Using Participatory Action Research (PAR) for Community Participation in Ecosystem Resiliency

The Pontchartrain Institute for Environmental Sciences at the University of New Orleans (PIES)

The Center for Hazards Assessment, Response and Technology at the University of New Orleans (CHART)

The Community of Grand Bayou, Louisiana

NASA – Stennis Space Center

The Louisiana Office of Coastal Protection and Restoration (OCPR)

Objective

To provide resource managers with an accurate, cost-effective, and comprehensive method of assessing ecological change in the Gulf coast that can benefit community sustainability through more informed marsh restoration decision-making.

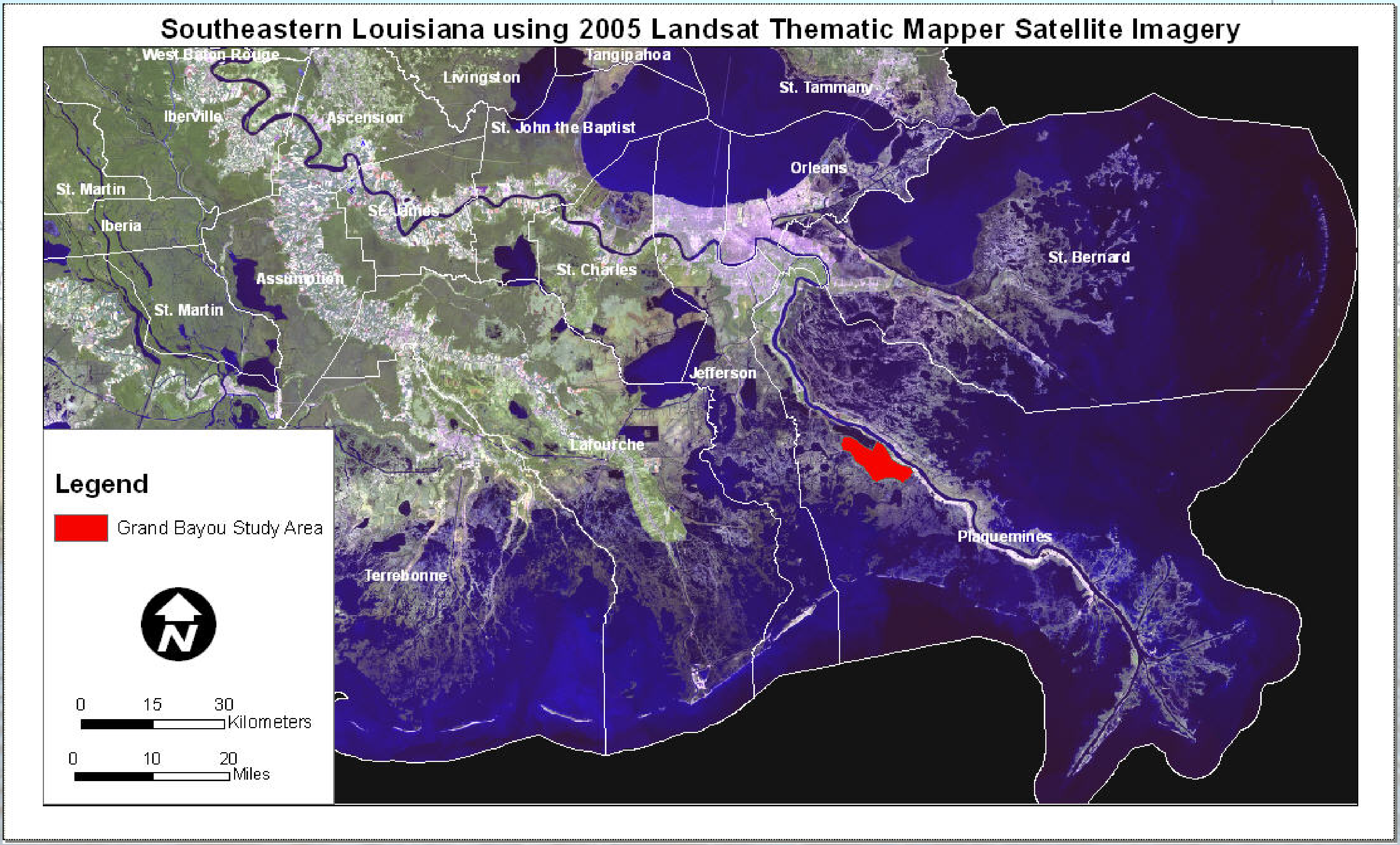
Key Questions

- **Can the information obtained with TEK and geospatial technologies be effectively integrated?**
- **Can this integrated dataset be used as a predictive tool to map marsh health, and identify marsh ‘hotspots’ critical to community sustainability that are susceptible to eventual loss to open water?**
- **Does this integrated dataset provide a measureable benefit to justify inclusion into the current decision-making process?**

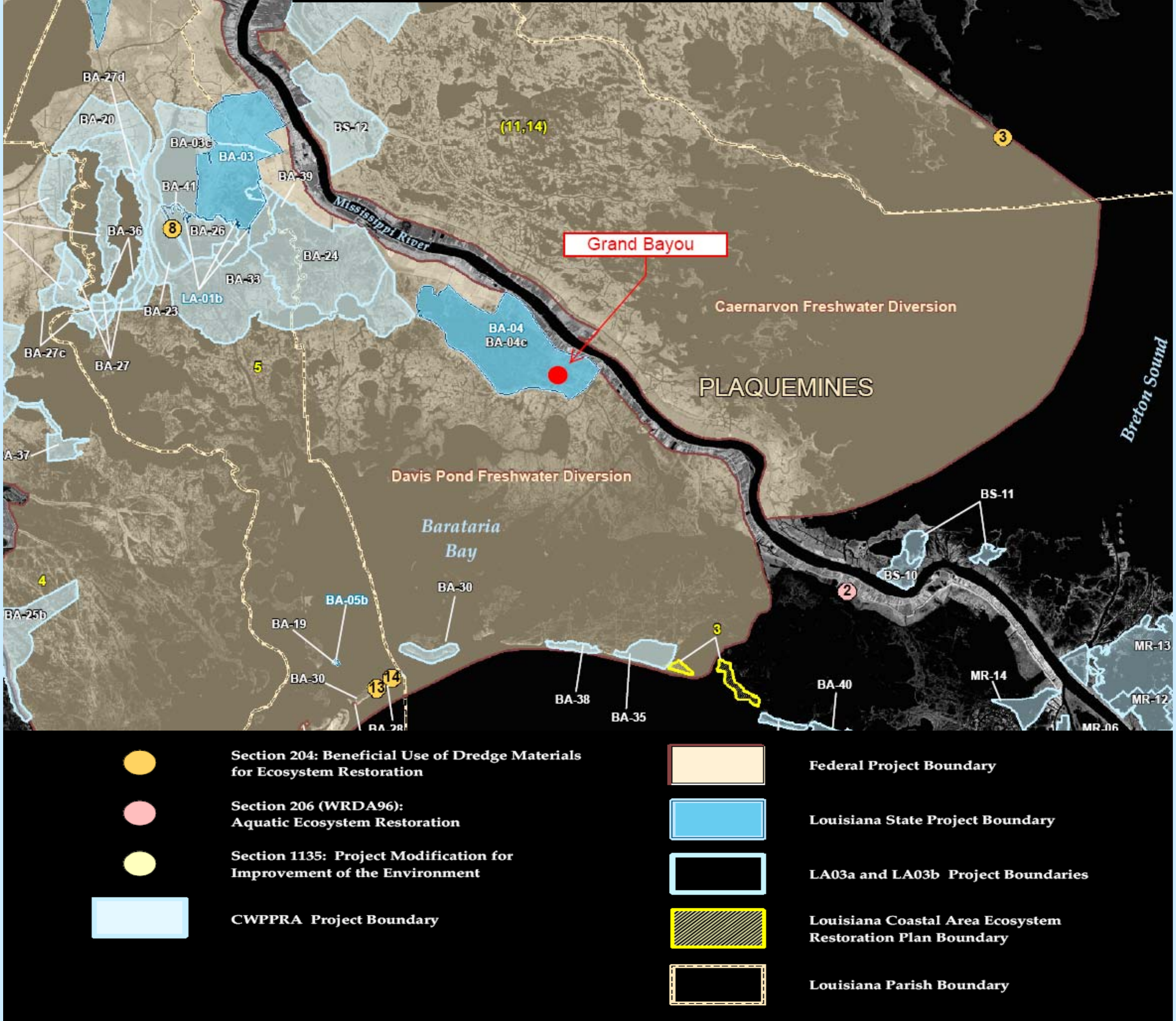
Examples of Studies this Work Builds Upon

Goodwin, 1998; Huntington, 2000; Hrenchuck, 1993; Calheiros et al. 2000; Ticktin and Johns 2002; and Castillo et al. 2005

Grand Bayou Study Area

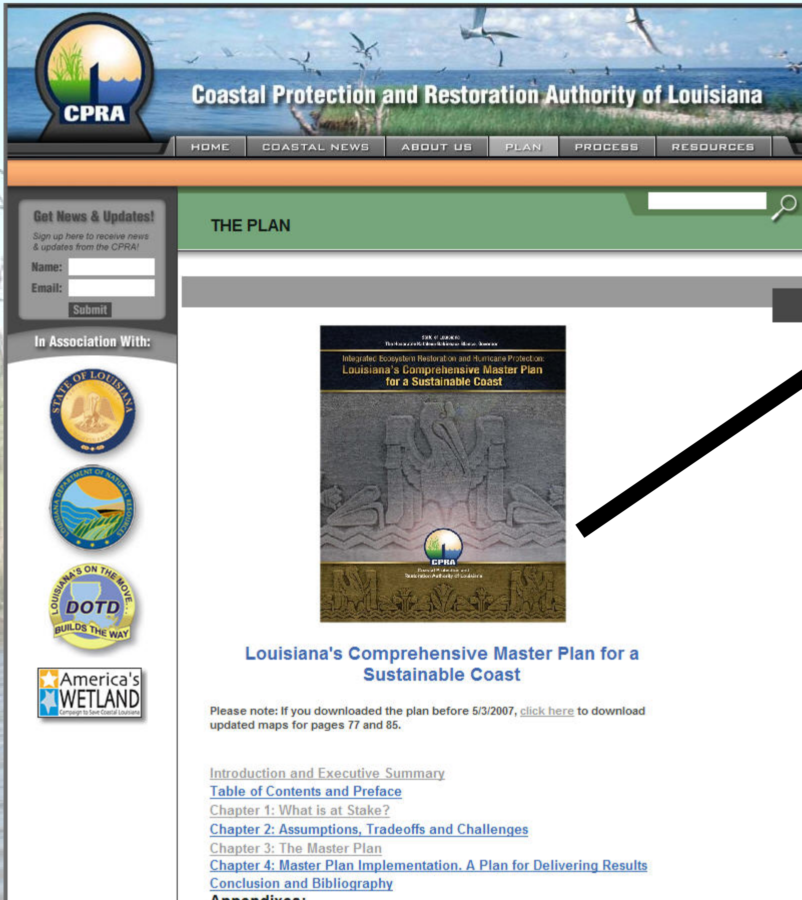


Study Area



BA-16
BA-27d
BA-20
BA-03c
BA-03
BS-12
(11,14)
BA-41
BA-39
Mississippi River
BA-36
8
BA-26
BA-24
BA-33
LA-01b
BA-23
BA-27c
BA-27
5
Grand Bayou
Caernarvon Freshwater Diversion
BA-04
BA-04c
PLAQUEMINES
Breton Sound
3
A-37
Davis Pond Freshwater Diversion
Barataria Bay
BS-11
BS-10
2
4
BA-25b
BA-05b
BA-19
BA-30
BA-30
13
14
BA-38
BA-35
BA-40
MR-14
MR-13
MR-12
MR-06
BA-28
Section 204: Beneficial Use of Dredge Materials for Ecosystem Restoration
Section 206 (WRDA96): Aquatic Ecosystem Restoration
Section 1135: Project Modification for Improvement of the Environment
CWPPRA Project Boundary
Federal Project Boundary
Louisiana State Project Boundary
LA03a and LA03b Project Boundaries
Louisiana Coastal Area Ecosystem Restoration Plan Boundary
Louisiana Parish Boundary

