1.000	0.900	1.000	0.975
1.000	1.000	1.000	1.000	1.000	1.000

FCI input		Subindices			FCI
Wetland Edge	Continuity with Other Habitats	Wetland Downfall	Wetland Plant Species	Wetland Stem Density	Wetland Habitat
$V_{wetedge}$	V_{contig}	$V_{wetdown}$	V_{wetspp}	$V_{wetdense}$	FCI_{wethab}
0.100	0.100	0.100	0.100	0.000	0.071
0.100	0.100	0.100	0.100	0.100	0.100
0.100	0.100	0.100	0.100	0.200	0.122
0.100	0.100	0.100	0.100	0.300	0.141
0.100	0.100	0.100	0.100	0.400	0.158
0.100	0.100	0.100	0.100	0.500	0.173
0.100	0.100	0.100	0.100	0.600	0.187
0.100	0.100	0.100	0.100	0.700	0.200
0.100	0.100	0.100	0.100	0.800	0.212
0.100	0.100	0.100	0.100	0.900	0.224
0.100	0.100	0.100	0.100	1.000	0.235
0.500	0.500	0.500	0.500	0.000	0.354
0.500	0.500	0.500	0.500	0.100	0.387
0.500	0.500	0.500	0.500	0.200	0.418
0.500	0.500	0.500	0.500	0.300	0.447
0.500	0.500	0.500	0.500	0.400	0.474
0.500	0.500	0.500	0.500	0.500	0.500
0.500	0.500	0.500	0.500	0.600	0.524
0.500	0.500	0.500	0.500	0.700	0.548
0.500	0.500	0.500	0.500	0.800	0.570
0.500	0.500	0.500	0.500	0.900	0.592
0.500	0.500	0.500	0.500	1.000	0.612
1.000	1.000	1.000	1.000	0.000	0.707
1.000	1.000	1.000	1.000	0.100	0.742
1.000	1.000	1.000	1.000	0.200	0.775
1.000	1.000	1.000	1.000	0.300	0.806
1.000	1.000	1.000	1.000	0.400	0.837
1.000	1.000	1.000	1.000	0.500	0.866
1.000	1.000	1.000	1.000	0.600	0.894
1.000	1.000	1.000	1.000	0.700	0.922
1.000	1.000	1.000	1.000	0.800	0.949
1.000	1.000	1.000	1.000	0.900	0.975
1.000	1.000	1.000	1.000	1.000	1.000

Exhibit C

Derivation of Success Criterion

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Exhibit C – Derivation of General Success Criterion

A. Introduction and Overall Approach

As described in Section 4 of the *Phase 1 Adaptive Management Plan*, the general success criterion for habitat replacement/reconstruction is:

For data aggregated at the river reach for each habitat type, success is achieved when 50% of the target station values exceed the 25th percentile of the reference data.

Habitat replacement and reconstruction within a river reach will be considered complete when each of the specific habitat parameter values and functional capacity index (FCI) values (supplemented if necessary with HSI values) described in Section 4 of this Plan meet this criterion (referred to as the median/25th percentile criterion). Application of this criterion involves comparison of the values from target (i.e., dredged) stations with reference data, referred to herein as the Reference Condition.

This Exhibit provides additional information concerning the application of the criterion, as well as supporting information describing the basis for this criterion. It also describes the Reference Condition data set. As noted below, as additional data are collected, the Reference Condition data set will be reviewed and updated.

B. Basis for the Approach

The approach is simple and transparent, relying on the measured 25th percentile and median for habitat-specific parameters and FCIs. Alternative approaches were considered, focusing on tests for significant differences between Reference Condition and Target Areas (e.g., Student's t test or a Wilcoxon test) but rejected for the following reasons.

Comparison with alternative approaches. The approach presented here shares key characteristics with statistical significance testing. In tests for significant differences, it is considered acceptable for the central tendency (mean, median) of the treatment (reconstructed habitats in this case) to be lower than the central tendency of the Reference Condition. The allowable difference is determined by the nature of the null hypothesis, the uncertainty in the data, and a pre-determined acceptable probability of failure (α), which is usually set equal to 0.05.

However, such statistical tests are difficult to apply in this case, relying upon several arbitrary choices for critical values. First, the traditional null hypothesis is not adequate here. A traditional null hypothesis could be stated as: There is no significant difference between target and reference habitats; both come from the same distribution of values. The value used to declare a significant difference (α) is usually set to a relatively low number (0.05). This is a high bar and means that we must be quite sure that target conditions are worse than reference conditions before declaring them to be different. Setting the bar high is appropriate where the costs associated with declaring the treatment to be different are great (for example, if the results of an experiment would lead to additional experiments, significant corrective action, etc. – things one might not want to do unless one is sure that the treatment does not equal the reference). In the case of the Upper Hudson River habitat replacement and reconstruction, this is not the goal: we do not want to declare the post-dredging habitat to be satisfactory unless we are relatively certain that it is similar to what is found in the Reference Condition.

There are two ways to achieve this goal. First, the value of α can be set lower. There is no objective way to set this value, however. Second, a different null hypothesis can be used. An alternative null hypothesis would be: the central tendency of post-dredge target areas in a given river reach differs by a specified amount from post-dredging reference areas. The alternative hypothesis is that the difference is not as great as the specified amount. The test is then designed so that one must be quite certain that the difference is less than specified in the null hypothesis before accepting the alternative hypothesis, and thus declaring replacement/reconstruction to be complete. The choice of the specific value for the null hypothesis, as well as the value for α, must be specified, and in the case of the Upper Hudson River habitat replacement and reconstruction, there is no objective way to do this. This is because the FCIs are qualitative indices, and there is no quantitative relationship between a specific difference in a specific FCI and the ecological community.

Therefore, because of the difficulties associated with significance testing, a simpler approach was chosen. The basis for the approach is described next.

Use of the median for post-dredging data. The approach focuses on the central tendency of the data, because the goal of the program is that the post-dredging target conditions be similar overall to the Reference Condition. The median was chosen as the measure of central tendency for the post-dredging condition, as it is less sensitive to outliers than the mean.

Choice of an appropriate percentile for the Reference Condition. The median of the Reference Condition is not a satisfactory value for comparison: because of limited sample size and variability, to require that the post-dredging target median be at least as great as the Reference Condition median would in effect require there to be a high probability that the post-dredging habitat was *improved* over the Reference Condition. Such a requirement would be more stringent than a significance test, which, as described above, actually allows the measured post-dredging target median to be less than the measured Reference Condition median by some amount, because of natural variability and uncertainty.

Therefore, the Reference Condition percentile must be less than the median. The Reference Condition percentile was chosen so that there would be only a small chance (5%) that if the Upper Hudson River were resampled prior to dredging, the results would fail the test. That is, given sample size limitations and natural variability, current conditions must have a high probability of meeting the criterion. Note that this methodology accepts a small probability that if the pre-dredge sampling were to be performed again, the Upper Hudson River, under current conditions, might actually fail the criterion. The percentile is derived below, following a discussion of the determination of the Reference Condition.

C. Determination of the Reference Condition

The Reference Condition refers to the data set with which post-dredging target area data will be compared. Currently, the Reference Condition consists of the pre-dredging data collected from both target Phase 1 dredge stations (in River Section 1) and associated reference stations (in all three river sections). To verify that the Reference Condition can appropriately include values from all three river sections, box plots of the FCI values and individual parameters from each river section were compared visually, and an analysis of variance (ANOVA) was performed for each FCI and individual parameters for each habitat type, using either the original data or log-transformed data, based on a visual assessment of cumulative probability distributions (Figures 1 through 4, which include all Phase 1 data from all three river reaches). Box plots of the FCI values, along with the individual parameters, are presented in Figures 5 through 8. In general, distributions overlap among the river sections. Single factor ANOVA was performed for each FCI and individual parameter using the Microsoft Excel statistical tool. FCI values and individual parameters did not differ significantly among reaches, supporting the visual assessment of the box plots. Based on this analysis, it was concluded that data from all three river sections can appropriately be combined in the Reference Condition.

Following the completion of Phase 1 habitat replacement and reconstruction, additional data will be collected from target and reference stations. An analysis will be performed to determine whether post-dredging reference station data are significantly different from the pre-dredging data from those stations, indicating that conditions in the Upper Hudson River have changed for reasons other than the dredging. If this analysis indicates that conditions have not changed, then the post-dredging data will be incorporated into the Reference Conditions data set. If this analysis indicates that conditions have changed for reasons unrelated to dredging, then the Reference Condition data set will be adjusted. The method of adjustment will be determined based upon an analysis of the data. Possibilities include adjusting the pre-dredging data (e.g., multiplication of the data by a constant) or excluding the pre-dredging data and using only the post-dredging reference station data to represent the Reference Condition. Finally, the analysis to determine whether river sections should be combined or treated separately will be repeated with the full post-dredging data set.

D. Determination of the Critical Percentiles

To determine the critical percentile of the Reference Condition with which the post-dredging target area median is to be compared and to determine the numbers of stations needed to make such comparisons, a bootstrap analysis using available parameter data and FCIs was performed. Each habitat type (UCB, SAV, SHO, and WET) was analyzed independently. For each habitat type, the stations were sampled with replacement 1,000 times. Each time an individual station was sampled, all parameters and FCIs from that station were placed in the bootstrap data set. This methodology accounts for correlation among the FCIs. For each of the 1,000 realizations, the median of each parameter and FCI was tested against the 25th percentile of the original data. The proportion of realizations that passed for all parameters and all FCIs was then tabulated.

The probability of the Upper Hudson River under current conditions (as represented with the bootstrap resampling) passing the criterion was found to increase with increasing sample size. To support the selection of post-dredging sample sizes, the bootstrap results were evaluated for both a range of percentiles and a range of post-dredging sample sizes.

In Figure 9, the probability of passing the median/25th percentile criterion for all parameters and all FCIs is presented as a function of post-dredging sample size. For each habitat type, the sample sizes (i.e., numbers of target stations) required to achieve a 95% probability of passing the criterion for all FCIs under current conditions are given in Table C-1.

Table C-1 - Number of Target Stations Required to Achieve a 95% Probability of Passing the Median/25th Percentile Criterion for all FCIs and Parameters Under Current Conditions

Habitat Type	Number of Target Stations Required
Unconsolidated River Bottom	10
Aquatic Vegetation Beds	22
Shoreline	24
Riverine Fringing Wetland	24

Thus, the 25th percentile of the Reference Condition can be used in the comparisons, provided that the numbers of target stations listed in Table C-1 are sampled. Therefore, for the unconsolidated river bottom, aquatic vegetation bed, and shoreline habitats, the post-dredging sampling for Phase 1 will be conducted at the numbers of stations in Table C-1. An equal number of stations in reference areas will also be sampled to enhance the Reference Condition. However, it is not possible to collect data from 18 riverine fringing wetland stations in Phase 1 areas: there simply are not enough locations. Therefore, an alternative method is required to assess success of riverine fringing wetland replacement and reconstruction (see Section 4 of the Phase 1 AM Plan).

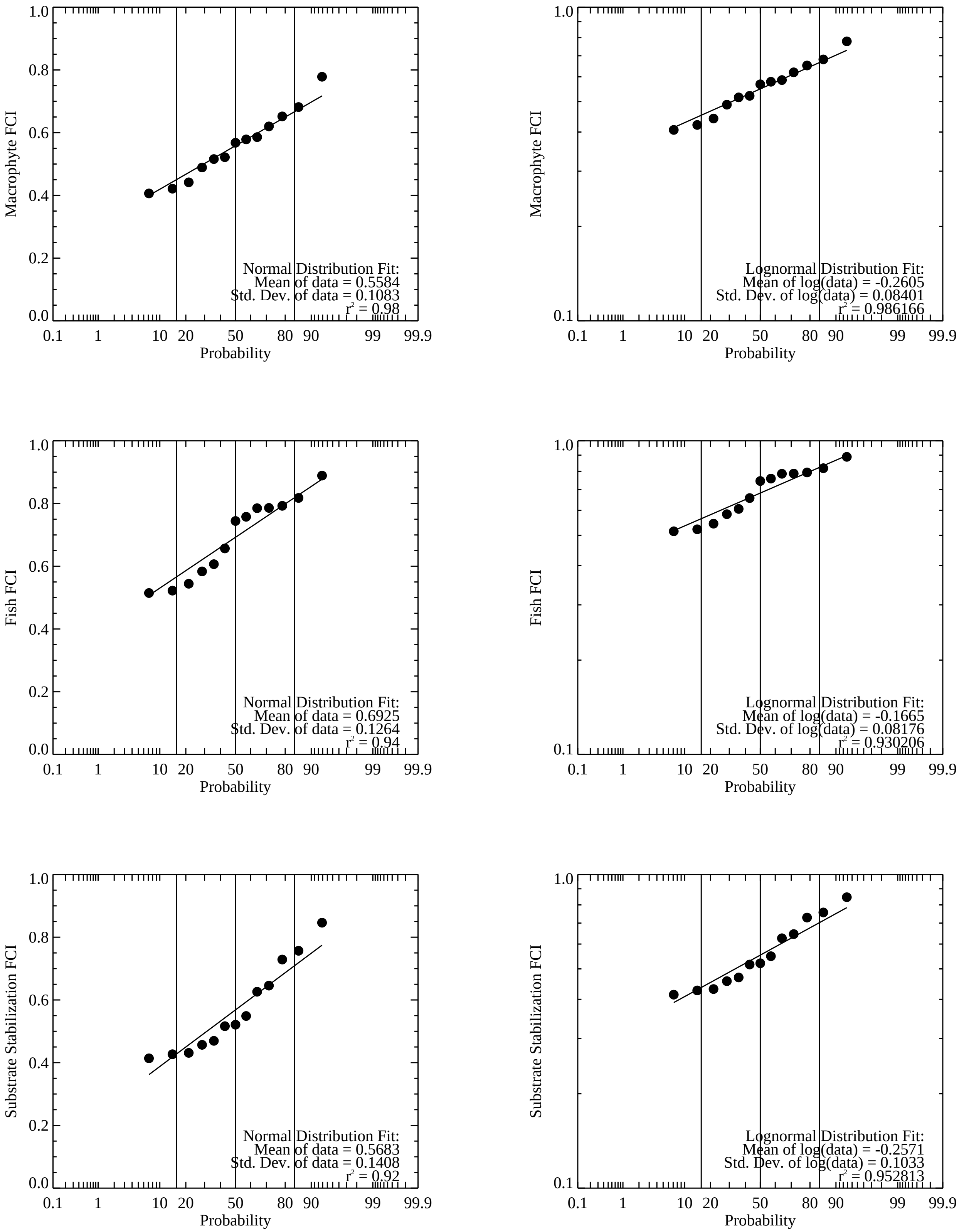


Figure C-1. Cumulative probability distributions of FCIs and individual parameters for SAV.

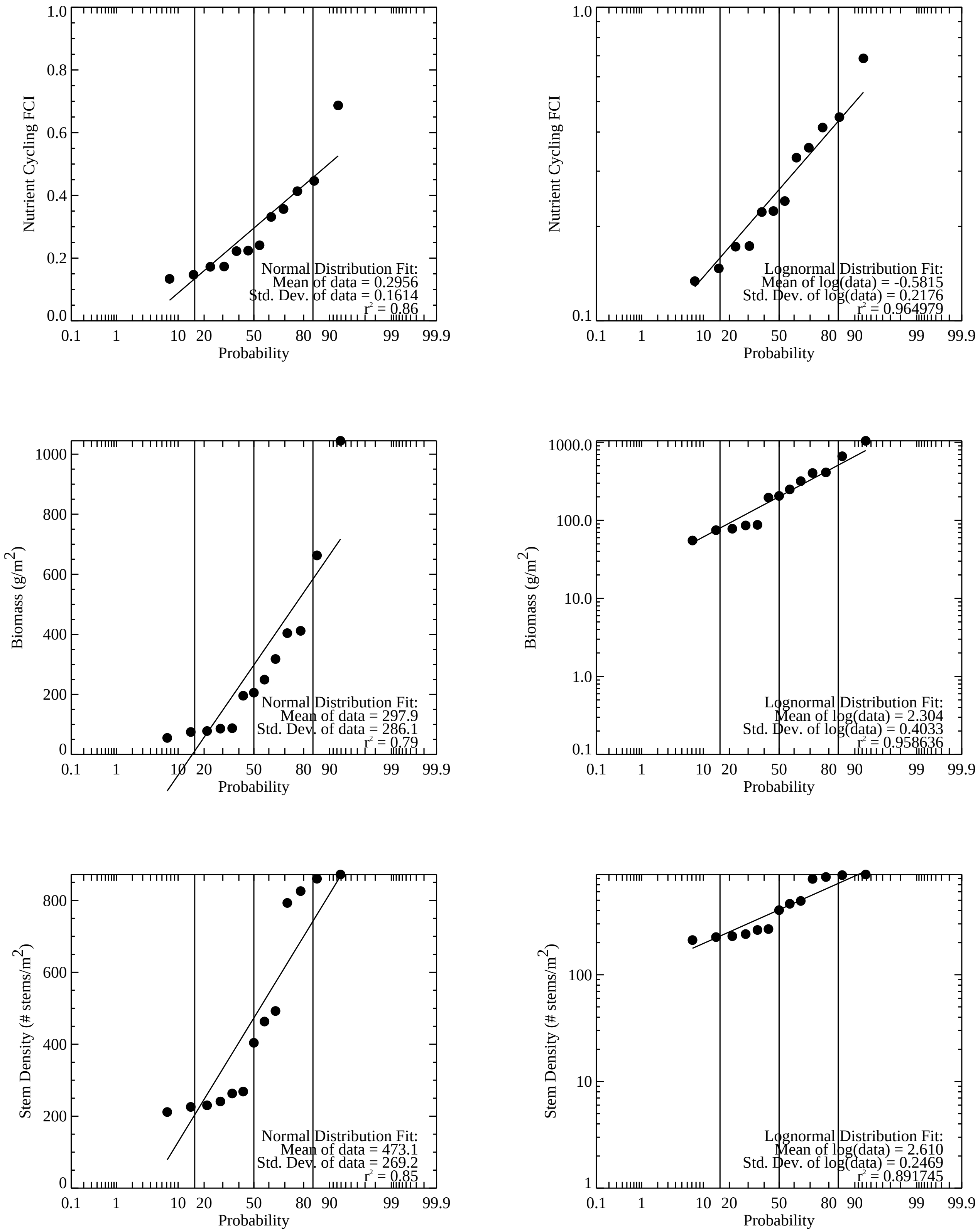


Figure C-1. Cumulative probability distributions of FCIs and individual parameters for SAV.

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Fri Mar 17 14:01:23 2006

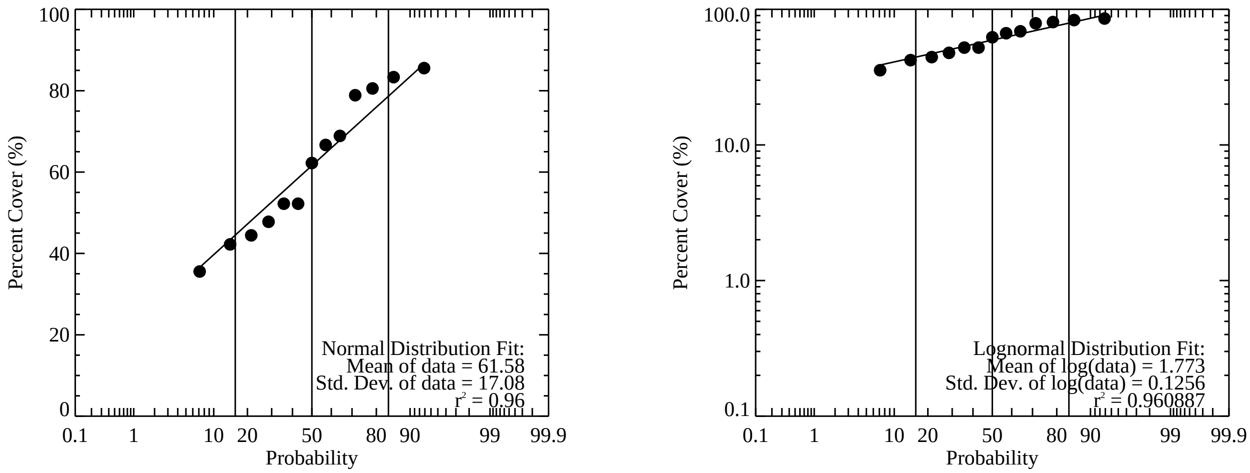

Figure C-1. Cumulative probability distributions of FCIs and individual parameters for SAV.

