

Adaptive Capacity of Vermilion Parish, Louisiana

GIS Water Resources :: Fall 2012

Adams, Danica C

EXECUTIVE SUMMARY

This project fits in to a larger research project geared towards providing a unique and relevant perspective on planning for coastal resilience in Vermilion Parish through an analysis of the adaptive capacity of cattle ranching in Vermilion Parish. Adaptive capacity is a significant component of resilience. Cattle ranching is a key element of coastal resilience in Vermilion Parish. The first step in the process of analyzing adaptive capacity is to understand the baseline characteristics of Vermilion Parish from a social and environmental perspective.

This project focuses on identifying social and environmental characteristics of Vermilion Parish, Louisiana, particularly those that contribute to the overall resilience or vulnerability of the parish. The parish may experience increased vulnerability from increased risk of flooding due to extreme weather conditions, coastal subsidence, and sea level rise.

In order to identify spatial vulnerabilities, I first performed a base analysis to identify existing demographic, environmental and cultural features. The next step in my analysis will be to include statistical data about total number of cattle and total number of land acres dedicated to pasture from the National Agricultural Statistical Service.

By combining this GIS mapping project with resident interviews and archival research, I will eventually stitch together a larger picture of overall adaptive capacity of cattle ranching in Vermilion Parish.

INTRODUCTION and BACKGROUND

Adaptive capacity is the ability of a system to adapt to changing circumstances while still retaining fundamental functions. Adaptive capacity has many facets. Economic, environmental, and political issues may be considered different aspects of it, as well as social capital. Social capital is defined by Putnam (1995) as “features of social life – networks, norms and trust that enable participants to act together more effectively to pursue shared objectives.” Adaptive capacity is one characteristic of the bigger concept of resilience. Resilience ecology has evolved since C.S. Holling first applied the concept of resilience and alternate stable states in his paper “Resilience and Stability of Ecological Systems” (Holling, 1973). In this 1973 article, resilience was stated to be one of the defining characteristics of an ecological system. According to Holling, resilience is an inherent property of a system – it determines the persistence of relationships within

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a system and is a measure of the ability of these systems to absorb changes and still persist.

As climate change progresses, the sea level is projected to rise. Due to climate change, extreme weather conditions such as hurricanes and floods are increasing in frequency. Due to subsidence, coastal erosion and land use change, coastal ecosystems are dwindling in number, size, and quality. At the same time, these extreme weather conditions are putting additional pressure on existing areas to provide critical ecosystem services such as flood protection. In the last century, sea level rose 5 to 6 inches more than the global average along the Mid-Atlantic and Gulf Coasts, because coastal lands there are subsiding.¹ Vermilion Parish is located on the Gulf Coast along the western region of the Louisiana coastline.

“Water levels along the Louisiana coast—from Holly Beach to New Orleans to the Chandeleur Islands—have risen by up to 40 inches over the past 100 years due to a combination of globally rising seas and substantial local sinking of the land (subsidence).”² The marshes, wetlands, and estuaries along the coast of Louisiana are support systems for a significant portion of the commercial fisheries in the Atlantic Ocean. Many residents of Vermilion parish rely on these fisheries for income. “Preservation and stewardship of our coast should be understood as a region-wide responsibility.”³

This climatic data shows increasing vulnerability of coastal Louisiana, a place of rich cultural history. This area is inhabited by an enclave of communities who make their living as oilfield workers, rice and crawfish farmers, shrimpers and oystermen, and cattle ranchers. Marshes, wetlands, and estuaries along the coast of Louisiana, or the miles-wide transition from land to sea and from freshwater to saltwater, are support systems for a significant portion of the commercial fisheries in the Atlantic Ocean (NOAA, Coastal Habitats). These areas also act as a sponge, soaking up water that is dumped on the marshes during hurricanes, thereby protecting homes, businesses, and critical infrastructure. In addition to being environmentally significant, these upland coastal areas are also ideal places for cattle ranching, a major livelihood of Vermilion Parish.

¹ <http://epa.gov/climatechange/effects/coastal/index.html>

² http://www.ucsusa.org/gulf/gcstatelou_cli.html

³ Louisiana Speaks Regional Plan, 2007. Pg 4.

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PROBLEM STATEMENT and HYPOTHESIS

Vermilion Parish is home to 57,000 residents.⁴ The cities, towns and villages currently located in Vermilion Parish are long-standing, established communities that are increasingly at risk of flooding or other natural disaster.

I anticipate finding that much of the study area has a very low density settlement pattern with concentrated population centers in the northeastern portion of the Parish. I also anticipate finding that there are ecologically sensitive zones in the southern portion of the Parish. Additionally, through the base analysis I will determine what areas of the US Census Designated Places are within Federal Emergency Management Agency (FEMA) designated high to moderate risk zones. I suspect that several identified cities and city services such as hospitals, parish offices and schools are within these FEMA high or moderate risk zones.

METHODOLOGY

DATA DECISIONS:

Given that this study is an analysis of the intersection of cultural and environmental forces, a complete base analysis necessarily included scientific, environmental, and cultural aspects.

