Status and Trends of Coastal Vulnerability to Natural Hazards Project Annual Report for Phase 5

by

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Status and Trends of Coastal Vulnerability to Natural Hazards Project
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When originally conceived, the Status and Trends of Coastal Vulnerability to Natural Hazards project was a multi-phase project designed to undertake a status and trends study of coastal vulnerability to natural hazards of counties located in the Coastal Management Program (CMP) boundary. The original target areas for this study were Harris, Galveston, and Brazoria counties. However, much of the overall analysis included counties along the entire Texas Coast.[1] The original full project included the following tasks:

1. Evaluate content and implementation of the State of Texas Hazard Mitigation Plan (SHMP) (2004) for applicability to the CMP.
2. Assess the regulatory regime and effectiveness of construction codes and land use planning policies to mitigate potential impacts of coastal natural hazards.[2]
3. Identify best practices and emerging technologies related to building code and land use planning that could further mitigate potential impacts of coastal natural hazards.
4. Assess the local, state and federal resources available for mitigation, preparedness, response, and recovery to coastal natural hazards and evaluate their application to the CMP.
5. Evaluate the geographic relationship between current coastal management program boundaries and projected impacts from various categories of hurricanes based on the latest coastal study area maps.
6. Assess the physical and social vulnerabilities of coastal populations to facilitate planning and policy development related to hazard mitigation and response.
7. Assess the adoption of hazard mitigation technologies (e.g., hurricane shutters), issues related to the adoption of these technologies, and disaster planning by households and municipalities so that effective and targeted outreach and education activities can be developed.[3]

[1] The original proposal targeted counties in and around the Lake Sabine area, which included Chambers, Hardin, Jasper, Jefferson, Liberty, Newton, and Orange counties. However, after consulting with GLO staff, it was mutually agreed that the target areas would be Harris, Galveston and Brazoria counties, with an emphasis on those areas and communities within the CMP boundary. Throughout the first phase of this project, other changes were made to the original proposal, always based on consultation and agreement with the GLO staff. This document reflects these changes.

[2] By mutual agreement, the emphasis of this task shifted from construction codes and land-use planning policies, to a focus and assessment of mitigation actions plans and mitigation actions for areas within the CMZ.

[3] By mutual agreement and due to budget cuts in March of 2010 it was agreed that this task would focus on the adoption of mitigation polices by municipalities and not households.

It is hoped that the research outlined above will generate policy and programmatic recommendations related to coastal programs, management, and regulations. This research also developed tools for enhancing public involvement in mitigation decision making and planning, as well as for assessing programmatic and policy weaknesses and hazard vulnerabilities along the Texas coast. Finally, it is hoped that this research will generate recommendations to better insure compatibility between and concerted action based on the SHMP and the CMP, strengthening mitigation activities throughout the CMP boundary.

The following report provides a brief overview of the accomplishments for the fifth phase of this project and its associated tasks as outlined in the specific contract for Cycle 15. The tasks outlined below are those specifically identified in Cycle 15, not the general tasks outline above. In addition, workshop materials associated with Cycle 15's Task 5 discussed below are included as Appendices at the end of this report.

Task 1 - Phase 5: Identify best practices and emerging technologies related to hazard mitigation planning, building code, land use planning that could further mitigation against potential impacts of coastal natural hazards.

Task Description: This task will draw from findings emerging from Phases 1-3. As part of the interviewing and investigations of building codes and land use planning policies, best practices will, on a continuing basis, be identified. This task highlight best practices in terms of their relative effectiveness and outline issues that emerged as local jurisdictions have sought to incorporate these practices into their local building codes or land use practices. Best practices that emerged and/or were adopted by local jurisdictions within Texas will be sought. However, this task will also review literature on land use planning, building codes, and emerging construction technologies that have the potential to positively impact coastal mitigation actions.

Deliverable(s): The website will be enhanced and updated as content is identified.

The initial *Best Practices* website was launched at the end of November 2008 on the TAMU website and has also been added to the TAMU-Galveston website (http://coastalatlas.tamug.edu). The development of the content of the *best practices* website was informed by the ongoing and evolving analysis of hazard mitigation planning, policies and strategies with respect to their relative effectiveness and applicability to coastal communities in Texas based on the existing literature and our direct analysis of interview data, hazard mitigation plans and proposed actions, existing hazard exposure and social vulnerability of the Texas Coast, and finally our analysis of actual mitigation policies and strategies being employed along the Texas Coast, with an emphasis of jurisdictions (counties and communities) within the Coastal Management Zone (CMZ).

As reflected in our report entitled *The Adoption and Implementation of Hazard Mitigation Polices and Strategies by Coastal Jurisdictions in Texas* (Peacock and Husein, 2011), there is a host of ways to characterize broad based hazard mitigation strategies. Traditionally these are often characterized as structural versus non-structural (Burby & French 1981; Alexander 1993; Moga 2002; William & Micalef 2009; Godschalk et al., 1999; Lindell et al., 2006). Structural mitigation generally is considered to involve some form of engineering features providing protection from disaster agents with common examples being levees, dams, seawalls, dykes, and riprap (Godschalk et al., 1999; Klee1999; Lindell et al., 2006). Non-structural mitigation involves a broad set of mitigation strategies that include regulating development in environmentally sensitive areas, installing window shutters for buildings located on hurricane-prone coastlines, and educating the public to reduce any impact of hazards (Burby, 1998; Godschalk et al., 1999; Lindell et al., 2006). Interestingly, building codes, which are often derived from engineering studies and yet represent development policies, are considered by many to fall in both forms of mitigation strategies (Lindell et al. 2006).

Historically structural mitigation strategies were often given precedence, because they were often seen as most effective at addressing mitigation issues. However, the literature has pointed out that structural strategies often require modifications of the natural and physical environment causing physical damage and degradation of the natural environment reducing or eliminating ecosystem services that provide mitigation and increase vulnerably. For example the destruction of wetlands reduces the mitigation services they can provide in coastal regions as well as increasing the likelihood of human-made disasters resulting from the failure of damns and levees (Klee, 1999; Dalton & Burby, 1994). Structural approaches are often very expensive to build and require high maintenance costs (Alexander, 1993; Burby, 1998). The failure to maintain them can lead to great losses as in the case of Hurricane Katrina where much of New Orleans was destroyed because of the failures and breaches of the levees and floodwalls protecting the city due to poor maintenance and design failure (Daniels et al., 2006). In addition, structural approaches may provide a false sense of security to the public (Dalton & Burby, 1994; White, 1936) encouraging new development in the hazardous or environmentally sensitive areas (Burby et al., 1985), thereby resulting in net increases in vulnerability. Even in the case of building codes, which are generally considered a basic step in insuring hazard mitigation, their effectiveness is doomed without timely and responsible code enforcement, as was made evident after Hurricane Andrew.

The literature also suggests that non-structural policies and strategies offer comprehensive approaches that may result in fewer negative effects to the natural environment while promoting appropriate development in risky areas. Non-structural approaches offer a number of advantages in that they are relatively less costly, provide sustainable tools at the local level, offering obvious way to avoid many high risk areas (Hyndman & Hyndman, 2006), and yet provide important tools for reducing losses to natural disasters (Burby et al., 2000). Numerous studies have been conducted showing the effectiveness of these strategies in the US and other countries (Berke et al., 1999;

Burby et al., 1985; Burby, et al., 1999; Godschalk, Brower, & Beatley, 1989; Henstra & McBean, 2004; Brody 2012). In general these approaches focus on adjusting human activities, such as encouraging development outside high-risk areas, appropriate development that explicitly addresses the natural hazard exposure, the risks associated with an area, and the preservation of environmental resources and ecosystem services.

While the literature offers research addressing specifics with respect to specific building components, control experimental research on now whole structures that incorporate permutations and combinations of codes, components, and techniques, similar to what is often found in actual homes as they evolve through time are nonexistent. Furthermore while organizations such as the American Society of Civil Engineers help insure that newer building codes can be generally characterized as improvements over older buildings codes, the literature also has also shown that the actual building codes adopted can be weakened through time. Similarly, while there is research evaluating the effectiveness of many non-structural policies and strategies and some work that seeks to control for specific forms of structural mitigation strategies, the full complexities and possibilities are never assessed. As a consequence there simply is no research that assesses the complexities of the relative effectiveness of many structural versus non-structural approaches.

However, the literature is quite clear that the key for adopting appropriate and more effective mitigation strategies and policies starts with an understanding of the potential vulnerabilities of local jurisdictions by analyzing the nature of its hazard exposure and physical and social vulnerabilities. This becomes the fact basis upon which to develop appropriate mitigation planning and adopting a portfolio of policies and strategies that address the many and complex dimensions of local communities with respect to their hazard vulnerabilities. Indeed, the literature is also quite clear that there is no magic combination of mitigation strategies that will work in all cases, what is required is an understanding of the hazard vulnerabilities and the development of a portfolio of strategies and policies that can promote mitigation across the full complexity of local communities composed, as they are, of individuals, households, small and large businesses, various government agencies and a host of local organizations and stakeholders. In some sense we undertook a similar, but broader assessment and analysis of coastal jurisdictions (counties and municipalities) to develop a *fact basis* upon which to develop the *Best Practices* website.

The first step in this process began by conducting a survey of State, County, and Local Officials on mitigation and mitigation issues (Peacock, Husein Burns, Kennedy, Kang, and Prater 2009a). There were a host of issues that emerged during these interviews that shaped our selection and focus for best practices with some of these being: there was a general appreciation that hazard mitigation policies and strategies can take on many forms, but the nature of non-structural forms is less clear; mitigation planning in generally handled with assistance from outside consulting firms, with little understanding for how it might be handled locally; environmental issues, such as

wetland preservation, are not generally viewed as significant for hazard mitigation; and recovery planning and its relationship to mitigation planning is little recognized.

To better understand the nature of coastal vulnerabilities we undertook an assessment of coastal hazards, disaster impacts, and policy analysis for coastal jurisdictions (Peacock, Kang, Lin, Grover, Husein and Burns 2009). In particular we examined the nature of the exposure for coastal jurisdictions, inside and outside CMZ areas related their jurisdictional and population exposure to surge, flooding, and wind related hazards. We also examined disaster losses from 1960 through the 2007 and undertook an examination of various forms of hazard mitigation polices including hazard mitigation plans, comprehensive plans, zoning, CRS participation, and building codes. In addition, we undertook a detail examination of actual hazard mitigation plans for jurisdictions in the Coastal Management Zone (Peacock, Kang, Husein, Burns, Prater, Brody and Kennedy 2009). These findings reinforced our earlier findings related to hazard mitigation planning being highly dependent on outside contractors often lacking local understanding and broad based participation. Not surprisingly we found significant hazard exposure with respect to surge, flooding, and wind, particularly for CMZ jurisdictions. The results with respect to the analysis of hazard mitigation plans suggested that the overall scores were relatively low and even more importantly, the *fact basis* of these plans were extremely low often resulting in action plans that were not consistent with hazard exposures. In addition, the analysis of the action plans reflected a rather narrow range of mitigation actions, often focused on emergency management, not mitigation. Our analysis suggested a need to increase the understanding the nature of hazard mitigation planning in the first place, a need to better understand the full range of hazard mitigation policies and strategies that might be employed, and the need for further technical understanding for tools that might be employed to address the fact basis of this planning process.

The final stages of our analysis consisted in undertaking an extensive examination into the social vulnerabilities of coastal populations (Peacock, Grover, Mayunga, Van Zandt, Brody and Kim 2011) and a survey and analysis of the actual types of mitigation strategies and policies have been adopted and implemented by coastal jurisdictions. Our findings for the latter were contained in a report entitled, *The Adoption and Implementation of Hazard Mitigation Policies and Strategies by Coastal Jurisdiction in Texas* (Peacock and Husein 2011). Our findings with respect to social vulnerability show increasing vulnerabilities as populations become more diverse, older, and many experiencing challenges with respect to poverty, housing, etc. The policy analysis firmly established a number of issues: may counties have no building code, and the codes in existence are often terribly out of date; the range of mitigation policies being considered are very narrow, limiting the portfolio of options being considered; working with and among community organizations and various associations seems to strengthen the range of approaches considered and adopted; and external funding and contact and involvement with state and other agencies promotes the range and diversity of approaches considered.

In light of our analysis the Best Practices website has evolved to include information on in a variety of areas to address issue we encountered throughout our analysis to help identify area that have the potential of helping insure effective mitigation planning and strategies are adopted throughout the coastal areas of Texas. More specifically we have focused on the collection of information related to best practices in general hazard mitigation planning and strategies given that there was often limited knowledge and understanding. We have also targeted and identified best practices related to specific hazard types that are potentially germane to jurisdictions, as well as some more general areas. Considerable effort has been focused on identifying best practices as they related to broad based land use and more non-structural approaches that have been more neglected. The webpage also identifies multiple technical and modeling tools, to address the limited fact basis we found in coastal mitigation planning efforts. A host of academic education and research sources have been identified to help provide important research upon which to guide mitigation planning. And, finally we have sought to identify a host of organizations and associations that can be contacted by local jurisdictions because we found that those areas that partnered with others agencies and organizations had more diverse mitigation policy and strategy portfolios. The details on each of the aforementioned areas are discussed below.

The Best Practices websites can be accessed off the Coastal Atlas portal website: http://coastalatlas.tamug.edu (see figure 1 below).

Figure 1. Texas Coastal Atlas web-portal

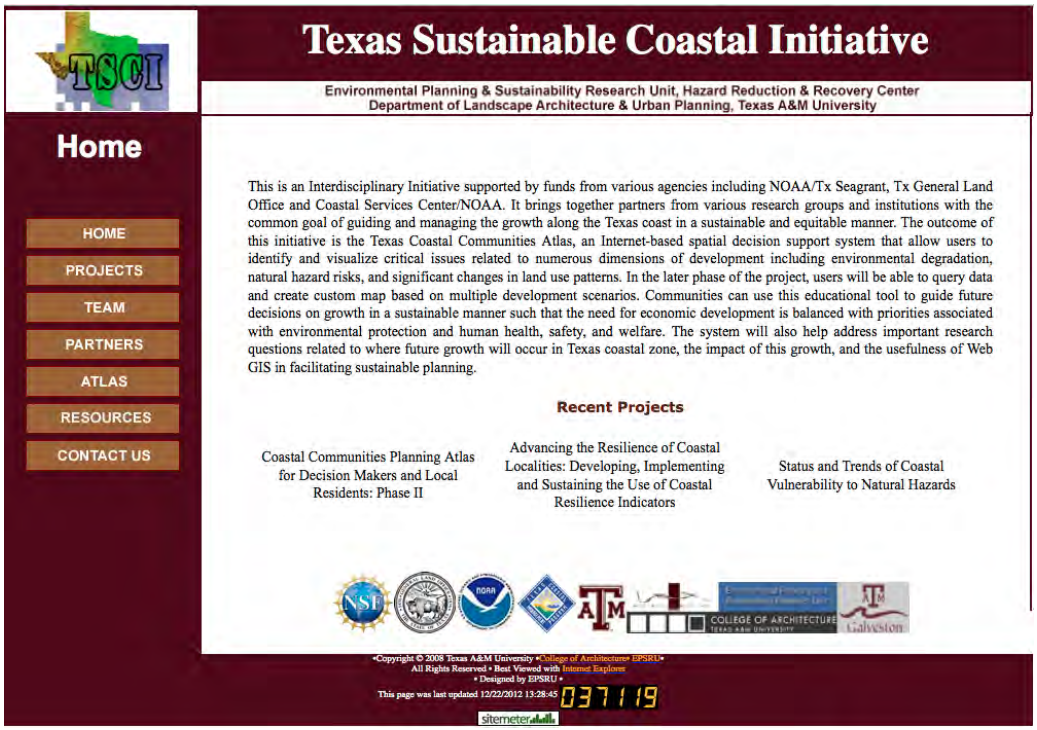
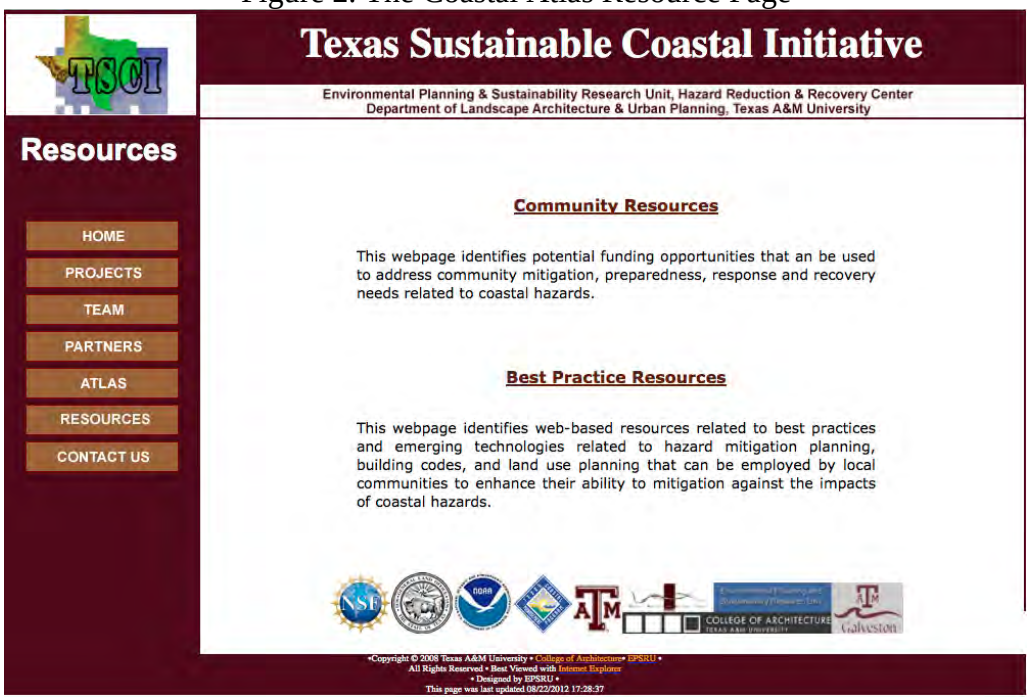