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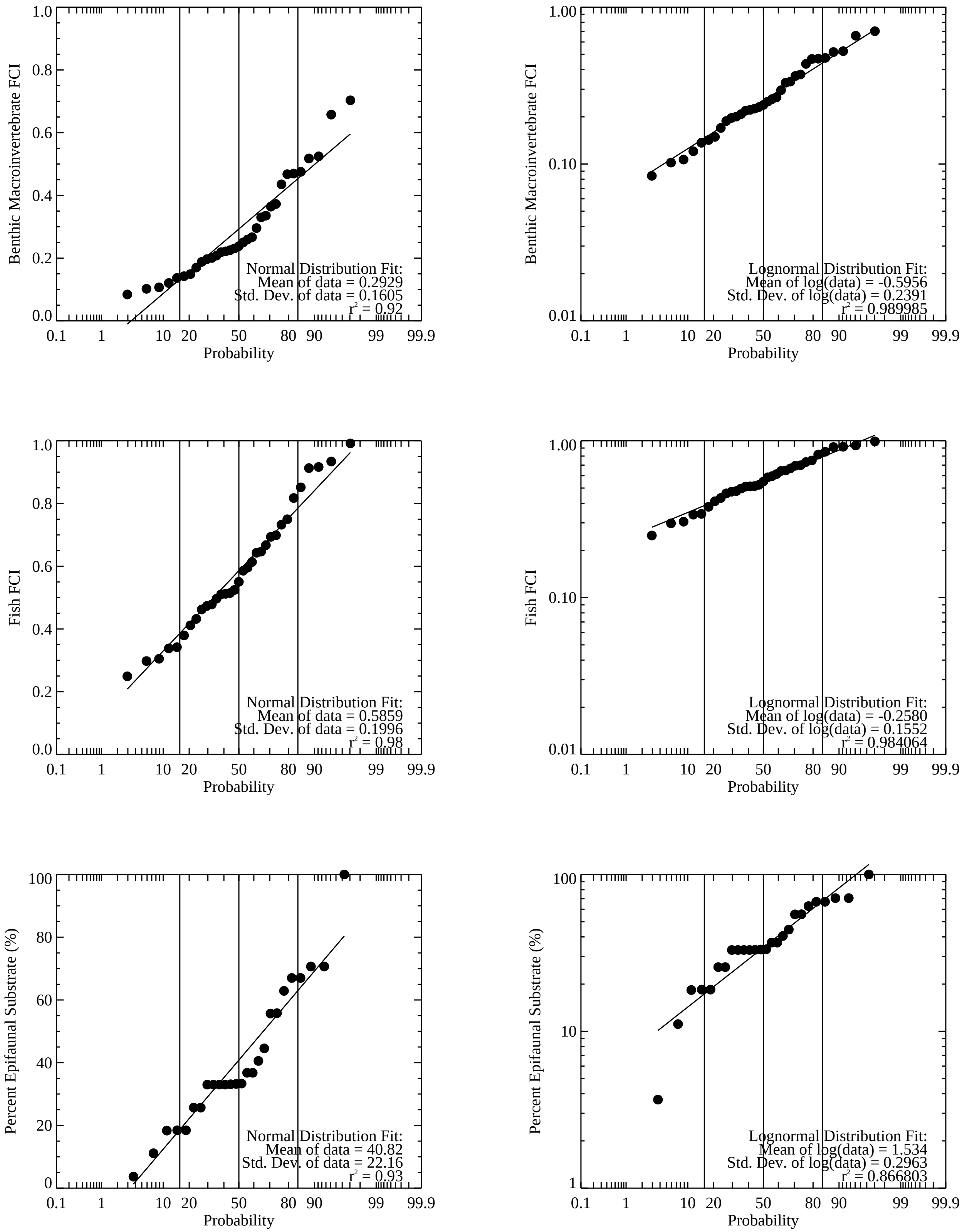

Figure C-2. Cumulative probability distributions of FCIs and individual parameters for UCB.

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Fri Mar 17 14:04:12 2006

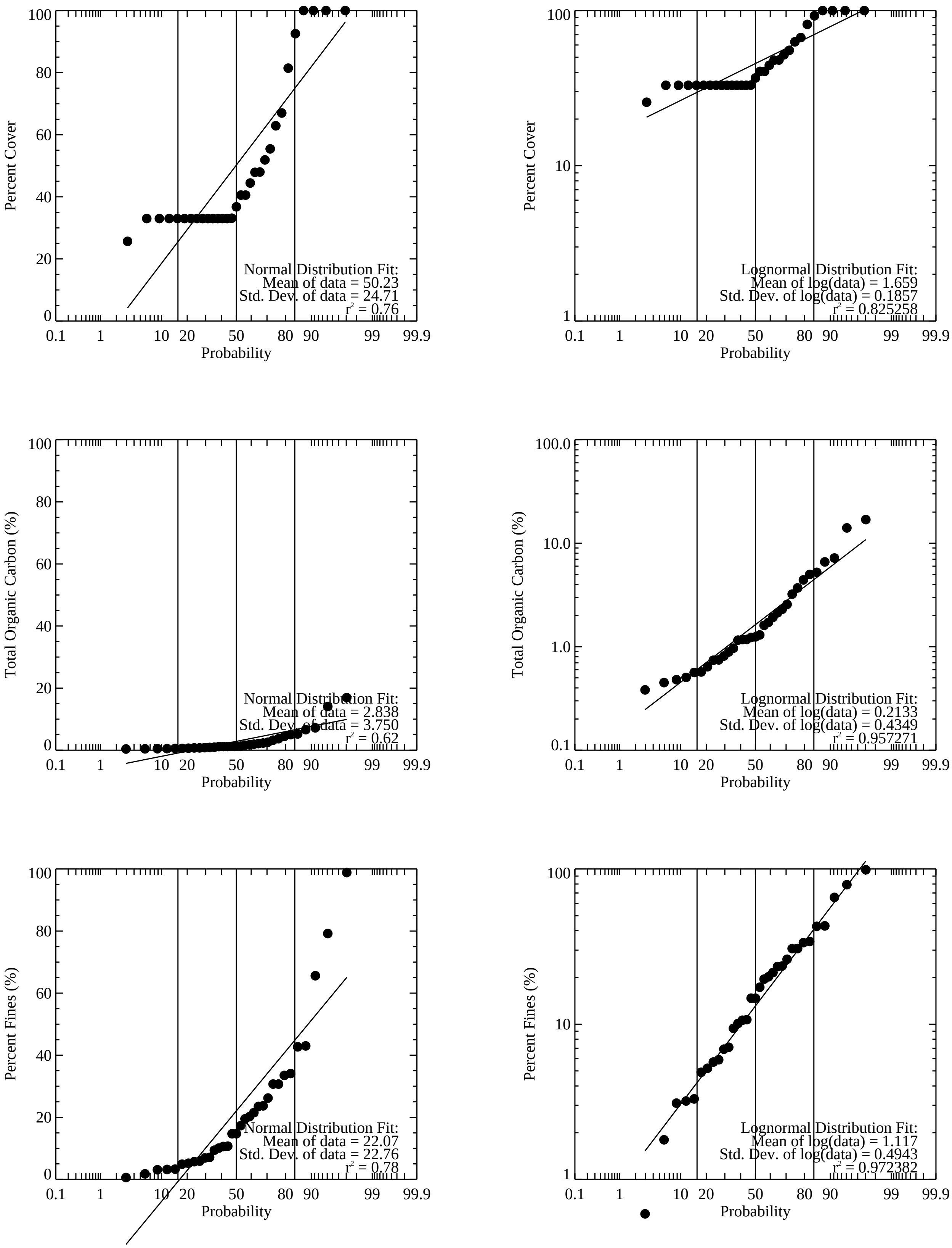

Figure C-2. Cumulative probability distributions of FCIs and individual parameters for UCB.

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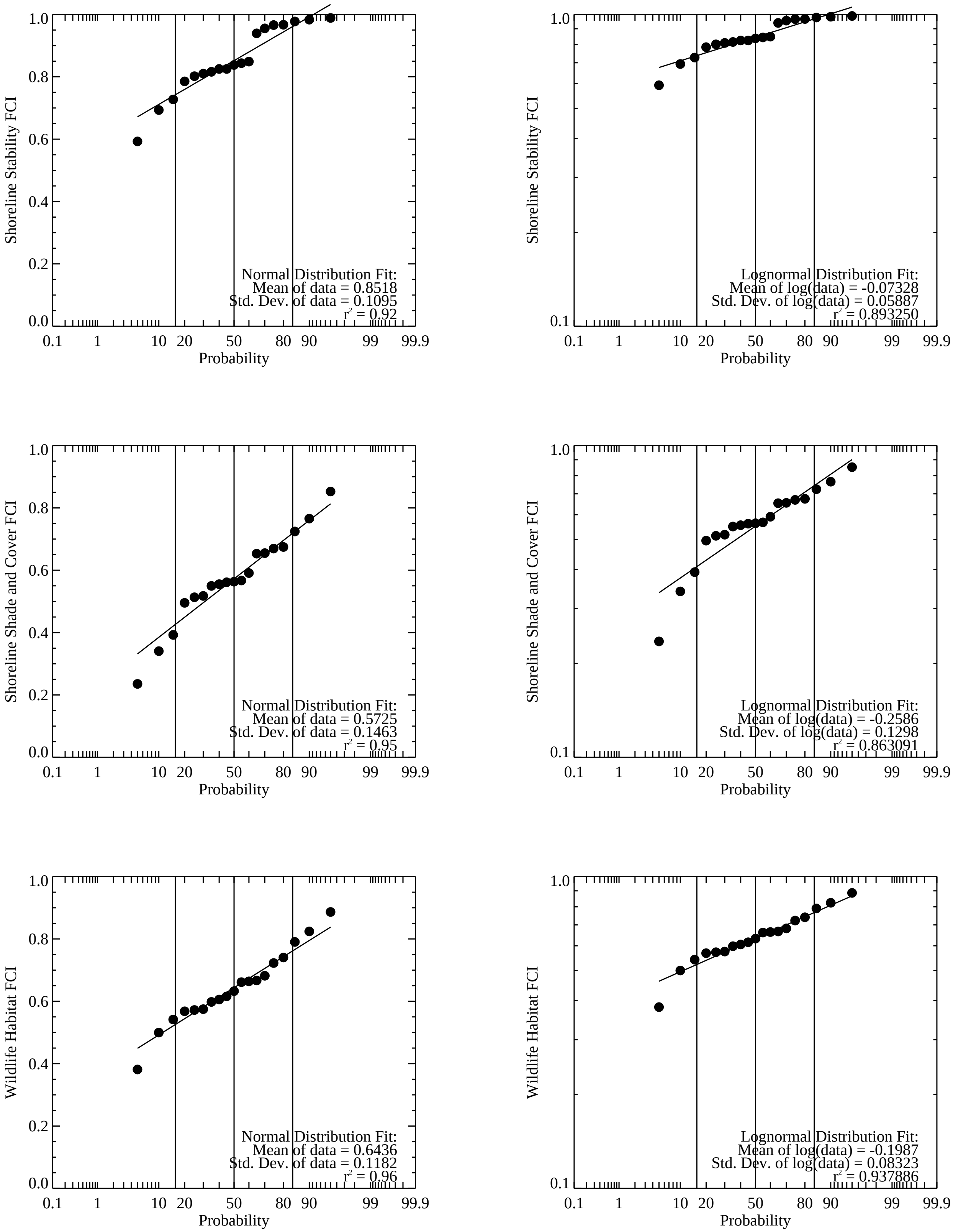

Figure C-3. Cumulative probability distributions of FCIs and individual parameters for SHO.

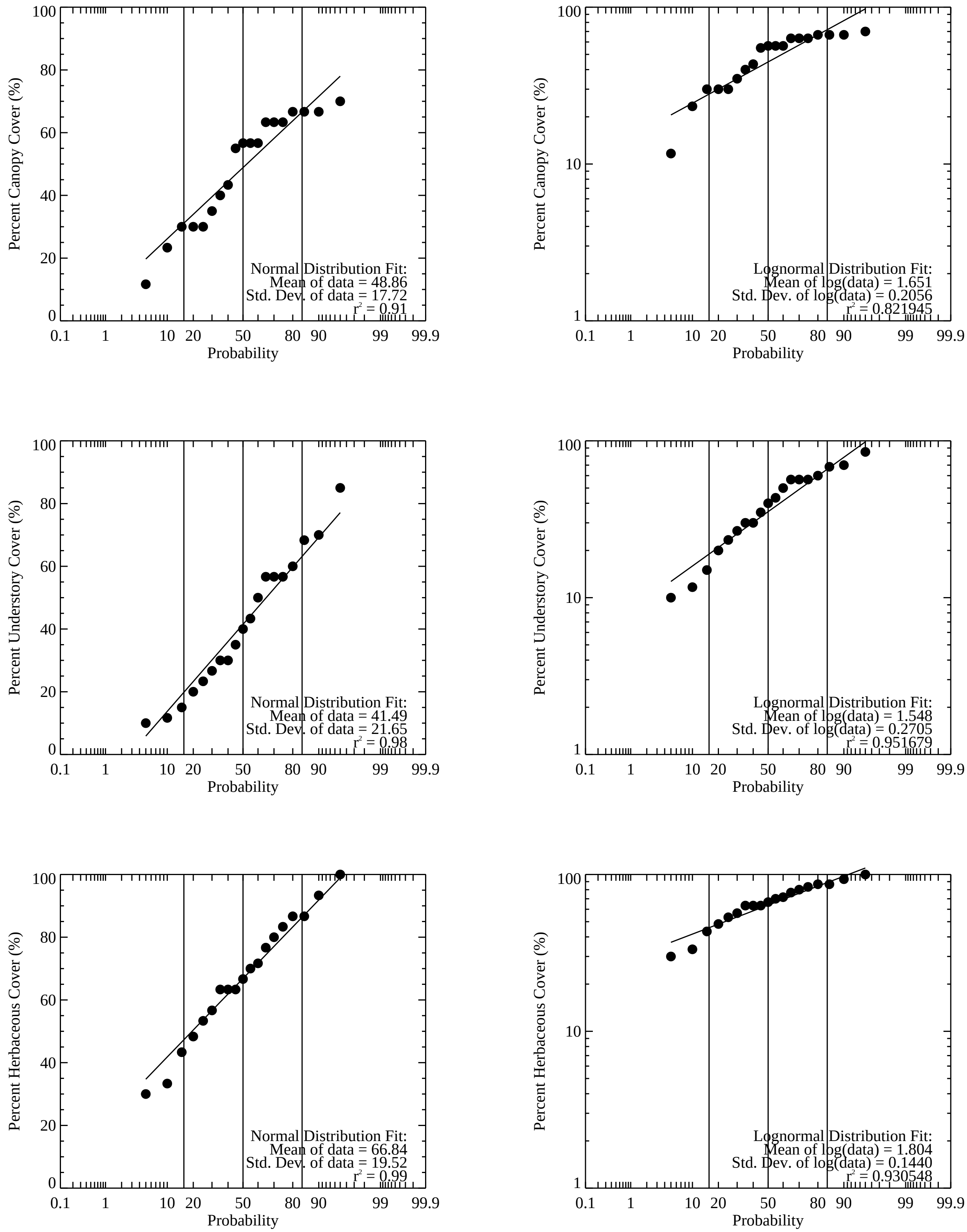

Figure C-3. Cumulative probability distributions of FCIs and individual parameters for SHO.

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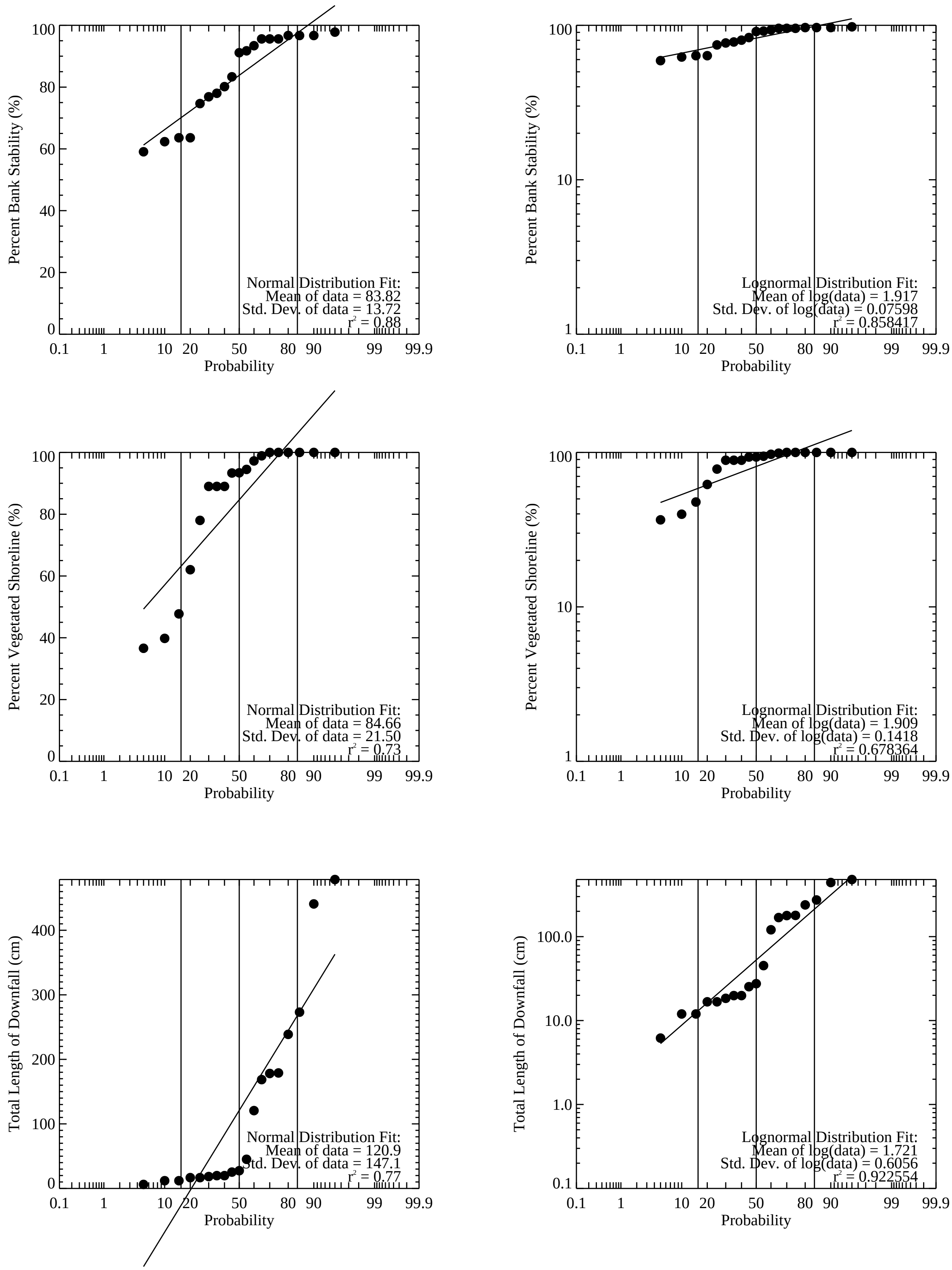

Figure C-3. Cumulative probability distributions of FCIs and individual parameters for SHO.

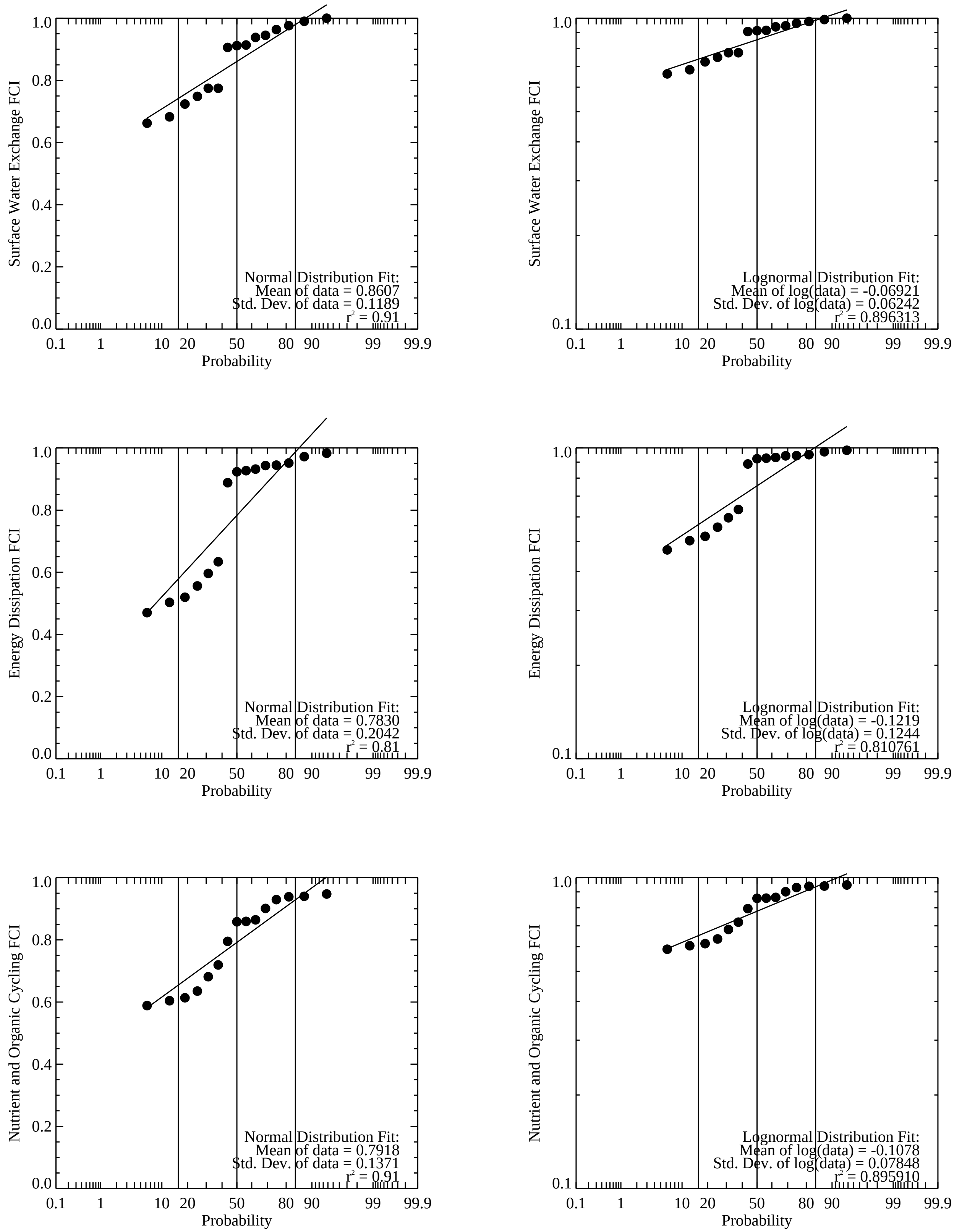

Figure C-4. Cumulative probability distributions of FCIs and individual parameters for WET.

