A PROPOSED STRATEGY FOR A NATIONAL COASTAL DEVELOPMENT PLAN

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Introduction

Our nation's coastal conservationists had high hopes for the Coastal Barriers Resources Act (CBRA) as a means to limit coastal development in a comprehensive manner. CBRA provides for wildlife habitat preservation and minimizing the wasteful expenditure of revenues by curtailing federal investment on identified undeveloped coastal barriers. However, eliminating federal financial incentives may not achieve the desired level of environmental protection and hazard mitigation that Congress intended for these vulnerable coastal areas. Although the CBRA states that: "A program of coordinated action by Federal, state, and local governments is critical to the more appropriate use and conservation of coastal barriers," such a program does not exist.

Our coast is a national resource that should be protected against excessive exploitation. The federal effort initiated by CBRA should be expanded through the establishment of a National Coastal Development Plan which is considerate of 1) developed and undeveloped barriers and adjacent mainland areas; 2) natural interdependent coastal processes and capacities; 3) state and local economies; and 4) the private investor. Such a National Coastal Development Plan would rely on a quota system, individual state participation, and voluntary plan enforcement.

The Coastal Barrier Resources Act

The Coastal Barriers Resources Act (CBRA) and the Department of Interior's report to Congress were important first steps in establishing a comprehensive federal policy for the nation's coastal barrier system. However, without additional cooperative federal and state incentives and disincentives, continued piecemeal development will continue on the nation's developed, partially developed, and undeveloped barrier resources.

CBRA and its accompanying studies provide an excellent basis for further-

ing national and state policies and initiatives which will:

1) Establish more specific guidelines for developing and conserving both developed and undeveloped coastal resources,

2) Encourage cooperation among coastal states, and

3) Provide federal and state financial incentives for both barrier resources and possibly non-barrier resource areas in coastal states to make barriers less vulnerable to flood and ecological catastrophes, and less of a liability to taxpayers through careful coastal development and greater use of open space.

Despite its strengths, CBRA will not halt development of undeveloped barriers, nor will it, in its present form, deal with the problems of developed or semi-developed barriers. It is, at best, a "negative" planning act with a relatively weak implementation mechanism as long as there is sufficient private funding for new development. The interdependencies between developed and undeveloped barriers have not been recognized by CBRA. Nor is there any effort to balance development and conservation needs except by endorsing the status quo.

Determining appropriate levels of additional development and redevelopment for undeveloped, semi-developed, and developed barrier resources and guiding public and private actions consistent with such levels will not be easy; however, more definitive procedures and implementing mechanisms are badly needed. For starters the following could be considered for establishing such development levels:

1) Health and safety considerations for individual barriers such as evacuation capacity during time of hurricane, ground water supplies, and sewage disposal capability,

2) Ecological considerations for not only the individual barriers but the entire regional barrier, estuarine, and marine system including wetlands, littoral zone, and dune systems,

3) Existing development on the entire system within the state, and

4) Economic considerations for the barrier system as a whole in the state and/or region including need for fishing ports, future residential development for tax base considerations, fuel exploration, etc.

From a federal and statewide perspective, the whole regional system must be considered in establishing policies for individual barriers. This will require inputs from all levels of government.

A Coastal Conservation Quota

In spite of the many problems in establishing quotas, such an approach is one of the few viable ways to consider when managing coastal growth. A Barrier Resources Coastal Conservation Quota could be established for each state which would reflect a variety of factors and inputs from all levels of government, and from social and scientific disciplines. A coastal conservation quota would be jointly established by the states and federal government and apply to developed, semi-developed, and undeveloped barrier resources. It would be implemented through a broad range of measures--not simply federal subsidies for the barriers themselves.

A quota system could reflect the realities and benefits of economic development as well as environmental protection. Based upon total barrier resource system acreage, barrier characteristics, and other factors, a development limit in the state might be set for each state with flexibility as to how this quota would be achieved (i.e., condominiums, industrial development). The incentives to develop barrier resources are much stronger than those incentives intended to protect these coastal areas.

This nation is not adverse to using quotas, standards, or funding in order to achieve social changes. However, such mechanisms have been called various things and generally depend upon voluntary state and/or local participation and cooperation. Consider the 55-mile-an-hour national speed limit. States have voluntarily set the maximum speed limit at 55 miles per hour on all state and county road systems, and must demonstrate that they are properly enforcing the speed limit. States may increase the limit within their jurisdiction, but they will most certainly lose federal transportation funds. In any event, the speed limit program remains voluntary. The same may be said for certain affirmative action programs.

The Coastal Conservation Quota system suggested here would be voluntary. States which chose to participate and conserve a good portion of their coast

would be compensated for the loss in revenue in other areas of the state through federal funding. Those states which decide to exploit the coast to the maximum extent in order to increase state and local revenues would suffer a decrease in general federal funding.

A Prototype

The tax and economic development benefits of barrier resource development have not been adequately considered by previous coastal zone management efforts. During the last decade (without major storms), many developed barrier communities have been contributing significantly to the National Flood Insurance pool, state property taxes, and other taxes.

Over the past twelve years, the Town of Ocean City in Maryland has paid a conservatively estimated $3.7 million in flood insurance premiums. Since 1978, $187,589 has been paid in claims to Ocean City residents. Ocean City has been a moneymaker for the Federal Insurance Administration and the State of Maryland, although this may not continue when a major northeaster or hurricane strikes the area. Economically speaking, Ocean City is the third most important city in the state. The 5.5 square-mile area which comprises Ocean City supports an assessable base of over $.5 billion dollars, which is third only to the City of Rockville and Baltimore City--both physically larger cities. Other revenues generated by Ocean City are equally impressive to the point that the state of Maryland would realize a significant economic blow if the island development were not there. In other words, it behooves the state to contribute to shore erosion protection measures and assist with the rebuilding after an Ocean City disaster simply to protect the state economy. Compared to other areas in Maryland, state and federal aid to the Ocean City area is next to nothing.

Another interesting aspect of Maryland is that all of the state's coastal barrier development is concentrated within a 5.5 square-mile area. The remaining portion of the 30-mile coast is total open space, state and federal park land. The infrastructure serving the Ocean City area is concentrated along two main accesses and in the immediate island and back bay area.

The state of Maryland has informally established a de facto conservation quota of approximately 80% of its total barrier resources system. This conservation quota was made possible only through prudent state and federal acquisition and management programs years ago. Such massive public funds are no longer available for acquisition purposes. Therefore, other states would need

a companion policy to CBRA, relying on regulation and financial incentives to achieve the purposes of minimizing loss of life, curtailing wasteful expenditures of federal revenues, and mitigating damages to coastal natural resources.