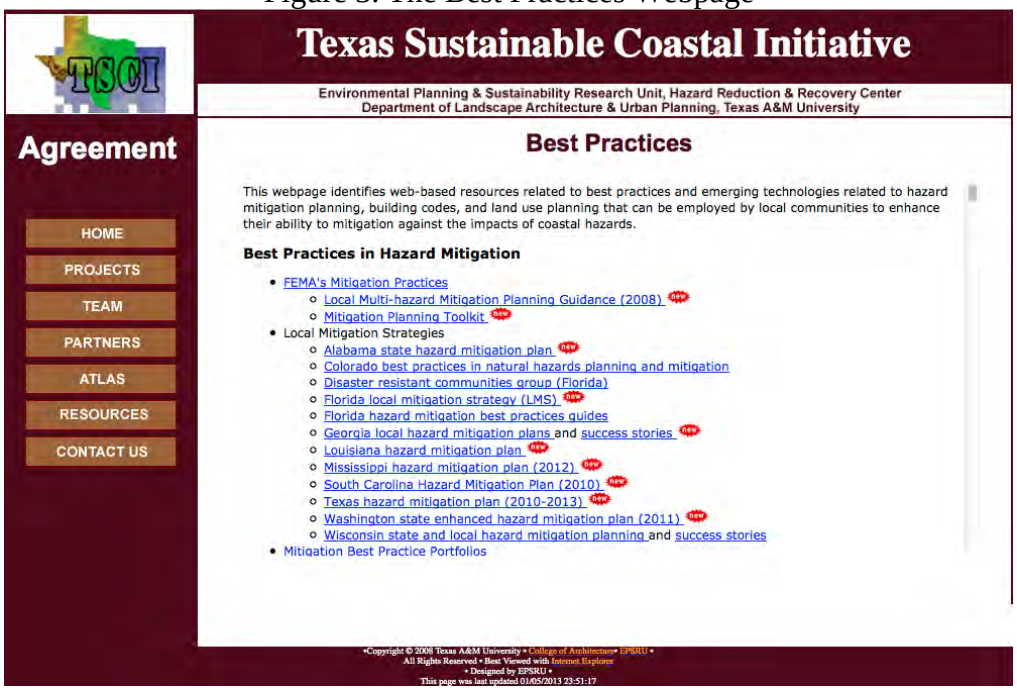
Figure 2. The Coastal Atlas Resource Page



After entering the portal, the user clicks on the “Resources” button, which is on the left side of the screen. After clicking the resources button, the resources web-page

(http://coastalatlas.tamug.edu/resources.htm) opens. This page gives users access to two resources pages; one of those pages is the "Best Practice Resources."

Figure 3. The Best Practices Webpage



The actual location of the website is: http://coastalatlas.tamug.edu/bestpractices.htm.

The Best Practices web-page displays information regarding special websites that identify a host of suggested best practices related to hazard mitigation policies and actions, videos of best practices projects and examples, and other information. In total the web-pages offer 6 different categories of potential best practices that include 230 sources including websites, books and articles. The main sections are as follows:

- ***Best practices in hazard mitigation***: This section offers a series of websites and even videos. Many of these sites are state or federal government websites that provide general mitigation best practices. In addition to the FEMA mitigation best practices website there are websites from Florida, Wisconsin, Colorado, and the National Governor Association's website. There are 41 links in this category.
- ***Best practices by hazard type:*** This section offers a series of websites that focus on best practices related to flood, wind and wildfire hazards. This section, again targets a variety of websites, including the National Flood Insurance Program (NFIP) and the Community Rating System's website. These two websites are important information that can greatly enhance policies focused on flooding. There are 46 links in this section.
- ***Best Practices in Planning, Management, and Administration:*** This section addresses best practices with respect to land use planning, recovery planning, and

building codes. These best practices are particularly important because they offer information on a great variety of non-structural approaches to hazard mitigation, which we found to be under utilized in the mitigation action plan analysis. There are 21 links in this section.

- ***Technical Tools and Modeling Tools for Best Practices:*** This section includes websites that offer information on three sets of tools including FEMA's HAZUS modeling tool, various evacuation modeling tools (HURREVAC, ETIS, and OREMS) and a flooding risk modeling tool (HEC-RAS). There are 23 links in this section.
- ***Academic Resources on Best Practices:*** This section providing a set of references for important research articles and books that discuss mitigation, vulnerability, resiliency and sustainability, recovery, and emergency planning. There are 63 sources listed in this section
- ***Organizations and Associations:*** This section lists and give web links to organization and associations that address mitigation and hazard mitigation planning. These have been roughly classified into general and specific hazard areas as well as a listing of academic research centers that offer a host of information on mitigation. There are 36 links in this section.

The following offers a complete listing of the contents of the best practices website. The newer listings are in red.

I. Best Practices in Hazard Mitigation

- FEMA's Mitigation Best Practices
  - Local Multi-hazard Mitigation Planning Guidance (2008) new
  - Hazard Mitigation Planning Toolkit new
- Local Mitigation Strategies
  - Alabama state hazard mitigation plan new
  - Colorado best practices in natural hazards planning and mitigation
  - Disaster resistant communities group (Florida)
  - Florida local mitigation strategy (LMS) new
  - Florida hazard mitigation best practices guides
  - Louisiana hazard mitigation plan new
  - Georgia local hazard mitigation plans and success stories new
  - Mississippi hazard mitigation plan (2012) new
  - South Carolina hazard mitigation plan (2010) new
  - Texas hazard mitigation plan (2010-2013) new
  - Washington state enhanced hazard mitigation plan (2011) new
  - Wisconsin state and local hazard mitigation planning and success stories
- Mitigation Best Practice Portfolios
- National Governor Association

- Public and Private Sector Best Practice Stories for All Hazards by FEMA
- Texas Local Jurisdictions Best Practices
    - Beaumont 1 2
    - Bolivar Peninsula
    - Freeport
    - Galveston 1 2 3 4
    - Houston 1 2
    - Kemah
    - Maverick
    - Orange
    - Port Neches
    - Rio Bravo
    - Shoreacres
    - Surfside Beach
    - Tiki Island
- US Army Corps of Engineers-Planning Guidance Notebook
- US Army Corps of Engineers-Planning Manual
- US Army Corps of Engineer-Planner's Study Aids
- US Environmental Protection Agency (EPA)-Natural Disaster and Weather Emergency

II. Best Practices by Hazard Type

- Climate Change
    - Environmental Protection Agency (EPA)-Adapting to climate change
    - National Oceanic and Atmospheric Administration (NOAA)-Climate Prediction Center
    - National Weather Service (NWS) Forecast Model
    - Natural Resources Conservation Service (NRCS)
    - NWS Aware and Disaster Preparedness Report
    - US Global Change Research Program
- Earthquakes
    - Earthquake Country Alliance
    - National Earthquake Hazards Reduction Program (NEHRP)
    - Network for Engineering Earthquake Simulation (NEES)
- Flood
    - Best practices for flood mitigation
    - EPA-Mold Remediation
    - FEMA Community Rating System (CRS)
    - Kinston, North Carolina (floodplain management)
    - Mecklenburg County (hazard mitigation plan, flood mitigation implementation, stormwater management)
    - Mississippi coastal mapping projects
    - National Flood Insurance Program (NFIP)

- NOAA-Service Assessment
- Shoreline management
- Stormwater best management practices
- USACE-Flood Risk Management Program (FRMP)
- USACE-Risk Management Center (RMC)

- Heat
  - Centers for Disease Control and Prevention (CDC)-Hot Weather Health Emergencies
  - EPA-AIRNow
  - EPA-Energy Star
  - NOAA's NWS-Air Quality Forecast
  - The National Association of Clean Air Agencies (NACAA)
  - US Department of Agriculture (USDA)-Food Safety and Inspection Service
- Hurricane
  - Hurricane Ike: : Nature's Force vs. Structural Strength
  - NWS' National Hurricane Center
- Tornadoes
  - NOAA-Service Assessment
  - The Northeast States Emergency Consortium (NESEC)
- Tsunami
  - Geohazard International
  - NOAA Center for Tsunami Research
  - USGS-Pacific Coastal & Marine Science Center
- Wildfire
  - Bastrop Complex Wildfire, Texas
  - Fire Dynamics Simulator in Texas
  - National Database of State and Local Wildfire Hazard Mitigation Programs:
    This database provides various information about current policies and programs related to wildfire.
  - National Interagency Coordination Center (NICC)
  - Texas Extension Disaster Education Network (EDEN)
  - USGS-Fire Ecology
  - USGS-Wildfire Hazards-A National Threat
- Wind
  - Florida's Foundation
  - IBHS shutter selection
  - New School Building "Hardened" Against the Wind
  - Texas Department Insurance (TDI)-Windstorm Inspection Program
  - Wind Mitigation Inspection

III. Best Practice in Planning, Management, and Administration

- Building Code
  - American Society of Civil Engineers (ASCE):
    This webpage provides building codes and standards
  - Building code examples
    - Building codes by states
    - California Code of Regulations (CCR)
    - Hurricane Andrew/Building codes
  - Building code reference library:
    This webpage provides detailed information on building codes for all 50 states, major cities, and some counties.
  - Florida Department of Business & Professional Regulation:
    This webpage provides information of Florida building code.
  - Institute for Business & Home Safety (IBHS)
    - Building codes
    - Rating the States
  - National Institute of Building Sciences-Whole Building Design Guide (WBDG)
- Coastal Zone Management (CZM)
  - NOAA Boundary Making
  - National Flood Insurance Program: Flood Hazard Mapping
- Environmental Quality
  - Renewable Natural Resources Foundation
  - US Department of Energy (DOE) National Environmental Policy Act
  - US Forest Service (USFS)-Healthy Forests Initiative
- Land Use Planning
  - American Planning Association (APA):
    The APA has conducted research regarding integrating hazard mitigation into local planning and introduced best practices.
  - Annotated bibliography regarding integrating hazard mitigation in local planning and best practices
  - The Bureau of Land Management (BLS)
  - USACE-Federal Interagency Floodplain Management Task Force
- Recovery Planning
  - American City and County:
    Coastal towns rethink development patterns: Katrina recovery plans incorporate mixed uses.
  - NOAA Post-storm Assessments
  - US American Society of Civil Engineers (ASCE)

IV. Technical Tools and Modeling Tools for Best Practices

- Evacuation Modeling

- CATS/JACE (Consequence Assessment Tool Set/Joint Assessment of Catastrophic Events)
- ETIS (Evacuation Traffic Information Systems): Recommended practices for hurricane evacuation traffic operations by Texas Transportation Institute (TTI).
- HURREVAC (Hurricane Evacuation)
- Hurricane Evacuation Management Decision Support System (EMDSS) new
- MASSVAC (Mass Evacuation Transportation Model) new
- OREMS (Oak Ridge Evacuation Modeling System) new

- Flood Risk Modeling
  - HEC-RAS (Hydrologic Engineering Centers River Analysis System)
  - NFIP-Flooding costs/flood risks new
  - NOAA Sea Level Rise and Coastal Flooding Impacts new
  - SLOSH (Sea, Lake, and Overland Surges from Hurricanes) new
  - Sources of Assistant (Reducing Damage from Localized Flooding: A Guide for Communities)
  - USACE-2011 Flood Fight new
- Multi-hazards
  - FEMA-HAZUS: for estimating potential losses from earthquakes, wind, and floods.
  - National Institute of Building Sciences (NIBS)- Multihazard Risk Assessment/HAZUS: for estimating potential building and infrastructure losses from earthquakes, riverine and coastal floods, and hurricane winds.
  - Spatial Hazard Events and Losses Database for the United States (SHELDUS): records of county-level hazard data set for the U.S. for 18 different natural hazard events types. new
  - Texas Coastal Communities Planning Atlas Mapping Service new
  - Texas Hazard Mitigation Package (THMP): new
    THMP is an online digital geographic data resource for hazard analysis in Texas.
- Winter Weather
  - National Climate Data Center (NCDC)-GIS-Based Map Interface new
  - NCDC-NOMADS Ensemble Probability Tool new
  - NCDC-Weather and Climate Toolkit new
  - WunderMap new
- Wildfire
  - USGS Fire Danger Forecast new
  - USGS_LANDIFRE Data Distribution Site new

V. Academic Resources on Best Practices (journal articles, books, reports, etc.)

- Emergency Planning

    - Chiu, Y.-C., Zheng, H., Villalobos, J. A., Peacock, W. G., & Henk, R. (2008). Evaluating Regional Contra-Flow and Phased Evacuation Strategies for Central Texas Using a Large-Scale Dynamic Traffic Simulation and Assignment Approach. Journal of Homeland Security and Emergency Management, 5(1): 34 (1–27).
    - House, D., Cox, J. & Lindell, M.K. (2011). Visualizing Uncertainty in Predicted Hurricane Tracks. College Station TX: Texas A&M University Hazard Reduction & Recovery Center. new
    - Lindell, Michael K. and Brooks, Harold. (2012). Workshop on Weather Ready Nation: Science Imperatives for Severe Thunderstorm Research. new
    - Lindell, M.K. (2008). EMBLEM2: An empirically based large-scale evacuation time estimate model. Transportation Research Part A 42, 140–154.
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    - Perry, R.W. & Lindell, M.K. (2007). Emergency planning. Hoboken, NJ: Wiley.
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    - Deyle, R. E., Chapin, T. S., & Baker, E. J. (2008). The proof of the planning is in the platting: An evaluation of Florida's hurricane exposure mitigation planning mandate. Journal of the American Planning Association, 74(3), 349–370.
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  - USACE-Sustainability Plan (2011-2020) new

- Social Vulnerability
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VI. Organizations and Associations

- Multi-hazards
  - APA Growing Smart
  - American Red Cross new
  - FEMA Mitigation
  - Institute for Business and Home Safety (IBHS)
  - National Institute of Building Science-Multihazard Mitigation Council
  - http://www.nibs.org/?page=mmcUS Geological Survey (USGS) Hazards new
  - International Strategy for Disaster Reduction
  - Union of concerned scientists – citizens and scientists for environmental solutions – special resource info for gulf coast new

- Drought
  - National Interagency Fire Center
  - US EPA-Water Conservation
  - US Drought Portal
- Earthquake
  - Building Seismic Safety Council (BSSC)
  - Earthquake Engineering Research Institute (EERI)
  - International Code Council (ICC)
  - Ready
  - ShakeOut
- Fire
  - Color Country Interagency Fire Management Area
  - The Fire Safe Council
  - Firewise Communities
  - National Fire Protection Association
  - National Institute of Standards and Technology
  - National Interagency Fire Center
- Flood
  - Association of State Floodplain Managers (ASFPM)
  - Coastal States Organization (CSO)
  - Flood Smart
  - State Offices and Agencies of Emergency Management
- Hurricane & Wind
  - HazNet:
    The National Sea Grant Network website provides coastal natural hazards information.
  - Hurricane and Storm Damage Risk Reduction
  - NOAA's NWS-National Hurricane Center
  - Wind Science and Engineering Research Center, Texas Tech University
- Research Institute
  - Disaster Research Center, University of Delaware
  - FEMA's Listing of Emergency Management Collegiate Programs
  - Hazards Center, University of North Carolina at Chapel Hill
  - Hazard Reduction and Recovery Center, Texas A&M University
  - Hazards & Vulnerability Research Institute, University of South Carolina
  - Natural Hazards Center, University of Colorado at Boulder

Task 2 – Phase 5: Assess the local, state and federal resources available for mitigation, preparedness, response and recovery from coastal natural hazards and evaluate their application to the TCMP.