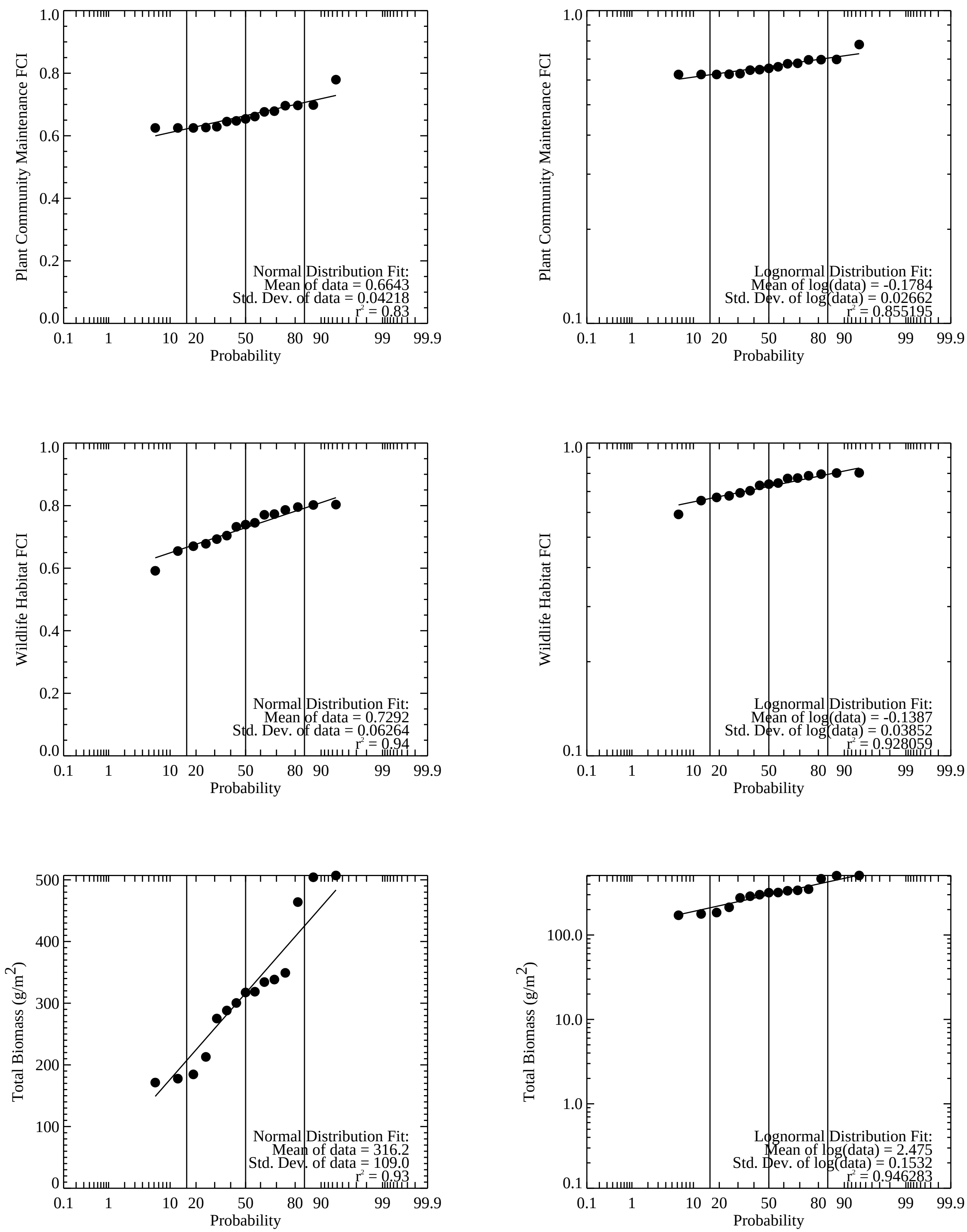

Figure C-4. Cumulative probability distributions of FCIs and individual parameters for WET.

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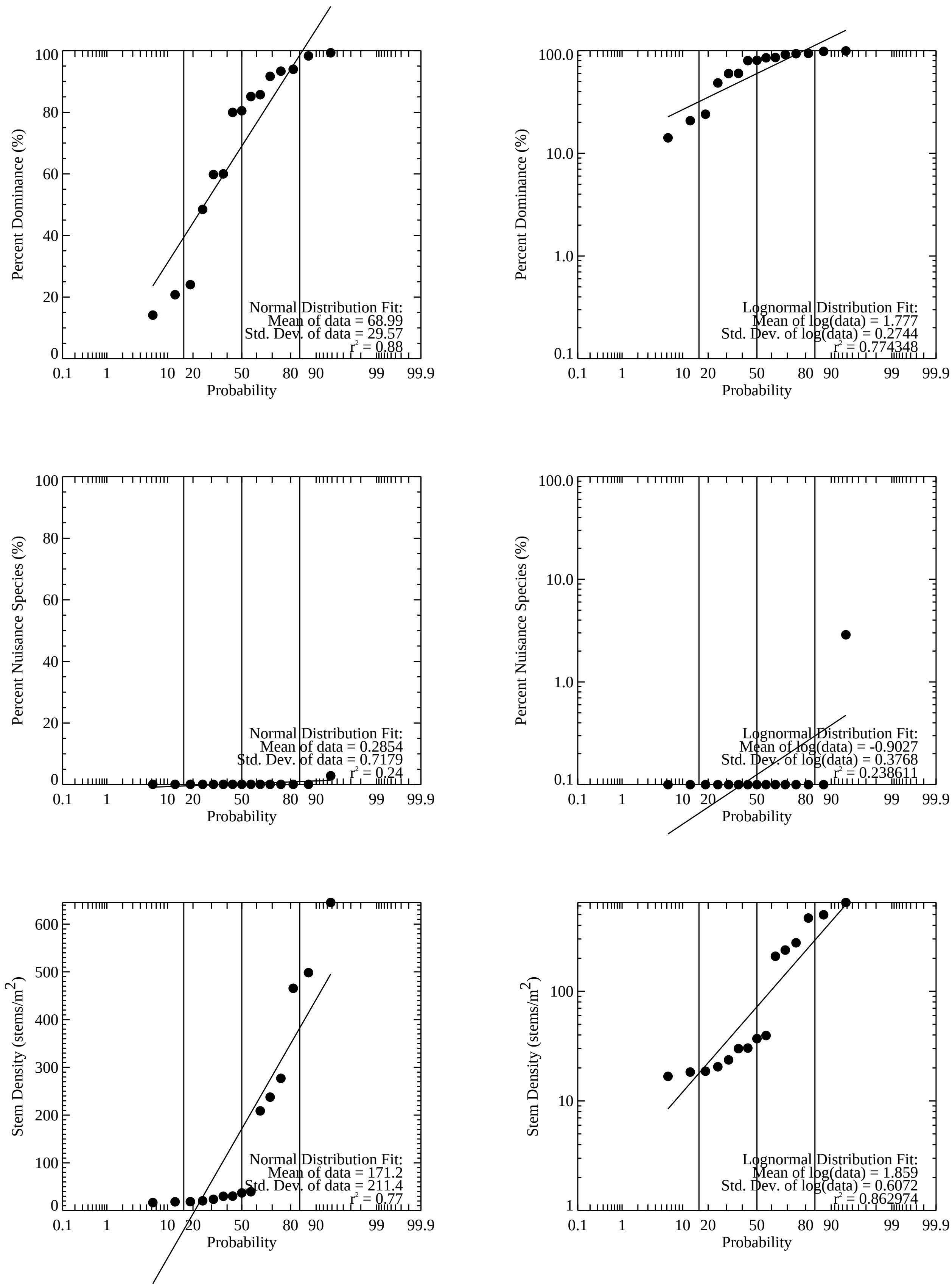

Figure C-4. Cumulative probability distributions of FCIs and individual parameters for WET.

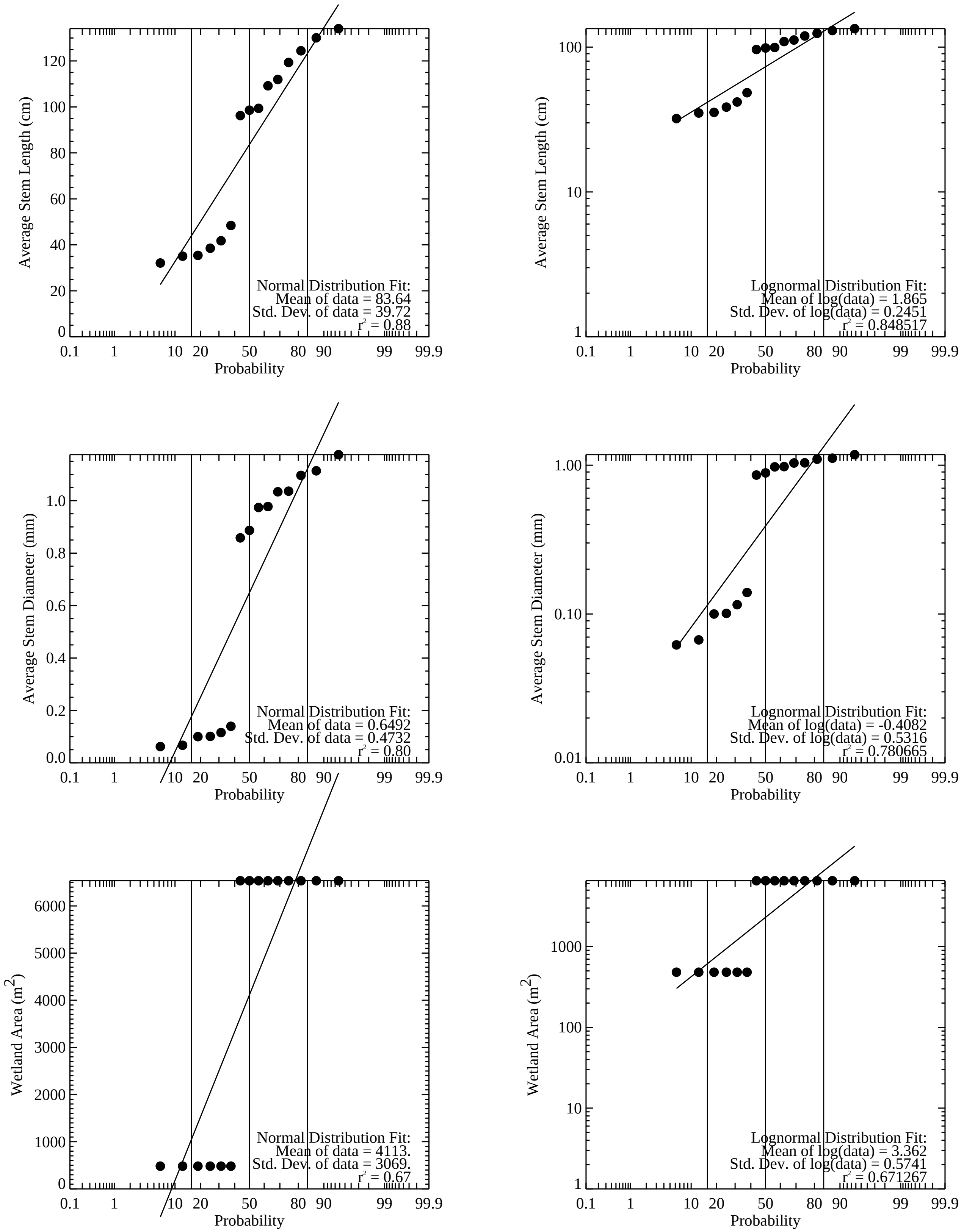

Figure C-4. Cumulative probability distributions of FCIs and individual parameters for WET.

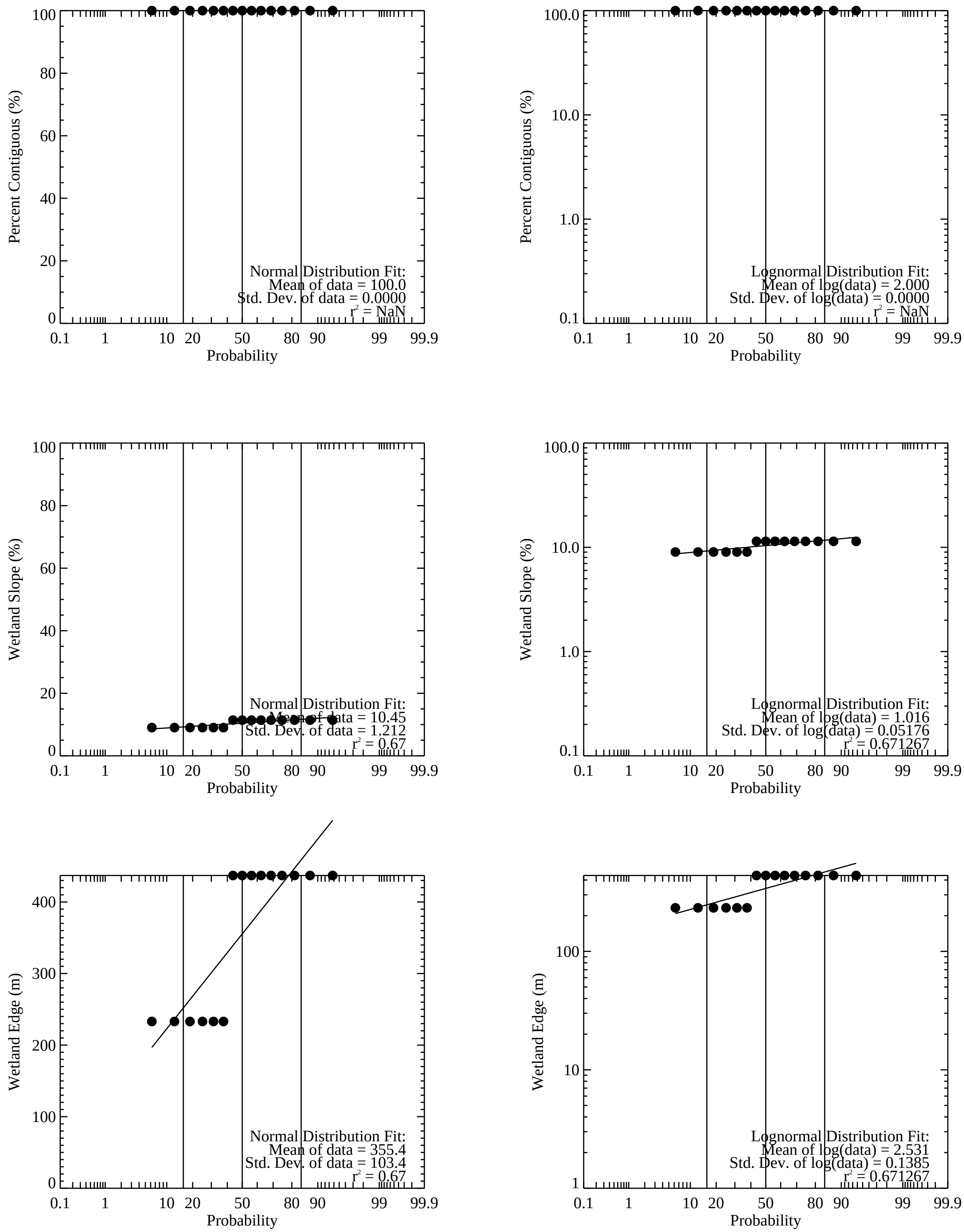

Figure C-4. Cumulative probability distributions of FCIs and individual parameters for WET.

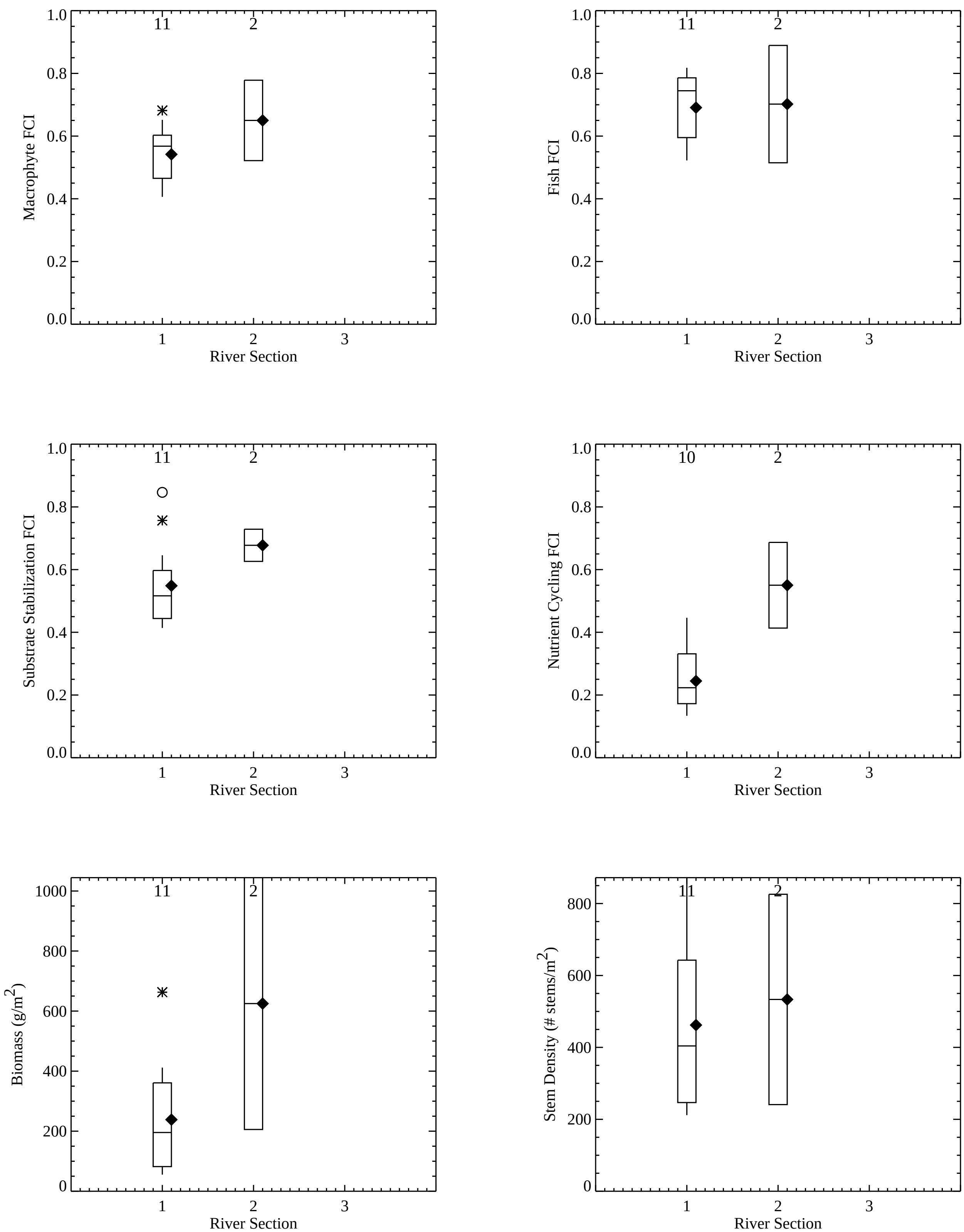

Figure C-5. Box plots comparing FCI values for SAV among River Sections.

✳ Outlier between inner and outer fences
○ Outlier outside outer fence
◆ Mean

Notes: Median values are indicated by the horizontal line at the center of the box for each group of measured values. The number above each box plot indicates the number of observations in that river section. There are no Phase 1 SAV stations in RS3.

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Fri Mar 17 14:00:59 2006

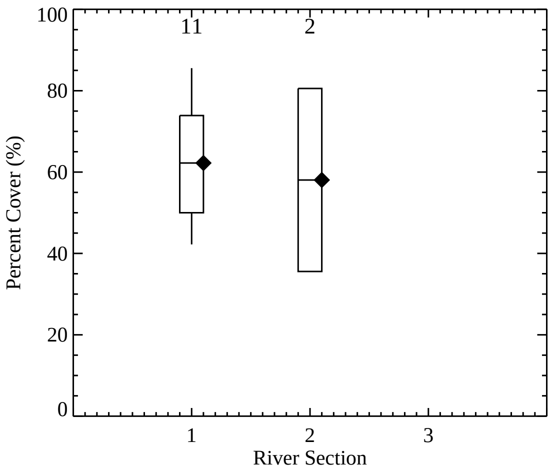
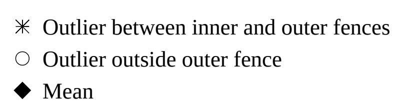


Figure C-5. Box plots comparing FCI values for SAV among River Sections.



Notes: Median values are indicated by the horizontal line at the center of the box for each group of measured values. The number above each box plot indicates the number of observations in that river section. There are no Phase 1 SAV stations in RS3.

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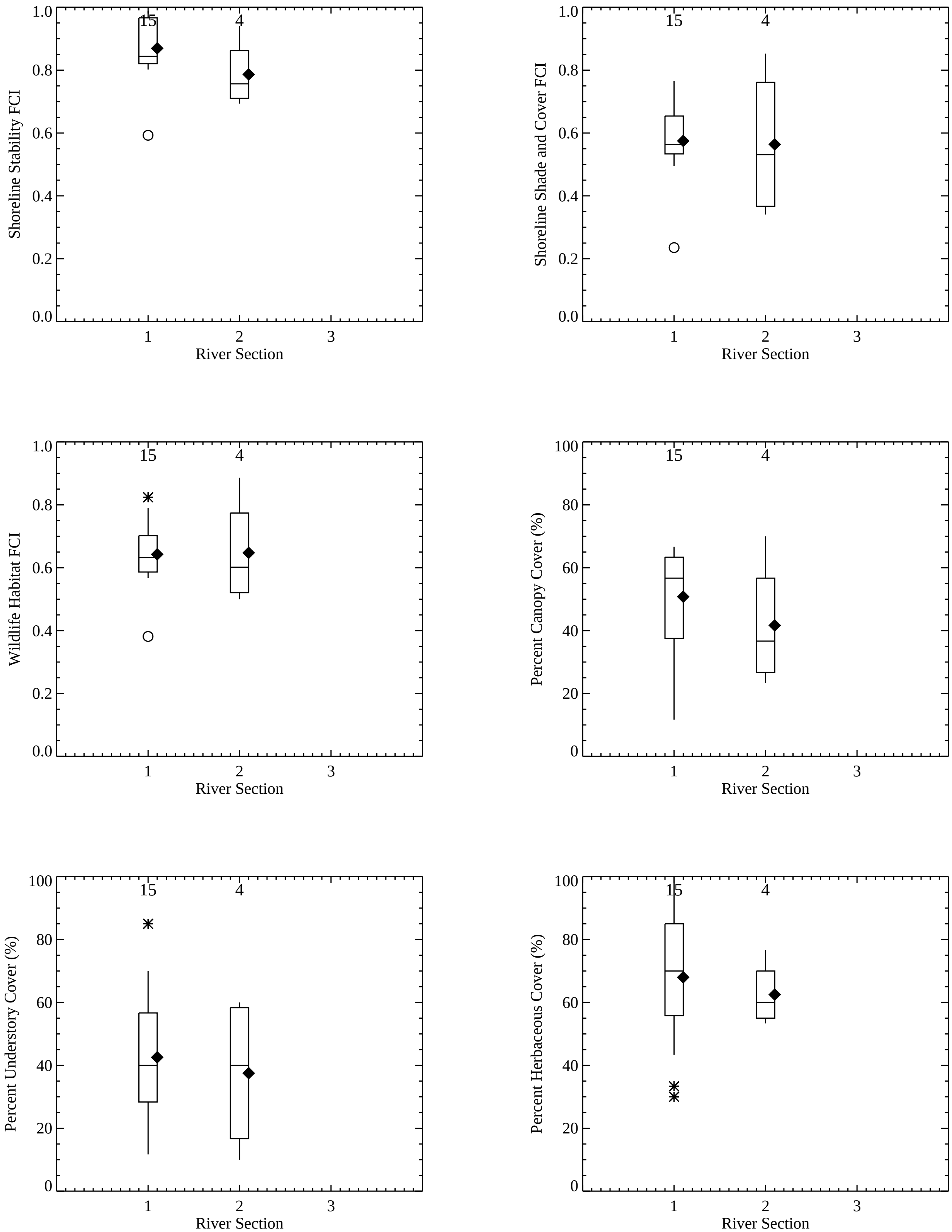

Figure C-6. Box plots comparing FCI values for SHO among River Sections.

