52-17

Survey for Submerged Aquatic Vegetation (SAV) and Other Aquatic Habitats

Mattaponi River
King William County, Virginia
WSSI #21931.01

Prepared for:
EA Engineering, Science and Technology
15 Loveton Circle
Sparks, Maryland 21152

September 13, 2010

Prepared by:

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Survey for Submerged Aquatic Vegetation (SAV) and Other Aquatic Habitat

Mattaponi River
King William County, Virginia
WSSI #21931.01

I. Introduction

Wetland Studies and Solutions, Inc. (WSSI) conducted a survey for submerged aquatic vegetation (SAV) and other aquatic habitats in a portion of the tidal Mattaponi River for a study area associated with the proposed Large Component Transport Route in King William County, Virginia.

II. Submerged Aquatic Vegetation Life History and Habitat Requirements

Submerged aquatic vegetation (SAV) refers to vascular plants that grow completely underwater or up to the water surface. The flowers of some species may protrude above the water surface, but at all other times the plant is completely submerged. Most SAV in the Chesapeake Bay Region grow between March and October (STAC, 2007), with peak biomass in the summer and fall depending on species (Moore et al., 1998). SAV can reproduce sexually using seeds and/or asexually by clonal growth and/or vegetatively via propagule production (STAC, 2007). SAV are considered important components to the Chesapeake Bay Region because they provide habitat for fish and shellfish; provide food for waterfowl, fish and mammals; absorb wave energy and nutrients; produce oxygen; improve water clarity; and stabilize bottom sediments (Batiuk et al., 2000).

In general, there is a strong positive correlation between water clarity and the depth to which SAV species grow (Dennison et al., 1993). In the Chesapeake Bay Region, SAV grows in areas of shallow water where light can penetrate at intensities sufficient to support photosynthesis, typically in water less than six feet deep (Hurley, 1990). However, outside of this region, in more transparent freshwater environments, SAV has been documented at much deeper depths (Chambers and Kalff, 1985). SAV establishment and growth depends mostly on light availability but also on several other factors including availability of propagules; suitable water quality, salinity, temperature, water depth and tidal range; suitable sediment quality, wave action and current velocity; and low enough levels of physical disturbance and toxic substances (Batiuk et al., 2000). The distribution, abundance, and species composition of SAV beds can vary from year to year, as well as from season to season depending on fluctuations in any of the factors listed above.

III. Regulation of Submerged Aquatic Vegetation and Other Aquatic Habitat in Virginia

SAV and other tidal aquatic habitat are regulated at both the federal and state levels. At the federal level, SAV and other tidal aquatic habitat are regulated under Section 404 of the Clean Water Act of 1977 (as amended, 1987). In the Section 404(b)(1) Guidelines, SAV is referred to as vegetated shallows, which are defined at 40 CFR part 230.43(a) as "permanently inundated areas that under normal circumstances support communities of rooted aquatic vegetation..." The definition also states that vegetated shallows may occur in marine and estuarine systems as well as in freshwater lakes and rivers. As vegetated shallows, SAV is regulated as one of several categories of "Special Aquatic Sites", each of which is a subset of Waters of the United States.

At the state level, SAV and other tidal aquatic habitats are regulated as Submerged Land under Title 28.2 of the Code of Virginia. In Virginia, the Virginia Marine Resource Commission (VMRC) has jurisdiction over the beds of tidal waterways below mean low water, and all non-tidal waterbodies

with a drainage basin of greater than 5 square miles. Permits are required from the VMRC to encroach upon or over such State-owned bottomlands.

IV. Historical Submerged Aquatic Vegetation Surveys in Study Area

Because of the ecological importance of SAV, numerous studies of the distribution and abundance of SAV in the Chesapeake Bay (including the Mattaponi River) have been conducted in recent years by the School of Marine Science at the Virginia Institute of Marine Science (VIMS). In each year, areas of SAV are mapped from black-and-white aerial photography and digitized. From these maps, the acreage and density of the SAV beds are determined.

In 1998, the Upper Mattaponi River was mapped for the first time in the history of the VIMS mapping, reporting 34.38 hectares of SAV (Orth et al. 1999). The Upper Mattaponi River was not flown in 1999 due to poor atmospheric conditions resulting from hurricanes Dennis and Floyd and an early, possibly salinity-related, die-off in freshwater SAV species (Orth et al. 2000). However, ground surveys by VIMS personnel did show SAV in the same locations as shown in the 1998 photography. In 2000 – 2002, the Upper Mattaponi River was flown, but no SAV was mapped in the vicinity of the study area (Orth et al. 2001-2003). However, in 2003, a substantial increase in SAV coverage was observed (Orth et al. 2004). This coverage continued to be observed in subsequent years (Orth et al. 2005-2009).

The results of the VIMS mapping for the Mattaponi River in the vicinity of the study area in for the years 1998 through 2008 (Orth et al. 1999-2009) are included as Exhibit 4a-k. This mapping documented SAV beds within or in the vicinity of the study area. Species documented include coontail (*Ceratophyllum demersum*), common elodea (*Elodea canadensis*), water stargrass (*Heteranthera dubia*), hydrilla (*Hydrilla verticillata*), southern naiad (*Najas guadalupensis*), unknown naiad (*Najas* sp.), muskgrass (*Nitella* sp.), widgeon grass (*Ruppia maritima*), and water celery (*Vallisneria americana*).

V. Study Area

The study area is for the proposed Large Component Transport Route project. The study area includes approximately 4.3 acres of submerged land and immediately adjacent shoreline along the Mattaponi River in King William County, Virginia. The Walkerton Landing Road bridge over the Mattaponi River marks the western boundary of the study area. Exhibit 1 is a vicinity map that shows the boundaries of the study area and its general location.

VI. Survey Methodology

The survey was conducted on September 8, 2010 by Sean D. Sipple, PWS, PWD, CT, CE[1], Brian Gottfried, SIT[2], and Matthew Hazzard, SIT. Fieldwork began at approximately 8 AM, at low tide, to maximize visibility of SAV and other habitats. The SAV survey methodology included a combination of visual observation of SAV from a jon boat and dragging a double-sided rake along the bottom to collect SAV. Visual observations from the boat were used to determine the boundaries of differing densities of SAV cover, including "Dense" and "Sparse" beds. "Dense" vegetative cover was

[1] *Professional Wetland Scientist #1730, Society of Wetlands Scientists Certification Program, Inc.; Virginia Certified Professional Wetland Delineator #3402-000096; North American Benthological Society (NABS) Certified Level 1 Taxonomist: All Phyla; NABS Certified Level 2 Taxonomist: EPT Taxa (Ephemeroptera, Plecoptera, Trichoptera); Ecological Society of America Certified Ecologist.*

[2] *Surveyor in Training, Virginia Department of Professional and Occupational Regulations.*

categorized as having an average of 0 to 5 feet of space between SAV clumps. SAV with an average of 5 feet or greater between clumps were considered "Sparse" density vegetative cover. Representative photographs of observed densities can be seen in Exhibit 5. Other aquatic habitats were identified and categorized using the VMRC Wetland Guidelines (VMRC 1993). Boundaries of different habitat types were survey-located upon field observation. These boundaries can be seen on the Submerged Aquatic Vegetation (SAV) and Other Aquatic Resource Location Map (Exhibit 2).

VII. Survey Results and Discussion

The results of the survey indicate that six different types of SAV and other aquatic habitats are present within the study area. These habitats include dense SAV beds, sparse SAV beds, dense SAV/mixed flat community, sparse SAV/yellow pondlilly community, mixed freshwater community, and intertidal beach community. These habitats are described in detail below. The remainder of the study area did not contain such habitats and is characterized by Photo #10.

A. Dense SAV Beds – these areas totaled 0.49 acres of the study area and were dominated by hydrilla (*Hydrilla verticillata*) and water celery (*Vallisneria americana*), with a relative cover of 90% and 10% respectively. Hydrilla and water celery are common and well documented in the Mattaponi River (VIMS 1999-2009). Photo #1 characterizes the dense SAV beds within the study area. Photo #2 shows hydrilla collected using the SAV rake from a dense bed on the southern portion of the study area.

B. Sparse SAV Beds – these areas totaled 0.18 acres of the study area and were dominated by hydrilla and water celery, with a relative cover of 20% and 80% respectively. Photo #3 shows water celery collected using the SAV rake from a sparse bed on the southern portion of the study area.

C. Dense SAV/Mixed Flat Community (VMRC Type XV) – these areas totaled 0.05 acres and were dominated by hydrilla. Areas not rooted with hydrilla consisted of mixed sand and mud flats (VMRC Type XV community) dominated by clams, snails, aquatic worms, and crustaceans. Photo #8 characterizes the dense SAV/mixed flat community within the study area.

D. Sparse SAV/Yellow Pondlilly Community (VMRC Type IX) – these areas totaled 0.29 acres and were dominated by hydrilla and yellow pondlilly (*Nuphar luteum*), but also included pickerel weed (*Pontederia cordata*), sweet flag (*Acorus calamus*), wild rice (*Zizania aquatica*), american three-square (*Scirpus americanus*), rice cutgrass (*Leersia oryzoides*), swamp smartweed (*Polygonum hydropiperoides*), golden club (*Orontium aquaticum*), and sneezeweed (*Helenium autumnale*). Areas with yellow pondlilly match the VMRC Type IX community. Photo #6 characterizes the sparse SAV/yellow pondlilly community within the study area.

E. Mixed Freshwater Community (VMRC Type XI) – these areas totaled 0.17 acres and were dominated by wild rice (*Zizania aquatic*) and swamp smartweed, but also included hydrilla, arrow-leaf tearthumb (*P. sagittatum*), pickerel weed, Walter's millet (*Echinochloa walteri*), swamp rosemallow (*Hibiscus moscheutos*), and Asiatic dayflower (*Murdannia keisak*). Photo #7 characterizes the mixed freshwater community within the study area.

F. Intertidal Beach Community (VMRC Type XIII) – these areas totaled 0.06 acres and consisted of wave-washed shoreline inhabited by crustaceans and aquatic worms. Photo #9 characterizes the intertidal beach community within the study area.

Analysis of historical aerial photography (Exhibit 3a-e) and VIMS surveys (Exhibit 4a-k) indicates that SAV was historically present within and adjacent to the study area. Although the historical VIMS surveys documented a diverse mixture of freshwater species in the past (Orth et al. 1999-2009), it is clear that hydrilla, a highly invasive exotic species, has become much more prevalent in this area over recent years and displaced the native populations. This is consistent with our observation of extremely high densities on the southern portion of the study area.

VIII. Limitations

This study is based on examination of the conditions within the study area at the time of our review and does not address conditions in the future. The distribution, abundance, and species composition of SAV beds and other aquatic habitats can vary from year to year, as well as from season to season depending on fluctuations in environmental factors. Such conditions change over time. Therefore, our conclusions may vary from future observations. Our survey and report have been prepared in accordance with generally accepted guidelines for the conduct of such evaluations. We make no other warranties, either expressed or implied, and our report is not a recommendation to buy, sell or develop the property.

We offer no opinion and do not purport to opine on the possible application of various building codes, zoning ordinances, other land use or platting regulations, environmental or health laws and other similar statutes, laws, ordinances, code and regulations affecting the possible use and occupancy of the Property for the purpose for which it is being used, except as specifically provided above. The opinions set forth herein are rendered only and exclusively for the benefit of the addressees and no other parties, successors or assigns. The foregoing opinions are based on applicable laws, ordinances, and regulations in effect as of the date hereof and should not be construed to be an opinion as to the matters set out herein should such laws, ordinances or regulations be modified, repealed or amended.

This document is solely for your benefit and is not to be quoted in whole or in part or otherwise referred to in any statement or document (except for purposes of identification) nor is it to be filed with any governmental agency or other person, without the prior written consent of this firm, unless required by law.

This report does not constitute a waters of the U.S. delineation or jurisdictional determination of waters of the U.S. since only an evaluation of aquatic habitat was undertaken and such determinations must be verified by the U.S. Army Corps of Engineers or the Natural Resources Conservation Service (as applicable), and are subject to review by the U.S. Environmental Protection Agency.

WETLAND STUDIES AND SOLUTIONS, INC.