Task Description: Regardless of whether one is a period of declining or expanding funding from federal, state, or local sources, the funding of activities to address hazard impacts or potential impacts will often require the creative use of a host funding resources, many of which might not appear to be particularly relevant at first glance. For example, low-income housing is often the most susceptible to hurricane hazards, yet targeting a program to directly address these issues can be difficult. However, using local housing authority and energy efficiency funding, some local communities have been able to match State funding and provide shutters for low-income elderly homeowners. The focus of this task will identify local, state, and federal resources that might be employed to meet mitigation, preparedness, response, and recovery needs stemming from coastal hazards.

Deliverable(s): The website will be enhanced and updated as content is identified.

Figure 4. Community Resources Webpage

Figure 4, above, displays the community resource webpage that was initially launched in November of 2008. It is accessible by selecting or clicking on the hot link off the Community Resources webpage (see Figure 2). The actual website is at: http://coastalatlas.tamug.edu/community.htm It is frequently updated and its links are checked for accuracy. The community resource page lists over 160 State and Federal websites that provide information on different types of resources that can be utilized to improve and develop mitigation policies and, most importantly, fund and implement potential mitigation actions. In addition we have now provide access to an education and training section that offers information on where special programs or workshops are or have been offered.

The complete listing of resource hot links is provided below. Again, the listings in red represent new additions to the weblink.

I. State Authorized Programs

- Texas Commission on Environmental Quality
  - Clean Rivers Program (CRP)
- Texas Department of Housing and Community Affairs
  - Community Services Block Grant (CSBG) new
  - Housing Trust Fund new
- Texas Department of Rural Affairs (TDRA)
  - Community Development Block Grant (CDBG) Program new
  - Downtown Revitalization Program new
- Texas Division of Emergency Management
  - Emergency Management Performance Grant (EMPG)
  - Funds Management Section (FMS) new
  - Hazard Mitigation Grant Program (HMGP) new
  - State of Texas Hazard Mitigation Plan (2010-2013) new
- Texas General Land Office (TGLO)
  - Coastal Management Program (CMP) new
  - Disaster Recovery
  - Hazard Mitigation
- Texas Water Development Board
  - Clean Water State Revolving Fund (CWSRF) Loan Program
  - Flood Mitigation Planning Program
  - Flood Protection Planning Program new
  - Regional Facility Planning Grant Program new
  - Regional Water Planning Group Grant Program new
  - State Loan Program Texas Water Development Fund II (DFund) new
  - State Participation Program
  - Texas Natural Resources Information System (TNRIS)- Strategic Mapping Program

- Texas Water Bank and Water Trust
- Water Research Grant Program

II. Federally Authorized Programs

- Federal Grants:
  Find/Apply for federal grants.
  Federal Grants Wire:
  A free resource for federal grants, government grants and loans.
- GovLoans:
- Search for disaster relief loan programs.
- Army Corps of Engineers
  Grant Search
  - Institute for Water Resources
    - Emergency Operations new
    - Emergency Preparedness and Disaster Relief
    - Emergency Streambank and Shoreline Protection
    - FY13 Budget new
- Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE)
  - Costal Impact Assistance Program (CIAP) for Construction
- Centers for Disease Control and Prevention
  - CDC-Budget, Grants, and Funding new
- Department of Agriculture
  - Disaster Assistance Programs
  - Natural Resources Conservation Service (NRCS) Conservation Programs
    - Emergency Watershed Protection (EWP) Program
    - Watershed and Flood Prevention Operations (WFPO) Program
    - Watershed Protection and Flood Prevention Program
    - Watershed Rehabilitation
    - Wetlands Reserve Program (WRP)
    - Watershed Surveys and Planning
  - Rural Development Disaster Assistance
    - Emergency Community Water Assistance Grants
    - Rural Business Opportunity Grant (RBOG) Program
    - Rural Business Enterprise Grant (RBEG) Program
    - Rural Economic Development Loan and Grant (REDLG)
- Department of Health and Human Services
  - Office of Acquisition Management, Contracts, & Grants (AMCG) new
- Department of Housing and Urban Development (HUD)
  - Community Development Block Grant (CDBG) program
  - Disaster Recovery Assistance
- Department of Transportation, Federal Highway Administration
  - Emergency Relief (ER) Program new
  - Emergency Relief Manual

    - Pipeline and Hazardous Material Safety Administration (PHMSA) Hazardous Materials Emergency Preparedness (HMEP) Grant Program new
- Department of Homeland Security
    - Grants for Business
    - Grants and Assistance Programs for Governments
    - State Homeland Security and Emergency Services
- Federal Emergency Management Agency (FEMA)
    - All-Hazards Emergency Operational Planning (FY2009)
    - Comprehensive Planning Guide (CPG) 101
    - Comprehensive Preparedness Guide 502
    - Citizens Corp
        - Community Emergency Response Teams (CERT)
        - Competitive Training Grants Program (CTGP)
        - Cooperating Technical Partners (CTP)
        - COPS Interoperable Communications Technology Program
    - FEMA Preparedness Cycle and Resources
    - Homeland Security Grant Program (HSGP)(FY2012) new
        - Assistance to Fire Fighter Grants (AFG)
        - Emergency Management Performance Grant (EMPG)
        - Intercity Passenger Rail Security Grant Program (IPR)
        - Non-Profit Security Grant Program (NSGP)
        - Operation Stonegarden (OPSG)
        - Port Security Grant Program (PSGP)
        - State Homeland Security Program (SHSP)
        - Transit Security Grant Program (TSGP)
        - Tribal Homeland Security Grant Program (THSGP)
        - Urban Areas Security Initiative (UASI)
    - Preparedness (Non-Disaster) Grant Program new
        Grant Program Overview (FY2012) new
        Grant Program Overview (FY2013) new
        - Buffer Zone Protection Program
        - Chemical Stockpile Emergency Preparedness Program (CSEPP)
        - Commercial Equipment Direct Assistance Program (CEDAP)
        - Community Assistance Program, State Support Services Element (CAP-SSSE)
        - Community Disaster Loan Program
        - Disaster Assistance: A Guide to Recovery Programs
        - Emergency Food and Shelter Board Program
        - Emergency Operations Center Grant Program (FY2011)
        - Fire Management Assistance Grant Program
        - Flood Mitigation Assistance (FMA) Program
        - Hazard Mitigation Grant Program (HMGP)
        - Homeland Security Exercise and Evaluation Program

        - Hazardous Materials Assistance Program
        - National Infrastructure Protection Program (IPP)
        - Map Modernization Management Support
        - Multi-Year Flood Hazard Identification Plan (MHIP)
        - National Dam Safety Program
        - National Earthquake Hazards Reduction Program (NEHRP)
        - National Flood Insurance Program (NFIP)
        - National Incident Management System (NIMS)
        - National Hurricane Program
        - Pre-Disaster Mitigation (PDM) Grant Program new
        - Public Assistance Grant Program
        - Radiological Emergency Preparedness (REP) Program
        - Regional Catastrophic Preparedness Grant program
        - Reimbursement for Firefighting on Federal Property
        - Repetitive Flood Claims Program
        - Section 406 Hazard Mitigation Grant Program
        - Severe Repetitive Loss Program
        - Superfund Amendments and Reauthorization Act
- Environmental Protection Agency (EPA)
    - Drinking Water State Revolving Fund (DWSRF)
    - Gulf of Mexico Project Funding
    - Nonpoint Source Pollution Funding
    - Water Pollution Control Program Grants
    - Water Quality Cooperative Agreements
    - Watershed Funding
    - Drinking Water State Revolving Fund (DWSRF)
    - Wetland Program Development Grants (WPDG)
- Federal Corporation for National and Community Service
    - Ameri Corps
    - Senior Corps
- National Institute of Justice
    - Communications Technology, Office of Justice Programs (OJP)
- National Oceanic and Atmospheric Administration (NOAA)
    - Coastal Zone Management (CZM) Program (FY2013), Office of Ocean and Coastal Resource Management new
- National Storm Shelter Associations (OJP) new
- Recovery.gov
- Small Business Administration (SBA)
    - Disaster Loan Program
    - Small Business Administration Disaster Assistant Program

III. Education and Training

- American Red Cross

- CDC-Bioterrorism Training and Education
- EPA-Watershed Academy Webcast Seminars
- FEMA-Blog
- FEMA-Center for Domestic Preparedness (CDP)
- FEMA-Hazardous Materials Emergency Preparedness Training and Planning
- FEMA-HAZUS Training
- FEMA-National Preparedness Directorate National Training and Education
- MetEd by by UCAR and NOAA's NWS
- NOAA-Education Resources
- TGLO-2012 Disaster Recovery Housing Conference
- USACE-2012 Flood Risk Management and Silver Jackets workshop
- USACE-Water Resources Training and Education
- US Department of Health and Huamn Services

Tasks 3 and 4 – Phase 5:

Both Tasks 3 and 4 deal with assembling various forms of data, such as mapping or spatial data and utilizing these data to create, populate and improve the platform for their usage to help Texas coastal communities and various stakeholders communities and stakeholders in their planning activities. Indeed the primary activity required by these tasks was development and maintenance of a website to display data and tools that will enable the public to gain access to these data in a user friendly website environment. Over the course of this multi-year project the website developed for this purpose is called the Coastal Planning Atlas, the most up to date version is now hosted and in Galveston (coastalatlas.tamug.edu). Given the similarities between these two tasks, the accomplishments for each will be discussed together. The following will briefly outline the tasks and subtasks associated with each. This will be followed by a discussion of the accomplishments for both tasks and their subtasks during phase 5.

Task 3 – Phase 5: Evaluate the geographic relationship between current CMP boundaries and project impacts from various categories of hurricanes based on the latest coastal study area maps.

Task 3 Description: Task 3 is developing procedures for spatially displaying and analyzing the mosaic of coastal management and planning regimes in conjunction with coastal management program boundaries and physical hazard vulnerabilities. The goal is to provide insights with respect to the spatial distribution of quality management and contiguous (or noncontiguous) consistency and compatibility in management in order to identify weaknesses in broader coastal management issues. In a very real sense, the focus of this task will be a spatial analysis of coastal management vulnerability – an analysis of vulnerabilities emerging due to management deficiencies or inconsistencies.

This task includes the following objectives:

a. Continue assembling physical hazard analyses related to coastal natural hazards (surge maps, inland flooding maps, flood plain maps, and wind field maps).
b. Continue assembling and integrating coastal management and policy boundary files.
c. Continue development and refinement of methodologies for displaying general policies based on quality and area of implementation.
d. Continue spatial analysis of these data and where necessary develop methodological tools to display these data and the results from the analyses.
e. Continue development of website to make the findings available to prospective users.

Deliverable(s): Updates provided in progress reports

Task 4 – Phase 5: Assess the physical and social vulnerabilities of coastal populations to facilitate planning and policy development related to hazard mitigation and response.

Task 4 Description: A critical element in the determining "management vulnerabilities" and hazard mitigation plans and planning along with building codes is an assessment of the physical and social vulnerabilities of a coastal population. This task is important to the success of the larger project and will provide a usable set of products for end users making decisions related to hazard management planning and policy development.

This task includes the following objectives:

a. Continue acquiring, refining, and compiling additional data as it becomes available.
b. Continue spatial analysis and finalize methodologies for identifying socially vulnerable populations.
c. Update and complete the development of the website or make the findings available to prospective users.
d. Refine temporal and spatial assessments of social (and physical if possible) vulnerability utilizing historical census data.

Deliverable(s): Updates provided quarterly

In sum, both Tasks 3 and 4 include collecting data (primarily secondary data), creatively enhancing a website to allow for the mapping of these data and the development of tools to utilize these data. While Task 3 focuses on hazard data and policy data, Task 4 includes additional hazard data, data on physical hazards and, most importantly this year data for establishing and measuring population social vulnerabilities. Both tasks address continuing to spatially analyze these data and develop methodological tools for displaying the data and results and providing a web based system whereby prospective users can make use of the data and their results. The following offers some of the highlights of the website, its data, and its tools.

I. Introduction:

Phase 5 of the Status and Trends project has seen major improvements to the Coastal Atlas Website. We have continued to modify the look, feel, and content of the Coastal Planning Atlas by improving data layers, displays and tools. Yet again a new server has been brought on line at Texas A&M Galveston, without cost to the project, that has greatly enhanced the capabilities of the website. A major effort was undertaken to integrate the five (5) different atlas websites; enhancing the data possibilities. We are still hosting five (5) different Atlas websites delivering a variety of data and tools targeting particular areas or analysis themes in an easily accessible manner with a host of tools to allow for visualization of the data and data analysis. However, The *Main Atlas* website now contains a more fully integrated set of data layers including all of the social vulnerability layers for the entire Texas coast and many other layers. The following provides an update of what has been accomplished, a brief excursion into using the atlas, and a brief discussion of beta testing new elements for the atlas. This discussion is broken down into the following sections: System Configuration and Effects on Services;

The Atlas and its Components and Data Base and Thematic Updates; Using the Atlas; and New Enhancements/Tools and Beta-testing.

II. System Configuration Effects on Services

With a few exceptions, updates to the Coastal Atlas Website during the past year have been structural in affecting improved system performance, system maintenance, data consistency, and data availability. In this regard, very little has changed in the look and feel of the Coastal Atlas experience. However, these improvements made in the background have been critical to the system's continued development. As a result, performance of the system has stabilized incurring limited downtime. Significant performance improvements from spatial and attribute indexing, consolidation and standardization of database tables have been realized facilitating an improved user experience and enabling efficient maintenance and updated processes. To the user, the effects of these changes can be recognized through improvements in response times and data and presentation consistency when compared to previous atlas performance

The entire now Main Atlas operates off of a normalized database accessed through ESRI's Spatial Database Engine. In early atlas operations, each theme as presented to the user represented a corresponding set of files that supported view of that theme. When multiple attribute sets were linked to the same spatial information (eg. Population and Social Vulnerability Indices to Census block groups), multiple copies of the same spatial files were required to display them. In the Main Atlas, fifteen themes related to three sets of decennial census data are presented for displaying population demographics, housing and property value maps. Further, the user has available 178 different themes representing Social Vulnerability Indices alone. By normalizing the underlying spatial and attribute databases, the system data set size is reduced from storing and maintaining the many individual file sets for each of these themes to a simple configuration consisting of a single set of spatial tables, one population table, one property value table and one Social Vulnerability table. Under this configuration, themes are represented through database queries rather than multiple redundant copies of data.

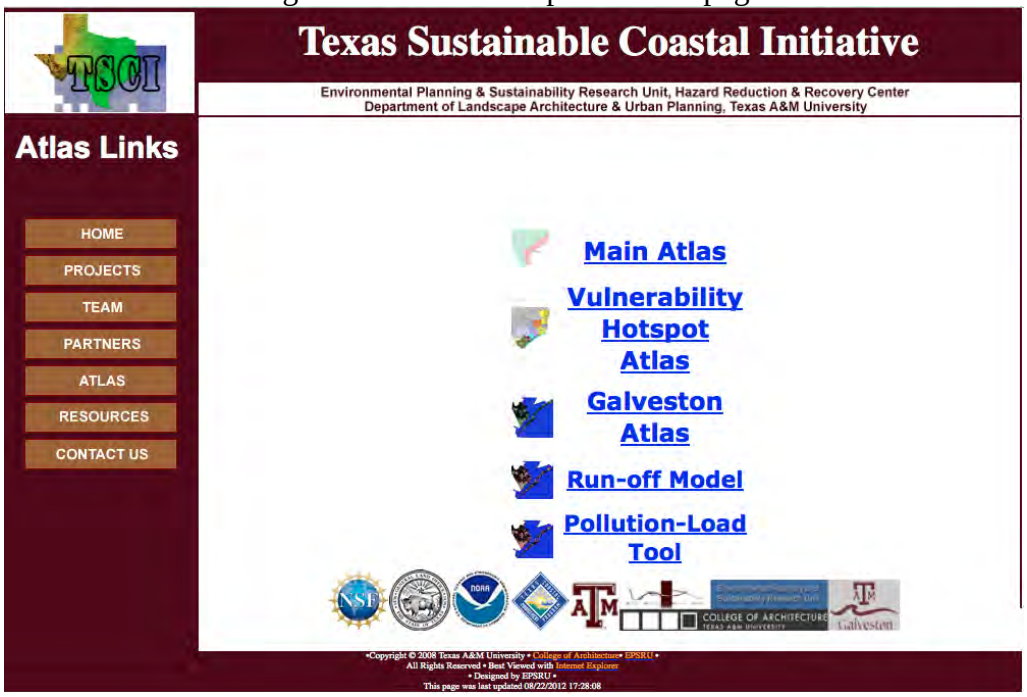
The benefits of this configuration are many. First and simplest, the data storage footprint is greatly reduced. Atlas operators have fewer data tables to maintain and consistency is ensured by the fact that all views draw from the same tables. The user sees this consistency in data field identification, in graphics presentation and in boundary placement. The simpler configuration enables the Coastal Atlas operators to quickly add themes as new data become available or modified representations of existing data are requested. In database management, redundant copies of data provide an avenue to foment corruption of databases. By eliminating as many redundancies as possible, the likelihood of corruption introduced from inconsistently updated similar files is greatly removed. Finally, consistent methodology enables the database administrator to fine tune system configuration to enable peak access performance for the user. Through these

improvements, previous issues of adverse impacts to performance and data volume restrictions have been solved.