✳ Outlier between inner and outer fences
○ Outlier outside outer fence
◆ Mean

Notes: Median values are indicated by the horizontal line at the center of the box for each group of measured values. The number above each box plot indicates the number of observations in that river section. There are no Phase 1 SHO stations in RS3.

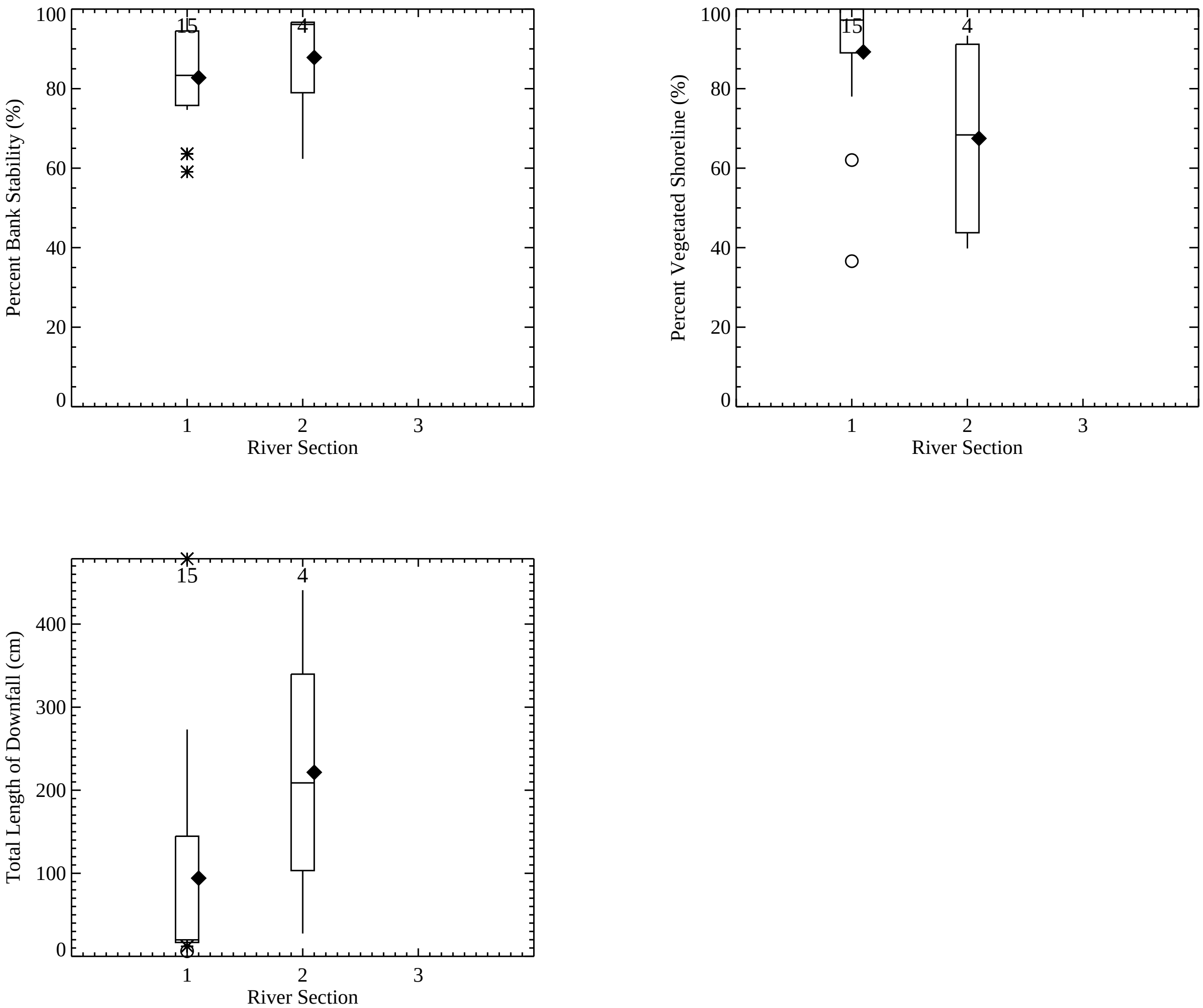

Figure C-6. Box plots comparing FCI values for SHO among River Sections.

✳ Outlier between inner and outer fences
○ Outlier outside outer fence
◆ Mean

Notes: Median values are indicated by the horizontal line at the center of the box for each group of measured values. The number above each box plot indicates the number of observations in that river section. There are no Phase 1 SHO stations in RS3.

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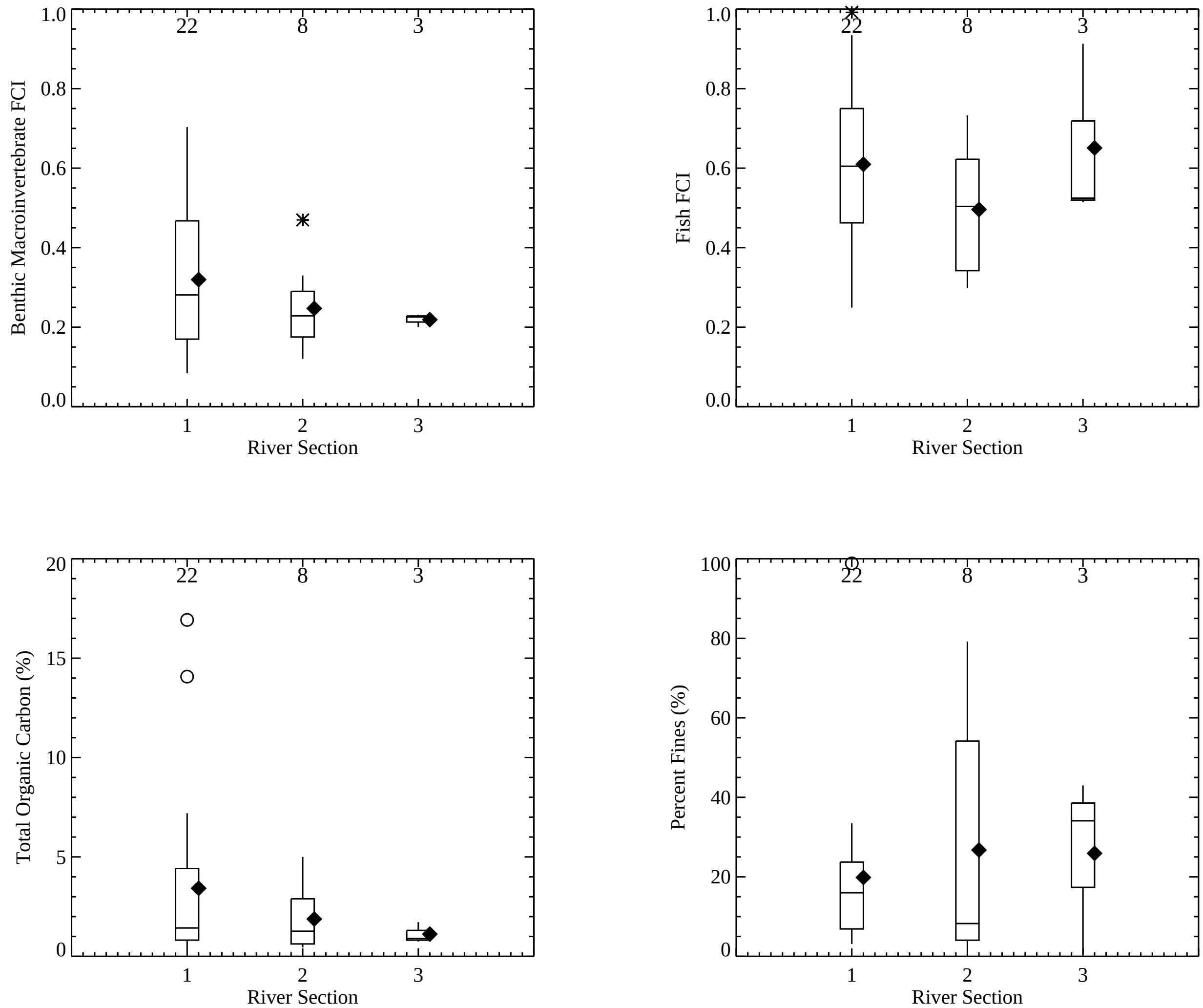

Figure C-7. Box plots comparing FCI values for UCB among River Sections.

✳ Outlier between inner and outer fences
○ Outlier outside outer fence
◆ Mean

Notes: Median values are indicated by the horizontal line at the center of the box for each group of measured values. The number above each box plot indicates the number of observations in that river section.

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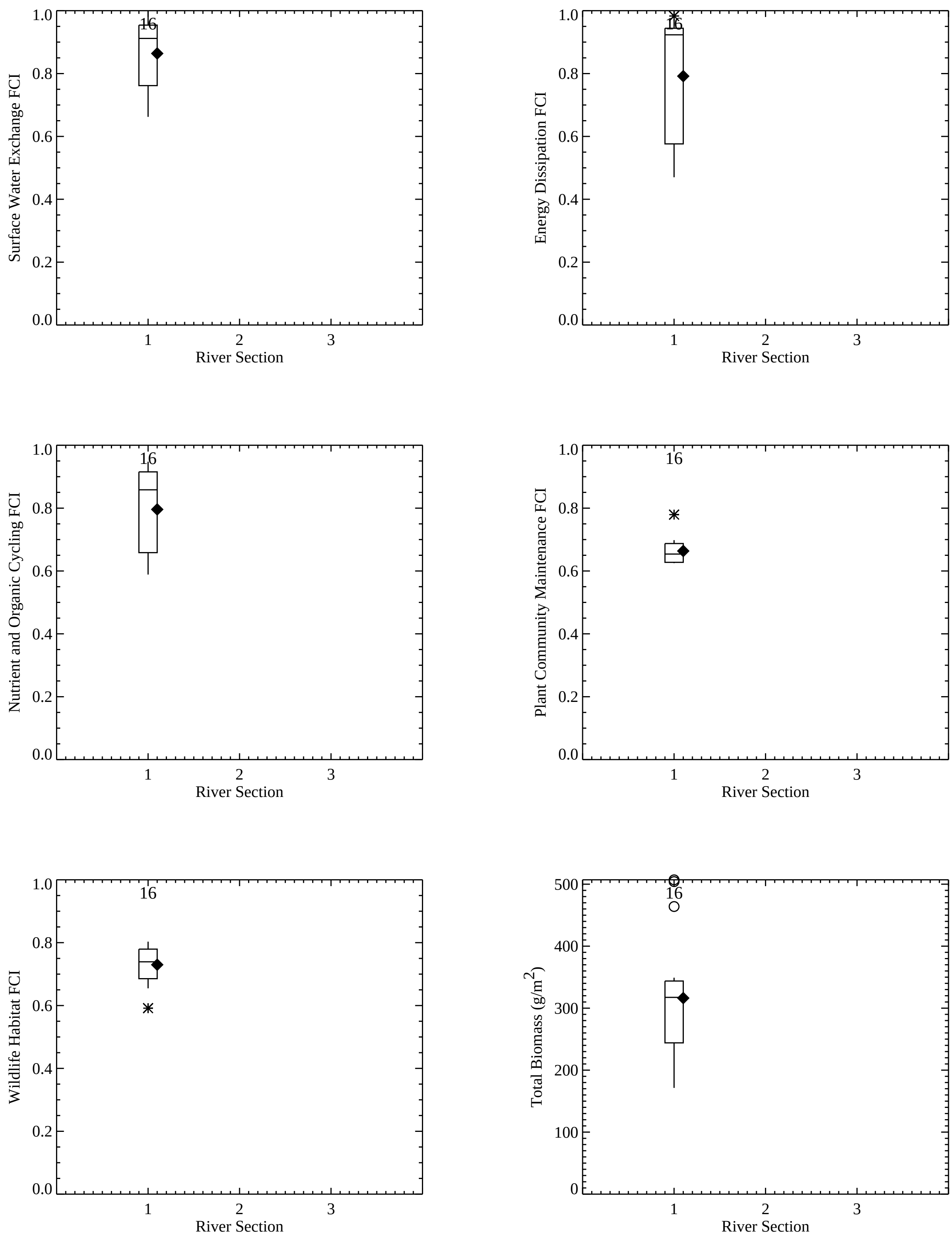

Figure C-8. Box plots comparing FCI values for WET among River Sections.

✳ Outlier between inner and outer fences
○ Outlier outside outer fence
◆ Mean

Notes: Median values are indicated by the horizontal line at the center of the box for each group of measured values. The number above each box plot indicates the number of observations in that river section. No Phase 1 WET stations in RS2 or RS3.

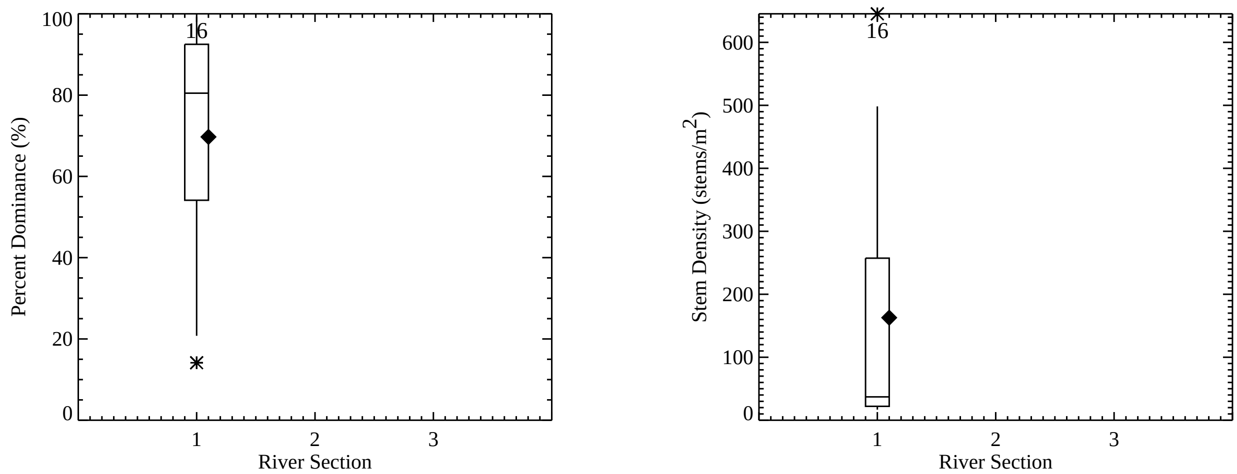

Figure C-8. Box plots comparing FCI values for WET among River Sections.

✳ Outlier between inner and outer fences
○ Outlier outside outer fence
◆ Mean

Notes: Median values are indicated by the horizontal line at the center of the box for each group of measured values. The number above each box plot indicates the number of observations in that river section. No Phase 1 WET stations in RS2 or RS3.

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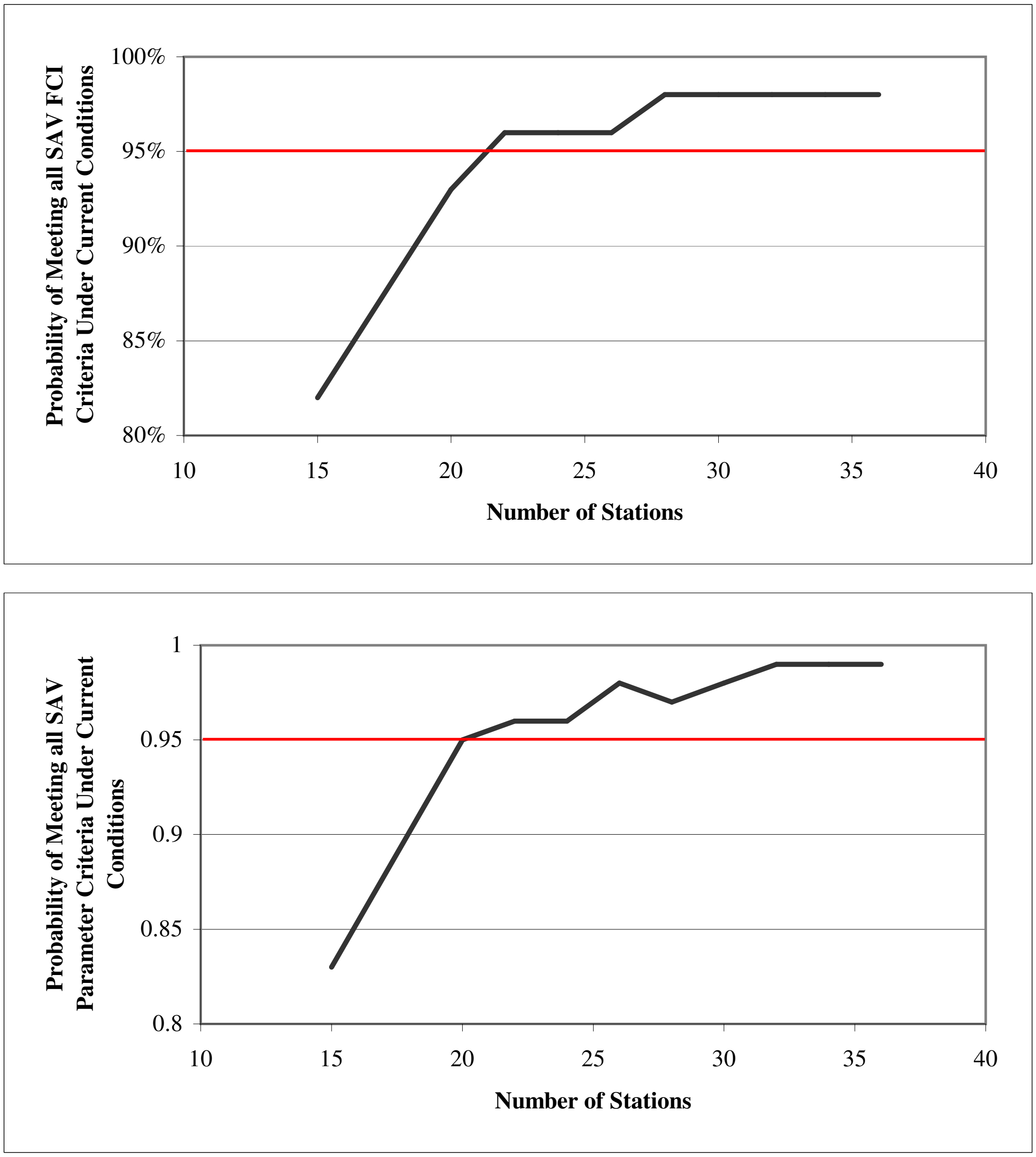


Figure C-9. Relationship between meeting all FCI values and number of stations. Results of bootstrap analysis SAV stations.

Note: The horizontal red line indicates 95% probability of success.

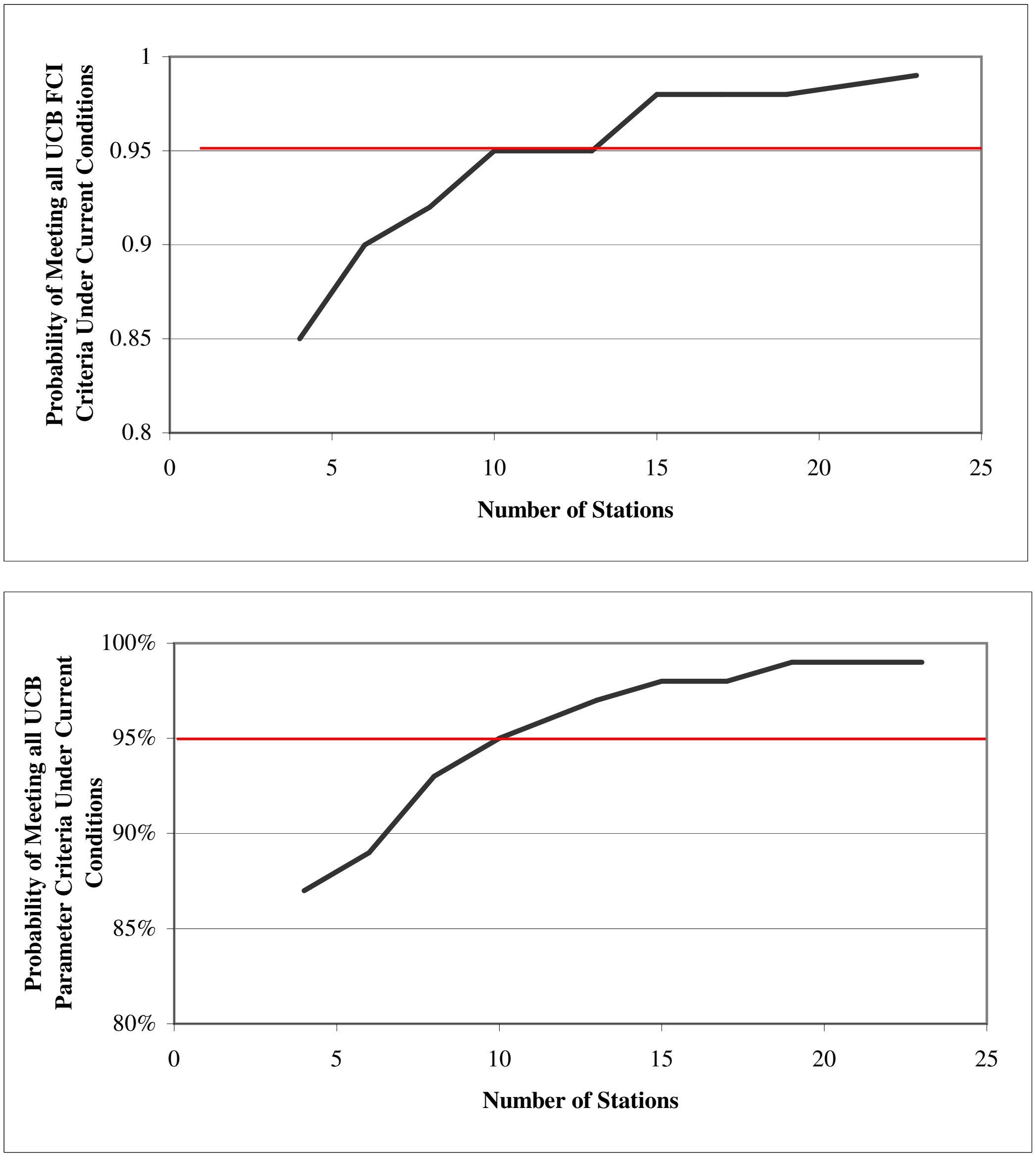
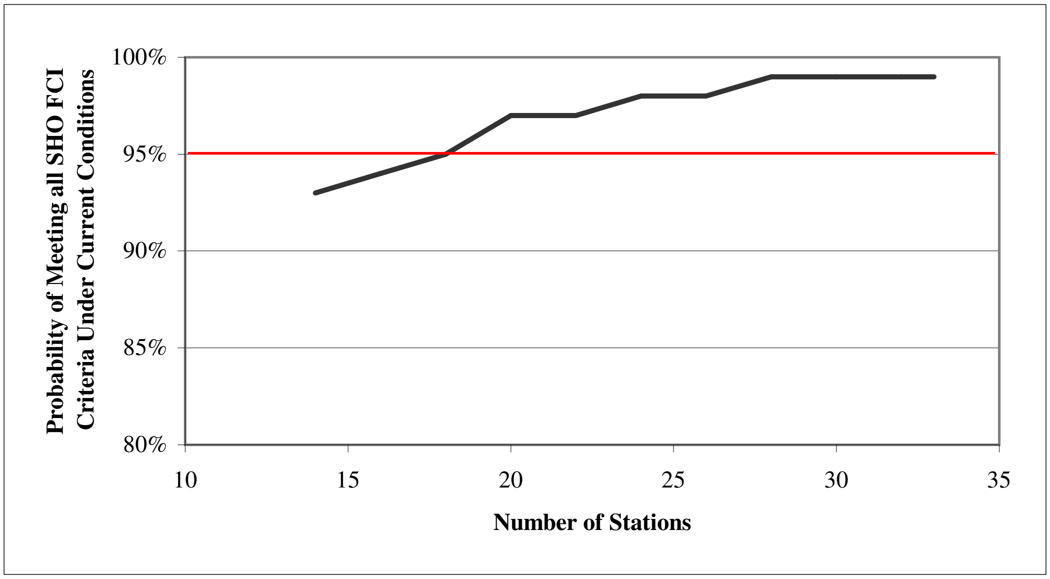


Figure C-9. Relationship between meeting all FCI values and number of stations. Results of bootstrap analysis for UCB stations.