The Louisiana Restoration Program and Decision-Making Process



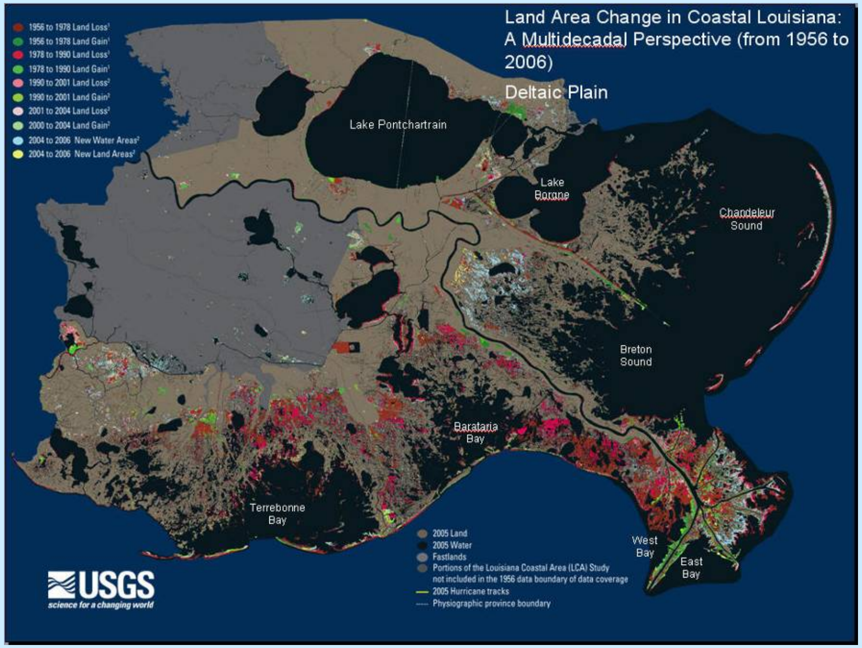
Objective #4: Sustain, to the extent practicable, the unique heritage of coastal Louisiana by protecting historic properties and traditional living cultures and their ties and relationships to the natural environment.

- Louisiana coastal communities are valuable. They are living stewards of the culture, history, land, and environmental resources of the coast for themselves, for the state, and for the nation.
- Sensitivity and fairness must be shown to those in the coastal communities whose homes, lands, livelihoods, and ways of life may be adversely affected by the implementation of any selected alternatives.
- Displacement and dislocation of resources, infrastructure, and possibly communities may be unavoidable under some scenarios. Because of the negative near-term effects some restoration projects may have on the sustainability of existing cultures, careful consideration of mitigation efforts on human disruption must be undertaken.

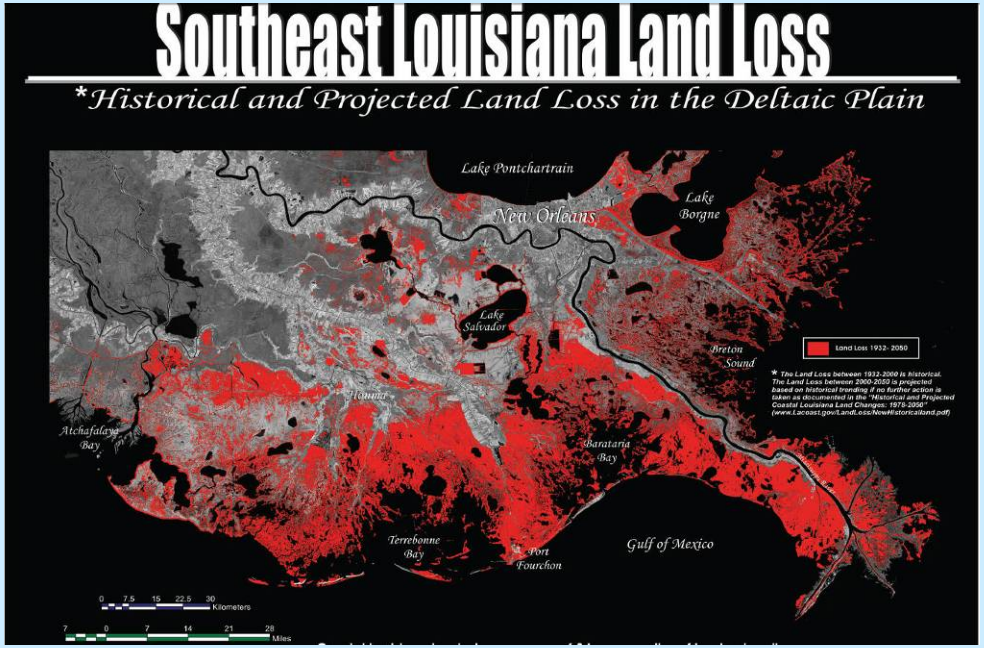
Page 34, Objective #4

The Louisiana Restoration Program and Decision-Making Process

Current Land Loss and Projected Land Loss Maps:



Barras, J.A., Bernier, J.C., and Morton, R.A., Land area change in coastal Louisiana—A multidecadal perspective (from 1956 to 2006): U.S. Geological Survey Scientific Investigations Map 3019, scale 1:250,000, 14 p. pamphlet.



Produced by USGS National Wetlands Research Center (www.lacoast.gov/landloss)

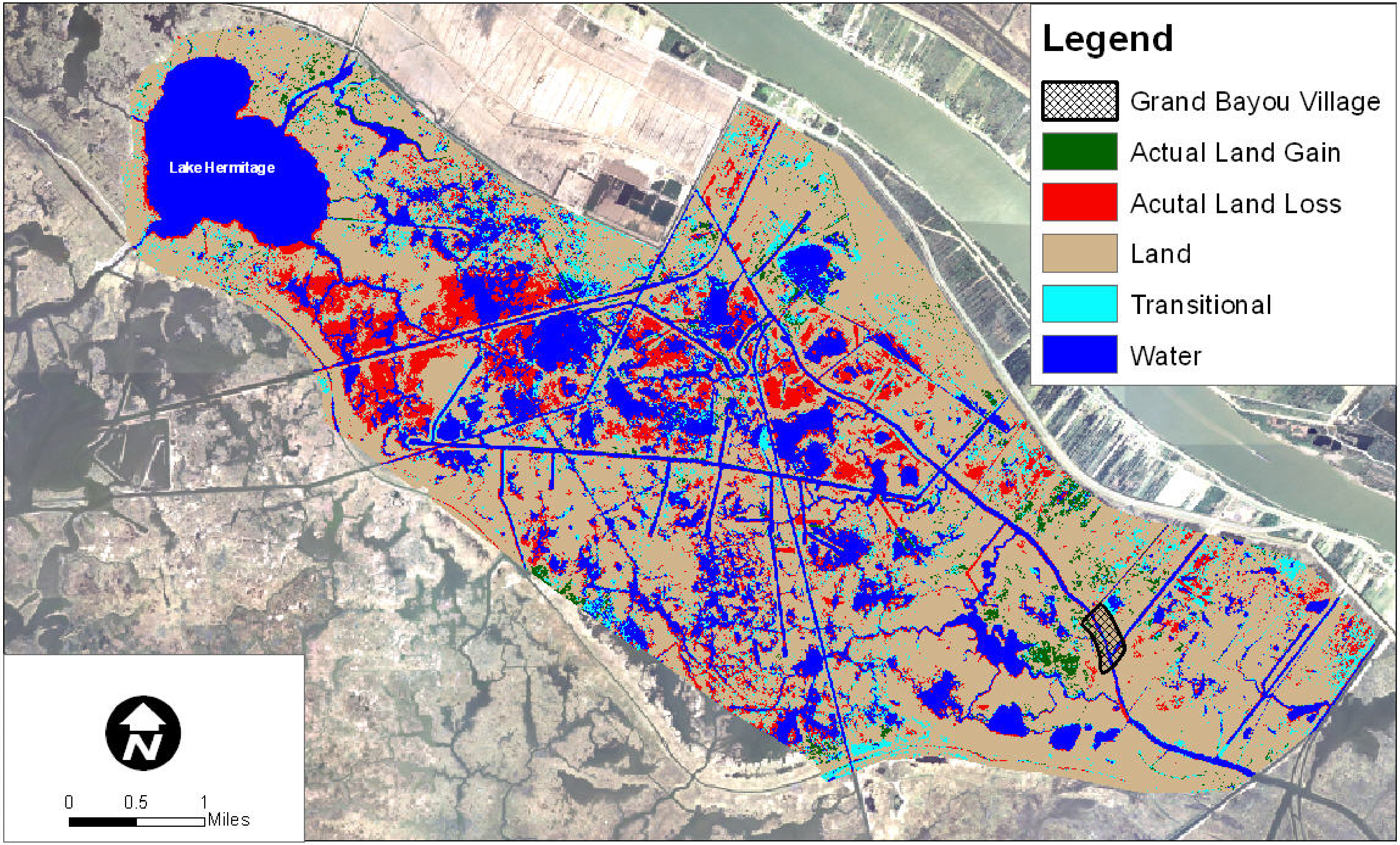
Image Datasets Used in Land Change Analysis

Image Date	Image Type	Image Source	Image Resolution
11/25/1968	BW scanned aerial photography	US Army Corps of Engineers New Orleans	1:30,000 (600 dpi)
03/26/1979	CIR scanned aerial photography	NASA/UL Lafayette Regional Application Center	1:65,000 (1,500 dpi)
11/05/1991	Digital Orthophoto Quarter Quadrangles (DOQQ)	USGS Earth Resources and Observation Science (EROS) Center	1 m
01/24/1995	CIR Scanned aerial photography	NASA/UL Lafayette Regional Application Center	1:65,000 (1,500 dpi)
01/24/1998	Digital Orthophoto Quarter Quadrangles (DOQQ)	USGS Earth Resources and Observation Science (EROS) Center	1 m
01/21/2004	Digital Orthophoto Quarter Quadrangles (DOQQ)	USGS Earth Resources and Observation Science (EROS) Center	1 m
10/27/2005	Digital Orthophoto Quarter Quadrangles (DOQQ)	USGS Earth Resources and Observation Science (EROS) Center	1 m
10/30/2008	Digital Orthophoto Quarter Quadrangles (DOQQ)	USGS Earth Resources and Observation Science (EROS) Center	1 m
10/30/2009	Satellite imagery	DigitalGlobe Quickbird	2.39 m
11/12/2009	Satellite imagery	DigitalGlobe Quickbird	2.39 m

