Status and Trends of Coastal Vulnerability to Natural Hazards Project Annual Report for Phase 2

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The Texas Coastal Zone, as defined by the Texas Coastal Management Program (CMP), is home to six of the top twenty most populated counties in the state, including Harris, Cameron, Nueces, Jefferson, Galveston, and Brazoria counties. Together the 18 coastal counties of Texas [Orange, Jefferson, Calhoun, Harris, Galveston, Brazoria, Matagorda, Aransas, Nueces, Calhoun, Kenedy, San Patricio, Victoria, Kleberg, Willacy, Cameron, Jackson, Victoria] contain just over 5.2 million people, representing approximately 25% of Texas' population and that population is projected to grow to 8.6 million by 2040. Harris County, which includes the greater Houston area, is the most populous county in Texas. For perspective at a national scale, the greater Houston area is one of the top ten largest metropolitan areas in the country and one of only two located in a coastal zone. Hurricane Ike, the fourth most costly hurricane in United States history (Berg, 2009) clearly demonstrated that this population is highly vulnerable to the surge and wind hazards that are associated with hurricanes.

To address the increasing vulnerability of our nation, the 2000 reauthorization of the Stafford Act called for an increased emphasis on natural hazard mitigation. In response, the State of Texas, through the Governor's Division of Emergency Management (GDEM), prepares a State of Texas Mitigation Plan (STMP) every three years that for approval by the Federal Emergency Management Agency (FEMA). During the planning and early initiation of this project, the 2004 STMP was in effect. That plan identified five natural hazards, including floods, tornadoes, tropical storms and hurricanes, droughts and wildfires as being of particular concern to Texas. Since the inception of this project, the 2007 STMP has been developed and has extended the number of natural hazards of concern to include, among others, coastal erosion and subsidence. The 2004 STMP suggests that losses due to a major hurricane could reach 20 billion and the 2007 plan increases this only slightly to 21 billion. In light of the 84 deaths directly or indirectly attributed to Ike, the over 30 individuals still missing, and current estimated losses of 19.3 billion (Berg, 2009), the STMP's estimates appear low. Considering that Ike was a Category 2 storm, these deaths and losses drive home the importance of addressing the increasing vulnerability of our coastal population. Indeed, one of the primary goals of the STMP is to stimulate and enhance the development of local mitigation action plans seeking to reduce the vulnerability of Texas coastal areas to hurricane and tropical storm impacts.

The CMP may be another important mechanism for addressing coastal vulnerabilities. The CMP seeks to be the "state's answer" to calls for a more "comprehensive approach for the management of coastal natural resources" through "effective and efficient" decision making (CMP Guide, page 2). The CMP's goals of protecting, restoring, and enhancing the diversity, quality, quantity, function and values of coastal natural resource areas (CRNAs) while at the same time seeking to minimize loss of human life, property

and the benefits of CNRAs argues for effective mitigation to ensure these goals are better achieved. There are undoubtedly many activities that the CMP could undertake to enhance the mitigation decisions and activities by coastal communities that will enhance coastal resources while minimizing vulnerabilities and risks. Unfortunately hazard mitigation issues have not received a level of attention within the CMP that is perhaps commensurate to the growing coastal vulnerability to coastal hazards and potential property losses they represent. There are undoubtedly many reasons for this, such as the lack of representation of the Governor's Division of Emergency Management (GDEM) on the Coastal Coordination Council and directives to focus more on erosion avoidance and remediation than on long-term mitigation issues.

The Status and Trends of Coastal Vulnerability to Natural Hazards project is a multi-phase project designed to undertake a status and trends study of coastal vulnerability to natural hazards of counties located in the CMP boundary. The target areas for this study will be Harris, Galveston, and Brazoria counties. However, much of the overall analysis will include counties along the entire Texas Coast.[1] The project includes the following tasks:

1. Evaluate content and implementation of the STMP (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.

[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.

It is hoped that the research outlined above will generate policy and programmatic recommendations related to coastal programs, management, and regulations. This research will also develop 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 STMP and the CMP, strengthening mitigation activities throughout the CMP boundary.

During Phase 1, the focus was on Tasks 1, 2, 5, 6, and the formation of a status and trends project advisory committee. Phase 2 of this project completed Task 1, substantially finished Task 2, initiated Tasks 3 and 4, continued work on Tasks 5 and 6, including a major report on the coastal planning mosaic and also held the first advisory committee meeting. The following report provides a brief overview of the accomplishments for the second phase of this project for each task and associated subtask. More detailed information associated with many of these tasks is provided in appendixes which include major reports produced during phase 2. The project effectively ran from January 2008 through the end of June 2009.

Task 1: Evaluate content and implementation of the State of Texas Mitigation Plan (October 2004) for applicability to the Coastal Management Program.

Task 1: Description: Task 1 is focused on a documentary analysis of the Texas Mitigation Plan and the Texas Coastal Management program addressing issues of compatibility, consistency and the capacities of the plan and program to promote concerted actions that work toward Coastal Hazard Mitigation. This assessment is based on documentary analysis and the perspectives of officials and stakeholders gained through interviews undertaken as part of Task 2.

A preliminary draft report on the comparison of these two documents has been submitted and very preliminary information from limited interviews regarding the TMP and TCMP are included as part of the year one final report.

Deliverable(s): Assessment of Task 1 activities and findings: This report will combine the documentary analysis and a more complete discussion from the interviews conducted with stakeholders. While the initial agreement was to compare the Texas Mitigation Plan (TMP) that was in effect at the time the project was initiated, a new TMP is in development that includes an appendix related to the TGLO and its relationship to the plan. The final document will not undertake a detailed reexamination of TCMP and the new TMP, however it will be discussed.

A final report was submitted with the January 2009 quarterly report and is also submitted as Appendix 1 of this report.[3] That report undertook a documentary analysis of the STMP and the CMP and found a relatively high degree of compatibility and consistency between the STMP and the CMP. While the STMP of 2004 primarily addresses five hazards (flooding, tropical storms and hurricane, tornados, drought, and wildfires), tropical storms and hurricanes are recognized as highly probable hazards for the state of Texas and considerable space is devoted to these hazards.

Based on the analysis of that report and insights gained from interviews during the elite survey, discussed in the next section, the reported noted that there are a variety of ways in which the GLO can better integrate hazard mitigation into the TCMP. All of these methods involve the development of closer ties with local governments and other relevant state agencies. The importance of networking and building relationships cannot be overemphasized. Frequent meetings can help dissimilar groups come to a shared definition of problems and develop plans and projects that can work together to address these problems. To this end, the GLO should continue and accelerate its current efforts to create working relationships with local governments. Two specific groups should be targeted: land use planning/development professionals in the cities, and emergency management professionals at the city and county level. These groups have not historically had close relationships, understood each other, or worked very closely together. In this new century, it is time to move beyond stove piped public agencies and learn to collaborate. Hazard mitigation is a clear case of the need for collaboration across disciplinary and agency boundaries.

The GLO is familiar with thinking in long-range terms rather than considering only short-term political or economic benefits, and this orientation is a valuable one that can serve as the basis for long-range thinking about the best way to use and protect the state's natural and economic resources. The GLO also has a unique set of partner agencies in the CCC, and can build on these relationships as well as extend working relationships to other state agencies. By aligning their goals, these various agencies and organizations can increase their effectiveness. Now we will address the three areas in which the GLO can act.

1. *Promote a clearer understanding of and a stronger commitment to hazard mitigation at the local level.* The STMP is built on a model that is not well adapted to reducing natural hazard exposures. It focuses on meeting FEMA requirements in the "crosswalk" process (for an explanation of this process see the manual available at http://www.fema.gov/plan/mitplanning/guidance.shtm and see discussions in the mitigation plan evaluation report prepared by the HRRC staff as part of it activities for the GLO), which ensures that mitigation plans meet minimum standards and includes the elements required for receiving federal funds. This approach does not result in a readable, user-friendly plan. It reads more like a laundry list of state agencies and their varied programs and projects. The plan's definition of mitigation as "any action taken to eliminate or reduce the long-term risk to life and property from natural and human-

[3] Unfortunately it was unclear as to whether a final amendment or appendix to the TMP specifying the GLO's activities with respect to mitigation planning was ever adopted. Project staff never received the appendix if it was ever adopted.

caused hazards" (STMP p. 3-1) can certainly encompass the most useful tools for mitigating coastal hazards, but these tools are not the focus of the plan as it stands.

The plan does recognize that Texas state law places the burden of actual mitigation actions on local governments, usually meaning cities (STMP p. 3-2). Counties in Texas, unlike in many other states, have no planning or land use control authority. This places the burden of legislation, implementation, and monitoring on the governments least likely to have the resources to undertake hazard analyses, the political will to pass the needed legislation, or the capacity to implement policy and monitor compliance.

There are many reasons local governments do not, cannot, or will not undertake adequate mitigation activities. Chief among these is lack of political will, or commitment (Godschalk et al. 1999). In most coastal cities, economic development defined as growth remains an important goal. The imposition of limits to such growth, resulting from land use planning, hazard zoning, or adopting and enforcing building codes, places local governments at odds with important local political forces. In such cases, it can be useful to educate elected and appointed officials as well as the public about the real present costs of disasters, methods of preventing them or minimizing the effects of hazard events, and the benefits that can flow to cities that undertake to reduce their hazard exposure. The GLO can undertake such a process of education through contacts it has already made at the local level, deepening these relationships and reaching out to small communities in particular. In addition, the GLO can work with emergency management professionals in groups such as the Texas Coastal Advisory Team to help educate local decision makers.

Another reason for the lack of serious mitigation action is a lack of local capacity. The GLO can address this issue through offering technical assistance to local governments that want to do more, for example through offering assistance in undertaking hazard and risk analysis. The website project currently in development can be shaped to meet local government needs for information and analysis, and training sessions for using the website should be developed while it is in progress. In addition, the funding of projects designed to create tools, data, and models that will facilitate making sound development and mitigation decisions that are consistent with a localities hazard risk should be continued and expanded. Examples might include modeling projects on local sea-level rise, wind fields, the geo-hazards mapping project undertaken with Dr. Gibeaut for Galveston Island and incorporation of the results of these projects in to web-based decision support tools – like the coastal planning atlas – that can be employed at the local level to guide development and mitigation decisions.

2. *Promote the use of land use planning, zoning and building codes to reduce disaster exposure in the coastal zone*. In order to withstand legal challenges zoning ordinances must be tied to legally adopted, comprehensive land use plans that address the community's goals for the future through measurable objectives and policies that will help the jurisdiction meet stated goals. An open and collaborative planning process is helpful in gaining public acceptance for zoning ordinances and land use plans, but many smaller jurisdictions need assistance with the planning process at one point or another. Technical assistance in city comprehensive planning and zoning ordinance development

is available at many universities around the state, and the GLO can assist interested local governments by helping them find a program that will work with them to develop or update their plans and ordinances, including hazard mitigation elements. A simple table of funding opportunities, with information on amounts available, criteria for evaluation, and requirements for funding, similar to that available as Attachment 7 to the 2007 STMP prepared by H_2O partners, can be very useful. GLO could prepare a list like this of funding assistance available to local planning and development agencies.

In addition, the GLO could prepare a model county planning enabling act, based on models used in other states (Institute for Business & Home Safety 2006), to put forward at the next State Legislative session. Mandating that counties undertake such planning would reduce the hazard to settlements located in unincorporated areas. Such a legislative change should be accompanied by a change to the city planning enabling act that makes land use planning mandatory rather than elective as it currently is in Texas (Texas State Local Government Code Chapter 219). By preparing a model county planning act and recommending it to the Texas Legislature, and working to promote mandatory comprehensive city planning that includes hazard mitigation as one of its goals, GLO could advance awareness of the need for more attention to hazards mitigation at the local level, and influence the legislative outcome in a positive way. Research has shown that state planning mandates do matter, and that states with mandated local planning have more appropriate local land use practices than states that do not (May and Deyle1998).

Undertaking these types of activities might be greatly enhanced by partnering and working with the Texas Chapter of the American Planning Association (www.txplanning.org). The Texas APA offers not only a yearly workshop with training sessions, but a variety of local workshop on issues related to planning in Texas such as developing a comprehensive plan, creating ordinances that work, and tools to implement planning. Exploring the holding joint workshops on mitigation, environmental and coastal planning issues, model mitigation ordinances, and integrating mitigation planning into comprehensive plans might be vehicles to promote long term mitigation efforts by communities in the coastal management zone.

3. *Partner with the TWIA and TDI's efforts to promote better building practices through building codes, inspections, and enforcement*. The Texas Department of Insurance educates consumers about wind hazards through its website at www.tdi.state.tx.us. This educational effort should be extended to promoting the adoption of adequate building codes in all coastal communities. The adoption of building codes at the municipal and county levels should be mandatory, and legislative changes to this effect should be developed for adoption by the Texas legislature. GLO may be able to assist TDI in the attempt to formulate and pass such legislation.

In addition, TDI is responsible for approving insurance rates in the state and for inspecting buildings for compliance with building codes. TDI can continue its educational efforts by closely linking rates to wind exposure, and can be invited to participate in the CCC's various public education and outreach projects. Consumers need

to be educated about the connections between the quality of homes built in their areas and the potential for damages in the case of hurricanes.

The TWIA is increasingly serving as the insurer of choice or indeed the only insurer of coastal properties. TWIA has a broad base of funding, but it may still be unable to meet the needs of a large event or a series of smaller ones occurring in rapid succession. If demand for its services could be lessened through reducing the amount of new building on the coast and making such building that does occur compliant with strong wind codes, the Association would have a better chance of surviving to offer its services to future generations of Texans.

One important area of potential collaboration is the need for stricter and more widespread building codes. Such codes could help reduce damages from hurricane force winds and the state's financial exposure to risk. By creating working partnerships and networks with local governments through the TCMP, along with the TDI and TWIA, GLO can help local governments and businesses better understand the true nature of coastal hazards and the risks they pose. Making local politicians and business leaders more aware of the hazards is one important step. Another one is providing examples of how increased control of development can improve the fiscal health of state and local governments, by reducing subsidies for risky development.