III. The Atlas, its Components and Data Base and Thematic Updates

The following provides a reintroduction to the Atlas and its components. As mentioned above, the primary focus of this phase has been to integrate much of the atlas data into the Main Atlas website. As part of that integration we have also introduced new data products. The following will address these new additions as well.

Figure 5. Atlas Link Options Web-page.



The principle access point for the website is through **http://coastalatlas.tamug.edu** pictured in Figure 1 (see above). The user clicks on the "Atlas" button on the left hand side of the webpage. Once that button is clicked, the Atlas-options webpage (see Figure 5) opens offering 5 different Atlas web page links or entry portals. These websites were first made available during phase 3 and they continued to be available and maintained during phase 5. The ***Main Atlas*** has been the site of major changes that will be discussed below, the ***Vulnerability Hotspot Atlas*** offers pre-analyzed and configured data layers to enable users to undertake both physical, social, and environmental vulnerability and sustainability analysis, the ***Galveston Atlas*** provides very rich and refined data at a high resolution for the Galveston County, and the ***Run-off Model*** and ***Pollution-Load Tool*** offer a unique 'what if' approach that allows the user to understand the consequences, in terms of potential flooding runoff and pollution consequences for different types of

development in Galveston county. The following will provide a brief tour of these first four atlas pages.

Access to the main atlas webpage can be gained by simply clicking on the "Main Atlas" hotlink in the center of the Atlas Options Webpage. Figure 6 displays a visual representation of the main atlas page indicating the two tiers of coastal counties for which data are available and the Coastal Management Zone boundary. This website has been improved and expanded during phase 5. Indeed, it now can display all of the data and analysis features available formerly in both the Main Atlas and Vulnerability Hotspot Atlas web page. This webpage now displays 28 different categories of data layers organized into 19 folders including administrative boundaries, policy data, transportation, census data, social vulnerability analysis, topography, ecological data, hot spot analysis, hydrological data, protected areas, recreational facilities, development data, natural hazards data, costal data, coastal development data, offshore risk, place and facilities data, climate data and additional base mapping data. During phase 3 the main atlas contained approximately 100 data layers, as part of Phase 4, the number of layers was increased to just over 270, and now in Phase 5 the number is 299. The entire detailed listing of these 299 data layers can be found in Table 1. The new layers are indicated in red.

What is most exciting about the changes to the main atlas is that we have now incorporated new census data products that have allowed us to update the social vulnerability analysis. Specifically, prior to the 2010 census the U.S. Census decided to modify the nature of the data it collected during the decennial census to just basic demographic data. In other words, they were no longer collecting detailed socio-economic information about individuals and households that were part of the so called "long-form" that was administered to a subsample of the population. Rather, beginning in 2006, the Census began the American Community Survey. This survey was conducted employing a sample of approximately 3 million households per year and collected data on social, economic, housing, and demographic characteristics, much as the old long-form procedure would collect. Furthermore, these data are released as 1, 3, and 5 year estimates. The 5-year estimate were most important for our work, because these are the only data that are provided at the block-group level of aggregation. The first 5-year estimates (2005-9) began to be rolled out in 2010, although data for Texas were not released until later in its release cycle. We have spent most of this year gathering, compiling and analyzing these data to assess their utility and comparability to our social vulnerability analysis tools. After determining we were able to replicate the analysis tools developed for earlier years, we were able to produce new social vulnerability products creating over 20 data layers using these data. In addition, we have added data on hydrological units (HUCs 8, 10, and 12) that are often critical for understanding flooding within particular watersheds, and new more simplified flood plain data (100 year, 500 year, and coastal high hazard areas).

Figure 6. The Main Atlas Page

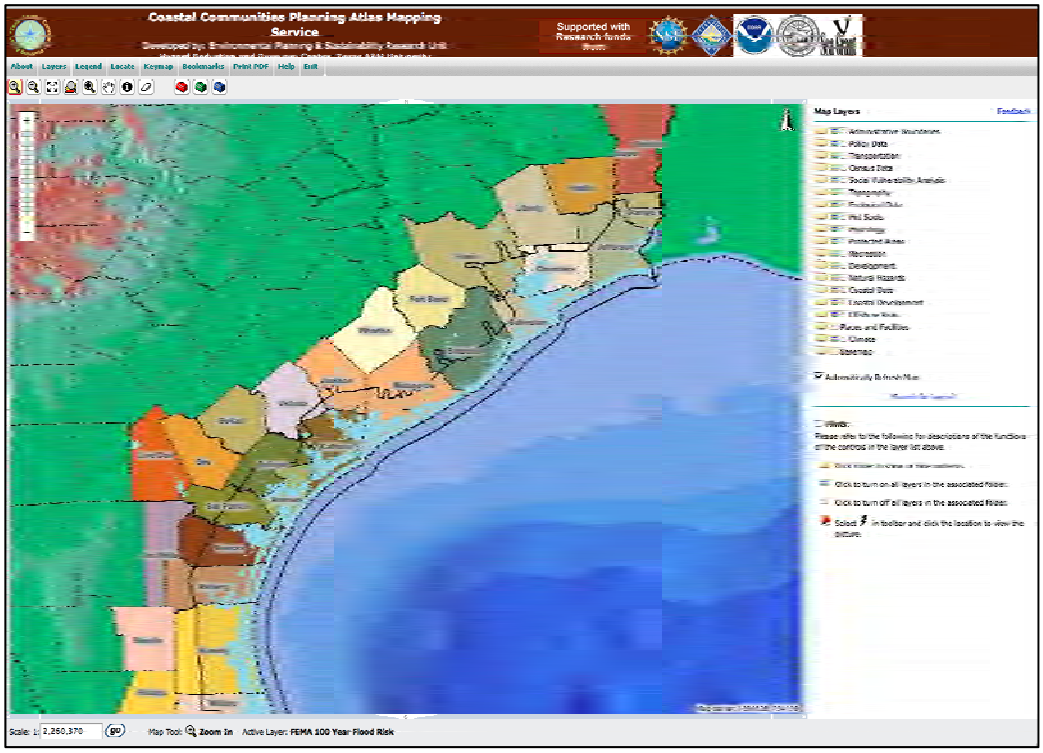


Table1: Detailed listing of Data Layers Available Through the Main Atlas Webpage (updates in red)

Administrative Bountaries

1. State boundary
2. Texas Counties
3. School Districts
4. City Limits
5. Three Nautical Mile Line
6. Three Marine League

Policy Data

7. Coastal Zone Boundary
8. Coastal Management Zones
9. Study Area
10. Building Code
11. Colonias
12. School District Wealth Index
13. School District Tax Rate
14. School District Revenue

Transportation

15. Interstate Highway
16. Major Highway
17. Roads
18. Hurricane Evacuation Route
19. Railroad
20. Heliports
21. Airports

Census Data 2000

22. County Population (2000)
23. Census Tract Population (2000)
24. Block Group Population (2000)
25. Block Population (2000)

Census 1980-1990

26. Tract new population (1990)
27. Tract new population (2000)
28. Group new population (1990)
29. Group new population (2000)
30. County new population (1990)
31. County new population (2000)
32. Place new population (1990)
33. Place new population (2000)

Social Vulnerability Analysis: ACS 2005 – 2009

34. Single Parent HHs with Children
35. Population Age Below 5 years
36. Population Age 65+
37. Population Age 65+ Below Poverty Line
38. Workers Using Public Transportation
39. Households without Vehicle
40. Occupied Housing Units
41. Renters

42. Race (Non-whites)
43. Persons in Group Quarters
44. Housing Units under 20yrs Old
45. Mobile Homes
46. Persons in Poverty
47. Occupied Housing Units No Telephone
48. HS Education
49. Unemployed
50. Non-English Speaking

Social Vulnerability 2nd & 3rd Level Measures ACS 2005 - 2009

51. Child Care Needs
52. Elder Care Needs
53. Transportation Needs
54. Housing Recovery Needs
55. Capacity Building Needs
56. Social Vulnerability Index

Social Vulnerability Analysis Census 2000

57. Single Parent Households with Children
58. Population < 5 years
59. Population Age > 65 years
60. Population Age > 65 years below Poverty
61. Workers using Public Transportation
62. Households without Vehicle
63. Occupied Housing Units
64. Renters
65. Race (non-White)
66. Persons in Group Quarters
67. Housing Units > 20 years
68. Mobile Homes
69. Persons in Poverty
70. Occupied Housing Units without phone
71. Education less than HS for Age > 25 years
72. Unemployed (Age > 16 years)
73. Population speaking English not well/not at all (Age>5years)

Social Vulnerability: 2nd and 3rd Level Measures 2000

74. Child Care Needs
75. Elderly Care Needs
76. Transportation Needs
77. Recovery Needs
78. Capacity Building Needs
79. Total Social Vulnerability Index (SVI 2000)

Social Vulnerability Analysis Census 1990

80. Single Parent Households with Children
81. Population < 5 years
82. Population Age > 65 years
83. Population Age > 65 years below Poverty Line
84. Workers using Public Transportation
85. Households without Vehicle
86. Occupied Housing Units
87. Renters
88. Race (non-White)
89. Persons in Group Quarters
90. Housing Units > 20 years
91. Mobile Homes
92. Persons in Poverty
93. Occupied Housing Units without phone
94. Education less than HS for Age > 25 years
95. Unemployed (Age > 16 years)
96. Population speaking English not well/not at all (Age>5years)

Social Vulnerability 2nd and 3rd Level Measures 1990

97. Child Care Needs
98. Elderly Care Needs
99. Transportation Needs
100. Recovery Needs
101. Capacity Building Needs
102. Total Social Vulnerability Index (SVI 1990)

Social Vulnerability Analysis Census 1980

103. Single Parent Households with Children
104. Population < 5 years
105. Population Age > 65 years
106. Population Age > 65 years below Poverty Line
107. Workers using Public Transportation
108. Households without Vehicle
109. Occupied Housing Units
110. Renters
111. Race (non-White)
112. Persons in Group Quarters
113. Housing Units > 20 years
114. Mobile Homes
115. Persons in Poverty
116. Occupied Housing Units without phone
117. Education less than HS for Age > 25 years
118. Unemployed (Age > 16 years)
119. Population speaking English not well/not at all (Age>5years)

Social Vulnerability: 2nd and 3rd Level Measures 1980

120. Child Care Needs
121. Elderly Care Needs
122. Transportation Needs
123. Recovery Needs
124. Capacity Building Needs
125. Total Social Vulnerability Index (SVI 1980)

Intra-County Analysis (1980, 1990, 2000)

126. SVI Aransas_1980
127. SVI Aransas_1990
128. SVI Aransas_2000
129. SVI Bee_1980
130. SVI Bee_1990
131. SVI Bee_2000
132. SVI Brazoria_1980
133. SVI Brazoria _1990
134. SVI Brazoria _2000
135. SVI Brooks_1980
136. SVI Brooks _1990

137. SVI Brooks _2000
138. SVI Calhoun_1980
139. SVI Calhoun _1990
140. SVI Calhoun _2000
141. SVI Cameron_1980
142. SVI Cameron _1990
143. SVI Cameron _2000
144. SVI Chambers_1980
145. SVI Chambers _1990
146. SVI Chambers _2000
147. SVI FortBend_1980
148. SVI FortBend _1990
149. SVI FortBend _2000
150. SVI Galveston_1980
151. SVI Galveston_1990
152. SVI Galveston_2000
153. SVI Goliad_1980
154. SVI Goliad_1990
155. SVI Goliad_2000
156. SVI Hardin_1980
157. SVI Hardin _1990
158. SVI Hardin _2000
159. SVI Harris_1980
160. SVI Harris _1990
161. SVI Harris _2000
162. SVI Hildalgo_1980
163. SVI Hildalgo_1990
164. SVI Hildalgo_2000
165. SVI Jackson_1980
166. SVI Jackson _1990
167. SVI Jackson _2000
168. SVI Jasper_1980
169. SVI Jasper _1990
170. SVI Jasper _2000
171. SVI Jefferson_1980
172. SVI Jefferson _1990
173. SVI Jefferson _2000
174. SVI JimWells_1980
175. SVI JimWells_1990
176. SVI JimWells_2000
177. SVI Kenedy_1980
178. SVI Kenedy_1990
179. SVI Kenedy_2000
180. SVI Liberty_1980
181. SVI Liberty _1990
182. SVI Liberty _2000
183. SVI LiveOak_1980
184. SVI LiveOak _1990
185. SVI LiveOak_2000
186. SVI Matagorda_1980
187. SVI Matagorda _1990
188. SVI Matagorda _2000
189. SVI Newton_1980
190. SVI Newton _1990
191. SVI Newton _2000
192. SVI Nueces_1980
193. SVI Nueces _1990
194. SVI Nueces _2000
195. SVI Orange_1980
196. SVI Orange _1990
197. SVI Orange _2000
198. SVI Refugio_1980
199. SVI Refugio_1990
200. SVI Refugio_2000
201. SVI SanPatricio_1980
202. SVI SanPatricio _1990
203. SVI SanPatricio _2000
204. SVI Victoria_1980
205. SVI Victoria _1990
206. SVI Victoria _2000
207. SVI Wharton_1980
208. SVI Wharton_1990
209. SVI Wharton_2000
210. SVI Willacy_1980
211. SVI Willacy _1990
212. SVI Willacy _2000

Topography
213. Elevation

Ecological Data
214. Ecosystem Criticality Measure
215. Eco-Regions
216. Vegetation
217. Seagrass
218. Washover Areas
219. Environmental Sensitivity Index

Hot Spots
220. Ecosystem Criticality Measure
221. Location Quotient Analysis
222. Colonias

Hydrology
223. Lakes and Reservoirs
224. Hydrological Units (8)
225. Hydrological Units (10)
226. Hydrological Units (12)
227. Rivers and Streams

Protected Areas
228. Federal Lands
229. National Parks
230. State Parks
231. Wildlife Refuge
232. Marine Sanctuaries
233. Audubon Sanctuaries
234. Coastal Preserves
235. Burn Exclusion Zone
236. Habitat Priority Areas
237. Wetland Inventory Data
238. Historic Places (National Register)
239. Species
240. Rookery
241. Hard Reefs
242. Open gulf
243. Redfish Bay State Scientific Area

Recreation
244. County and City Parks
245. Beach Access
246. Marinas
247. Boat Ramps

Development
248. Census County Property Values (2000)
249. Census Tracts Property Values (2000)
250. Census Groups Property Values (2000)

Natural Hazards
251. Ecosystem Criticality Measure
252. Location Quotient Analysis
253. Populated Places
254. Dams
255. Wetland Permits
256. Hurricane Surge Zones Category 1
257. Hurricane Surge Zones Category 2
258. Hurricane Surge Zones Category 3
259. Hurricane Surge Zones Category 4
260. Hurricane Surge Zones Category 5
261. Hurricane Risk Zones Category 1
262. Hurricane Risk Zones Category 2
263. Hurricane Risk Zones Category 3
264. Hurricane Risk Zones Category 4
265. Hurricane Risk Zones Category 5
266. Hurricane Tracks
267. Hazard Events (1960-2005)
268. Fire Risk Zones
269. Earthquake Risk Zone
270. FEMA 100-Year Flood Risk
271. FEMA 500-Year Flood Risk
272. FEMA Coastal High Hazard

Coastal Data
273. Coastal Topography
274. Bathymetry Points
275. Bathymetry Lines (Bathymetry contours)
276. Sea Floor Features
277. Tidal Influence Zone
278. Detailed Shoreline
279. Ship Channel
280. Ship Fairway
281. Coast Guard

Coastal Development
282. Resource Management codes
283. Offshore Blocks
284. Oil and Gas Leases
285. Oil and Gas Units
286. Coastal Lease Polygons
287. Oil and Gas Platforms

Offshore Risks
288. Coastal Barriers
289. Dredged Sites

Places and Facilities
290. Public Schools
291. Place Names
292. Populated Places

Climate
293. Rainfall

Basemap
294. Texas Image
295. Coastal County Name
296. Coastal County Shade
297. Texas County Boundaries
298. State Boundary
299. Water

The mapping websites have full set of operative GIS tools that are located in the upper left hand corner, just above the map itself. These tools are available in all three of the Atlas webpages (Main, Hotspot, and Galveston). The buttons in the grey bar offer tools that, for the most part, provide information regarding the current map. Activating or selecting one of these tools results in the information appearing in the left frame of the atlas screen. For example, clicking the "Layers" button results in the 19 categories (or 299 detailed categories) of data layer options appearing in this frame, which allows the user to apply specific data layers for presentation. Furthermore, if a user clicks on the "Legend" button, a legend will appear in the left frame providing the user with information regarding the data currently being displayed in the map frame. Users can also select the "Print PDF" button to obtain a hardcopy of the current map. There are also a set of quick tools including: zoom in (+), zoom out (-) query tool (***i***), and a tool to move the map (the hand symbol).