Note: The horizontal red line indicates 95% probability of success.



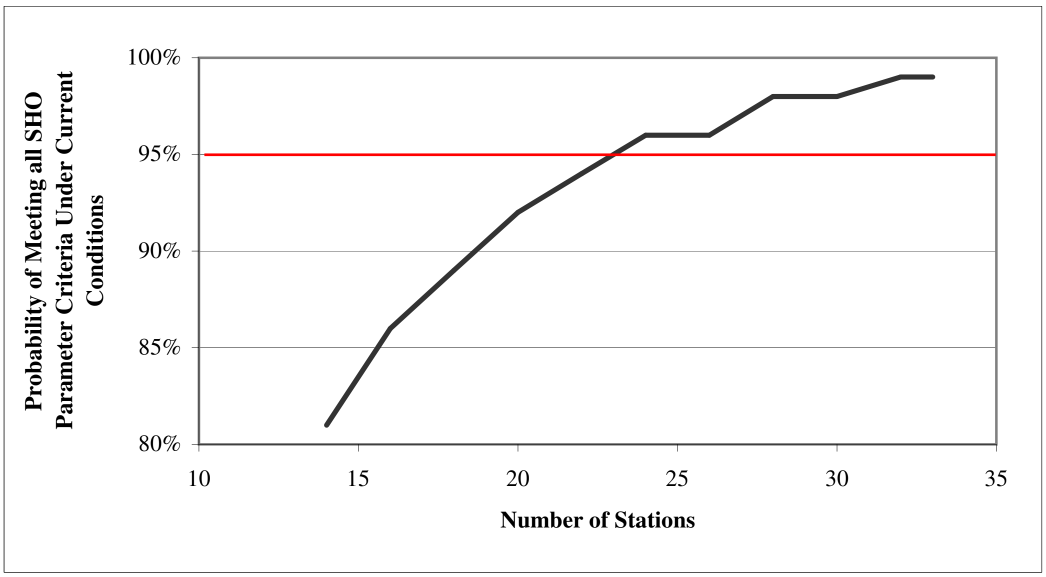
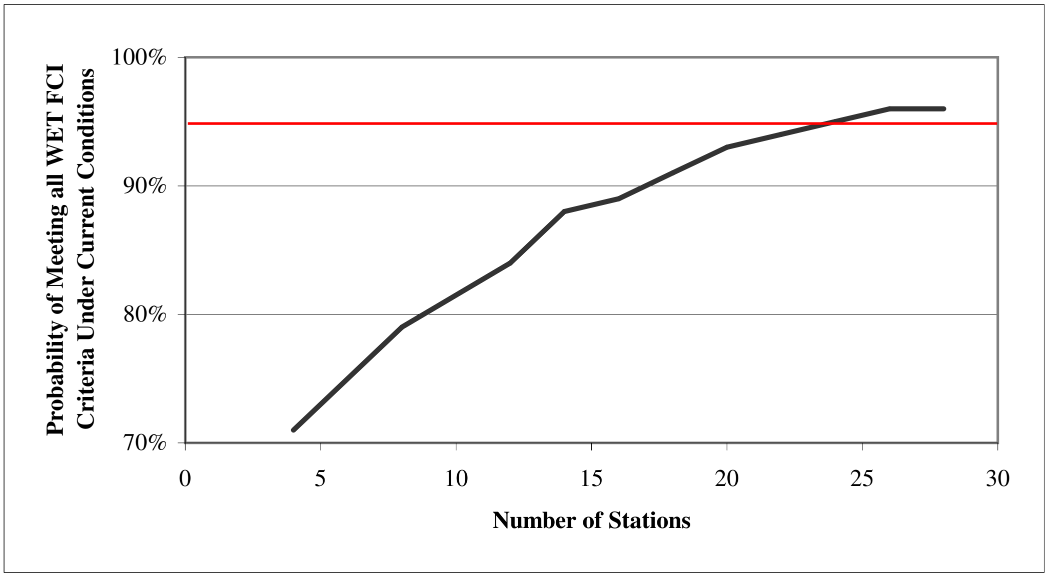


Figure C-9. Relationship between meeting all FCI values and number of stations. Results of bootstrap analysis for shoreline stations.

Note: The horizontal red line indicates 95% probability of success.



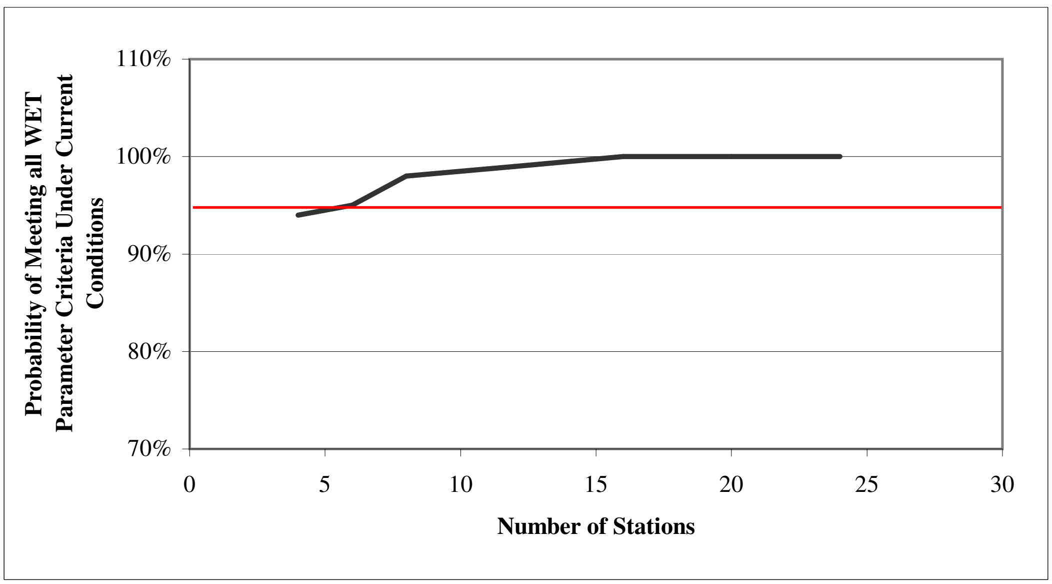


Figure C-9. Relationship between meeting all FCI values and number of stations. Results of bootstrap analysis for wetland stations.

Note: The horizontal red line indicates 95% probability of success.

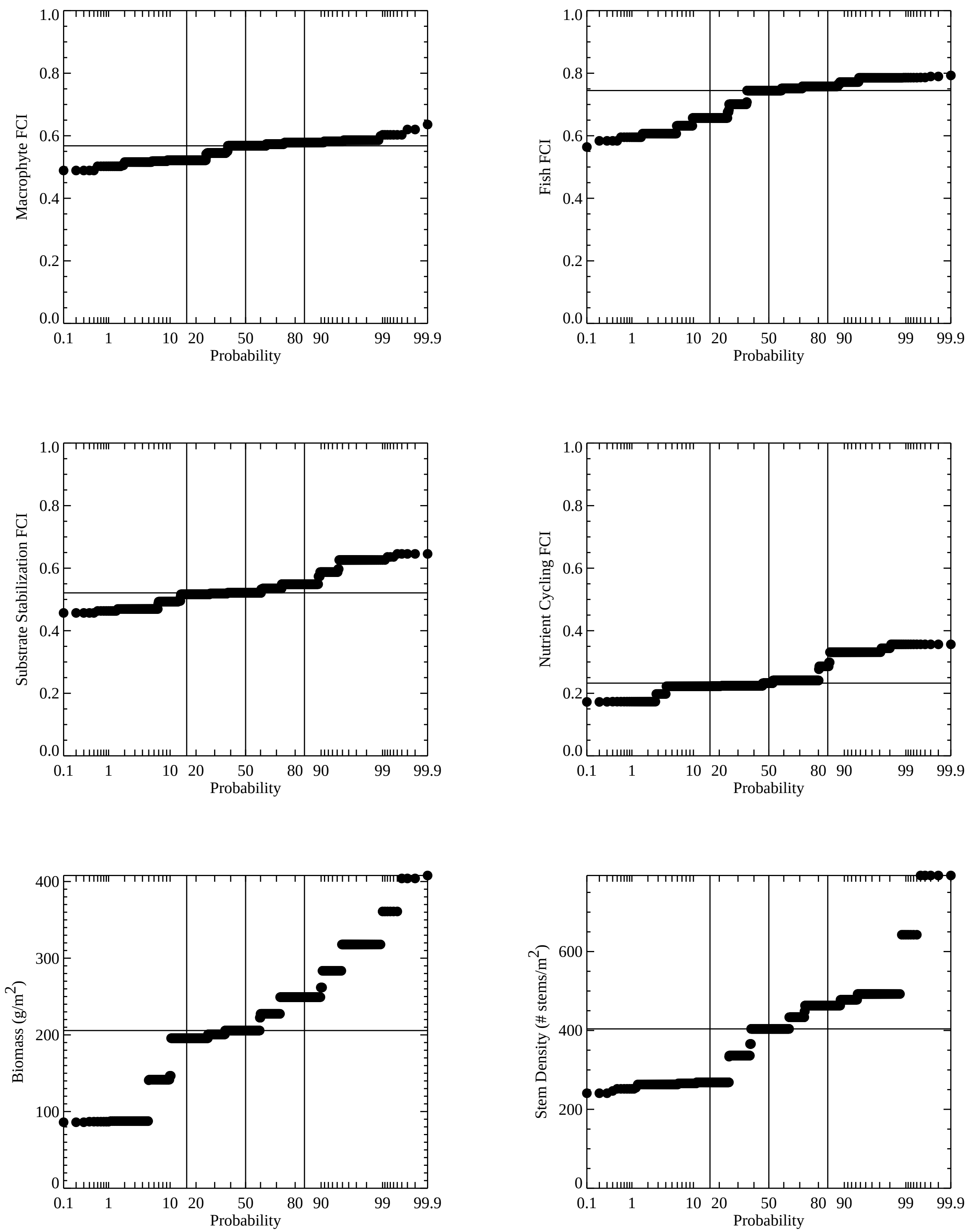


Figure C-10. Probability plots of SAV bootstrap medians.

Note: The horizontal line denotes the median of the actual population.

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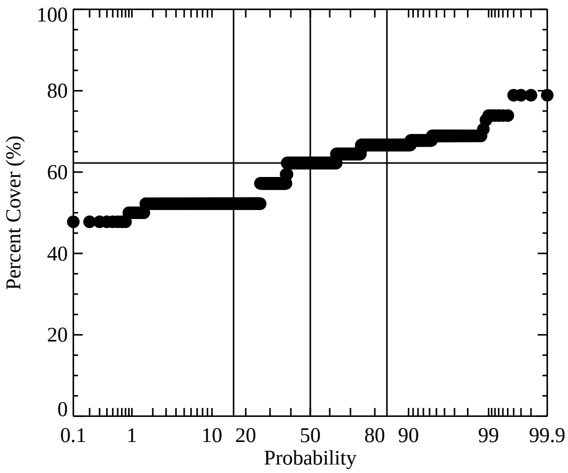

Figure C-10. Probability plots of SAV bootstrap medians.

Note: The horizontal line denotes the median of the actual population.

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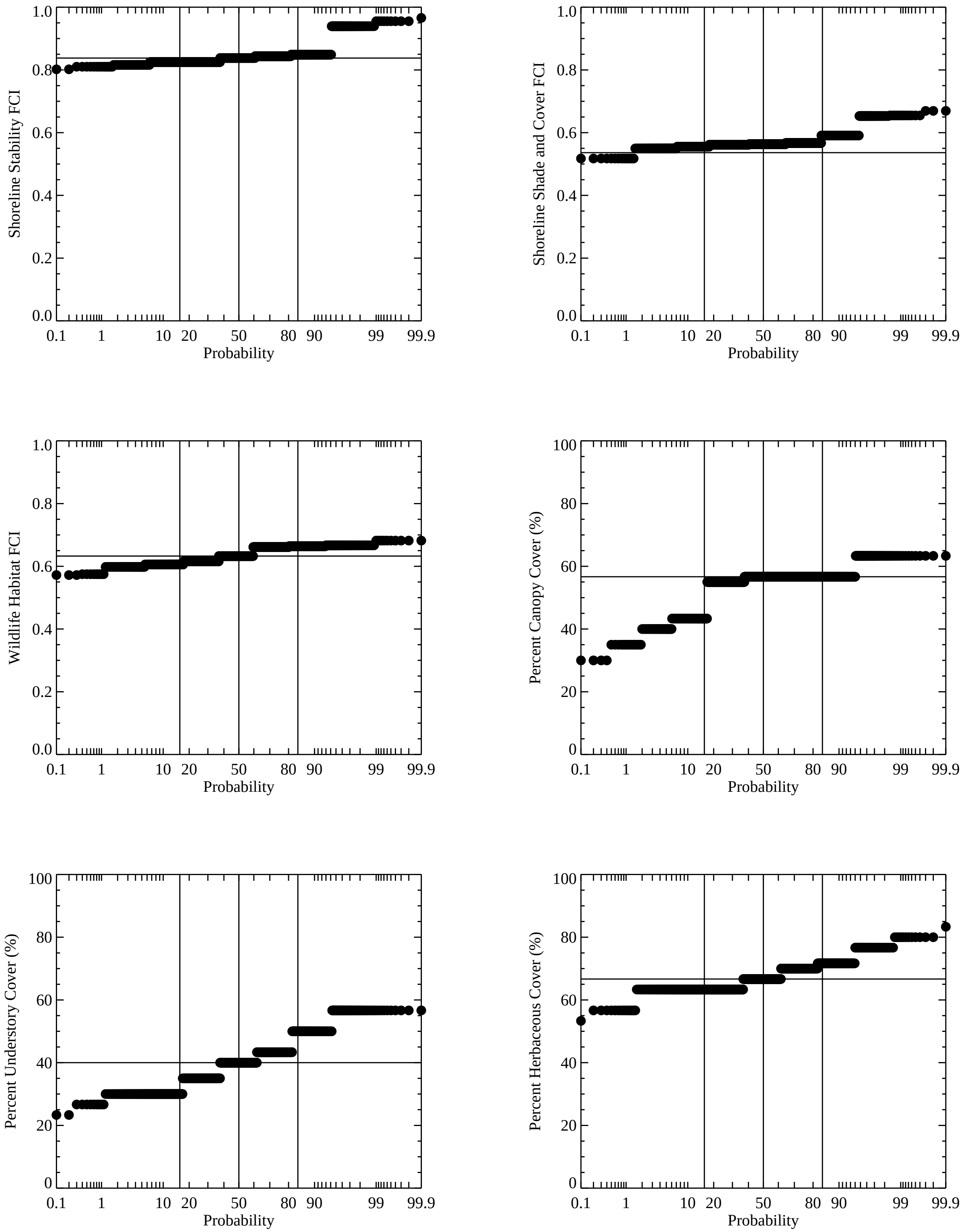

Figure C-11. Probability plots of SHO bootstrap medians.

Note: The horizontal line denotes the median of the actual population.

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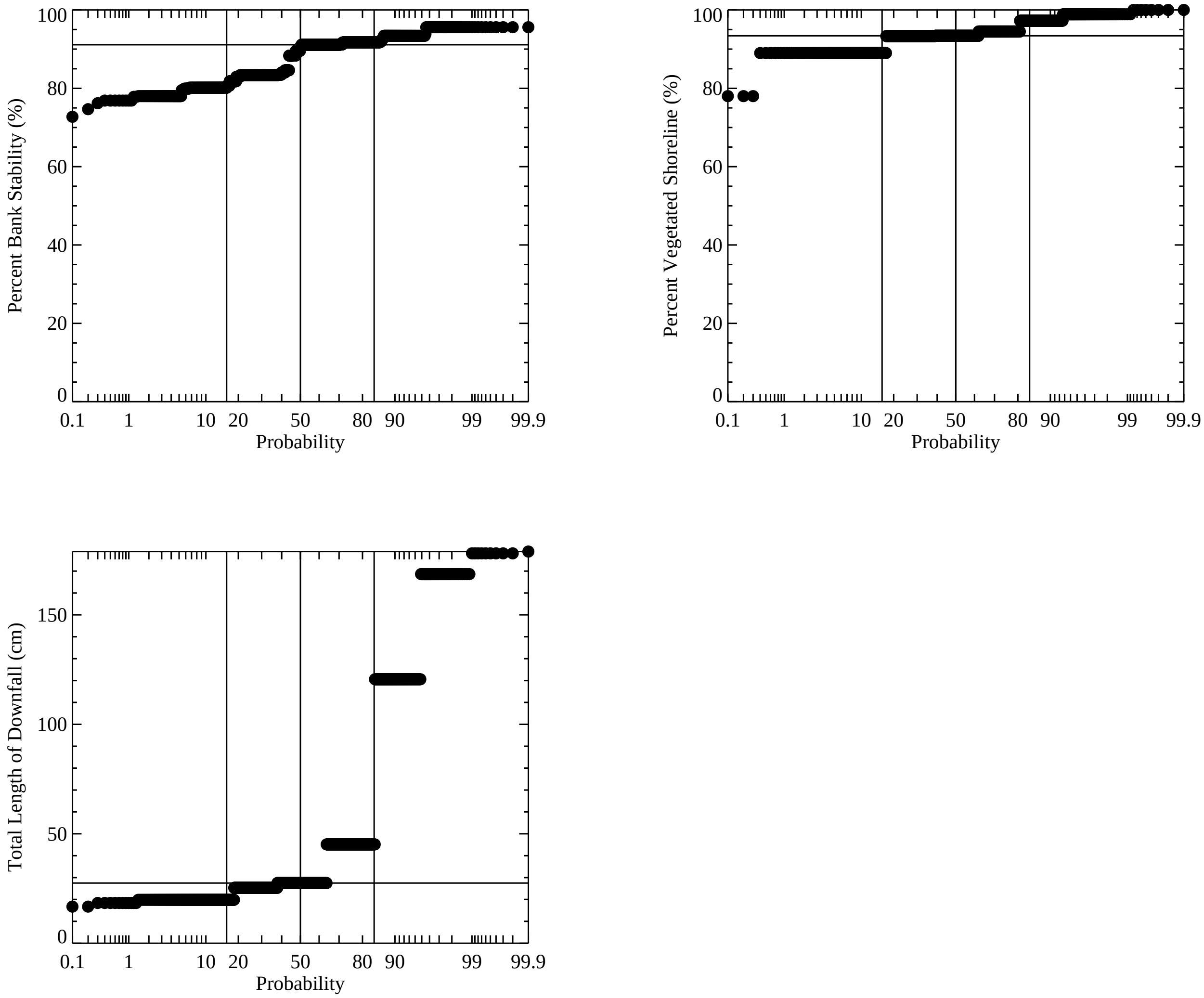

Figure C-11. Probability plots of SHO bootstrap medians.

Note: The horizontal line denotes the median of the actual population.