Plan Implementation

In coastal states, barrier resources are often viewed as a valuable commodity similar to oil, natural gas, and minerals. It is not inconsistent with established state resource policies to set limits on exploitation of such resources. Assuming that adequate criteria and a federal/state process were developed for establishing conservation and development quotas, how would such quotas be implemented? Three steps might be followed.

First, a coastal conservation quota would be established for each state. Such a quota would consider the natural capacity of the barrier system to support development, acreage in the system, the value of the environmental resources on the barriers, economic development potential, and the level of development which could be tolerated before the barrier resource becomes a financial liability to the state. High-density development on smaller islands might be less of a liability than low-density development on larger islands because of the extra miles of infrastructure and expense of evacuation. In some cases, it may be best to encourage high-density development in specific areas in order to leave remaining barriers free of development. For development areas, it may be preferable to choose a section of the barrier on which all environmental concerns would be secondary to development concerns, and to allow for optimum density with the condition that no other section of the barrier would be disturbed.

Second, a Coastal Development Plan would be developed for each state. Federal agencies would assist states and local communities with the development and implementation of such a plan. Similar to the assistance provided under the National Flood Insurance Program and the Coastal Zone Management Act, federal and state agencies would cooperate technically and financially in the planning process consistent with the conservation quota.

Third, all federal financial assistance appropriated for each coastal county with barrier resources would be conditional upon proper implementation of the Coastal Development Plan. For example, if the City of Wilmington applied for federal urban renewal funds, a clearing house system similar to E.O. 11988 could reveal whether coastal conservation measures were in order,

and funds would be distributed only after a satisfactory finding.

It is also suggested that perhaps non-coastal federal financial assistance and flood insurance should be conditioned upon each state and local government's proper management of its coastal barriers. It is taking CBRA considerably farther and making the entire state dependent upon prudent use of the coast.

GREENHOUSE EFFECT AND SEA LEVEL RISE

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Introduction

Most of our discussions and policies address flood losses as acts of God. There is a certain probability that the forces of nature will combine to create a flood from a storm surge or rainfall. Because we cannot predict where or when the next major storm will strike, we tell everyone in a certain area that there is a certain probability that a storm will strike them, and we ask them to plan accordingly. Although there are some notable examples of people disregarding the risk of a serious storm, policies have moved a long way toward addressing the risk of flood losses.

The papers by Groat, Gagliano, Edmonson, Pilkey, and others in this volume address a different aspect of the problem: the loss of land. Even though the loss of land is more predictable than the occurrence of a storm, our flood prevention policies often ignore the future increase in flood damages resulting from this factor. In Louisiana, for example, where the loss of 50 square miles per year will almost certainly make many developed areas extremely vulnerable in the next 30-40 years, no one has even estimated the flood claims that can be expected in the year 2015 if present trends continue.

In the coming decades, most of the U.S. coast may be experiencing rates of land loss similar to the current Louisiana situation. Increasing concentrations of carbon dioxide and other gases are expected to cause a global warming that could raise sea level several feet in the next century and one foot in the next 30-40 years. This paper discusses the basis for expecting a rise in sea level and the implications for strategies to prevent land loss in Louisiana.[1]

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[1] For a comprehensive review of the implications of sea level rise, see Barth, M.C. and J.G. Titus (Eds.), 1984. Greenhouse Effect and Sea Level Rise: A Challenge for This Generation. New York: Van Nostrand Reinhold.

Sea Level Rise and the Greenhouse Effect

A planet's temperature is determined primarily by the amount of sunlight it receives, the amount of sunlight it reflects, and the extent to which its atmosphere retains heat. When sunlight strikes the earth, it warms the surface, which then radiates the heat as infrared radiation. However, water vapor, carbon dioxide, methane, chlorofluorocarbons and other gases in the atmosphere absorb some of the energy rather than allowing it to pass undeterred through the atmosphere to space. Because the atmosphere traps heat and warms the earth in a manner somewhat analogous to the glass panels of a greenhouse, this phenomenon is generally known as the "greenhouse effect."

Since the industrial revolution, the combustion of fossil fuels, deforestation, and cement manufacture have released enough CO_2 into the atmosphere to raise the atmospheric concentration of carbon dioxide by 20 percent (Hoffman, 1984). Energy experts generally expect the concentration of CO_2 to double in the latter half of the 21st century, and the concentration of all greenhouse gases is expected to double by 2050, perhaps sooner. Because the extent to which these gases absorb infrared radiation is well-established, Hansen et al. (1984) calculate that a doubling would directly raise the earth's average temperature 1.2°C if nothing else changed, an estimate that is universally accepted by physicists and climatologists.

The direct effect of the doubling of greenhouse gases would most likely be amplified, however, because of the effect on other climatic factors. For example, a warmer atmosphere would retain more water vapor, also a greenhouse gas, and snow and floating ice would retreat, decreasing the extent to which sunlight is reflected into space, thus causing an additional warming. After evaluating all of the evidence, two National Academy of Sciences (NAS) panels concluded that the eventual warming from a doubling of greenhouse gases would be 1.5 to 4.5°C (3-8°F) (Hoffman, Keyes, and Titus, 1983).

A global warming of a few degrees and the resulting expansion of sea water could be expected to raise sea level by one-half meter in the next century. Mountain glaciers, which have retreated in the last century, could melt and

release enough water to raise sea level 12 centimeters (5 inches) (Revelle, 1983). Antarctica could contribute to sea level rise either by meltwater running off or by deglaciation (ice discharge); however a complete deglaciation of the west antarctic ice sheet would take several centuries (Bentley, 1983; Hughes, 1983). Revelle estimates that a 3°C warming could cause Greenland's glaciers to melt enough water to raise the sea another 12 centimeters in the next century and that the combined impact of thermal expansion and melting of Greenland and mountain glaciers could raise sea level 70 centimeters (2 and 1/3 feet) in the next century (Revelle, 1983). Although Revelle stated that Antarctica could contribute two meters per century to sea level starting around 2050, he declined to add this contribution to his estimate.