The Federal Emergency Management Agency (FEMA) is widely regarded as the primary organization for assessing flood risk. FEMA distinguishes several risk categories for flooding, including undetermined, minimal, moderate and high risk areas. In order to illustrate the flood zone categorization and the elevation of Vermilion Parish, I downloaded a flood zone characterization shapefile from FEMA and an elevation raster from the Louisiana Department of Environmental Quality (LDEQ).

For the environmental analysis, I searched for data such as wildlife management areas and Louisiana Department of Wildlife and Fisheries (LDWF) ecoregion types, endangered species locations and environmentally sensitive areas. I was able to access shapefiles for wildlife management areas and ecoregion types.

I determined that relevant cultural information is that which indicates existing infrastructure and population concentration. Government services such as schools,

⁴ 2010 Census

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hospitals, airports, roads, state-owned land and buildings, and US Census Designated Places as well as demographic information was included.

DATA ACQUISITION:

I downloaded most of my data in the form of shapefiles and rasters from Louisiana's Geospatial Metadata Catalog, a website created by Louisiana Geographic Information Center to collect and distribute GIS data. It is found online at agic.lsu.edu/datacatalog/. Other data sources include ESRI Census 2000 TIGER/Line Data, for demographic and census block information, and the Entergy sponsored Louisiana Site Selection Center, for the point locations of government services, ecoregions, and shapefiles for Wildlife Management Areas.

DATA SUMMARY:

I used the following data:

▪ Watersheds	shapefile	poly
▪ State owned lands and buildings	shapefile	poly
▪ 1999 FEMA flood zones	shapefile	poly
▪ Census Blocks	shapefile	poly
▪ Census Designated Places	shapefile	poly
▪ Parish Boundaries	shapefile	poly
▪ Airports	shapefile	poly
▪ Water bodies	shapefile	poly
▪ Ecoregions	shapefile	poly
▪ Wildlife Management Areas	shapefile	poly
▪ Roads	shapefile	line
▪ Parish offices	shapefile	point
▪ Social Services	shapefile	point
▪ Health and hospital facilities	shapefile	point
▪ Schools	shapefile	point
▪ Digital Elevation	raster	tif

FINDINGS

I produced six base maps showing various social and environmental characteristics of Vermilion Parish.

POPULATION DENSITY ANALYSIS:

Vermilion Parish is located on the Louisiana Gulf Coast, in the southwest portion of the state, directly south of Lafayette Parish. It is home to approximately 57,000 permanent

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residents in 2012. Vermilion Parish is expected to experience a small growth in the next 20 years, bringing its projected population to 60,000 residents. In 2010, residents in the age range 25-29 make up the largest category. By 2030, the age category with the largest number of people will be 45-49, reflecting an aging population (State of Louisiana, Demographics and Census Geography: Louisiana State Census Data Center).

Abbeville is the Parish seat, and is located in the north-central area of the parish. Abbeville is home to 12,250 residents in 2012 (U.S. Census Bureau, 2012). Vermilion Parish is largely rural, with the majority of families making a living as rice or crawfish farmers, cattle ranchers, or working for oil and gas companies. These professions largely rely on their land for their income; in this way, the social, economic and environmental components of well-being of the area are linked.

The population of Vermilion Parish is highly deconcentrated, with multiple census blocks containing no residents at all. Population concentrations are located in the northeastern portion of the parish, falling primarily within the towns of Kaplan, Maurice, Abbeville, Erath and Delcambre, and, to a lesser extent, Gueydan in the northwest quadrant. Population in the southern half is limited to 0 – 0.05 ppl/acre, or 1 person for every 20+ acres.

The Social Vulnerability Index, used in a study by Oxfam America, indicates that 71% of Vermilion Parish is located in a flood zone and 55% is located in what they refer to as a Sea Level Rise Zone (OxFam America, Louisiana Fact Sheet: The Social Effects of Global Warming). According to this study, which combines social and physical factors with climate impacts to determine an area’s overall social vulnerability, Vermilion Parish is currently considered highly vulnerable.