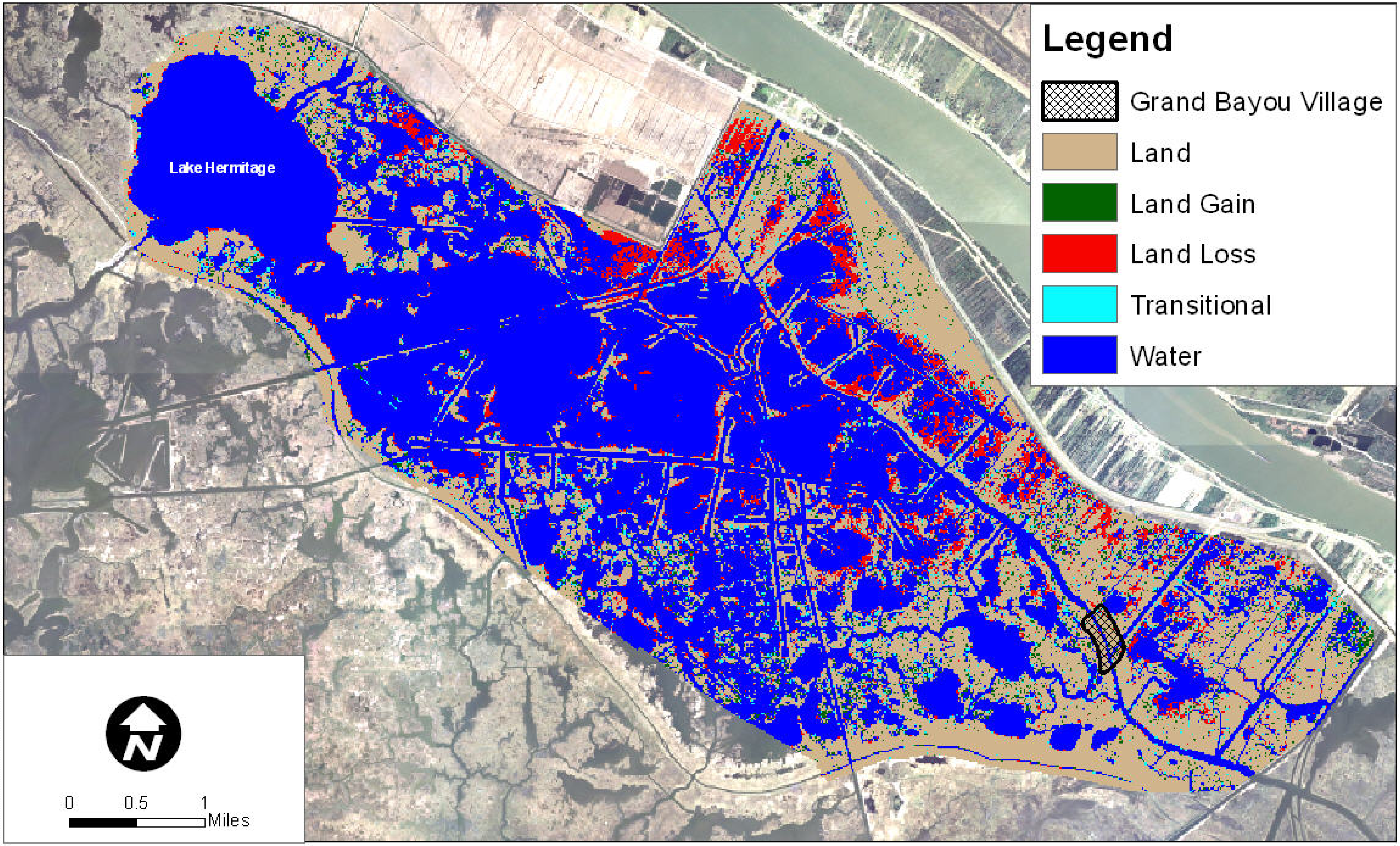
Land Loss by Time Periods and Hurricanes that Passed Within 65 Miles of Study Area

Time Period	Actual Land Loss	Actual Land Gain	Hurricane Event	Net Land Loss	Average Land Loss Per Year
11/25/1968 – 03/26/1979 (~10yr 4m)	711 ha (1758 ac)	148 ha (367 ac)	Camille	563 ha (1391 ac)	69 ha (170 ac)
03/26/1979 – 11/05/1991 (~12yr 7 m)	1042 ha (2574 ac)	148 ha (367 ac)	Bob, Florence	894 ha (2208 ac)	83 ha (205 ac)
11/05/1991 – 01/24/1998 (~6yr 3m)	392 ha (969 ac)	243 ha (600 ac)	Danny	149 ha (369 ac)	63 ha (155 ac)
01/24/1998 – 01/21/2004 (~6 yr)	288 ha (711 ac)	167 ha (413 ac)	Georges	121 ha (298 ac)	48 ha (119 ac)
01/24/2004 – 10/27/2005 (~1yr 9 m)	343 ha (848 ac)	199 ha (491 ac)	Ivan, Cindy, Katrina	144 ha (357 ac)	196 ha (484 ac)
10/27/2005 – 11/12/2009 (~ 4yr)	397 ha (980 ac)	62 ha (154 ac)	Gustav	335 ha (826 ac)	99 ha (245 ac)

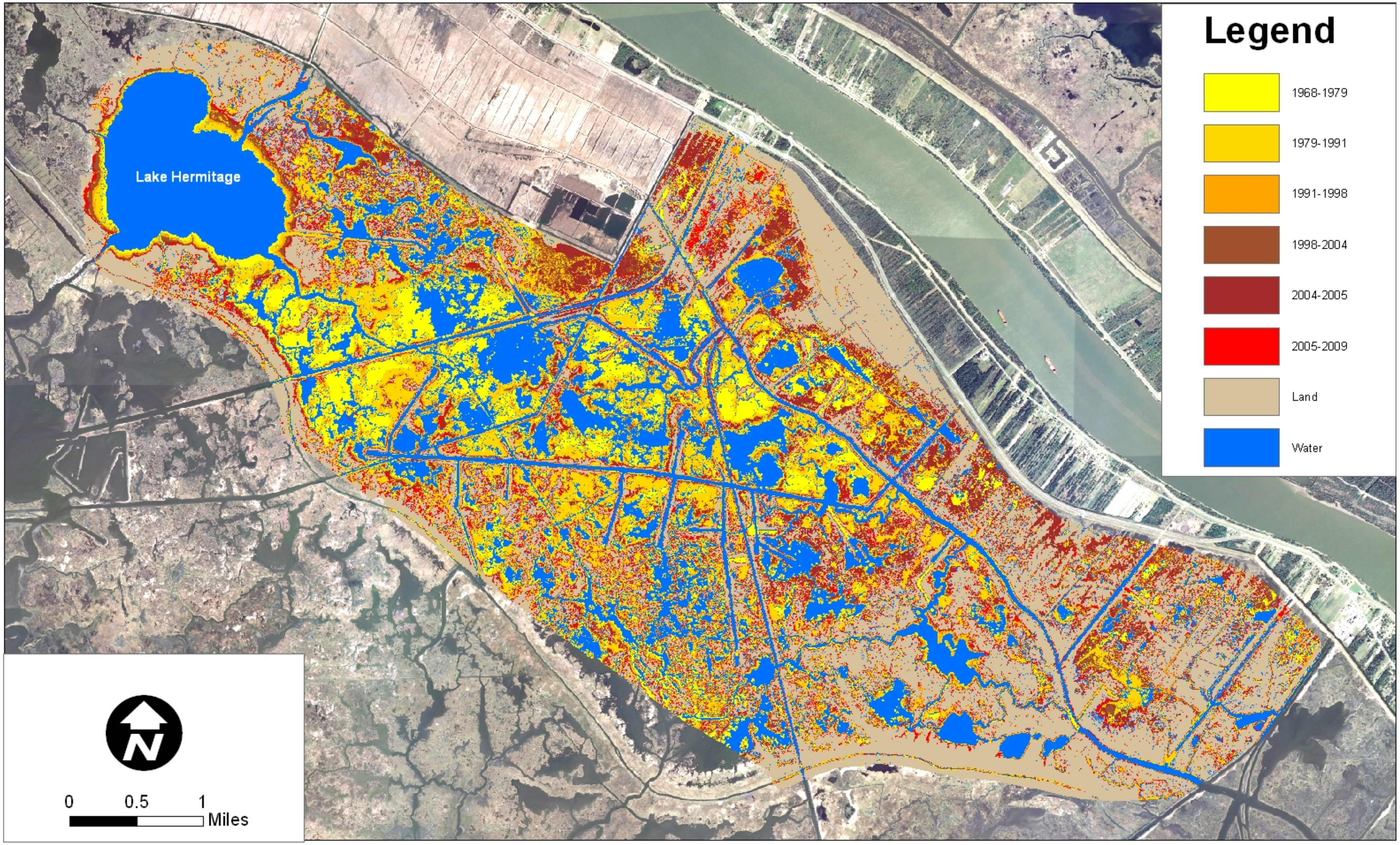
Grand Bayou Area Land Change from 11/25/1968 to 3/26/1979



Grand Bayou Area Land Change from 1/21/2004 to 10/27/2005



Grand Bayou Area Actual Land Loss from 1968 to 2009

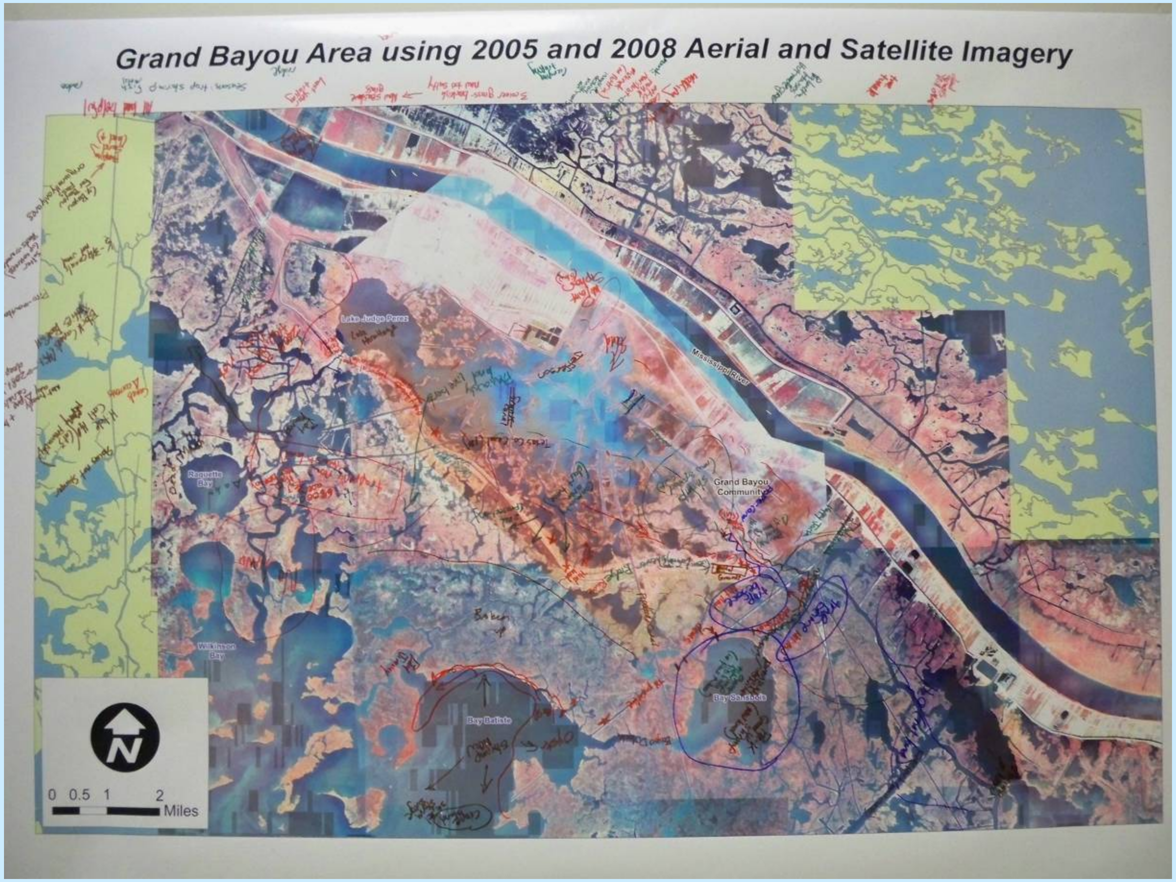


Data Collection and Integration Methods

TEK Data Collection:

- **A proper entrée procedure (West et al., 2008) was initiated, and map biographies were conducted (Hrenchuk, 1993)**

- **Utilizes ‘Collaborative Field Work’ methods based on previous research where TEK was used in scientific studies (Huntington, 2000) to locate study sites, obtain data, and interpret field observations and results**



Data Collection and Integration Methods

TEK Data Collection:

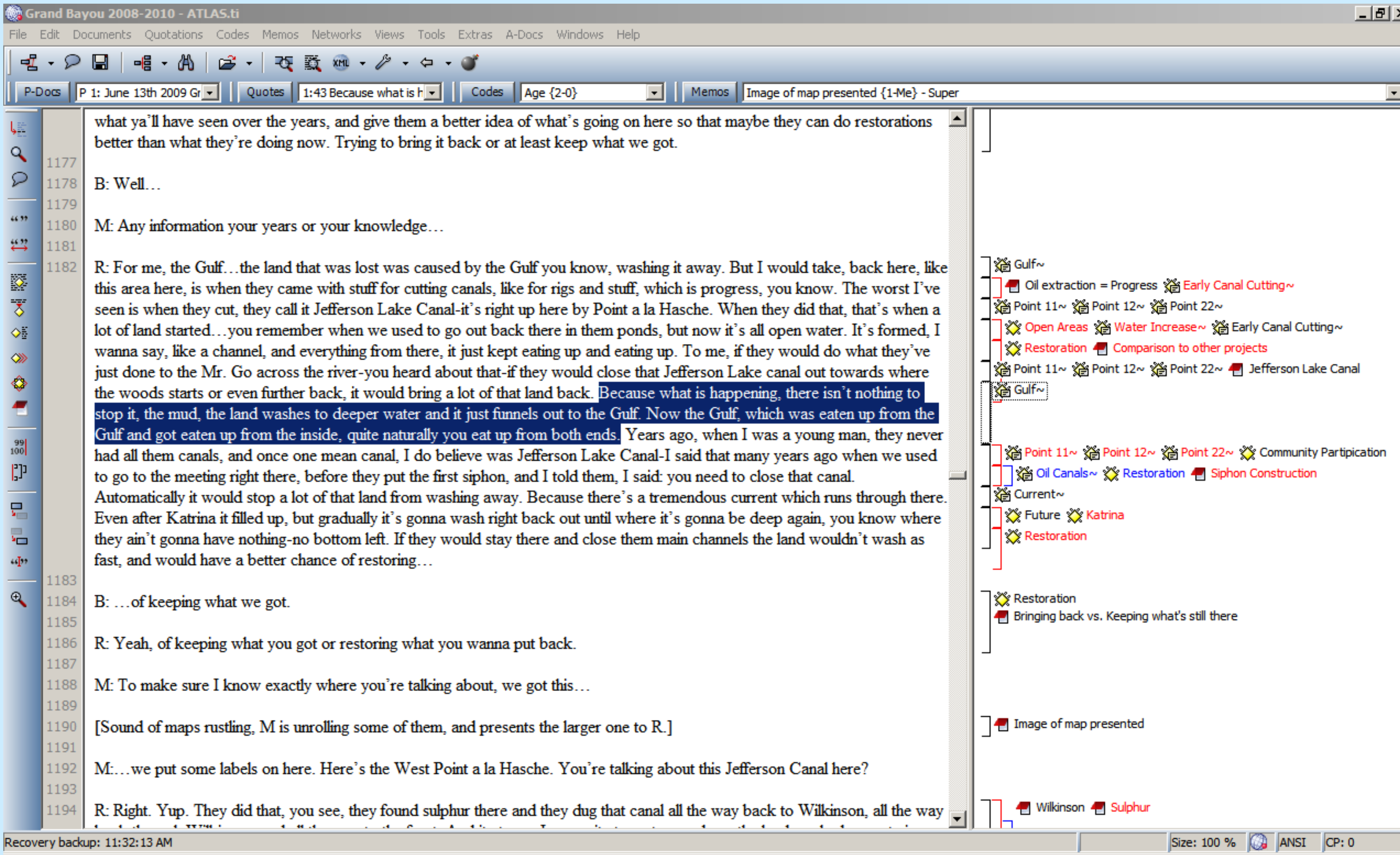
- **A primary TEK informant was identified for interview/field work who has the expertise and in-depth understanding of the study area as it relates to the project objectives (Davis and Wagner, 2003).**

- **Additional informants are then recommended through the primary informant.**

- **TEK collected to date includes:**
- changes in the flora and fauna over time
- changes in environmental conditions observed over time such as land loss
- a history of man-made structures and impacts to the area
- marsh condition observations at sampling locations

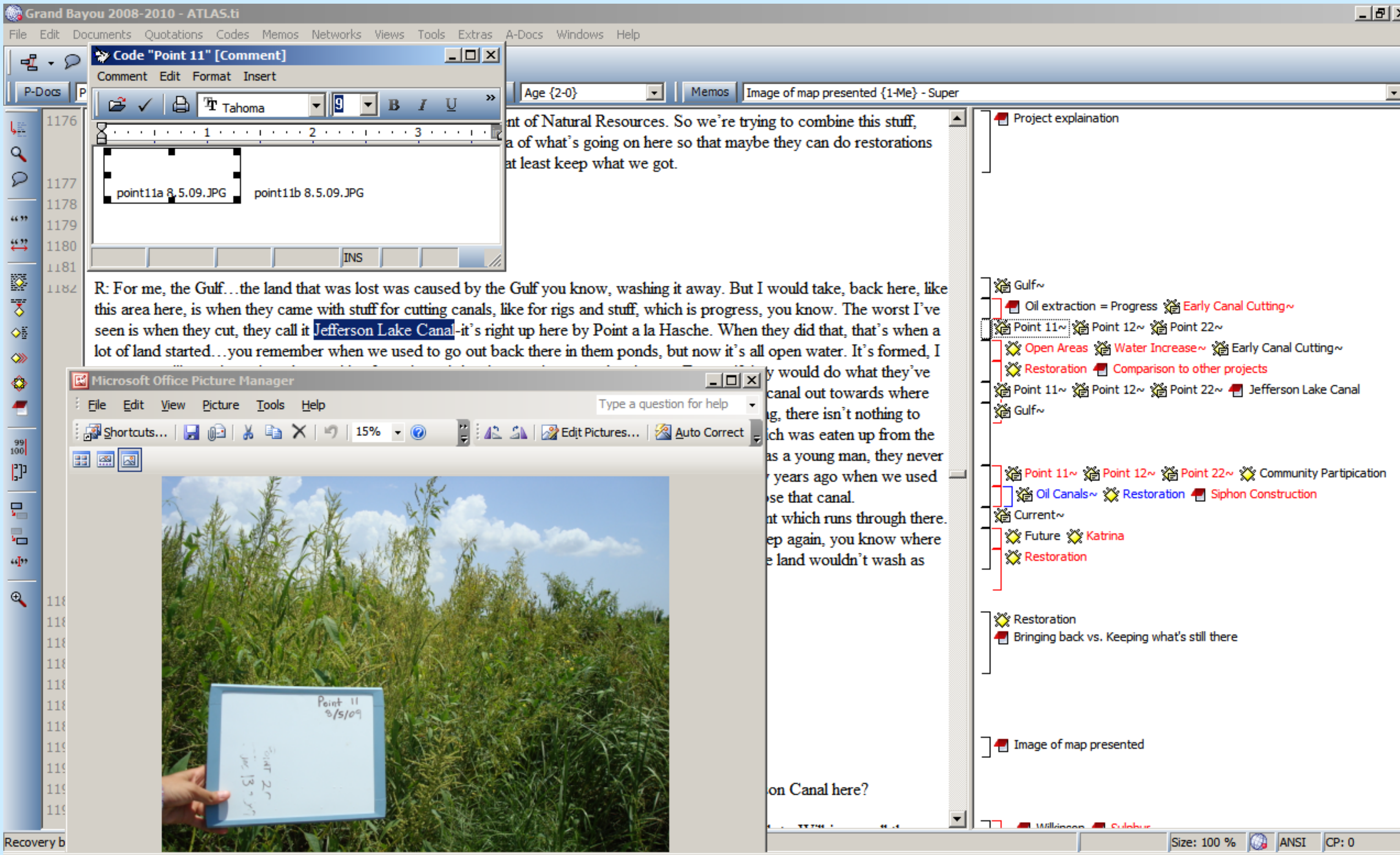
Data Collection and Integration Methods

TEK Data Transcription/Coding:



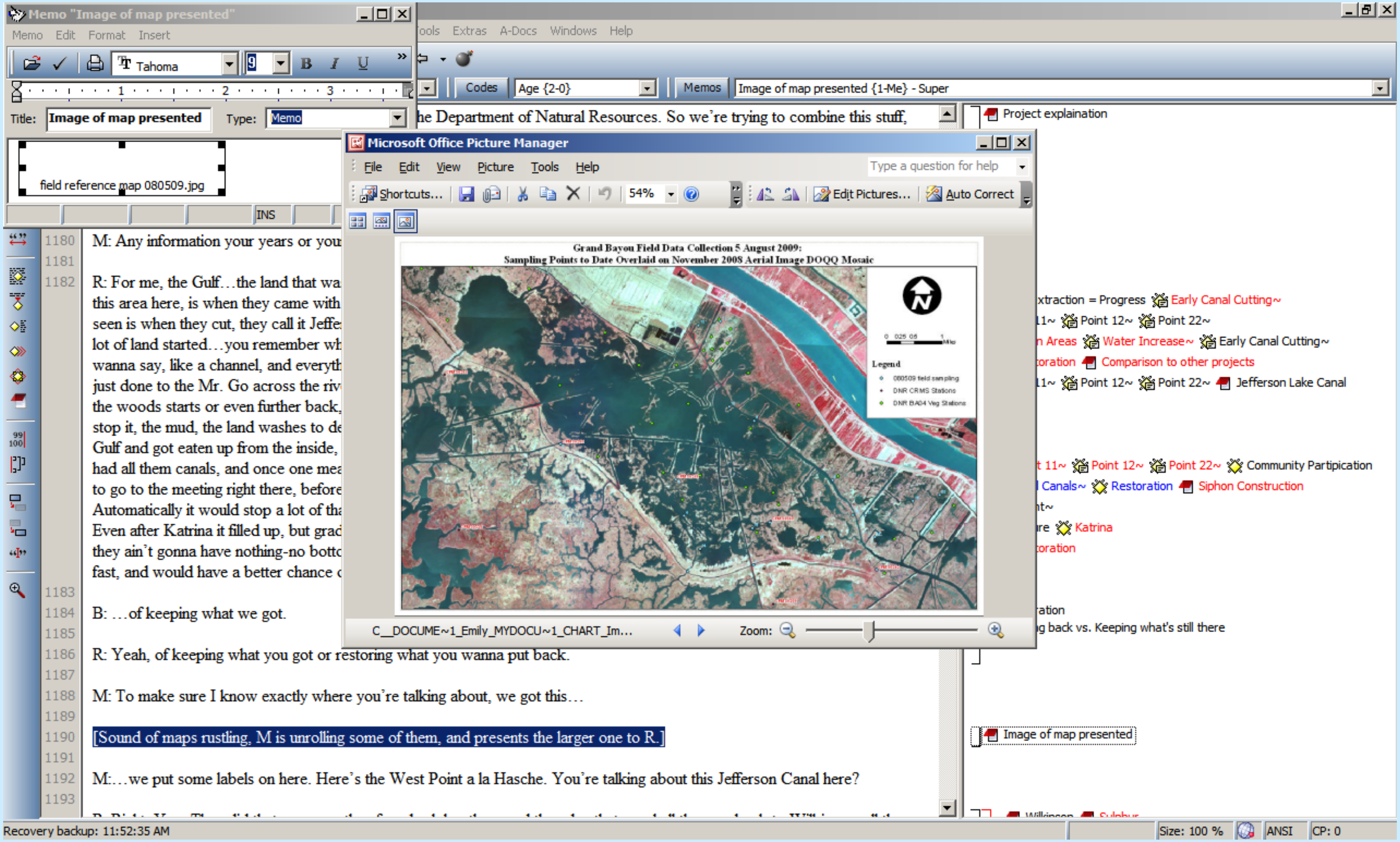
Data Collection and Integration Methods

TEK Data Transcription/Coding:



Data Collection and Integration Methods

TEK Data Transcription/Coding:



Examples of codes for restoration importance:

-Burns (they have made the effort to restore themselves)

-Political Action (area is important enough that residents assert themselves politically to protect it)

- Legal Action (area is important enough that residents assert themselves legally to protect it)

- Land leasing/Land ownership

- Storms (Evacuation spots)

- Restoration

- Farming (contributes to sustenance and culturally important)

- Hunting and trapping (while a mobile activity, there is so few places left with wildlife, the areas that do exist are important to protect in order to allow community members to continue this cultural activity)

- Wildlife

- Generations (areas with historical, cultural importance)

- Oysters (while a dynamic operation, fishermen cannot move their sites on short notice due to annual leasing systems

- Money

-Cultural significance

Calculation of Restoration Index:

RI=(a-b)/x
RI= Restoration Index
a= number of codes with value of +1
b= number of codes with value of -1
x= total number of codes

Example of TEK-Based Map Creation Indices Table

Physical Places	a_{VI}-b_{VI}	Vulnerability	a_{RP}-b_{RP}	Restoration Priority
Bay Batiste	-1	-0.045454545	2	0.153846154
Bay Roquette	-7	-0.318181818	3	0.230769231
Bay Sonwa	-7	-0.318181818	0	0
Bayou Traverre	1	0.045454545	0	0
Beach	-2	-0.090909091	2	0.153846154
Chanier	-1	-0.045454545	7	0.538461538
Crane Island	-3	-0.136363636	1	0.076923077
Freeport Canal	2	0.090909091	0	0
Foster's Canal	-2	-0.090909091	3	0.230769231
Grand Bayou Pass	-1	-0.045454545	0	0
Grand Bayou Village	-3	-0.136363636	11	0.846153846
Grand Lake	-3	-0.136363636	0	0
Green Island	-2	-0.090909091	1	0.076923077
Gulf	-6	-0.272727273	0	0
Indian Mounds	3	0.136363636	8	0.615384615
Jefferson Lake	-4	-0.181818182	5	0.384615385
Lake Hermatage	-4	-0.181818182	1	0.076923077
Mississippi River	1	0.045454545	0	0
Texas Company Canal	-5	-0.227272727	1	0.076923077
Shell Canal	1	0.045454545	0	0
Siphon	1	0.045454545	-4	-0.307692308
Wilkinson Bay	-7	-0.318181818	2	0.153846154

Data Collection and Integration Methods

Scientific Data Collection:

- **FieldScout CM 1000 Chlorophyll Meter (relative chlorophyll content)**
  - “Changes in leaf chlorophyll content can serve as relative indicators of plant vigor and environmental quality.” (Carter and Spiering, 2002)

- **LI-COR Leaf Area Index-2000 Plant Canopy Analyzer (relative biomass measurement)**
  - “LAI has been identified as the most important variable for characterizing vegetation energy and mass exchange for global research” (Pierce, 1988).

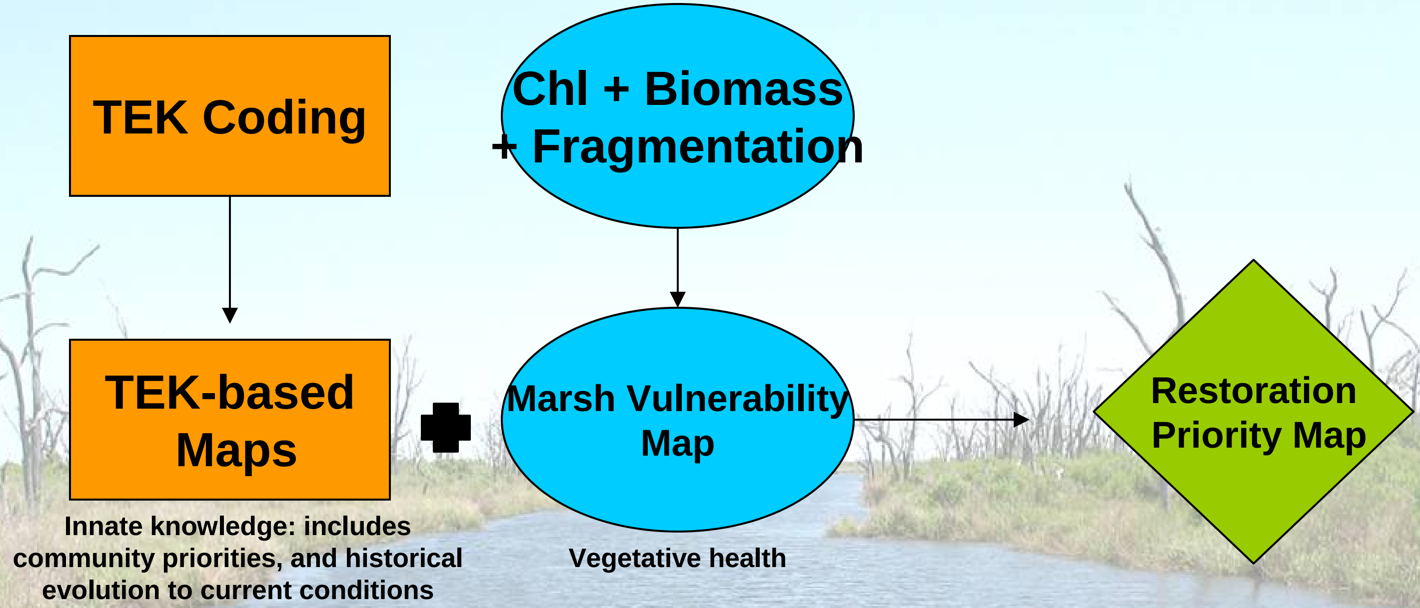
- **Ocean Optics VNIR Field Spectroradiometer (spectral reflectance from 400 to 1100nm)**
  - “Vegetation indices derived from satellite and/or hand-held spectroradiometer-based are frequently used to estimate net primary production and monitor vegetation phenologic patterns” (Zhang et al., 1997).

- **HP iPAQ with GPS and ArcPad GIS Software (allows for field data entry tied to GPS located sampling sites overlaid on image maps)**

Data Collection and Integration Methods

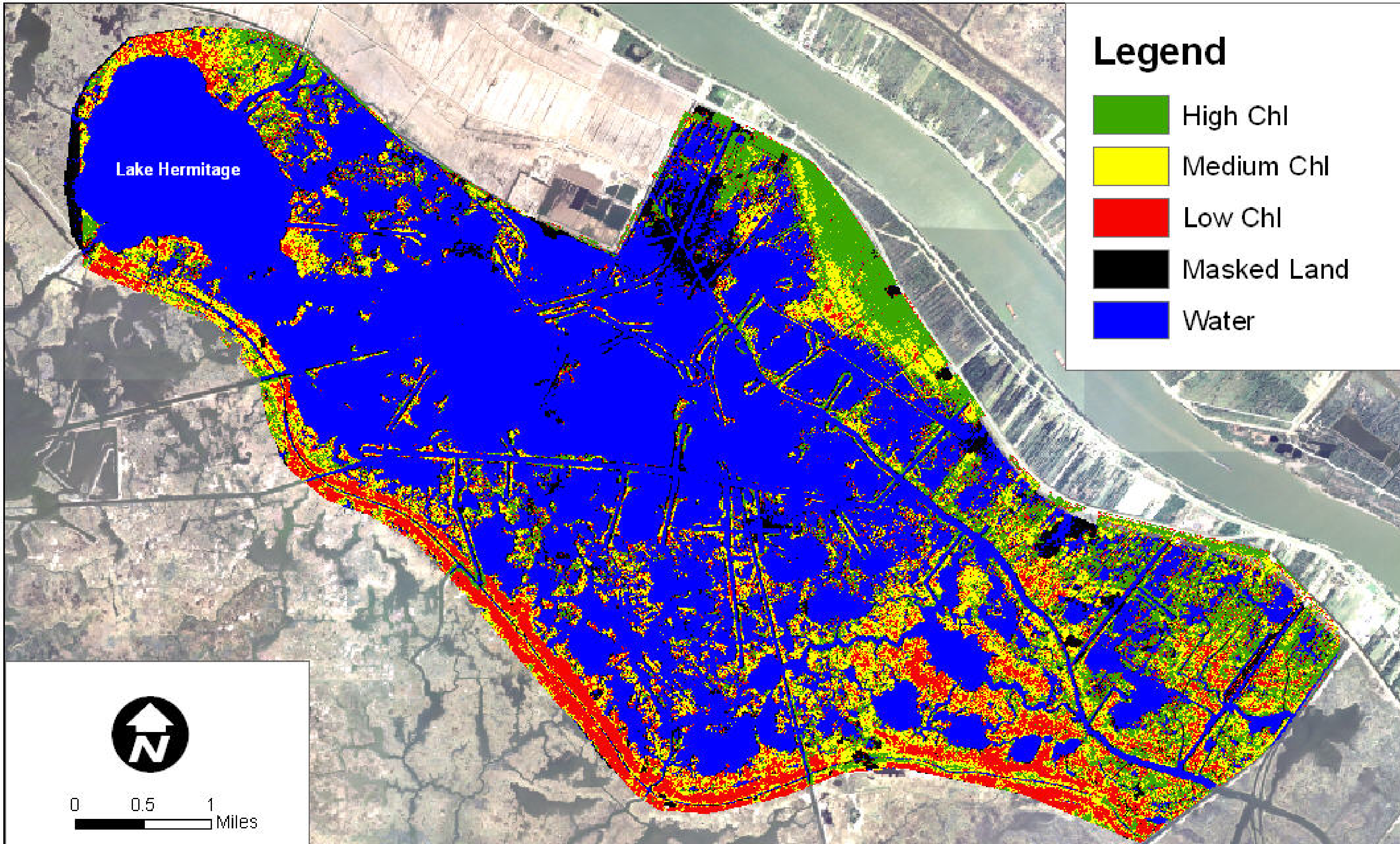
Scientific Data Collection:

Data Collection and Integration Methods

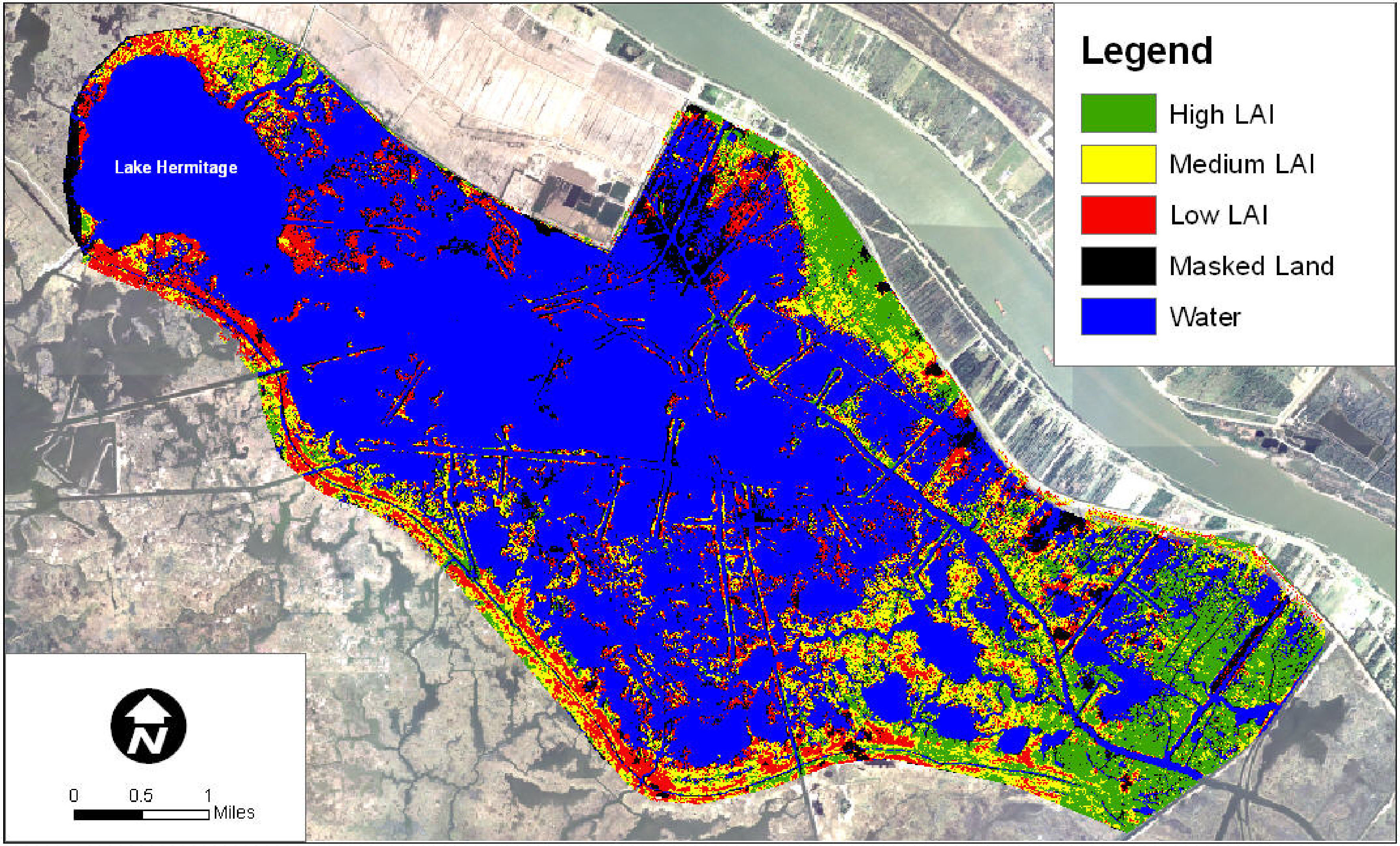


- Various techniques such as band ratios and vegetation indices were applied to an image dataset and tested for correlation with the biophysical field data.
- The average value of the pixels in a ten-square meter area around each sampling point was utilized for the correlation with the field data.
- A regression equation was derived for the image processing-technique that has the highest correlation to each measured parameter at the sampling sites.
- Fragmentation Maps were produced from each historical land-water image, and then tested for proportion of each class that intersected with subsequent land loss
- Statistical analysis was performed on the resulting fragmentation class proportions to determine any significance with land loss

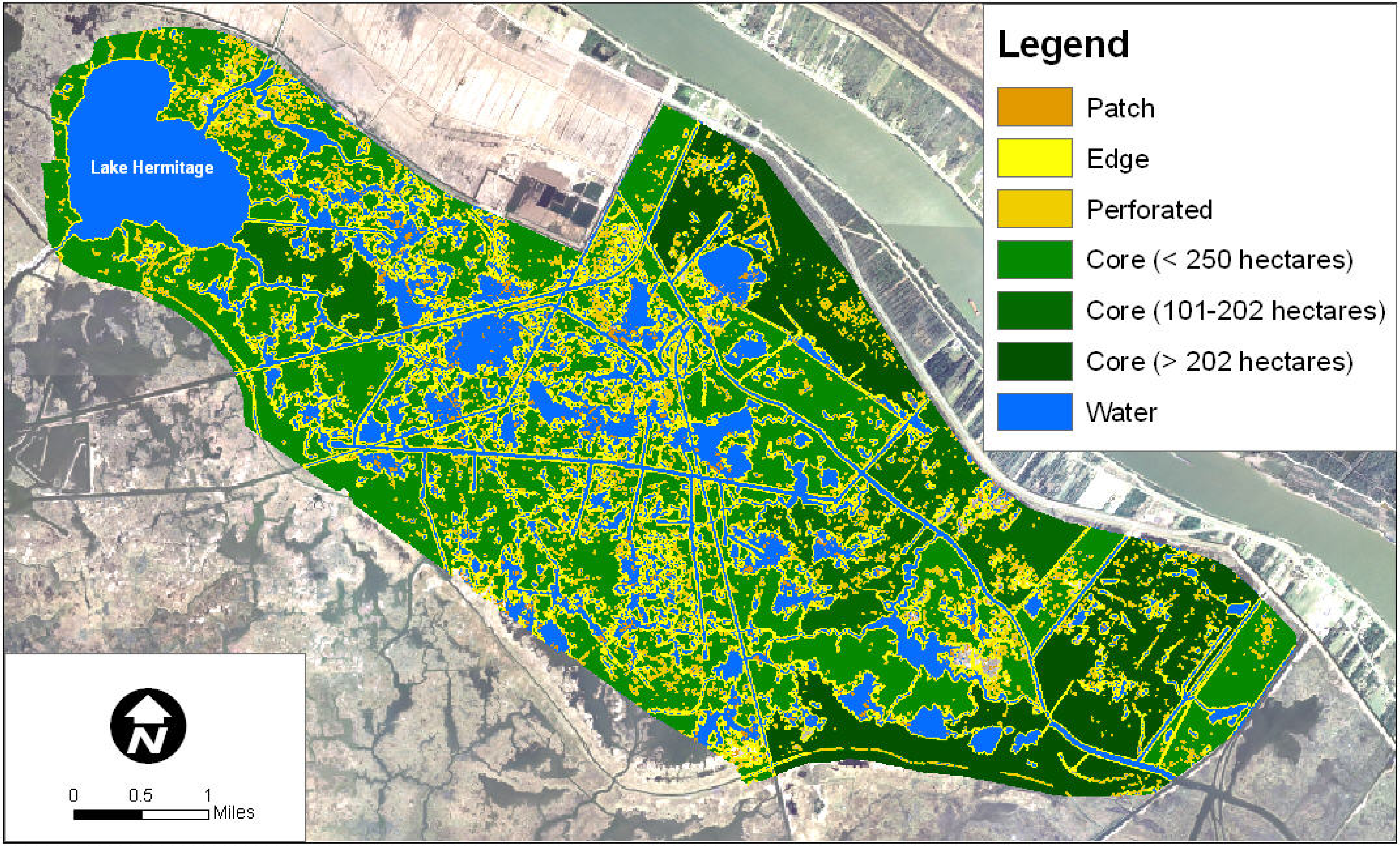
Grand Bayou Area Estimated Chlorophyll Content Map