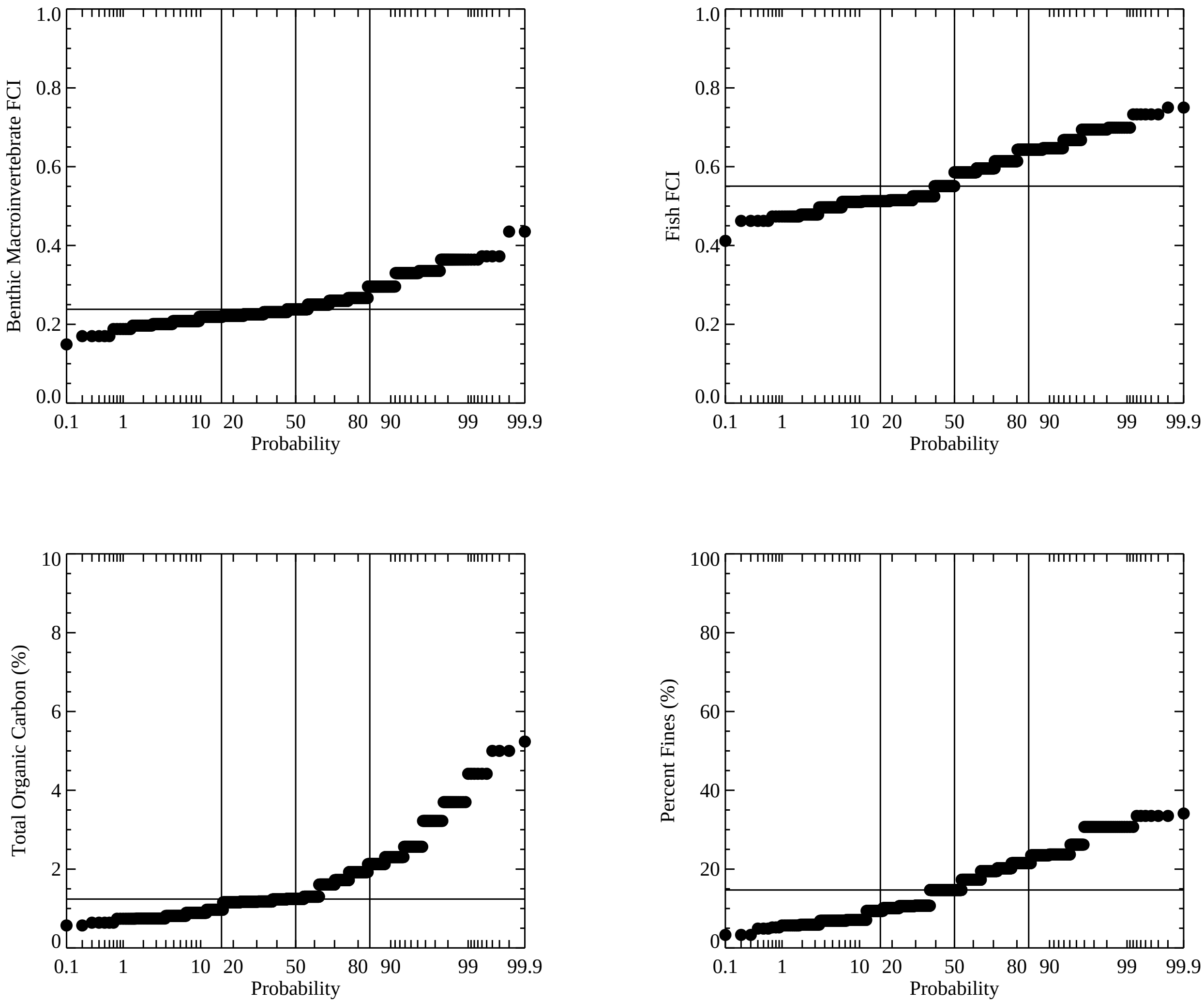

Figure C-12. Probability plots of UCB bootstrap medians.

Note: The horizontal line denotes the median of the actual population.

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Fri Mar 17 14:03:38 2006

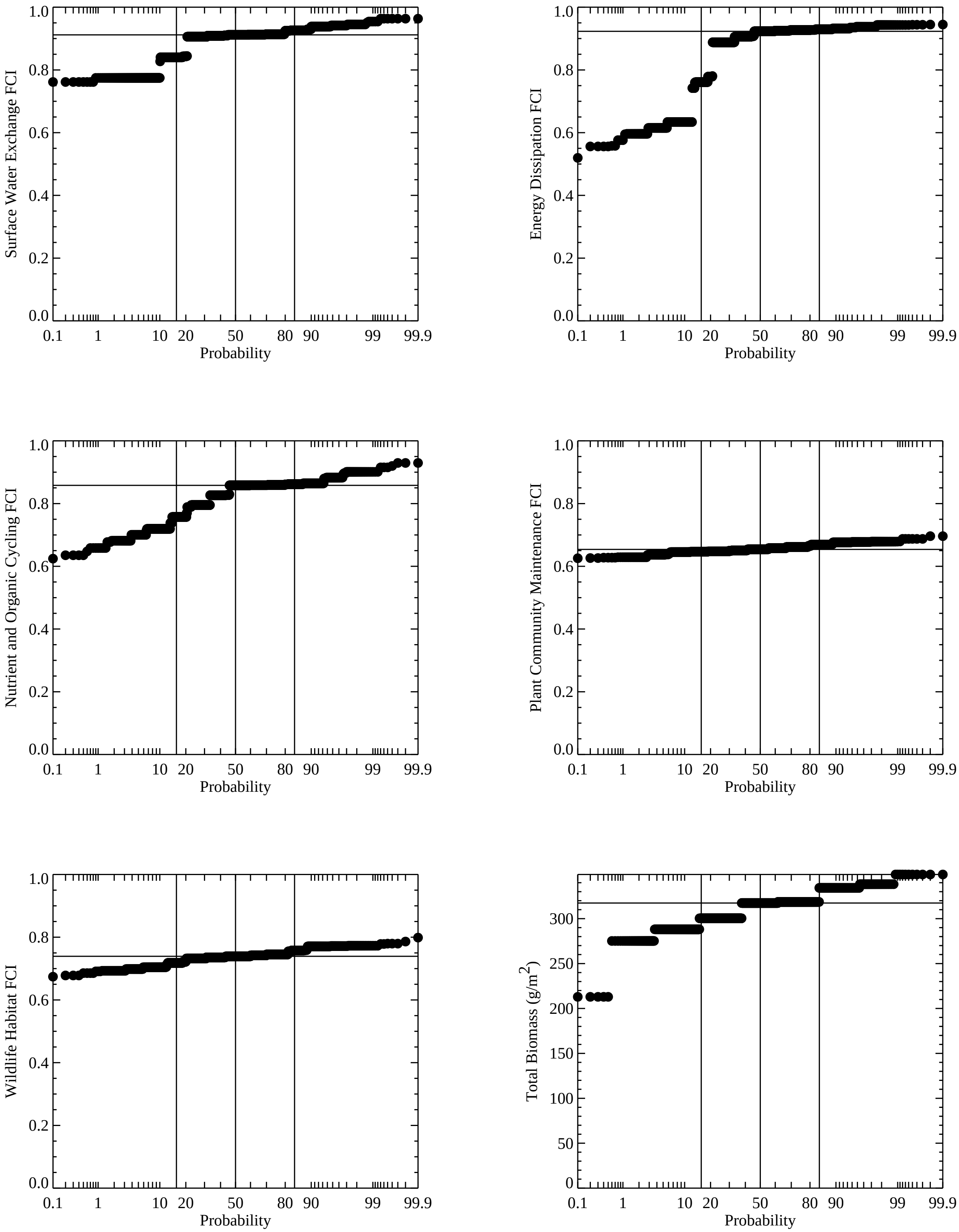


Figure C-13. Probability plots of WET bootstrap medians.

Note: The horizontal line denotes the median of the actual population.

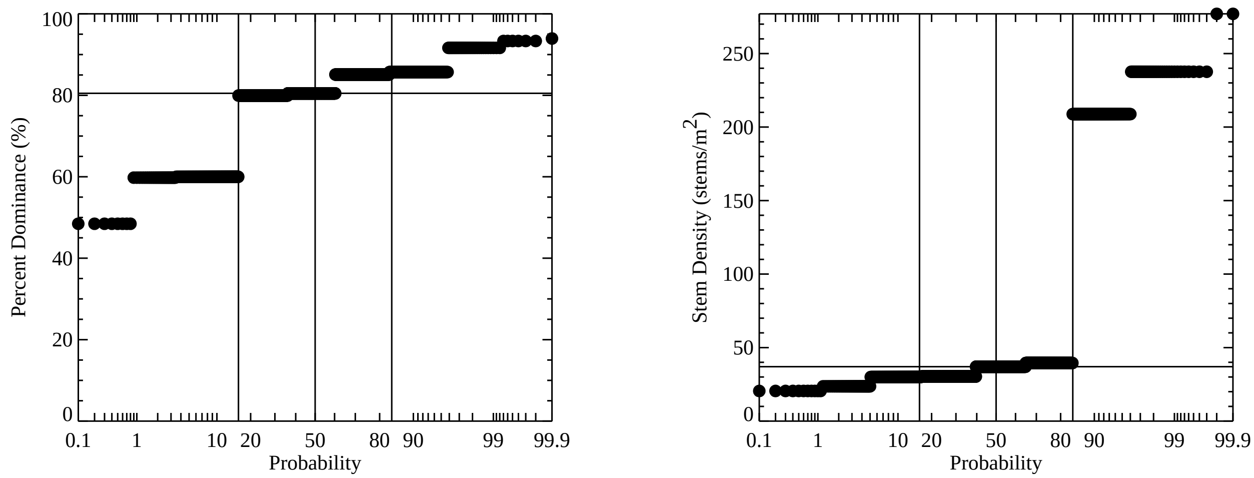


Figure C-13. Probability plots of WET bootstrap medians.

Note: The horizontal line denotes the median of the actual population.

NDK - Q:\GENhab\ANALYSIS\FCI\bootstrap\WET\wet_bootstrap_median_probplots.pro
Fri Mar 17 14:04:32 2006

Exhibit D

SAV Model Sensitivity Analysis Plots

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Exhibit D – Aquatic Vegetation Model Sensitivity Analysis Plots

A. Introduction

As described in Section 2 of the *Phase 1 Adaptive Management Plan*, an aquatic vegetation model was developed for the Upper Hudson River. Model runs were completed using the following scenarios to assess the sensitivity of the input parameters:

- One model run using all parameters;
- Five model runs with one parameter removed each time (e.g., the full model without velocity); and
- Five model runs using a single parameter each time (e.g., velocity only).

Model scores were compared to the actual aquatic vegetation cover in each cell to determine the number of times the model predicted vegetation correctly. Multiple model score cut-off values were used (0, 40, 60, 70, and 80) to assess model prediction (e.g., for a cut-off value of 40, no cells with a model score of 40 or less should have aquatic vegetation). The results of this test (shown on Figures D-1 through D-11) are as follows:

- Percent correct;
- Percent of false negatives – model score is less than or equal to the cutoff value and aquatic vegetation cover is greater than 0 %; and
- Percent of false positives – model score is greater than the cutoff value and there is no aquatic vegetation cover.

For each plot on the figures, the X-axis shows the cut-off value. The Y-axis is percent (correct, false negative, false positive).

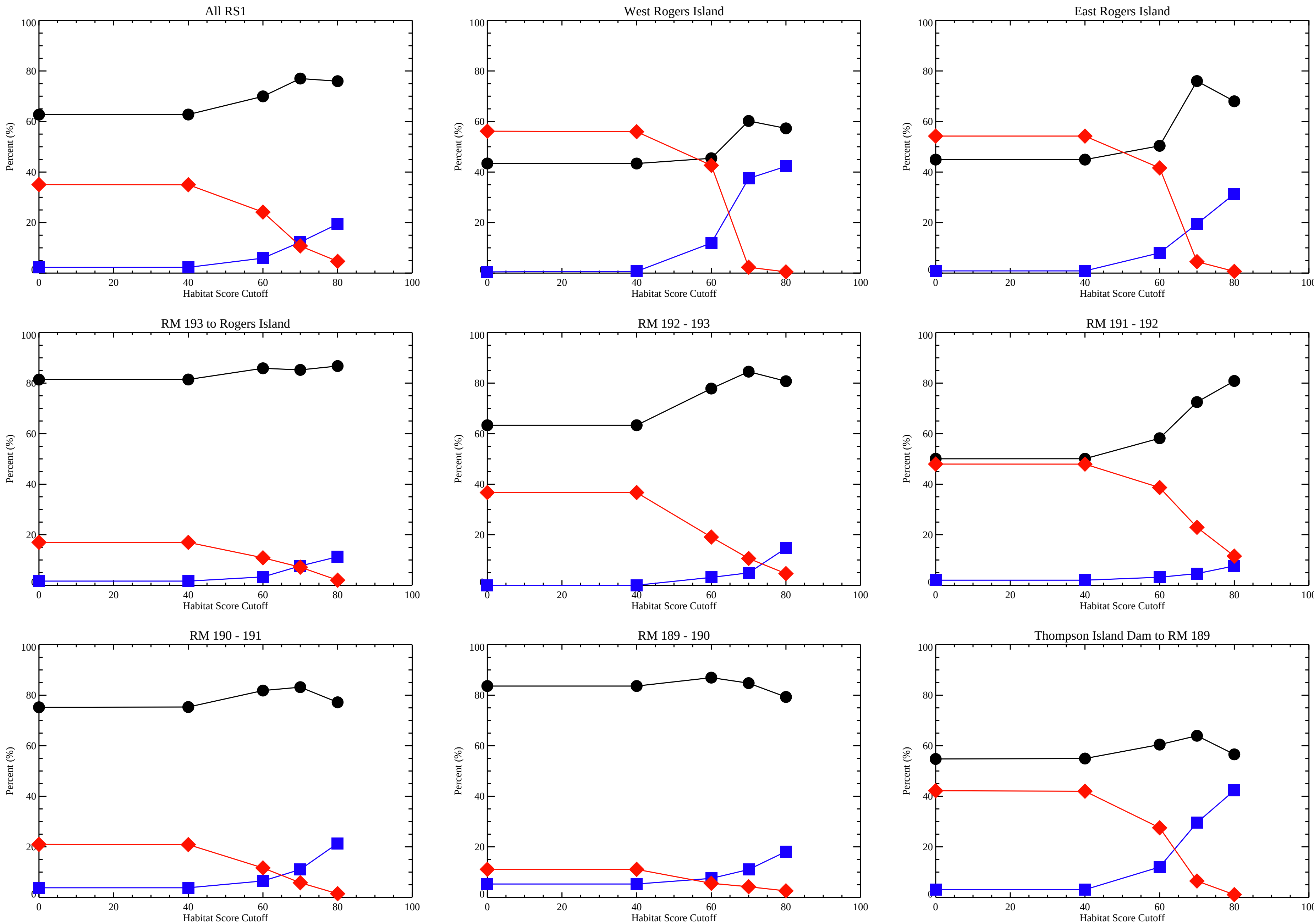
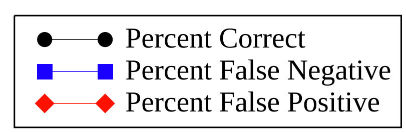


Figure D.1. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when all model variables were used.



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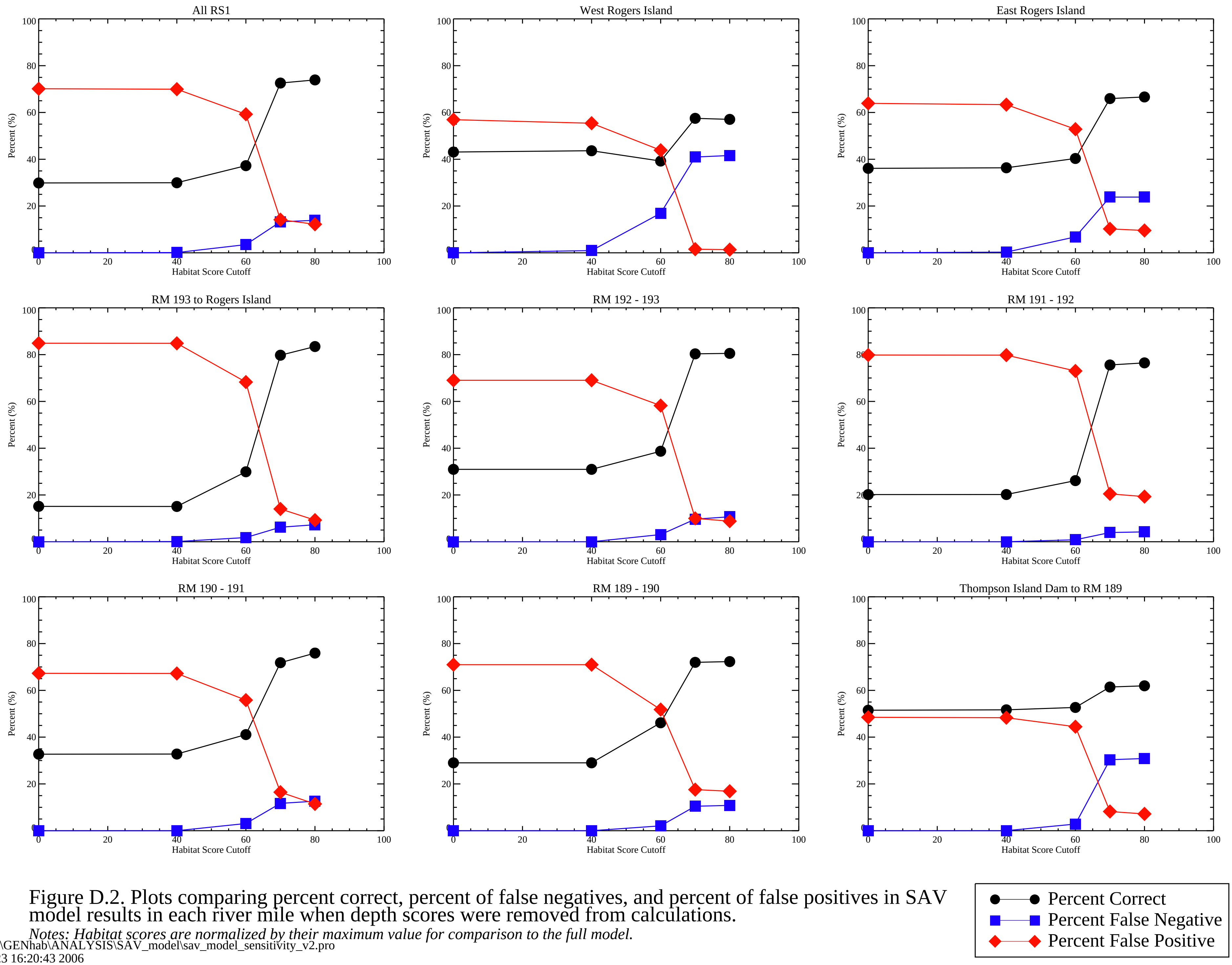

Figure D.2. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when depth scores were removed from calculations.

Notes: Habitat scores are normalized by their maximum value for comparison to the full model.

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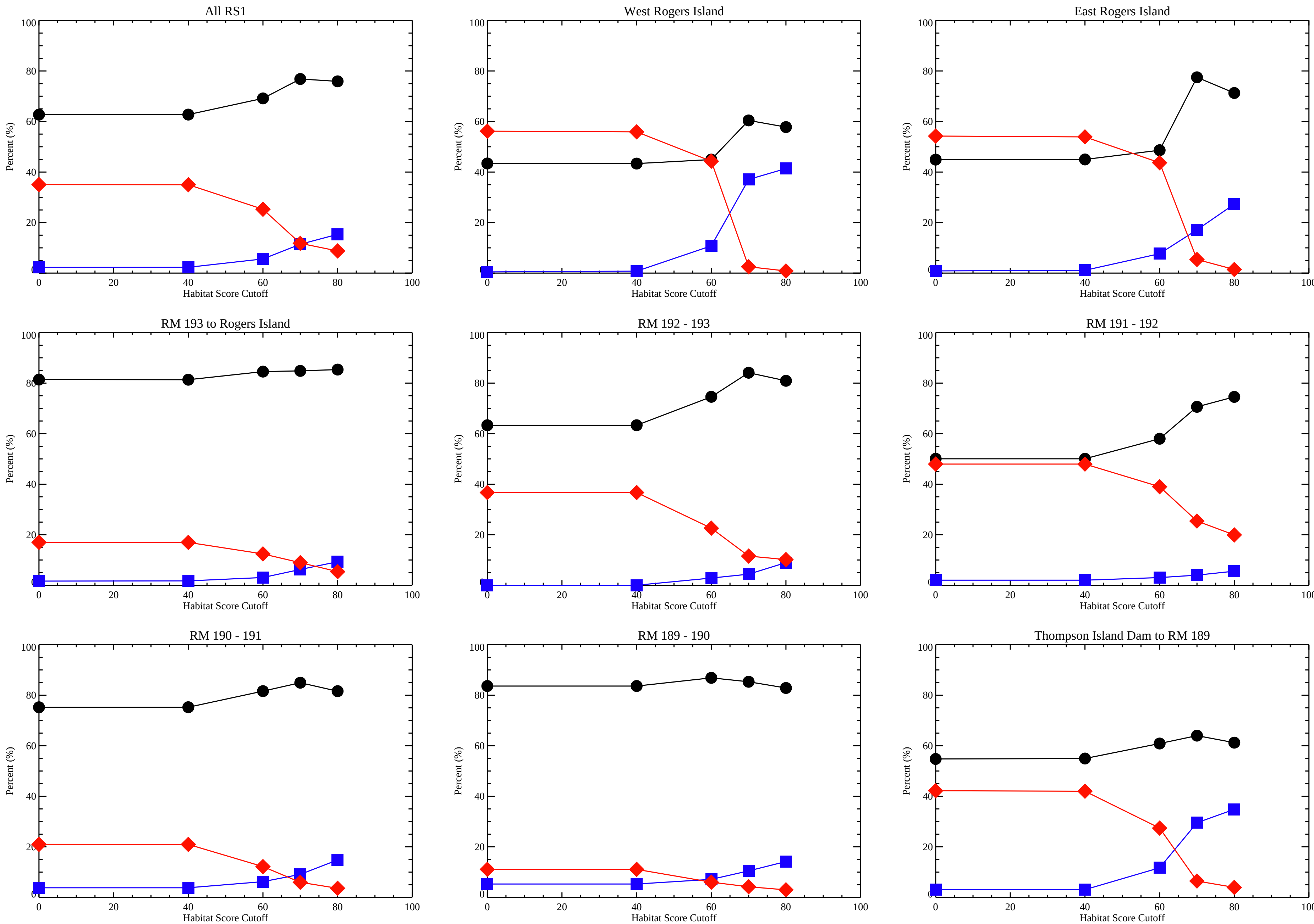

Figure D.3. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when debris scores were removed from calculations.

Notes: Habitat scores are normalized by their maximum value for comparison to the full model.