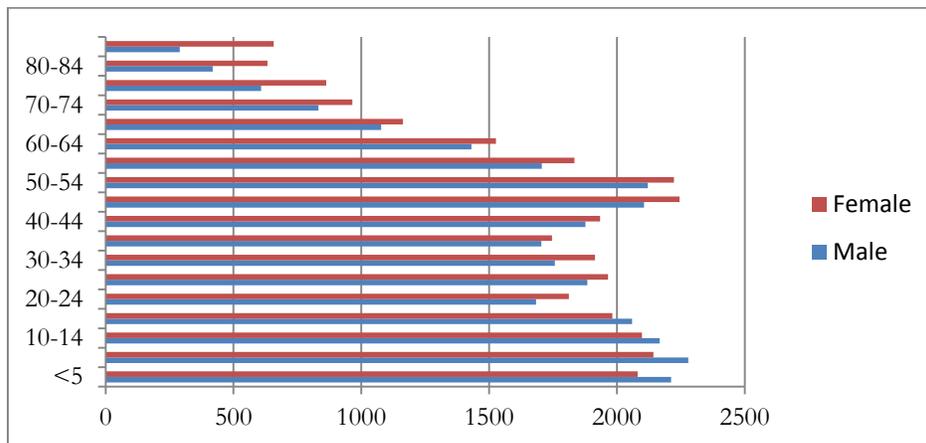
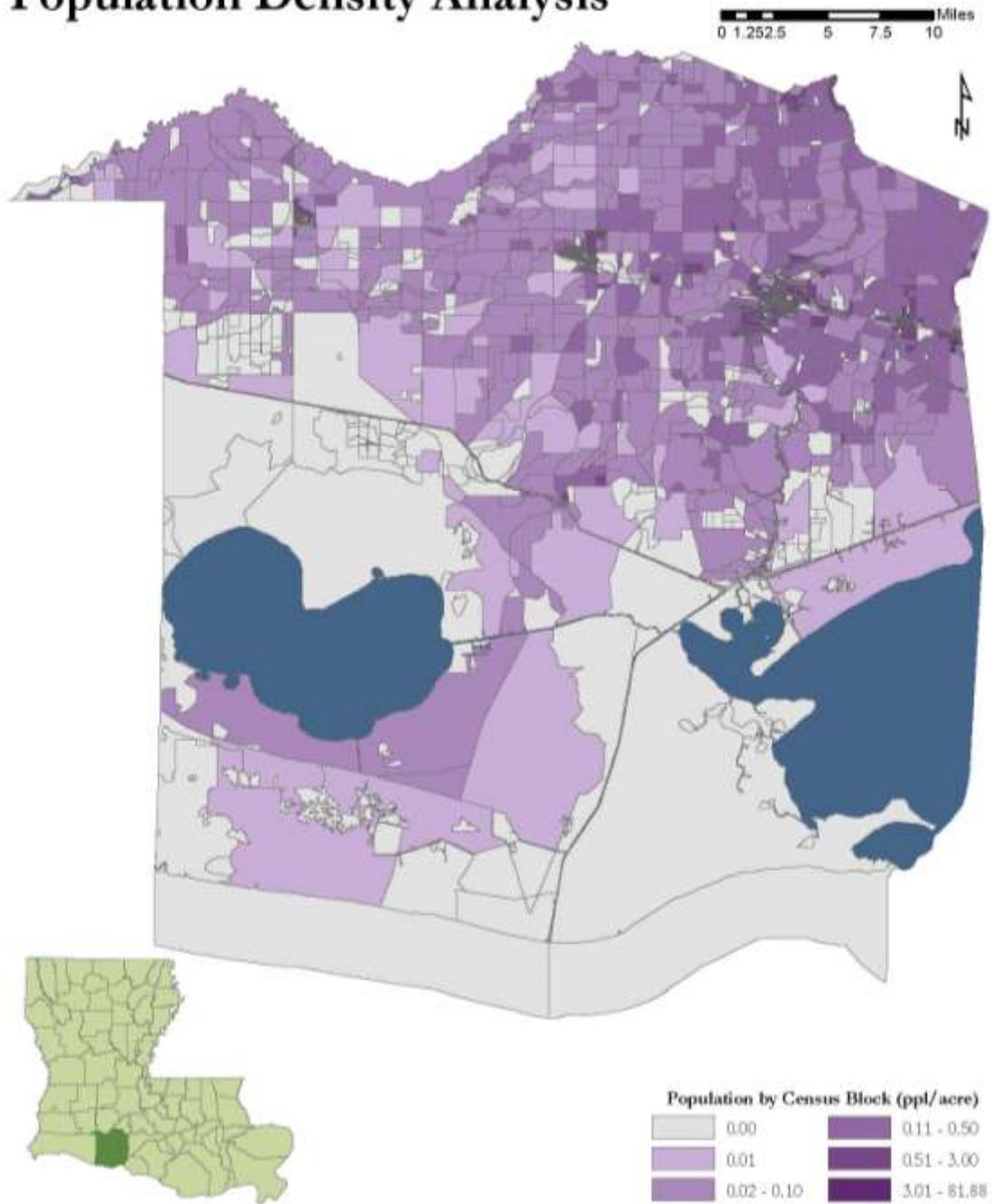


Figure 1: Population profile of Vermilion Parish, Louisiana (2012 Census Data)

Vermilion Parish Base Analysis

Population Density Analysis



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Figure 2: Population map of Vermilion Parish

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PLACEMENT OF GOVERNMENT SERVICES AND INFRASTRUCTURE:

Governmental services and cultural amenities such as parish offices, schools, social services, hospitals, roadway infrastructure, and census designated places are primarily found in the northern portion of the state. While the majority of this infrastructure is found in higher elevations, there is still a significant percentage that is present in low lying areas with a high risk of flooding.