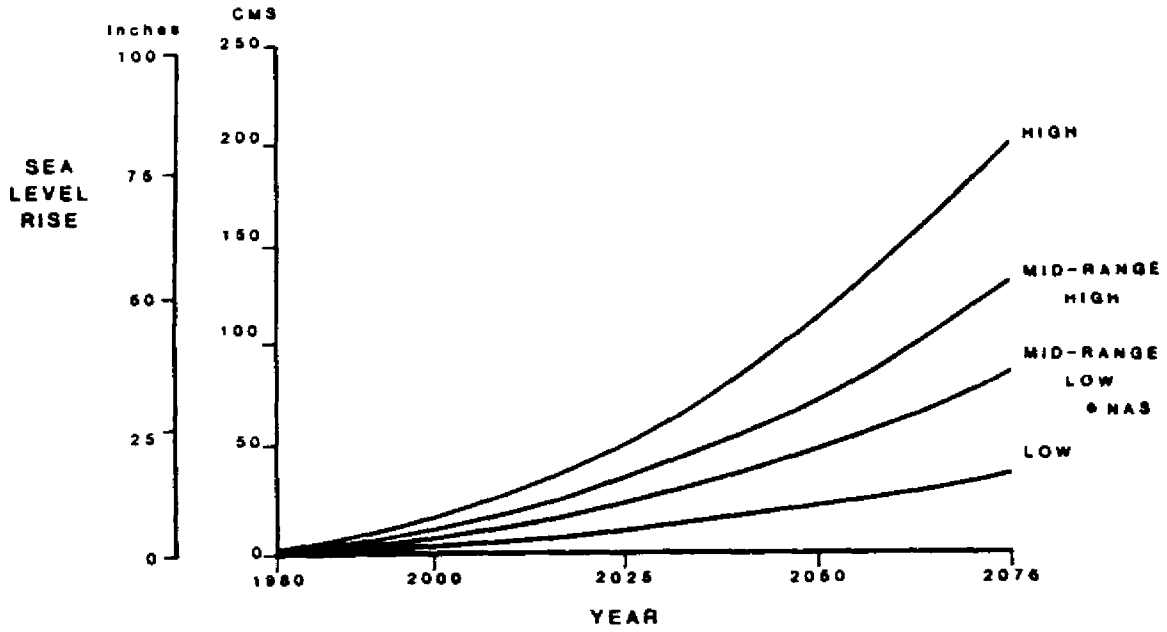
In a report by the U.S. Environmental Protection Agency (EPA) entitled Projecting Future Sea Level Rise, Hoffman, Keyes, and Titus (1983) stated that the uncertainties regarding the factors that could influence sea level are so numerous that a single estimate of future sea level rise is not possible. Instead, they consulted the literature to specify high, medium, and low estimates to account for all of the major uncertainties, including fossil fuel use; the portion of carbon dioxide that remains in the atmosphere; future emissions of trace gases; the global warming that would result from a doubling of greenhouse gases (the NAS estimate of 1.5-4.5°C); the diffusion of heat into the oceans; and the impact of ice and snow. Figure 1 illustrates the EPA and NAS estimates.

Implications for Louisiana

A rise in sea level from the greenhouse effect would accelerate the loss of wetlands that Louisiana is experiencing today. Marsh drowning and saltwater intrusion would both increase. The required time for Terrebonne Parish to convert to open water, for example, would be reduced from 100 to 60-75 years, if no action is taken. The local government there has developed a 25-year construction plan to help restore natural processes and curtail wetland loss. Given the long lead time necessary for gaining a public consensus on the public works that may have to be built or modified, decisions that local officials might like to delay until 2020 will probably be necessary within the next ten years.

FIGURE 1

GLOBAL SEA LEVEL RISE SCENARIOS:
LOW, MID-RANGE LOW, MID-RANGE HIGH, AND HIGH



Source: Projecting Future Sea Level Rise, EPA, 1983. Changing Climate, National Academy of Sciences, 1983, (does not include Antarctica).

One of the most important problems concerning the greenhouse effect is our inability to forecast future sea level rise accurately. Although much of the nation has the luxury of being able to wait 20 years until better forecasts are available, Louisiana cannot wait that long. Thus, it is very likely that we will have to develop a wetland protection strategy that addresses the possibility of a "greenhouse" rise in sea level before we know what its magnitude will actually be. Nevertheless, the sooner we have better forecasts of sea level rise, the sooner Louisiana will be able develop strategies that address an accurate understanding of what lies ahead.

The most fundamental threat to any government is the possibility that its land will be taken away. In response to current trends, local governments and the State of Louisiana have initiated a level of effort unprecedented in the history of environmental protection. The Louisiana Legislature created a $35 million Coastal Protection Trust Fund to research, develop, and demonstrate methods to slow coastal erosion. Local governments have also appropriated millions of dollars and have been joined by private landowners such as Texaco and Tenneco LaTerre. Terrebonne Parish has initiated a public awareness campaign that includes billboards, pamphlets, slide shows, and its secondary school curriculum (Edmonson, this volume).

Although there are many uncertainties surrounding the issue of future sea level rise, we feel that two recommendations are appropriate. First, the state must take a more active role to ensure that the research necessary to accurately forecast sea level rise is undertaken in a timely manner. If coastal interests ignore the issue of future sea level rise until conclusive predictions are available, the predictions may never become available; the substantial increase in basic research that is necessary will not take place until the people who need the information start to make that need clear.

Secondly, the state must recognize that it will probably have to make major decisions before the verdict is in, even if an acceleration in research does take place. We will probably not have accurate forecasts of future sea level rise before 1995; action to address land loss will be necessary before then. In the meantime, it would be very unwise to assume that a rise in sea level will not take place. Instead, our policies should be based on the fact that we do not know what will happen. This will require assessing the consequences of particular actions if the sea does rise and if it does not.

It would be nice if we could ignore this issue until it is proven, but certainty is not always possible. Like financial markets, we should follow the principle of using all available information and treat sea level rise as a risk to be recognized. The fact that the future is unknown does not mean that we cannot have confidence in policies that leave us better prepared for what could happen.

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SEA LEVEL RISE AND SUBSIDENCE IN COASTAL LOUISIANA

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Introduction

The major impact of relative sea level (RSL) in Louisiana is: 1) land loss within the wetlands and marshes and 2) erosion of beaches and barrier islands along the shoreline. However, the exact role sea level rise plays in the nature and severity of land loss and coastal erosion remains unresolved. This question is most important to wetland managers and coastal planners in assessing the future existence of southern Louisiana's coastal zone.