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Mark Headly, PWS, PWD, LEED® AP
Executive Vice President

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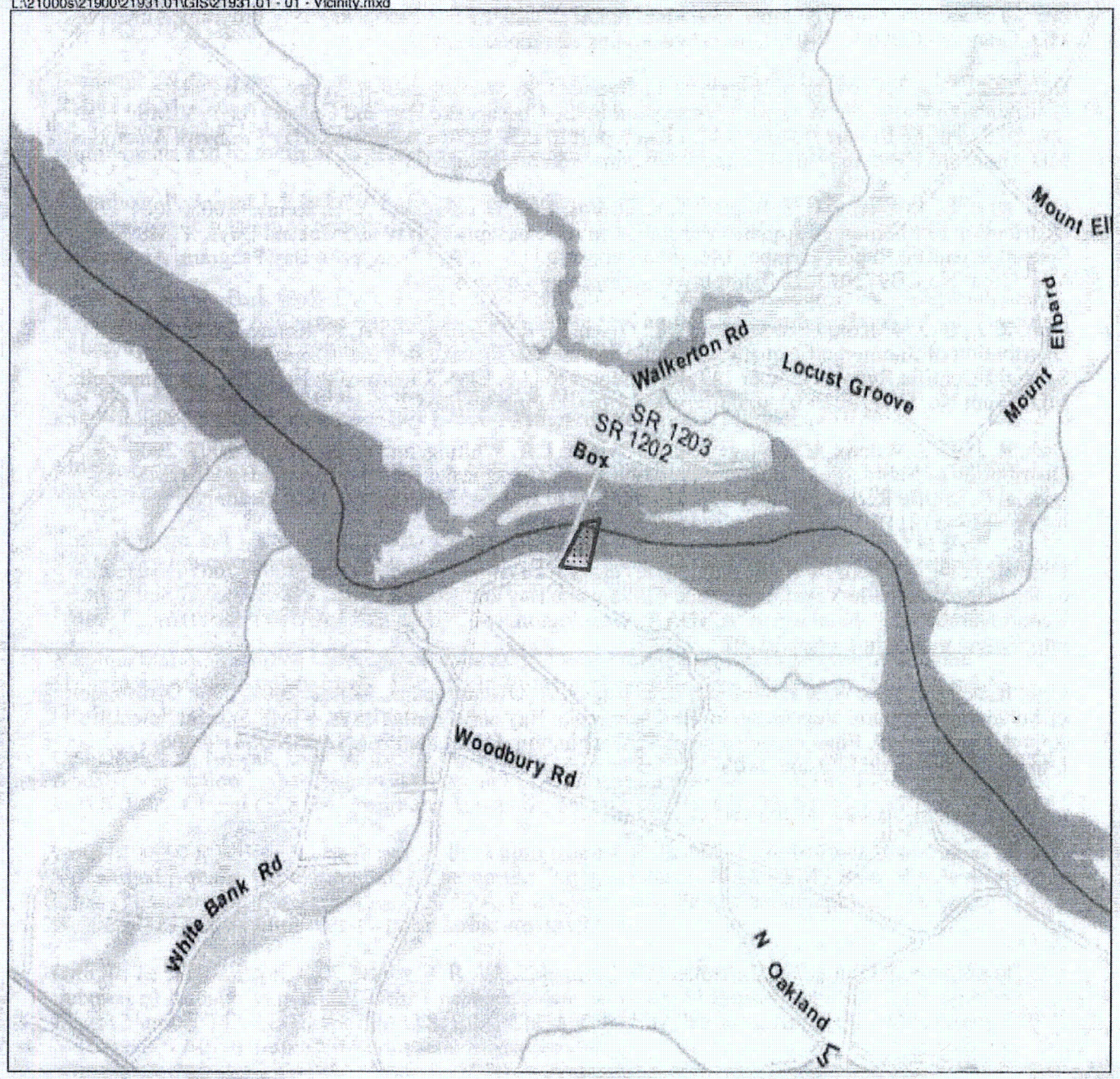
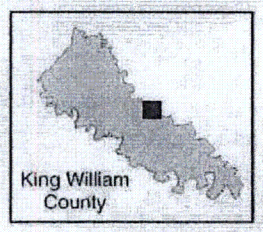
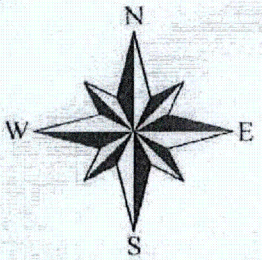


Map Source: 2008 ESRI Street Map

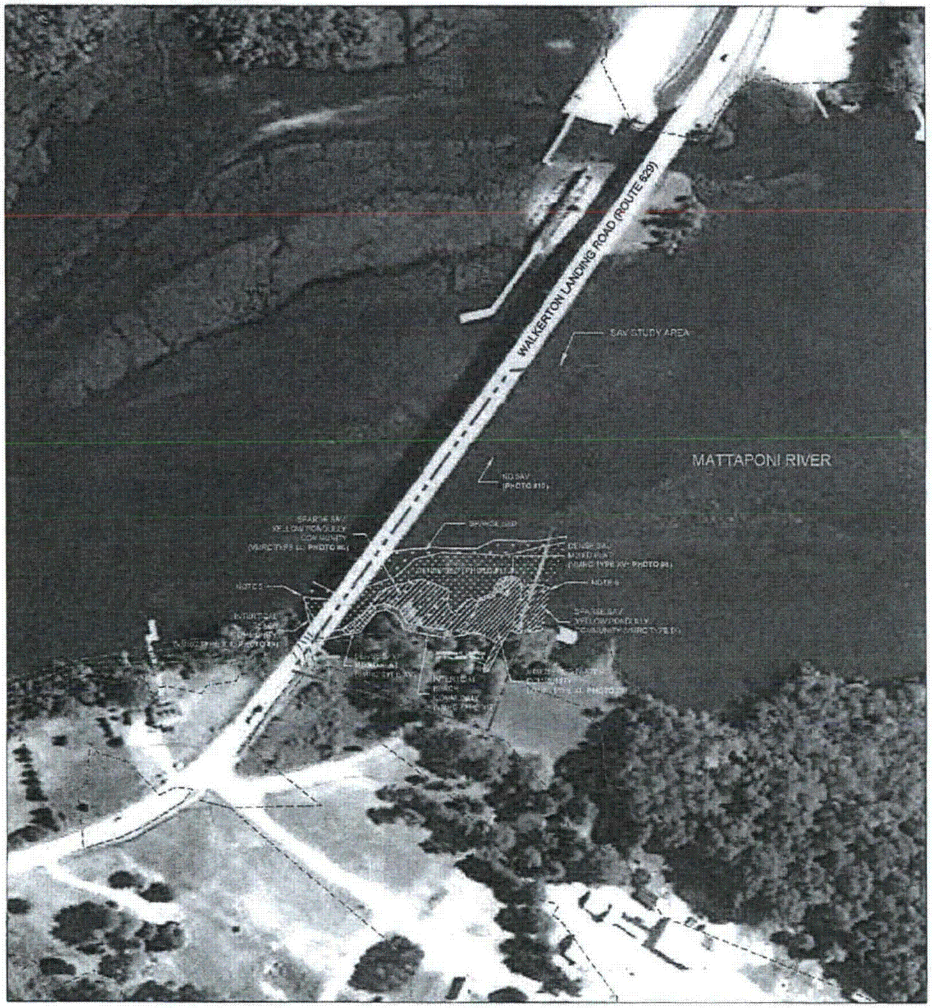


Vicinity Map
Mattaponi River SAV Survey
WSSI #21931.01
Scale: 1" = 2000'



Wetland Studies and Solutions, Inc.

Exhibit 1



LEGEND

- STUDY AREA
- SPARSE SAV BED
- DENSE SAV BED
- SPARSE SAV/YELLOW PONDLILY COMMUNITY (VMRC TYPE IX)
- DENSE SAV/MIXED FLAT COMMUNITY VMRC TYPE XV)
- MIXED FRESHWATER MARSH COMMUNITY (VMRC TYPE XI)
- INTERTIDAL BEACH COMMUNITY (VMRC TYPE XIII)

ESTIMATED AREAS OF AQUATIC HABITATS WITHIN THE MATTAPONI RIVER STUDY AREA*

AQUATIC HABITAT TYPE	AREA SURVEYED	
	(SQUARE FEET)	(ACRE)
SPARSE SAV	7,853	0.18
DENSE SAV	21,300	0.49
DENSE SAV MIXED FLAT COMMUNITY	2,190	0.05
SPARSE SAV YELLOW PONDLILY	12,442	0.29
MIXED FRESHWATER COMMUNITY	7,440	0.17
INTERTIDAL BEACH COMMUNITY	2,600	0.06
TOTAL	53,330	1.24

* These numbers are based on the surveyed locations of the delineated aquatic habitat boundaries within the study area.

SUBMERGED AQUATIC VEGETATION SURVEY NOTES:

1. Wetland Studies and Solutions, Inc. (WSSI) conducted a survey of submerged aquatic vegetation (SAV) and other aquatic habitats in a portion of the Mattaponi River for a study area associated with the proposed Large Component Transport Route in King William County, Virginia.

2. The survey was conducted on September 8, 2010 by Sean D. Sipple, PWS, PWD, CT, CE, Brian Gottfried, SIT, and Matthew Hazzard, SIT.

3. The SAV survey methodology included a combination of visual observation of SAV from a jon boat and dragging a double-sided rake along the bottom to collect SAV. Visual observations from the boat were used to determine the boundaries of differing densities of SAV cover, including "Dense" and "Sparse" beds. "Dense" vegetative cover was categorized as having an average of 0 to 5 feet of space between SAV clumps. SAV with an average of 5 feet or greater between clumps were considered "Sparse" density vegetative cover. Other aquatic habitats were identified and categorized using the VMRC Wetland Guidelines (VMRC 1993).

4. The following SAV and aquatic habitats were identified during this study, as depicted on this exhibit:

   A. Dense SAV Beds - these areas totaled 0.49 acres of the study area and were dominated by hydrilla (*Hydrilla verticillata*) and water celery (*Vallisneria americana*), with a relative cover of 90% and 10% respectively. Hydrilla and water celery are common and well documented in the Mattaponi River (Carter et al., 1983).

   B. Sparse SAV Beds - these areas totaled 0.18 acres of the study area and were dominated by hydrilla and water celery, with a relative cover of 20% and 80% respectively.

   C. Dense SAV/Mixed Flat Community (VMRC Type XV) - these areas totaled 0.05 acres and were dominated by hydrilla. Areas not rooted with hydrilla consisted of mixed sand and mud flats (VMRC Type XV community) dominated by clams, snails, aquatic worms, and crustaceans.

   D. Sparse SAV/Yellow Pondlily Community (VMRC Type IX) - these areas totaled 0.29 acres and were dominated by hydrilla and yellow pondlily (*Nuphar luteum*), but also included pickerel weed (*Pontederia cordata*), sweet flag (*Acorus calamus*), wild rice (*Zizania aquatica*), american three-square (*Scirpus americanus*), rice cutgrass (*Leersia oryzoides*), swamp smartweed (*Polygonum hydropiperoides*), golden club (*Orontium aquaticum*), and sneezeweed (*Helenium autumnale*). Areas with yellow pondlily match the VMRC Type IX community.

   E. Mixed Freshwater Community (VMRC Type XI) - these areas totaled 0.17 acres and were dominated by wild rice and swamp smartweed, but also included hydrilla, arrow-leaf tearthumb (*P. sagittatum*), pickerel weed, Walter's millet (*Echinochloa walteri*), swamp rosemallow (*Hibiscus moscheutos*), and Asiatic dayflower (*Murdannia keisak*).

   F. Intertidal Beach Community (VMRC Type XIII) - these areas totaled 0.06 acres and consisted of wave-washed shoreline inhabited by crustaceans and aquatic worms.

5. This mapped habitat area continues outside of the study area.

6. This map has been oriented to the Virginia Coordinate System of 1983, South Zone, using real time DGPS. SAV and other aquatic habitat shown were located in the field using conventional survey methods. Field locations were completed on September 8, 2010.

7. 5-foot topographic information obtained from King William County Digital Data, study area information obtained from Dominion Resources, and May 2008 Natural Color Imagery obtained from the National Agricultural Imagery Program (NAIP) were used as a base for this attachment.

8. This survey does not constitute a waters of the U.S. delineation or jurisdictional determination of waters of the U.S. since only an evaluation of aquatic habitat was undertaken and such determinations must be verified by the U.S. Army Corps of Engineers or the Natural Resources Conservation Service (as applicable), and are subject to review by the U.S. Environmental Protection Agency.

Exhibit 2:
SUBMERGED AQUATIC VEGETATION (SAV) AND OTHER AQUATIC HABITATS LOCATION MAP
Prepared For: EA Engineering, Science and Technology
MATTAPONI RIVER
KING WILLIAM COUNTY, VIRGINIA

REVISIONS

No.	Date	Description	Rev. By	App. By

DATE: SEPTEMBER 2010 | SCALE: 1" = 100'

Horizontal Datum: VCS NAD 83
Vertical Datum: Unknown
Boundary and Topo Source: Dominion Resources; King William County Digital Data

Design	Draft	Approved
SDS	SDS	MH

Sheet # 1 of 1

Computer File Name:

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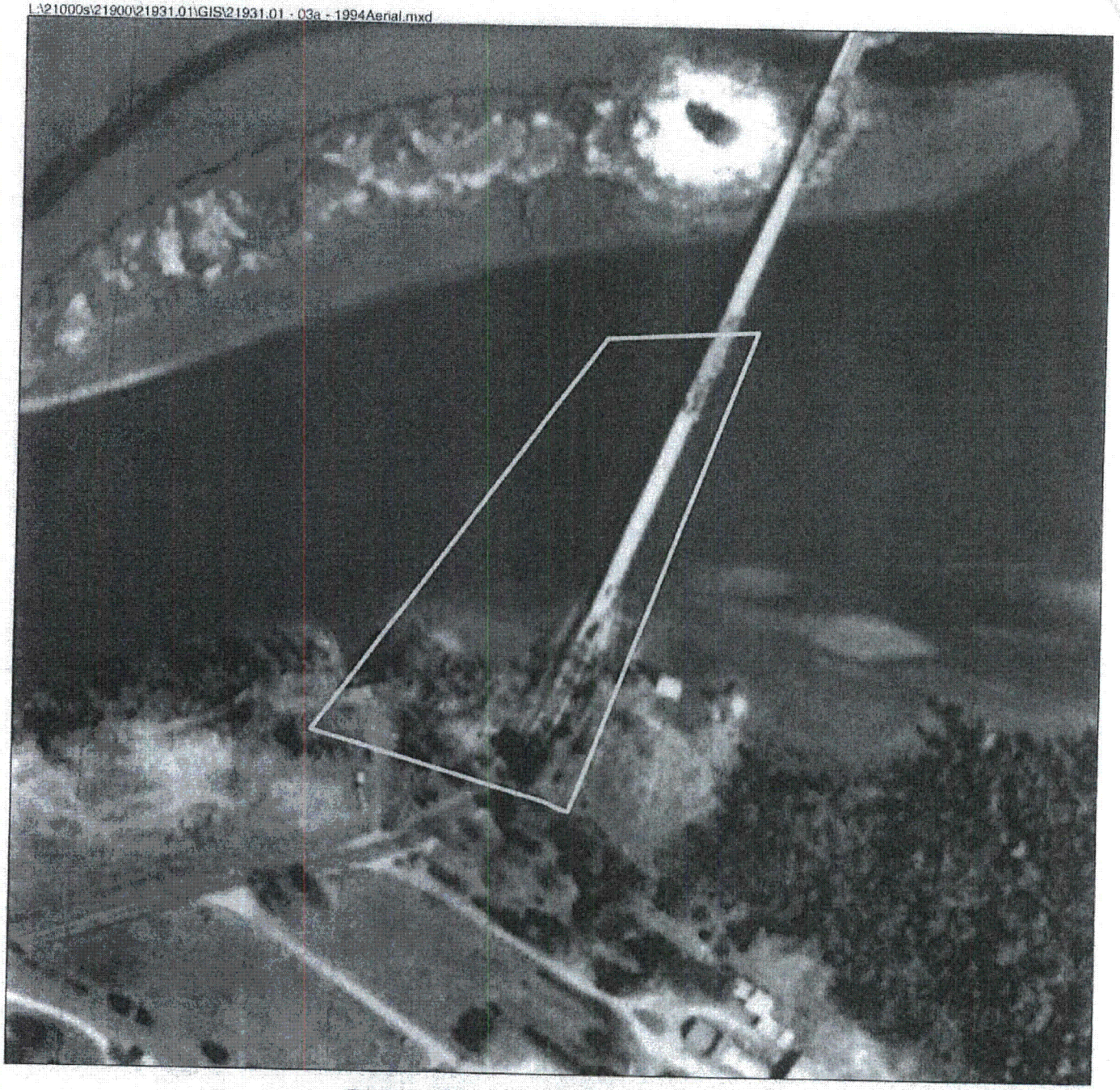
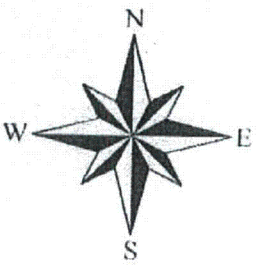


Spring 1994 Color Infrared Imagery
Mattaponi River SAV Survey
WSSI #21931.01
Scale: 1" = 200'



Source: USGS Digital Orthophoto Quarter Quadrangle

Wetland Studies and Solutions, Inc.

Exhibit 3a

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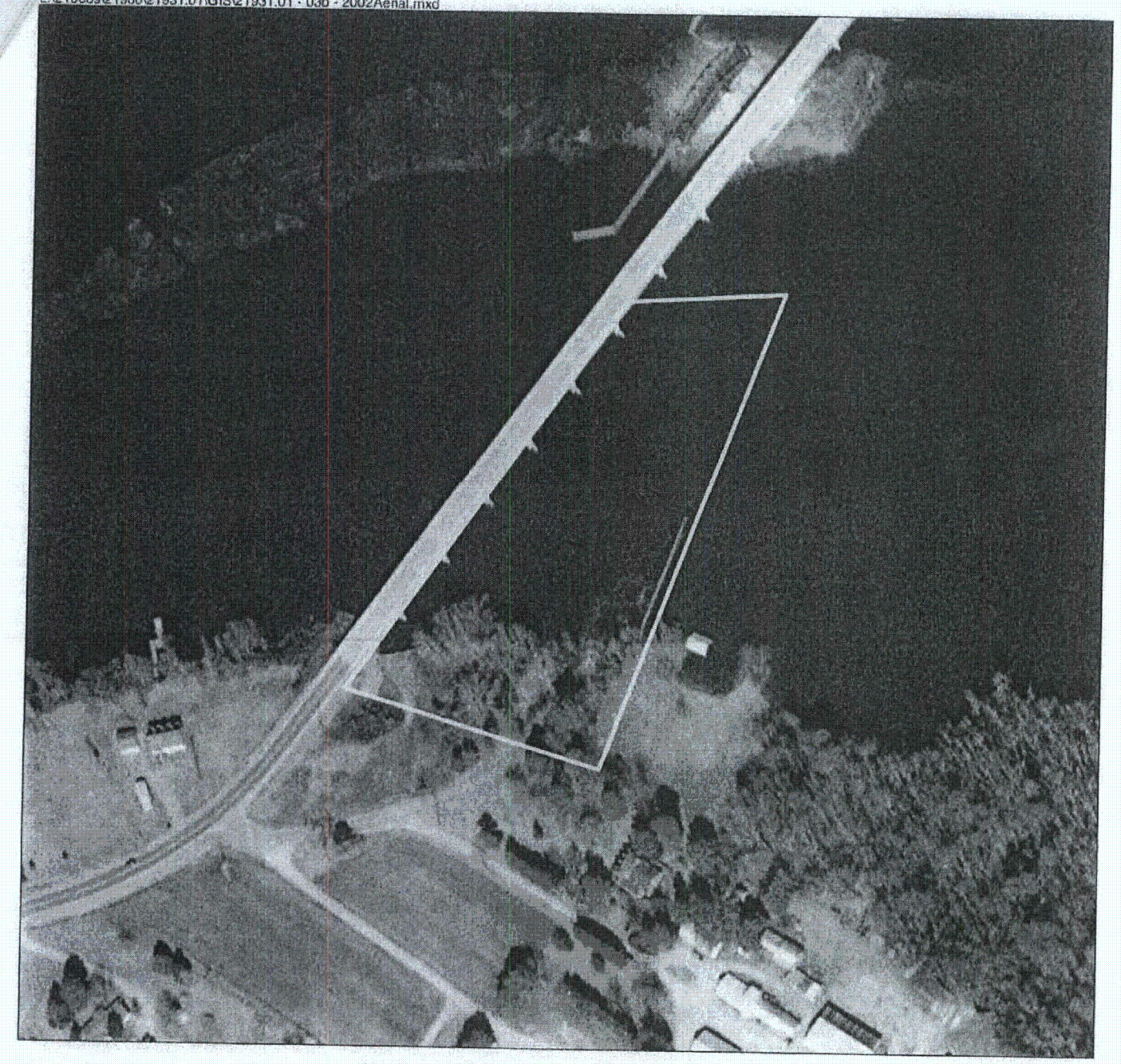
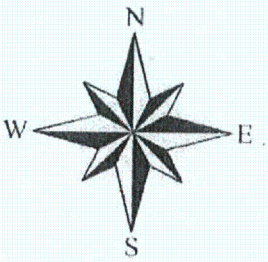


Spring 2002 Natural Color Imagery
Mattaponi River SAV Survey
WSSI #21931.01
Scale: 1" = 200'



Source: 2002 VGIN Natural Color Imagery

Wetland Studies and Solutions, Inc.

Exhibit 3b

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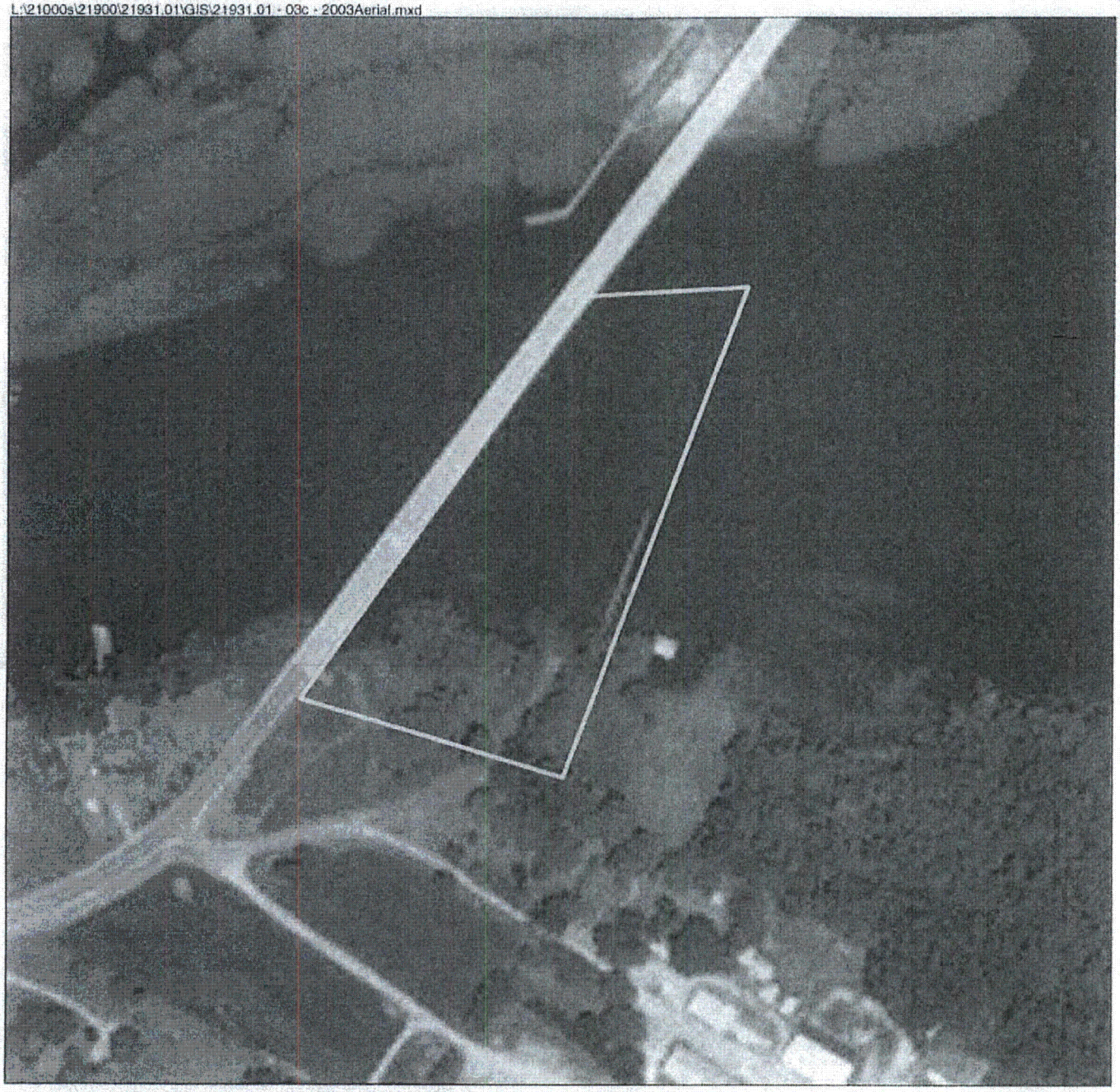
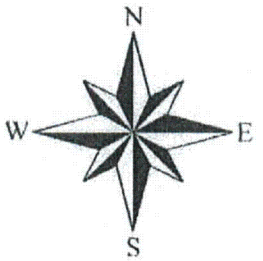
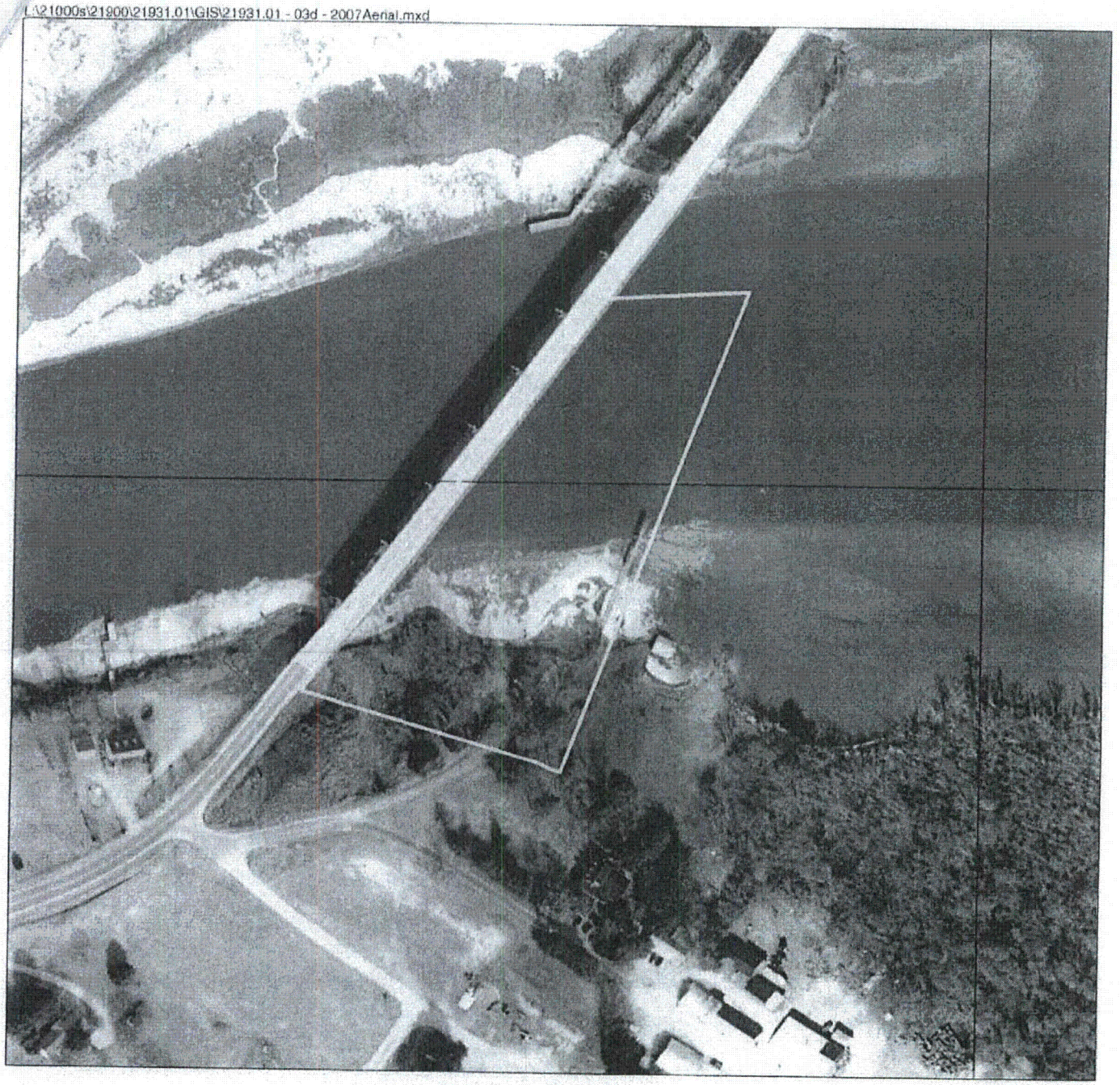