There are more advanced tools that can be opened in the red, green, and blue toolbox icons. The red tool box contains tools to save current work, email the results, upload or download data, as well as a tool that allows the user to use additional visualization tools such as “Virtual earth,” or “Google earth” to obtain a visual picture of a mapped location. This toolbox also contains tools to get measurements and add captions to a map. The green toolbox contains a number of mark-up tools. These tools allow the user to draw on or add additional information to a map. For example a user can draw dots, add lines, add geo-referenced lines or points, draw polygons, move mark-up symbols, and add labels. These are all tools that should be particularly useful when conducting workshops or planning charrettes. During these events participants can display a variety of attributes and then use markup tools to discuss “what if” scenarios and ask questions like: What if land-use patterns are changed in ‘this’ area? What wetland areas might be impacted? How would the look of your community change? The final tool box, the blue tool box, contains additional query tools providing the ability to select and create complex sets of queries that use attribute tables to select and combine data to answer questions.

The following are some examples of simple maps that display some of the data available in the Main Atlas web page. The first map, Figure 7, is a very simple map of hurricane surge zones for an area in and around Galveston, Harris, Brazoria and Chambers counties. The surge zones range from those associated with a category 1 storm in dark red, category 2 in light red, category 3 in dark pink, category 4 in lighter pink and, lastly category 5 storm in very light pink that because of the green background almost looks light green. This is an interesting map because it clearly shows many surge risk areas extend well beyond the CMZ. This may well be a good argument for extending the CMZ further inland in many areas, because these are coastal areas subject to coastal storm surge. Furthermore, it should also be clear that substantially all areas within the CMZ are highly vulnerable to surge.

Figure 7. Main Atlas with Surge Zones and CMZ layers active.

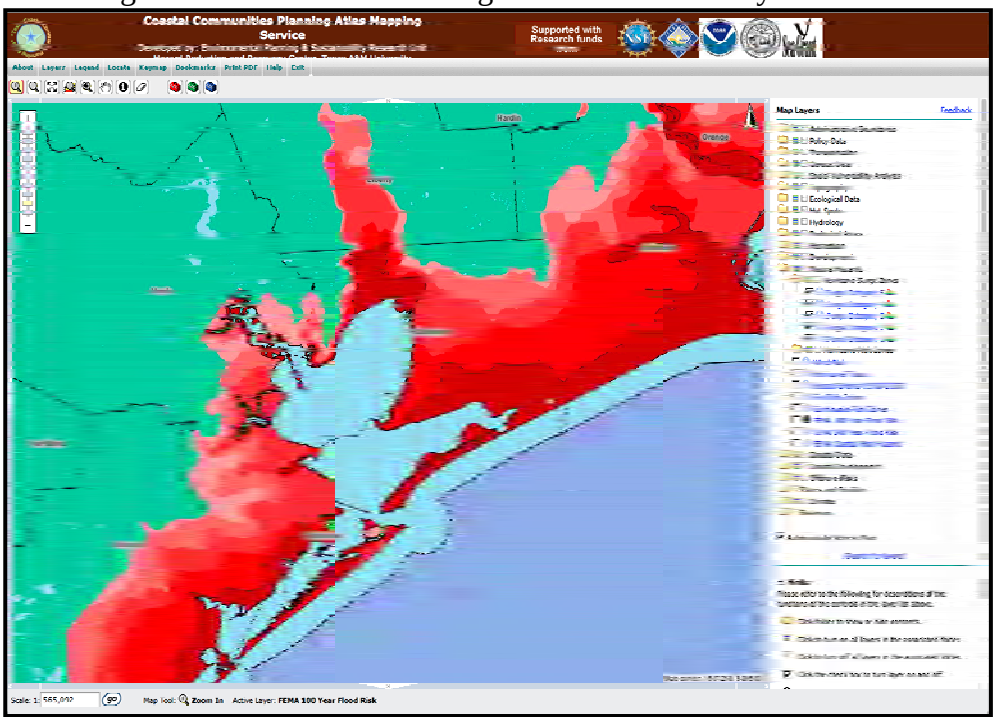


Figure 8. More Elaborate map of Corpus Christi & Port Aransas Areas.

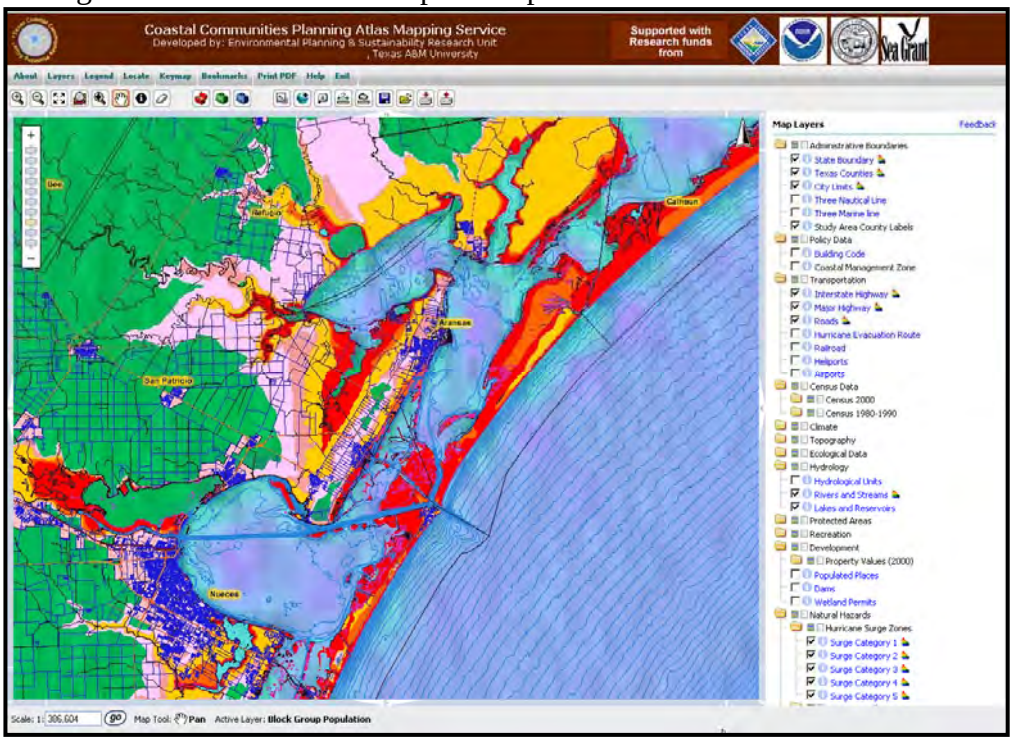
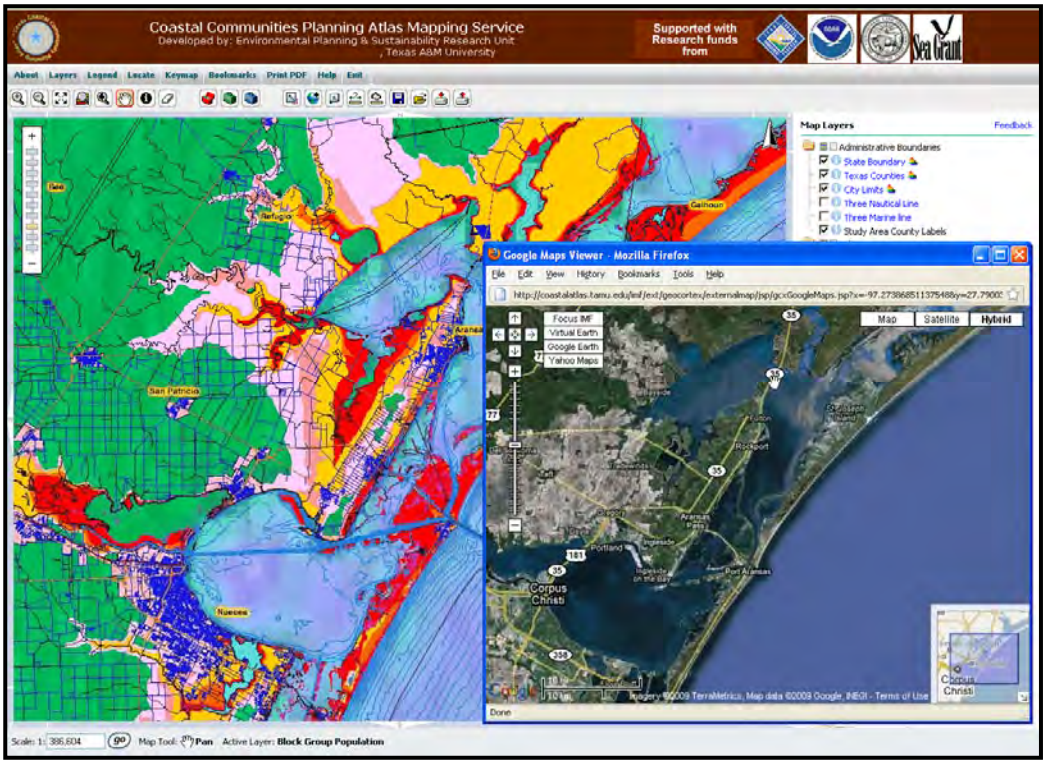


Figure 8 offers a bit more elaborate map of the Corpus Christi and Port Aransas area. This map includes bathometry data and road/highway data along with the surge zone data from category 1 through 5. Of course, users can zoom all the way into a much higher resolution to capture surge zones relative to specific roads and neighborhoods. In addition, as shown in Figure 9, by activating the external map visualization tool, users can bring up a virtual map of any location, geo-referenced to the map being developed within the Atlas. Here, a Google-map has been activated to actually display a picture of this location.

Figure 9. Figure 8's Map including a Google Map Viewer Image of the Map's Location



As noted above, one of the most exciting features of the new main atlas page is that all of the social vulnerability data layers, and more, that were only available on the vulnerability hotspot page for the northeastern coast, are now available for the entire coast. Many of these data have been processed with respect to the county or municipality to allow for county and city planners, emergency management officials, stakeholders, or just the general public throughout the entire Texas coast to undertake analysis that is relevant for their particular area of interest. These include ecosystem criticality measures that assess how critical ecosystem areas (defined by county area, census tract area, and census block area) are under stress due to development. Land-use changes over decades. Social vulnerability analysis utilized census data at the block level to identify areas containing populations likely to have difficulty preparing for and responding to

environmental hazards and disasters, can also be undertaken with this website. A full discussion of this type of analysis is presented in the detailed report on social vulnerability and the Coastal Atlas that was part of the deliverables in Phase 3. These data have also been analytically combined so that one may examine areas with particular types of needs (child care, elder care, public transportation, housing recovery, and overall social vulnerability hotspots) at the municipality or county level. Finally there are basic economic analyses, based on Location Quotient Analysis, included at the county level as well. Again, these data are now available on the main atlas webpage for all areas on the coast.

Table 2. Data still Available on the Hotspot Website for the Northeastern Texas Coast.

Political & Administrative Boundaries
1. 2000 Census Count
2. 2000 Census Tracts
3. 2000 Census Block Groups
4. 2000 Blocks
5. Focus Texas Counties
6. Non-Coastal Counties
7. City Limits
8. Building Codes

Transportation
9. Interstate Highway
10. Major Highway
11. Hazardous Cargo Routes
12. Hurricane Evacuation Routes

Demographic Data (Census 2000)
13. County
14. Census Tracts
15. Census Block Groups
16. Census Blocks

Natural Hazards: Hurricane Surge Zones
17. Category 1 Surge Zone
18. Category 2 Surge Zone
19. Category 3 Surge Zone
20. Category 4 Surge Zone
21. Category 5 Surge Zone

Natural Hazards: Hurricane Risk Zones
22. Risk Zone A
23. Risk Zone B
24. Risk Zone C

Natural Hazards: Hurricane Tracks
25. Hurricane Tracks (1851-2005)

Natural Hazards: Flooding
26. FEMA Flood plains

Ecosystem Critically Measures (ECM)
27. ECM County
28. ECM Census Tract
29. ECM Block Group
30. ECM Block

Social Vulnerability Assessment: Base Characteristics
31. Population < 5 years
32. Single Parent Households with Children
33. Population Age > 65 years
34. Population Age > 65 years below Poverty Line
35. Workers using Public Transportation
36. Households without Vehicle
37. Occupied Housing Units
38. Renters
39. Race (non-White)
40. Persons in Group Quarters
41. Housing Units > 20 years
42. Mobile Homes
43. Persons in Poverty
44. Occupied Housing Units without phone
45. Education less than HS for Age > 25 years
46. Unemployed (Age > 16 years)
47. Population speaking English not well/not at all (Age>5years)

Social Vulnerability Assessment: Indexes (Block Groups regional comparisons)
48. Child Care Needs
49. Elderly Care Needs
50. Transportation Needs
51. Recovery Needs
52. Capacity Building Needs
53. Raw total Social Vulnerability Index (SVI)
54. Weighted SVI

Social Vulnerability Assessment: Block Group County Comparison using SVI
55. Orange County
56. Newton County
57. Liberty County
58. Jefferson County
59. Jasper County
60. Harris County
61. Hardin County
62. Galveston County
63. Fort Bend County
64. Chambers County
65. Brazoria County
66. Construction
67. Others

Location Quotient Analysis
68. Natural Resources and Mining
69. Construction

70. Other
Land Cover Data
71. Land Use 1996
72. Land Use 2001
73. Land Use 2005

Figure 10 displays a map of areas (census block groups) in and around Corpus Christi that contain concentrations of socially vulnerable households when it comes to transportation needs. Specifically as areas shift from yellow to dark red, they contain higher proportions of households without vehicles and with workers that are more likely to depend on some form of public transportation to get back and forth from work. In other words, these are areas with high concentrations of households without easy access to transportation. These areas can be expected to have individuals and households that will find it much more difficult to evacuate for hurricanes. Hence they are vulnerable because of their social characteristics.

Figure 10. Transportation Dependent Areas in and around Corpus Christi, TX.