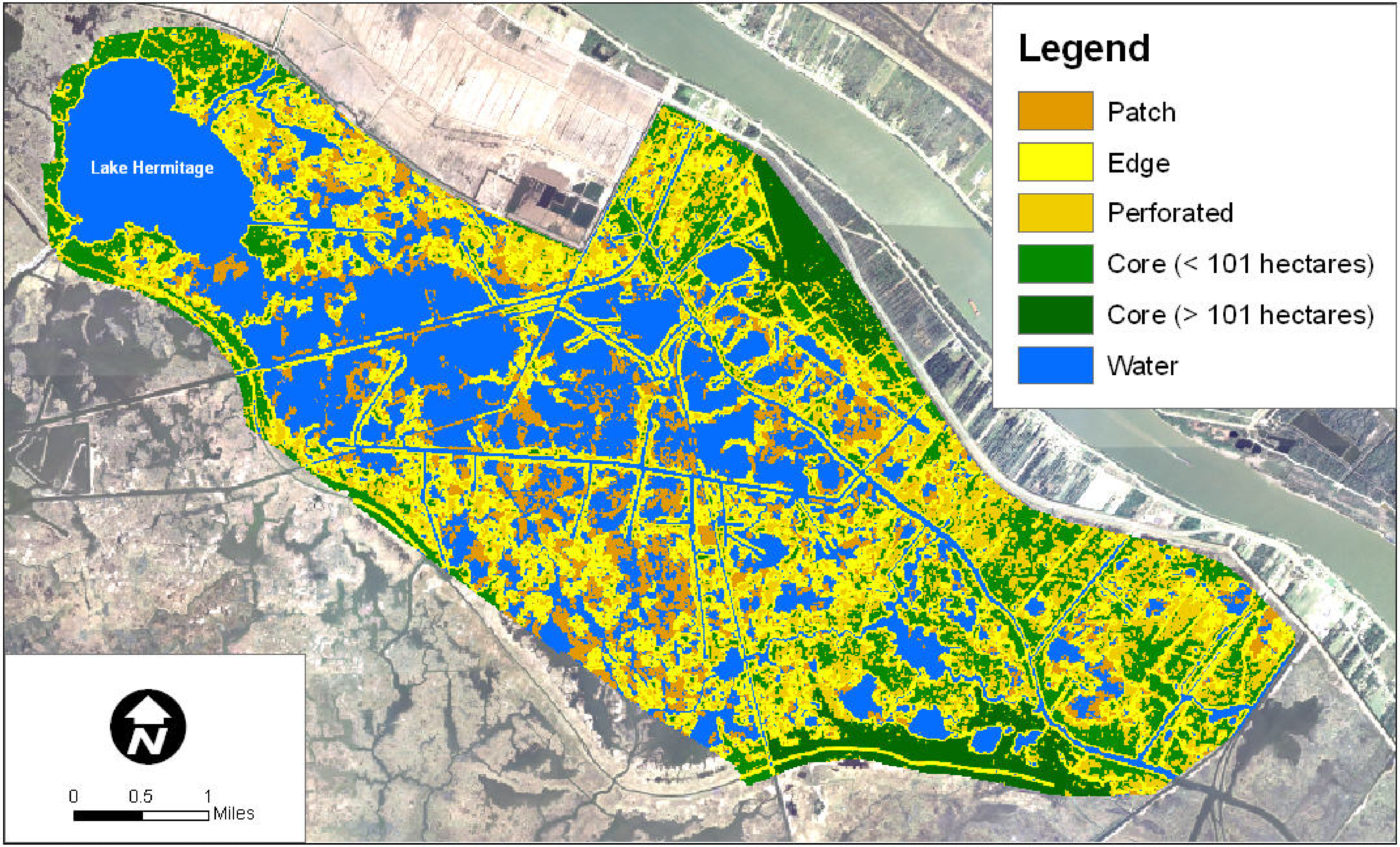
Grand Bayou Area Estimated Leaf Area Index Map