Yet another area might be explored between the GLO and TDI might be in jointly funding of wind field modeling and assessment tools that will yield risks and vulnerability assessments at refined geographical scales to facilitate community based mitigation planning, high wind ordinances, and risk appropriate and relevant building codes. One of the difficulties local communities, stakeholders and individual citizens have when trying to undertake mitigation planning is the "fact basis" components of a plan which require not only identifying the hazards that threaten an area, but also detailed assessments of specific vulnerabilities and risks. Using broad based ASCE wind field maps, if they are available, provide only limited understanding of the wind risks at the local level where refined locational data on risk (i.e., Probabilities of sustained and gusting wind of various speeds) is needed for mitigation planning. Perhaps working with the TDI can make the funding of these types of projects more likely and can better ensure that the needs for local community's can be met. In addition, the results of these projects should be made available free to local communities and stakeholders in a format that is useful and readily accessible.

4. Partner with the Governor's Division of Emergency Management to promote mitigation and seek out opportunities to coordinate efforts. As noted above, it is important that closer working relationships between the GLO and other relevant state and local governments be developed to insure coordinated and concerted action related to mitigation efforts. One critical step might be having representation of the Governor's Division of Emergency Management on the Coastal Coordinating Council. The specific goals of including a member of DEM on the CCC would be to help shape funding policy to ensure that issues of relevance for broad issues of hazard mitigation become an ongoing agenda item and to better ensure coordination between DEM and the TCMP.

Task 2: Assessment of coastal zone planning regimes

Task 2 Description: Tasks 2 will focus on an assessment of mitigation plans and mitigation actions and their potential consequences for mitigating impacts of coastal natural hazards.

The State of Texas regulatory regime is best described as a complex mosaic of regimes at the state and local municipality level. As a consequence it is highly difficulty to understand potential vulnerabilities because there are not single planning mandates and statewide codes. Phase 1 began the process of developing an understanding of this regulatory mosaic, phase 2 will focus on the following activities:

a. Continue the environmental scan, the assessment of the number and spatial boundaries of regulatory regimes related to building codes and land use planning policies, and secondary data gathering activities (e.g., collecting information on building codes, various land use policies, etc.) for the target area counties.
b. Employ the sampling frame and interview schedules developed during Phase 1, continue and complete the interviewing of the elite sample which consists of state and local officials, building officials, etc. in the target area counties.
c. Develop a mitigation action plan assessment protocol evaluating the overall quality of mitigation action plans (regional and municipal) focusing on areas within the coastal management zone.
d. Continue the systematic data collection related to building codes and land use planning policies.
e. Conduct analysis and report writing on mitigation action plans for areas located in the coastal management zone.

Deliverable(s): 1) Preliminary report on mitigation action plan measurement protocols and early assessments; 2) Preliminary report on the mitigation action plans; 3) Final report on mitigation action plans; 4) Preliminary report on elite survey; and 5. Final report on elite survey

The primary activities of Task 2 were to 1) complete the comprehensive evaluation of Coastal Hazard Mitigation Action Plans and 2) to complete the survey of representatives from state and local agencies involved or potentially involved in coastal hazard mitigation planning and issues. The former was submitted in January of 2009 and the latter was submitted in March 2009. Each of the full reports can be found in Appendix 2 & 3 of this report. The following offers a summary of the major points of the findings from the mitigation action plan analysis and the major findings of the elite survey.

2.1 The Assessment of Coastal Zone Hazard Mitigation Plans:

The purpose of undertaking an assessment of Hazard Mitigation Action Plans and the subsequent report was to provide a comprehensive assessment of FEMA approved hazard mitigation action plans developed for and being implemented in areas located in the Texas Coastal Management Zone. Specifically, the report offers an evaluation of twelve

hazard mitigation plans that include three municipality plans, four county plans and five regional plans. Together these plans were developed to shape mitigation policies and actions in a total of 130 jurisdictions composed of 18 counties and 112 municipalities located in Texas's Coastal Management Zone.

The goal was not simply to replicate FEMA's approval process but rather to undertake a systematic analysis of current mitigation action plans, based on the most recent scientific literature on plan evaluation and hazard mitigation. This assessment is designed to provide feedback to the various constituencies, stakeholders, and jurisdictions involved in developing future versions of these and other mitigation plans. That feedback focuses on identifying the relative strengths of these plans as well as areas that should be improved upon as these plans evolve. The hope is that by improving mitigation planning and subsequent mitigation actions, communities in Texas's coastal management zone can significantly enhance their abilities to reduce the loss of life, property, and natural resources.

To undertake this assessment a comprehensive hazard mitigation plan protocol was developed based on FEMA guidelines and the research literature on plan evaluation and hazard mitigation. FEMA guidelines specify four plan components (*planning process, risk assessment, mitigation strategy,* and *plan maintenance*), composed of 15 sub-components, and 32 planning element upon which all hazard mitigation plans were evaluated. The protocol developed for this research recognized and targeted seven plan components: *1) vision statement, 2) planning process, 3) fact basis, 4) goals & objectives, 5) inter-organizational coordination, 6) policies & actions, and 7) implementation.* These seven components have been divided into 30 sub-components which in turn were composed of 164 planning elements. Plans were scored based on these 164 planning element which were evaluated by first determining if a plan dealt with each of these elements and second, if addressed, the level of detailed and direction with respect to each element was assessed. The explicit assumption was that the greater the detail and guidance in an element's assessment, the higher the quality displayed by the plan. Based on this scoring scheme, individual plans were assessed in terms of their total raw score and standardized plan and component quality scores (*PQS* and *CQS* respectively) which ranged between 0 and 100. In addition, each planning element was evaluated across all 12 plans in terms of the proportion (or percentage) of plans that actually discussed each element and how well each was addressed on average across all twelve plans and across those plans that explicitly addressed the element. The following provides a brief discussion of major findings.

2.1.1 Overall Plan and Component Quality Assessments

When assessed against a comprehensive planning protocol based on the FEMA guidelines and the research literature on plan quality and mitigation, the average plan quality score (*PQS*) was only 41.6 on a 100 point scale, with a high of 53.3 and a low of 28.7. Regional and county plans appeared to display slightly higher plan quality scores than did city plans. With respect to the seven plan components a number of plans had component quality scores (*CQS*) at or above 70%, but the averages for these components were at best just slightly above, but usually well below 50. *Implementation* had the highest average *CQS* at 51.9, followed closely by *planning process* at 51.7, *goals & objectives* at 45.5, *inter-organization coordination* at 42.2, and *vision statement* at 38.3.

Most disconcerting of all were the very low component quality scores for *fact basis* at *33.6* and mitigation *policies & actions* at only *28.2*. These two components are at the heart of mitigation actions plans for they define the nature of the hazards, risks and vulnerabilities faced by jurisdictions and the types of mitigation policies and actions that should be undertaken with mitigation funding in response to those risks and vulnerabilities. These relatively low scores *PQS* and *CQS* results suggest that there are significant areas of potential improvement that should be undertaken in future iterations of mitigation hazard action plans.

2.1.2 Detailed Planning Element Analysis

Following the general assessments of the overall plans and the seven key components, a very detailed assessment of each of the 164 planning element associated with the seven principle planning components was undertaken. The following is a summary of the major findings with respect to each of the primary seven components and their associated planning elements:

- *Vision Statement:* In general, planning elements associated with the *vision statement* component are addressed by nearly 70% of mitigation plans; however, they are addressed only minimally, resulting in somewhat low quality measures for the depth of coverage throughout the coastal zone. While not an absolutely critical component of a mitigation plan, this element can be important to insure "buy-in" by various constituencies and stakeholders, as well as motivating participation and political will. These can be critical for the overall success and implementation of a plan.
- *Planning Process:* The *planning process* component was one of the higher scoring components in the plan analysis, yielding a *CQS* of 51.7%. Not surprisingly detailed analysis of the 10 planning elements associated with this component found that most plans incorporated detailed discussions of the planning process undertaken for the development of their plans, and techniques such as open meetings, surveys, websites and even workshops were widely employed and well described. However techniques such as formal public hearings, citizen advisory committees and interview with key stakeholders are not widely employed and yet may increase broader public involvement and more significant input.
- *Fact Basis:* A plan's *fact basis* is critical for laying the foundation of mitigation analysis for it analyzes hazard exposure, vulnerabilities and risks. Unfortunately the *fact basis* component earned the second to the lowest *CQS* of only 33.6%. The detailed analysis of planning elements associated with the sub-components (*hazard identification, vulnerability assessment, risk analysis and emergency management*) in this *fact basis* component area do not lessen the concerns expressed above, but they do provide some additional guidance. First, on the positive side, most plans include and produce relatively high quality scores for general *hazard identification* planning elements. In other words, the general picture with respect to the hazards areas are exposed to and their general profiles are good. Unfortunately the same cannot be said for the other sub-component areas:

- When considering a common set of eleven natural hazards (hurricane, floods, tornadoes, hail, winter storms, wildfire, thunderstorms, drought, heat, earthquakes, and coastal erosion) the planning elements associated with the delineation and history of hazards, vulnerability assessment and risk analysis achieved consistently low depth scores suggesting little planning detail in addressing these eleven hazards across all plans.
- When focusing more narrowly on hurricane and flood hazards separately, the result showed a mark improvement with hazard delineation and vulnerability assessments related to property, but still yielded low depth scores for population, infrastructure and, at times, critical facility vulnerability assessments. Narrowing the hazard focus had no consequences for risk analyses, for these elements still had very low depth scores.
- On the whole, these results suggest the need to target mitigation planning efforts to better address vulnerability assessments, particularly assessments associate with social, population, public infrastructure and critical facilities vulnerabilities, as well as risk assessments across the board. While particular attention needs to be extended to all major natural hazards, even the more frequently encounter hazards of flooding and hurricanes, should not be ignored.

- *Mitigation Goals & Objectives:* When addressing the *mitigation goals & objectives* component, mitigation plans tend to focus on important public interest issues, particularly promoting public safety and hazard awareness programs, and reducing economic impacts, at least in terms of losses. Much less prevalent in these plans were goals related to reducing impacts and protecting environmental resources which should go hand in hand with promoting safety and reducing economic impacts in the long run. While those plans that discussed these issues did included a good deal of detail addressing these goals, , the combination of a limited number that did address them and the narrow focus on a limited set of these goals resulted in relatively poor coverage of these mitigation planning issues throughout the coastal management zone. These limitations were particularly pronounced for the goals of reducing environmental the impacts and promoting and protecting environmental resources.
- *Inter-Organizational Coordination & Capabilities:* On the whole large proportions of these plan addressed basic issues of coordination among organizations and between mitigation plans and other planning efforts. However the issues of mitigation planning capacity development was not pervasive and need to be better addressed. In addition, conflict management, which can be critical to insure coordinated community efforts in mitigation planning and implementation, were not addressed by a single plan. It may well be that when focusing and considering how to expend limited potential resources, issues like building capacity was not seen as important. In other words, the issue may be, "why spend on building organizational capacities and skill sets, when storm water management is more important, life threatening, and helpful at addressing NFIP and CRS issues." Facilitating and targeting capacity development may well be an area that the TGLO can be particularly helpful in promoting.

- *Mitigation Policies & Actions*: The heart of a mitigation plan addresses the policies and actions that should be undertaken in an area, given a jurisdiction's hazard exposure, vulnerabilities, and risks. In light of its centrality and importance, the protocol for this component was the most comprehensive and detailed. Unfortunately, the results suggest that like *fact basis,* this component also had a very low, indeed, the lowest component quality score (*CQS*). Scoring only 28.2 out of 100. In truth, given the comprehensive nature of the protocol associated with this component, there was a likelihood that *CQS* would have been low in the first place, simply because it can be difficult for plans to address all planning element associated with this component. Indeed, an argument might be made that some planning elements may not be as relevance or salience for some jurisdictions as others. Nevertheless, on the whole, the majority of the planning elements have relevance particularly since the focus was on mitigation issues of relevance for coastal hazards and areas. Furthermore mitigation plans should be more comprehensive, not narrowly focused, in order to insure their effectiveness. Hence a more comprehensive assessment tool will better capture broader based plans. Following the discussion above, this summary also addresses ….
    - *General policies, regulatory tools and modeling techniques*: While there was at least moderate (67%) support for adopting new regulatory, the nature of the regulatory tools under consideration was, for the most part limited to building codes and standards (92%), land and property acquisition (82%), and retrofitting private structures (67%). These are very important. However, additionally important land use policies like low density conservation zones, overlay zones, transfer of development rights, cluster development, impact fees, setbacks, dedicated open spaces for hazard zones and locating public facilities in non-hazard zones were mentioned by two or fewer plans.
    - *Floodplain regulation, incentive based tools and structural tools*: A relatively large percentage of plans addressed floodplain management (75%) and ordinances (67%) as well as incentive based approaches such as participation in the National Flood Insurance Program (75%) and joining the Community Rating System (83%). In addition when addressed by a plan, the discussions of these planning elements displayed good detail and hence quality. Unfortunately additional incentive based tools such as tax abatements, density bonuses, etc were not addressed at all. Structural tools addressed by these plans also focused on flooding related issues such as drainage (83%), storm water management (67%), detention ponds (50%), and the maintenance of these structures (67%). Here too, the plans that addressed these tools generally offered good quality detailed discussions. Unfortunately planning elements like wetland restoration received scant attention.
    - *Awareness/Educational tools, social considerations, and public facilities and infrastructure*: As might be hoped, public awareness programs were unanimously mentioned across all plans. In addition a solid majority of plans discussed education programs for their staff (75%) and private stakeholders (75%) as well as disaster warning and response programs

(75%) and maps of hazard areas (75%). Each of these elements is addressed with good detail, although a combination of some low scores and the failure of some plans to even address these basic element results in relatively low quality coverage in the coastal zone. Substantial percentages of plans also address capital improvement based on hazard analysis and retrofitting public and critical facilities, however the quality of these elements even for plans addressing them are relatively low.