Vermilion Parish Base Analysis Civic Service and Infrastructure Placement

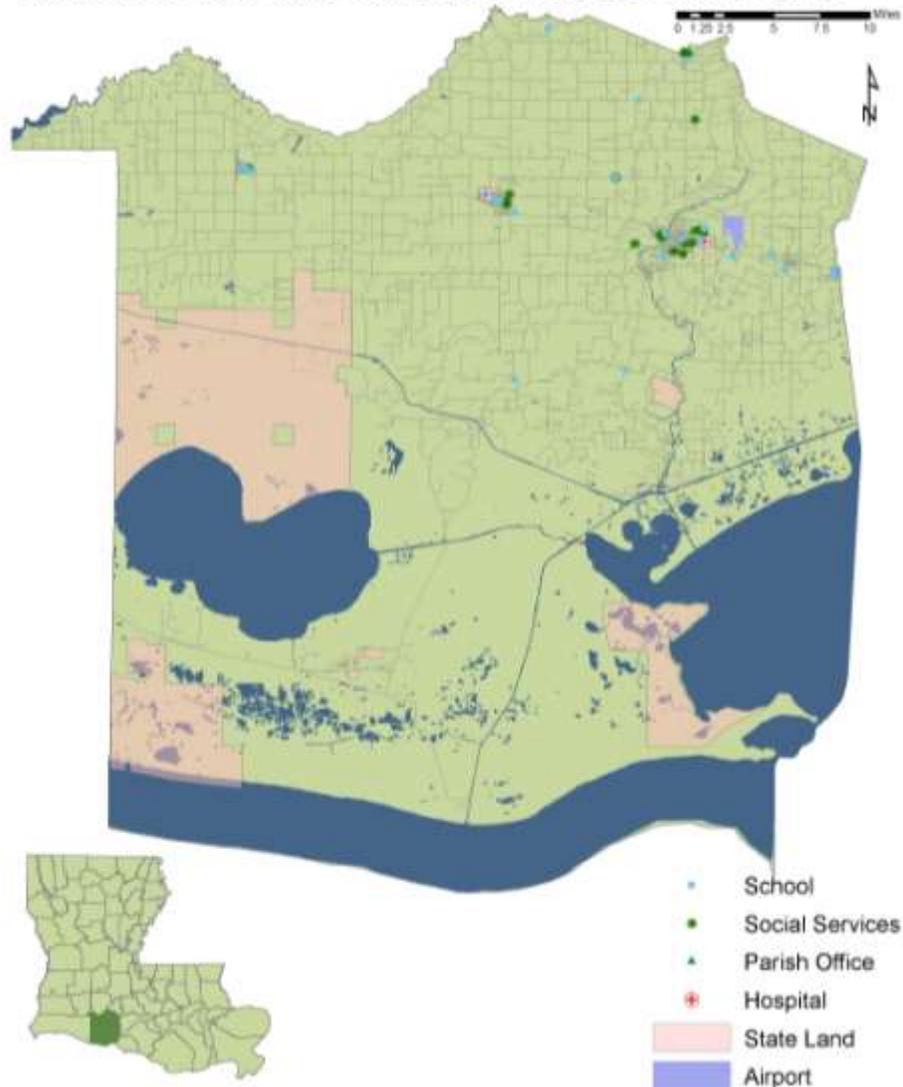


Figure 3: Civic Service and Infrastructure Placement

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ELEVATION ANALYSIS:

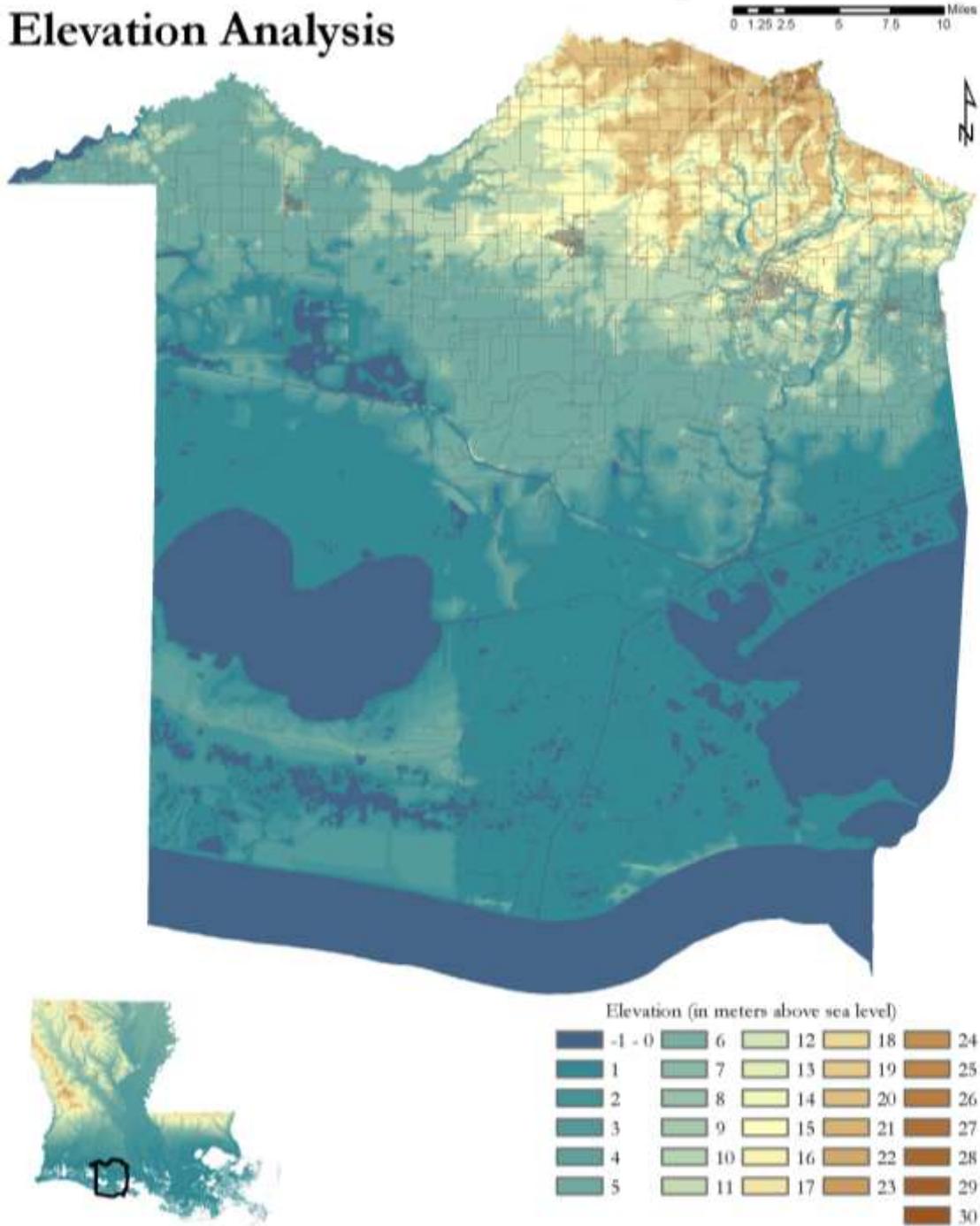
The elevation of Vermilion Parish ranges from one meter below sea level to 30 meters above sea level. The highest areas of the Parish are located in the northeast corner of the state and the lowest elevations are found around the two lakes in the south. There is one swath of low-lying land (six meters in elevation) that extends from the northwest corner, curves down below Abbeville, and moves to encompass Delcambre on the eastern boundary. The mean elevation of the parish is 14.5 meters above sea level, and there are 80,282 acres, or 125.5 sq mi, in the parish at 10 meters or less above sea level.

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Vermilion Parish Base Analysis Elevation Analysis



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Figure 4: Digital elevation of Vermilion Parish, Louisiana

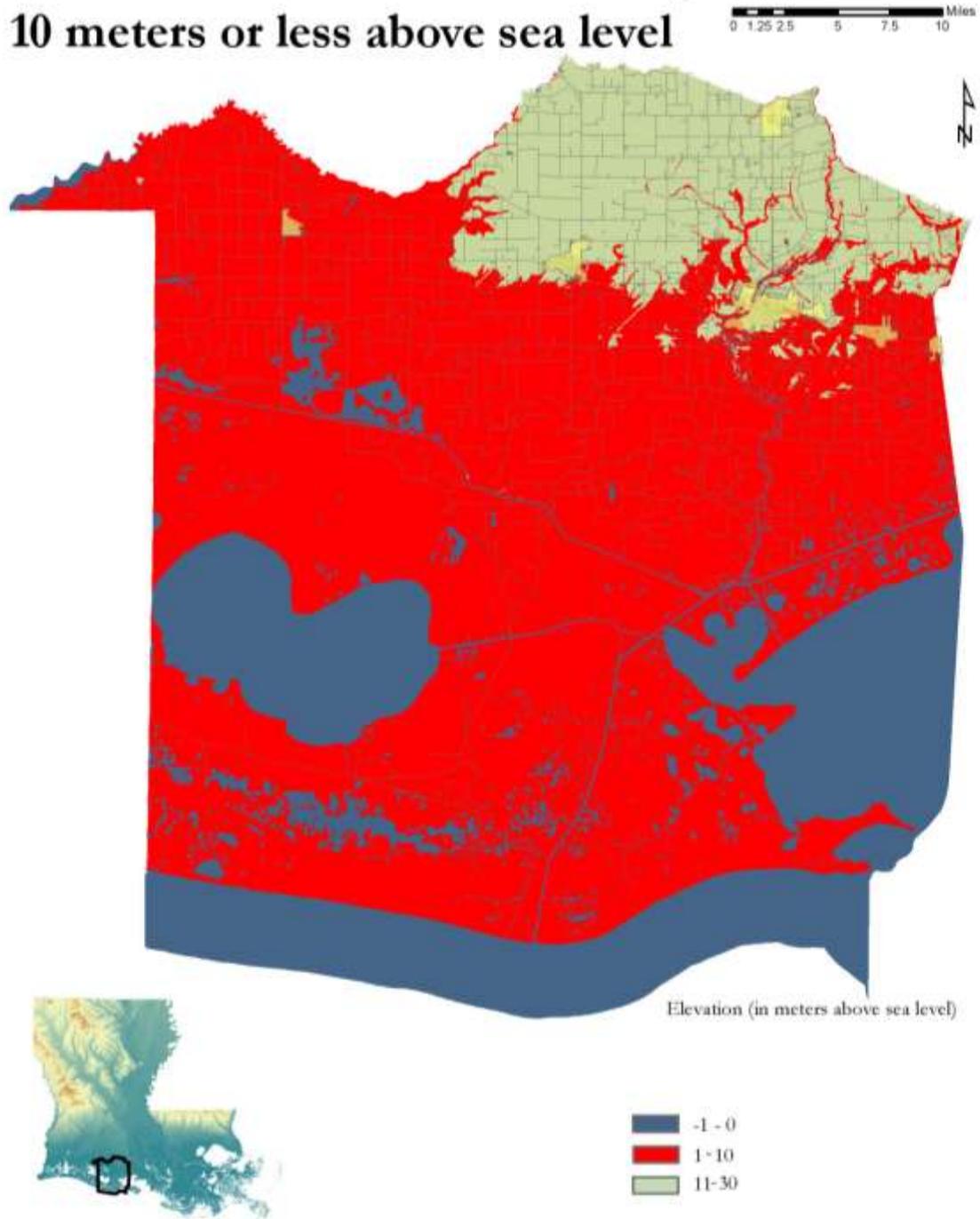
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Vermilion Parish Base Analysis