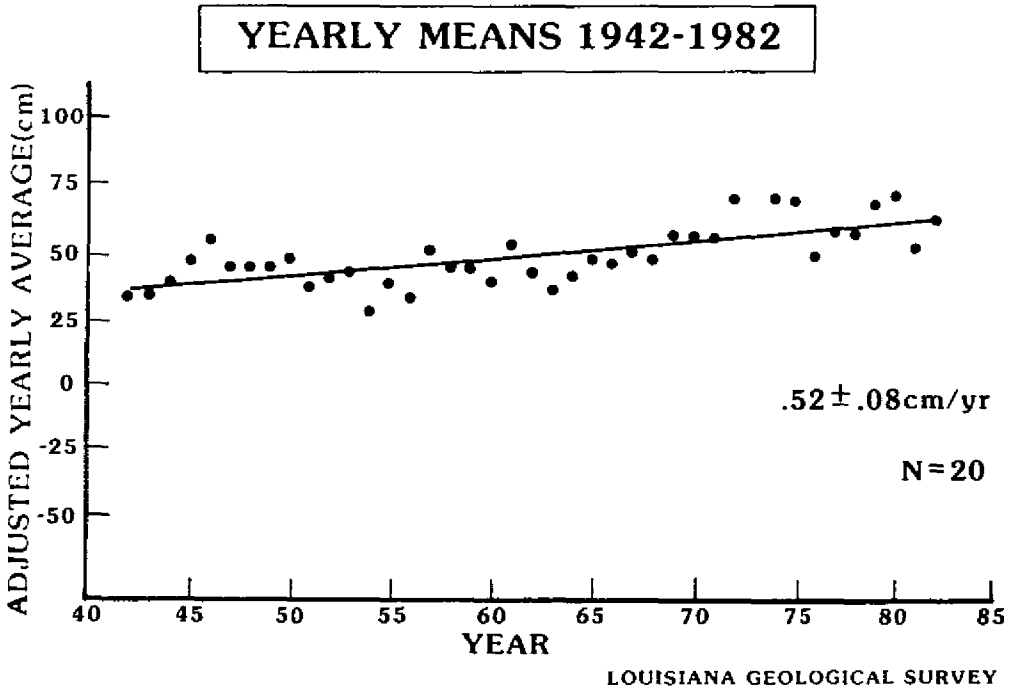
A number of depositional environments are represented within the 26 million sq. km of coastal wetlands in southern Louisiana. The most common environments are the coastal marshes which account for 40% of all coastal wetlands in the United States (Gosselink, 1980; Davis, 1983). The coastal wetlands are flat, low lying areas with average elevations of less than 1 m and are being converted to open water bays or lagoons at a progressive geometric rate exceeding 101 sq. km per year (Gagliano et al, 1981). Louisiana faces the most critical barrier shoreline erosion problem in the United States due to relative sea level rise upon which storms and man's activities are superimposed accelerating the problem (Penland and Boyd 1982).

Data Analysis

Eighty-one tide gauge stations, maintained by the Army Corp of Engineers (ACE) and National Oceanic and Atmospheric Administration (NOAA) (Fig. 1), and several kilometers of historical leveling data have been analyzed in this study for the purpose of determining the history of recent sea level rise in coastal Louisiana. Yearly means have been calculated for 20 tidal stations with continuous records from

Figure 1. Location of tide gauge stations in coastal Louisiana examined in this study.

Figure 2. State-wide yearly means from 1942-82 for 20(N) tide gauge stations.



1942-82, and display a sea level rise rate of 0.52 ± 0.08 cm/yr (Fig. 2). This rate is 2.26 times greater than the assumed Gulf of Mexico eustatic sea level rate (0.23 ± 0.03 cm/yr at Pensacola, Florida) and 3.47 times greater than the assumed world-wide eustatic rate. There is no concensus as to a world-wide eustatic rate, but an average rate is estimated at 1.5 mm/yr (Hicks, 1978; Gornitz et al, 1982; Barnett, 1983).

Tide gauge measurements at 20 localities across the Louisiana coastal zone were plotted relative to mean sea level against the period of record. A computer-generated linear regression was calculated to determine a rate of rise for each tide gauge station (Fig. 2). In order to compare the tidal data, it was necessary to divide the 20 stations with continuous record into two 20-year epochs (1942-62 and 1962-82) to encompass the 18.9 year lunar orbital cycle. River stations were avoided and anomalies in the data were corrected to adjust for major storm impacts and flooding. From these analyses, temporal differences and rise rates were determined for seven physiographic regions in the coastal zone. These regions each posess a unique set of geologic process, sedimentation rates, drainage patterns and depositional histories. Subsidence rates are determined by analysis of geodetic leveling profiles and assuming subsidence is the only significant remaining component accounting for RSL rise after deleting the eustatic component in that area.

Results

Figures 3A,B depict the rates of rise from 1942-62 and 1962-82. The first 20 year epoch shows a rise of 0.11 ± 0.20 cm/yr, whereas, the second 20-year epoch reflects a rise of 0.91 ± 0.23 cm/yr, approximately nine-times greater rate of rise. Regional variation in sea level rise is shown in Figures 4A,B for 1942-62 and 5A,B for 1962-82. Regions II and V show the greatest increase in water level rise between the two epochs, with Region VII being the least variable.

Grand Isle, located in Region IV, is the reference station to which the leveling datum is based (Fig. 6). Grand Isle was arbitarily chosen since it contained a tidal station which is maintained by NOAA and can be compared easily to the Pensacola, Florida station. Assuming compactional subsidence at Grand Isle by comparison to Pensacola is 1.03 cm/yr, the rates of subsidence descrease markedly as one moves

Figure 3. A) Graph of sea level rise for 1942-62. B) Graph of sea level rise for 1962-82.

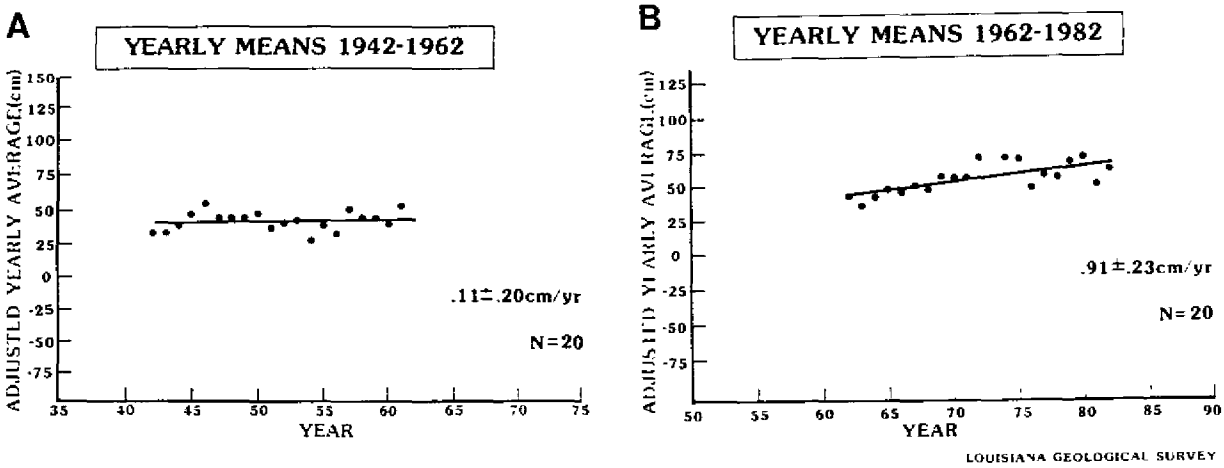


Figure 4. A) Regional summary showing water level rise from 1942-62. B) Histogram of water level rise from 1942-62 by physiographic regions.