  - *Recovery planning, emergency preparedness and natural resource protection*: Preplanning for mitigation actions during a post disaster recovery period can be critically important to better ensure that a community reduces vulnerabilities rather than repeating the same mistakes in the aftermath of a disaster. Unfortunately, with the exception of two plans that identified recovery organizations, planning element such as considering land-use changes in response to a disaster, building code changes, development moratoria, financing recovery, and the acquisition of private holdings were not addressed by a single plan. Similarly, the percentages of plans that addressed five planning elements associated with natural resource protection were very low and lacked quality, with the exception being sediment erosion control. The relative high points were mitigation issues in emergency response, where a sizable percentage addressed the purchasing of equipment (75%), and moderate percentages also addressed evacuation (58%) and contingency planning (50%). In addition, if plans addressed emergency preparation mitigation issues, they generally did so in a quality fashion.

- *Implementation*: In sum, with respect to the thirteen planning elements associated with plan implementation and evaluation there was broad coverage with at least ten of the twelve plans addressing nine of these elements within their plans. And, when addressed, most plans offered a good deal of detail in their discussions that should help ensure guidance in the implementation of the mitigation plans and subsequent evaluation, monitoring and updating. Overall, however, there is a need to focus on specific details associated with technical assistance and the evaluation of actual funded projects, enforcement of the plan, and possible sanctions. The combination of good coverage and depth in general, but low enforcement issues and sanctions, raises the question of how likely is it that the proposed planning actions will actually be implemented. This is to not say that they will not be implemented, but rather without these additional mechanisms being addressed, the question does arise.

2.1.2 Mitigation Actions Analysis

In total there were 836 mitigation actions proposed by the 130 jurisdictions participating in these twelve plans, with 814 or 97% representing single actions that could be classified into different categories consistent with those examined by the protocol. Not surprisingly, given the general analysis of these plans, the largest single category of actions, 34.4%, proposed had to do with structural mitigation actions, but the second largest at 25.8% were related to regulatory, planning and research policies and issues, follow closely by emergency management related mitigation actions. Interestingly, the tendency toward focusing on structural mitigation actions was even more pronounced among cities than

among counties. Unfortunately very few mitigation actions were related to natural resource protection. The sense is that there is a general tendency to focus mitigation actions on structural solutions to mitigation, with some consideration of non-structural mitigation solutions related to land use planning policies, however these tend to be focused, at this time, more narrowly on flooding such as the NFIP and CRS ratings. Nevertheless there is clearly recognition that mitigation cannot be confined exclusively to structural solutions.

2.1.3 Some Final Thoughts and Considerations

The report begins with the general goal of undertaking a detailed assessment of hazard mitigation plans that have been developed for jurisdictions along the Texas coast in order to better understand the strengths and weaknesses of these plans; not to grade what has been accomplished, but rather to shape the nature of future plans. The hope is that this information will influence future mitigation planning efforts in a positive way resulting in more effective mitigation plans which in turn will reduce future losses in lives, property and natural resource. This report also offered the caveat and expressed concerns that this research should not be viewed as an attempt to grade existing plans or to make invidious or pejorative statements regarding current plans or the planning efforts that generated them. In that spirit, the following statements are offered about this research effort itself.

As is the case with all research, there are going to be limitations that should be recognized in order to frame its results as well as improve upon future research efforts. While the development of the protocol used in this research sought to enhance and improve upon FEMA's crosswalk and past research efforts, the resulting protocol was not necessarily perfect and it is undoubtedly the case that it could be improved upon. In this context, it might be argued that it was too comprehensive or that some of the planning elements employed should have been modified or excluded and perhaps others added. It might also be argued that the "common" set of hazards considered was too broad and perhaps even irrelevant for some jurisdictions. That in part is why modified assessments for just flooding and hurricanes were undertaken. If a narrower set of hazards had been considered, this might have resulted in improved depth scores for many planning elements and hence planning component quality scores.

Another potential weakness may well have been in the application of the protocol to assess city, county, and regional mitigation plans. When first approached by the GLO staff to consider undertaking this assessment, the fact that three types of plans would be assessed was not fully recognized. To address this issue, the protocol was changed and modified over an extended period of months, which resulted in many plans being re-evaluated several time by the team, because the protocol itself changed. Of course, it must be recognized that FEMA's cross walk is employed to assess even more divergent types of plans. The final protocol utilized in this research, along with the validity and reliability controls undertaken, did result in consistent application regardless of the jurisdiction or type of plan considered. Nevertheless, developing a very refined and specific protocol for addressing city, county and regional plans would have result in variations in findings.

A final limitation concerns what the protocol measures and what it does not. Strictly speaking, the protocol simply evaluates the mitigation plans developed by these various

jurisdictions. It does not and is not based upon what types of mitigation efforts may already be in place within these communities. The protocol reveals nothing about the current mitigation status of a community, other than what might be implicit, to a certain extent, in the fact basis component of these plans, which as seen above was not the strongest component across these plans. Nevertheless, a community's current "mitigation status" is not addressed; rather, the focus is on the mitigation plans as specified and developed. So, simply because a jurisdictions plan did not score well in this research, does not necessarily mean that its mitigation status is very low as well.

There are undoubtedly other limitations that the reader might bring forward. The important point is that there are always likely to be problems in any research application and there will always room for improvement. Despite the limitations, the comprehensive nature of the protocol developed and its usage to assess the twelve coastal mitigation plans reviewed here in, does provide a good deal of information regarding the relative strengths and weaknesses mitigation plans currently in effect. It is our sincere hope that the findings of this research are employed to strengthen future planning efforts.

2.2 The Elite Survey Report

A purposive elite survey was initiated during phase 1 and completed during phase 2. The purpose of this survey is to gain detailed information and individual insights regarding the State of Texas Mitigation Plan, the Coastal Management plan, and general issues concerned with and surrounding mitigation planning along the Texas coast. More specifically the objectives of this project was to interview government, planning leaders and other stakeholder to ascertain their perceptions and knowledge of Costal Management Program, the Texas State Mitigation Plan and mitigation issues in the Texas coast. Secondly, this survey sought to assess general perception of hazard mitigation policies and actions that might be taken by planners and emergency managers in local jurisdictions and how the GLO might enhance and encourage the knowledge and adoption of mitigation policies and actions.

The key methodological strategy employed in this study was the qualitative interviewing of key informants. Two methodological strategies were employed in the qualitative interviewing activities. The first was semi-structured interviews with a purpose sample of key informants. The first phase of this survey targeted individuals who are filling particular positions within state, county and local governmental departments and agencies. The targeted individuals are those holding key staff positions with the TGLO, the Texas Department of Insurance (TDI), the Texas Wind Insurance Association (TWIA), The Governor's Division of Emergency Management, and individuals holding key positions in county and municipal emergency management departments, planning departments, building departments, flood plain managers, county judges, etc. As part of the interview, interviewees were asked if there were other individuals (reputational or influential leaders) that should be interviewed. By using this snowballing technique, we were able to get a good purposive sample of individuals who were likely to know about or be involved with mitigation activities.

In addition to the semi-structured interviews with a purpose sample of key informants, the second methodology employed in this study was participant observation. Participant observation is a qualitative method whereby researchers participate in activities and can

through that participation informally interview and observe participants engaged in these community activities. By participating in these activities the researcher can observe and informally interviewing the participating individuals, gaining rich qualitative information of the particular actions being undertaken, obtain reports from participants concerning their perception and thoughts about the activity, observe interactions among participants, and grasp what types of activities and conversations are actually being undertaken. In total project staff participated in fifteen activities generally associated with local mitigation planning, environmental planning, coastal management, community planning charrettes, and coastal research/practitioners workshops. Interviewing during the participate observation was more informal and free flowing in comparison to the semi-structured interviews conducted with key informants during a face to face interview session. However, many of the same topics were covered, particularly if they were germane to the activities at hand. More importantly, participation in these activities provided accesses to representatives of key stakeholders such as local business owners, developers, as well as contractors supporting local efforts in mitigation activities.

The implementation of the semi-structured interviews with key informants and informal interviews during participant observation resulted in interviews with approximately 50 individuals. These individuals included: representatives of state agencies such as the Texas General Land Office, Texas Department of Insurance, Division of Emergency Management, Texas Wind Insurance Association, municipal planning department officials, municipal building inspectors, local and county emergency management officials, Sea-Grant extension agents, floodplain managers, contractors with planning and engineering firms, local business owners and developers, mayors, university coastal researchers, directors of various research centers.

The final report offered 51 findings that emerged from the data collection activities. These were organized into five thematic areas: 1) state level agencies (11 findings); 2) county and local emergency management and managers (11 findings), 3) local planners and related local agencies (18 findings), 4) mitigation planning activities and mitigation actions. On the basis of those findings five recommendations are offered to better promote hazard mitigation in the Texas coastal management zone. Rather than repeating the discussion of the 51 findings – which are available in the full report that can be found in Appendix 3 – the following offers the summary and the five recommendations.

After a quick perusal of the 51 findings in the final report on the elite survey, it will be easy to become discouraged when it comes to addressing mitigation issues along the Texas Coast. There are many constraints that can prevent comprehensive mitigation planning and action including the lack of planning mandates, divisions among and between emergency management and planners, a lack of coordination, and a lack of resources, technical skill, and human resources at so many critical points, but particularly in the many communities scattered through the coastal management zone. At times, the thought of engaging in comprehensive hazard mitigation planning seems like a lost cause.

However, there are also many positive points to build on. First of all there are a large number of dedicated individuals throughout the coastal zone and particularly in the target counties that firmly believe in mitigation and mitigation issues. They may not all agree

on the solutions or actions that should be taken, but they do agree that something must be done to address the ever-increasing vulnerability of the Texas Coast. We were also impressed by the dedicated individuals at state, county, and local levels that recognize the nature of the problems facing the Texas Coast and that hazard mitigation is a prime factor in moving us toward a solution. Furthermore, as seen above, there are already the beginning stages of cooperative and coordinated action between the GDEM and TGLO with respect to mitigation planning, and there is the potential of increasing that coordination with the TDI and TWIA. In addition, recent events related to Hurricane Rita and Ike have provided an important window of opportunity that can perhaps motivate greater participation in broader mitigation activities at the state and local level.

Perhaps the best strategy is to build on the strengths that are already evident and by building on these strengths seek to develop a more comprehensive and integrated program promoting coastal hazard mitigation through the TSMP and the CMP. Some of the actions that might be recommended are as follows:

1. ***Build on current cooperation and seek to enhance future coordination:*** In a sense the first steps have already been taken with cooperation between the TGLO and GDEM focusing on mitigation planning efforts. However, future cooperative efforts among TGLO, GDEM, and TDI should be explored. One important step that should be considered is expanding membership on the CCC for GDEM and, perhaps even, the TDI should be considered. Clearly there are commonalities in the missions of these agencies and there is a strong possibility of enhancing synergies through coordinating efforts through the CCC.
2. ***Targeted Education and Training programs:*** Education programs are often mentioned as a solution to enhancing mitigation, however it might be more strategically sound to target those education programs focusing on local emergency management and planning officials. The goal would be to increase the understanding of broad based mitigation approaches, policies, and actions that can be undertaken. Here again, coordination among agencies will be important. In particular, it makes since for GDEM and the TGLO to coordinate efforts. Furthermore, when developing these programs it may well make sense to work with professional emergency management organizations, the Texas Chapter of the American Planning Association, and various state universities that have planning and coastal management programs. These programs should focus on broad based mitigation planning including "soft" mitigation strategies such as: overlay zoning, performance zoning, density bonuses, infill/community redevelopment policies, conservation easements and setbacks, land banking, real estate disclosures, etc. In addition, as noted above, there is little recognition that recovery planning, as part of mitigation planning, can be an important tool for addressing past development problems. Hence education programs might address topics such as land banks, damage-building acquisition, and development rights acquisition as tools that can, in the aftermath of a disaster, promote the conversion of damaged and abandoned properties to more appropriate land-uses, shifting development away from high hazard areas.

3. ***Developing policy and planning templates:*** In addition to education programs, the development of policy and planning templates might well be a logical next step to promote the adoption of mitigation policies. For example, as part of the Texas Chapter of the American Planning Association's list-serve one constantly encounters local planners asking for examples of ordinances and plans that can be employed as models in their own community. These examples are important, not only because they make it easier for a community considering an ordinance to develop its own, but also because these examples have often withstood legal challenges thus better insuring effective policy and ordinance development.
4. ***Providing Strategic Tools and Technical Assistance:*** It is clear that many local communities (as well as counties) lack the tools and technical knowledge to engage in the critical elements of hazard mitigation planning: hazard Identification, vulnerability assessment, and risk analysis. This is particularly the case with the latter. Investment in hazard risk assessment tools, such as the wind risk assessment tools discussed above, might well be a sound investment toward helping coastal communities better understand their risk. The TGLO and GDEM have already developed some of these tools and have sought to develop and make available to the public a variety of data sets to help in hazard identification and risk. Perhaps the TDI might be an additional partner in these efforts, working with the TGLO and GDEM to enhance the development of tools and data bases related to wind risk, as well as higher resolution flooding and surge mapping tools. Of course the development of tools and technical capacities must be coupled with the creation of additional tools and technologies that can integrate data, model output and enhance the ability of local communities, grassroots organizations, stakeholders, and ultimately the public to visualize the problems they face and potential solutions.
5. ***Enhancing visualization and data integration tools:*** Community planning and emergency management agencies, stakeholders, and the public must have access to tools that can enable them to better visualize and integrate data necessary to not only understand and analyze their current mitigation status, but also to envision their future under a variety of different scenarios. If tools are only left in the hands of a few, then the hopes of widening access and increasing community involvement in coastal planning in general and hazard mitigation planning in particular is doomed. This is particularly important the case of Texas, where planning can most effectively be undertake at the local municipality level. The efforts being undertaken as part of this project to develop a coastal community planning atlas is an important step in the direction of creating web-based visualization and data integration tools that be easily accessed by the broader public. However, as important as this effort is at providing as a test of concept, enhancing and maintaining this tool or developing the next generation of tools that can be easily accessed must be considered.
6. ***Promoting involvement and increasing stakeholder involvement:*** Mitigation planning must be seen as part of the larger solution for developing resilient and sustainable coastal communities in Texas. If disaster mitigation planning is seen as part of a portfolio of related issues for developing resilient communities, then the stakeholder base will be increased and, perhaps, involvement also enhanced.