10 meters or less above sea level



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Figure 5: Land area of Vermilion Parish that is 10 meters or less above sea level

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FLOOD RISK ANALYSIS:

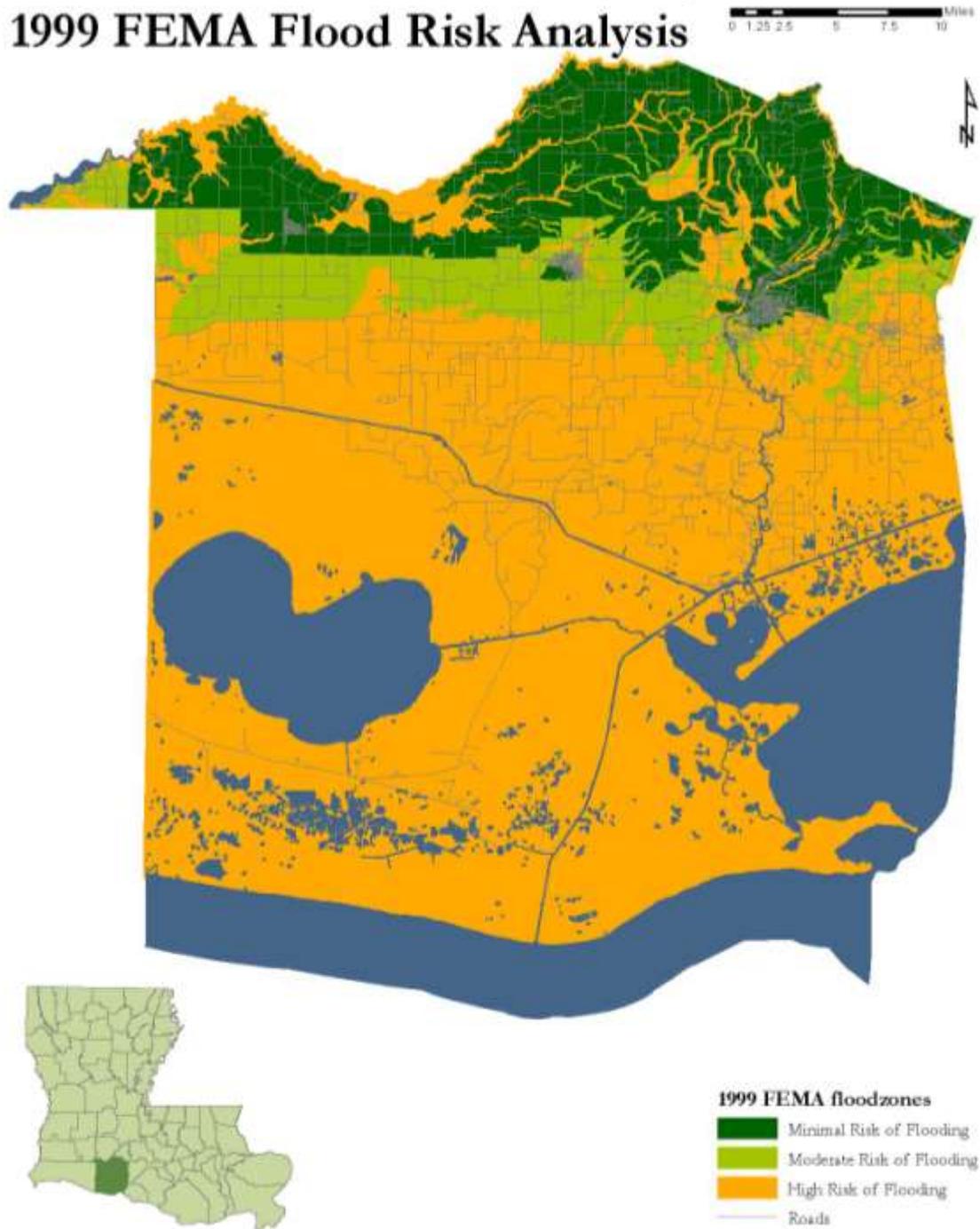
The majority of Vermilion Parish is within the moderate or high risk flood zones. FEMA has designated zone X as areas above the 500 year floodplain that have a ‘minimal’ risk of flooding, X500 as areas between the 100 and 500 year floodplain that have a ‘moderate’ risk of flooding, and zone A, or ‘significant’ flood hazard areas, as areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. The town of Maurice is highest in elevation, with the entire town in the minimal flood hazard zone. Meanwhile, Abbeville, Kaplan and Gueydan are on the border between the minimal and moderate flood zones, with portions of the town in each. The towns of Erath and Delcambre are fully in the high risk zone.