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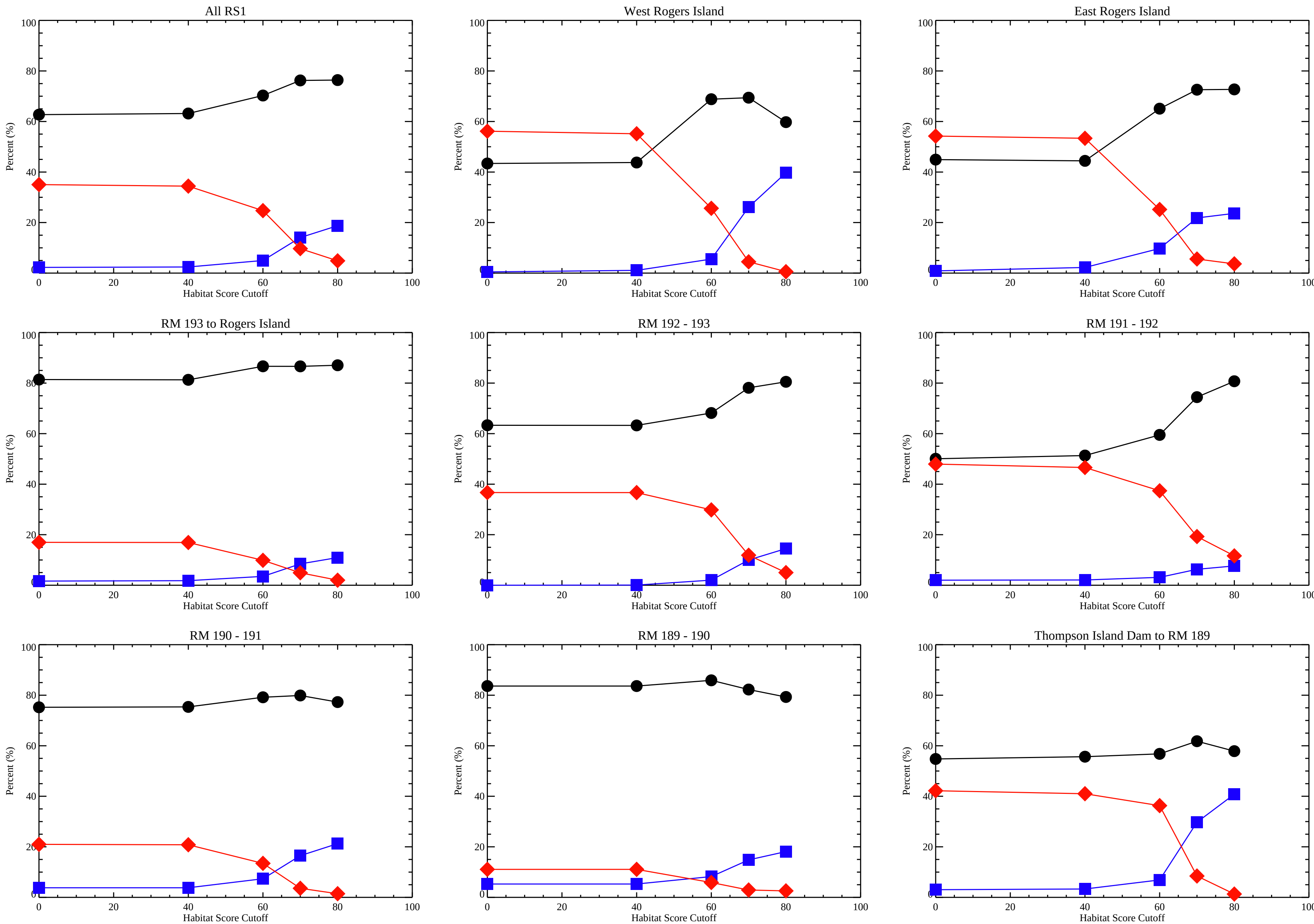
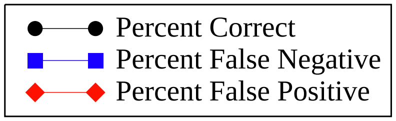


Figure D.4. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when velocity scores were removed from calculations.

Notes: Habitat scores are normalized by their maximum value for comparison to the full model.



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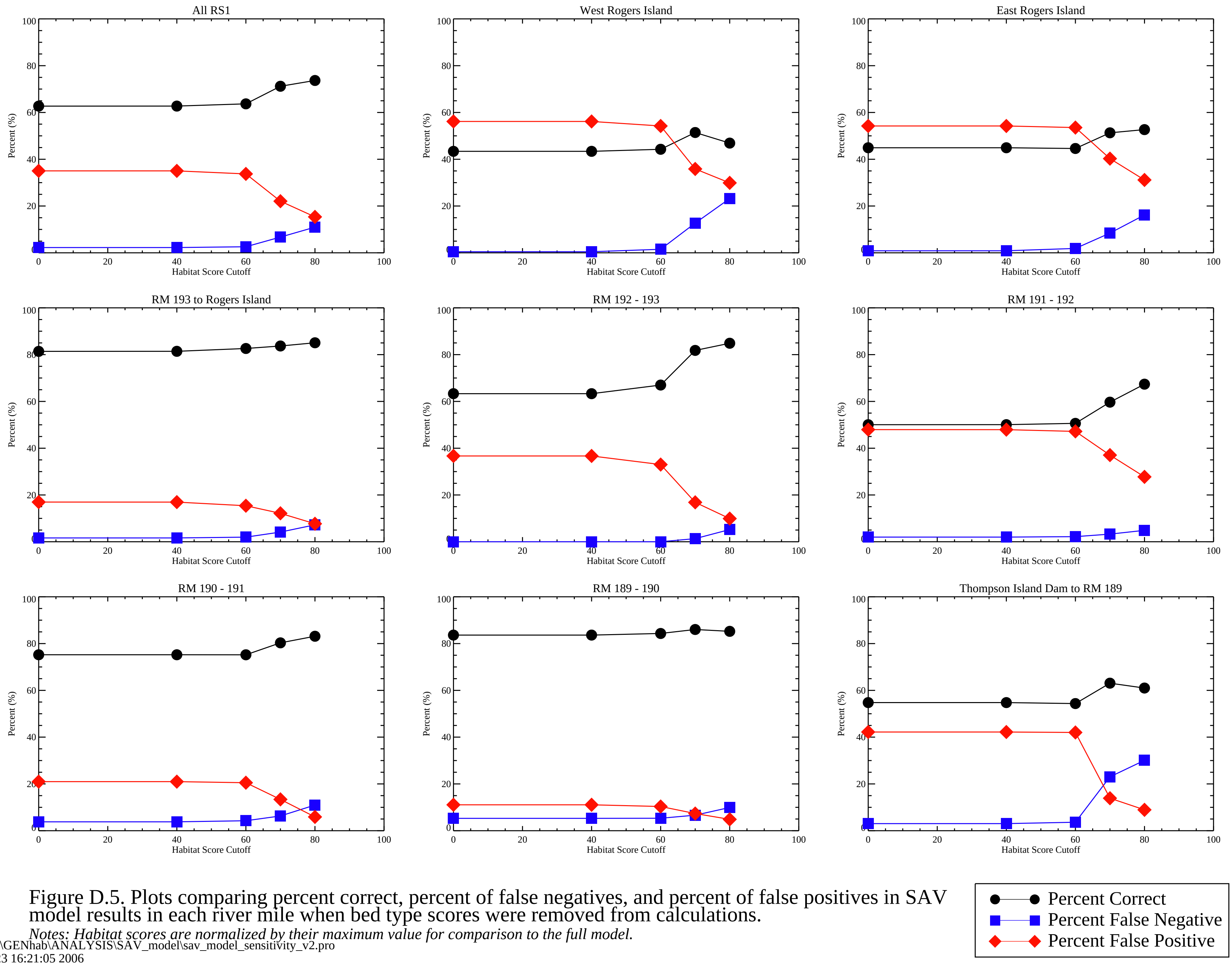

Figure D.5. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when bed type scores were removed from calculations.

Notes: Habitat scores are normalized by their maximum value for comparison to the full model.

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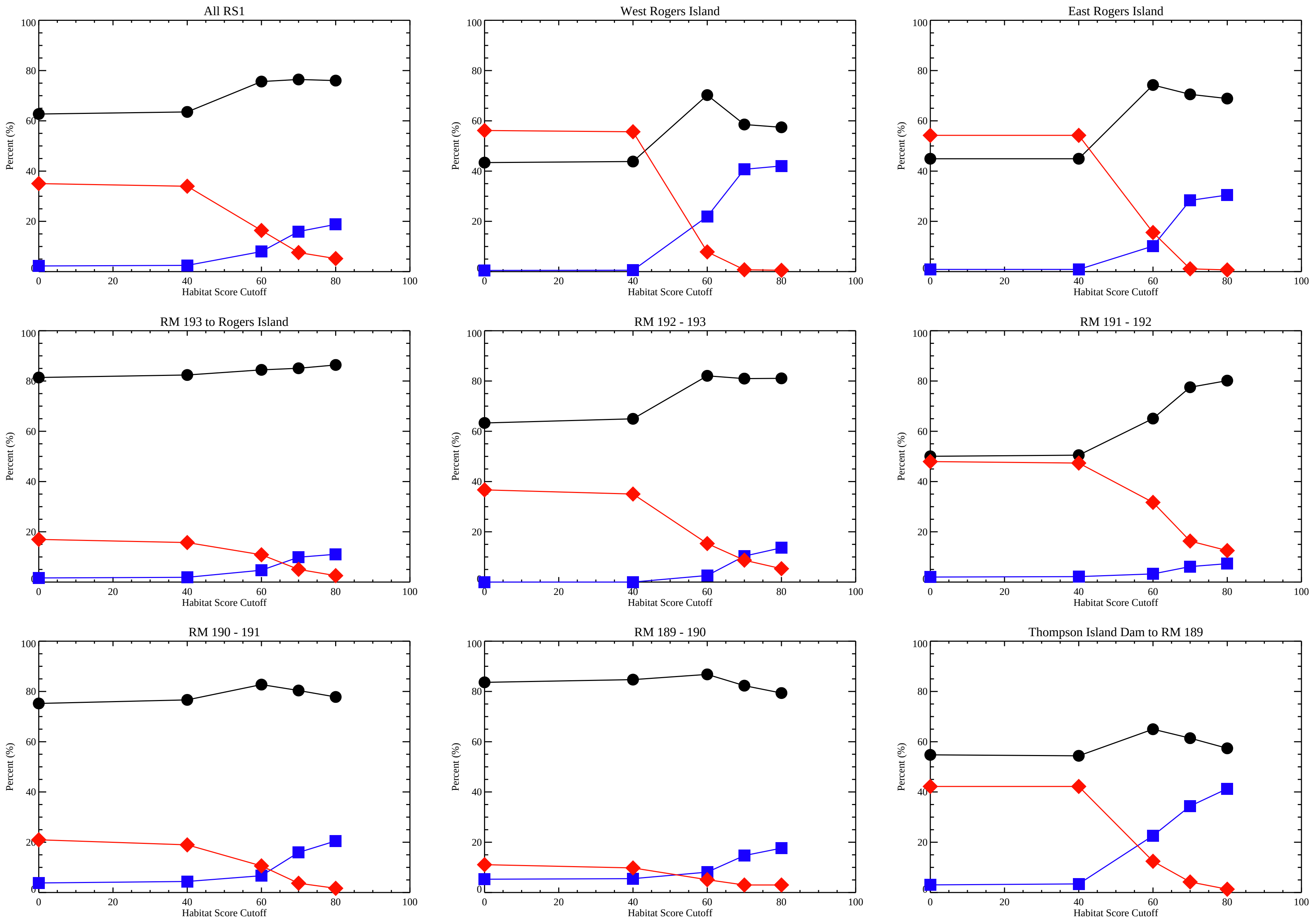
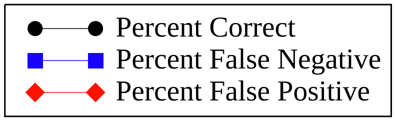


Figure D.6. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when shoreline type scores were removed from calculations.

Notes: Habitat scores are normalized by their maximum value for comparison to the full model.



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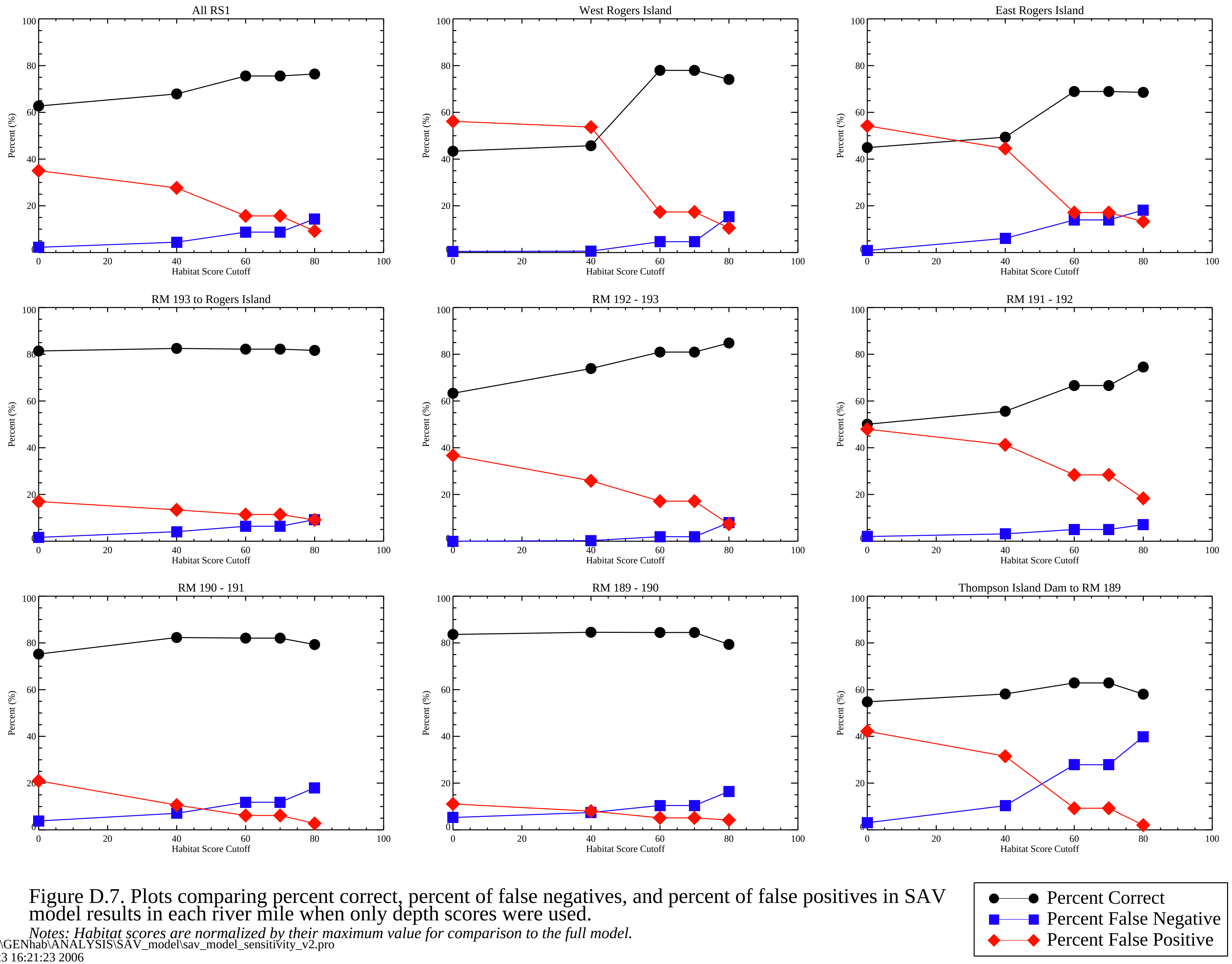

Figure D.7. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when only depth scores were used.

Notes: Habitat scores are normalized by their maximum value for comparison to the full model.

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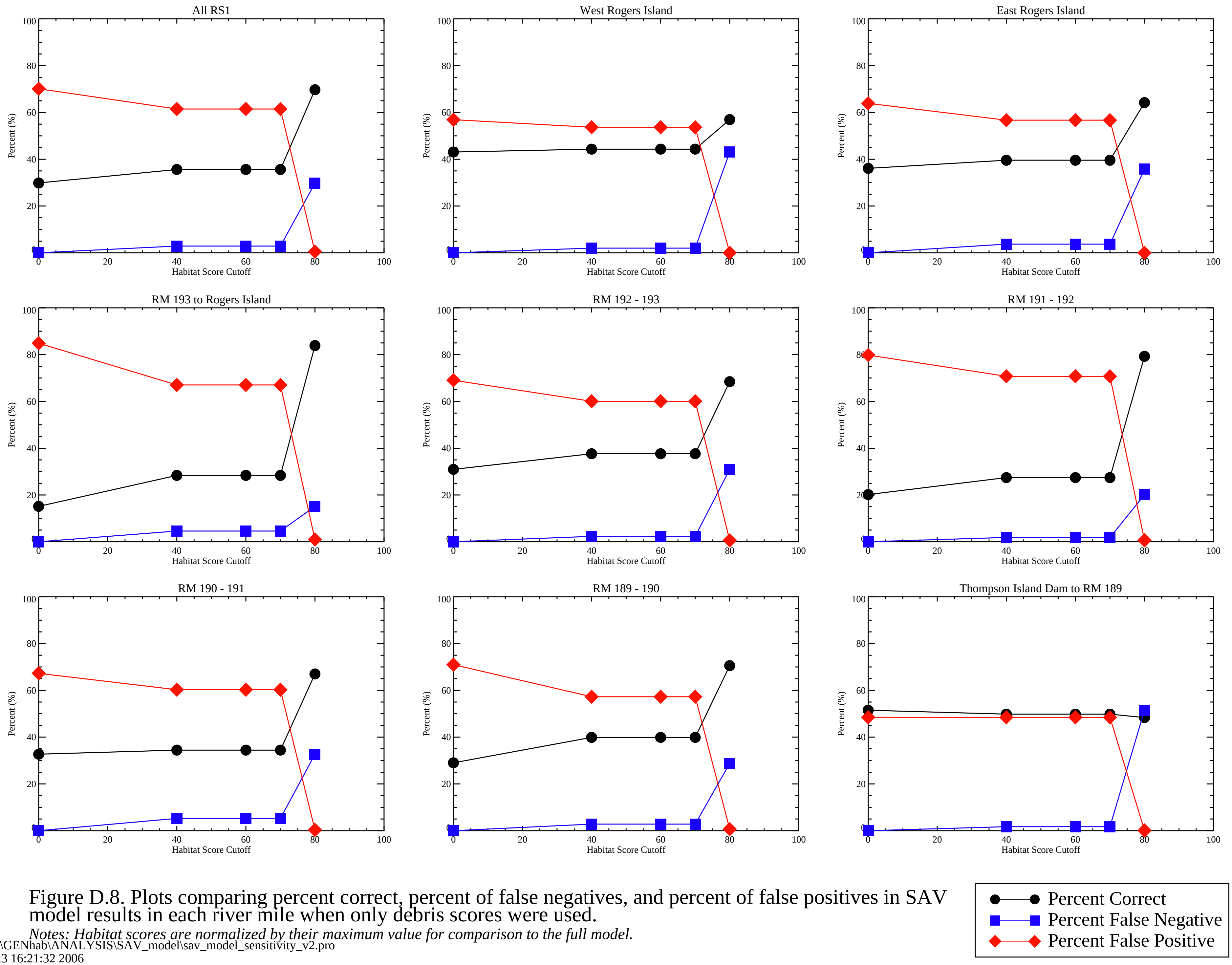

Figure D.8. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when only debris scores were used.

Notes: Habitat scores are normalized by their maximum value for comparison to the full model.

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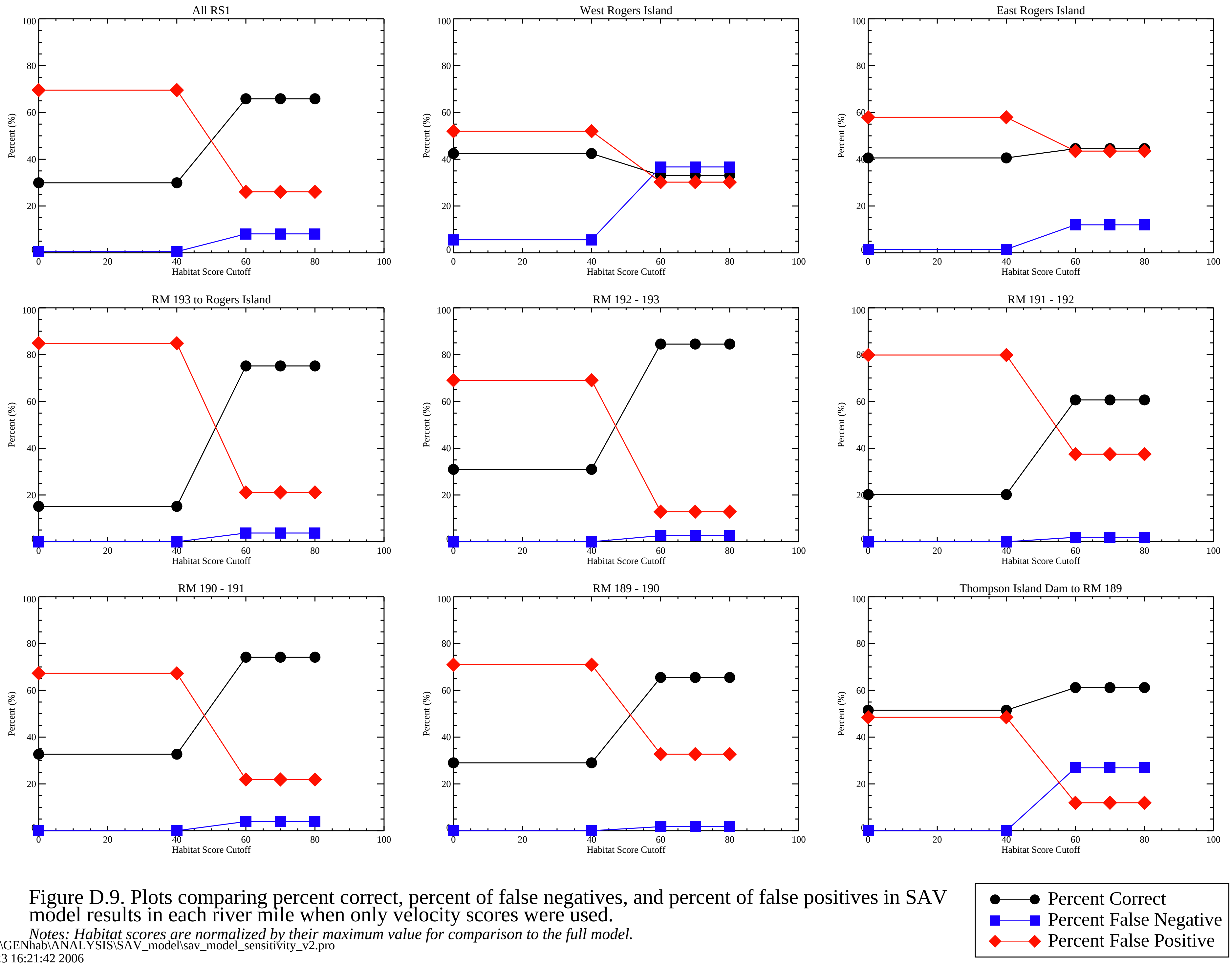

Figure D.9. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when only velocity scores were used.