Summer 2003 Natural Color Imagery
Mattaponi River SAV Survey
WSSI #21931.01
Scale: 1" = 200'

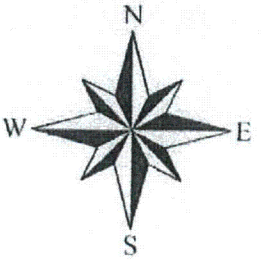


Source: NAIP

I:\21000s\21900\21931.01\GIS\21931.01 - 03d - 2007Aerial.mxd

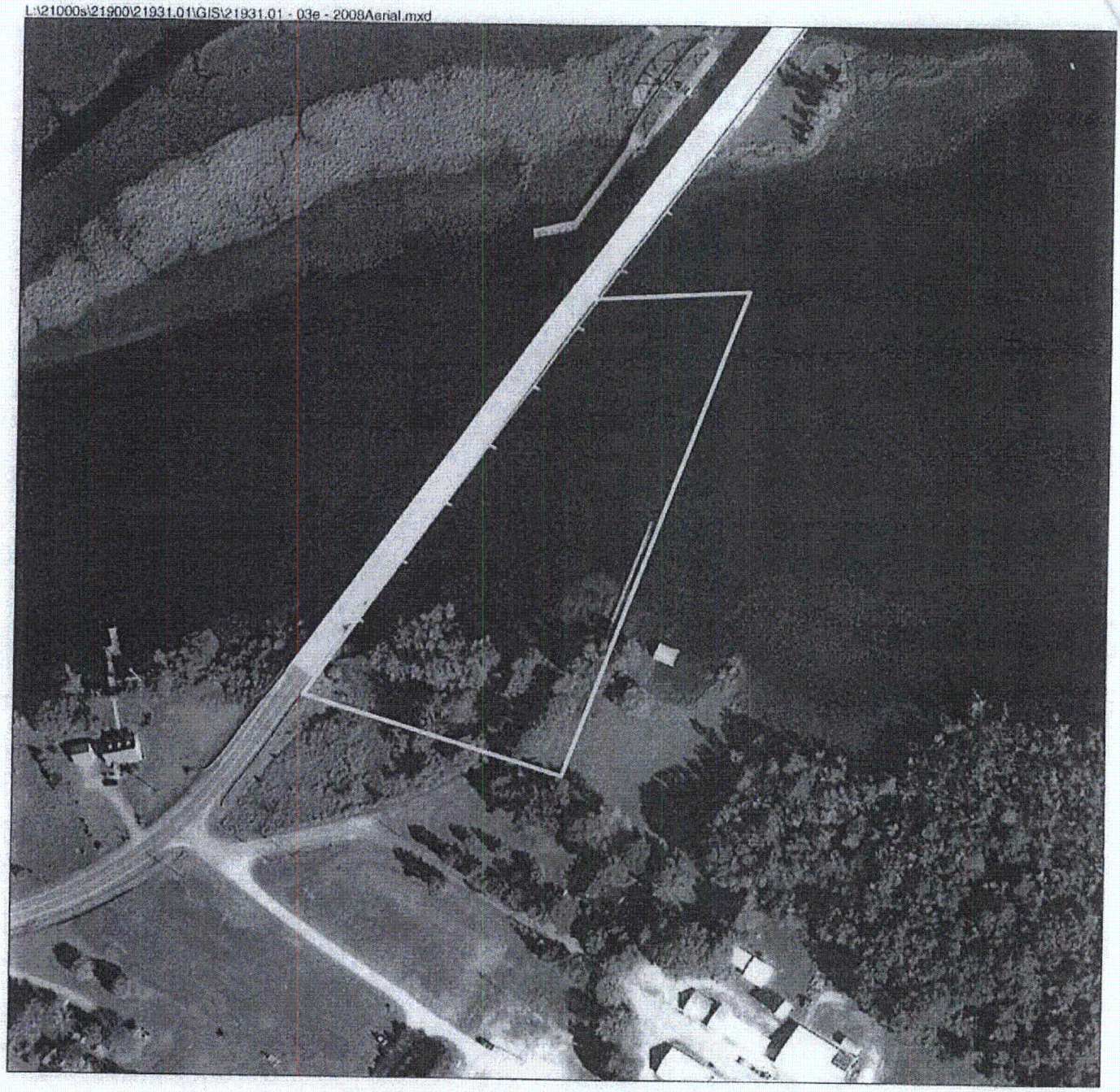


Spring 2007 Natural Color Imagery
Mattaponi River SAV Survey
WSSI #21931.01
Scale: 1" = 200'

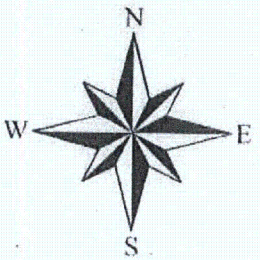


Source: 2007 VGIN Natural Color Imagery

L:\21000s\21900\21931.01\GIS\21931.01 - 03e - 2008Aerial.mxd



October 2008 Natural Color Imagery
Mattaponi River SAV Survey
WSSI #21931.01
Scale: 1" = 200'



Source: ESRI ArcGIS online

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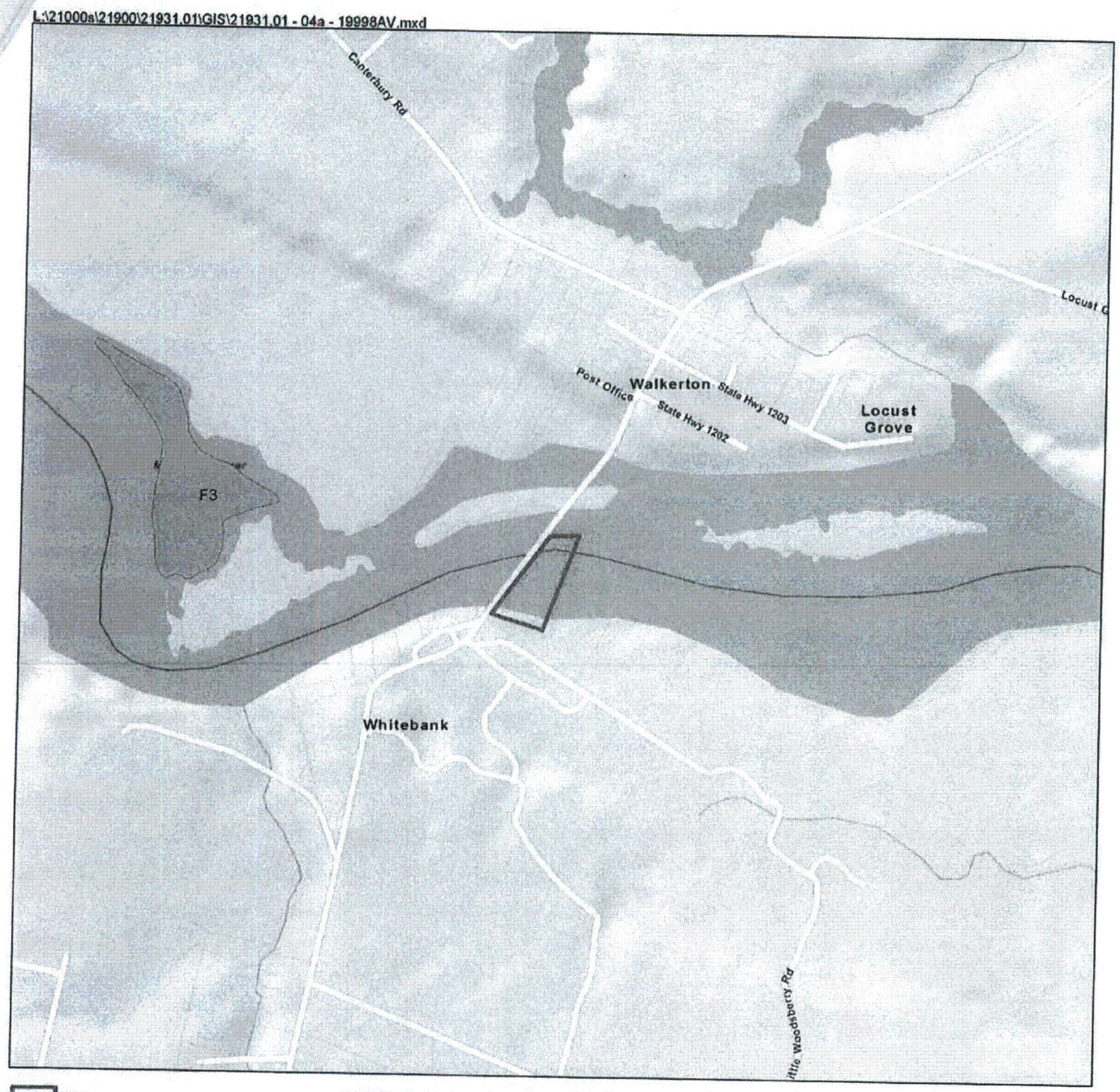

Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

1998 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

N
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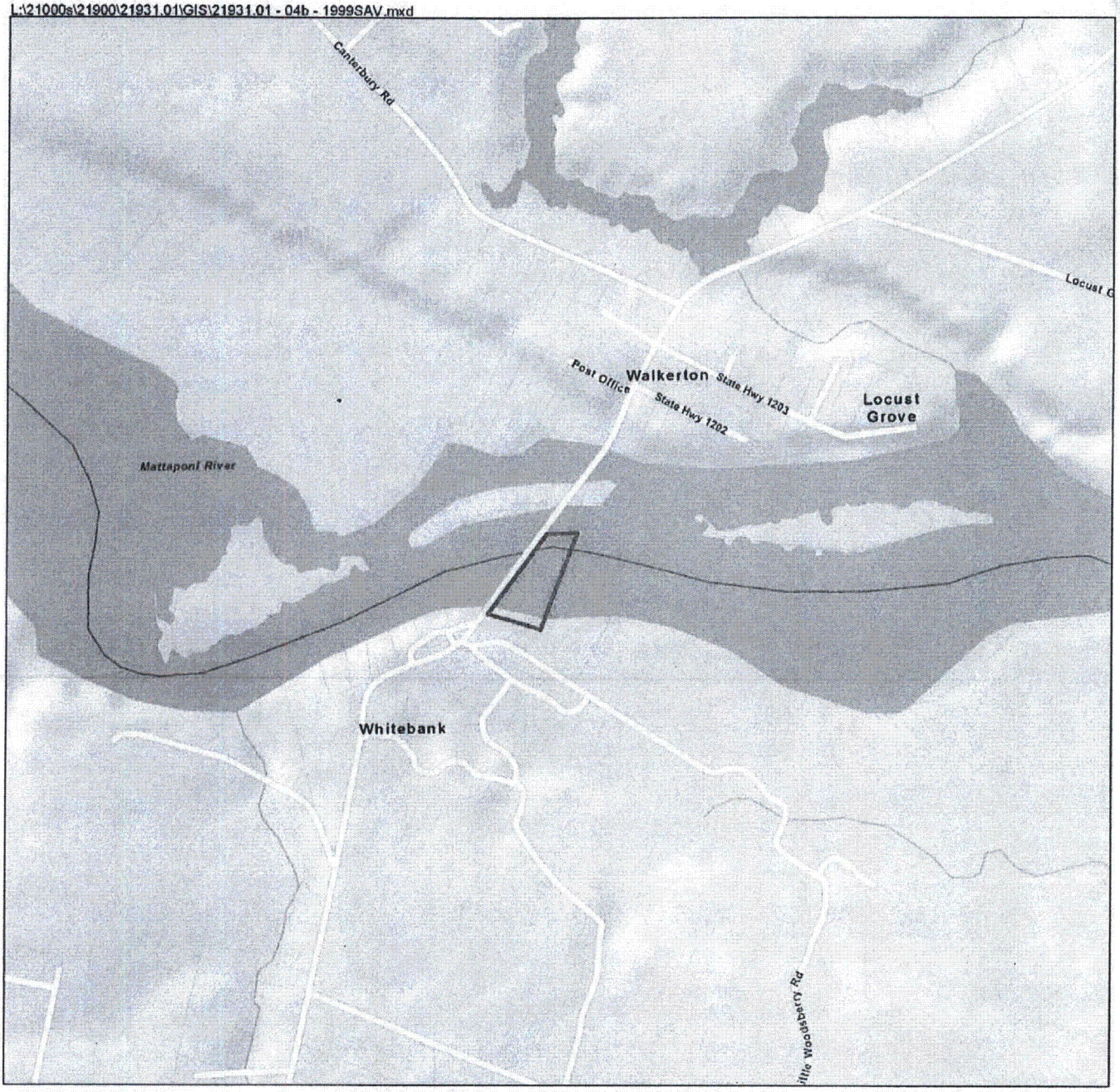
S

SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

Wetland Studies and Solutions, Inc.