This should be part of the targeted education and training programs mentioned above, but also part of a targeted public education program as well. Specifically these programs can be designed to place hazard mitigation into a large context of environmental sustainably, climate change and variability, sea-level rise, and other issues of critical importance to coastal counties in general and coastal communities in particular. These programs should work through and in conjunction with local elementary, middle, and high schools and local community colleges and universities.

Task 3 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.

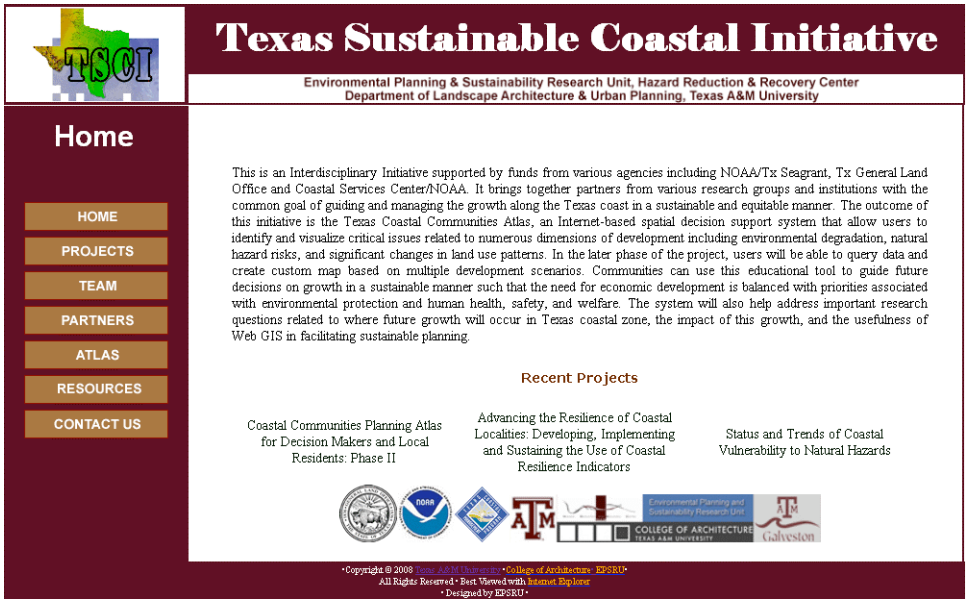
Task Description: This Task will draw from findings emerging from Tasks 1 and 2. As part of the interviewing and investigations of building codes and land use planning policies, best practices will, on a continuing basis, be identified. This task will focus on highlighting best practices in terms of their relative effectiveness and outline issues that emerged as local jurisdictions sought to incorporate these practices into their local building codes or land use practices. In the ideal, it would be wonderful to highlight practices that emerged and/or were adopted by local jurisdictions within the State of Texas. However, this task will also review existing and emerging literatures on land use planning, building codes, and emerging construction technologies that can positively impact coastal mitigation actions.

This task will initiate website development for best practices base upon work completed in Task 1 and 2 and reviews of the planning academic literature.

Deliverable(s): Best Practices web page on Coastal Atlas website will be launched and updates provided in progress reports.

The initial Best Practices website was launched at the end of November, 2008, and the content has been updated periodically since its inception. The Best Practices website is accessed off the Coastal Atlas portal website: http://coastalatlas.tamu.edu (see figure 1 below.

Figure 1. Texas Coastal Atlas web-portal



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 opens. This page gives users access to two resources pages, one of those pages is the "Best Practice Resources."

Figure 2. The Coastal Atlas Resource Page

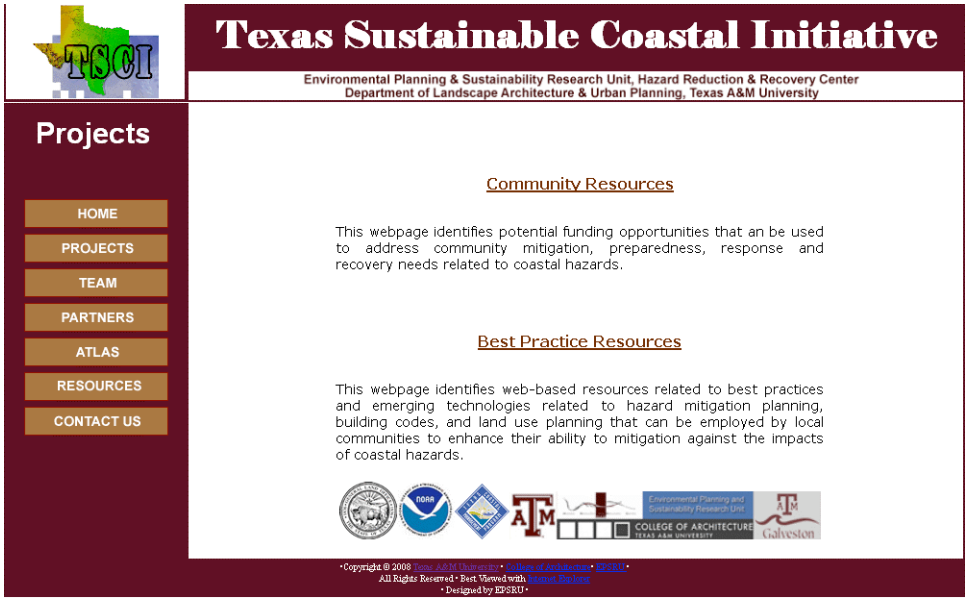
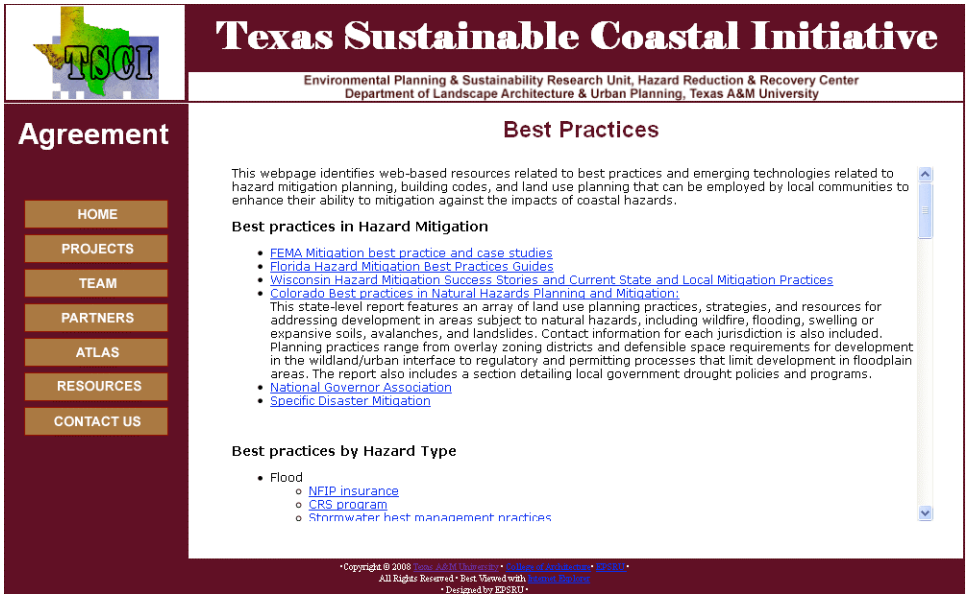


Figure 3. The Best Practices Webpage



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. In total the web-page offers 6 different categories of potential best practices that include over forty (40) websites and over ten books and articles. The first three of six categories of best practices are displayed in Table 1. The first, ***best practices in hazard mitigation***, offers a series of websites, many of which 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. The second category, ***best practices by hazard type***, 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. The final category, ***Best Practices in Planning, Management, and Administration***, 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 (see task two and Appendix 2).

Table 1. Best Practices Resource Page Information, Part 1.

I. Best practices in Hazard Mitigation

- FEMA Mitigation best practice and case studies
- Florida Hazard Mitigation Best Practices Guides
- Wisconsin Hazard Mitigation Success Stories and Current State and Local Mitigation Practices
- Colorado Best practices in Natural Hazards Planning and Mitigation:
- National Governor Association
- Specific Disaster Mitigation

II. Best practices by Hazard Type

- Flood
  - NFIP insurance
  - CRS program
  - Stormwater best management practices
  - Best practices for Flood Mitigation
  - Best practices in Wisconsin for Flood Mitigation
- Wind
  - Texas Department Insurance (TDI), Windstorm inspection program
  - New School Building "Hardened" Against the Wind
- Wildfire
  - National Database of State and Local Wildfire Hazard Mitigation Programs

III. Best practice in planning, management and administration

- Land use planning
  - APA(American Planning Association) : APA has conducted research regarding integrating hazard mitigation into local planning and introduced best practices in their webpage
- Recovery planning
  - ASCE (American society of Civil Engineers)
  - American City and County:
    Coastal towns rethink development patterns: Katrina recovery plans incorporate mixed uses. May 2006.
- Building Code
  - IBHS (Institute for Business &Home Safety) building code webpage
  - Building code reference library:
    This webpage provides you with detailed information on building codes for all 50 states, major cities, and some counties.
  - Florida Building code:
    this webpage provide information of Florida building code.
  - Whole Building Design Guide (WBDG)
  - ASCE (American Society Civil Engineers):
    Building standards guide information
  - Building code examples
    - Miami-Dade County
    - California Code of Regulations (CCR)

Table 2. Best Practices Resource Page Information, Part 2.

V. Academic resources on best practices (Journal articles, books etc.)

- Mitigation
  - Godschalk, D.R. (2000) Avoiding Coastal Hazard Areas: Best State Mitigation Practices. Environmental Geosciences Mar2000, Vol. 7 Issue 1, p13-22
  - Deyle, R. E., T. S. Chapin, and E. J. Baker (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, Vol. 74, No. 3, Summer
  - Nelson, A. C., and S.P. French (2002). Plan Quality and Mitigating Damage from Natural Disasters: Case Study of the Northridge Earthquake with Planning Policy Consideration. Journal of the American Planning Association, Vol: 68. No. 2
- Vulnerability
  - Boruff, B.J.; Emrich, C., And Cutter, S.L., (2005). Erosion hazard vulnerability of US coastal counties. Journal of Coastal Research, 21(5), 932-942.
  - Simpson, D. M. and R. J Human (2008) Large-scale vulnerability assessments for natural hazards. Natural Hazards 47:143–155
  - Social Vulnerability to Environmental Hazards (Cutter, Boruff and Shirley)
  - Social vulnerability and the natural and built environment: a model of flood causalities in Texas (Zahran, Brody, Peacock, Vedlitz and Grover)
- Resiliency and sustainability research
  - Disasters by Design (Mileti)
  - Godschalk, David R., 2003 Urban Hazard Mitigation: Creating Resilient Cities. Natural Hazards Review, Vol. 4, No. 3, August 1.
- Recovery
  - Hurricane Andrew (Peacock, Gladwin and Morrow)
- Emergency planning
  - Emergency planning(Perry and Lindell)
- Natural resource management

VI. Organizations and Associations

- Multi-hazards
  - FEMA Mitigation
  - APA Growing Smart
  - IBHS (Institute for Business and Home Safety)
  - National Institute of Building Sciences Multihazard Mitigation Council
  - USGS Hazards
  - International Strategy for Disaster Reduction
- Earthquake
  - Building Seismic Safety Council(BSSC)
  - Earthquake Engineering Research Institute (EERI)
- Hurricane, Wind
  - Wind Science and Engineering Research Center, Texas Tech University
  - HazNet: The National Sea Grant Network Web Site for Coastal Natural Hazards Information.
- Flood
  - Association of State Floodplain Managers (ASFPM)
- Fire
  - Color Country Interagency Fire Management Area
  - The Fire Safe Council
  - Firewise Communities
  - National Interagency fire Center
  - National Database of State and Local Wildfire Hazard Mitigation Programs
  - National Fire Protection Association
- Research Institute
  - Hazard Reduction and Recovery Center, Texas A&M University
  - Natural Hazards Center, University of Colorado at Boulder
  - Disaster Research Center, University of Delaware
  - Hazards & Vulnerability Research Institute, University of South Carolina

Table 2 lists the second set of three categories of best practices beginning with ***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). The second section includes a variety of ***Academic Resources on Best Practices***, providing a set of references for important research articles and books that discuss mitigation, vulnerability, resiliency and sustainability, recovery, and emergency planning. The final section of this website provides the websites for ***Organizations 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.

Task 4: 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.

This task includes the following objectives:

a. During interviewing in Tasks 1 & 2 local officials will be asked about innovative funding sources that can be utilized to enhance local mitigation, preparedness, response and recovery.

b. The natural hazard literature, particularly the literature with a more applied focus, and the internet will be searched in order to identify potential resources that might be brought to bear on these issues.

c. Sources will be identified and narrative discussions evaluating their potential utility will be provided on a web site devoted to identifying potential resources.

Deliverable(s):
Mitigation Resources webpage on Coastal Atlas website will be initiated in November of 2008 and updated periodically.

Figure 4. Community Resources Webpage

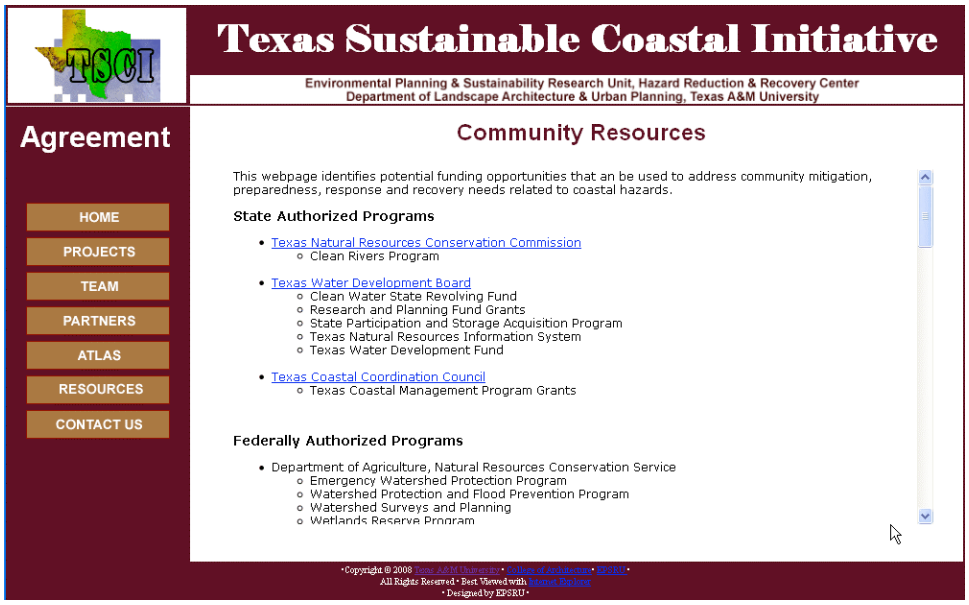


Figure 4, above, displays the community resource webpage that is accessed by selecting the Community Resources hotlink on the resource page (see Figure 2). The community resource page lists over seventy (70) State and Federal websites that provide information on different types of resources that can be utilized to improve and develop mitigation policies and, most importantly, fund and implement potential mitigation actions. These are presented in Table 3.