This is important when we consider that the pressures exerted on the coast are increasing. Due to climate change, extreme weather conditions such as hurricanes and floods are increasing in frequency. Due to subsidence, coastal erosion, and landuse change, coastal ecosystems are dwindling in contiguosness, size, and quality. At the same time, these extreme weather conditions are putting additional pressure on existing areas to provide critical ecosystem services such as flood protection (US EPA, Climate Change Impacts and Adapting to Change, June 2012; NOAA, Coastal Habitats; & NOAA, Climate Change).

The 2012 Louisiana Coastal Master Plan estimates that, due to these factors, the relative sea level in Louisiana will increase by 0.4 to 2.1 feet by 2062, 50 years from now (Coastal Protection and Restoration Authority of Louisiana, May 2012. Pg. 83). This open water does not provide the same ecological services that the wetlands do – instead of absorbing the storm surge, this open water contributes to it. Instead of protecting homes, the proximity of open water makes them more vulnerable to floods.

Vermilion Parish Base Analysis

1999 FEMA Flood Risk Analysis



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Figure 6: FEMA Flood Risk Analysis

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ENVIRONMENTAL ANALYSIS:

The State of Louisiana owns significant acreage just north and south of White Lake, as well as on the eastern boundary of Vermilion Parish. The southern half of the Parish is comprised of two different types of coastal marshes while the northern half of the Parish, where existing towns are located, is comprised of Lafayette Loess Plain and Northern Humid Gulf Coastal Prairies. There are large state-managed wildlife management areas in what is classified as the Texas-Louisiana Coastal Marshes. In addition to the WMA's, cattle ranching is a significant land use and occupation in this southern ecosystem. Cattle ranching is common in the coastal marshes because coastal areas rarely freeze. This means that the cows can stay in pasture year-round and the ranchers should rarely, if ever, have to supply baled hay. There is a significant environmental legacy left over from draining the marshes for use as pasture. This was done by building a system of levees and dykes that still exists today. In addition to Sec. 404 of the Clean Water Act (CWA) banning the dredge and fill of wetlands, the Louisiana Department of Wildlife and Fisheries (LDWF) has also explicitly banned the practice of levees and dykes to form crawfish and rice ponds or cattle pastures. Existing levees were legally grandfathered in.

At the end of the winter season, ranchers will burn their fields. This practice of burning is a point of collaboration between LDWF and ranchers. LDWF supports the burns for the same reason the ranchers do: it promotes new grass growth. This, in turn, generates an ecosystem of insects that support the spring migratory bird population.

The most significant point of vulnerability of the cattle ranching industry is during hurricane season when the risk of serious flooding may prompt ranchers to move their cattle upland.