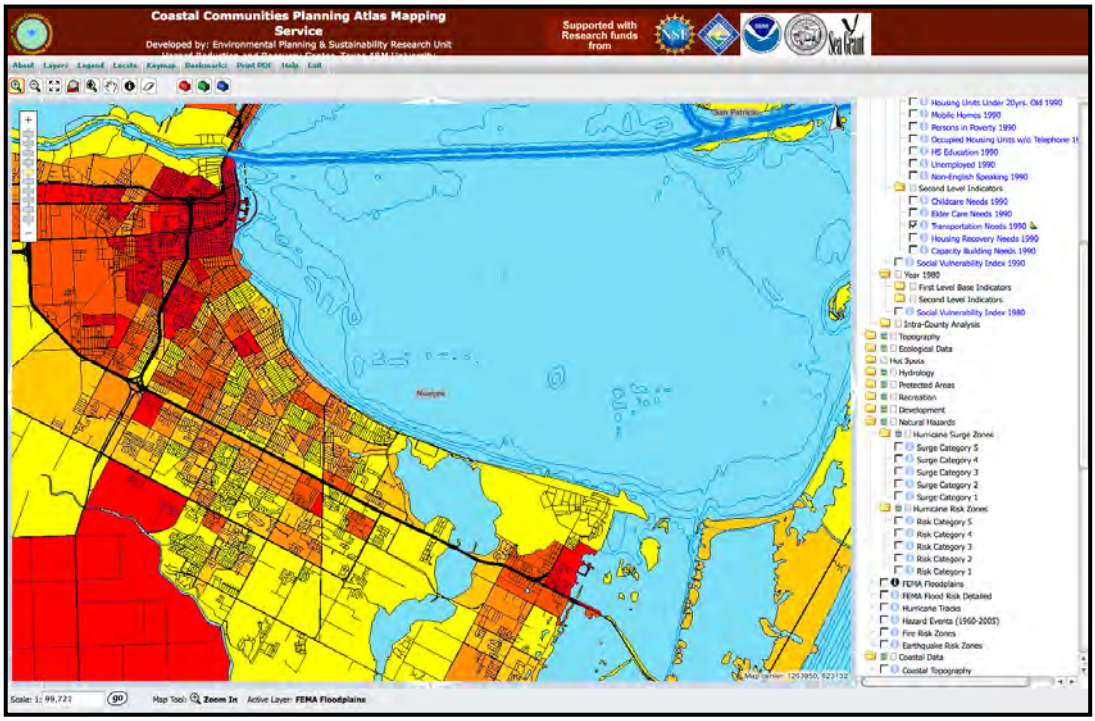
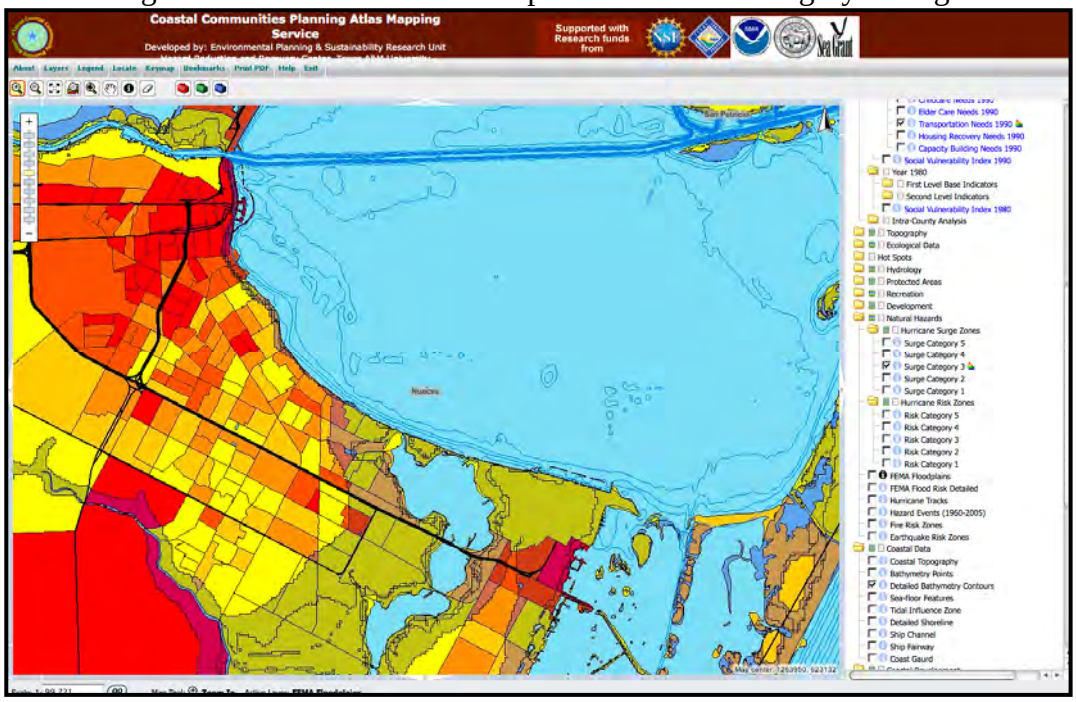


Figure 11. The same area in Corpus Christi with Category 3 Surge



What can make the Atlas so valuable for planning is the ability to compare areas with high social vulnerability and physical vulnerability. Figure 11 displays the same populations with high transportation dependence and areas subject to surge from category 3 hurricanes. Areas likely to be subject to hurricane storm surge are mapped in a light blue overlay. There are many areas with high concentrations of households without easy access to transportation that are also subject to surge risk given a category 3 storm. These are areas that will need to be targeted for evacuation and preparation assistance.

While the new main atlas website essentially contains almost all of the data layers that were available on the vulnerability hotspot website, the older hotspot website has been maintained. Table 2 provides a listing of all the data that are available on the hotspot website.

Table 3. Data Available on the Galveston Atlas Website.

Administrative Districts Boundaries

1. County
2. City
3. Water Control and Improvement Districts (WCIDs)
4. Municipal Utility Districts (MUDs)
5. Independent School Districts (ISDs)
6. Drainage Districts
7. Emergency (police, fire, EMS) Service Networks (ESNs)
8. College Boundaries
9. Navigational Districts

Census 2000 Data

10. Census Tracts
11. Census Block Groups
12. Census Blocks

Development

13. Streets
14. Railroads

15. Landmarks

Physical Risks: Hurricane Surge Zones

16. Category 1 Surge Zone
17. Category 2 Surge Zone
18. Category 3 Surge Zone
19. Category 4 Surge Zone
20. Category 5 Surge Zone

Physical Risks: Wetland Loss (2000-2004)

21. Freshwater Natural Wetland Loss
22. Freshwater human Modified Wetland

Physical Risks: Others Natural Hazards

23. Hurricane Risk Zones (A, B, & C)
24. Flood Risk Zones (FEMA-Q3)
25. Flood – 1994
26. Tropical Storm Tracks
27. Subsidence Risk Zones
28. Coastal Shoreline Types (ESI)
29. Tornado Events (F3-F5) 1950-2003
30. Hazardous Waste Sites 2004
31. Flood Events 1993-2003
32. Drought Events 1994-2003
33. Coastal Erosion Rates (Ft per year)

Parcel Data

34. Parcels 2008
35. Lot Lines 2008

Background Data

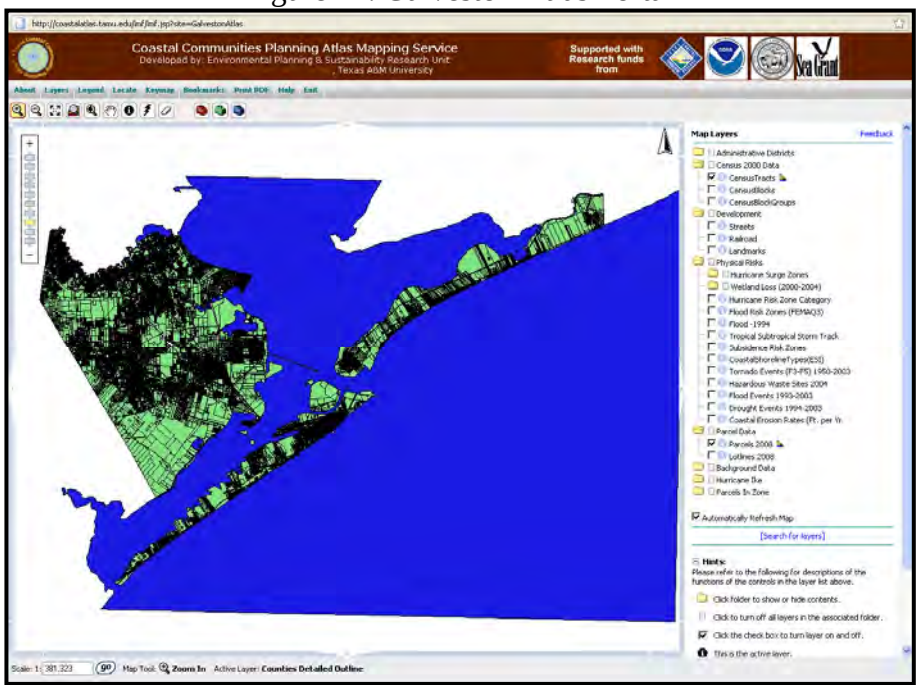
36. Water
37. County detailed Outline

Hurricane Ike

38. Damage Pictures

The Galveston Atlas provides very detailed data on Galveston property that allow users to analyze at a much finer resolution. The Galveston Atlas provides users with 38 different data layers. The foundation of these layers is parcel data for Galveston County providing data on each individual property parcel for the entire county. In addition to the parcel data, some of the other data layers include layers for Water Control and Improvement Districts (WCIDs), Municipal Utility Districts (MUDs), Independent School districts and Emergency Service Networks. A complete listing of the data layers can be found in Table 3 (above). Figure 12 displays the main website for the Galveston Atlas that is reached by clicking the hotlink in the Atlas Options webpage (see Figure 5).

Figure 12. Galveston Atlas Portal



Figures 13 and 14 offer two examples of maps and analysis that can be performed with data layers available on the Galveston Atlas website. Figure 13 displays the property parcel level data for a section of the City of Galveston near the port area and just across from Pelican Island; indicated by the sliver of green just north of the port waterway, and extending south toward the Strand area near the sea wall. The northern area near the seaport was the area that received the most extensive flooding from the surge that accompanied Hurricane Ike. Overlaid on the parcels are the surge zones for Category 1 and Category 2 hurricanes. Users should be cautious while interpreting the precise boundaries of the surge risk areas, since they are only approximate and not designed for this fine of a resolution. Users can obtain a clear indication of the areas of Galveston City property that are more threatened by surge damage than others. The much narrower band of surge areas to the south reflects the protection of the sea-wall and the fact that the elevation of the island increases toward the sea-wall due to the filling of this area following the great Hurricane of 1900.

Figure 13. Cat 1 & 2 Surge Zones Over Galveston City Parcel Data

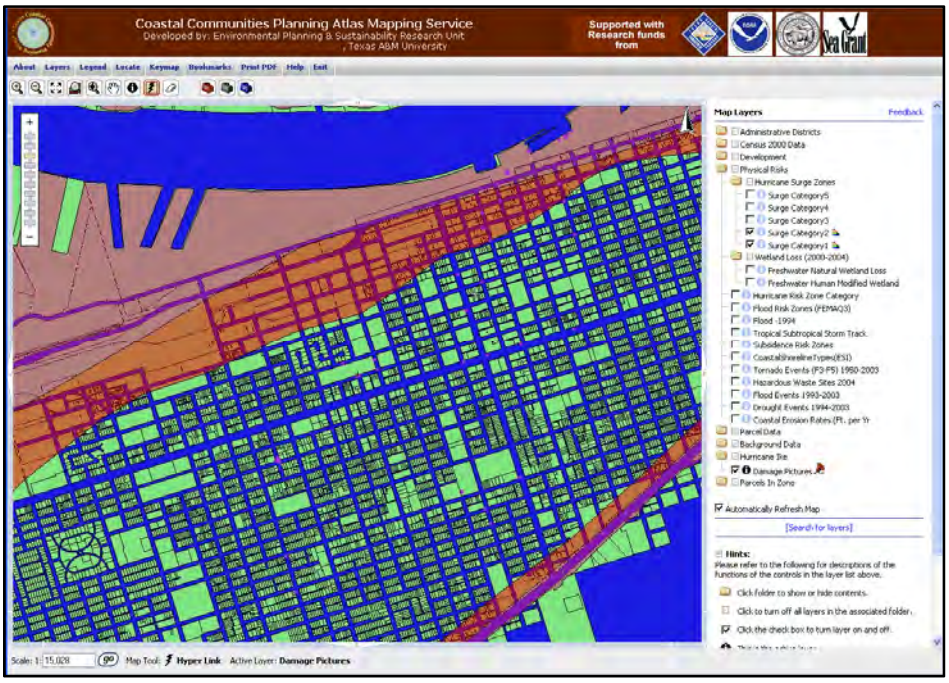
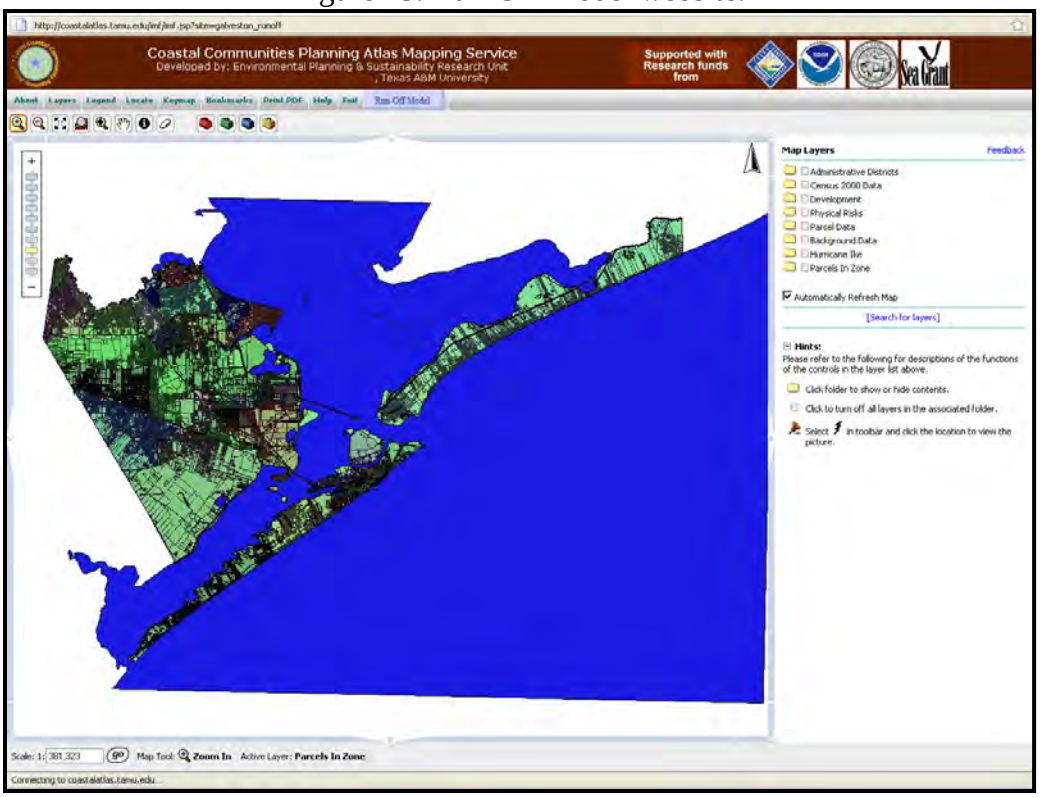


Figure 14. Cat 2 Surge Zones over Galveston Parcel
Data on the Island's West End

Figure 14 provides yet another example of the functionality of the Galveston Atlas website. Here parcel data from the west end of the island, near the community of Jamaica Beach, was used to generate a category 2 storm surge layer. This representation clearly shows that all properties in this are subject to major surge flooding under normal category two events. Furthermore, this example indicates how a user can obtain specific information regarding a given parcel and a visual representation of the location being mapped. Here, instead of using Google Map, a Virtual Earth tool is employed. These examples clearly illustrate that finer resolution data can clearly help planners, emergency managers, and, perhaps most importantly, the public understand how potentially vulnerable they are to coastal hazards.

A final component of the Coastal Atlas is a "what if" scenario tool for Galveston County that enables a user to project the consequences of development from storm water runoff. This is the most interactive and predictive component of the Atlas system because a user can change existing land use at the parcel level based on a development scenario and then receive a graphical and statistical output of the impacts at the landscape level. To reach this tool, the user simply clicks on the "Run-off Model" hotlink on the main atlas link webpage (see Figure 5). After clicking the hotlink the Run-off Model webpage (http://coastalatlas.tamu.edu/imf/imf.jsp?site=galveston_runoff) can be reached. This webpage is shown in Figure 15.

Figure 15. Run-Off Model website.



Under the storm water runoff model, the system calculates percentage change in acre-feet of surface runoff within a Census Tract. For example, using the yellow toolbox, a user can select multiple parcels for which the Atlas will calculate storm water runoff and potential flooding based on existing land use within the chosen zone. A user can then change the percentages of land use based on a hypothesized development scheme (e.g. 80% urban open to 80% single-family residential) to estimate the change in surface runoff within the zone (Census Tract).