Table 3. Community Resources

I. State of Texas Programs

- Texas Natural Resources Conservation Commission
  - Clean Rivers Program
- Texas Water Development Board
  - Clean Water State Revolving Fund
  - Research and Planning Fund Grants
  - State Participation and Storage Acquisition Program
  - Texas Natural Resources Information System
  - Texas Water Development Fund
- Texas Coastal Coordination Council
  - Texas Coastal Management Program Grants

II. Federally Authorized Programs

- Department of Agriculture, Natural Resources Conservation Service
  - Emergency Watershed Protection Program
  - Watershed Protection and Flood Prevention Program
  - Watershed Surveys and Planning
  - Wetlands Reserve Program
    http://www.nrcs.usda.gov/programs/watershed/index.html
    http://www.nrcs.usda.gov/programs/wrp/
- Department of Housing and Urban Development
  - Disaster Relief/Urgent Needs Fund
  - Texas Community Development Program

- Community Development Block Grant (CDBG)

- Environmental Protection Agency
  - Drinking Water State Revolving Funds
  - Nonpoint Source Grant Program
  - Water Protection Coordination Grants to States
  - Water Quality Cooperative Agreements
  - Watershed Initiative Grants
  - Wetlands Grants
- Federal Corporation for National and Community Service, Special Volunteer Programs and the Retired and Senior Volunteer Program
- Department of Homeland Security
  Citizens Corp
  http://www.dhs.gov/xopnbiz/grants/
  http://www.dhs.gov/xgovt/grants/index.shtm
  http://www.grants.gov/
  http://www.dhs.gov/xlibrary/assets/OfB_CDFA_Crosswalk.pdf
  - All-Hazards Emergency Operational Planning
  - Antiterrorism and Emergency Assistance Program
  - Assistance to Firefighters Grant
  - Buffer Zone Protection Program
  - Chemical Stockpile Emergency Preparedness Program
  - Community Assistance Program, State Support Services Element (CAP-SSSE)
  - Citizens Corp
  - Community Emergency Response Teams (CERT)
  - Community Disaster Loans
  - Competitive Training Grants Program
  - Cooperating Technical Partners
  - COPS Interoperable Communications Technology Program
  - Disaster Preparedness Improvement Gant (DPIG)
  - Emergency Food and Shelter Program
  - Emergency Operations Center Funding
  - Emergency Management Performance Grant
  - Fire Management Assistance Grant Program
  - First Responder Counter-Terrorism Training Assistance
  - Flood Hazard Mapping Program
  - Flood Mitigation Assistance Grant Program
  - Flood Recovery Mapping
  - Hazard Mitigation Grant Program (HMGP)
  - Hazardous Materials Assistance Program
  - Hazardous Materials Emergency Preparedness Training and Planning
  - Hurricane Local Grant Program
  - Infrastructure Protection Program (IPP)Law Enforcement Terrorism Prevention Programs
  - Individual Assistance Program
  - Map Modernization Management Support
  - National Dam Safety Program
  - National Earthquake Hazard Reduction Program
  - National Flood Insurance Program
  - National Urban Search and Rescue (US & R) Response System
  - Pre-Disaster Mitigation Grant Program (PDM)
  - Public Assistance Grant Program
  - Preparedness Grant Fund
  - Repetitive Flood Claims Program (RFC)
  - Regional Catastrophic Preparedness Grant program -- http://www.fema.gov/government/grant/rcp/index.shtm

- Section 406 Hazard Mitigation Grant Program
- Severe Repetitive Loss (SRL)
- State Homeland Security Program
- State and Local Domestic Preparedness Training Program
- Superfund Amendments and Reauthorization Act

- Small Business Administration
  - Small Business Administration Disaster Assistant Program
  - Pre-Disaster Mitigation Loan Program
- U.S. Army Corps of Engineers
  Useful Government Links
  Programs
  Planner's Study Aids
  - Aquatic Ecosystem Restoration
    http://www.usace.army.mil/CECW/PPA
    http://www.usace.army.mil/CECW/PlanningCOP/Documents/library/pgms/pgl97-05.pdf
  - Aquatic Habitat and Wetlands
  - Beach Erosion and Coastal Projects
  - Clearing and Snagging Projects
  - Emergency Advance Measures for Flood Prevention
  - Emergency Rehabilitation of Flood Control Works or Federally Authorized Coastal Protection Works
  - Emergency Streambank and Shoreline Protection
  - Floodplain Management Services
  - Nonstructural Alternatives to Structural Rehabilitation of Damaged Flood Control Works
  - National Flood Risk Management Program
  - Planning Assistance to States
  - Small Ecosystem Restoration
  - Small Flood Control Projects
- Community Capacity Development Office (CCDO), Office of Justice Programs (OJP), U.S. Department of Justice
  - Operation Weed and Seed
- Department of Health and Human Services
  - Public Health Emergency Preparedness
  - Bioterrorism Training and Curriculum Development

Tasks 5 and 6:

Both Tasks 5 and 6 deal with assembling various forms of data, such as mapping or spatial data. Examples include transportation routes or building codes. The other similarity is both tasks require the development 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. The website developed for this purpose is called the Coastal Communities Planning Atlas (coastalatlas.tamu.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.

Task 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 5 Description: Task 5 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. Begin spatially analysis of these data and where necessary develop methodological tools to display these data and the results from the analyses.
e. Begin the development of a web based system for making the findings available to prospective users.

Deliverable(s): Preliminary report on spatial analysis and web-based tools to display analysis results and updates to website throughout the year.

Task 6: Assess the physical and social vulnerabilities of coastal populations to facilitate planning and policy development related to hazard mitigation and response.

Task 6 Description: A critical element in the determining "management vulnerabilities" (identified in Task 5) and hazard mitigation plans and planning along with building codes (identified in Task 2), is an assessment of the physical and social vulnerabilities of a coastal population. Task 6 therefore is important for the other tasks to be undertaken as part 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 with the assembling and integrating physical hazard maps and analyses related to coastal natural hazards (surge maps, inland flooding maps, flood plain maps, and wind field maps).
b. Continue the assembling and integrating of relevant coastal hazard physical vulnerability assessments undertaken by potential partnering agencies such as DEM's Hurricane Risk Area maps, the Texas State Department of Insurance's "designated catastrophe areas".

c. Continue assembling and integrating data from the census and other governmental sources critical for assessing social vulnerabilities (i.e., transportation dependence, income, household structure, and critical facilities).
d. Begin to spatially analyze these data and developing methodologies for identifying socially vulnerable populations.
c. Begin the development of a web based system for making the findings available to prospective users.

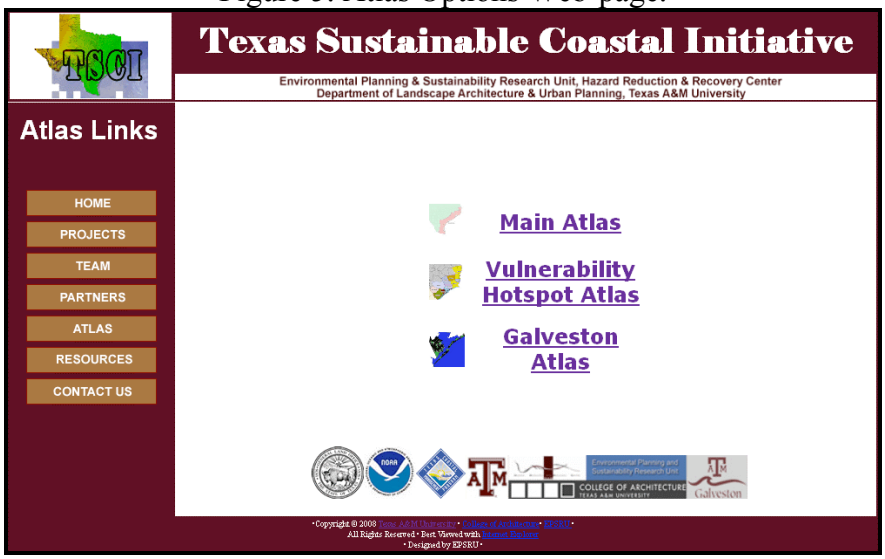
Deliverable(s): The Coastal Atlas website will be updated and improved. Updates will be provided in quarterly reports.

In sum, both Tasks 5 and 6 include collecting data (primarily secondary data), continue creating and evolving a website that will allow for the mapping of these data and the development of tools to utilize these data. While Task 5 focuses on hazard data and policy data, Task 6 includes additional hazard data, data on physical infrastructure and vulnerability, and data for establishing social vulnerabilities. Both task 5 & 6 added new sub-tasks related to beginning the process of spatially analyzing these data and developing 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 additional major task for this phase was to undertake a the writing of a report utilizing the data collected to spatially analyze the physical hazard vulnerability of coastal counties, focusing on the CMZ, and the mosaic of policies that can potentially or do address hazard mitigation.

Website options and enhancements:

Phase 2 of the Status and Trends project has seen major improvements to the Coastal Atlas Website. The entire look, feel, and content of the Coastal Planning Atlas has been modified and enhanced. It now offers multiple Atlas websites delivering a variety of data 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. The principle access point for the website is through **http://coastalatlas.tamu.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 (Figure 5, below) opens offering 3 different Atlas web-pages are. (entry portal is presented in Figure 2). The Main Atlas offers a host of data for all coastal counties, the vulnerability hot-spot atlas offers pre-analyzed and configured data layers to enable users to undertake both physical, social, and environmental vulnerability and sustainability analysis, and the Galveston atlas provides very rich and refined data at a high resolution for the Galveston County. These data provide users interested in Galveston to conduct very detailed mitigation analysis down to the parcel (house structure). The following will provide a brief tour of these three atlas pages.

Figure 5. Atlas Options Web-page.



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. This webpage displays 17 different categories of data layers including administrative boundary layers, transportation, topography, ecological data, and natural hazards data layers to name a few. In total, the Main Atlas webpate provides 87 different data layers in a fully operative Geographical Information Systems format. The entire detailed listing of these 87 data layers can be found in Table 4.

Figure 6. The Main Atlas Page

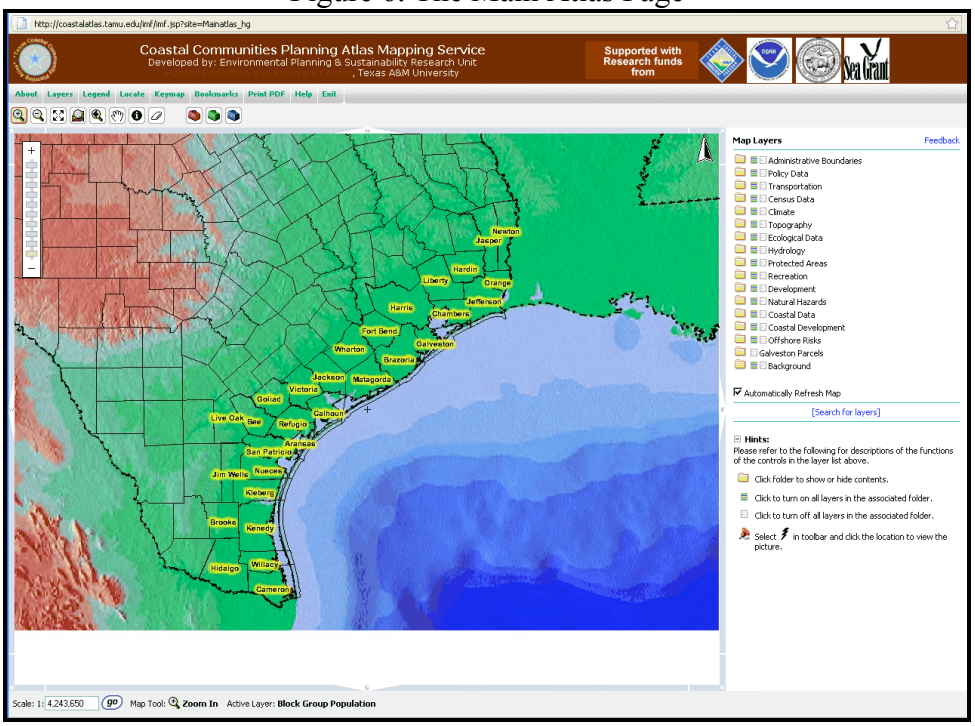


Table 4. A Detailed Listing of Data Layers Available Through the Main Atlas Webpage.