Figure 7: Burning the Marshes

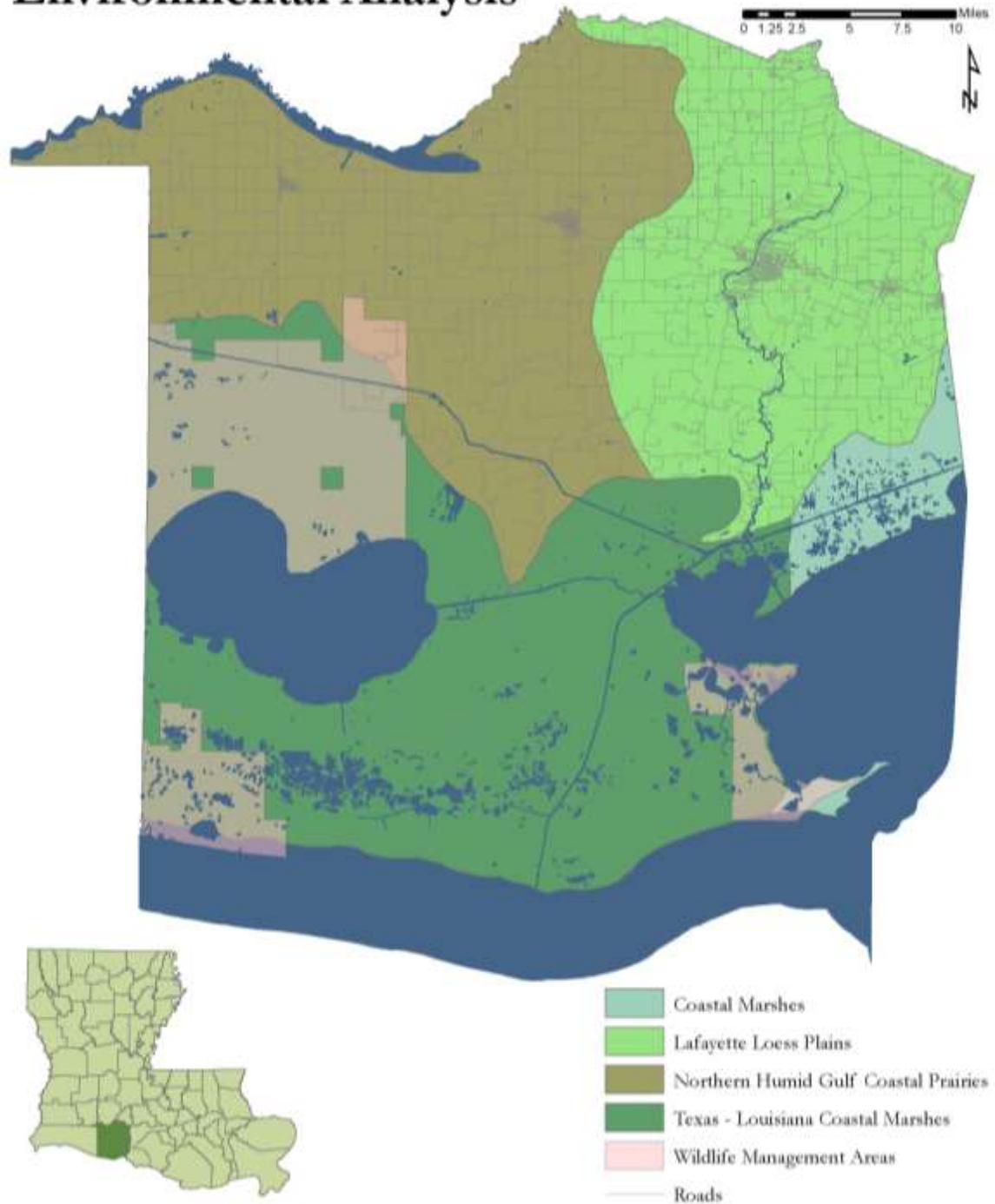
Source: USACE <http://www.mvs.usace.army.mil/rivers/RMBS.html>

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Vermilion Parish Base Analysis Environmental Analysis



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Figure 8: Environmental Zone Map

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ANALYSIS & DISCUSSION

CAVEATS/ POTENTIAL SOURCES OF INACCURACY/ LIMITATIONS

According to the Environmental Protection Agency, efforts to project flooding and shoreline change where wetlands dominate require both good elevation information and a model of how wetlands erode, subside and accrete, as well as a scenario regarding future shore protection efforts.⁵ Due to the limitations of existing spatial datasets and my limited experience with ArcGIS 10, as well as an ever-changing body of scientific knowledge regarding the effectiveness of various coastal protection efforts, this study was unable to take specific sea level change projections into account.

There is limited GIS data available for Louisiana, and even less data available for Vermilion Parish. Much of the data that is available was developed previous to the recent devastating hurricanes and so does not include the most recent changes to coastal boundaries or government services, which have changed dramatically. The schools shapefile, for instance, is from 2007, the year before Hurricane Ike. This hurricane wiped out multiple school facilities in Vermilion Parish and significantly reduced the population of certain areas.

Environmental information that I found was frequently not detailed enough to be significant in this study. I was unable to find spatial representation of the location of endangered species habitats or other critical ecosystems. The shapefiles that I obtained that detailed salt marsh, brackish, intermediate, and fresh water marsh as well as swamp land were locked for editing. This prevented me from defining or projecting them, and thus prevented my use of them.

In addition to the above complications, I included the 1999 FEMA flood zone maps. There was an updated set of FEMA maps released in January 2011, but I was unable to locate a GIS shapefile that I could use for this project.

Another relevant dataset would be landuse. Since landuse change is one of the most significant drivers of habitat loss and contributes to saltwater infiltration/coastal land loss, exploring options for increasing density of agricultural uses or shifting agricultural production away from space-intensive uses would be exciting.

⁵ <http://www.epa.gov/climatechange/effects/downloads/maps.pdf>

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Figure 7: Burning the Marshes

Source: <http://www.mvs.usace.army.mil/rivers/RMBS.html>

Figure 8: Environmental Zone Map

REFERENCES & DATA SOURCES

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