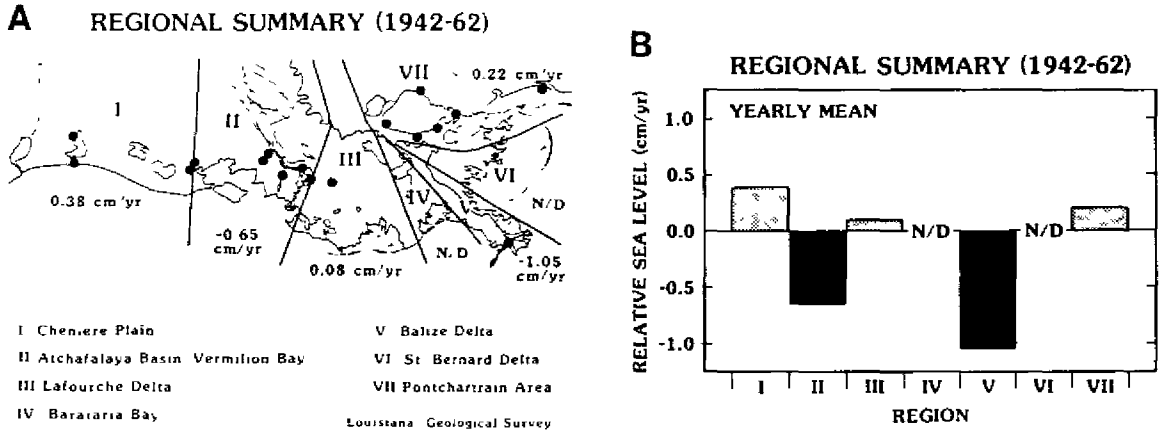


Figure 5. A) Regional summary showing water level rise from 1962-82. B) Histogram of water level rise from 1962-82 by physiographic regions.

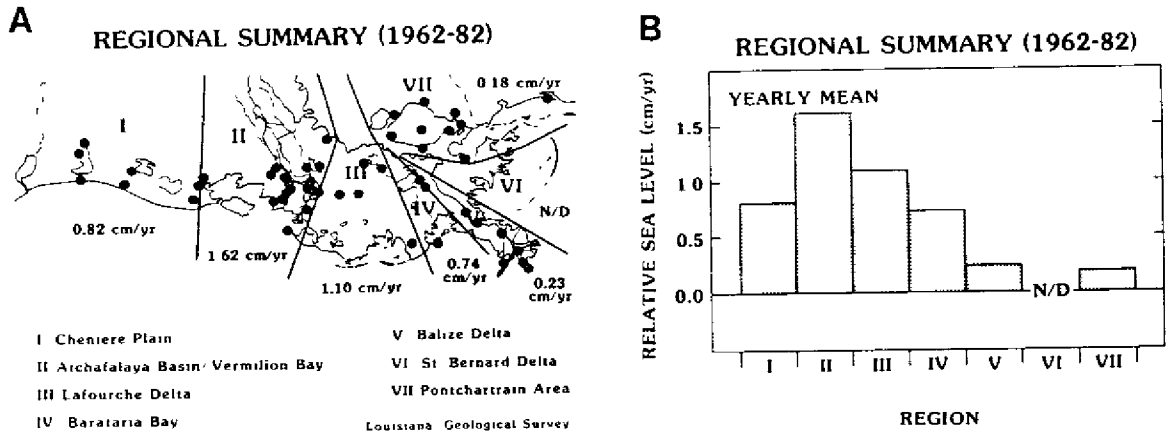
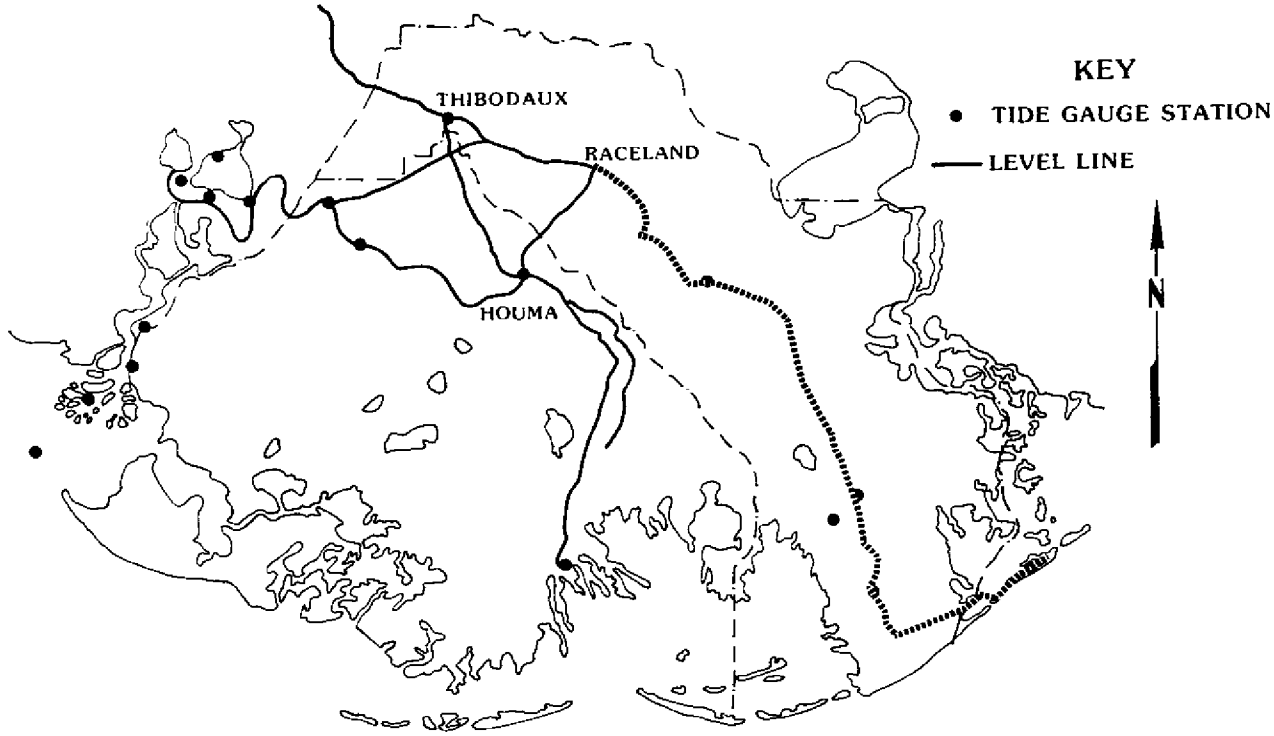


Figure 6. Location of leveling datum lines used in this study to compute subsidence rates.