Administrative Boundaries
1. State Boundary
2. Texas Counties
3. Study Area
4. City Limits
5. Three Nautical line
6. Three Marine league

Policy Data
7. Coastal Management Zones
8. Building Code

Transportation
9. Interstate Highway
10. Major Highway
11. Roads
12. Hurricane Evacuation Route
13. Railroad
14. Heliports
15. Airports

Census Data (2000)
16. County Population (2000)
17. Census Tract Population (2000)
18. Block Group Population (2000)
19. Block Population (2000)

Census 1980-1990
20. County Population Growth Rate
21. Census Tract Population Growth Rate
22. Block Group Growth Rate

Climate
23. Rainfall

Topography
24. Elevation

Ecological Data
25. Eco-regions
26. Vegetation
27. Seagrass
28. Wash over Areas

Hydrology
29. Hydrological Units
30. Rivers and Streams
31. Lakes and Reservoirs

Protected Areas
32. Federal Lands
33. National Parks
34. State Parks
35. Wildlife Refuge
36. Marine Sanctuaries
37. Audubon Sanctuaries
38. Coastal Preserves
39. Burn Exclusion Zones
40. Habitat Priority Areas
41. Wetlands Inventory Data
42. Historic Places (National Register)
43. Species
44. Rookery
45. Hard Reefs
46. Open gulf

Recreation
47. County and City Parks
48. Beach Access
49. Marinas
50. Boat Ramps

Development
51. Property Values (2000): Counties
52. Property Values (2000): Tracts
53. Property Values (2000): Block Grps
54. Populated Places
55. Dams
56. Wetland Permits

Natural Hazards
57. Hurricane Surge Zones (Cat. 1-5)
58. Hurricane Risk Zones (Cat. 1-5)
59. Hurricane Tracks
60. Hazard Events (1960-2005)
61. FEMA Flood Zones
62. Fire Risk Zones
63. Earthquake Risk Zones

Coastal Data
64. Coastal Topography
65. Bathymetry Points
66. Bathymetry Lines
67. Sea Floor Features
68. Detailed Shoreline
69. Ship Channel
70. Ship Fairway
71. Coast Guard

Coastal Development
72. Resource Management Codes
73. Offshore Blocks
74. Oil and Gas Leases
75. Oil and Gas Units
76. Oil and Gas Platforms

Offshore Risks
77. Environmental Sensitivity Index
78. Erosion Areas
79. Tidal Influence
80. Coastal Barriers
81. Dredged Sites

Parcel Data
82. Galveston Parcel data 2005

Background Coverages
83. Texas Image
84. Background
85. Water
86. Mexico
87. Dredged Sites

There is now a 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 17 categories (or 87 detailed categories) of data layer options appearing in this frame, which allows the user to active specific data layers for presentation. Furthermore, of one 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. One 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 tool box 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 tool box also contains tools to get measurements and add captions to a map. The green tool box contains a number of mark-up tools. These tools allow one to draw on or add additional information to a map. For example one 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 oru community change?

The final tool box, the blue tool box, contains additional query tools where by one can select and create complex sets of queries where by one can use attribute tables to select and combine data to answer questions. There is also a fully function tutorial that can be executed to provide more information about how to use the full GIS capabilities built into the system by Geocortex® and ArcIMS ®

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 is of hurricane surge zones with the Coastal Management Zone boundary file overlaying these zones for the northeastern part of the Texas coast. The surge zones range from those associated with a category 1 storm in red, category 2 in dark orange, category 3 in dark yellow (slightly darker than the county background color), category 4 in pink and, lastly category 5 storm in light pink. 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.

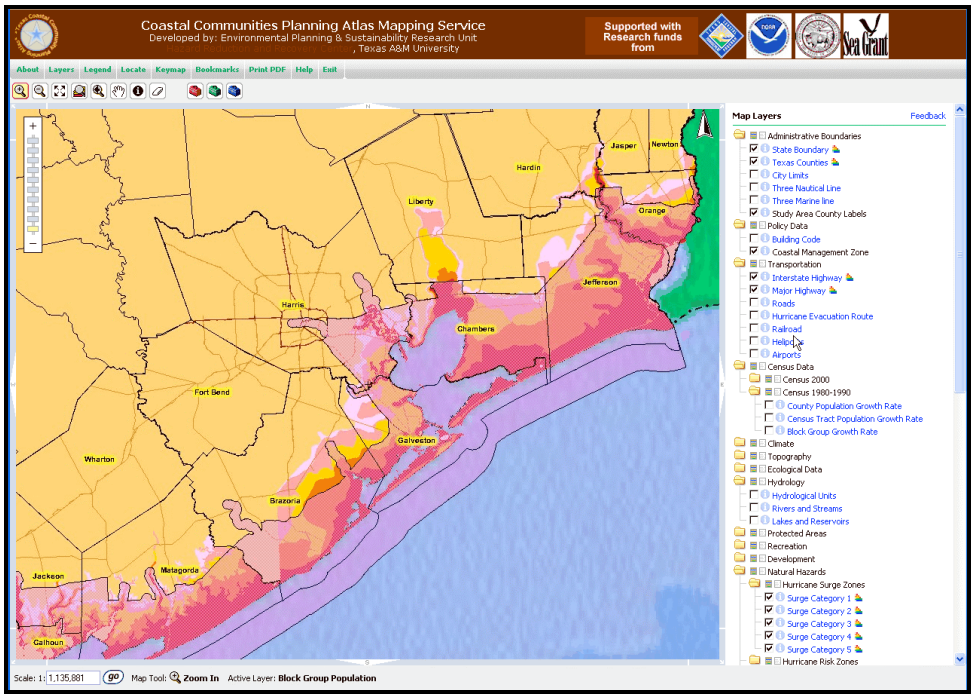


Figure 8. More Elaborate map of Corpus Christi & Port Aransas Areas.

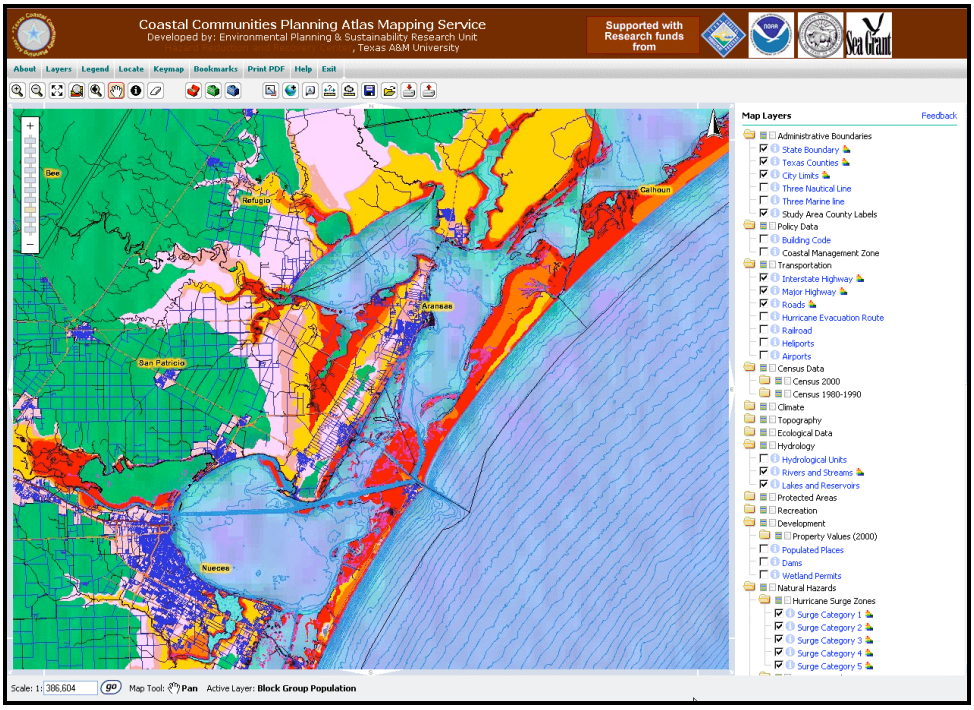
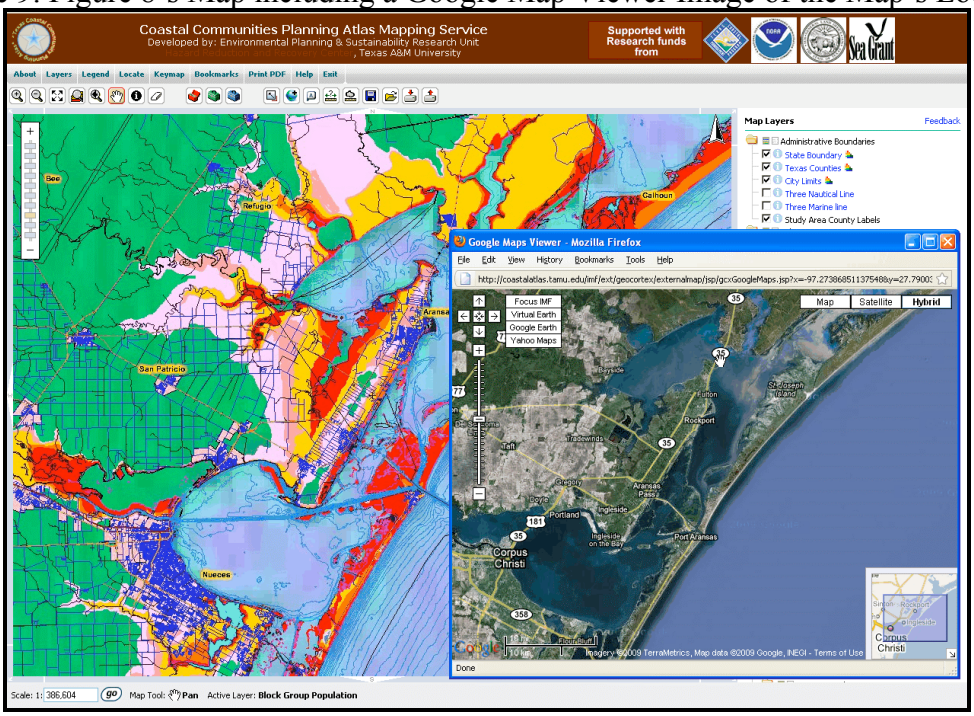


Figure 8 offers a bit more elaborate map of the Corpus Christi and Port Aransas area. This map includes bathometry data and road/highway data along with the surge zone data from category 1 through 5. Of course, one can zoom all the way into a much higher

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, the user can bring up a virtual map of any location, geo-referenced to the map being developed within the Atlas. Here, a Google-map is 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



In addition to the 87 layers discussed above as part of the main atlas webpage, the hotspot webpage contains 77 layers of data. The vulnerability hotspot page is accessed from the Atlas options page (see Figure 6). This page provides more detailed data associated with counties in the northeastern portion of the Texas 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 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. 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. The full list of data available for the hotspot webpage is listed in Table 5.

Table 5. Data Available on the Hotspot Website.

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

Census 1980-1990
17. County Population Growth Rate
18. Census Tract Population Growth Rate
19. Block Group Growth Rate
20. Boat Ramps

Natural Hazards: Hurricane Surge Zones
21. Category 1 Surge Zone
22. Category 2 Surge Zone
23. Category 3 Surge Zone
24. Category 4 Surge Zone
25. Category 5 Surge Zone

Natural Hazards: Hurricane Risk Zones
26. Risk Zone A
27. Risk Zone B
28. Risk Zone C

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

Natural Hazards: Flooding
30. FEMA Flood plains

Ecosystem Critically Measures (ECM)
31. ECM County
32. ECM Census Tract
33. ECM Block Group
34. ECM Block

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

Social Vulnerability Assessment: Indexes (Block Groups regional comparisons)
52. Child Care Needs
53. Elderly Care Needs
54. Transportation Needs
55. Recovery Needs
56. Capacity Building Needs
57. Raw total Social Vulnerability Index (SVI)
58. Weighted SVI

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

Location Quotient Analysis
72. Natural Resources and Mining
73. Construction
74. Other

Land Cover Data
75. Land Use 1996
76. Land Use 2001
77. Land Use 2005

Figure 10 displays a map of areas (census block groups) in Galveston that are socially vulnerable when it comes to transportation needs, in that the darker areas have higher proportions of households without a vehicles and in which workers are more likely to depend on some form of public transportation to get back and forth from work. These areas can therefore be expected to have individuals and households that will find it more difficult to evacuate for hurricanes.

Figure 10. Transportation Dependent Areas in the City of Galveston.

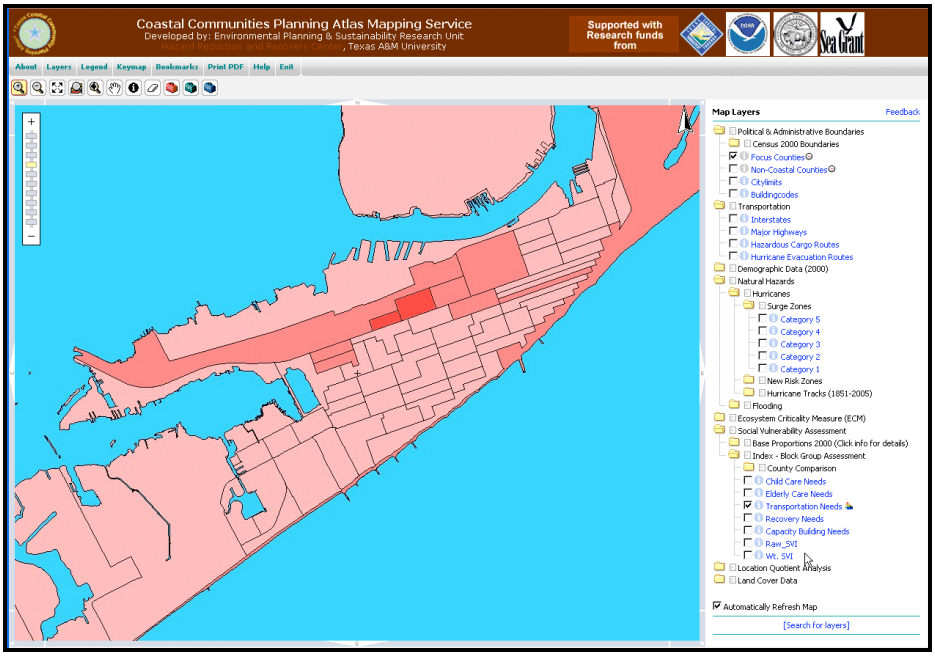
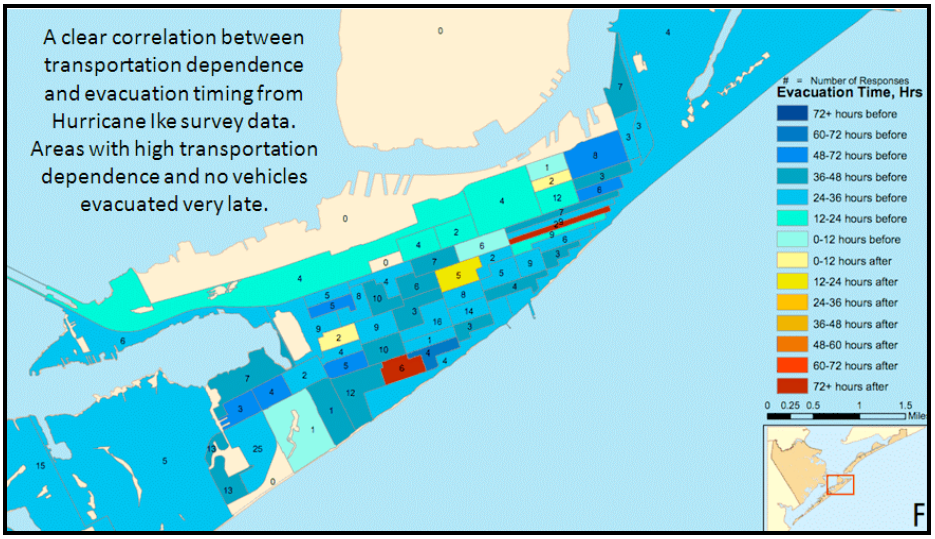


Figure 11. Evacuation Timing for Hurricane Ike



It is interesting to contrast the image in Figure 10 with that of Figure 11, which displays the evacuation timing of households from a survey of a random sample of households conducted after hurricane Ike. These data have been aggregated (averaged) to the block group and the averages have then be categorized ranges of evacuation timing periods. This procedure results in often very small numbers of observations (the numbers embedded in each block group polygon) being averaged, however it does provide a means of looking for patterns of evacuation. It should be clear that areas with higher proportions of households that were transportation dependent were more likely to evacuate between 12 to 24 hours before the storm. In other words these households left very late in the evacuation period.