Exhibit 4a

L:\21000s\21900\21931.01\GIS\21931.01 - 04b - 1999SAV.mxd



Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

1999 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

N
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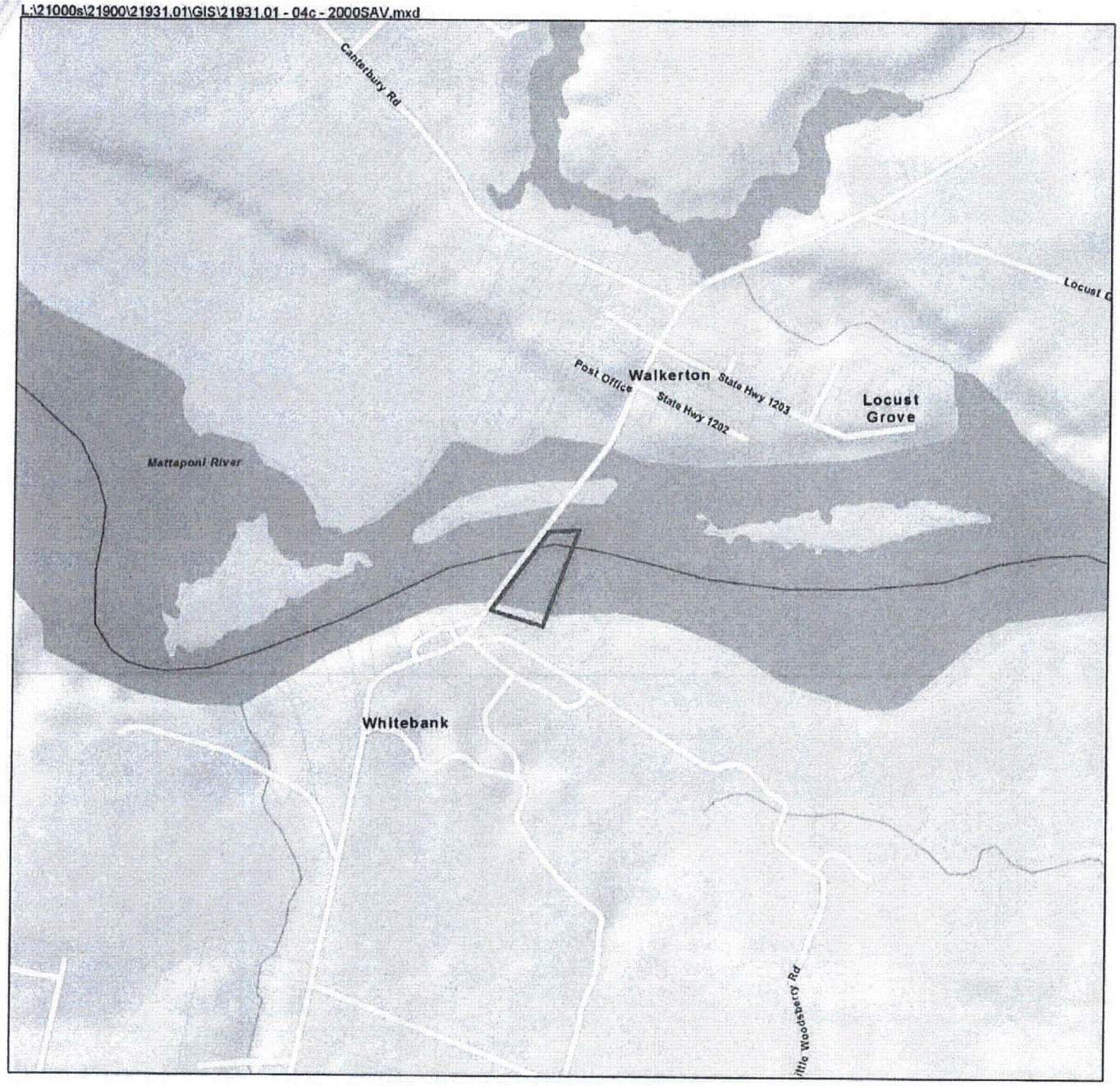
SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

Wetland Studies and Solutions, Inc.

Exhibit 4b

L:\21000s\21900\21931.01\GIS\21931.01 - 04c - 2000SAV.mxd



Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

2000 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

N
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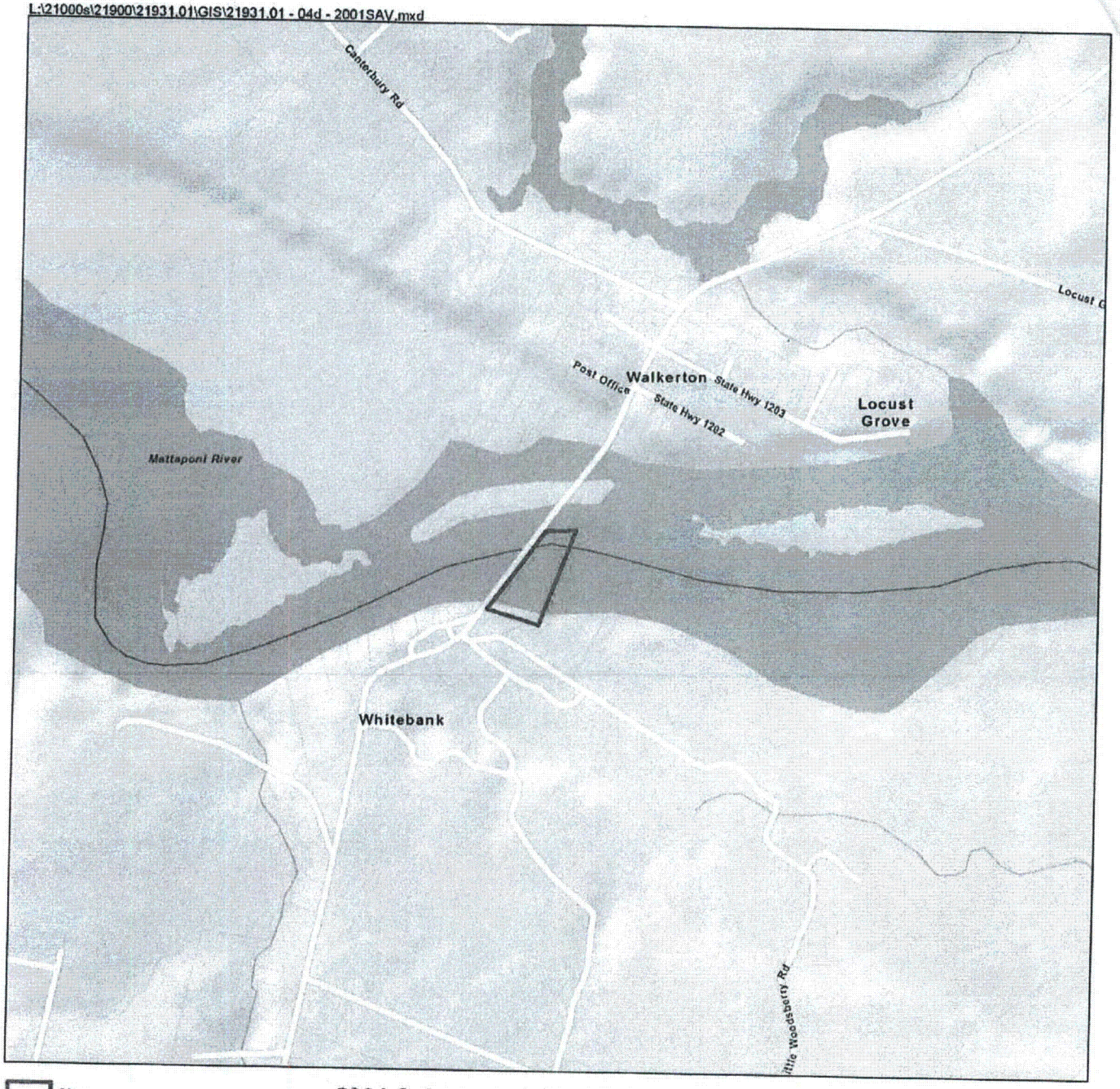
SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

Wetland Studies and Solutions, Inc.

Exhibit 4c

L:\21000s\21900\21931.01\GIS\21931.01 - 04d - 2001SAV.mxd



Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

2001 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

N
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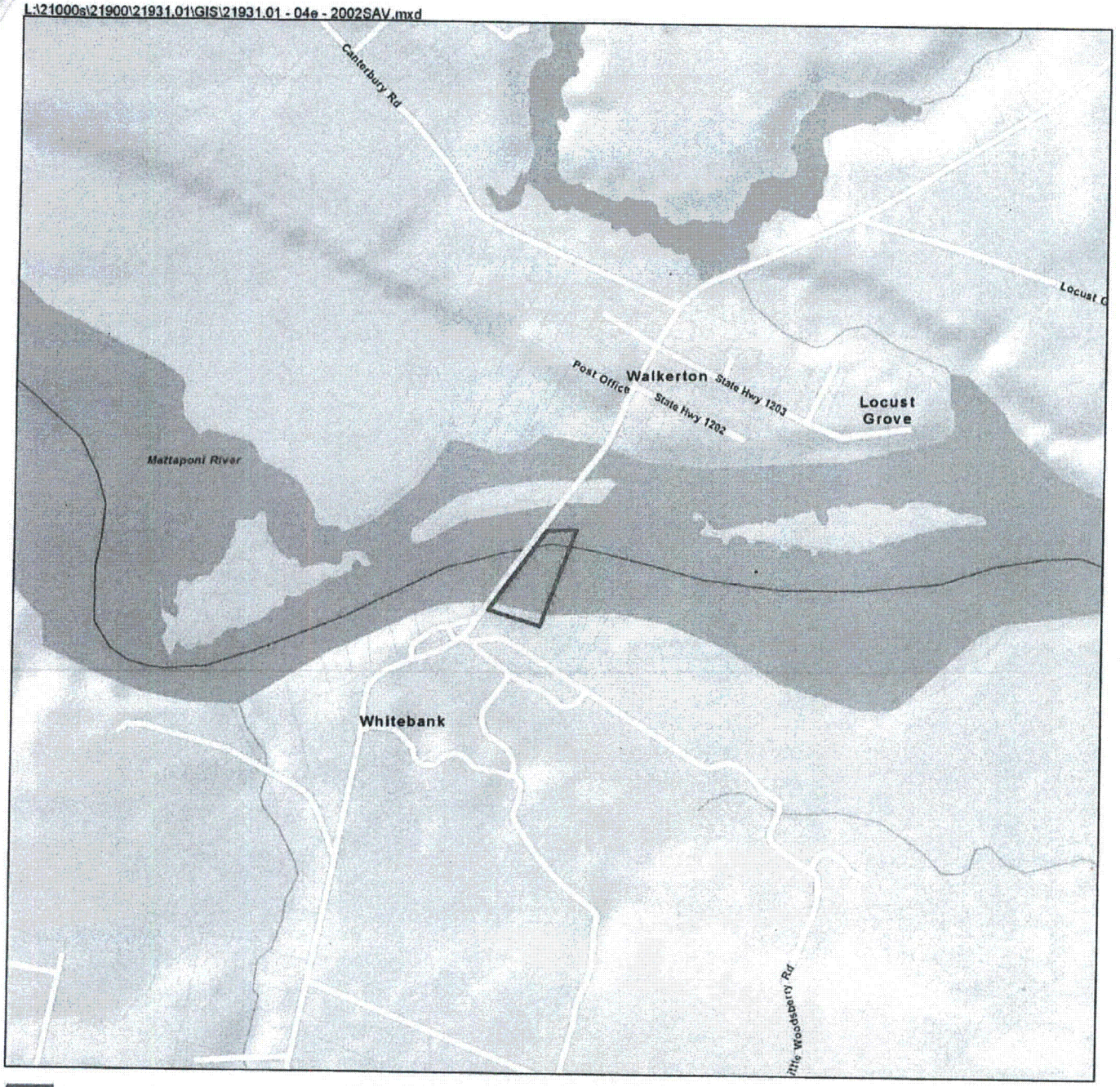
SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

Wetland Studies and Solutions, Inc.