Figure 16. Selected parcels

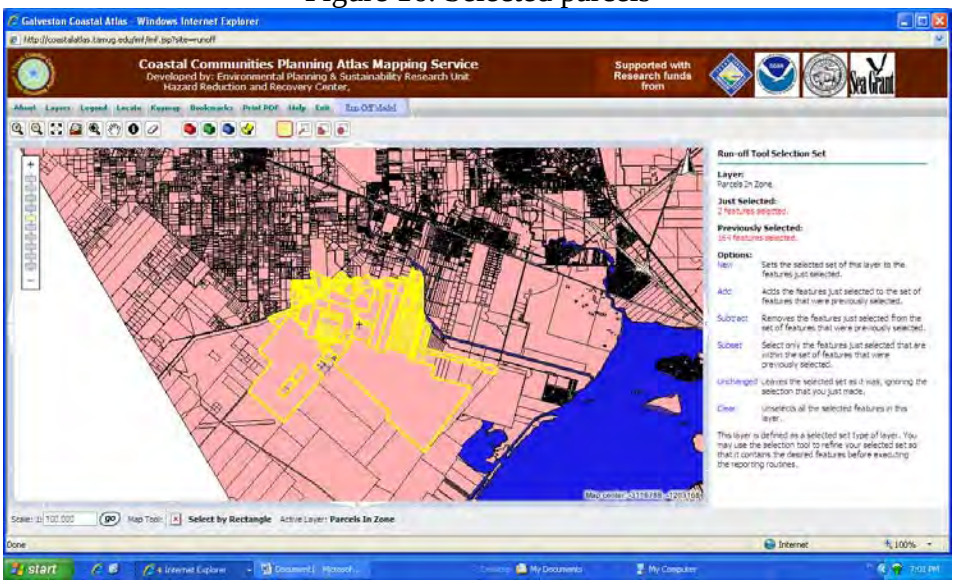
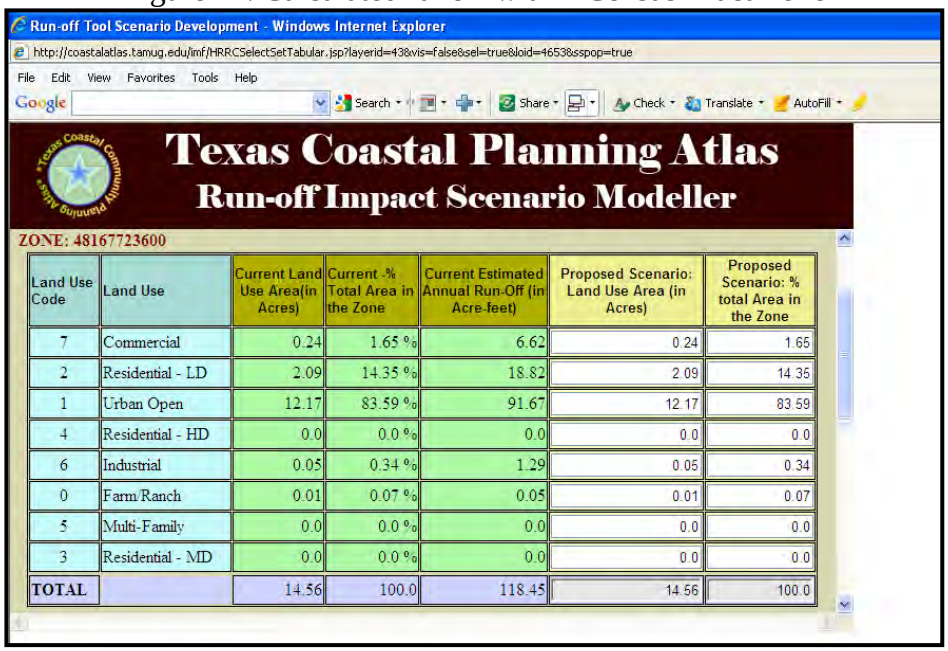


Figure 17. Calculated runoff within Census Tract Zone

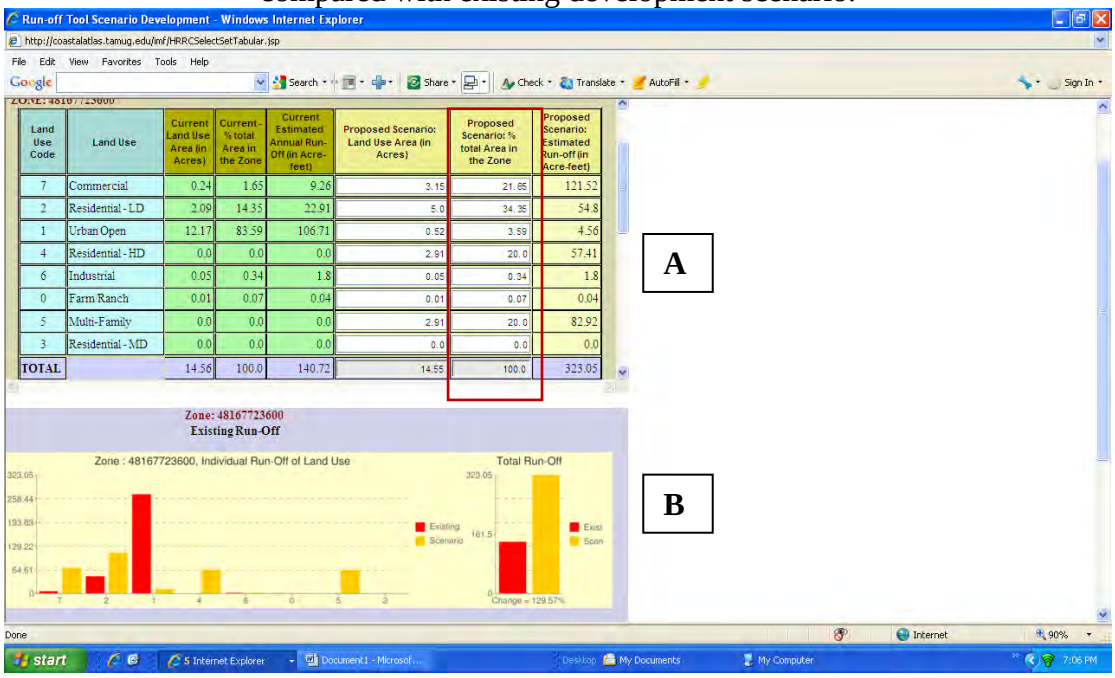


Land Use Code	Land Use	Current Land Use Area(in Acres)	Current -% Total Area in the Zone	Current Estimated Annual Run-Off (in Acre-feet)	Proposed Scenario: Land Use Area (in Acres)	Proposed Scenario: % total Area in the Zone
7	Commercial	0.24	1.65 %	6.62	0.24	1.65
2	Residential - LD	2.09	14.35 %	18.82	2.09	14.35
1	Urban Open	12.17	83.59 %	91.67	12.17	83.59
4	Residential - HD	0.0	0.0 %	0.0	0.0	0.0
6	Industrial	0.05	0.34 %	1.29	0.05	0.34
0	Farm/Ranch	0.01	0.07 %	0.05	0.01	0.07
5	Multi-Family	0.0	0.0 %	0.0	0.0	0.0
3	Residential - MD	0.0	0.0 %	0.0	0.0	0.0
TOTAL		14.56	100.0	118.45	14.56	100.0

An illustration of a runoff scenario is given in Figures 16 through 18. Figure 16 shows 166 parcels in Galveston County selected for analysis (outlined in yellow). The system then calculates runoff in acre-feet based on existing land use for the selected parcels within the designated zone, which in this case is a Census Tract, as shown in Figure 17. Figure 18 illustrates the changes a user could make under the proposed scenario column (outlined in red) in the land use table. In this case, the 84% Urban Open land use is largely re-distributed to commercial, residential (high and low density), and multi-family

categories. Finally, the bar chart in Figure 18 shows the consequences of the proposed development in terms of surface water runoff. The red bars represent the existing land use scenario and the yellow bars indicate the proposed development. In this case, the proposal would generate an estimated 129% increase in total runoff, which could exacerbate area-wide flooding.

Figure 18: Changed percentage of land use within zone and predicted runoff for future compared with existing development scenario.



IV. New Enhancements/Tools in Testing Stage

Consolidation and other database improvements discussed above in part II, have set the basis for upgrading to the new ArcGIS Server platform. In addition, new software capabilities have provided a means to enhance the capabilities of the atlas. The following are enhancements and tools that we have developed over this year and are currently in testing. While they were not released by the end 2012, we hope to have them fully tested and up on the Atlas in the future.

1. **New Base Map Options**: The use of new ARCGIS platform allows us to add Google maps, and Bing maps in the background of the existing mapping interface. Presently these maps are linked externally and show up as pop-up windows based on user input. The software update has enabled us to display these maps as base maps within the existing mapping window. Users will now have the option to choose and display any of the available base maps in the background of the existing mapping interface.
2. **Customized SV Calculator**: An online tool that will allow users to select and create social vulnerability assessment in real time. Users will be able to select

specific social vulnerability indicators, and use variable weights for each of the indicators. The output will be generated in real time and displayed on the mapping window. Presently, this tool is being tested for block groups. We hope to extend it to block level data too.

3. **Extending the run-off impact calculator:** We are in the process of developing extending the run-off impact calculator at the regional level using land cover indicators. Preliminary data collection efforts for identifying impacts of regional land cover change are underway. Once the research team finalizes the impact constants, we will start the work on creating the new expanded tool.
4. **Climate change and variability data:** There are a host of organizations such as NCAR/UCAR that are generating climate variability and anomaly data related to temperature and rainfall that can have utility for assessing increases in flood, drought, and potential fire hazard, which continue to plague the state of Texas. We are working with developing data layers that will become part of the coastal atlas Main Atlas page.

Task 5 – Phase 5: Coastal Atlas outreach

Task Description: In a continuing effort to promote the usage of the coastal atlas website developed and its various components, task 5 of this project will continue to utilize and create opportunities to introduce the website to the public and develop specific learning modules to facilitate usage of the resources being develop.

Specifically this task will focus on utilizing opportunities to do presentations on the coastal planning atlas in various venues that would provide information about the atlas and how it can be utilized to enhance local mitigation planning. These activities will target state and local stakeholders. Two formal training classes targeting at local governments will be conducted by TAMU.

One of the important features of the atlas is that it can serve as an educational tool to promote awareness of coastal hazards, the vulnerabilities of local communities, and promote awareness of the need for mitigation. To facilitate the potential utility of the atlas and its data, learning modules utilizing coastal atlas data will be created for classes at the university level and work with teachers at the K-12 level to include Atlas activities in their classes.

Deliverable(s): Agendas and any distribution materials for 2 formal TAMU Coastal Atlas/Hazards training classes.

While we were required to only undertake two formal workshops as part of Phase 5, we actually undertook 3 formal workshops and utilized a number of opportunities to present the Coastal Atlas and our findings from the Coastal Status and Trends project in public venues. Furthermore we became aware that the Atlas is being employed by Sea Grant

Extension agents to facilitate community mitigation and land use planning. The following will provide information on each of these areas.

I. Formal Workshops.

Workshop 1: *Preparing for Change: Creating Resilient Communities.* Several times a year the American Planning Association (APA) offers, as part of their Planners Training Service, workshops to help train planners on a host of issues. These workshops are generally two days in length and offer/provide continuing education credits to help professionals maintain their professional credentials or licensing. We were approached by the APA to offer a workshop on a topic of our choice and we decided this would be a great opportunity to do our first formal workshop featuring the Coastal Planning Atlas sanctioned by a nationally recognized planning organization like the APA. This opportunity provided a wonderful platform in a two-day format in which to give participants hands on experience using the Atlas to facilitate planning for natural hazards mitigation as well as disaster recovery; the two key dimensions of community resilience. Furthermore, it provided a golden opportunity to share not only the Atlas tools, but also findings from research undertaken as part of the Status and Trends project.

Photos from the first workshop.

The workshop was entitled: "Preparing for Change: Creating Resilient Communities" and was held on November 11 and 12, 2012. The participants came from a variety of organizations including personnel from local planning and emergency management departments, local floodplain management and a river authority (Colorado River Authority) organizations, engineering firms located in Austin and Washington that work with local governments, non-profit environmental organizations and even a Federal Government employee that works with local governments. All are involved in local planning often related to mitigation, natural hazards, or community planning and some

of the non-Texas participants worked with engineering firms that have done or are hoping to do work for local jurisdictions in Texas.

Copies of the workshop's introduction and agenda can be found in Appendix I. The full set of power points and workshop materials that were distributed to the participants will be attached to this report when it is posted on the HRRC's website under research reports (http://hrrc.arch.tamu.edu/publications/reports/), because they are far too large to email with this draft. The APA, conducted an evaluation of the workshop by the participants and the results were quite good. Participants were asked to rate the workshop and instructors using a five point scale ranging from 5 = strongly agree to 1 = strongly disagree with respect to two key statements: 1) "The workshop met or exceeded expectations" and 2) "The presenters met or exceeded expectations." The average scores across all participants were 4.3 and 4.2, respectively. In addition, Dr. Peacock was specifically rated on two questions regarding whether or not he was: 1) "knowledgeable about content" and 2) "delivered material well." Dr. Peacock had an average rating across all participants at 4.7 with respect to both statements. Overall the results were quite good.

Photos from the second workshop.

Workshop 2: *Preparing for Change: Creating Resilient Communities.* In light of the response to our first workshop we were given the opportunity to offer a similar workshop as part of the American Planning Association's Planners Training Service. The workshop was again entitled: *Preparing for Change: Building Resilient Communities* and was held on June 14 and 15. The workshop was structured using the same two day format, allowing for extended time to work closely with participants and share information on the Atlas and our general findings. Unfortunately, this workshop was not as well attending as the first, having only 6 participants. Again, the majority worked as local planners and with non-profits that also work with local planning agencies.

Copies of the second workshop's introduction and agenda can be found in Appendix 2. The full set of power points and workshop materials that were distributed to the participants will also be attached to this report when it is posted on the HRRC's website under research reports (http://hrrc.arch.tamu.edu/publications/reports/). As with the previous workshop, the participants evaluated the content and presenters and the results were slightly better than the first workshop. Participants were again asked to rate the workshop and instructors using a five point scale ranging from 5 = strongly agree to 1 = strongly disagree on two key statements: 1) "the workshop met or exceeded expectations" and 2) "presenters met or exceeded expectations." The scores were 4.4 for both statements. Dr. Peacock was again rated on two questions regarding whether or not he was: 1) "knowledgeable about content" and 2) "delivered material well." He was rated at 5.0 on the first and 4.7 on the second.

Workshop 3: *Planning for Sustainable Coastal Communities.* The final workshop was undertaken using a slightly different format and done in partnership with the Nature Conservancy. It turns out that as part of our second workshop Christine Shepard attended and that began communication about what they were trying to accomplish along the Texas Coast. After the workshop we began an extended discussion that culminated with a decision to try a joint workshop since we had many of the same target stakeholders. The result was a one-day, but a full day, held on December 6, 2012 in which we were able to share our research and the Coastal Atlas, along with some similar tools they are developing.

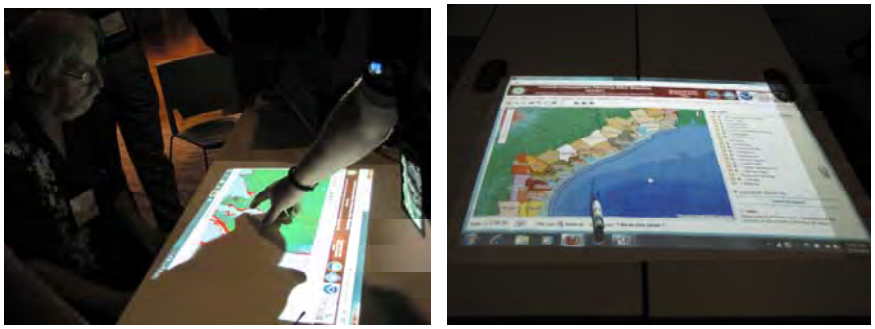
The workshop generated a good deal of interest, was well attended, and well received. In total 26 individuals responded to our mail-out and emails indicating that they would be attending. On the day of the workshop 19 participants actually attended the day long event. The participants were from a wide range of local communities and agencies. The vast majority of participants, 11 in all, came from local communities and worked with local planning organizations. The remainder came from local universities, private research centers, and various regional program offices.

We also solicited evaluations from the participants regarding the workshop's content and presenters using a similar scoring scheme of 5 for strongly agree to 1 being strongly disagree. When asked their agreement as to whether or not the workshop "met or exceeded my expectations," and "provided useful ideas or techniques" the average scores were 4.4 and 4.2, respectively. When further asked if content from the workshop helped better prepare them for their work duties, the average rating was 4.3. Dr Peacock received average scores of 4.4 for both his knowledge of content and presentation of the material.

Photos from Workshop 3

Use of the coastal planning atlas is continuing to spread and we have undertaken and utilized opportunities to spread the word about the coastal atlas. Texas Sea Grant extension and the Nature Conservancy have utilized the atlas in a variety of their planning and training activities. For example, on July 18, 2012 the Atlas was employed as a central tool in a coastal community resilience-planning workshop undertaken in Corpus Christi, Texas. This activity included 22 community participants from local planning agencies and other organizations learned how to employ the Atlas to facilitate community planning with respect to resiliency. The following are some photos of the atlas in use.

Similarly, on September 25, 2012, Heather Wade, with Texas Sea Grant, presented the Atlas to Texas Sea Grant extension agent conference. We have also found that a coastal housing authority agency is employing the Atlas for its planning activities.




Photos from a Sea Grant Nature Conservancy Workshop.

In addition to the above, project staff have utilized a host of opportunities to present the Coastal Atlas in a variety of venues. Drs. Van Zandt, Wunnebuger, Brody, and Peacock continue to utilize the Atlas in their planning classes. Since many of our student go on to professional positions in planning departments and with various forms of planning organizations, knowledge of this tool and more importantly, the concepts behind the tool are carried by our students as they advance in their planning careers. Heather Wade is an example of a student who was trained in our Masters of Urban Planning program, exposed to the Atlas, and has gone on to work for Texas Sea Grant.

Appendix 1.