Figure 12. Populations likely to Display High Recovery Needs.

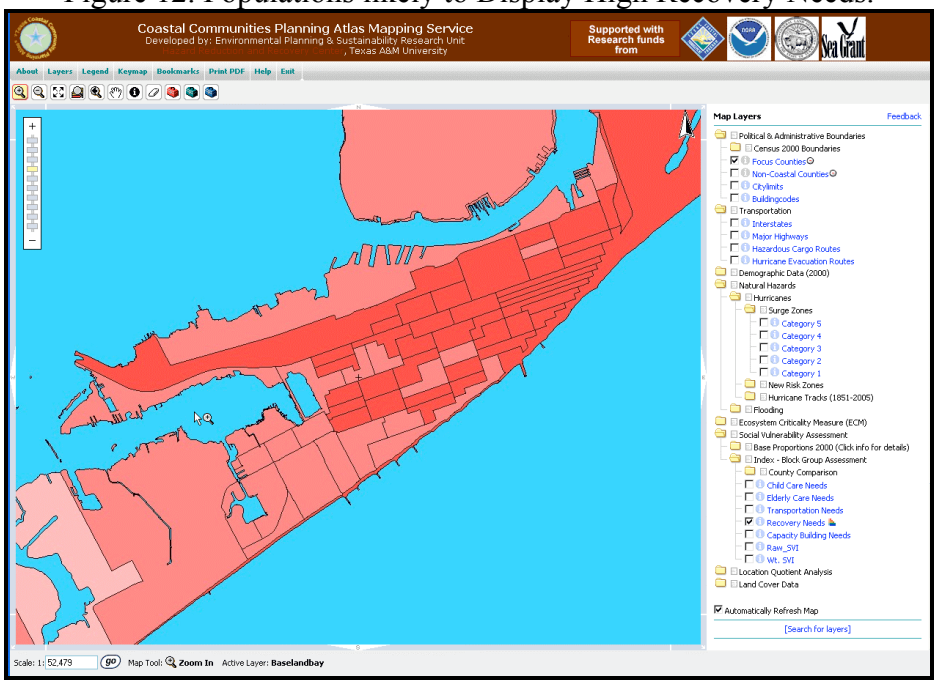


Figure 11 takes this analysis a step further by looking at recovery issues. This map displays data on areas likely to have high recovery needs due the characteristics of the population and housing in these areas. Specifically these are areas with high vacancy rates, high renters, high non-Anglo populations, older construction, and high numbers of individuals living in poverty. These characteristics have been identified by the literature to be associated with very low recovery resources, failing to obtain or even apply for potential recovery resources, and as a consequence, lower recovery levels and a much slower recovery trajectory.

Figure 12, again displays data from the Hurricane Ike Survey results. The data presented here represent the percentage of respondents in each block that have applied for either a FEMA disaster program, such as individual and family grant program or the minimum home repair program, or a SBA disaster recovery loan. Yet again, the recovery needs map shows a great deal of correspondence to the FEMA/SBA program application map

in that those areas with high recovery needs are failing to apply for these potential resources. These findings, again, closely correlate with those found in the literature that it is often those in greatest need that fail to apply (e.g., Dash, Peacock, and Morrow 1997; Fothergill…)

Figure 12. FEMA and SBA Disaster Recovery Applications by Block Group

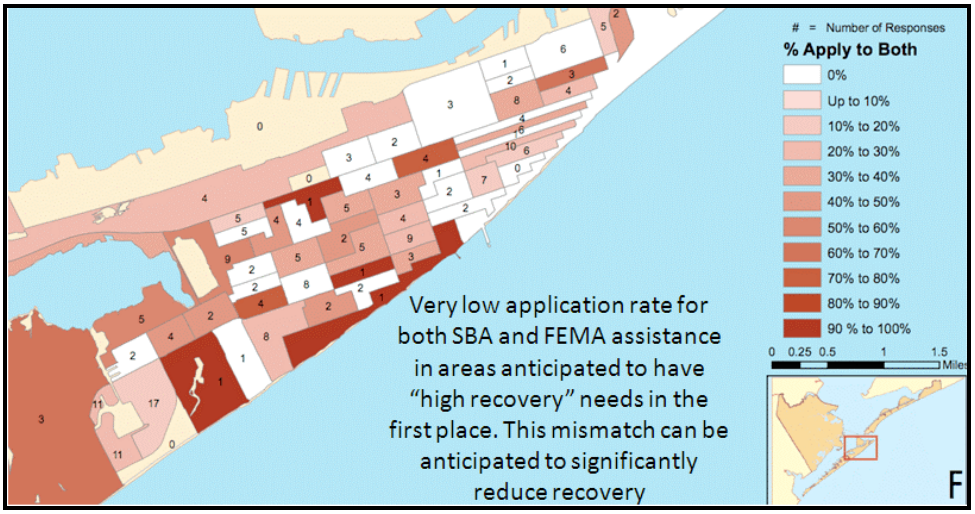


Table 6. Data Available on the Galveston Atlas Website.

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

Parcels in Zone
39. Identification

The final component of the Coastal Atlas proper is the Galveston website. This component of the Atlas provides very detailed data on Galveston proper that allows users to undertake analyses at a much finer resolution. The Galveston Atlas provides users with 39 different data layers. The foundation of these layers is the parcel data for Galveston County which 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 6 (above). The portal for this component of the atlas (see Figure 13) is reached by clicking on the Galveston Atlas hotlink in the Atlas Options webpage (see Figure 5).

Figure 13. Galveston Atlas Portal

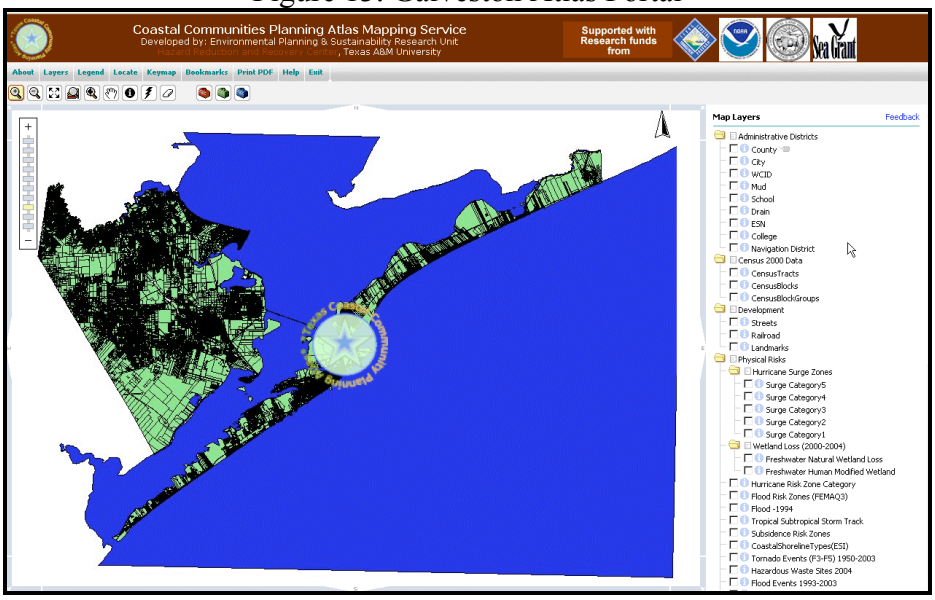


Figure 14 and 15 offers but two examples of the types of maps and analysis that can be undertaken with data layers available at Galveston Atlas website. Figure 14 displays the property parcel level data for a section of the City of Galveston near the port area, just across from Pelican Island which is just barely 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 sea port 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. While one must be cautious about interpreting the precise boundaries of the surge risk areas, since they are only approximate and not designed for this fine of a resolution, one can clearly get an indication of the areas of Galveston City proper that are more subject to surge damage than others. The much narrower band of surge areas to the south reflect the protection of the sea-wall and the fact that the elevation of the island increases markedly as one moves toward the sea-wall due to the filling of this area following the great Hurricane of 1900.

Figure 14. Cat 1 & 2 Surge Zones Over Galveston City Parcel Data

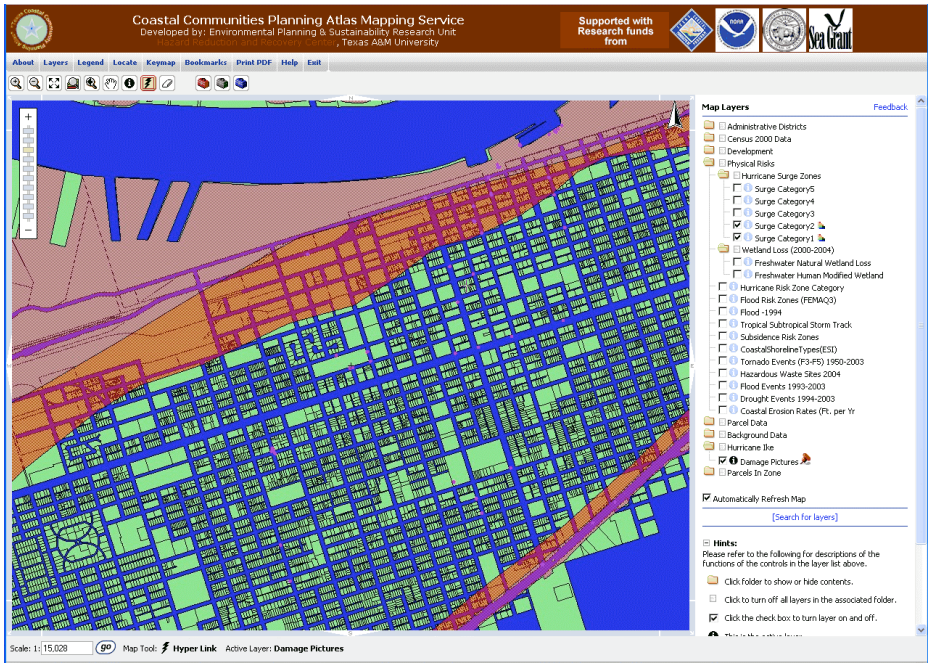


Figure 15. Cat 2 Surge Zones over Galveston Parcel Data on the Island's West End

Figure 15 takes 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, have a category 2 storm surge layer active. This representation clearly shows that all properties in this are subject to major surge flooding under normal category two event. Furthermore, this example indicates how a user can obtain specific information regarding a given parcel and also obtain a visual representation of the

location being mapped. Here, instead of using Google Map, a Virtual Earth tool is employed. These examples, make it clear how these finer resolution data can more clearly help planners, emergency managers, and, perhaps most importantly, the public understand how potentially vulnerable they are coastal hazards.

In sum, activities associated with Tasks 5 and 6 have produced a multifunctional website that offers coastal planners, emergency managers, stakeholder and the public access three different Atlas websites. The main coastal atlas website contains over 87 data layers for all coastal counties in Texas, the vulnerability hotspot website contains 77 data layers on the 11 northeastern coastal counties, and, finally, the Galveston Atlas contains nearly 40 data layers with the foundational layer being all property parcel data for the entire county. Each of these websites provides a fully functional web-based GIS environment that can be used to facilitate planning activities with respect to a coastal hazards, ecosystem characteristics, and physical and social vulnerability analysis.

The website has been presented in a number of venues and locations, including: The City of Galveston Planning Department; to several representative from FEMA and at FEMA headquarters in Washington, Friendswood School District, Seagrant researchers conference, TX APA, SPEED research Center, Rice University, State of the Bay Symposium, Smithsonian Environmental Research Center, HRRC Anniversary Workshop, GIS Day at TAMU, University Libraries Map and GIS Collections Services, Texas Coastal Applied Research Review Team Meeting, Severe Storm Prediction and Global Climate Impact in the Gulf Coast Conference, at USGS Headquarters – Silver Springs Maryland; the National Academies of Science meeting on Community Sustainability, The Planning Program's Advisory Committee for the Department of Landscape Architecture and Urban Planning - TAMU, TAMU-Galveston's Center for Texas Beaches and Shores; Galveston – Hurricane Ike Recovery Planning Committee.