Exhibit 4d

L:\21000s\21900\21931.01\GIS\21931.01 - 04e - 2002SAV.mxd



Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

2002 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

N
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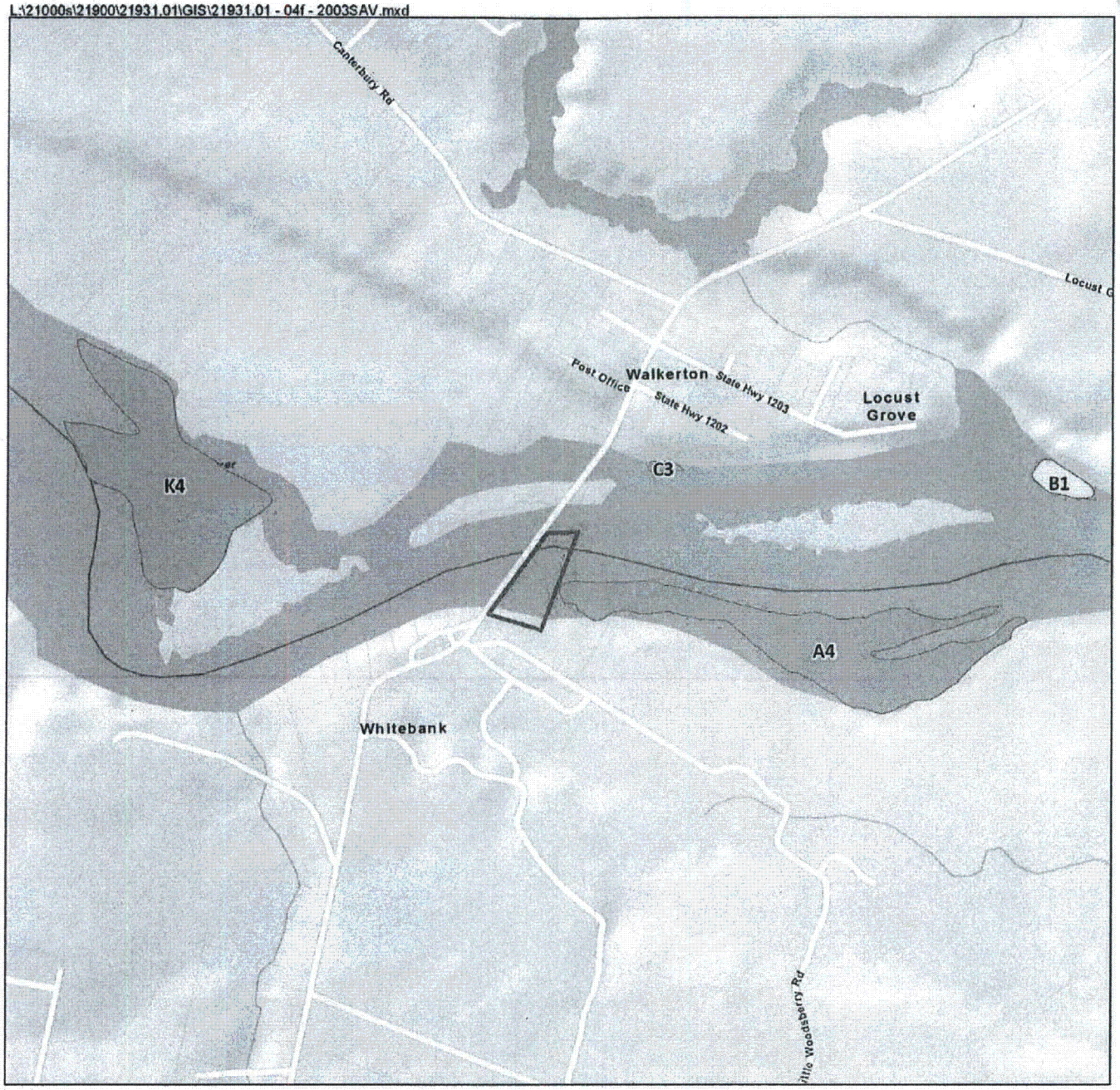
SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

Wetland Studies and Solutions, Inc.

Exhibit 4e

L:\21000s\21900\21931.01\GIS\21931.01 - 04f - 2003SAV.mxd



Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

2003 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

N
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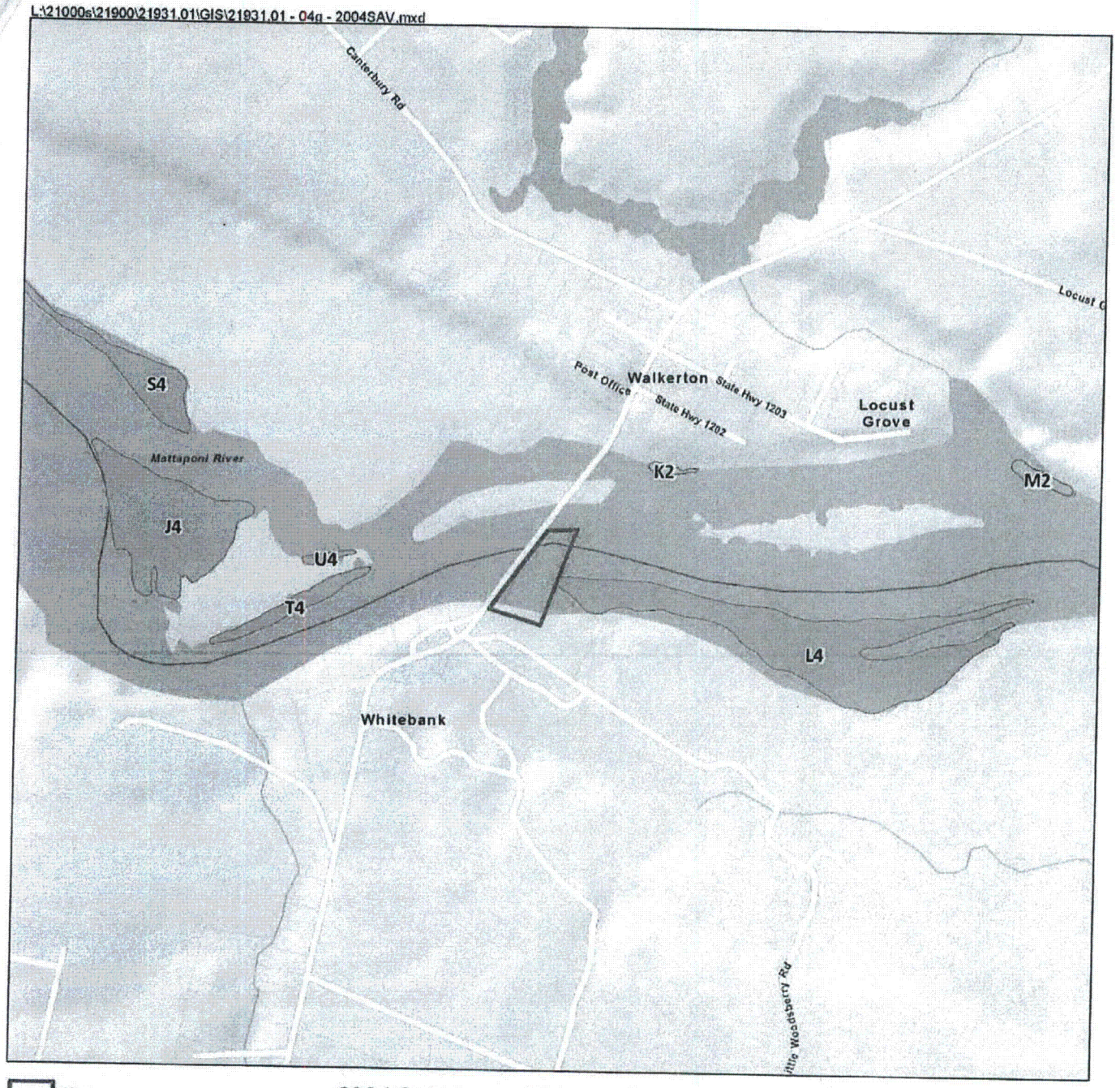
SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

Wetland Studies and Solutions, Inc.

Exhibit 4f

L:\21000s\21900\21931.01\GIS\21931.01 - 04g - 2004SAV.mxd



Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

2004 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

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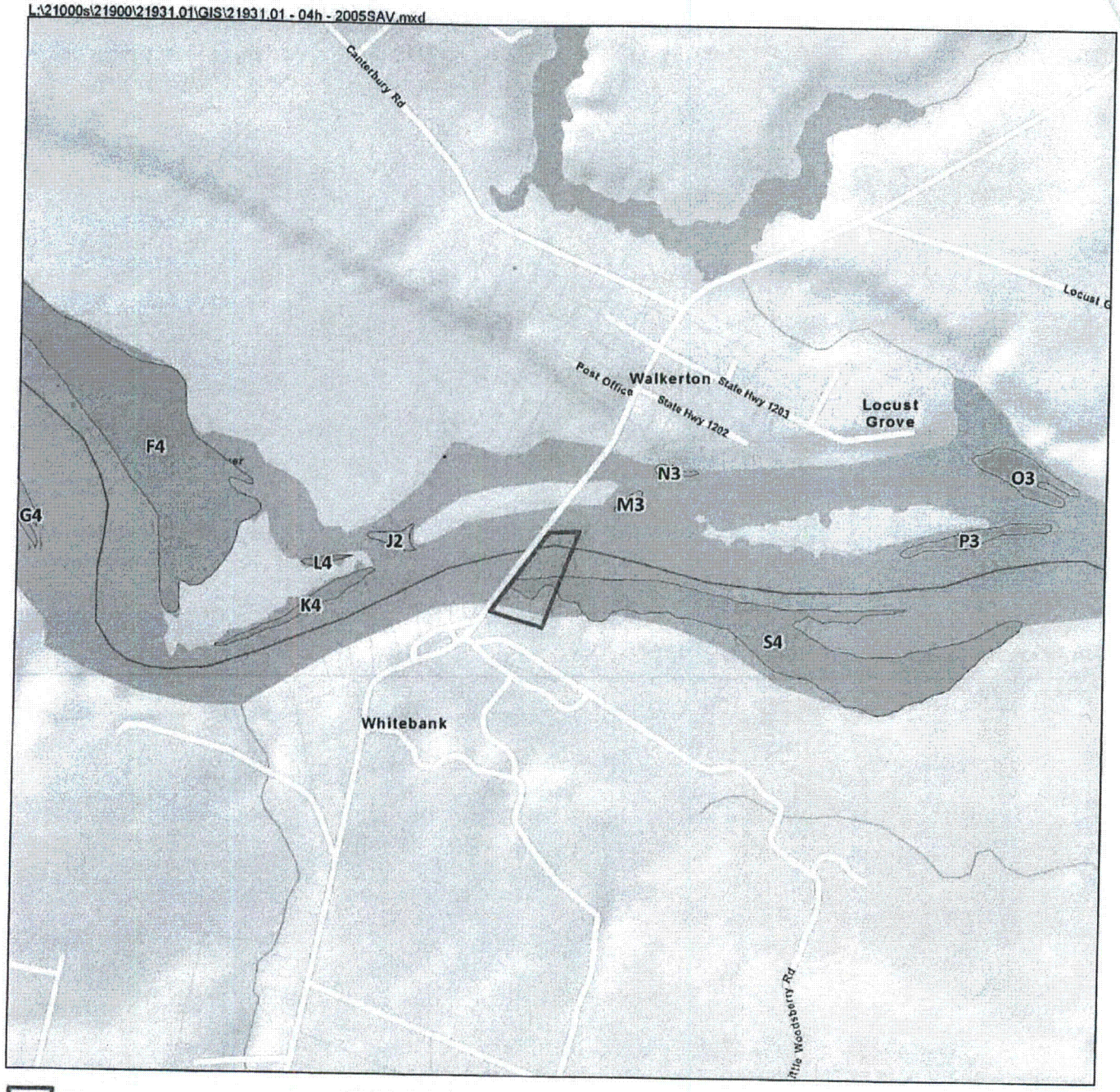
SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

Wetland Studies and Solutions, Inc.