Notes: Habitat scores are normalized by their maximum value for comparison to the full model.

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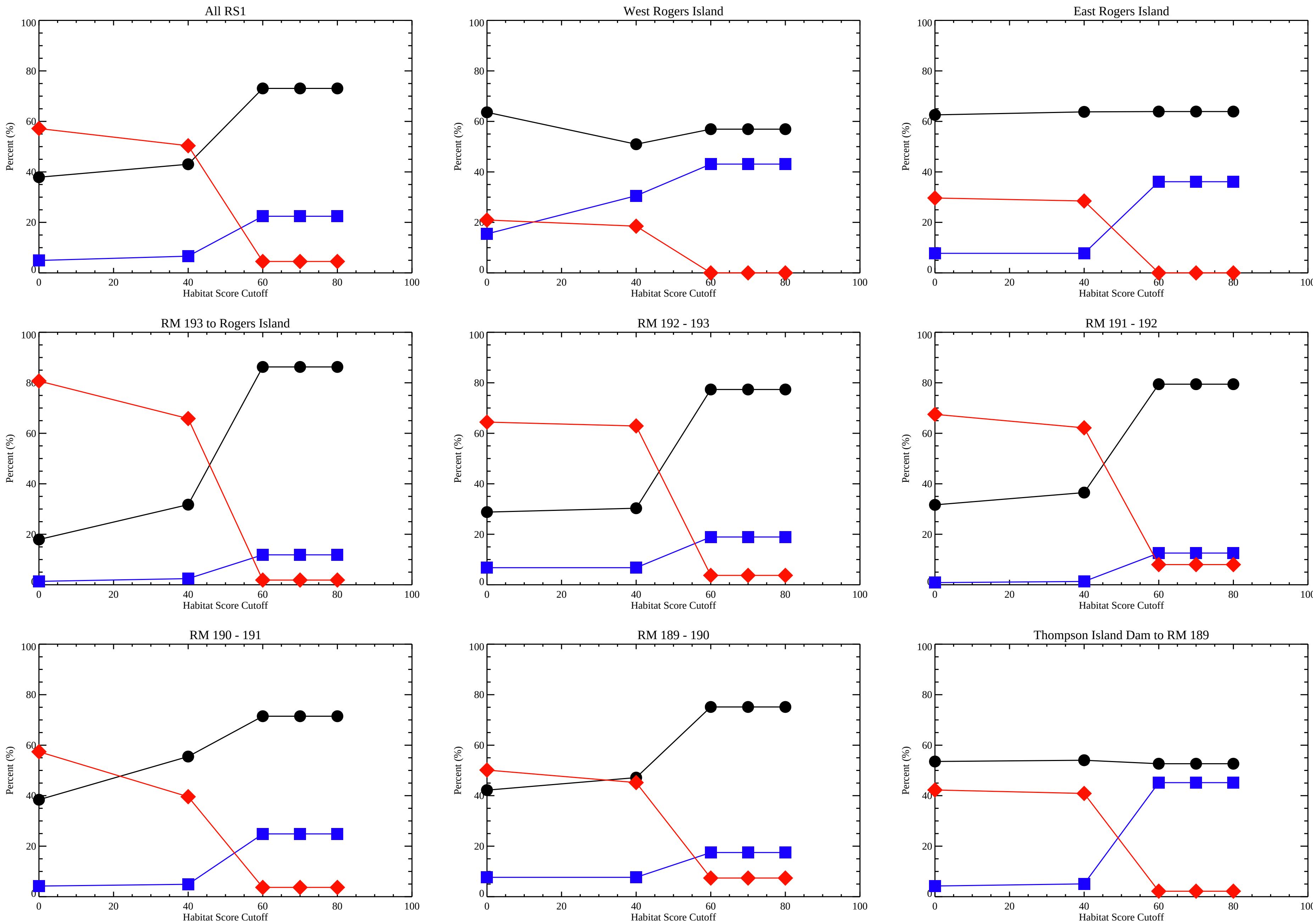
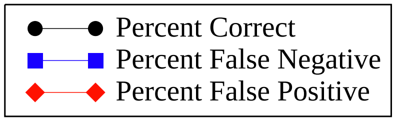


Figure D.10. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when only bed type scores were used.

Notes: Habitat scores are normalized by their maximum value for comparison to the full model.



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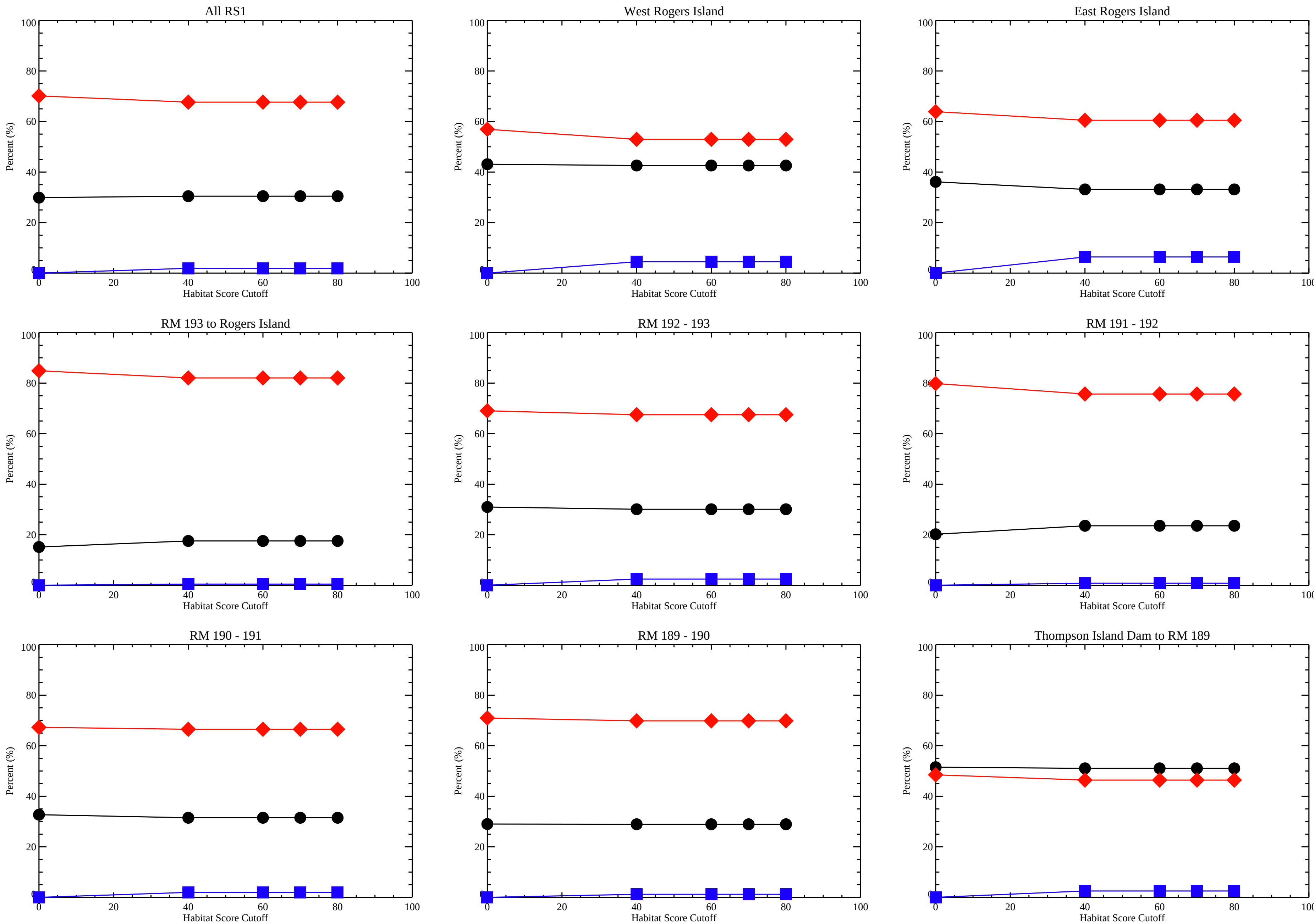

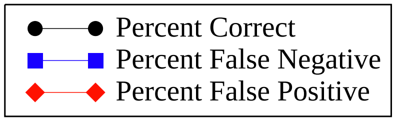

Figure D.11. Plots comparing percent correct, percent of false negatives, and percent of false positives in SAV model results in each river mile when only shoreline type scores were used.

Notes: Habitat scores are normalized by their maximum value for comparison to the full model.

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Exhibit E

Invasive Species Management Plan Summary

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Exhibit E – Invasive Species Management Plan Summary

A. Introduction

This *Phase 1 Invasive Species Management Plan* (ISM Plan) has been prepared as part of the remedial design (RD) program for the remedy selected by the United States Environmental Protection Agency (EPA) for the Upper Hudson River, located in New York State. Additional discussion of the RD program can be found in the *Remedial Design Work Plan* (RD Work Plan) (Blasland, Bouck & Lee, Inc. [BBL], 2003a). The ISM Plan builds upon objectives described in the *Habitat Delineation and Assessment Work Plan* (HDA Work Plan) (BBL 2003b), and was developed to provide a framework for invasive species control in the project area, to be implemented in association with the *Phase 1 Adaptive Management Plan* (Phase 1 AM Plan) and monitoring programs for this project.

Spread of invasive species is a widely recognized environmental problem. Such species can reduce local biodiversity, disrupt ecosystem processes, and constrain habitat functions (NISC, 2001). Habitat replacement and reconstruction efforts in the Upper Hudson River will, to the degree possible within the parameters of the selected remedy, include measures designed to control the potential spread of invasive species. The habitat replacement and reconstruction program emphasizes the establishment of appropriate macrophyte plant communities as the key to ecosystem functions in areas designated for aquatic vegetation. Remediation (dredging, capping) and habitat replacement/reconstruction (substrate reconstruction, passive and active revegetation) in such areas have their greatest potential effect on plants. Invasive animal species (e.g., mammals such as Norway rat, birds such as starling and house sparrow, fish such as carp, and invertebrates such as the Asiatic clam) tend to be ubiquitous and their distribution will not be greatly affected by the dredging/capping or habitat replacement and reconstruction activities.

B. Invasive Plant Species

Four habitat types are present within the Upper Hudson River project area: unconsolidated river bottom, aquatic vegetation beds, shoreline, and riverine fringing wetland habitats. Invasive plant species were not observed in unconsolidated river bottom habitat, and hence this type of habitat is not discussed further in this ISM Plan. Beginning in 2003, habitat delineation and assessment activities were completed in accordance with the HDA

Work Plan. These investigations documented 11 invasive plant species within the Upper Hudson River. Table E-1 summarizes the invasive species documented and the habitats in which they were found.

Table E-1 – Invasive Species in Upper Hudson River Habitats

Common name	Scientific name	# obs
Aquatic Vegetation Beds		
Water Chestnut	*Trapa natans*	8
Yellow Floating Heart	*Nymphoides peltata*	4
Curly Pondweed	*Potamogeton crispus*	2
Eurasian Water Milfoil	*Myriophyllum spicatum*	9
Riverine Fringing Wetlands		
Purple Loosestrife	*Lythrum salicaria*	122
Common Reed	*Phragmities australis*	2
Shoreline		
Japanese Knot Weed	*Polygonum cuspidatum*	4
Tatarian Honeysuckle	*Lonicera tatarica*	110
Bittersweet spp.	*Celastrus* spp.	13
Black Locust	*Robinia pseudoacacia*	21
Common Buckthorn	*Rhamnus cathartica*	6

Of these 11 invasive species, only the following five species are known to exist in habitats that overlap Phase 1 dredge areas:

- Purple Loosestrife (*Lythrum salicaria*);
- Tatarian Honeysuckle (*Lonicera tatarica*);
- Bittersweet spp. (*Celastrus spp.*);
- Black Locust (*Robinia pseudoacacia*); and
- Common Buckthorn (*Rhamnus cathartica*).

This list includes species actually observed in the Phase 1 dredge areas during field activities associated with remedial action planning; these are the species that are likely to be of principal concern for the success of habitat replacement and reconstruction efforts. During ongoing monitoring and adaptive management activities following remediation, observations will be made in all habitats and the presence of additional species noted, should they occur. Under the adaptive management process, control measures for such additional species will be included as necessary in annual *Adaptive Management Reports*.

The following section provides a brief introduction to each of the potentially invasive plant species recorded in the Phase 1 dredge areas, along with corresponding methods that have been used in the literature to control each species. Section 3 discusses the control methods potentially appropriate for the Upper Hudson River and how such methods will be incorporated in the adaptive management program.

Invasive Plants in Phase 1 Riverine Fringing Wetlands

Purple loosestrife (*Lythrum salicaria)*

Purple loosestrife is a native of Eurasia that has spread throughout the United States since its first report in 1814. Purple loosestrife prefers to colonize portions of disturbed wet areas such as ditches, wetlands, or areas along streams, rivers, and lakes that are exposed to full sunlight. The plant is grows to 0.5 to 2.0 meters in height, and has a well developed taproot. Vegetative reproduction is minimal, as most of the root system is centered around the taproot. Reproduction is primarily through seeds, which are dispersed by wind and (to a lesser degree) by animals. Prolific seed production, high seed viability, high germination density, and rapid growth help purple loosestrife out-compete native plants when colonizing new areas. Purple loosestrife can create monotypic stands by crowding and shading out competitors (Bender and Rendall, 1987).

Control methods for purple loosestrife have exhibited varying degrees of success. Because stands over three acres in size may not be effectively eradicated, containment of these stands to their present size and location is often a management objective. Stands of less than three acres or plants extending beyond the boundaries of a contained stand may be controlled by hand-pulling or chemical application. Purple loosestrife stands under three acres may also be controlled by cutting. Purple loosestrife can be removed by hand prior to seed set; however, the entire rootstock must generally be removed to prevent regeneration. Recommended herbicides includes glyphosate applied after August or broadleaf herbicide applications in late Spring (Bender, 1987).

Biological controls have also been developed for purple loosestrife. Under certain environmental conditions, the beetle species *Galerucella calmariensis* and *G. pusilla* have been effective at dramatically degreasing purple loosestrife populations, enabling native species to recolonize. The beetles are effective for stands that are located in sunny areas that are not permanently flooded. Studies indicate that the beetles have minimal effects on non-target species (Adirondack Park Invasive Plant Program [APIPP], 2004).

Invasive Plants in Phase 1 Shorelines

Tatarian honeysuckle (*Lonicera tatarica*)

The tatarian honeysuckle ranges (*Lonicera tatarica*) from the central Great Plains to southern New England, and belongs to the family of bush honeysuckles that includes seven species in the genus *Lonicera*. Bush honeysuckles originated in Eurasia. Historically, these plants were used as ornamentals, wildlife cover, and erosion control shrubs. Bush honeysuckles tend to be intolerant of shade, occurring in forest edges, fields, and other open upland habitats. Woodland areas disturbed by grazing or other activities can be susceptible to colonization by this genus. The plants reproduce primarily through seeds, as the fruits are attractive to wildlife; however, vegetative reproduction enables the plant to persist and spread (Swearingen et al., 2002).

Control methods that have been used for tatarian honeysuckle include harvest, herbicide application, stump cutting combined with herbicide application, and basal bark herbicide application. Hand removal of plants or seedlings may be effective for small areas that are ecologically sensitive. Biological control agents have not been identified (SEPPC, 2006; WAPM, 2006).

Bittersweet spp. (*Celastrus orbiculatus)*

Bittersweet is a woody vine that occupies open woods or thickets, and can climb to 18 meters. It is native to temperate eastern Asia, and is believed to have appeared in North America prior to 1879. By the 1970s, the documented range extended from Maine to Georgia, and west to Iowa. The vine reproduces primarily through seeds. Animals are the primary vector of seed dispersal, but humans can be important dispersal agents as well by using the vine in dried arrangements and conservation plantings. Bittersweet can also reproduce by rootsuckering, which results in large patches of the plant. Dense canopies of bittersweet are believed to shade out desirable native plants (Dreyer, 1994).

Control methods include chemical and mechanical techniques. Combinations of cutting and chemical treatments have been used to control bittersweet. Triclopyr is a recommended herbicide, as it will not kill beneficial monocots. Mowing alone is not recommended, as poorly scheduled mowing events can stimulate rootsuckering (Dreyer, 1994).

Common Buckthorn (*Rhamnus cathartica*)

Common buckthorn is a deciduous shrub or small tree between two to six meters in height; it is found in wooded areas, hedgerows, and pastures. The plant is native to Europe and Asia, and is believed to have arrived in North America before 1800. It now ranges in the eastern portions of Canada and the United States.

Common buckthorn reproduces sexually. Fruits are dispersed by wildlife, and the plant is also spread through horticulture. Seedlings will invade apparently stable habitats where there are ample light and exposed soils. The plants will form thickets that create dense shade through lateral crown spread (Converse, 1984b).

Potentially successful control options for common buckthorn include mowing, girdling, excavation, underplanting, and chemical application. Repeated mowing maintains open areas to prevent seedling establishment, and can reduce vigor of existing plants. Girdling can successfully kill plants, and will not disrupt soil or affect non-target plants. Excavation has been recommended for low density areas, where root or soil disturbance will not promote recolonization. Chemicals such as glyphosate, fosamine, picloram, and 2,4-D may be effective for stump and wick application, mist application, frill application, and basal application, respectively. Establishment of common buckthorn may also be prevented by underplanting viable desirable species (Converse, 1984b).

Black Locust (*Robinia psuedoacacia*)

Black locust has extended beyond its natural range in the Appalachian and Ozark Mountains to areas throughout the world. The tree can grow up to 25 meters in height. Most reproduction occurs vegetatively through root suckering or stump sprouting. Black locust is most successful where it has room to grow, and its rapid growth allows it to out-compete other trees (Converse, 1984a).

The powerful potential for vegetative reproduction in black locust hinders the effectiveness of many control methods, as cutting or burning can stimulate root suckering or stump sprouting. Chemical control using glyphosate, picloram, AMS, triclopyr, or 2,4-D have demonstrated some success; however, plants can re-sprout years after treatment. Combinations of chemical treatment, burning, basal application, and plant removal have demonstrated varying degrees of success (Converse, 1984a).

C. Invasive Species Control in Phase 1 Areas

River Section 1 does not include large areas or monospecific stands of invasive plant species. In this river section, it is anticipated that controls will be implemented for small stands and isolated patches of invasive species. The following invasive species control program components are intended to operate in this context.

Controls During Dredging

As discussed above, many of the invasive species plants can spread via the dispersal of fragments of roots, rhizomes or stems, and/or seeds. The potential for such dispersal during dredging will be managed for each habitat as follows:

Aquatic Vegetation Beds

No invasive species have been identified in the aquatic vegetation beds within the areas to be dredged during Phase 1 or in the immediately adjacent areas. If invasive species do occur within the areas to be dredged, they are expected to be removed in their entirety by dredging.

Shorelines

As described in the *Phase 1 Final Design Report* (BBL, 2006), the shoreline is defined as the 119-foot elevation contour. As such, disturbance to terrestrial vegetation during dredging will be minimal and the inadvertent dispersal of invasive species is unlikely. Any invasive species that occur within the areas to be dredged are expected to be removed in their entirety by dredging. Stands or patches of invasive species identified adjacent to the areas to be dredged will be marked in the field and will be avoided, to the extent practicable, to minimize the potential for the displacement of invasive plant parts or fragments

Riverine Fringing Wetlands

Invasive species that occur within the riverine fringing wetlands to be dredged are expected to be removed in their entirety by dredging. Stands or patches of invasive species identified adjacent to the areas to be dredged will be marked in the field and will be avoided, to the extent practicable, to minimize the potential for the displacement of invasive plant parts or fragments.

Controls During Post-Remediation Adaptive Management

After habitat replacement and reconstruction has been completed for Phase 1, the presence of and dispersal by invasive plant species will be monitored as part of the Operations, Maintenance and Monitoring program. Invasive species control will be implemented as an adaptive management response under the following conditions:

1. If the frequency of occurrence (as a relative percent of total species observations) of invasive species in target areas is greater than the range of invasive species in the reference condition, invasive species control measures will be implemented. The reference condition is defined as the range of observations on invasive species occurrence in target and reference areas prior to dredging and in reference areas after dredging (subject to any adjustments to the reference condition, as described in Exhibit C to the Phase 1 AM Plan).

2. If FCIs that include invasive species information lag behind other FCIs in recovery trajectory, or fail to meet success criteria when others do, invasive species control will be evaluated as a component of adaptive management response and implemented as warranted.

As appropriate, adaptive response measures to be implemented in the above instances will be in accordance with the Aquatic Ecosystem Restoration Foundation (AERF) (2005) and New York State Department of Environmental Conservation (NYSDEC) (2005) and will include some or all of the following:

a) Continued monitoring: If invasive species are present but not spreading or thriving, continued monitoring will be conducted to document ongoing patterns of dispersal.

b) Hand harvesting: If appropriate and useful, hand-harvesting and disposal of limited areas of dense stands of invasive species will be considered.

c) Herbicide application: If appropriate and useful, herbicide application will be considered, and discussed with EPA.

d) Other methods as appropriate: A range of alternate control methods is available, including mechanical harvesting, burning, dye additions, isolation barriers, biological controls, and substrate amendments. Most of these are inappropriate for flowing waters or for small patches or scattered individuals of invasive species. However, should FCI success criteria be impeded by the presence of invasive species, all available control methods will be evaluated and considered for adaptive management response.

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