Status and Trends of Coastal Hazard Exposure and Mitigation Policies for the Texas Coast

The final major activity undertaken as part of Task 5 was an assessment of the vulnerability of coastal counties both with respect to their areas and populations, paying particular attention to CMZ areas, when considering likely hazard impacts and the mitigation policies in place to address these vulnerabilities. Likely hazard impacts were assessed by utilizing surge, flooding, and wind risk maps in combination with the population data that have all be assembled for the Coastal Planning Atlas. The resulting report was entitled: *Status and Trends of Coastal Hazard Exposure and Mitigation Policies for the Texas Coast: The Mitigation Policy Mosaic of Coastal Texas,* which was delivered to the TGLO staff in July, 2009. The following offers a short summary of that report (the full report can be found in Appendix 4).

In 1980 the coastal population was approximately 3.9 million, with 36% (1.39 million) located in the CMZ. By 2000 the coastal population grew by 34% to 5.2 million, with 1.64 million located in the CMZ. Projections for the future are for rapid growth of coastal populations by 2030. By that time it is projected that 7.7 million will live in coastal counties, with over 2.4 million being located in the CMZ. The highest CMZ population growth rates between 2000 and 2030 are projected for Brazoria, Chambers, San Patricio,

Cameron, and Harris counties. In other words, the projects are for substantial growth in coastal populations, particularly within the CMZ. The areas where this growth is projected are areas with high risk to coastal hazards.

All coastal counties are at high wind risk zones, with sizable proportions being located within the highest two wind risk zones. Furthermore, the CMZs of these counties all fall within the highest two wind risk categories which are areas likely to experience sustained winds greater than 109 mph, with sizable areas likely to experience winds of 127 mph or greater. While all coastal counties are subject to surge risk, that risk is particularly evident in each county's CMZ. Seven counties – Aransas, Cameron, Chambers, Galveston, Jefferson, Matagorda, and Orange – have approximately 90% or more of their CMZs falling into surge risk zones. In addition, Galveston, Jefferson and Orange counties have 90% or more of their CMZs falling into category 1, 2, or 3 surge zones, even without extending to higher category surge zones. While wind seemingly captures the attention of the media during and after a hurricane event, surge is the real killer. In fact the old adage for hurricane safety is that you evacuate from surge, and "hunker down" (stay put in a safe place) for wind. The future population growth trends suggest much higher concentrations of population within these high risk surge zones in the CMZ. Much like wind, flooding risk is pervasive in coastal counties and these risks are particularly evident in the CMZ. On average 49.7% of all CMZ areas fall into the top three flooding risk zones with virtually 100% of all CMZ areas fall into flooding risk zone. Clearly, wind, surge, and flooding risks are pervasive in coastal counties and ubiquitous in the CMZ.

When examining coastal hazard losses from the SHELDUS data, it appears that there is a general trend toward increasing losses, despite a lull during the 1990s. Indeed, when Hurricane Ike's losses are included there is not just a trend toward increasing losses, but a dramatic increase during the first decade of this century. Insured flooding losses between 1996 and 2007 show no clear trend through this short term time period. Nevertheless, it is clear that insured flooding losses are higher for communities completely or partially within the CMZ in comparison to those of other municipalities outside the CMZ. Given these trends in losses and the demographic data that anticipates higher growth and concentrations of population in coastal counties and their CMZs, it appears that exposure and vulnerability levels can be expected to increase. In light of these trends, the question becomes; do we see mitigation planning efforts that are consistent with these risks?

Table 7 (see below) offers a summary of the findings presented in the *Status and Trends of Coastal Hazard Exposure and Mitigation Policies for the Texas Coast: The Mitigation Policy Mosaic of Coastal Texas* report with respect to mitigation planning policies for the 112 communities that were the primary focus of this policy assessment. The most pronounced and obvious pattern evident from just a cursory glance at this table is that larger percentages of the population residing in communities completely located within the CMZ are more likely to have adopted or be practicing planning activities that are generally recognized for their mitigation potential. Nearly 80% of the residents of these municipalities are located in areas with subdivision ordinances, followed by 70.8% under newer versions of the international building code (IRC/IBC 2003 or greater), and

approximately 66% are residing in areas that engaged in floodplain and storm water management. Particularly surprising was the relatively high percentage of the population that is located in communities that utilize zoning (60.8%) and comprehensive planning (59.8%). Unfortunately, the 59 communities completely located within the CMZ only account for 18.5% of the coastal county population as a whole.

Table 7: A Summary of Municipality and Population Percentages Adopting or Engaging in Specific Form of Mitigation Planning or Management

	All Municipalities		CMZ Municipalities		Partial-CMZ Municipalities	
	Num.	**Pop %**	**Num.**	**Pop %**	**Num.**	**Pop %**
Comp. Plan	36	19.1	19	59.8	3	1.6
Floodplain	53	30.0	32	66.0	7	13.7
Storm water	34	24.6	19	65.6	4	7.9
Zoning	39	18.6	25	60.8	1	1.1
Subdivision	44	24.2	26	79.9	5	0.4
CRS	13	69.4	9	49.8	2	86.0
IRC/IBC 03-06	47	86.5	28	70.8	7	97.2
Municipalities	**112**		**59**		**15**	
Population	**3,626,348**		**964,465**		**2,305,348**	

The reality is that when considering communities partially located in the CMZ, many of which are very large urban areas such as Houston, Beaumont, and Brownsville (comprising just over 44% of the coastal population) the mitigation planning percentages are very low for comprehensive planning (1.6%), Subdivision ordinances (.4%), zoning (1.1%) and even for issues like floodplain management (13.7%). On the bright side, the higher levels of participation in the CRS and the fact that many counties, Harris County in particular, do have major efforts addressing flooding issues offsets the very low levels of flood plain and storm water management. However, the simple fact is that comprehensive planning, zoning, and subdivision ordinances are rarely practiced in these very large communities.

The exceptions to the general pattern of greater CMZ community participation, does not hold for CRS and building codes, both of which are more likely to cover substantial proportion of municipalities that are partially in the CMZ, rather than those completely in the CMZ. However, and again on the bright side, the percent of population coverage among residents of communities inside the CMZ, is not terribly low particularly with respect to building codes. The overall picture, when considering the total population within all 112 municipalities is quite positive for CRS and NFIP participation as well as for building code coverage. However, when considering other approaches to natural hazard mitigation, particularly comprehensive planning and zoning, the picture is bleaker and more disconcerting.

On the whole, the picture that emerges is one of a rather elaborate mosaic of mitigation planning efforts that could perhaps be better characterized as a multi-layered patchwork.

Some layers are paper-thin, while other layers are more substantial and comprehensive. Regardless of the general characteristics of these layers, thin or substantial, they all display rents and gaps, sometimes substantial gaps, that reflect areas and populations that are not effectively covered. When it comes to more traditional planning methods and tools such as comprehensive planning, zoning, and subdivision regulation, the layers are paper thin, more ghosts like than substantial, with large gaps. Very few areas are utilizing these tools, methods or approaches. The floodplain and storm water management layers are more wide-spread, particularly when considering counties as a whole, but these two management techniques must be combined to insure effective flood control. This is often lacking, particularly in urban areas, and the question of how well counties and municipalities work together on these issues is an open question. The NFIP and CRS layers are also more substantial, in that there appears to be good potential coverage, and much more could be done to enhance CRS participation which would yield good mitigation payoffs. Also, coverage does not always mean participating. As we see again and again, a county or municipality may participate in the NFIP, but whether or not actual people participate by purchasing flood insurance is yet another open question. Finally, there is good spread of building code coverage, which bodes well for the ability of future construction to withstand hazard risks. However, even here, it should be remembered that the population residing in the 112 communities for which building code and other mitigation planning issues were discussed represent only about 70% of the total population residing in coastal counties. In other words, we simply do not know the mitigation status of the remaining population residing in small communities and unincorporated areas of coastal counties. It is highly likely that they are not covered by effective mitigation planning policies.

Thus the policy gaps – areas where the coastal population is highly vulnerable to coastal flooding, surge, and wind hazards – mentioned above could possibly be even larger than suggested by these findings. While there is room for optimism, the thin policy layers and major gaps must be of paramount concern and should be addressed in the not too distant future. We clearly are a long way from insuring that Texas coastal communities, particularly those in the CMZ, are effectively addressing the very real risks to coastal hazards they face.

Task 7: Advisory Committee:

Task 7 Description: The advisory committee meeting will be held during the first half of the revised project year. The meeting will have three principal activities: 1) presentation previous years accomplishments, 2) presentation of plans for current year; and 3) obtaining comments, critiques, and suggestions from the advisory committee regarding how project activities and outcomes can be improved to facilitate and enhanced.

Deliverable(s): Report on advisory committee meeting:

The following constitutes the report on the Advisory Committee Meeting.

Status & Trends Advisory Committee Report

The advisory committee membership includes individuals from state and local agencies, as well as members from various non-profit organizations and associations concerned with coastal mitigation issues. These members include: Lori Feild-Schwarz, Historic Preservation, City of Galveston Planning Department; Penny Goode, Former Administrator, Brazoria County Floodplain, Robert Harris, President, Houston Advanced Research Center, Tracy Hughes, Planning Coordinator, Galveston County Office of Emergency Management; John Jacobs, Director of Coastal Watershed Program and Community Development Specialist; John Lee, Mitigation Coordinator, Galveston County Office of Emergency Management, Gregory Pekar, State Hazard Mitigation Officer, GDEM; Wendy Odonohoe, Director of Planning, City of Galveston Planning Department; Logan Respess, formerly Aransas County – Sea Grant Extension now Associate Director and Extension Program Leader; Linda Shead, Program Director, Trust for Public Land; Bob Stickney, Director, Texas-Sea Grant; Jim Weatherford, Hazard mitigation Program, GLO; Shannon Van Zandt, Member, Texas American Planning Association Board of Directors.

On April 8th, 2009, the first Status and Trends Advisory Committee Meeting was held at the College of Architecture, Texas A&M University, College Station, Texas. In attendance were the following advisory committee members: Bob Harris – Director, Houston Advanced Research Center; John Gaete – Department of Public Safety, Governor's Division of Emergency Management, Ben Buchanan –Texas Department of Public Safety, Governor's Division of Emergency Management, Kelly Hamby – Brazoria County Floodplain/911; Bob Stickney – Texas Sea Grant, Linda Shead – Texas Coastal Partners – Trust for Public Land; and Shannon Van Zandt – Board, Texas Chapter American Planning Association. John Gaete and Ben Buchanan attended at the request of Gregory Pekar, who requested that they be made permanent members of the advisory committee in lieu of his participation. Wendy O'Donohoe, Lori Field-Schwarz, John Lee, and Tracy Hughes were all unable to attend due to continuing activities related to Hurricane Ike's impact on areas in Galveston County.[4] John Jacob and Jim Weatherford were both unable to attend because of commitments that arose just prior to the meeting.

The meeting started at 10:30 AM and lasted until approximately 3:30. The meeting began by giving the members an overview of the project, its activities, and goals. They then were given access to a computer and the entire committee got on the Coastal Planning Atlas website where they were introduced to the overall structure of the website and then allowed to explore the Main Coastal Atlas website and the Vulnerability Hotspot Atlas website. As part of this introduction they were given general instructions on how to use the data layers and tools. Following the exploration of the Atlas, they were introduced to the Best Practices and Mitigation Resource pages. During the afternoon sessions, the advisory committee was given a detailed presentation on the coastal Mitigation plan

[4] I have met or talked with all members who were not able to attend and they all have expressed an interest in continuing to be involved with our Status and Trends project.

evaluations. This was followed by a presentation of the Coastal Mitigation Survey planned for Phase 3 in which the draft survey instrument was handed out and discussed.

Some of the general comments and suggestions made during the advisory committee meeting included the following, which also include to project staff responses.

- There was a suggestion to include, where possible, data from the U.S. Census' American Community Survey.
    - Response: Unfortunately, these data are not available except at the county level. In other words, they are not available at the block-group level, hence will be of limited utility for the atlas. Nevertheless the project team will explore this option.

- The project team was encouraged to get the up-load tools operable so that users can up-load their own data to the Coastal Atlas website.
    - Response: This tool is now up and operational, albeit to a limited extent. This will be a focus during Phase 3.

- The project team was encouraged to provide opportunities where-by users can interact with the website and project team, providing opportunities to add additional information and make information requests. This generated an interesting discussion on the possibility of wikifying the coastal atlas – creating a learning community to explore new ways of interacting with the data and ideas and thereby creating an evolving website.
    - Response: These were exciting discussions and certainly something to explore for future Atlas development. The creation of GIS web-based site that evolves in response to a community of users would be an ideal goal for all future website developments.

- There was a general discussion about how to represent error, uncertainty and fuzziness in the data. This relates to combining data of different quality and refinement, as well as data that undoubtedly contain uncertainty and utilizing tools of various levels of specificity.
    - Response: These were all excellent comments and project staff will at a minimum address these issues in the meta-data files and explore potential visual representations for the inherent uncertainty of the data.

- Project staff were encourage to explore other opportunities to include pictures of Hurricane Ike's damage and impact from NOAA and other sources into the Atlas.
    - Response: This idea has already been incorporated into the Galveston Atlas.

- Project staff were encourage to develop pretested training scenarios that can facilitate mastery of the Coastal Planning Atlas and its tools. These could be use as training examples. Some examples suggested were to develop a recovery

module, showing how the atlas can be used to chart, monitor, and plan post disaster recovery. Also how to use the atlas to help "green" the community.
    - Response: This idea is currently being implemented with the development of classroom pre-canned examples and exercises.

- Project staff were encouraged to explore interactions with COGs as potential partners and was of reaching local communities.
    - Response: This was noted by the staff.

- Additional data that were suggested for inclusion into the Atlas included: Low income Housing Tax Credit properties, HUD's profiles of assisted households, the Houston Area Survey, collected by Dr. S. Klienberg at Rice, and forecasting tools.
    - Response: All of these sources will be explored by the project staff for inclusion into the Atlas.

- Project staff were encouraged to take the Coastal Planning Atlas on the road now, rather than waiting until the final year of the project. The sense of the committee is that the Coastal Atlas already has major possibilities to enhance public involvement in effective mitigation and environmental planning.
    - Response: Project staff agrees with this assessment and will seek to find and create opportunities to get the

On the whole, the response to project staff's accomplishments with respect to creating the Coastal Planning Atlas website and tools was very, very positive. The Advisory committee offered encouragement and good suggestions for improving it further.

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