Preparing for Change: Building Resilient Communities

Planners Training Service Workshop

November 11 and 12, 2011

Himanshu Grover, Ph.D., AICP
Walter Gillis Peacock, Ph.D.
Lori Feild Schwarz, AICP
Shannon Van Zandt, Ph.D., AICP

Hazard Reduction & Recovery Center

Preparing for Change: Building Resilient Communities

TEXAS A&M UNIVERSITY

In regions facing both severe weather conditions and burgeoning populations, the potential for disaster is great. In an era of financial austerity, planning becomes even more important—to provide cost-effective solutions which mitigate harm and provide the foundation for rapid recovery. Featuring real data and interactive technology, instructors use case studies and survey data from Texas coastal communities to demonstrate how community planners can design and defend planning interventions in their own communities, ultimately creating stronger, more resilient communities.

Attendees will be able to:

- Identify the characteristics of a resilient community, and evaluate their own community's level of resilience
- Assess mitigation techniques that are commonly-used in area communities, as well as those that are effective, but often overlooked
- Use American Community Survey data to assess and forecast demographic changes and community needs
- Identify how population characteristics may exacerbate vulnerability and exposure, leading to increased risk for loss of life and damage
- Test different scenarios for how populations may be affected by development scenarios and environmental conditions
- Mobilize community assets (capacity) to strengthen the community's ability to plan and respond
- Ways to incorporate climate change sensitivity in local planning decisions
- Identify opportunities for achieving multiple benefits from traditional planning policies (than may result in new opportunities for generating funds!)

Himanshu Grover, Ph.D., AICP
Walter Gillis Peacock, Ph.D.
Lori Feild Schwarz, AICP
Shannon Van Zandt, Ph.D., AICP

HR&RC

Hazard Reduction & Recovery Center

Agenda

FRIDAY	Time
Introductions	8:00-8:30
What is resilience? Concepts and principles	8:30-9:30
The Galveston Experience	9:30-10:00
	Short break
What are Texas communities doing?	10:15-11:00
Creating community profiles with the new Census products	11:00-12:00
LUNCH	12:00-1:00
The Coastal Community Planning Atlas	1:00-4:30

SATURDAY	
Understanding your community's vulnerability	8:00-9:30
	Short break
Assessing and tapping community capacity	9:45-12:00
Planning for climate change and variability to create resilient communities	12:00-2:00
Best practices for resilience	2:00-3:00

Instructors

Walter Gillis Peacock, Ph.D., is Professor and Director of the Hazard Reduction & Recovery Center at Texas A&M University. Peacock's research, which has been funded by the NSF, NOAA, the Texas General Land Office, among others, focuses primarily on natural hazards and human systems response to hazards and disaster. Having authored more than 100 journal articles, book chapters, or books on disaster recovery and mitigation, Peacock is one of the world's leading experts on planning for socially vulnerable populations. His current research focuses on the capacity of local communities to implement mitigation plans in Texas. His graduate-level planning courses include courses in statistical methods and hazard mitigation. He holds a Ph.D. in sociology from the University of Georgia.

Shannon Van Zandt, Ph.D., AICP, is Associate Professor and Coordinator of the Master of Urban Planning Program at Texas A&M University. Her work centers on the spatial distribution of housing and its consequences for vulnerable populations. Van Zandt connects her research to both the education of planning graduate students and the planning profession through engagement with real communities along the Texas Coast and elsewhere. She is a faculty fellow of the Hazard Reduction & Recovery Center, the Center for Texas Beaches & Shores, and the Center for Housing and Urban Development. Her graduate-level planning courses include courses in land use planning methods, planning theory, professional communications, and housing policy. She holds a Ph.D. in city & regional planning from the University of North Carolina at Chapel Hill.

Himanshu Grover, Ph.D., AICP, is Assistant Professor at the Urban and Regional Planning Department at University at Buffalo (SUNY). His research focuses on planning policies and design of sustainable and resilient communities. Grover examines and evaluates the impact of local planning policies on the ability of at risk communities to understand, analyze, and respond to environmental threats. He has more than 6 years of professional planning experience, and has been associated with numerous internationally funded projects. His courses include planning for climate change, urban infrastructure management, design of cities, and introduction to urban planning. He holds a Ph.D. in urban and regional sciences from the Texas A&M University at College Station.

Lori Feild Schwarz, AICP, is the Assistant Director of Planning and Special Projects for the City of Galveston. She manages the planning division and also serves as Historic Preservation Officer for the City. Schwarz was hired by the City in 2001 and has participated in numerous city-wide planning efforts, including: 2001 Comprehensive Plan, Beach Access Plan, Hazard Mitigation Plan, Disaster Response Plan for Historic Properties, and the Long-Term Recovery Plan for the City of Galveston. She is currently supervising the large-scale Progress Galveston project, which includes a comprehensive revision of the City's land development regulations and numerous specialized plans. Schwarz holds a Master in Historic Preservation degree from the University of Georgia.

Helpful Resources

Hazard Reduction & Recovery Center:
http://archone.tamu.edu/hrrc/

Coastal Community Planning Atlas:
http://coastalatlas.tamug.edu

Center for Texas Beaches & Shores:
http://www.tamug.edu/CTBS/

City of Galveston:
http://www.cityofgalveston.org/

Appendix 2.

Preparing for Change: Building Resilient Communities

Himanshu Grover, Ph.D., AICP
Walter Gillis Peacock, Ph.D.
Lori Feild Schwarz, AICP
Shannon Van Zandt, Ph.D., AICP

American Planning Association
Planner's Training Service
June 14-15, 2012

HAZARD REDUCTION & RECOVERY CENTER
TEXAS A&M UNIVERSITY

Preparing for Change: Building Resilient Communities

In regions facing both severe weather conditions and burgeoning populations, the potential for disaster is great. In an era of financial austerity, planning becomes even more important—to provide cost-effective solutions which mitigate harm and provide the foundation for rapid recovery. Featuring real data and interactive technology, instructors use case studies and survey data from Texas coastal communities to demonstrate how community planners can design and defend planning interventions in their own communities, ultimately creating stronger, more resilient communities.

LEARNING OBJECTIVES:

Part 1: The Problem- Increasingly More Vulnerable

1. Disasters magnify processes that are already taking place in your community
    - Understand the current and future problems our communities face
    - Discover ways to mobilize your organization and community when incorporating climate change and hazard sensitivity into local planning decisions

2. Resilience can be built in to existing plans using already-available tools
    - Be able to evaluate the vulnerabilities in your community by assessing the three pre-existing community characteristics
    - Be able to use the Coastal Planning Atlas or similar tools to discover current conditions and vulnerabilities
    - Use American Community Survey data and other Census data to assess and forecast demographic changes and community needs

Part 2: The Solution- Increasing our Resilience

3. Increasing resilience to disasters builds better communities (whether a disaster hits or not)
    - Understand the components of resilience and the Disaster Impacts Model
    - Mitigation actions and policies for climate change/variability versus other natural hazards should be treated the same.
    - Assess mitigation and recovery techniques that are commonly used in communities, as well as those that are effective, but often overlooked
    - Identify the ways communities can adaptively learn from past experiences
    - Mobilize community assets (capacity) to strengthen the community's ability to plan and respond

Himanshu Grover, Ph.D., AICP
Walter Gillis Peacock, Ph.D.
Lori Feild Schwarz, AICP
Shannon Van Zandt, Ph.D., AICP

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PART 1: Problem-Increasingly More Vulnerable

Focus: Problems, Concerns, & Vulnerabilities

Activity
Presentation

Time	Agenda	Instructor
8:00 AM	Coffee/Breakfast/Topic Questions	
8:15 AM	Introductions	Shannon
8:30 AM		
8:45 AM	01-Problem: Increasingly more vulnerable	Walt and
9:00 AM		Himanshu
9:15 AM		
9:30 AM		
9:45 AM	Climate Change Skepticism Activity	
10:00 AM	BREAK	
10:15 AM	02-Case Study: Galveston, TX	Lori
10:30 AM	How a community at risk responds	
10:45 AM	PCCA Activity	Himanshu
11:00 AM		
11:15 AM		
11:30 AM		
11:45 AM		
12:00 PM	LUNCH	
12:15 PM		
12:30 PM		
12:45 PM		
1:00 PM	03-Understanding Existing Conditions	Walt and
1:15 PM	Case Study: Hazard Exposure	Himanshu
1:30 PM	Coastal Atlas Activity	
1:45 PM		
2:00 PM	Case Study: Physical Vulnerability	
2:15 PM	Coastal Atlas Activity	
2:30 PM		
2:45 PM	Case Study: Social Vulnerability	
3:00 PM	Coastal Atlas Activity	
3:15 PM		
3:30 PM	BREAK	
3:45 PM	04-Getting refined data on your community	Walt
4:00 PM	Using US Census ACS and CSE data products	
4:15 PM		
4:30 PM		
4:45 PM	Onthemap.gov Activity	
5:00 PM		

PART 2: Solution-Increase our Resilience

Focus: Solutions, Assets, & Capacities

Activity
Presentation

Time	Agenda	Instructor
8:00 AM	Coffee/Breakfast/Topic Questions	
8:15 AM	Quiz	Walt
8:30 AM	Resilience Through the Senses	
8:45 AM	05-Solution: Increase our Resilience	
9:00 AM	Disaster Phases Activity	Shannon
9:15 AM	Disaster Phases & Injecting Resilience	
9:30 AM		
9:45 AM		
10:00 AM	Mitigation Best-Practice Strategies Activity	
10:15 AM	What are other communities doing?	Walt
10:30 AM		
10:45 AM	High-impact Mitigation Policy Example	Himanshu
11:00 AM		
11:15 AM	Galveston: Mitigation Planning	Lori
11:30 AM		
11:45 AM	Recovery Best-Practice Strategies- Activity	
12:00 PM	Recovery Best-Practice Strategies	Walt
12:15 PM		
12:30 PM	Galveston: Recovery Planning	Lori
12:45 PM		
1:00 PM	Community Capacity: Identifying Resources Activity	Shannon
1:15 PM		
1:30 PM	06-Community Capital and Capacity (Introduction)	
1:45 PM	Community Capacity: Identifying Community Capacity Activity	
2:00 PM	Building Capacity	
2:15 PM	Community Capacity: Your Commuity Capacity Activity	
2:30 PM		
2:45 PM		
3:00 PM		

Table of Contents

Appendix 3.

Planning for Sustainable Coastal Communities Symposium

Sam Brody
Walt Peacock
Shannon Van Zandt
Wes Highfield
Christine Shepard
Jorge Brenner

Galveston, TX
December 6, 2012

HAZARD REDUCTION & RECOVERY CENTER
TEXAS A&M UNIVERSITY

GALVESTON
TEXAS A&M UNIVERSITY

Planning for Sustainable Coastal Communities Symposium

In regions facing both severe weather conditions and burgeoning populations, the potential for disaster is great. In an era of financial austerity, planning becomes even more important—to provide cost-effective solutions which mitigate harm and provide the foundation for rapid recovery. Featuring real data and interactive technology, instructors use case studies and survey data from Texas coastal communities to demonstrate how community planners can design and defend planning interventions in their own communities, ultimately creating stronger, more resilient communities.

LEARNING OBJECTIVES:

- Understand the components of resilience and the Disaster Impacts Model
- Be able to use the Coastal Planning Atlas and similar tools to discover current conditions and vulnerabilities
- Develop a toolbox for mitigation actions and policies for coastal hazards
- Understand the hazard mitigation strategies that are most cost effective
- Assess mitigation techniques that are commonly used in communities, as well as those that are effective, but often overlooked
- Mobilize community assets (capacity) to strengthen a community's ability to plan and respond

Agenda

Planning for Sustainable Coastal Communities Symposium
Texas A&M University at Galveston
Ocean and Coastal Studies Building
Building 3029, 200 Seawolf Parkway
Galveston, Texas 77553

Workshop AICP & CFM CM | 7
Dec. 6th, 9am - 4pm in room#____
Lunch provided

Introduction.....Shannon Van Zandt (15 min)

Hazard Mitigation
- Overview.....Walt Peacock (30-45min)

Mitigation Strategies
- Coastal Policies That are Under-utilized.....Walt Peacock (30-45 min)

~Break~
- Flood Mitigation- What Works & What Doesn't.....Wes Highfield (30-45 min)

~Lunch~ Consistency of Plans.....Shannon Van Zandt(30min)

Tools for Planning
- The Nature Conservancy's Coastal Resilience Decision Support Tool
  - Overview and Intro to the Nearshore Waves Module .....Christine Shepard (45min)
  - Coastal Hazards, Sea Level Rise, and Benefits of Coastal Habitats.....Jorge Brenner (45min)

~Break~
- Coastal Planning Atlas
  - Run-off Scenarios .....Sam Brody (45min)
  - Social Vulnerability Scenarios.....Walt Peacock (45min)
- On the Map.....Walt Peacock (20min)

Where do I go from here?.....Walt Peacock (10 min)

Reception

Open House Reception
Dec. 6th, 4pm – 7pm in lobby
Drinks and Hors d'oeuvres

Welcome.....President Smith
Institute of Sustainable Coastal Communities.....Sam Brody
Hazard Reduction and Recovery Center.....Walt Peacock
Tours:
OCSB building
Institute for Sustainable Coastal Communities

Other information:
Registration is free. Participants should bring a personal laptop. Laptops can be made available upon request.
Please RSVP to Taylor Huff, thuff@arch.tamu.edu

Instructors

Institute for Sustainable Coastal Communities

Samuel D. Brody, Ph.D., is a Professor and holder of the George P. Mitchell '40 Chair in Sustainable Coasts in the Departments of Marine Sciences and Landscape Architecture and Urban Planning at Texas A&M University. He is the Executive Director of the Institute for Sustainable Coastal Communities and the Director of Center for Texas Beaches and Shores located on the Galveston campus. Dr. Brody's research focuses on coastal environmental planning, spatial analysis, environmental dispute resolution, climate change policy, and natural hazards mitigation. He recently authored the book, *Rising Waters: The causes and consequences of flooding in the United States*, published by Cambridge University Press. Dr. Brody teaches graduate courses in environmental planning, sustainable development, and dispute resolution. He has also worked in both the public and private sectors to help local coastal communities to draft land use and environmental plans. For more information, please visit www.tamug.edu/ctbs.

Wesley E. Highfield, Ph.D., is an Assistant Professor in the Department of Marine Sciences, Associate Director for the Center for Texas Beaches and Shores at Texas A&M University at Galveston, and Associate Faculty Fellow of the Hazard Reduction and Recovery Center at Texas A&M University. His research is centered on natural hazard mitigation and spatial analysis. Highfield's recent hazard related work includes investigations of the impacts of Hurricane Ike and evaluating the effectiveness of FEMA's Community Rating System. His course offerings include Geographic Information Systems and statistics. He holds a Ph.D. in Urban and Regional Science from Texas A&M University.

Instructors

Hazard Reduction & Recovery Center

Walter Gillis Peacock, Ph.D., is Professor and Director of the Hazard Reduction & Recovery Center at Texas A&M University. Peacock's research, which has been funded by the NSF, NOAA, the Texas General Land Office, among others, focuses primarily on natural hazards and human systems response to hazards and disaster. Having authored more than 100 journal articles, book chapters, or books on disaster recovery and mitigation, Peacock is one of the world's leading experts on planning for socially vulnerable populations. His current research focuses on the capacity of local communities to implement mitigation plans in Texas. His graduate-level planning courses include courses in statistical methods and hazard mitigation. He holds a Ph.D. in sociology from the University of Georgia.

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Instructors

The Nature Conservancy

Christine Shepard, Ph.D., is a Postdoctoral Scientist with The Nature Conservancy's Global Marine Team. Christine's primary research focuses on assessing coastal hazards risk, quantifying the role ecosystems play in reducing risk, and identifying where ecosystem based approaches such as conservation or restoration are likely to be effective for risk reduction. In addition, Christine works to develop innovative spatial analyses and community engagement tools to help decision makers address coastal risks from climate change and coastal hazards like storm surge and sea-level rise. She recently co-authored the 2012 World Risk Report in partnership with United Nations University and Development Works, an alliance of German aid organizations. In addition to assessing the countries most at-risk from natural hazards, this year's report focuses on the role of the environment in reducing risk, and how environmental degradation increases the risk to people. Christine also manages two site based Coastal Resilience projects in Charlotte Harbor, Florida and Galveston Bay, Texas. Christine completed her PhD in Ocean Science at the University of California-Santa Cruz in 2010 and her BSc in Zoology and Psychology at the University of Florida in 2002.

Jorge Brenner, Ph.D., is currently the Associate Director of Marine Science at the Nature Conservancy. Dr. Brenner is interested in coastal resilience ecosystem services' health assessment, integrated valuation models, and conservation science including the spatial dynamics of biodiversity. Dr. Brenner has experience working in related issues in Mexico, the Mediterranean, and the Gulf of Mexico regions. He earned a Ph.D. in marine sciences from the Catalonia Polytechnic University in 2007, a M.S. in environmental engineering, and a B.S. in biochemical engineering and aquatic resources, from the Monterrey Technology Institute University in 1997 and 1995, respectively.