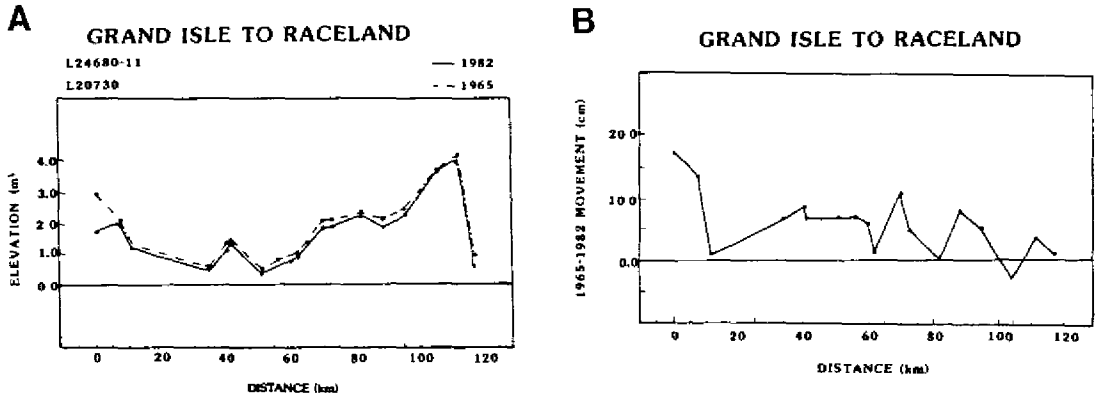
landward. One hundred twenty km away from the coast, the rates of subsidence are only 0.001 cm/yr (Fig. 7A,B).

Discussion and Conclusions

The following observations can be made from the analysis of tidal and leveling datum in the Gulf Coast of Louisiana. First, leveling data shows that subsidence is greater along the coast with a marked decrease landward. Second, there is a significant increase in water-level rise between the two 20-year epochs from 1942-62 and 1962-82 (Fig. 4B and 5B). Possible reasons for the spatial and temporal differences could be due to the amount of flooding, channelization and diversion of streams and rivers, increase in dredging, and decreasing rates of sedimentation. Temporal variations could also be due to variation in eustatic rise during that time period.

Accelerating RSL can have several effects on the Louisiana Coast including shoreline erosion, barrier island breaching due to storm impacts, salt water intrusion, marsh deterioration, flooding, and land loss. Comparing the regions of greater water-level rise to regions of highest land loss there does not appear to be a one-to-one relationship. Areas of greater amount of land loss. This suggests that sea-level rise contributes to land loss but is not the only causal factor.

Figure 7. A) Plot of leveling datum along a profile line from Grand Isle to Raceland, Louisiana for 1965 and 1982. B) Summary plot showing vertical elevation change from 1965-1982.



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LOCAL GOVERNMENT INVOLVEMENT IN COASTAL PROJECTS' FLOOD HAZARD REDUCTION

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Introduction

Although Terrebonne Parish lies near the terminus of North America's largest river system, its flood problems are caused by coastal deltaic processes. The channelization of the Mississippi River has contributed to the accelerated destruction of the deltaic plain. The combined influences of subsidence, sea level rise, and erosion have forced the Parish to address two types of flood hazard reduction: protection of homes, businesses and infrastructure; and protection of estuarine habitats. Regional flood hazards include tidal, backwater, and runoff flooding, and saltwater intrusion. To protect itself, the Parish has adopted a multi-faceted floodplain management program. Program activities include research, public education, construction, and management.

The lack of a state-implemented coastal management and protection program has made the Parish realize it has to undertake the management of its barrier islands and wetlands itself. We further understand that these management plans need to go beyond the land use regulatory nature of CZM to a long-range, capital-intensive maintenance and construction program.

Identification of the Problem

The disruptions in the natural cycles of Louisiana's deltaic plain have produced extreme land loss problems for Terrebonne Parish. Over a 23-year period from 1955-1978, it was documented that Terrebonne Parish lost 15% of its land area and 42% of its barrier islands to subsidence, erosion, and sea level rise (Wicker, et al., 1980). At these rates it is calculated that all of Terrebonne's erodible land will be gone in 98 years.

As erosional forces continue unchecked, flood hazard reduction measures become increasingly important not only for the protection of infrastructure, but also for the protection of valuable estuarine habitats. As the sea continues to encroach upon the mainland, natural drainage patterns are affected as

gradients are reduced. Reduced gradients, tides, and winds cause extreme backwater flooding problems in many areas of the Parish. Rainfall in excess of 65" per year compounds this problem. The interdistributary basin floods first, followed by the back side of the natural levee ridge. Bayous receive very little natural runoff.

With the continual breakup of the barrier islands and marsh ecosystems, saltwater travels further northward during tropical storms and southerly winds, further feeding the cycle of land loss, erosion and flooding. Saltwater intrusion, flooding, land loss, subsidence, and sea level rise are interrelated. When the people of Terrebonne Parish recognized this fact, we determined the only long-term solution was to manage the total ecosystem including the barrier islands and the wetlands. If the Parish can stabilize its land loss problem, it will be able to lessen salt water intrusion and flooding.

Program Goals

After identifying its problems, Terrebonne Parish developed goals to address the identified problems:

1) To develop additional facts about the barrier islands and our marshes.
2) To draw public attention to the problems associated with barrier island and marsh deterioration.
3) To develop and implement programs and plans for the preservation and protection of Terrebonne's estuary.
4) To reduce the scope of damage to the barrier islands through physical change.

Comprehensive Data Base

In the mid 1970s, the Parish recognized that it had little information on the subjects of shore erosion, subsidence, drainage, marsh preservation, and restoration of its barrier islands. As a result, several habitat and barrier island studies were conducted. The Parish is currently continuing the following studies to develop additional facts about its barrier islands and marshes:

1) Sand Resource Inventory
   The gulf bottom around the coastline is being investigated to locate sand resources for our barrier islands.

2) Marsh Valuation Study
A study is being conducted to develop economic valuations of Terrebonne Parish wetlands for input into the Corps' present studies and benefit/cost ratio procedures.

3) Oyster Contamination Study
The oyster contamination study deals primarily with the question of the sources of sewerage or fecal contamination, and the methods used by health authorities in monitoring for fecal contamination.

4) Subsidence Study
The subsidence study will classify the marsh and ridge lands as either stable, erodible, or accretional, and will aid the Parish with management and development decisions.

5) FEMA Appeal
An appeal of FEMA's information base and methods for calculating FIRM projects is in process.