Exhibit 4g

L:\21000s\21900\21931.01\GIS\21931.01 - 04h - 2005SAV.mxd



Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

2005 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

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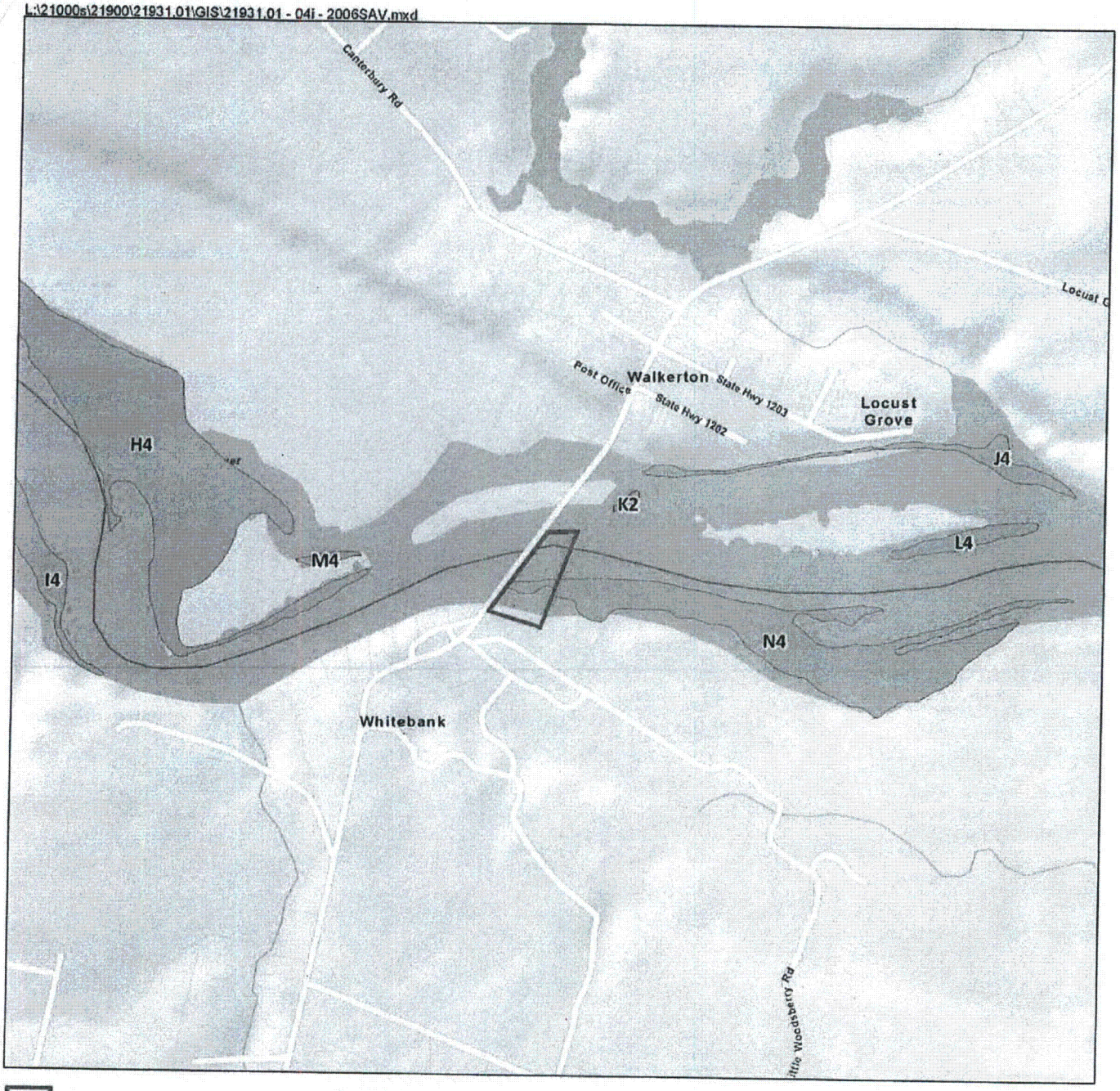
Wetland Studies and Solutions, Inc.

Exhibit 4h

L:\21000s\21900\21931.01\GIS\21931.01 - 04i - 2006SAV.mxd



Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

2006 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

N
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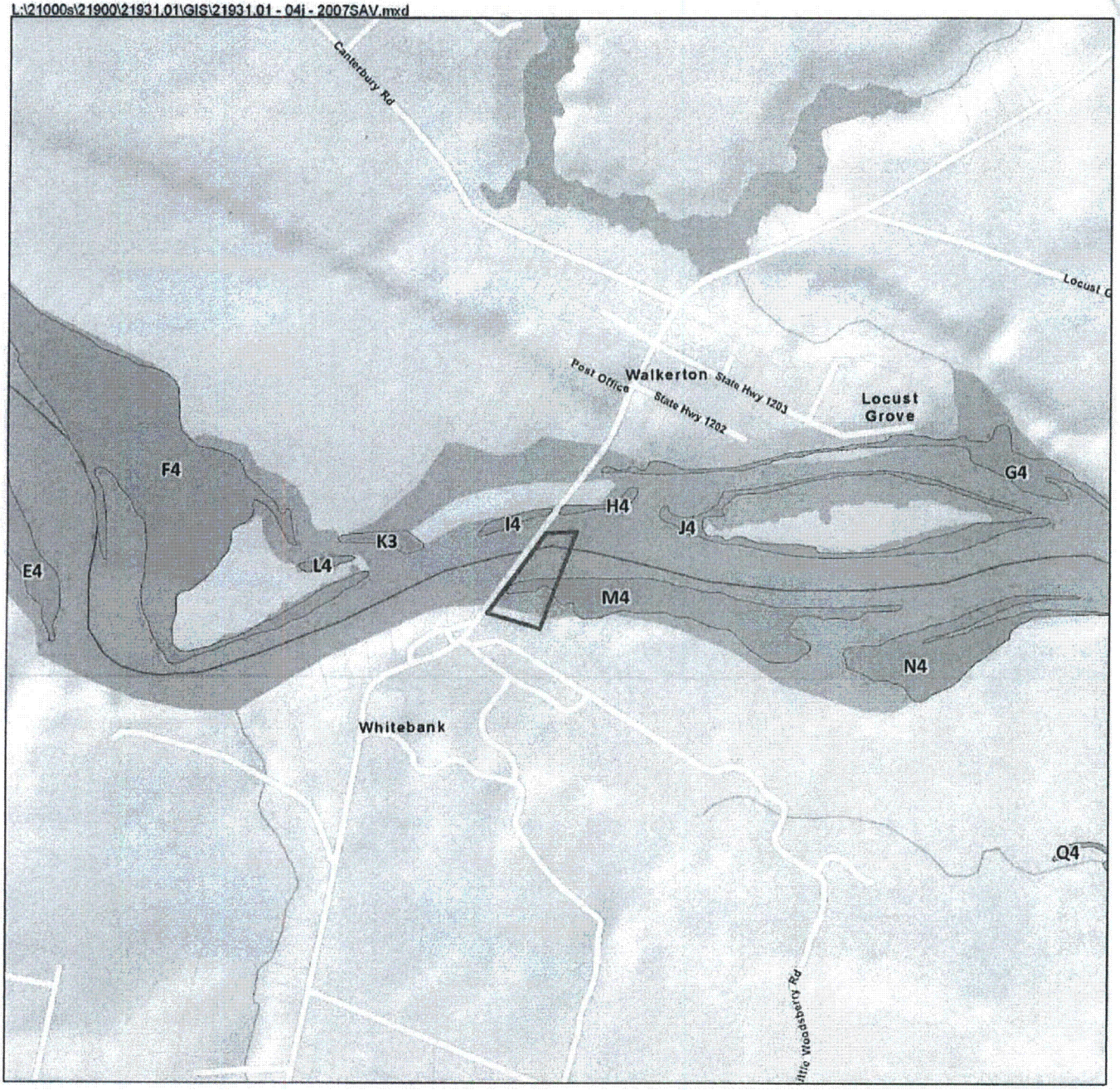
SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

Wetland Studies and Solutions, Inc.

Exhibit 4i

L:\21000s\21900\21931.01\GIS\21931.01 - 04j - 2007SAV.mxd



Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

2007 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

N
W E
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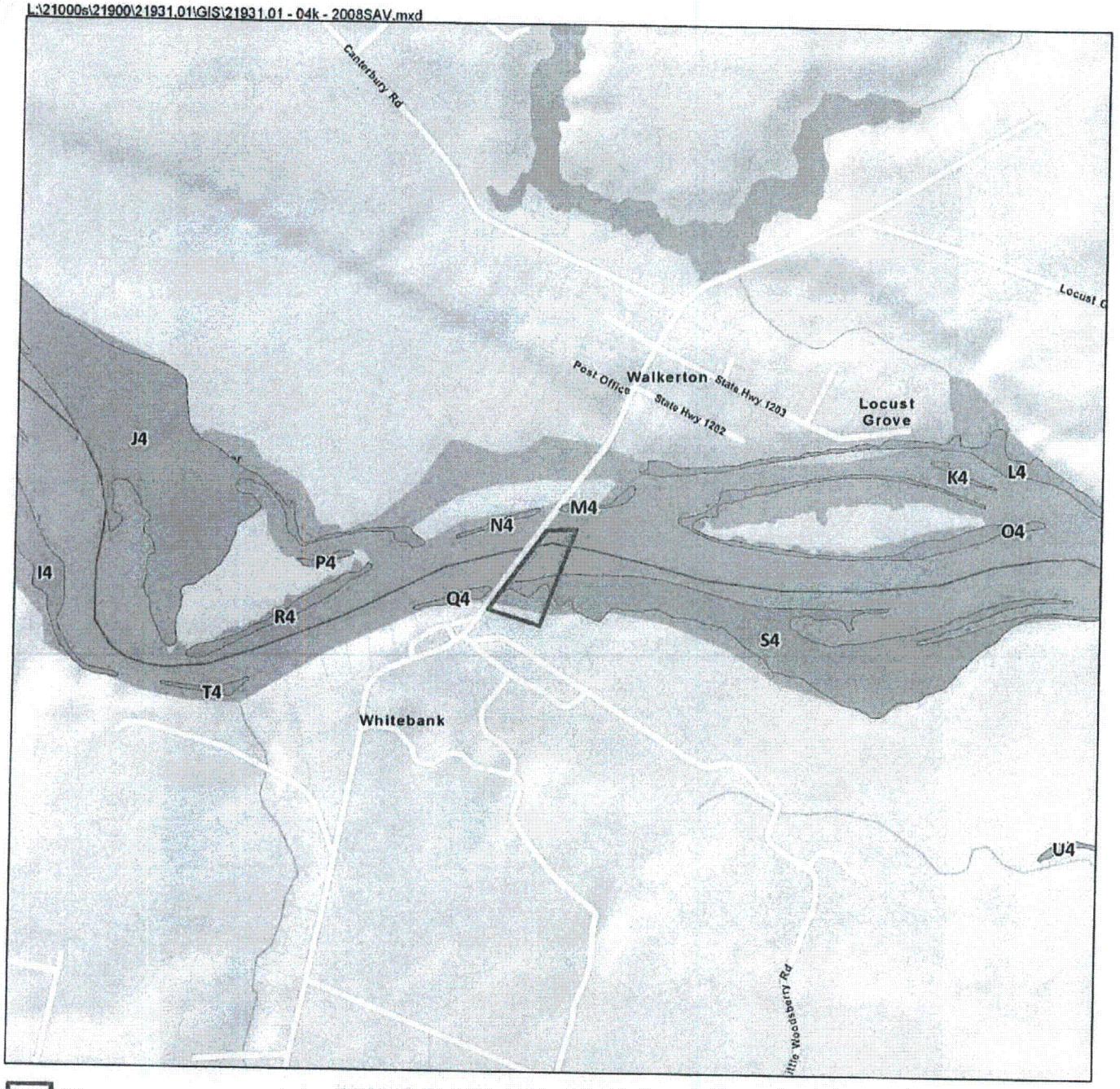
SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

Wetland Studies and Solutions, Inc.

Exhibit 4j

L:\21000s\21900\21931.01\GIS\21931.01 - 04k - 2008SAV.mxd



Site

SAV Density Class

- 0 - 10%
- 10 - 40%
- 40 - 70%
- 70 - 100%

2008 Submerged Aquatic Vegetation
Virginia Institute of Marine Science

Mattaponi River SAV Survey
King William County, VA
WSSI #21931.01
Scale: 1" = 1000'

N
W E
S

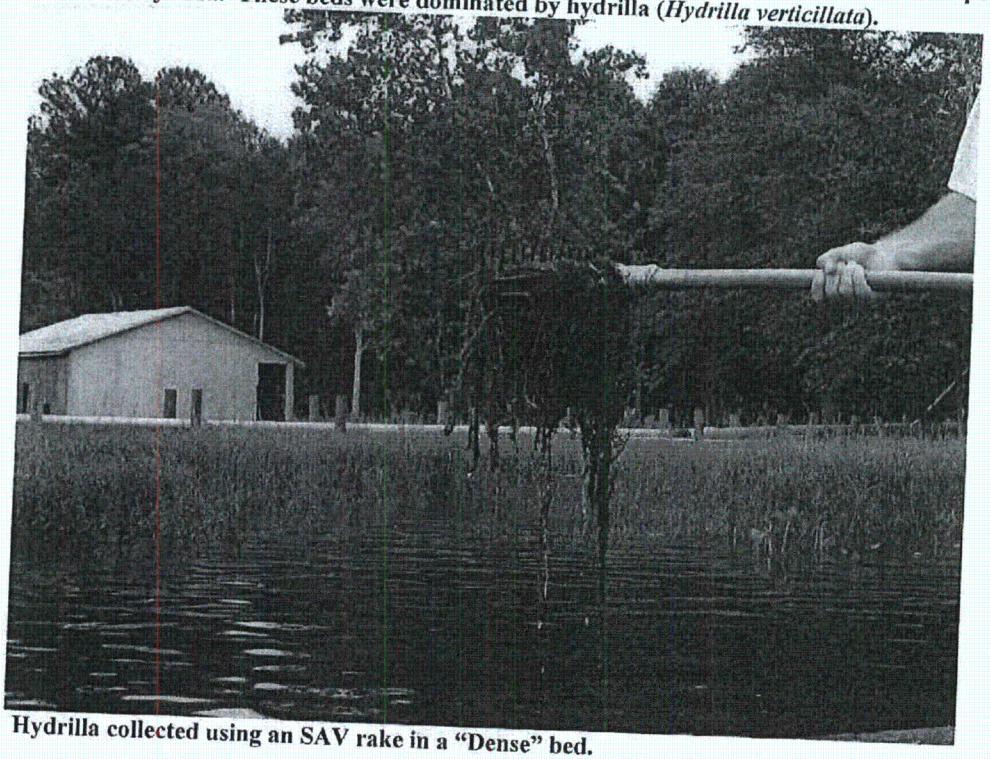
SAV Data Source: VIMS and USGS (225)
Base Map Source: ESRI ArcGIS online

Wetland Studies and Solutions, Inc.