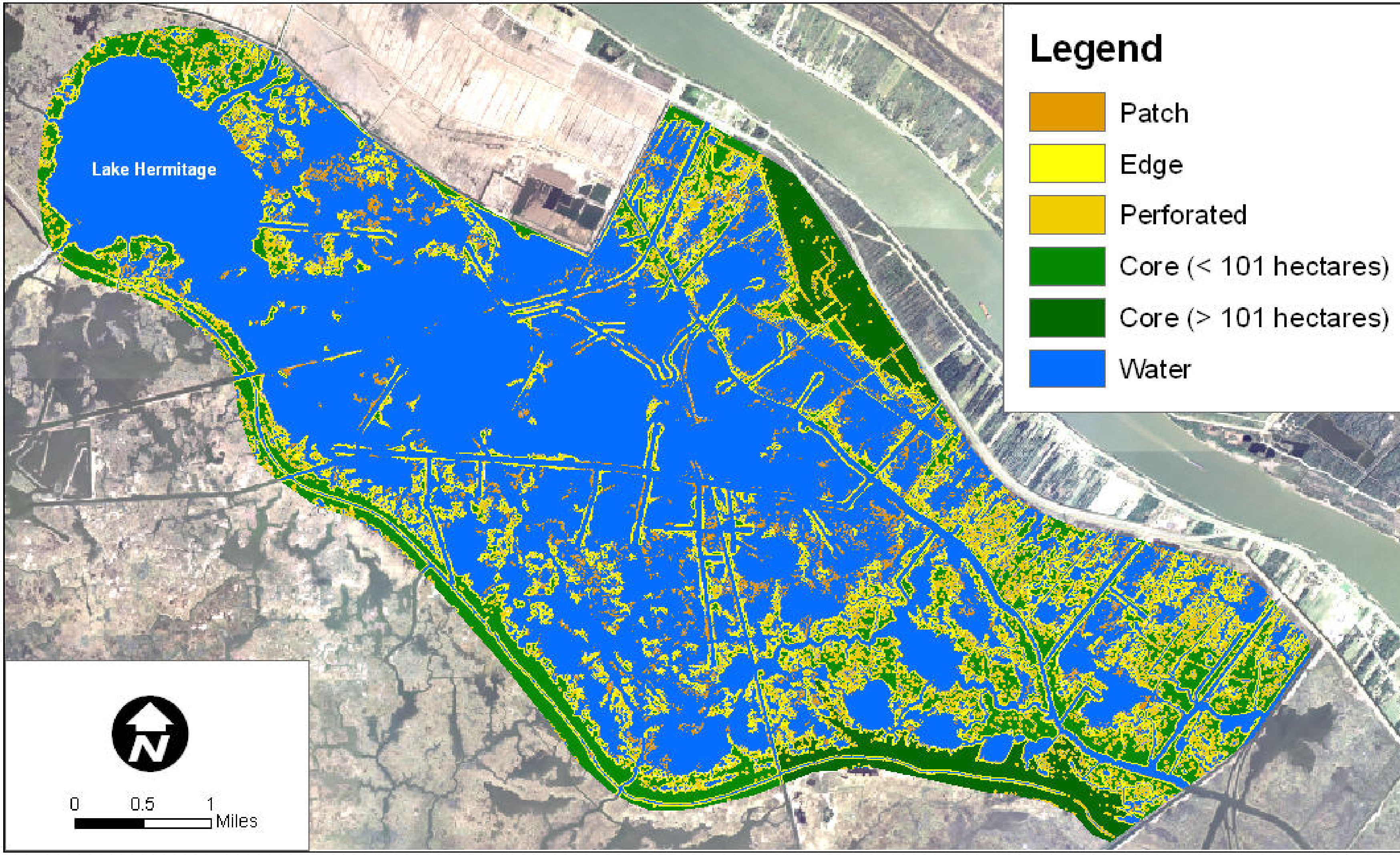
1968 Grand Bayou Area Fragmentation Map



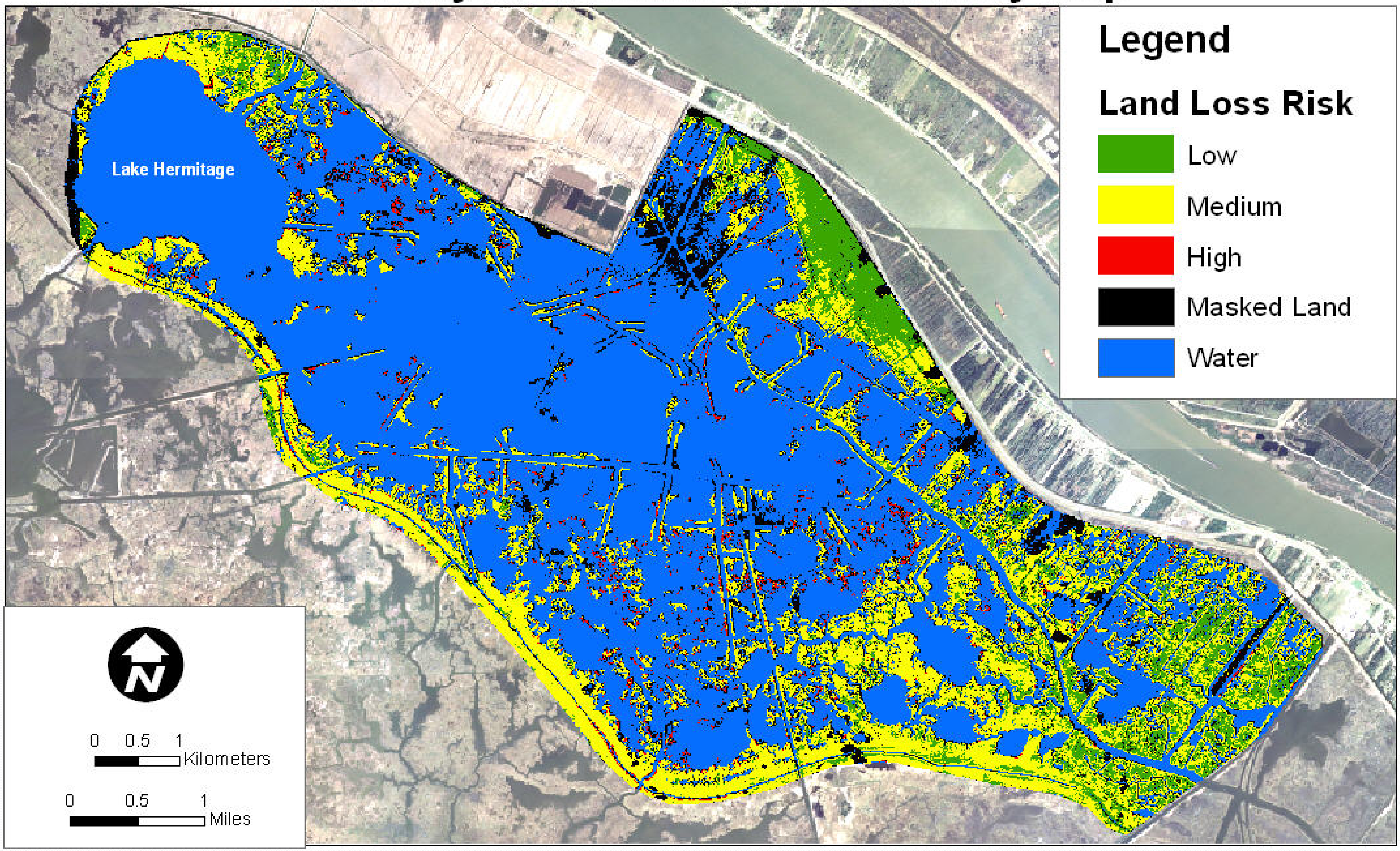
1991 Grand Bayou Area Fragmentation Map



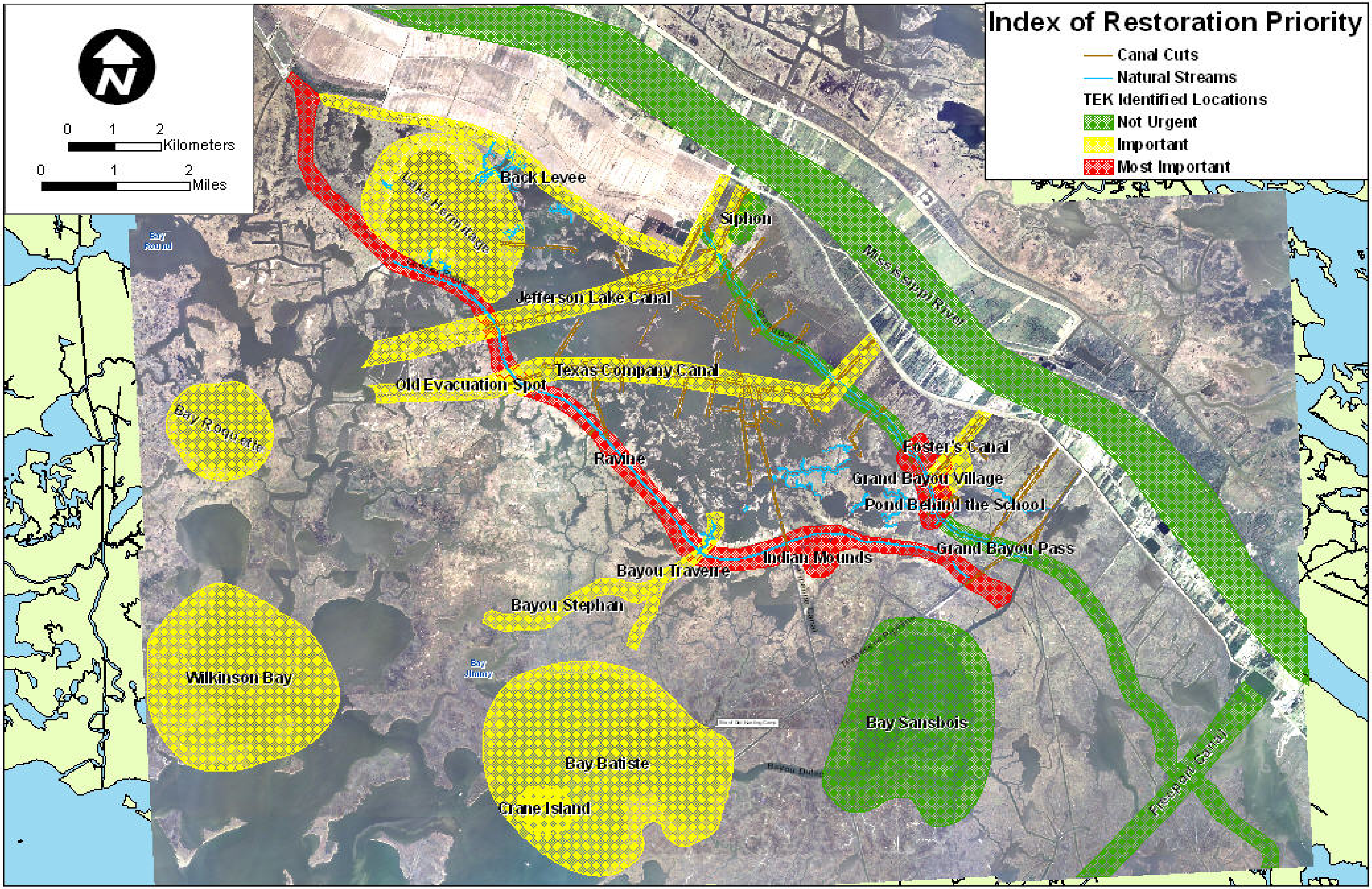
2009 Grand Bayou Area Fragmentation Map



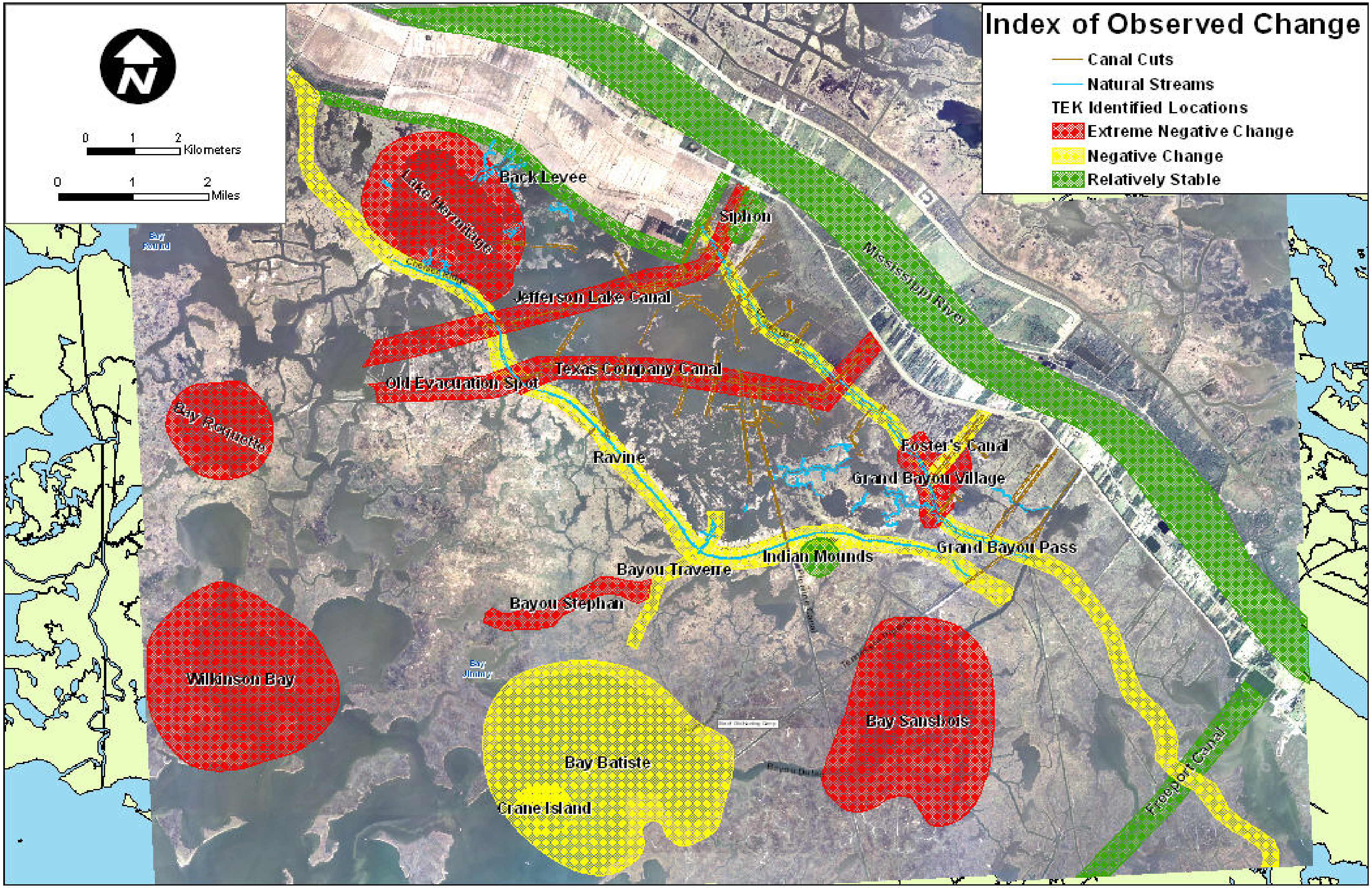
Grand Bayou Area Marsh Vulnerability Map



Traditional Ecological Knowledge (TEK)-Based Index of Restoration Priority for the Grand Bayou Area Overlaid on November 2008 Aerial Imagery



Traditional Ecological Knowledge (TEK)-Based Index of Observed Change for the Grand Bayou Area Overlaid on November 2008 Aerial Imagery



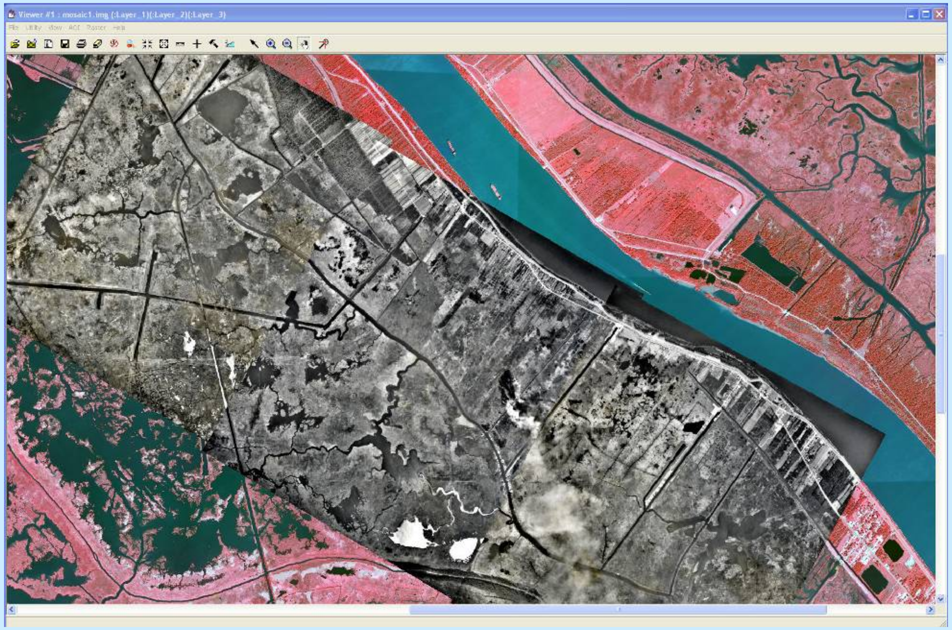
Data Collection and Integration Methods

If successful, the mapping products resulting from this study will provide the following information:

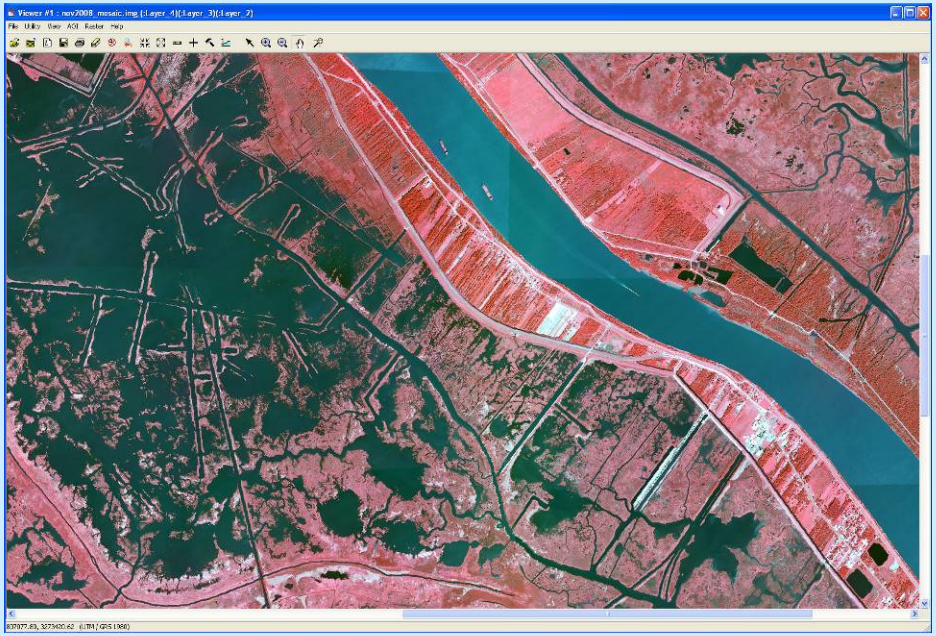
1) what marsh areas are most vulnerable (gained through a combination of the biophysical scientific data maps and the spatial fragmentation maps)

2) and areas that are most significant to the sustainability of the community (through the TEK-based maps)

**** these maps will be combined using GIS software***



11/13/1963 Aerial Photo Mosaic Overlaid on 10/30/2008 Image Mosaic



10/30/2008 Image Mosaic

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