6) Sea Level Rise Study
Marsh protection strategies will be analyzed against sea level rise scenarios in an anticipated upcoming study.

7) Master Drainage Plan
A comprehensive parish-wide drainage plan is being prepared.

8) Potable Water Supply Plan
To determine the long-range (20 years) potable water supplies and distribution requirements, the Parish has prepared an engineering economic feasibility and capital improvement program.

Public Education

Last year Terrebonne Parish began a public education campaign in recognition of the fact that it would need full public cooperation and support in order to combat all its problems with coastal erosion, land subsidence, sea level rise, saltwater intrusion, and flooding. The education program has a

number of facets:

1) Slide Presentations--Recently, the Parish produced two slide shows on the environment and the economy.
2) Handouts--To supplement the slide shows, three brochures were developed for distribution to the general public and the school students.
3) Posters--To convey the importance of preserving our barrier islands and wetlands, a set of posters was designed and printed.
4) Barrier Island Foundation--A foundation has been formed to encourage and support the continuation of efforts to preserve and protect the Parish and its inheritance.
5) School Programs--The Parish government and the school board developed and implemented an eighth grade curriculum dealing with geology, erosional problems, utilization of renewable and non-renewable resources, and solutions.

Wetland Preservation

Terrebonne Parish has recognized that its wetlands have immense monetary and aesthetic value. Presently, Terrebonne's estuary produces over $30 million per year in seafood and recreational income alone. The Parish is unwilling to abandon its wetlands to the forces of nature. Therefore, plans and programs are now being generated and/or implemented by both the public and private sectors. Included in these programs is the maintenance of, and hazard mitigation in, over 1,600 acres of wetlands within our present forced drainage system. The Parish is also preparing to construct salt water barriers to protect the interdistributary basins. These levees will follow water courses such as Bush Canal, Falgout Canal, and Lake Boudreaux. Water control structures will also be installed at critical locations to control flooding and manage habitats.

The overall scheme of wetland protection and flood hazard reduction incorporates several rings of protection levees: one at the wetland-nonwetland interface to protect infrastructure (present force drainage system), and one at the wetland-gulf water interface to protect the estuary (proposed).

Barrier Island Preservation

Terrebonne's barrier islands are its first line of defense against attacks from the sea. If these islands are lost, it is predicted that Terrebonne's land loss will accelerate geometrically, and increased flooding will follow. The state of deterioration on the barrier islands of Terrebonne Parish is quite dramatic. Specific erosion rates for the Isles Dernieres chain over a 25-year period have been estimated at 33% of its total land area. Shoreline erosion rates average 34' per year (Wicker et al., 1980).

Despite the various physical processes that are contributing to the loss of the barrier islands, remedial measures can be taken to retard them. Terrebonne Parish was the first to reconstruct 35 acres of barrier island in the state of Louisiana. Our nonstructural/flexible structural approach will allow the islands to migrate. Eventually, the island will migrate northward and abut the proposed levee, adding further toe protection. It is important to keep the overall integrity of the islands intact as they migrate. This does not require massive dune construction measures.

Conclusion

Terrebonne is fortunate that the extent of erosion caused by severe storms has been minimal over the past several years, and that it has not been subjected to the erosion forces of a major hurricane. However, if existing processes continue unchecked, all of Terrebonne's wetlands will be gone in 75 years. With the loss of the islands and the estuary, Terrebonne, Louisiana, and the nation will lose billions of dollars in renewable resources and recreational industries. In addition, the increased cost of hurricane and flood protection will become staggering for the Terrebonne-Lafourche Metro area.

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FLOOD INSURANCE STUDY REVISIONS: BLESSING OR CURSE?

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Introduction

This paper examines the Federal Emergency Management Agency's (FEMA) current processes for maintaining the accuracy and usability of a community's Flood Insurance Study. The paper is written from the perspective of a contractor to FEMA and, as such, carries no endorsement by FEMA.

Background

FEMA's current study effort is directed toward reaching the Congressionally mandated goal of converting all flood-prone communities to the Regular Phase of participation in the National Flood Insurance Program. As the number of communities entering this phase increases, FEMA's efforts will logically shift to maintenance, that is, keeping the Flood Insurance Studies up to date.

Two alternatives are available to FEMA to update a community's Flood Insurance Study: 1) Hire a contractor to generate new information and produce a restudy; or 2) Revise the Flood Insurance Study via a map revision or map amendment based on community-supplied information.

It is unlikely that a restudy program will ever receive as intensive a commitment of money and resources as has FEMA's current study effort. While it once may have been envisioned that communities would be restudied every five years, this kind of comprehensive maintenance program will be impossible under FEMA's current fiscal constraints. Therefore, in order to achieve a maintenance program of any value, FEMA must seek community support in sharing the responsibility for keeping studies up to date.

Why Flood Insurance Studies Become Outdated

In order to define the applications of the revision and restudy processes, the reasons why a Flood Insurance Study becomes outdated must be examined. The hydrologic and hydraulic impacts of development are by far the most common contributors to making a Flood Insurance Study, or portions of it, obsolete. Channel modifications, fill, and the construction of dams, levees, berms, bridges, and culverts affect the validity of Flood Insurance Study analyses. Projects of these types are sometimes built to protect existing development; however, they are most often constructed to allow for new development.

The potential for development in a given area is another factor contributing to the need for Flood Insurance Study revisions. Non-construction-generated revision requests may stem from the potential for development in a flood plain. For example, requestors submitting a new hydraulic analysis for a stream are often motivated to do so because they have new development plans that would be facilitated by the new analysis.

Two of FEMA's goals are to supply communities with the most accurate, up-to-date Flood Insurance Studies possible and to maintain the accuracy of these Flood Insurance Studies over time, thereby providing the communities with the best bases for making sound flood plain management decisions. The restudy process, which is currently applied only to the most out-of-date Flood Insurance Studies, does not keep up with development. It is more a means of catching up, rather than staying ahead. Therefore, communities face a Catch-22 situation: development causes a Flood Insurance Study to become outdated, but they need an up-to-date Flood Insurance Study to monitor the impacts of development. Thus, a periodic restudy plan is not appropriate for most maintenance purposes. However, predicated on updating a study with community-supplied information, the revision process can be an effective means of keeping Flood Insurance Studies up to date. Clearly, it's a blessing!

Communities' and States' Roles in the Study Maintenance Effort

Communities must recognize that for the revision/amendment approach to Flood Insurance Study maintenance to succeed, they must assume the responsibility of supplying FEMA with the new information. The responsible communities must then learn

what type of information FEMA requires and what FEMA can accomplish toward study maintenance with that information.