Exhibit 4k

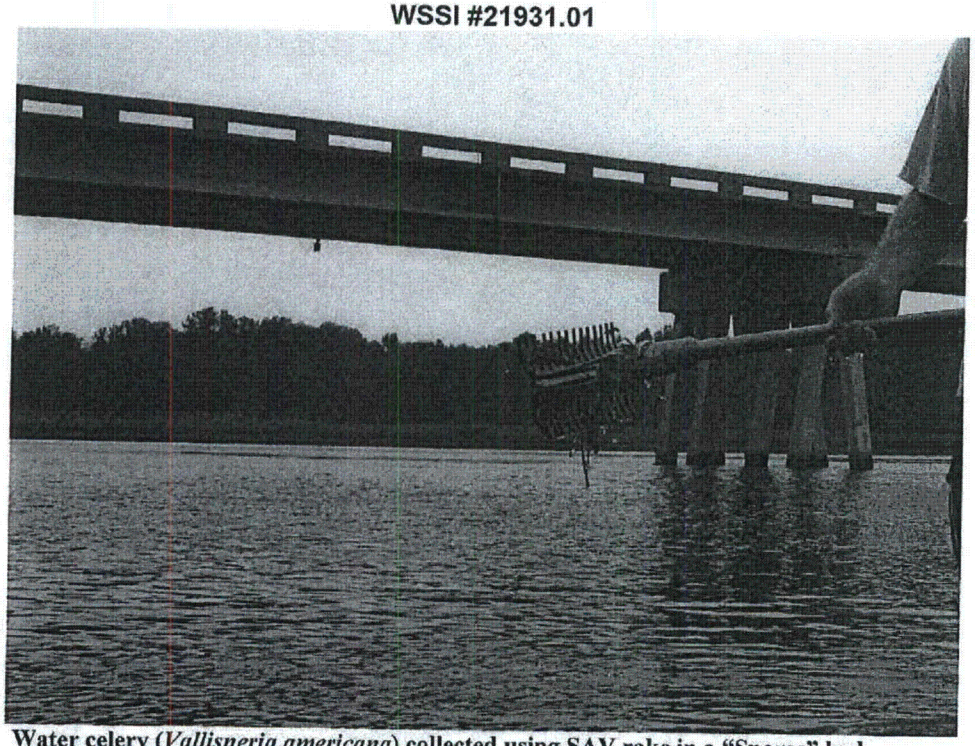
EXHIBIT 5
SAV SURVEY PHOTOGRAPHS
MATTAPONI RIVER
WSSI #21931.01

1. **Representative area with "Dense" submerged aquatic vegetation cover on the southern portion of the study area. These beds were dominated by hydrilla (*Hydrilla verticillata*).**

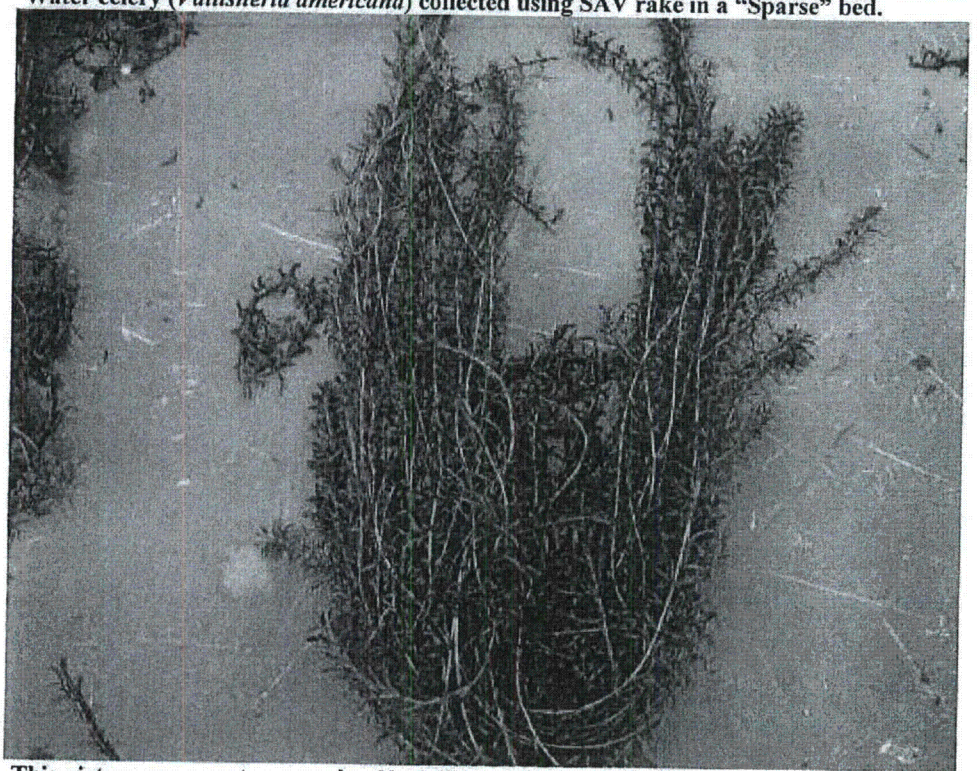


2. **Hydrilla collected using an SAV rake in a "Dense" bed.**

EXHIBIT 5
SAV SURVEY PHOTOGRAPHS
MATTAPONI RIVER
WSSI #21931.01

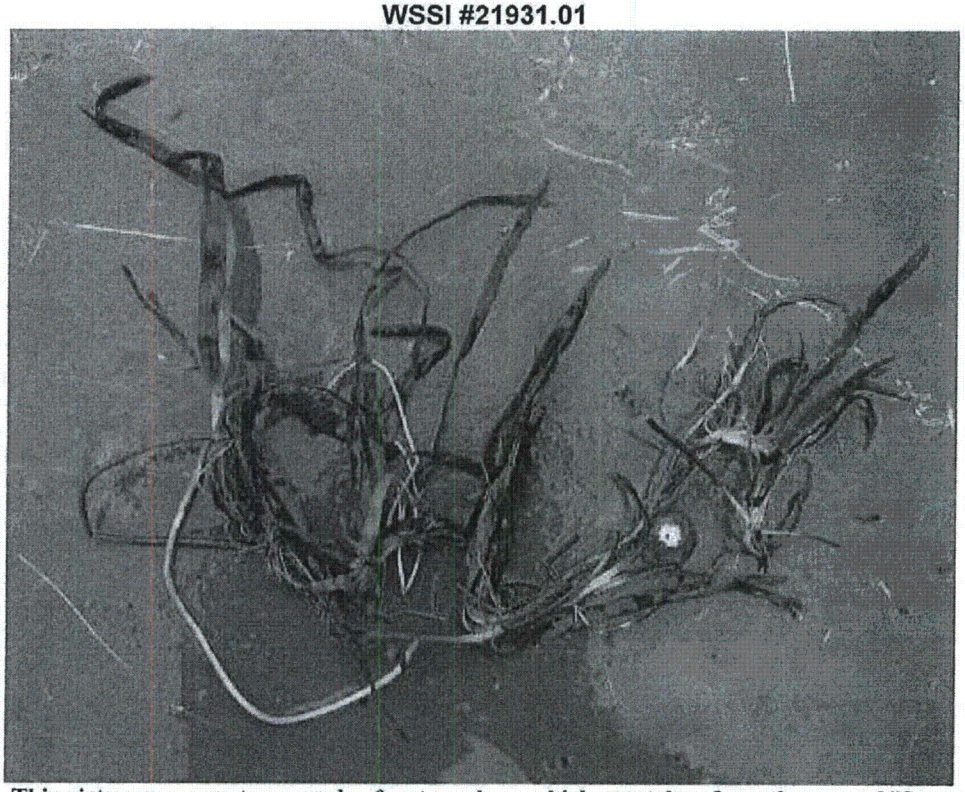


3. **Water celery (*Vallisneria americana*) collected using SAV rake in a "Sparse" bed.**

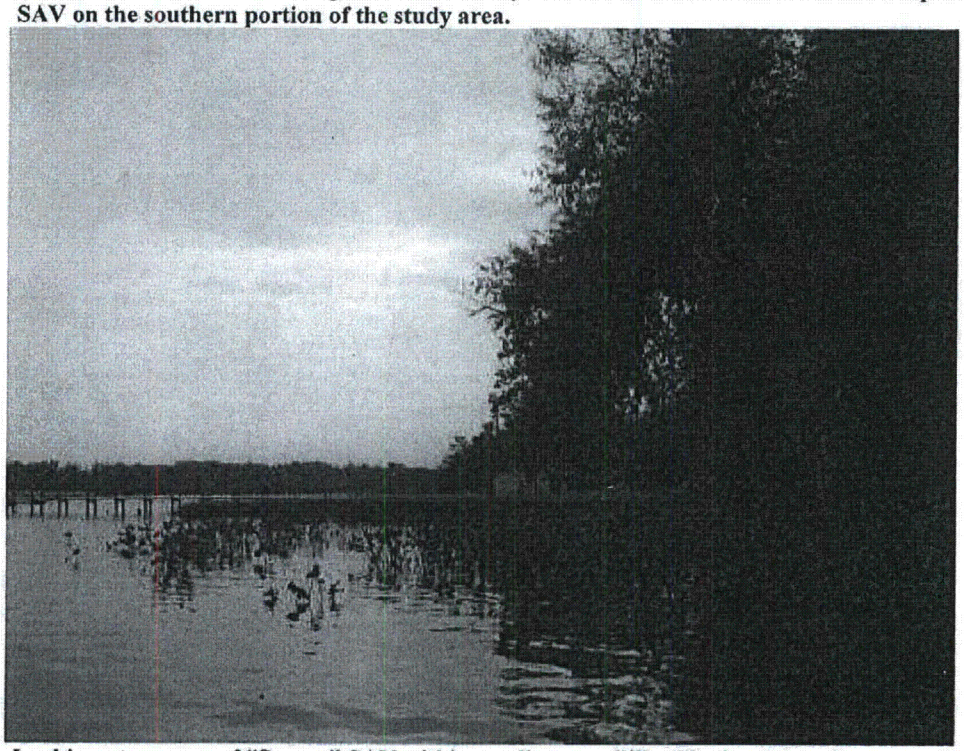


4. **This picture represents a sample of hydrilla, which was taken from the area of "Dense" SAV on the southern portion of the study area.**

EXHIBIT 5
SAV SURVEY PHOTOGRAPHS
MATTAPONI RIVER
WSSI #21931.01

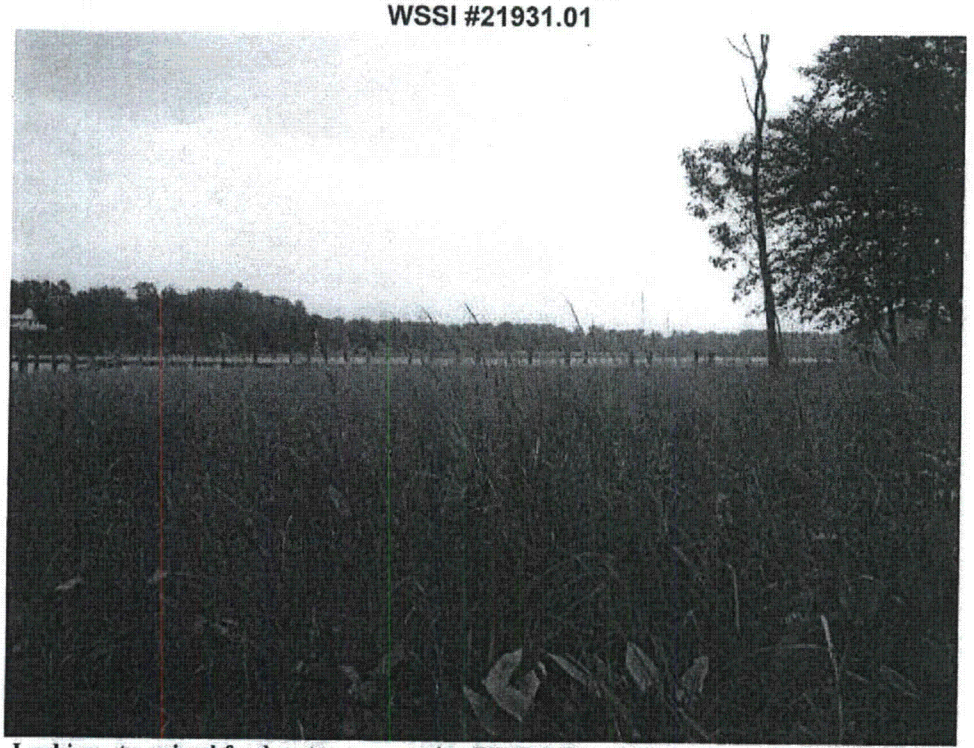


5. **This picture represents a sample of water celery, which was taken from the area of "Sparse" SAV on the southern portion of the study area.**



6. **Looking at an area of "Sparse" SAV within a yellow pondlilly (*Nuphar luteum*) community (VMRC Type IX) on the southern portion of the study area.**

EXHIBIT 5
SAV SURVEY PHOTOGRAPHS
MATTAPONI RIVER
WSSI #21931.01



7. **Looking at a mixed freshwater community (VMRC Type XI) on the southern portion of the study area. This area was dominated by wild rice (*Zizania aquatica*) and swamp smartweed (*Polygonum hydropiperoides*).**

8. **Looking at an area of "Dense" SAV within a mixed flat community (VMRC Type XV) on the southern portion of the study area.**

EXHIBIT 5
SAV SURVEY PHOTOGRAPHS
MATTAPONI RIVER
WSSI #21931.01

9. **Looking at an intertidal beach community (VMRC Type XIII) on the southern portion of the study area.**

10. **Looking at the Mattaponi River on the Central portion of the study area. No SAV were observed within this area.**