The distinction should be made between map revisions and map amendments. Map amendments were originally designed to remove structures that, due to graphical limitations, were inadvertently included in the Special Flood Hazard Area from that designation. To obtain a Letter of Map Amendment, an appellant must prove that his structure is above the base flood elevation by submitting survey or other topographic information to FEMA. Letters of Map Amendment have also been granted conditionally; that is, a proposed structure as located on a grading plan could obtain a determination that it would be above the base flood elevation if constructed as proposed. The process has been corrupted over the years in that conditional Letters of Map Amendment have been granted for structures proposed to be elevated above the base flood elevation on fill. This practice will probably be discontinued in the future.

Map revisions are needed if any change in the base flood elevation is involved. All of the construction-related flood plain modifications mentioned earlier, as well as the non-construction-related development of new hydrologic or hydraulic analyses, fall under the scope of map revisions. Map revisions are also granted conditionally, by FEMA stating that if a project were constructed as designed, it would be cause for a map revision. These conditional Letters of Map Revision, or "belief letters," are often needed by developers to obtain financing, construction permits, or buyers.

State flood plain managers can assist communities in working with FEMA in two general areas: education and coordination.

Education

The appropriate State agency should be familiar with FEMA processes and requirements for revisions and amendments to flood insurance maps. FEMA has published several documents that detail the steps necessary to obtain a revision or amendment. These documents are termed Conditions and Criteria and cover Map Revisions, Floodway Revisions, and Letters of Map Amendment; the State agency should have a supply of these available for distribution. FEMA spends a substantial amount of time and effort responding to and educating individuals who are not aware of the revision/amendment policies; these citizens realize that they need help too late, when they are unable to obtain financing or various permits. FEMA's map revision and amendment policies and procedures should be presented by the States to communities during visits. If, as with some States, representatives of the State Coordinator's office

attend the final community Consultation and Coordination Officer's meeting, where the Flood Insurance Study is presented to community members, the revision process could be brought up at that point, thereby arming citizens with the program knowledge they need to maintain a useful Flood Insurance Study before the fact. Of course, "monitoring visits" to communities already participating in the Regular Phase of the program would be appropriate occasions to discuss study maintenance.

Another area of responsibility the States can assume is to develop the role of the State repository. Under current revision procedures, it is essential that any new analyses be based on those in the original study. The original study data should be catalogued and stored such that it is easy to locate and distribute. If facilities or funding limit the State's ability to maintain the data, the State should work with individual communities in developing well-inventoried, accessible repositories in a uniform manner.

Coordination

There are many coordination efforts that the States can undertake to help communities keep their Flood Insurance Studies up to date and thus more usable. For example, they can coordinate, to the extent possible, with other State or non-FEMA Federal projects that will ultimately affect a community's Flood Insurance Study. States should encourage the development of information that would lend itself to a study revision. For example, many bridge replacements and channel modifications carried out by a State highway department will result in a change to the water-surface elevations and/or flood boundary and floodway delineations. Many of these projects (especially the replacement of an undersized bridge or culvert) will result in a reduction in flood hazards. A community will then request that its study be revised to reflect the change. If the data from the original study has been utilized by the highway department in the design phase of the project, and if any hydraulic analyses are performed so that they are compatible with the existing study, a map revision can most easily be accomplished by FEMA.

In keeping with a general National Flood Insurance Program principle, State agencies can also encourage the use of information presented in map revisions, conditional Letters of Map Revision, and conditional Letters of Map Amendment as minimum criteria. Communities should be aware that data and analyses have been reviewed with FEMA minimum criteria in mind and, as such, it is their prerogative to be conservative in the application of FEMA's findings. For example, in a rapidly developing

area, perhaps channel modifications or other structural measures should be designed with future conditions or ultimate development discharges, even though FEMA, for purposes of a conditional Letter of Map Revision, compares the design to existing Flood Insurance Study data. Likewise, while FEMA could grant a conditional Letter of Map Amendment for structures proposed to be built at or above the base flood elevation, perhaps community requirements to build one or even two feet above the base flood elevation would be more prudent.

Observations on and Expected Changes to the Study Maintenance Effort

Revisions can effectively put off the pressure or need for a restudy of a community's flood hazard. It is entirely feasible that revisions can be effective in keeping a community's Flood Insurance Study up to date. Factors that help determine the effectiveness of the revisions process include:

- the amount and rate of development
- the accuracy of the effective Flood Insurance Study analyses
- community awareness and monitoring of development in flood plains
- development of information/analyses documenting the flood plain changes.

Another related aspect of the revisions process is the fact that for the process to be at all successful, it inherently involves the community. This is not to say that revisions are the only way of involving communities in flood plain management, but they do lead to the community's being more aware of what is happening in its flood plains and the resultant impacts of development. Finally, revisions can save FEMA money, since the data is usually provided by the requestor. The information must still be reviewed and mapped as necessary.

The revision/amendment processes do have their criticisms. One is the patchwork nature ("band-aid approach") of updating a community's Flood Insurance Study. It is essential, though sometimes very difficult, to determine if the cumulative impacts of development are being properly considered. This is especially important in the rapidly growing communities with multiple revision requests.

Revision requests, particularly those involving proposed projects, also tend to draw FEMA into regulating a community's flood plain development. As mentioned earlier, many things can hinge on FEMA's "verdict," including construction permits,

financing, and large amounts of money in general. FEMA's conditional determinations are often used by developers as leverage with the community: "The Federal government endorses my plans; you have to grant me my construction permit." FEMA is also drawn into providing "free" engineering (at the taxpayers' expense) for reviewing design concepts, as opposed to a developer's final design that has the community's endorsement.

As a result of the experience FEMA has gained by processing an increasing number of revision requests each year, several changes in their philosophy toward current maintenance systems can be anticipated. For example, Letters of Map Amendment will probably be granted only for structures inadvertently included in Special Flood Hazard Areas; projects based on elevating structures on fill would be handled as map revision requests.

FEMA recently published a proposed rule on adopting a reimbursement procedure fo conditional determinations. Through this procedure, FEMA hopes to recover much of the cost associated with the review and processing of conditionals by billing the requestor. It would follow that knowing they will be charged for this, whether they get a favorable response or not, requestors will put together a better submittal. Ideally, the request would come through the community, with their endorsement and certification that the project is compatible with their flood plain management objectives. The experience gained with revisions based on community-supplied information may also be evidenced in FEMA's restudy philosophy. It is safe to assume tha FEMA will be working more and more closely with communities, keeping their needs and resources in mind. The concept of cost-sharing will probably become more evident. The community that supplies new topographic mapping or survey data will be in a better position to convince FEMA to perform a restudy.

In conclusion, the procedures and policies for FEMA's Flood Insurance Study maintenance system are constantly evolving. The map amendment/revision process is sure to play a key role in the maintenance system's future.